

ROBOTICS

# Product manual

## IRB 120



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**Product manual**

**IRB 120 - 3/0.6**

**IRB 120T - 3/0.6**

**IRC5**

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# Overview of this manual

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## 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.

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## 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.

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## Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

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## 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.

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## Product manual scope

The manual covers covers all variants and designs of the IRB 120. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

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## 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 the robot. Contains general safety aspects as well as more specific information on how to avoid personal injuries and damage to the product.
Installation and commissioning	Required information about lifting and installation of the robot.
Maintenance	Step-by-step procedures that describe how to perform maintenance of the robot. Based on a maintenance schedule that may be used to plan periodical maintenance.
Repair	Step-by-step procedures that describe how to perform repair activities of the robot. Based on available spare parts.

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## Overview of this manual

Continued

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

## References

Reference	Document ID
<i>Product specification - IRB 120</i>	3HAC035960-001
<i>Product manual, spare parts - IRB 120</i>	3HAC049098-001
<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>Product manual - IRC5 Compact</i>	3HAC035738-001
<i>Product manual - IRC5 Panel Mounted Controller</i>	3HAC027707-001
<i>Technical reference manual - Lubrication in gearboxes</i>	3HAC042927-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - Emergency safety information</i>	3HAC027098-001 Same document number regardless of language.
<i>Safety manual for robot - Manipulator and IRC5 or OmniCore controller<sup>i</sup></i>	3HAC031045-001

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

## Revisions

Revision	Description
-	First edition
A	This revision includes the following additions and/or changes: <ul style="list-style-type: none"> <li>Section "<i>Product documentation, M2004</i>" added.</li> <li>Section "<i>How to read the product manual</i>" added.</li> <li><b>Safety chapter</b>- Updated safety signal graphics for levels Danger! and Warning! See section <a href="#">Safety signals in the manual on page 21</a>.</li> <li><b>Safety chapter</b> - New safety labels on the manipulators, see <a href="#">Safety symbols on manipulator labels on page 23</a>.</li> <li><b>Safety chapter</b>- Revised terminology: <i>robot</i> replaced with <i>manipulator</i>.</li> </ul>

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Revision	Description
	<ul style="list-style-type: none"> <li>• <b>Safety chapter</b> - Information not applicable to IRB 120 in <i>WARNING - Safety risks during work with gearbox lubricants (oil or grease)</i> removed.</li> <li>• <b>Installation chapter</b>- Illustration updated in <i>Risk of tipping/stability on page 48</i>.</li> <li>• <b>Installation chapter</b>- Attachment screws added in <i>Lifting the robot with roundslings on page 52</i>.</li> <li>• <b>Installation chapter</b>- Value in illustration updated in <i>Orienting and securing the robot on page 59</i>.</li> <li>• <b>Installation chapter</b> - Section <i>Setting the system parameters for a suspended or tilted robot on page 64</i> new.</li> <li>• <b>Installation chapter</b> - Section <i>Robot cabling and connection points on page 74</i> updated.</li> <li>• <b>Installation chapter</b> - Section <i>Customer connections on the robot on page 76</i> art. no. on connection at upper arm updated.</li> <li>• <b>Maintenance chapter</b> - Value for timing belt tension axis 5 updated.</li> <li>• <b>Repair chapter</b> - New chapter.</li> <li>• <b>Calibration chapter</b> - Section <i>Calibrating with manual calibration method on page 234</i> updated.</li> <li>• <b>Calibration chapter</b> - Section <i>Synchronization marks and synchronization position for axes on page 222</i> updated.</li> <li>• <b>Reference information chapter</b> - New chapter.</li> <li>• <b>Spare parts chapter</b> - Article numbers and illustrations updated.</li> </ul>
B	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• <b>Installation chapter</b> - Lifting capacity of roundslings updated. See: <i>Lifting the robot with roundslings on page 52</i>.</li> <li>• <b>Installation chapter</b> - New illustration showing IRB 120 added. See: <i>Setting the system parameters for a suspended or tilted robot on page 64</i>.</li> <li>• <b>Repair chapter</b> - Illustrations xx0900001009 and xx0900000782 updated. See: <i>Removing the cable harness on page 115</i> and <i>Refitting the cable harness on page 129</i>.</li> <li>• <b>Repair chapter</b> - Illustration xx0900000924 updated. See: <i>Replacing the upper arm on page 150</i>.</li> <li>• <b>Repair chapter</b> - Motor axis 4 now delivered as part of the upper arm. The procedures Removal and Refitting are updated accordingly. See: <i>Replacing the upper arm on page 150</i>.</li> <li>• <b>Repair chapter</b> - Motor axis 4 now delivered as part of the upper arm. The section is updated accordingly. See: <i>Replacing motor axis 4, with gearbox on page 205</i>.</li> <li>• <b>Repair chapter</b> - Illustration xx0900001009 updated. See: <i>Replacing motor axis 5 on page 206</i>.</li> <li>• <b>Calibration chapter</b> updated. See sections: <i>Calibrating with manual calibration method on page 234</i> and <i>Synchronization marks and synchronization position for axes on page 222</i>.</li> <li>• <b>Reference information chapter</b> - "Other standards" added. See: <i>Applicable standards on page 248</i>.</li> <li>• <b>Reference information chapter</b> - Standard toolkit updated. See: <i>Standard toolkit on page 252</i>.</li> <li>• <b>Spare parts chapter</b> - Motor axis 4 (art. no. 3HAC037282-001) removed. Now part of the upper arm. See <i>Spare parts - Upper arm unit in Product manual, spare parts - IRB 120</i>.</li> <li>• <b>Circuit diagram</b> - Updated after circuit diagrams now are delivered as separate files. See: <i>Circuit diagrams on page 257</i>.</li> </ul>

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Revision	Description
C	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• <b>Repair chapter</b> - Text added on how to position axis 5. See section <a href="#">Removing the cable harness on page 115</a>.</li> <li>• <b>Repair chapter</b> - Text added on how to position axis 5. See section <a href="#">Refitting the cable harness on page 129</a>.</li> <li>• <b>Repair chapter</b> - Text added on how to position axis 5. See section <a href="#">Replacing the upper arm on page 150</a>.</li> <li>• <b>Calibration chapter</b> - Text added about updating the revolution counters. See section <a href="#">Calibrating with manual calibration method on page 234</a>.</li> <li>• <b>Calibration chapter</b> - Introduction updated. See section <a href="#">Synchronization marks and synchronization position for axes on page 222</a>.</li> <li>• <b>Spare parts chapter</b> - Illustration xx0900000544 updated. See <i>Spare parts - Upper arm unit</i> in <i>Product manual, spare parts - IRB 120</i>.</li> </ul>
D	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• A new block, about general illustrations, added in section <a href="#">How to read the product manual on page 17</a>.</li> <li>• Clean Room protection added.</li> <li>• Illustrations updated throughout the manual.</li> <li>• <b>Calibration chapter</b> - Text removed: <i>Updating the revolution counters</i>.</li> <li>• Added section <i>Handling of batteries</i>.</li> </ul>
E	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• Section <i>Expected component life</i> removed from the manual.</li> <li>• Added inspection activity for regular/daily inspection of robot to the maintenance schedule, see <a href="#">Maintenance schedule on page 83</a>.</li> <li>• Added the spare part number for the gearbox grease in section <i>Type of grease, gearboxes</i>.</li> <li>• Changed the working range of axis 3, see <a href="#">Working range and type of motion on page 46</a>.</li> <li>• Changed the illustration that shows the mounting surface of the tool flange, see <a href="#">Fitting equipment on robot on page 61</a>.</li> <li>• Added variant IRB 120T - 3/0.6 to the manual.</li> </ul>
F	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• Information regarding disassembly of <i>Clean Room</i> robots added to concerned repair instructions.</li> <li>• All data about type of lubrication in gearboxes is moved from the manual to a separate lubrication manual, see <a href="#">Type of lubrication in gearboxes on page 101</a>.</li> <li>• Added data for extended working range of axis 6, see <a href="#">Working range and type of motion on page 46</a>.</li> </ul>
G	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• Added information about brake release for other controller variants than IRC5 Compact, see <a href="#">Manually releasing the brakes on page 55</a>.</li> <li>• Procedure how to replace the axis-1 motor with gearbox has been updated. See <a href="#">Replacing axis-1 motor with gearbox on page 164</a>.</li> <li>• Procedure how to replace the axis-2 motor with gearbox has been updated. See <a href="#">Replacing axis-2 motor with gearbox on page 185</a>.</li> </ul>
H	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>• Changed torque value in instruction for refitting the axis-5 motor, see <a href="#">Replacing motor axis 5 on page 206</a>.</li> <li>• Added information about risks when scrapping a decommissioned robot, see <a href="#">Scrapping of robot on page 246</a>.</li> </ul>



Revision	Description
	<ul style="list-style-type: none"> <li>Added information about how to update the revolution counters, see <a href="#">Updating revolution counters on IRC5 robots on page 225</a>, and <a href="#">Checking the synchronization position on page 241</a>.</li> <li><i>Spare parts and exploded views</i> are not included in this document but delivered as a separate document. See <i>Spare part lists</i> in <i>Product manual, spare parts - IRB 120</i></li> </ul>
J	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>The list of applicable safety standards is updated. The IRB 120 does not comply with the CSA/UL standards, see <a href="#">id(19755)Applicable safety standards_en.xml</a>.</li> </ul>
K	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>Procedure how to change Cable harness has been updated.</li> <li>Procedure how to change axis-1 motor with gearbox has been updated. <a href="#">Replacing axis-1 motor with gearbox on page 164</a>.</li> <li>Release holes in swing plate and lower arm housing added (repair instructions motor axis-1 and motor axis-2 changed)</li> <li>Tightening torque for axis-3 motor changed</li> <li>Updated timing belt tension for axis-3 motor and axis-5 motor</li> </ul>
L	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>Removed information about signal lamp from the manual since it is not a valid option for IRB 120.</li> <li>Information about manual break release added to installation chapter.</li> <li>New standard calibration method is introduced (Axis Calibration). See <a href="#">Calibration on page 219</a>.</li> <li>Information about Absolute Accuracy removed from the robot.</li> <li>Food grade lubrication option added.</li> </ul>
M	<p>Published in release R16.2. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>Information of some attachment screws and washers added.</li> <li>Modified specification of attachment screws from M4x8 to M4x10 for fitting the bracket securing the upper arm to the base.</li> </ul>
N	<p>Published in release R17.2. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>Location and replacing procedure of lower arm have been updated. <a href="#">Lower arm on page 159</a>.</li> <li>Procedure about how to replace axis-1 motor with gearbox has been updated. <a href="#">Replacing axis-1 motor with gearbox on page 164</a>.</li> <li>Information about minimum resonance frequency added.</li> <li>Bending radius for static floor cables added.</li> <li>Updated list of applicable standards.</li> <li>Section <a href="#">Start of robot in cold environments on page 79</a> added.</li> </ul>
P	<p>Published in release R18.1. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>Added sections in <a href="#">General procedures on page 110</a>.</li> <li>Safety section restructured.</li> <li>Updated description about Clean Room class.</li> <li>Information about myABB Business Portal added.</li> </ul>
Q	<p>Published in release R18.2. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>Added section for inspection of labels in maintenance chapter.</li> <li>Added CP/CS cable information.</li> <li>Updated customer connector description.</li> </ul>
R	<p>Published in release R18.2. The following updates are made in this revision:</p> <ul style="list-style-type: none"> <li>Updated references.</li> </ul>

Continues on next page

Revision	Description
S	Published in release 19B. The following updates are made in this revision: <ul style="list-style-type: none"><li>• New touch up color Graphite White available. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>.</li><li>• New article numbers for manipulator cables in section <a href="#">Robot cable, signal on page 74</a>.</li><li>• Added adjustment procedures for axis-3 and -5 timing belts.</li></ul>
T	Published in release 19D. The following updates are made in this revision: <ul style="list-style-type: none"><li>• Note added about the need to calibrate if the robot is other than floor mounted. See <a href="#">When to calibrate on page 221</a>.</li></ul>
U	Published in release 20D. The following updates are made in this revision: <ul style="list-style-type: none"><li>• Clarified and added information in mounting instructions for rotating sealings, see <a href="#">Mounting instructions for sealings on page 110</a>.</li><li>• Clarified text about position of robot and added table with dependencies between axes during Axis Calibration.</li><li>• Added information about maintenance activity of robot overhaul.</li><li>• Replaced article number and name of grease, previously 3HAB3537-1.</li><li>• Replaced cable grease name for food grade lubrication, previously Mobil FM2222, to LUBRIPLATE SYNXTREME FG-0.</li></ul>
V	Published in release 21B. The following updates are done in this revision: <ul style="list-style-type: none"><li>• Text regarding fastener quality is updated, see <a href="#">Fastener quality on page 63</a>.</li><li>• Text regarding diameter of air hoses is updated, see <a href="#">Customer connections on the robot on page 76</a>.</li></ul>
W	Published in release 22B. The following updates are done in this revision: <ul style="list-style-type: none"><li>• Updated information about Gleitmo treated screws, see <a href="#">Screw joints on page 250</a>.</li><li>• Added cleaning instructions for robots with protection type Clean Room.</li></ul>

# Product documentation

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## Categories for user documentation from ABB Robotics

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



### Tip

All documents can be found via myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).

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## 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 corresponding figures (or references to separate spare parts lists).
  - References to circuit diagrams.
- 

## Technical reference manuals

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

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## Application manuals

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

An application manual generally contains information about:

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

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### Operating manuals

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

# How to read the product manual

## Reading the procedures

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

### References to figures

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

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

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

	Action	Note/Illustration
8.	Remove the <i>rear attachment screws, gearbox</i> .	Shown in the figure <a href="#">Location of gearbox on page xx</a> .

### 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 <a href="#">Required equipment on page xx</a> .

## 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 19](#).

## Illustrations

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

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

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# 1 Safety

## 1.1 Safety information

### 1.1.1 Limitation of liability

---

#### Limitation of liability

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

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

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

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

---

#### Spare parts and equipment

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

# 1 Safety

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## 1.1.2 Requirements on personnel

### 1.1.2 Requirements on personnel

---

#### General

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

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

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

---

#### Personal protective equipment

Use personal protective equipment, as stated in the instructions.



## 1.2 Safety signals and symbols

### 1.2.1 Safety signals in the manual







#### Introduction to safety signals

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

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

#### Hazard levels

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

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


*Continues on next page*

# 1 Safety

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## 1.2.1 Safety signals in the manual

*Continued*

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

## 1.2.2 Safety symbols on manipulator labels

### Introduction to symbols

This section describes safety symbols used on labels (stickers) on the manipulator. Symbols are used in combinations on the labels, describing each specific warning. The descriptions in this section are generic, the labels can contain additional information such as values.



#### Note

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




### Types of symbols

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

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 23](#).

The information labels can contain information in text.

### Symbols on safety labels

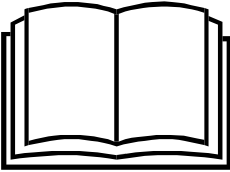
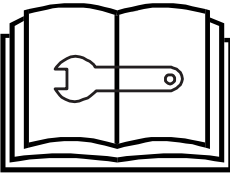
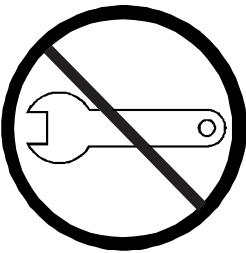
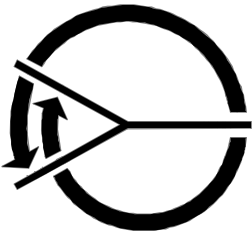

Symbol	Description
 xx0900000812	<p><b>Warning!</b></p> <p>Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc.</p>
 xx0900000811	<p><b>Caution!</b></p> <p>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.</p>
 xx0900000839	<p><b>Prohibition</b></p> <p>Used in combinations with other symbols.</p>

*Continues on next page*

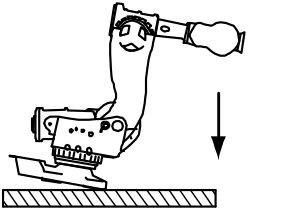

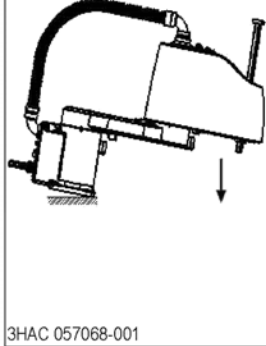
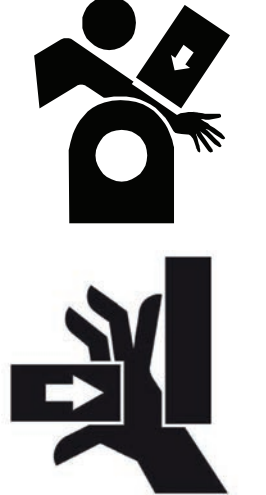
# 1 Safety

## 1.2.2 Safety symbols on manipulator labels

Continued

Symbol	Description
 xx0900000813	<b>See user documentation</b> Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none"><li>• No text: <i>Product manual</i>.</li><li>• EPS: <i>Application manual - Electronic Position Switches</i>.</li></ul>
 xx0900000816	<b>Before disassembly, see product manual</b>
 xx0900000815	<b>Do not disassemble</b> Disassembling this part can cause injury.
 xx0900000814	<b>Extended rotation</b> This axis has extended rotation (working area) compared to standard.
 xx0900000808	<b>Brake release</b> Pressing this button will release the brakes. This means that the robot arm can fall down.



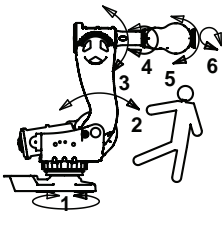
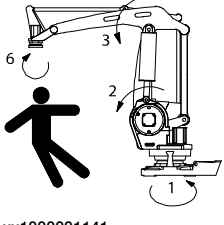
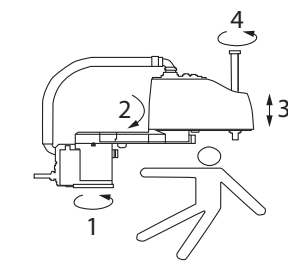
Continues on next page

Symbol	Description
 <p>xx0900000810</p>   <p>3HAC 057068-001</p> <p>xx1500002402</p>	<p><b>Tip risk when loosening bolts</b> The robot can tip over if the bolts are not securely fastened.</p>
 <p>xx0900000817</p>	<p><b>Crush</b> Risk of crush injuries.</p>

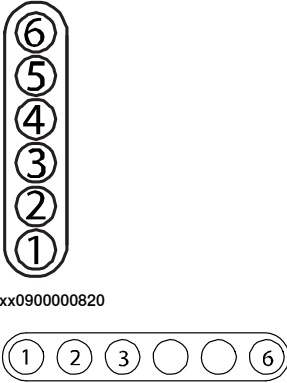

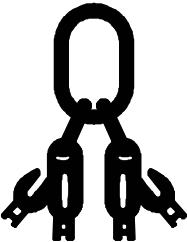



# 1 Safety

## 1.2.2 Safety symbols on manipulator labels

Continued

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

Continues on next page



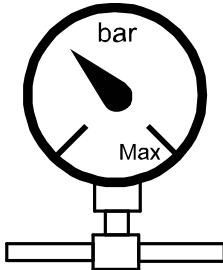
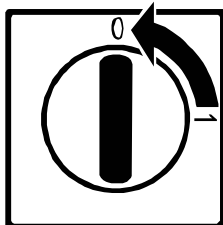

Symbol	Description
 <p>xx0900000820</p> <p>xx1000001140</p>	<p><b>Brake release buttons</b></p>
 <p>xx0900000821</p>	<p><b>Lifting bolt</b></p>
 <p>xx1000001242</p>	<p><b>Chain sling with shortener</b></p>
 <p>xx0900000822</p>	<p><b>Lifting of robot</b></p>
 <p>xx0900000823</p>	<p><b>Oil</b> Can be used in combination with prohibition if oil is not allowed.</p>
 <p>xx0900000824</p>	<p><b>Mechanical stop</b></p>

Continues on next page

# 1 Safety

## 1.2.2 Safety symbols on manipulator labels

Continued

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



### 1.3 Robot stopping functions

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#### Protective stop and emergency stop

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

For more information see:

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

# 1 Safety

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## 1.4 Safety during installation and commissioning

### 1.4 Safety during installation and commissioning

---

#### National or regional regulations

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

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

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

---

#### Layout

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

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

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

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

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

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

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

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

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

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

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#### Allergenic material

See [Environmental information on page 244](#) for specification of allergenic materials in the product, if any.

---

#### Securing the robot to the foundation

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

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

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*Continues on next page*

### Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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



#### Note

Use a CARBON DIOXIDE (CO<sub>2</sub>) extinguisher in the event of a fire in the robot.

### Safety devices

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

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

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

### Other hazards

A robot may perform unexpected limited movement.



#### WARNING

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

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

- Water
- Compressed air
- Hydraulics

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

*Continues on next page*

# 1 Safety

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## 1.4 Safety during installation and commissioning

*Continued*

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### Pneumatic or hydraulic related hazards



#### Note

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

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

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

Dump valves should be used in case of emergency.

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

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

---

### Verify the safety functions

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

### 1.5 Safety during operation

#### Automatic operation

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

#### Unexpected movement of robot arm



#### WARNING

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

A robot may perform unexpected limited movement.



#### WARNING

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

# 1 Safety

## 1.6.1 Safety during maintenance and repair

## 1.6 Safety during maintenance and repair

### 1.6.1 Safety during maintenance and repair

#### General

Corrective maintenance must only be carried out by personnel trained on the robot. Maintenance or repair must be done with all electrical, pneumatic, and hydraulic power switched off, that is, no remaining hazards.

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

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


Make sure that there are no loose screws, turnings, or other unexpected parts remaining after work on the robot has been performed.

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

#### Hot surfaces

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

#### Allergic reaction

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


#### Gearbox lubricants (oil or grease)

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








#### Note

Take special care when handling hot lubricants.

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

*Continues on next page*

Warning	Description	Elimination/Action
 <b>Allergic reaction</b>	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 <b>Possible pressure build-up in gearbox</b>	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.
 <b>Do not overfill</b>	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: <ul style="list-style-type: none"> <li>• damage seals and gaskets</li> <li>• completely press out seals and gaskets</li> <li>• prevent the robot from moving freely.</li> </ul>	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
 <b>Specified amount depends on drained volume</b>	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.
 <b>Contaminated oil in gearboxes</b>	For lifetime reasons always drain as much oil as possible from the gearbox. The magnetic oil plugs will gather residual metal chips.	

### Hazards related to batteries

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

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

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

Operating temperatures are listed in [Operating conditions, robot on page 45](#).

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

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# 1 Safety

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## 1.6.1 Safety during maintenance and repair

*Continued*

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### Unexpected movement of robot arm



#### **WARNING**

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

A robot may perform unexpected limited movement.



#### **WARNING**

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

---

### Related information

See also the safety information related to installation and operation.



### 1.6.2 Emergency release of the robot axes

#### Description

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

How to release the brakes is described in the section:

- [Manually releasing the brakes on page 55](#).

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

#### Increased injury

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



#### **DANGER**

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

Make sure no personnel is near or beneath the robot.

# 1 Safety

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## 1.6.3 Brake testing

### 1.6.3 Brake testing

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#### When to test

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

---

#### How to test

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

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

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



#### Note

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

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

### 1.7 Safety during troubleshooting

#### General

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

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



#### **DANGER**

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

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



#### **WARNING**

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

A robot may perform unexpected limited movement.



#### **WARNING**

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

#### Related information

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

# 1 Safety

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## 1.8 Safety during decommissioning

### 1.8 Safety during decommissioning

---

#### General

See section [Decommissioning on page 243](#).

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

---

#### Unexpected movement of robot arm



#### WARNING

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

A robot may perform unexpected limited movement.



#### WARNING

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

## 2 Installation and commissioning

### 2.1 Introduction to installation and commissioning

#### General

This chapter contains assembly instructions and information for installing the IRB 120 at the working site.

See also the product manual for the robot controller.

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

#### Safety information

Before any installation work is commenced, all safety information must be observed. There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 19](#) before performing any installation work.



#### Note

Always connect the IRB 120 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

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

## 2 Installation and commissioning

### 2.2.1 Pre-installation procedure

## 2.2 Unpacking

### 2.2.1 Pre-installation procedure

#### Introduction


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

#### Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

#### Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage.  <b>Note</b> Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: <a href="#">Weight, robot on page 42</a>
6	If the robot is not installed directly, it must be stored as described in: <a href="#">Storage conditions, robot on page 45</a>
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: <a href="#">Operating conditions, robot on page 45</a>
8	Before taking the robot to its installation site, make sure that the site conforms to: <ul style="list-style-type: none"><li>• <a href="#">Loads on foundation, robot on page 43</a></li><li>• <a href="#">Protection classes, robot on page 45</a></li><li>• <a href="#">Requirements, foundation on page 44</a></li></ul>
9	Before moving the robot, please observe the stability of the robot: <a href="#">Risk of tipping/stability on page 48</a>
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: <a href="#">On-site installation on page 50</a>
11	Install required equipment, if any.

#### Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 120	25 kg

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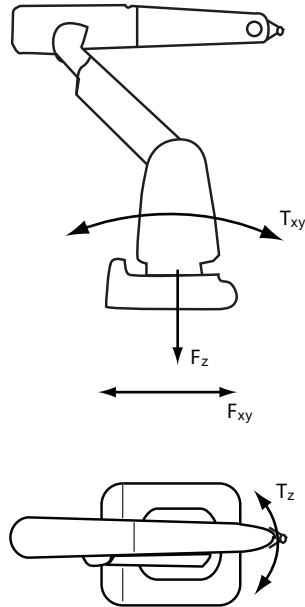
#### Note

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

#### Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

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



xx1100000521

$F_{xy}$	Force in any direction in the XY plane
$F_z$	Force in the Z plane
$T_{xy}$	Bending torque in any direction in the XY plane
$T_z$	Bending torque in the Z plane

The table shows the various forces and torques working on the robot during different kinds of operation.



#### Note

These forces and torques are extreme values that are rarely encountered during operation. The values also never reach their maximum at the same time!



#### WARNING

The robot installation is restricted to the mounting options given in following load table(s).

#### Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±265 N	±515 N

*Continues on next page*

## 2 Installation and commissioning

### 2.2.1 Pre-installation procedure

Continued

Force	Endurance load (in operation)	Max. load (emergency stop)
Force z	-265 ±200 N	-265 ±365 N
Torque xy	±195 Nm	±400 Nm
Torque z	±85 Nm	±155 Nm

Wall mounted


Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±470 N	±735 N
Force z	0 ±200 N	0 ±630 N
Torque xy	±240 Nm	±450 Nm
Torque z	±90 Nm	±175 Nm

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±265 N	±515 N
Force z	265 ±200 N	265 ±365 N
Torque xy	±195 Nm	±400 Nm
Torque z	±85 Nm	±155 Nm

### Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.1/500 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base.
Maximum tilt	5°	
Minimum resonance frequency	22 Hz  <b>Note</b> It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment. <sup>i</sup> For information about compensating for foundation flexibility, see the application manual of the controller software, section <i>Motion Process Mode</i> .

<sup>i</sup> The minimum resonance frequency given should be interpreted as the frequency of the robot mass/inertia, robot assumed stiff, when a foundation translational/torsional elasticity is added, i.e., the stiffness of the pedestal where the robot is mounted. The minimum resonance frequency should not be interpreted as the resonance frequency of the building, floor etc. For example, if the equivalent mass of the floor is very high, it will not affect robot movement, even if the frequency is well below the stated frequency. The robot should be mounted as rigid as possible to the floor.

Disturbances from other machinery will affect the robot and the tool accuracy. The robot has resonance frequencies in the region 10 – 20 Hz and disturbances in this region will be amplified, although somewhat damped by the servo control. This might be a problem, depending on the requirements from the applications. If this is a problem, the robot needs to be isolated from the environment.

Continues on next page



#### 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 <sup>i</sup>
Maximum ambient temperature	+45°C
Maximum ambient temperature for robots with food grade lubrication	+35°C <sup>ii</sup>
Maximum ambient humidity	Max 95% at constant temperature

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

<sup>ii</sup> For robots with food grade lubrication  
If environment temperature > 35°C, contact ABB for further information.

#### Protection classes, robot

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

Protection type	Protection class <sup>1</sup>
Manipulator, protection type Standard	IP 30
Manipulator, protection type Clean Room	IP 30

## 2 Installation and commissioning

### 2.2.2 Working range and type of motion

### 2.2.2 Working range and type of motion

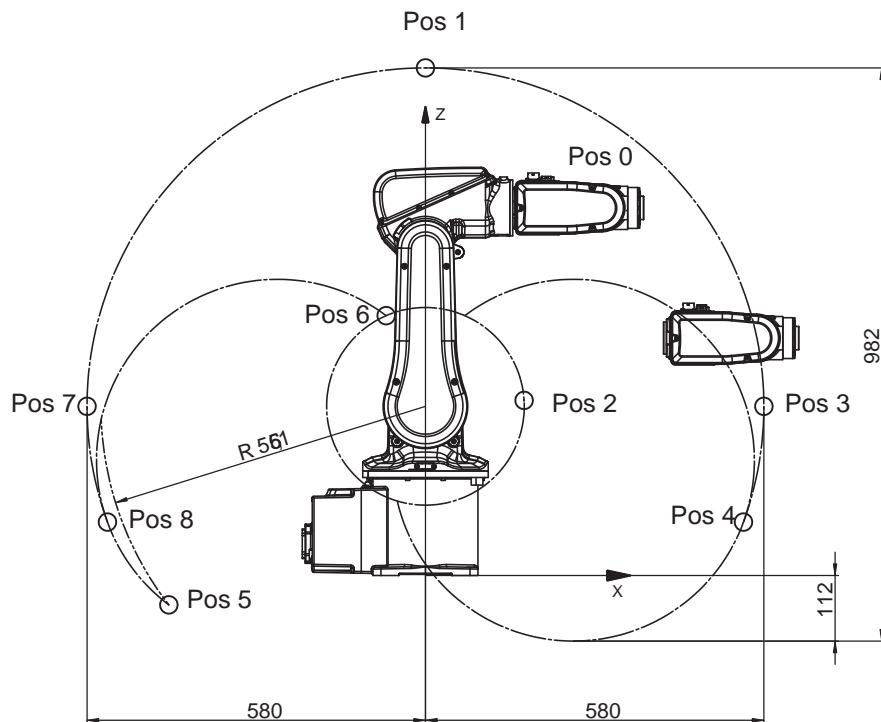
#### Working range

The figures show the working ranges of the robot.

The extreme positions of the robot arm are specified at the wrist center (dimensions in mm).

#### Working range

The illustration shows the unrestricted working range of the robot.



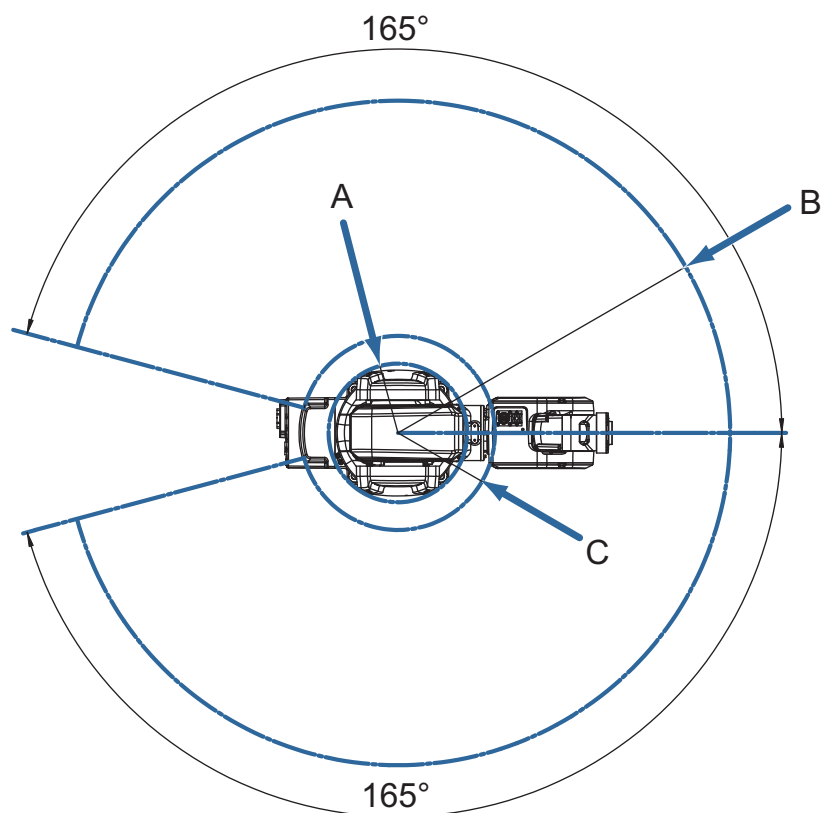
xx0900000263

Position	Position at wrist center (mm)		Angle (degrees)	
	X	Z	Axis 2	Axis 3
A	302 mm	630 mm	0°	0°
B	0 mm	870 mm	0°	-77°
C	169 mm	300 mm	0°	+70°
D	580 mm	270 mm	+90°	-77°
E	545 mm	91 mm	+110°	-77°
F	-440 mm	-50 mm	-110°	-110°
G	-67 mm	445 mm	-110°	+70°
H	-580 mm	270 mm	-90°	-77°
J	-545 mm	91 mm	-110°	-77°

Continues on next page

#### Turning radius

The turning radius of robot is shown in the figure.



xx0900000157

Robot variant	Pos. A	Pos. B	Pos. C
IRB 120-3/0.6	R121 <sup>i</sup>	R580	R169.4

<sup>i</sup> Minimum turning radius axis 1.

#### Robot motion

The table specifies the types and ranges of motion in every axes.

Location of motion	Type of motion	Range of movement
Axis 1	Rotation motion	+165° to -165°
Axis 2	Arm motion	+110° to -110°
Axis 3	Arm motion	+70° to -110°
Axis 4	Wrist motion	+160° to -160°
Axis 5	Bend motion	+120° to -120°
Axis 6	Turn motion	+400° to -400° (default) +242 revolutions to -242 revolutions maximum <sup>i</sup>

<sup>i</sup> 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).

## 2 Installation and commissioning

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### 2.2.3 Risk of tipping/stability

### 2.2.3 Risk of tipping/stability

---

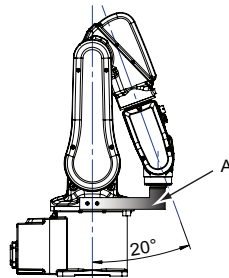
#### Risk of tipping

Do not change the robot position before securing it to the foundation.  
The shipping position is the most stable position.

---

#### Shipping and transportation position

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



xx0900000580



#### WARNING

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

### 2.2.4 The unit is sensitive to ESD

---

#### Description

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

#### Safe handling

Use one of the following alternatives:

- Use a wrist strap.

Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly.

- Use an ESD protective floor mat.

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

- Use a dissipative table mat.

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

## 2 Installation and commissioning

### 2.3.1 Brief installation procedure

## 2.3 On-site installation


### 2.3.1 Brief installation procedure

#### Introduction

This procedure is a brief guide when installing the robot for the first time. Also see [Pre-installation procedure on page 42](#).

#### First installation

Use these procedures to install the IRB 120.

	Action	Note
1	Transport the manipulator to its intended location.	
2	Install the valid platform or prepare the foundation for the manipulator.	
3	Lift and secure the manipulator to the platform/foundation.	See <a href="#">Lifting the robot on page 52</a> . See <a href="#">Orienting and securing the robot on page 59</a> .
4	Connect the manipulator to the controller.	See <ul style="list-style-type: none"><li>• <i>Product manual - IRC5</i></li><li>• <i>Product manual - IRC5 Compact</i></li></ul>
5	Configure the safety settings.	See <ul style="list-style-type: none"><li>• <i>Product manual - IRC5</i></li><li>• <i>Product manual - IRC5 Compact</i></li></ul>
6	How to start and run the robot is described in the product manual for the controller.	See <ul style="list-style-type: none"><li>• <i>Product manual - IRC5</i></li><li>• <i>Product manual - IRC5 Compact</i></li></ul>
7	Install required equipment, if any.	
8	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run.	

### 2.3.2 Test run after installation, maintenance, or repair

#### Safe handling

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



#### DANGER

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

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

#### Collision risks



#### CAUTION

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

## 2 Installation and commissioning

---

### 2.3.3.1 Lifting the robot with roundslings

## 2.3.3 Lifting the robot

### 2.3.3.1 Lifting the robot with roundslings

---

#### Introduction

This procedure details how to lift the robot using roundslings.

---

#### Required equipment

Equipment	Note
Overhead crane	-
Roundslings	(Circle) Length: 3 m Lifting capacity: 100 kg
Lifting tool, set	The set includes: <ul style="list-style-type: none"><li>• bracket</li><li>• attachment screws</li><li>• washers.</li></ul> For art. no. and details see chapter <i>Reference information</i> section: <ul style="list-style-type: none"><li>• <a href="#">Special tools on page 253</a></li></ul>

---

#### Lifting

Attach the roundslings as shown in the figure.



#### CAUTION

Use a thick cloth between round sling and robot where robot surface directly contact with round sling.

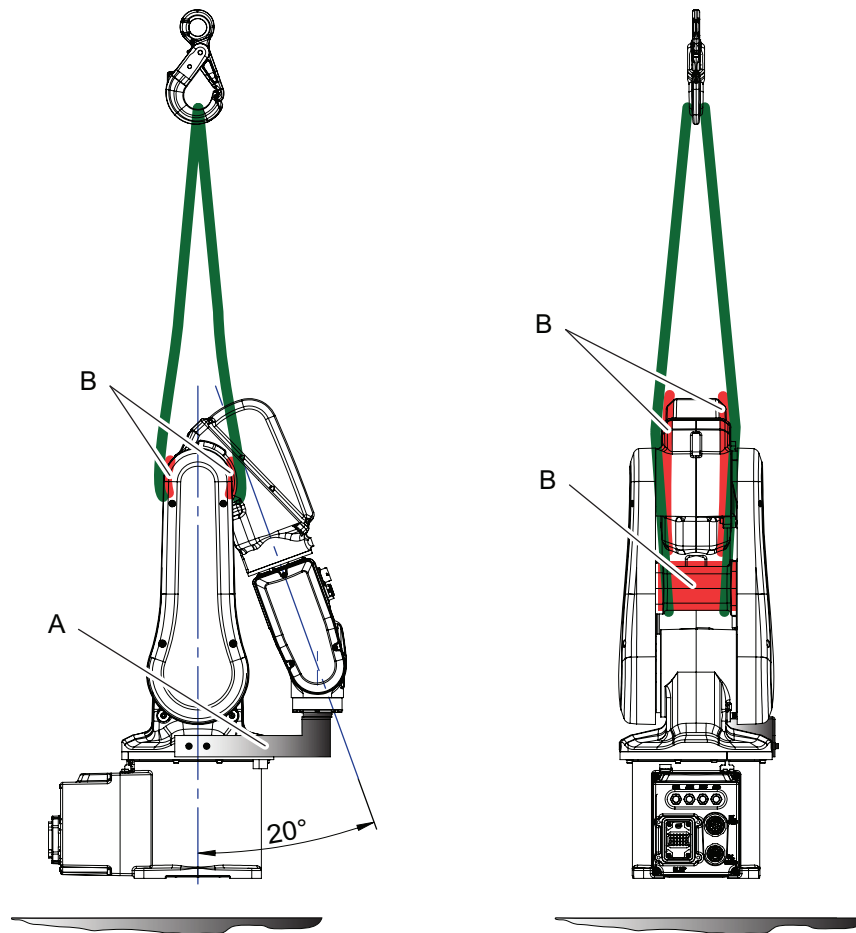
*Continues on next page*



## 2 Installation and commissioning

### 2.3.3.1 Lifting the robot with roundslings

*Continued*





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A	Bracket
B	Thick cloth

### Lifting instructions

Use this procedure to lift the robot in a safe way.



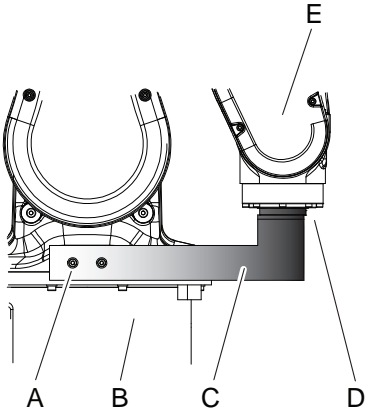
	Action	Note
1	 <b>CAUTION</b> The IRB 120 robot weighs 25 kg. All lifting accessories used must be sized accordingly!	
2	 <b>CAUTION</b> Attempting to lift the robot in any other position than that recommended may result in the robot tipping over and causing severe damage or injury!	

*Continues on next page*

## 2 Installation and commissioning

### 2.3.3.1 Lifting the robot with roundslings

Continued

	Action	Note
3	 <b>WARNING</b> Personnel must not, under any circumstances, be present under the suspended load!	
4	Move the robot to its most stable position.	Detailed in section: <ul style="list-style-type: none"> <li>• <a href="#">Risk of tipping/stability on page 48</a></li> </ul>
5	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
6	Fit the <i>bracket</i> with its attachment screws and washers, in order to secure the upper arm to the base.	See <a href="#">Required equipment on page 52</a> .  <p>xx0900000636</p> <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Attachment screws M4x10 quality steel 8.8 ELZN (2 pcs)</li> <li>• B: Base</li> <li>• C: Bracket</li> <li>• D: Attachment screws M5x12 quality 8.8-A2F (2 pcs)</li> <li>• E: Upper arm</li> </ul>
7	Attach the <i>roundsling</i> .	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Lifting on page 52</a></li> </ul>
8	Lift the robot with an overhead crane.	

### 2.3.4 Manually releasing the brakes

#### Introduction to manually releasing the brakes

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

This can be done in three ways:

- using the brake release unit (placed on the front of the IRC5 Compact controller) when the robot is connected to the controller. For other controller variants, the placing depends on the design of the cell.
- using the brake release unit when the robot is disconnected from the controller, but connected to an external power supply at the connector R1.MP.
- using an external voltage supply directly on the motor connector.



#### Note

On the single controller there is no brake release button. The customer or integrator is responsible to ensure that in case of emergency it is possible to release the brakes to move the manipulator axes without using motion power.

*Continues on next page*

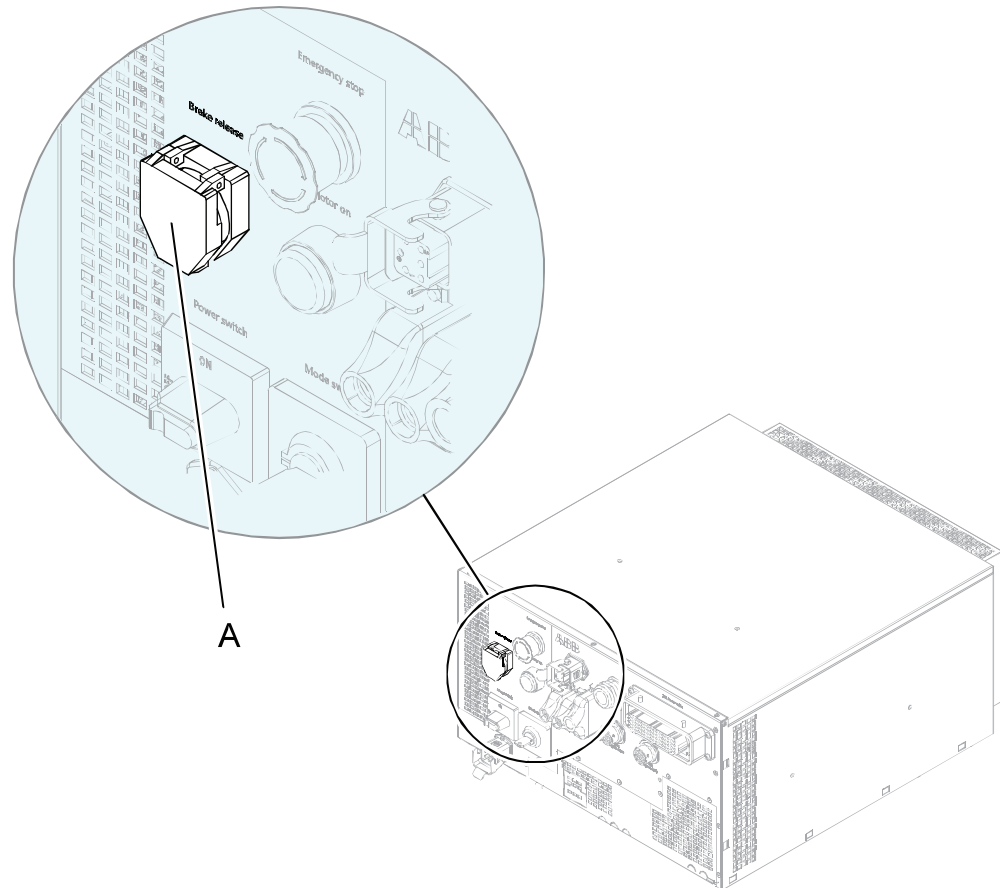
## 2 Installation and commissioning

### 2.3.4 Manually releasing the brakes

Continued

#### Brake release button at the front of IRC5 Compact controller

The IRB 120 robot has no brake release button, instead use the brake release button on the IRC5 Compact controller. For other controller variants, the placing depends on the design of the cell.




xx0900000559



A	Brake release button (beneath the cover)
---	--

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

Use this procedure to release the holding brakes using the internal brake release unit in the controller cabinet.


Action	Note
<p>1 The <i>brake release button</i> is located on the front of the IRC5 Compact controller.</p> <p> <b>Note</b></p> <p>The single brake release button, is used to release the brakes on all axes.</p>	<p>See the figure in:</p> <ul style="list-style-type: none"><li><a href="#">Brake release button at the front of IRC5 Compact controller on page 56</a></li></ul>

Continues on next page

	Action	Note
2	 <b>DANGER</b> When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways! Make sure no personnel is near the robot when brakes are released!	
3	Release the holding brakes by pushing the brake release button. The brake will function again as soon as the button is released.	 <b>Note</b> The controller must be powered on!

#### Using the brake release unit with an external power supply

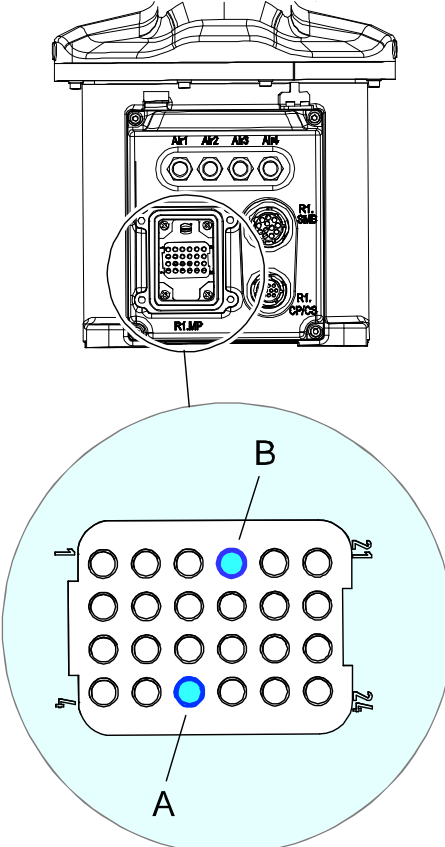

Use this procedure to release the holding brakes, when the robot is not connected to the controller.

	Action	Note
1	 <b>Note</b> Do not interchange the 24V and 0V pins. If they are mixed up, damage can be caused to the brake release unit and to the system board.	

## 2 Installation and commissioning

### 2.3.4 Manually releasing the brakes

Continued

	Action	Note
2	Connect an external 24VDC power supply to connector R1.MP on the robot base.	 <p data-bbox="954 1171 1061 1189">xx0900000638</p> <p data-bbox="954 1207 1284 1234">Connect to connector R1.MP:</p> <ul data-bbox="986 1236 1204 1294" style="list-style-type: none"><li>• A: 0V to pin 12</li><li>• B: 24V to pin 13</li></ul>
3	 <b>CAUTION</b> The holding brakes are released to all axes when power is connected to the pins.	

### 2.3.5 Orienting and securing the robot

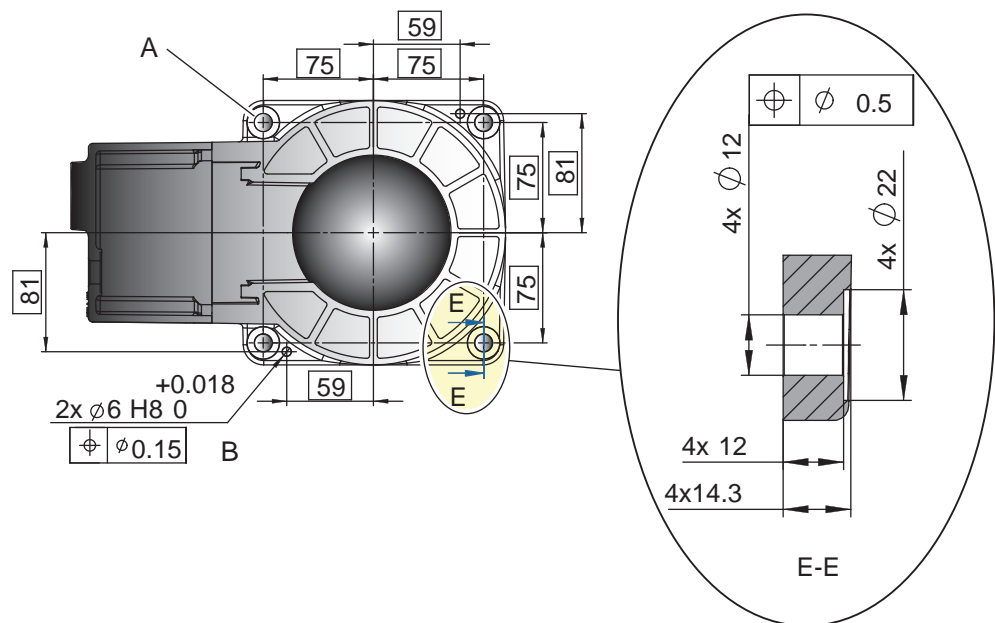
#### Introduction

This section details how to orient and secure the robot to the foundation or base plate in order to run the robot safely. The requirements made on the foundation are shown in sections:

- [Loads on foundation, robot on page 43](#)
- [Requirements, foundation on page 44.](#)

#### Hole configuration, base

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



xx0900000162

A	Holes for attachment screws (4 pcs)
B	Holes for pins (2 pcs)

#### Specification, attachment screws and pins

The table specifies the type of securing screws and washers to be used to secure the robot directly to the foundation. It also specifies the type of pins to be used.


Suitable screws	M10x25
Quantity	4 pcs
Quality	8.8-A3F
Suitable washer	10 mm
Guide pins	2 pcs, D6x20 ISO 2338-6 m6x30 - A1
Tightening torque	35 Nm

*Continues on next page*

## 2 Installation and commissioning



### 2.3.5 Orienting and securing the robot

Continued

Level surface requirements		0.2
xx0900000643		

### Orienting and securing the robot

Use this procedure to orient and secure the robot.

Action	Information
1	<p>Make sure the installation site for the robot conforms to the specifications in section:</p> <ul style="list-style-type: none"> <li>• <a href="#">Pre-installation procedure on page 42.</a></li> </ul>
2	<p>Prepare the installation site with attachment holes.</p> <p>The hole configuration of the base is shown in the figure in:</p> <ul style="list-style-type: none"> <li>• <a href="#">Hole configuration, base on page 59</a></li> </ul>
3	<p> <b>CAUTION</b></p> <p>The robot weighs 25 kg. All lifting equipment must be sized accordingly!</p>
4	<p> <b>CAUTION</b></p> <p>When the robot is put down after being lifted or transported, there is a risk of it tipping, if not properly secured.</p>
5	<p>Lift the robot to its installation site.</p> <p>How to lift the robot is described in section:</p> <ul style="list-style-type: none"> <li>• <a href="#">Lifting the robot with round-slings on page 52</a></li> </ul>
6	<p>Fit two <i>pins</i> to the holes in the base.</p> <p>2 pcs, D6x20 ISO 2338-6 m6x30 - A1</p>
7	<p>Guide the robot gently, using the attachment screws while lowering it into its mounting position.</p> <p>Make sure the robot base is correctly fitted onto the pins.</p>
8	<p>Fit the <i>securing screws</i> and <i>washers</i> in the attachment holes of the base.</p> <p>Screws: M10x25, quality: 8.8-A3F</p>
9	<p>Tighten the bolts in a criss-cross pattern to ensure that the base is not distorted.</p> <p>Tightening torque: 35 Nm</p>

### Securing robot on a mounting plate

When bolting a mounting plate or frame to a concrete floor, follow the general instructions for expansion-shell bolts.

Screw joints must be able to withstand the stress loads defined in section [Loads on foundation, robot on page 43.](#)



### 2.3.6 Fitting equipment on robot

#### Introduction

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.



#### Note

Never drill a hole in the robot without first consulting ABB!

#### Maximum loads

The table shows the maximum permitted loads for any extra equipment fitted in the holes intended for this purpose. See figure in [Fitting equipment on base and upper arm on page 62](#).

Robot	Max load A (base, on each side)	Max load B (upper arm)
IRB 120	0.5 kg	0.3 kg

*Continues on next page*

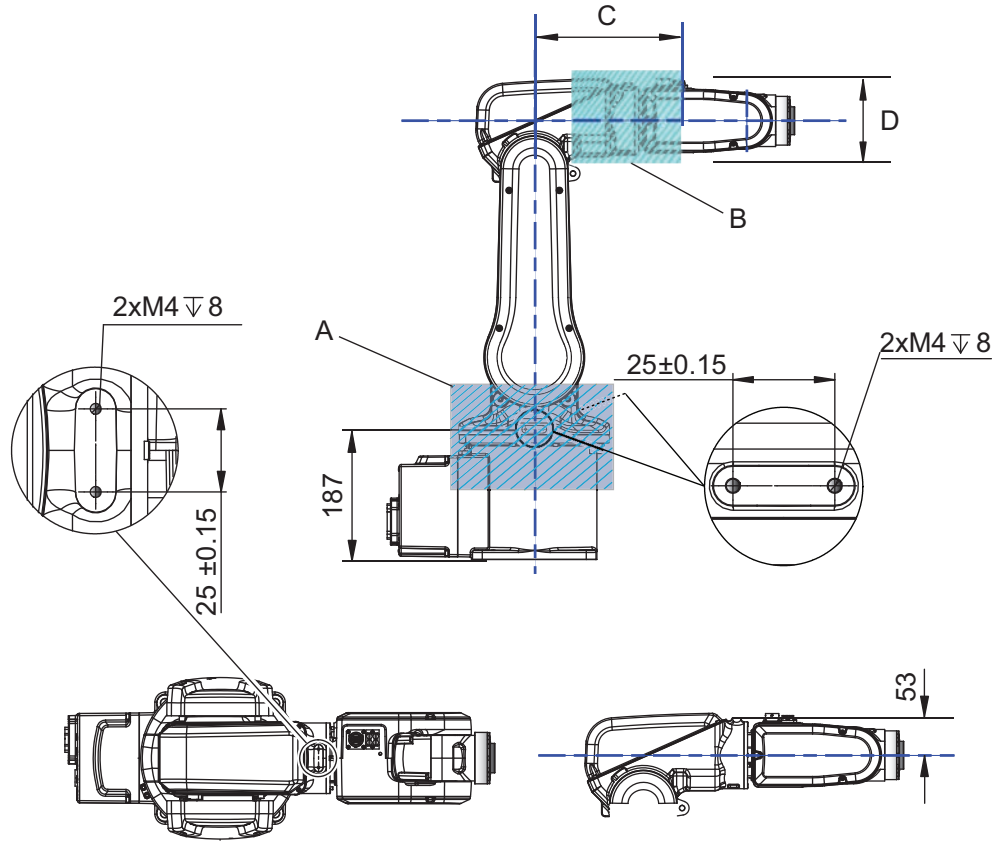
## 2 Installation and commissioning

### 2.3.6 Fitting equipment on robot

Continued

#### Fitting equipment on base and upper arm

The illustration shows the fitting holes available for fitting extra equipment on the base and upper arm of the robot.



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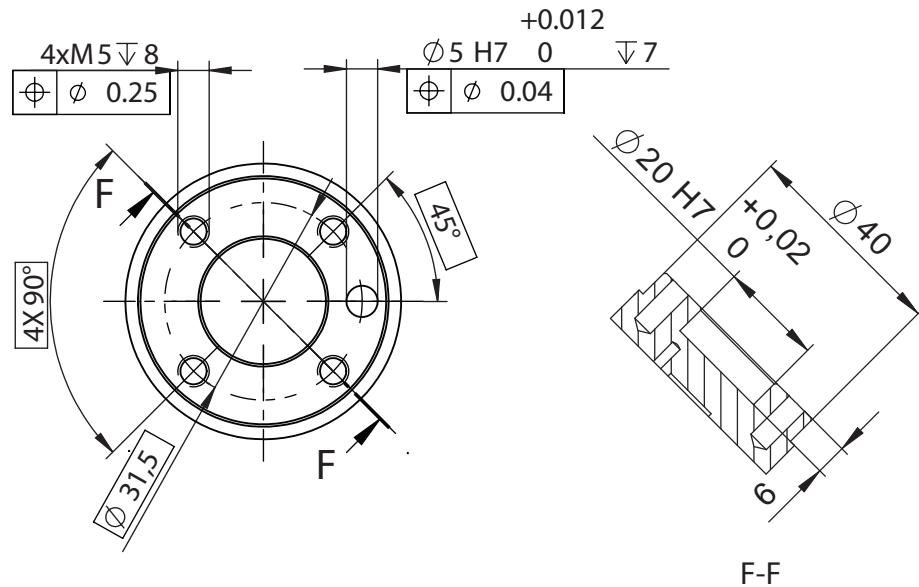
A	Load area base, max load 0.5 kg (on each side)
B	Load area upper arm, max load 0.3 kg
C	Max. 172 mm
D	Max. radius 75 mm

**NOTE!** Fitting holes at the base of the robot are placed on each side.

Continues on next page

#### Fitting equipment on mounting flange

The illustration shows the mechanical interface for the mounting flange.



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#### Fastener quality

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

## 2 Installation and commissioning

### 2.3.7 Setting the system parameters for a suspended or tilted robot

### 2.3.7 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 re-defined.



#### 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.

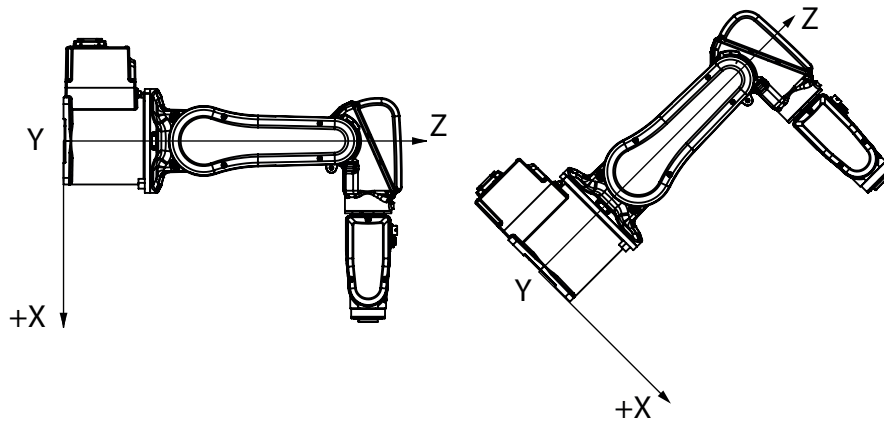


#### Note

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 44](#).

#### The x-direction in the base coordinate system

If the robot is wall mounted or mounted in a tilted position, it is important that the x-direction of the robot base coordinate system points downwards, as shown in the following figure.



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*Continues on next page*

#### System parameters



#### Note

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

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

#### Gravity Beta

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

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

#### 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  $\pm\pi/2$  ( $\pm 1.570796$ ).

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



#### 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).

*Continues on next page*

## 2 Installation and commissioning

### 2.3.7 Setting the system parameters for a suspended or tilted robot

Continued

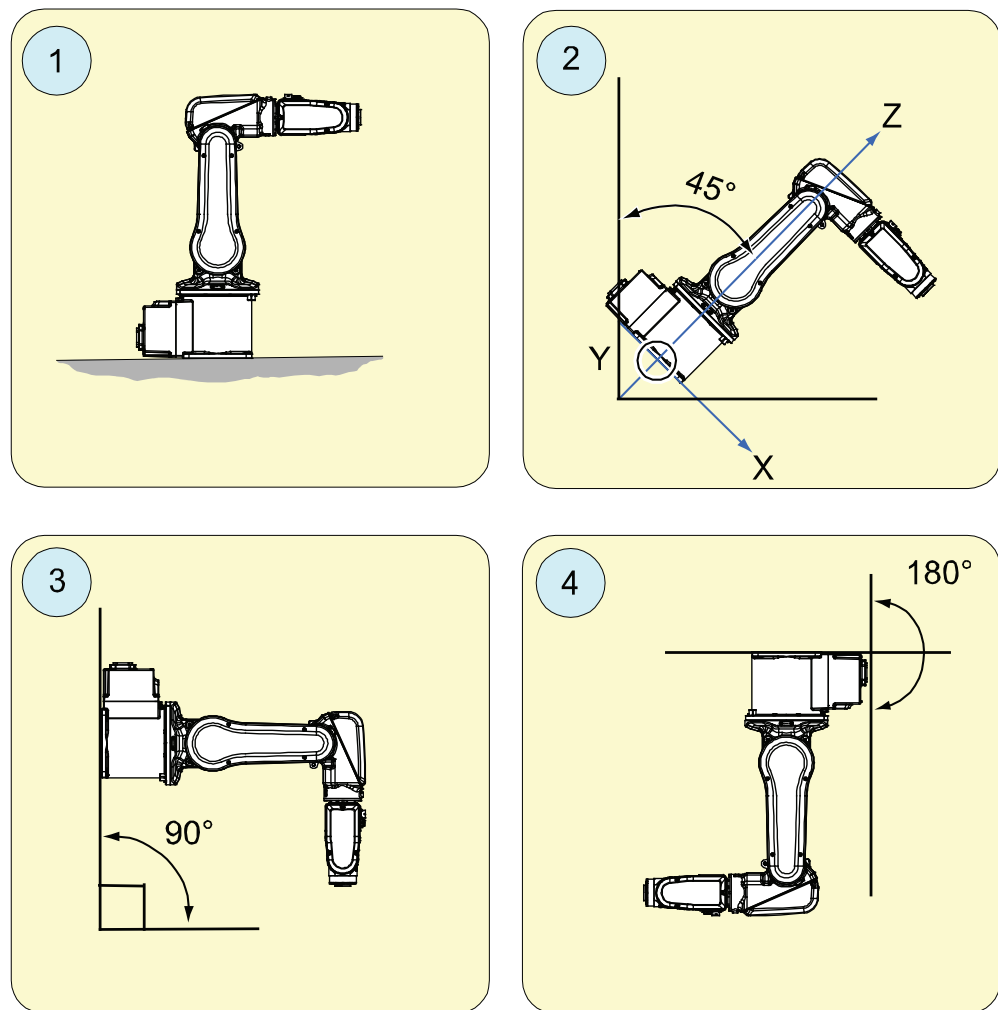
#### Mounting angles and values

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

$\text{Gravity Beta} = A^\circ \times 3.141593/180 = B \text{ radians}$ , where *A* is the mounting angle in degrees and *B* is the mounting angle in radians.

Example of position	Mounting angle (A °)	Gravity Beta
Floor mounted	0°	0.000000 (Default)
Wall mounting	90°	1.570796
Suspended mounting	180°	3.141593

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

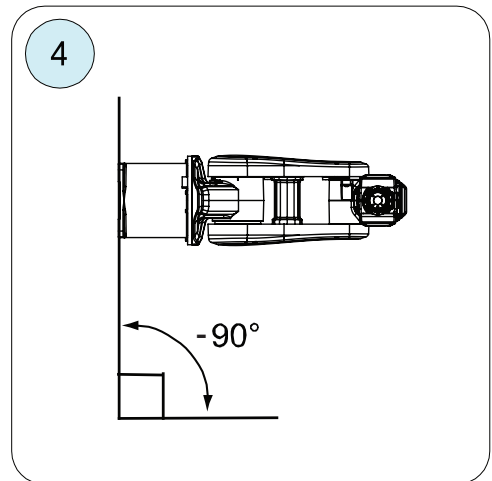
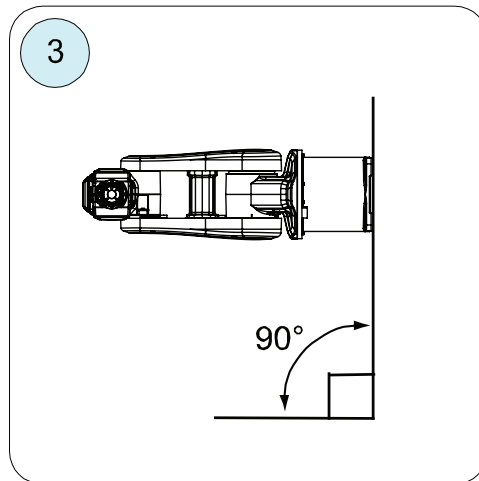
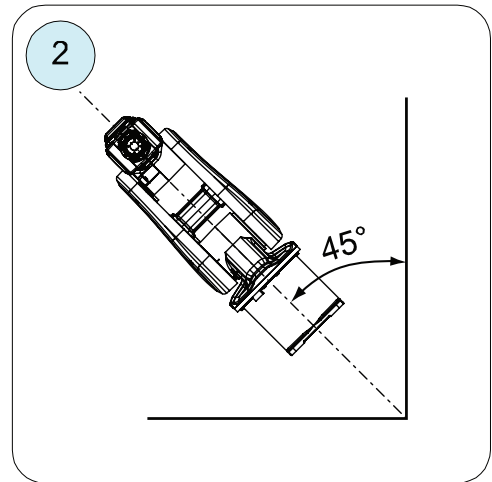
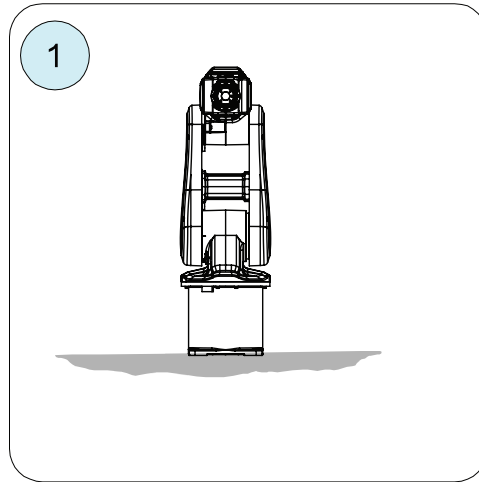


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Pos 1	Floor mounted
Pos 2	Mounting angle 45° (Tilted)
Pos 3	Mounting angle 90° (Wall)
Pos 4	Mounting angle 180° (Suspended)

Continues on next page

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



xx150000532

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



#### Note

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

#### Defining the parameter in RobotWare

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

How to calculate a new value is detailed in [Mounting angles and values on page 66](#).

*Continues on next page*

## 2 Installation and commissioning

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### 2.3.7 Setting the system parameters for a suspended or tilted robot

*Continued*

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

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



### 2.3.8 Loads fitted to the robot, stopping time and braking distances

---

#### General

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



#### CAUTION

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

#### References

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

- *Operating manual - IRC5 with FlexPendant*

#### Stopping time and braking distances

The performance of the motor brake depends on if there are any loads attached to the robot. For more information, see product specification for the robot.

## 2 Installation and commissioning

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### 2.4.1 Axes with restricted working range

## 2.4 Restricting the working range

### 2.4.1 Axes with restricted working range

---

#### General

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

The working range of the following axes may be restricted:

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



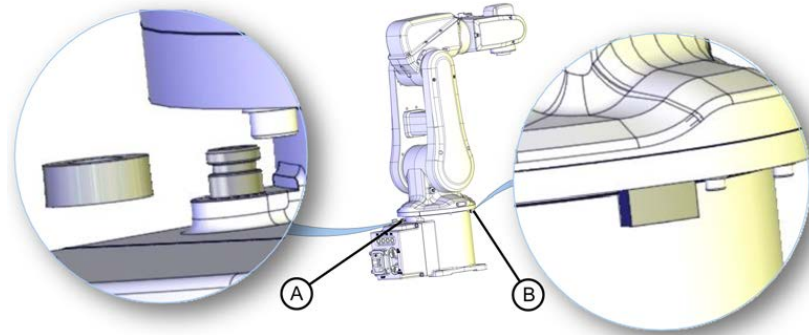
#### Note

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

2.4.2 Mechanically restricting the working range

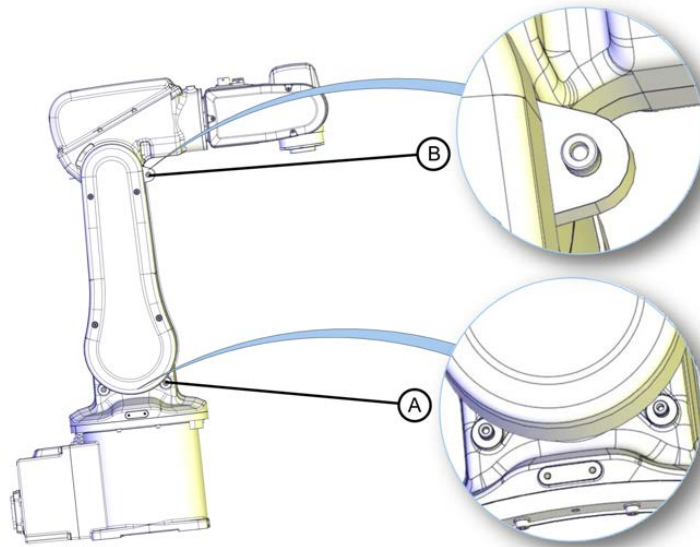
Location of mechanical stops

The figures shows where the mechanical stops are placed on the robot.



xx100000002

A	Mechanical stop axis 1 (base)
B	Mechanical stop axis 1 (swing plate)



xx090000583

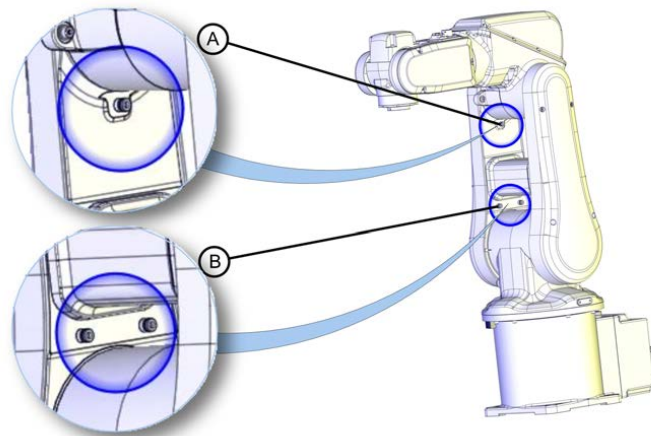
A	Mechanical stop axis 2 (swing housing)
B	Mechanical stops axis 2 (upper arm)

Continues on next page

## 2 Installation and commissioning

### 2.4.2 Mechanically restricting the working range

Continued



xx100000003

A	Mechanical stop axis 3 (lower arm)
B	Mechanical stops axis 2 (lower arm)

## 2.5 Making robot ready for operation

### 2.5.1 Additional installation procedure, Clean Room

#### General

Robots with protection type Clean Room are specially designed to work in a clean room environment.

Clean Room robots are designed to prevent from particle emission from the robot. For example, the maintenance work possible to perform without cracking the paint. The robot is painted with four layers of polyurethane paint. The last layer being a varnish over labels to simplify cleaning. The paint has been tested regarding outgassing of Volatile Organic Compounds (VOC) and been classified in accordance with ISO 14644-8.

Any Clean Room parts that are replaced must be replaced with parts designed for use in Clean Room environments.

#### Clean Room class 5

According to IPA test result, the robot IRB 120 is suitable for use in Clean Room environment.

#### Classification of airborne molecular contamination

Parameter				Outgassing amount		
Area (m <sup>2</sup> )	Test duration (s)	Temp (°C)	Performed test	Total detected (ng)	Norm based on 1m <sup>2</sup> and 1s(g)	Classification in accordance to ISO 14644-8
4.5E-03	3600	23	TVOC	2848	1.7E-07	-6.8
4.5E-03	60	90	TVOC	46524	1.7E-04	-3.8

#### Preparations before commissioning a Clean Room robot

During transport and handling of a Clean Room robot, it is likely that the robot has been contaminated with particles of different kinds. Therefore the robot must be carefully cleaned before installation.

Do not apply force on the plastic covers when lifting the robot! This may result in damage or cracks in the paint around the plastic cover.

## 2 Installation and commissioning

### 2.6.1 Robot cabling and connection points

## 2.6 Electrical connections

### 2.6.1 Robot cabling and connection points

#### Introduction

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

#### Connection point locations

For information about the connection point locations, see the chapter *Circuit diagram*.

#### 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 the control of the robot's motors as well as feedback from the encoder interface board. Specified in the table in <a href="#">Robot cable, power on page 74</a> .

The cable categories are divided into sub-categories. See [Robot cables on page 74](#).

#### Robot cables

The robot cable is included in the standard delivery of the robot. 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, signal	Transfers encoder data from and power supply to the encoder interface board.	XS2	R1.SMB

#### Robot cable, power

Cable	Art. no.
Robot cable, power: L=3 m	3HAC032694-001
Robot cable, power: L=7 m	3HAC032695-001
Robot cable, power: L=15 m	3HAC032696-001

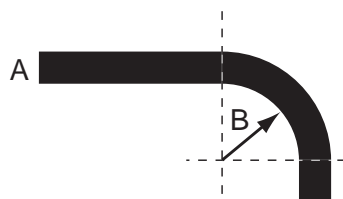
#### Robot cable, signal

Cable	Art. no.
Robot cable, signal: L=3 m	3HAC068916-001
Robot cable, signal: L=7 m	3HAC068917-001
Robot cable, signal: L=15 m	3HAC068918-001

*Continues on next page*

#### Bending radius for static floor cables

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



xx1600002016

A	Diameter
B	Diameter x10

#### Customer cables - CP/CS cable (option)

CP/CS cable length	Article number
3 m (IRC5)	3HAC049089-001
7 m (IRC5)	3HAC049089-004
15 m (IRC5)	3HAC049089-005
22 m (IRC5)	3HAC049089-006
30 m (IRC5)	3HAC049089-007
3 m (IRC5C)	3HAC049186-001
7 m (IRC5C)	3HAC049186-004
15 m (IRC5C)	3HAC049186-005
22 m (IRC5C)	3HAC049186-006
30 m (IRC5C)	3HAC049186-007

## 2 Installation and commissioning

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### 2.6.2 Customer connections on the robot

### 2.6.2 Customer connections on the robot

---

#### Introduction

The customer cables are integrated in the robot and the connectors are placed on the upper arm housing and at the base.

---

#### Connectors

The tables describes the connectors on base and upper arm housing.

#### Connectors, base

Position	Description	Art. no.
Robot	Pin connector 10p, bulkhead	3HAC022117-002
Customer connector	Connector set R1.CP/CS	3HAC037038-001

#### Connectors, upper arm housing

Position	Description	Art. no.
Robot	Socket connector 10p, flange mounted	3HAC023624-002
Customer connector	Connector set R3.CP/CS	3HAC037070-001

#### Air, connector

Position	Description	Art. no.
Robot	4xM5	
Customer cable	Air connector	3HAC032049-001

*Continues on next page*

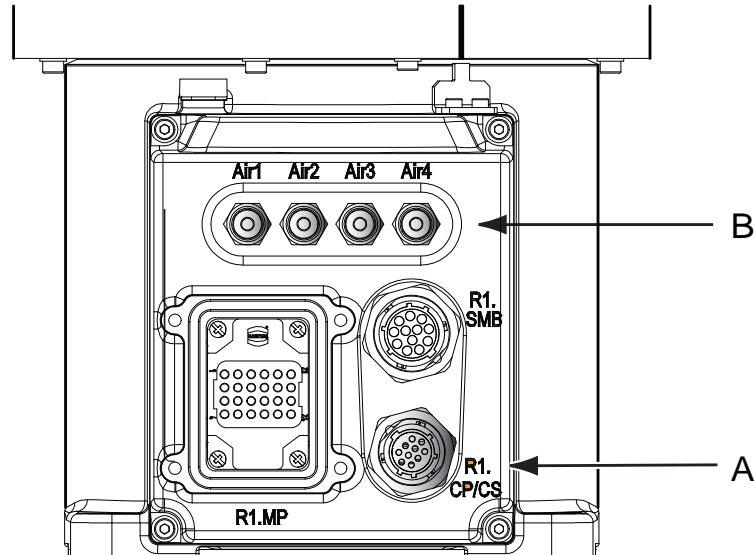


#### Customer connections

The location of the customer connections on the base and at the upper arm housing, are shown in the figures:

#### Customer connections, base

Customer connections, base.

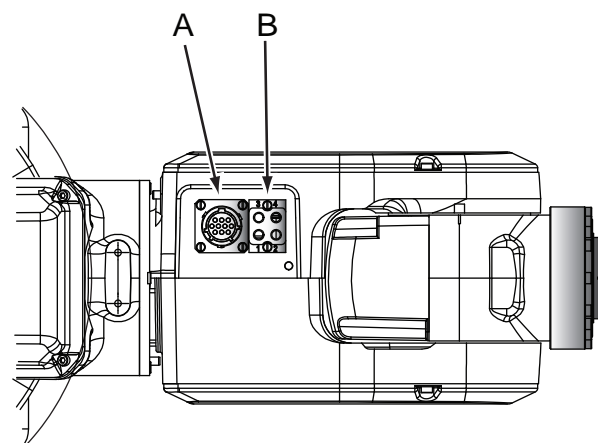


xx090000639

Pos	Connection	Description	Number	Value
A	R1.CP/CS	Customer power/signal	10	49 V, 500 mA
B	Air	Max 5 bar	4	Outer diameter of air hose: 4 mm

#### Customer connections, upper arm housing

Customer connections, upper arm housing.



xx090000640

Pos	Connection	Description	Number	Value
A	R3.CP/CS	Customer power/signal	10	49 V, 500 mA

*Continues on next page*

## 2 Installation and commissioning

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### 2.6.2 Customer connections on the robot

*Continued*

Pos	Connection	Description	Number	Value
B	Air	Max 5 bar	4	Outer diameter of air hose: 4 mm

## 2.7 Start of robot in cold environments

### Introduction

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

### Problems with starting the robot

#### Event message from Motion Supervision

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

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

#### Robot stopping with other event message

Use this procedure if the robot is not starting.

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

### Adjusting the speed and acceleration during warm-up

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

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

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

## 2 Installation and commissioning

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### 2.8 Test run after installation, maintenance, or repair

### 2.8 Test run after installation, maintenance, or repair

---

#### Safe handling

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



#### **DANGER**

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

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

#### Collision risks



#### **CAUTION**

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

## 3 Maintenance

### 3.1 Introduction

---

#### Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 120.

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.

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#### 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 19](#) before performing any service work.

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



#### Note

If the IRB 120 is connected to power, always make sure that the IRB 120 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*
- [Robot cabling and connection points on page 74.](#)

## 3 Maintenance

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### 3.2.1 Specification of maintenance intervals

## 3.2 Maintenance schedule

### 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 120:

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

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

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

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#### Overhaul

Depending on application and operational environment a complete overhaul may be necessary in average around 30000 hours.

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

Contact your local ABB Customer Service to get more information.

3.2.2 Maintenance schedule

General

The robot, consisting of robot and controller cabinet, must be maintained regularly to ensure its function. The maintenance activities and their respective intervals are specified in the table below.

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

The inspection intervals *do not* specify the life of each component.

Activities and intervals, standard equipment

The sections referred to in the table can be found in the different chapters for every maintenance activity.

The table below specifies the required maintenance activities and intervals:

Maintenance activity	Equipment	Interval	Detailed in section:
Inspection	Robot	Regularly <sup>i</sup> For Clean Room robots: Daily	Check for abnormal wear or contamination
Inspection	Damper, axes 1, 2 and 3	Regularly <sup>i</sup>	<a href="#">Inspecting dampers on page 89</a>
Inspection	Cable harnesses	Regularly <sup>i</sup>	<a href="#">Inspecting the robot cabling on page 85</a>
Inspection	Timing belts	36 mths <sup>ii</sup>	<a href="#">Inspecting timing belts on page 91</a>
Inspection	Plastic covers	Regularly <sup>i</sup>	<a href="#">Inspecting plastic covers on page 97</a>
Inspection	Mechanical stop pins	Regularly <sup>i</sup>	<a href="#">Inspecting mechanical stops on page 86</a>
Inspection	Information labels	12 months	Replace any damaged, missing or unreadable labels. Replace any damaged, missing or unreadable labels. <a href="#">Inspecting information labels on page 99</a>
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert <sup>iii</sup>	<a href="#">Replacing the battery pack on page 103</a>
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert <sup>iv</sup>	<a href="#">Replacing the battery pack on page 103</a>

Continues on next page

### 3 Maintenance

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#### 3.2.2 Maintenance schedule

*Continued*

Maintenance activity	Equipment	Interval	Detailed in section:
Cleaning	Complete robot	Regularly <sup>i</sup>	<a href="#">Cleaning the IRB 120 on page 106</a>

- i "Regularly" implies that the activity is to be performed regularly, but the actual interval may not be specified by the robot manufacturer. The interval depends on the operation cycle of the robot, its working environment and movement pattern. Generally, the more contaminated environment, the shorter intervals. The more demanding movement pattern (sharper bending cable harness), the shorter intervals.
- ii Service inspection including dismounting of robot parts shall always be done outside the clean room area.
- 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.



### 3.3 Inspection activities

#### 3.3.1 Inspecting the robot cabling

##### Introduction



#### CAUTION

##### For robots with protection type Clean Room

Always read the specific instructions before doing any repair work, see [Cut the paint or surface on the robot before replacing parts on page 113](#)

##### Location of robot cabling

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


##### Required tools and equipment

Visual inspection, no tools are required.

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

##### Inspection, robot cabling

Use this procedure to inspect the robot cabling.

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Visually inspect: <ul style="list-style-type: none"> <li>• the control cabling between the robot and control cabinet</li> </ul> Look for abrasions, cuts or crush damage.	
3	Replace the cabling if wear or damage is detected.	

## 3 Maintenance

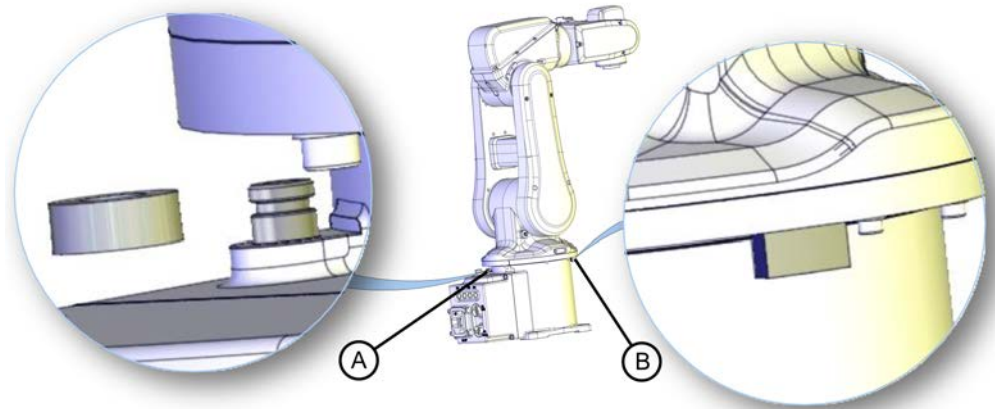
### 3.3.2 Inspecting mechanical stops

#### 3.3.2 Inspecting mechanical stops

##### Location of mechanical stops

The mechanical stops on axes 1, 2 and 3 are located as shown in the figures.

##### Axis 1

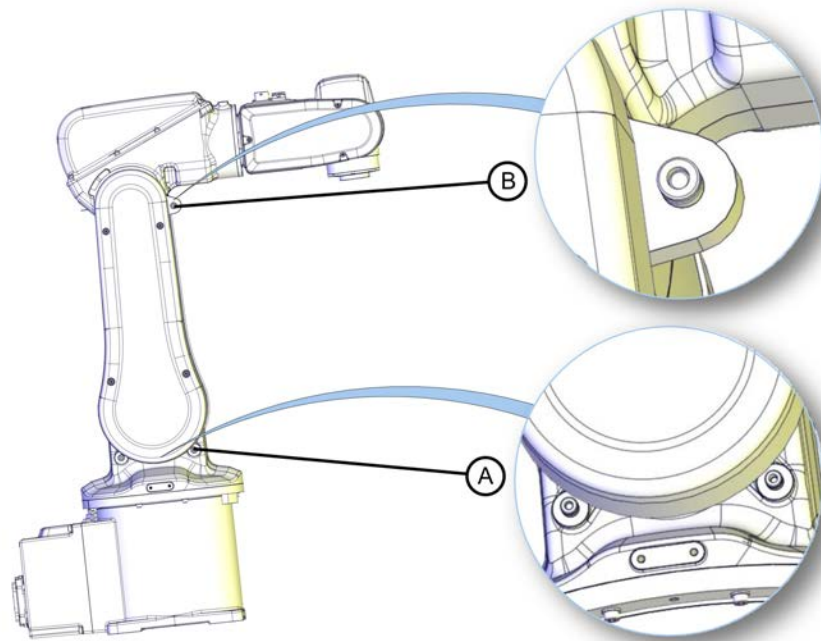


xx100000002

A	Mechanical stop axis 1 (base)
B	Mechanical stop axis 1 (swing plate)

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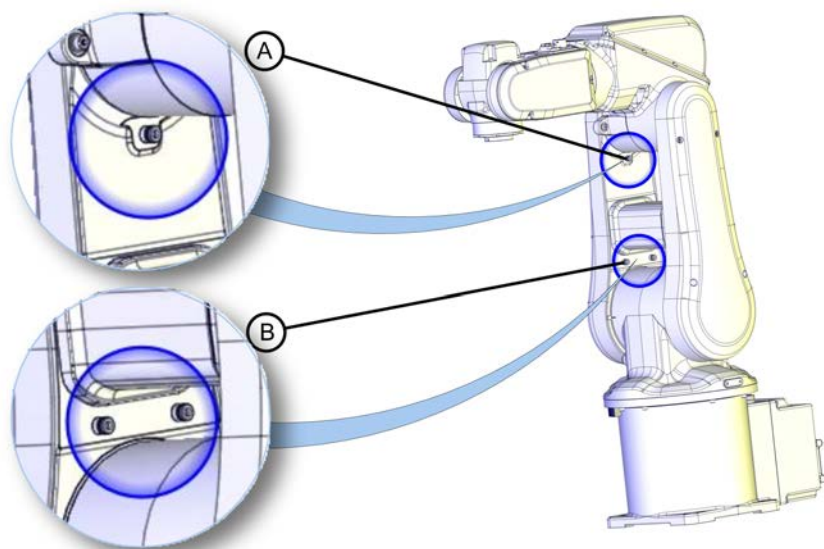
#### Axis 2



xx090000583

A	Mechanical stops axis 2 (swing housing)
B	Mechanical stop axis 3 (upper arm)

#### Axis 3



xx100000003

A	Mechanical stop axis 3 (lower arm)
B	Mechanical stops axis 2 (lower arm)

*Continues on next page*

## 3 Maintenance

### 3.3.2 Inspecting mechanical stops

Continued

#### Required spare parts



#### Note

The spare part numbers that are listed in the table can be out of date. See the latest spare parts of the IRB 120 via myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).

Spare part	Article number	Note
Mechanical stop set	See <a href="#">Spare parts on page 255</a> .	
Mechanical stop set	See <a href="#">Spare parts on page 255</a> .	
Mechanical stop set	See <a href="#">Spare parts on page 255</a> .	



#### Required tools and equipment

Visual inspection, no tools are required.

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

#### Inspecting mechanical stops

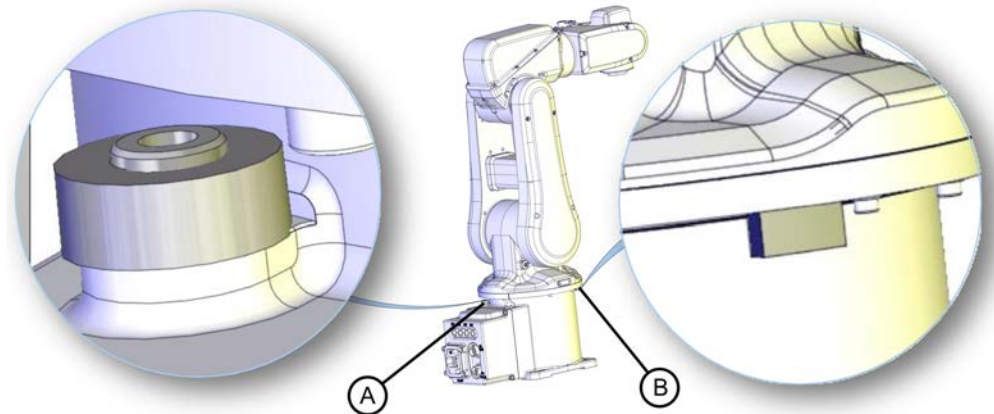
Use this procedure to inspect mechanical stops on axes 1, 2 and 3.

	Action	Information
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
2	Inspect the <i>mechanical stops</i> .	See the figures in: <ul style="list-style-type: none"><li>• <a href="#">Location of mechanical stops on page 86</a></li></ul>
3	Replace if the mechanical stop is: <ul style="list-style-type: none"><li>• bent</li><li>• loose</li><li>• damaged.</li></ul>  <b>Note</b> The expected life of gearboxes can be reduced as a result of collisions with the mechanical stop.	

### 3.3.3 Inspecting dampers

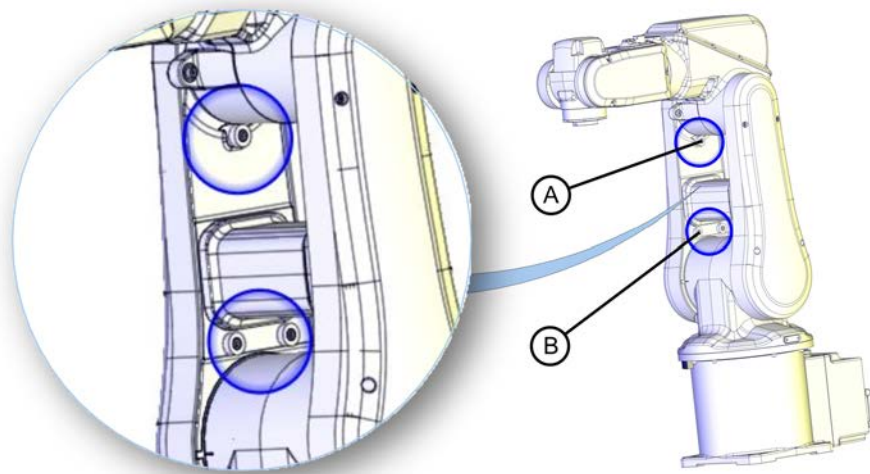
#### Location of dampers

The location of dampers are shown in the figures.



xx0900000579

A	Damper, axis 1
B	Mechanical stop axis 1 (swing plate)



xx0900000582

A	Damper, axis 3
B	Dampers, axis 2

#### Required equipment

Equipment	Art. no.	Note
Standard toolkit	-	The content is defined in the section <a href="#">Standard toolkit</a> on page 252.

Continues on next page


## 3 Maintenance

### 3.3.3 Inspecting dampers

*Continued*

#### Inspecting dampers

Use this procedure to inspect the dampers.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Check all <i>dampers</i> for damage such as: <ul style="list-style-type: none"><li>• cracks</li><li>• existing impressions larger than 1 mm.</li></ul>	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of dampers on page 89</a></li></ul>
3	Check all <i>attachment screws</i> for deformation.	
4	If any damage is detected, the damper must be replaced with a new one!	

### 3.3.4 Inspecting timing belts

#### Introduction



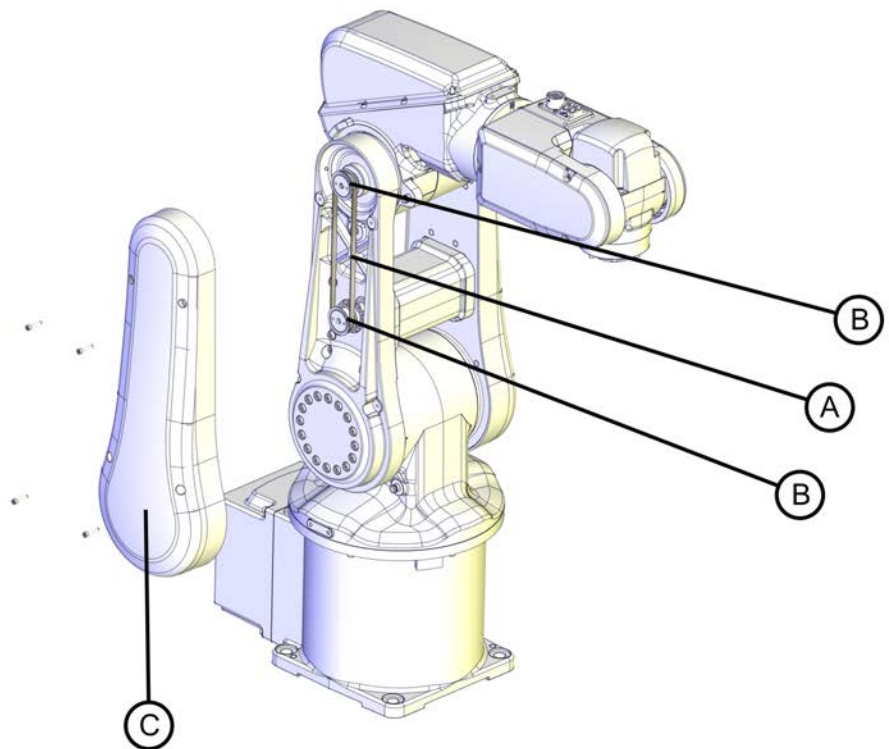
**CAUTION**

Always read the section "General procedures" before doing any repair work.  
*Cut the paint or surface on the robot before replacing parts on page 113.*

#### Location of timing belts

The timing belts are located as shown in the figures.

#### Axis 3



xx0900000610

A	Timing belt, axis 3
B	Timing belt pulley (2 pcs)
C	Lower arm cover

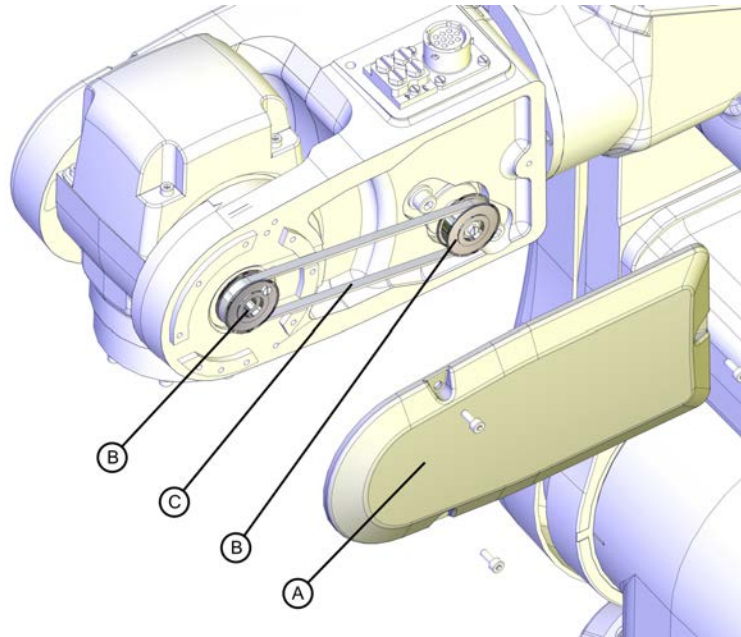
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## 3 Maintenance

### 3.3.4 Inspecting timing belts

Continued

#### Axis 5



xx0900000611

A	Wrist side cover
B	Timing belt pulley (2 pcs)
C	Timing belt, axis 5

#### Required tools and equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
Other tools and procedures may be required if the spare part needs to be replaced. These are specified in the replacement procedure.	

#### Timing belt tension

The table describes the timing belt tension.


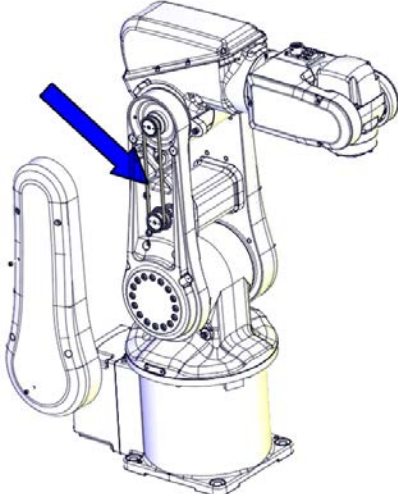
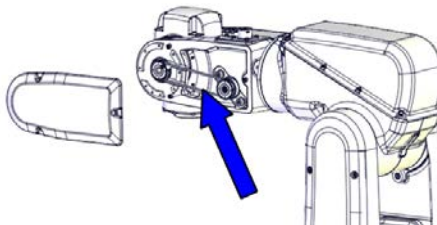
Axis	Timing belt tension
Axis 3	New belt: F = 18-19.7N Used belt: F = 12.5-14.3N
Axis 5	New belt: F = 7.6-8.4N Used belt: F = 5.3-6.1N

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#### Inspecting timing belts

Use this procedure to inspect timing belts.

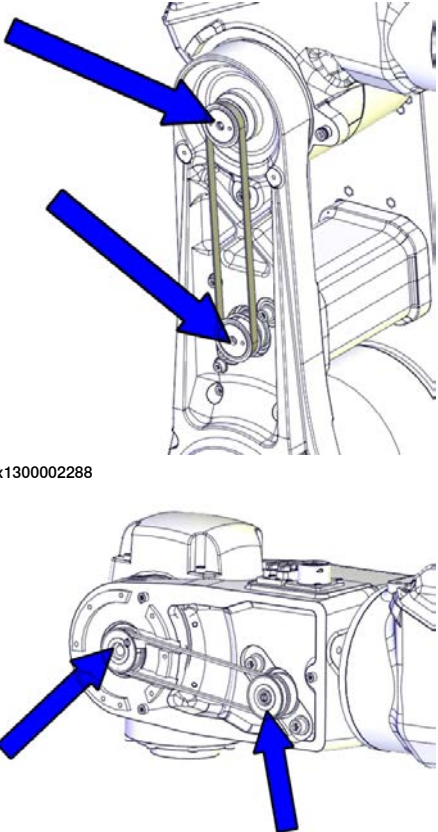
	Action	Information
1	<p> <b>DANGER</b></p> <p>Turn off all:</p> <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>	
2	Gain access to each <i>timing belt</i> by removing the cover.	 <p>xx1300002286</p>  <p>xx1300002287</p>
3	Check the timing belts for damage or wear.	

*Continues on next page*

### 3 Maintenance

#### 3.3.4 Inspecting timing belts

Continued

	Action	Information
4	Check the <i>timing belt pulleys</i> for damage.	 <p>xx1300002288</p> <p>xx1300002289</p>
5	If any damage or wear is detected, the part must be replaced!	
6	Check each belt for tension. If the belt tension is not correct, adjust it!	<p>Axis 3: . New belt: F = 18-19.7N Used belt: F = 12.5-14.3N</p> <p>Axis 5: . New belt: F = 7.6-8.4N Used belt: F = 5.3-6.1N</p>



#### Adjusting timing belts

##### Adjusting axis-3 timing belt

Use this procedure to adjust the axis-3 timing belt.


	Action	Note
1	<p>Jog the robot to the specified position:</p> <ul style="list-style-type: none"> <li>• Axis 2: -90°</li> <li>• Axis 3: move the upper arm until the mechanical stop is reached.</li> </ul>	

Continues on next page

	Action	Note
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	Loosen the <i>attachment screws</i> securing the <i>motor axis 3</i> .	
4	Fit the timing belt tension adjustment tool to the <i>lower arm</i> by pressing the two pins into the bores on the <i>lower arm</i> .	Axis-3 timing belt adjustment tool: 3HAC053095-001
5	Rotate the knob of the adjustment tool to tension the timing belt gradually, and at the same time, measure the belt tension using a tension meter.	
6	Measure the belt tension three times and record the average value as the measured value. The measured value should be within a reference range of 22-24N.	
7	Secure the <i>axis-3 motor</i> with its <i>attachment screws</i> and <i>washers</i> .   <b>Tip</b> Do not move the adjustment tool.	Tightening torque: 4 Nm.
8	Rotate the knob to loosen the adjustment tool.	
9	Measure the belt tension for three times and record the average value as the measured value. The measured value should be within the allowed range.	New belt: F = 18-19.7N Used belt: F = 12.5-14.3N
10	Remove the adjustment tool.	

#### Adjusting axis-5 timing belt

Use this procedure to adjust the axis-5 timing belt.


	Action	Note
1	Jog the axis 5 of the robot to the vertical position.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	

*Continues on next page*

## 3 Maintenance

### 3.3.4 Inspecting timing belts

Continued

	Action	Note
3	Loosen the <i>attachment screws</i> securing the <i>motor axis 5</i> .	
4	Fit the timing belt tension adjustment tool to the <i>upper arm</i> using a M3x10 screw.	Axis-5 timing belt adjustment tool: 3HAC053098-001
5	Rotate the knob of the adjustment tool to tension the timing belt gradually, and at the same time, measure the belt tension using a tension meter.	
6	Measure the belt tension three times and record the average value as the measured value. The measured value should be within a reference range of 10-11N.	
7	Secure the <i>axis-5 motor</i> with its <i>attachment screws</i> and <i>washers</i> .   <b>Tip</b>  Do not move the adjustment tool.	Tightening torque: 4 Nm.
8	Rotate the knob to loosen the adjustment tool.	
9	Measure the belt tension for three times and record the average value as the measured value. The measured value should be within the allowed range.	New belt: F = 7.6-8.4N Used belt: F = 5.3-6.1N
10	Remove the adjustment tool.	

### 3.3.5 Inspecting plastic covers

#### Introduction



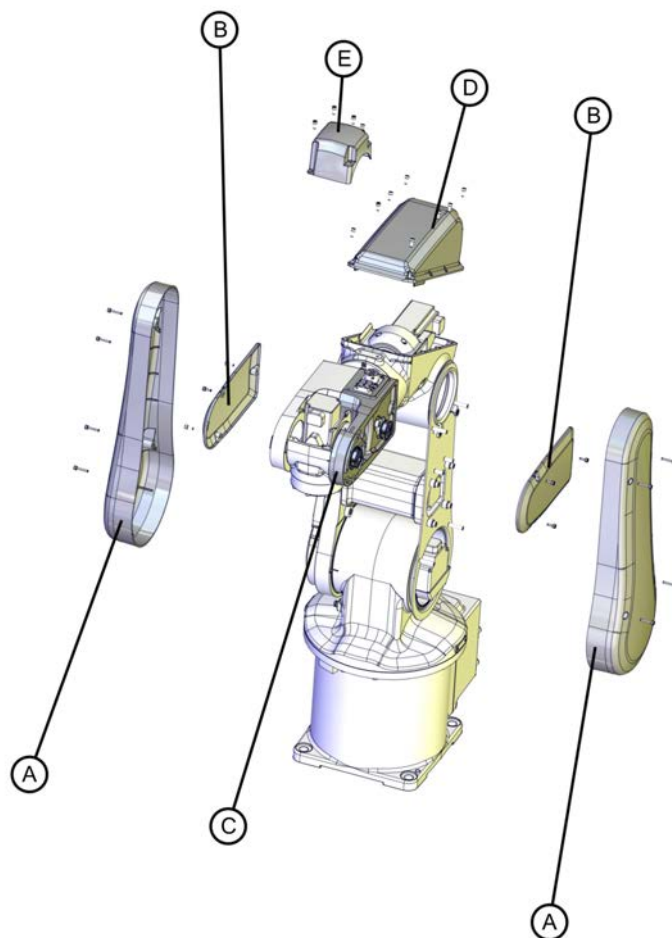
**CAUTION**

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

#### Location of plastic covers

Plastic covers are located as shown in the figure.



xx0900000607

A	Lower arm cover (2 pcs)
B	Wrist side cover (2 pcs)
C	Wrist support
D	Housing cover
E	Tilt cover

*Continues on next page*

### 3 Maintenance

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#### 3.3.5 Inspecting plastic covers

*Continued*

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#### Inspecting plastic covers

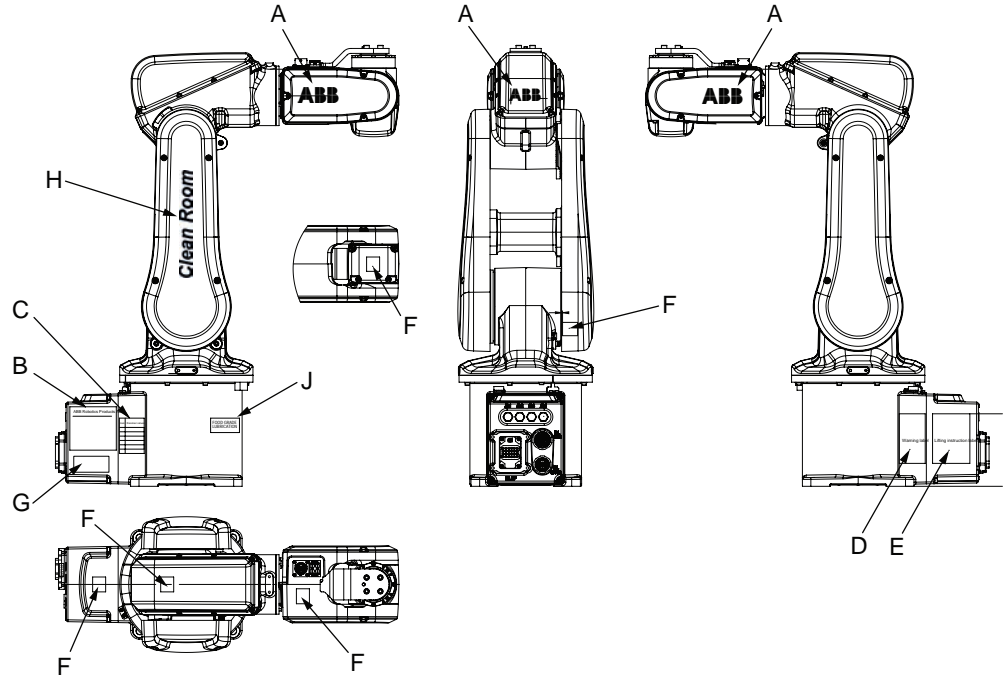
Use this procedure to inspect the plastic covers on the robot.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Check the plastic covers for: <ul style="list-style-type: none"><li>• cracks</li><li>• other kind of damage.</li></ul>	
3	Replace the plastic cover if cracks or damage is detected.	

3.3.6 Inspecting information labels

Location of information labels

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



xx180000641

A	ABB logotype
B	Rating label
C	Calibration label
D	Warning label - Risk of tipping
E	Lifting instruction label
F	Warning label - Electricity (symbol of flash) (5 pcs)
G	Label stock robots
H	Clean Room label
J	Food grade lubrication label

Required equipment

Equipment	Spare part number	Note
Labels	See <a href="#">Spare parts on page 255</a> .	

Continues on next page


## 3 Maintenance

### 3.3.6 Inspecting information labels

*Continued*

#### Inspecting labels

Use this procedure to inspect the labels on the robot.

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
2	Check all labels.	See the figure in <a href="#">Location of information labels on page 99</a> .
3	Replace any missing or damaged labels.	



## 3.4 Replacement/changing activities

### 3.4.1 Type of lubrication in gearboxes

#### Introduction

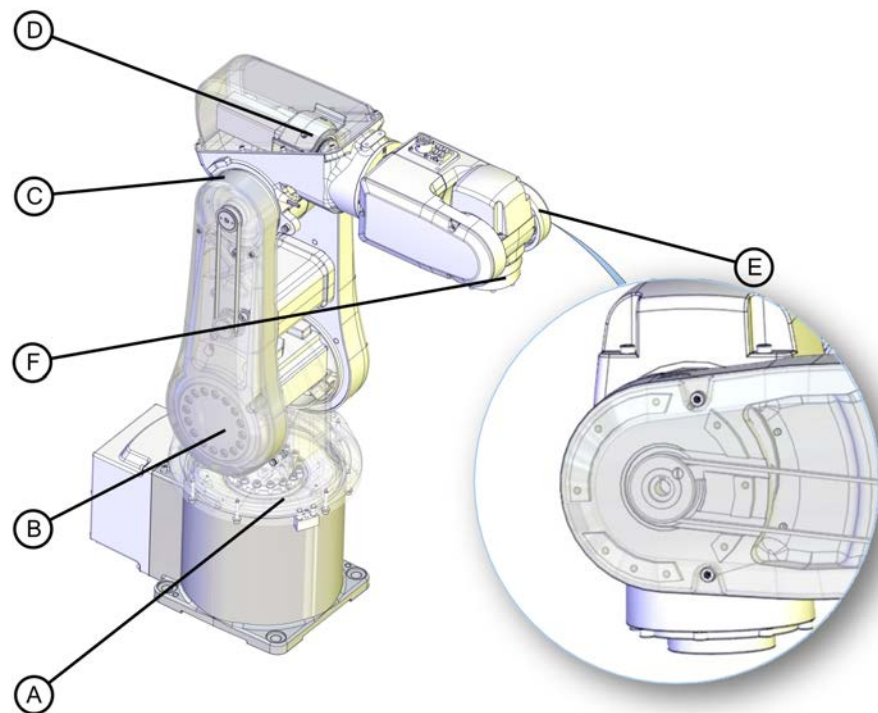
This section describes where to find information about the type of lubrication, article number and the amount of lubrication in the specific gearbox. It also describes the equipment needed when working with lubrication.

#### 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* available for registered users on myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).

#### Location of gearboxes

The figure shows the location of the gearboxes.



xx0900000612

A	Gearbox, axis 1 (inside the base)
B	Gearbox, axis 2
C	Gearbox, axis 3
D	Gearbox, axis 4
E	Gearbox, axis 5
F	Gearbox, axis 6

*Continues on next page*

### 3 Maintenance

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#### 3.4.1 Type of lubrication in gearboxes

*Continued*

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#### Equipment

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

### 3.4.2 Replacing the battery pack

#### Introduction

The section describes how to replace the battery pack on the robot.



**CAUTION**

Always read the section "General procedures" before doing any repair work.  
*Cut the paint or surface on the robot before replacing parts on page 113*

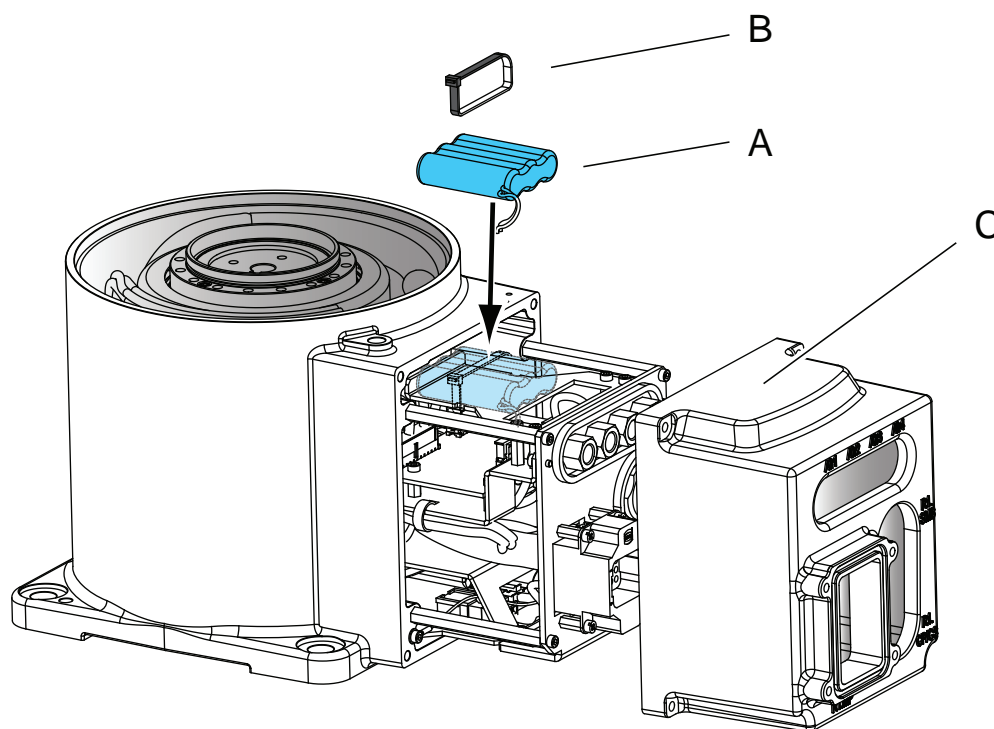


**WARNING**

See *Hazards related to batteries on page 35.*

#### Location of the battery pack

The location of the battery pack is inside the base cover as shown in the figure.



xx0900000588

A	Cable strap
B	Battery pack
C	Base cover

#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <i>Standard toolkit on page 252.</i>

*Continues on next page*

## 3 Maintenance



### 3.4.2 Replacing the battery pack

*Continued*

Equipment	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

#### Removing the battery pack

Use this procedure to remove the battery pack.


	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	
3	Remove the <i>base cover</i> from the robot by removing its attachment screws.	The <i>battery pack</i> is located inside the base cover as shown in the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the battery pack on page 103</a></li></ul>
4	Disconnect the battery cable from the Encoder Interface Board.	
5	Cut the cable strap.	
6	Remove the battery pack.	

#### Refitting the battery pack

Use this procedure to refit the battery pack.

	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Fit the new battery pack with a <i>cable strap</i> .	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the battery pack on page 103</a></li></ul>
3	Connect the battery cable to the Encoder Interface Board.	
4	Refit the <i>base cover</i> to the robot with its attachment screws.	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the battery pack on page 103</a></li></ul>

*Continues on next page*

	Action	Information
5	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	
6	Update the revolution counters.	

## 3 Maintenance

---

### 3.5.1 Cleaning the IRB 120

## 3.5 Cleaning activities

### 3.5.1 Cleaning the IRB 120



#### DANGER

Turn off all:

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

to the robot, before entering the safeguarded space.

---

#### General

To secure high uptime it is important that the IRB 120 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works. Different cleaning methods are allowed depending on the type of protection of the IRB 120.



#### Note

Always verify the protection type of the robot before cleaning.

---

#### Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

- Always use cleaning equipment as specified. Any other cleaning equipment may shorten the life of the robot.
- Always check that all protective covers are fitted to the robot before cleaning.
- Do not use compressed air to clean the robot.
- Never use solvents that are not approved by ABB to clean the robot.
- Do not spray from a distance closer than 0.4 m.
- Do not remove any covers or other protective devices before cleaning the robot.

---

#### Cleaning methods

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

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

*Continues on next page*

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Clean room	Yes	Yes. With light cleaning detergent. See <a href="#">Additional cleaning instructions for Clean Room robots on page 107</a> .	No	No

#### Wiping with cloth

##### Additional cleaning instructions for Clean Room robots

ABB robots with protection types *Clean Room* are designed to be cleaned at a low cleaning frequency, before entering the cleanroom environment, after robot commissioning or during cleanroom maintenance.

Wipe-down cleaning method is recommended. Robot surfaces shall be wiped with clean and low particle emission cleanroom cloth which is soaked in 70% ethanol

Use the following procedure to clean Clean Room robots:

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

##### Additional cleaning instructions for robots with food grade lubrication

Make sure that no liquid flows into the robot or stagnates in any gap or surface after cleaning.

#### Cables

Movable cables need to be able to move freely:

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

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# 4 Repair

## 4.1 Introduction

### Structure of this chapter

This chapter describes repair activities for the IRB 120. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.



#### WARNING

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

### Report replaced units



#### Note

When replacing a part on the IRB 120, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

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

### Safety information

Make sure to read through the chapter [Safety on page 19](#) before commencing any service work.



#### Note

If the IRB 120 is connected to power, always make sure that the IRB 120 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

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

## 4 Repair

### 4.2.1 Mounting instructions for sealings

## 4.2 General procedures

### 4.2.1 Mounting instructions for sealings

#### General

This section describes how to mount different types of sealings.

#### Equipment

Consumable	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2
Grease	3HAC043771-001	LUBRIPLATE SYNXTREME FG-0 Used for robots with food grade lubrication.

#### Rotating sealings

The procedure below describes how to fit rotating sealings.



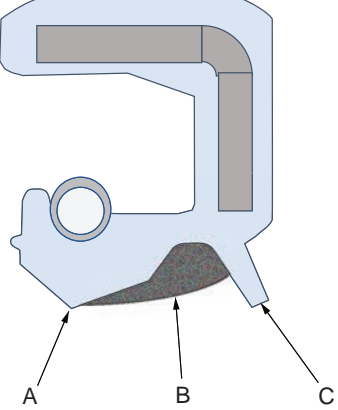
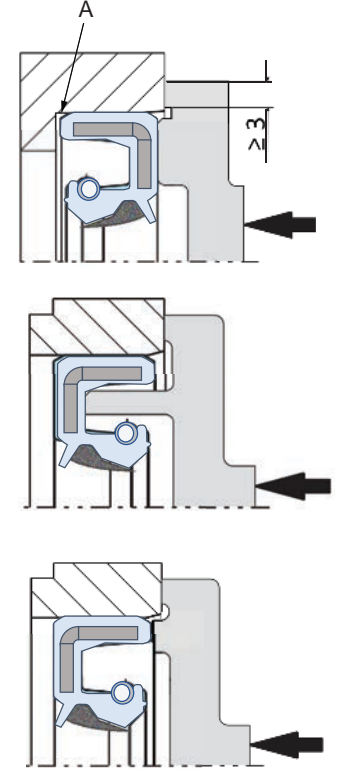
#### CAUTION

Please observe the following before commencing any assembly of sealings:

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

	Action	Note
1	Check the sealing to ensure that: <ul style="list-style-type: none"><li>• The sealing is of the correct type.</li><li>• There is no damage on the main lip.</li></ul>	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	

*Continues on next page*

	Action	Note
3	<p>Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.)</p> <p>Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.</p>	<p>Article number is specified in <a href="#">Equipment on page 110</a>.</p>  <p>xx200000071</p> <p>A Main lip B Grease C Dust lip</p>
4	<p>Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.</p>	 <p>xx200000072</p> <p>A Gap</p>
5	<p>Make sure that no grease is left on the robot surface.</p>	

Continues on next page

## 4 Repair

### 4.2.1 Mounting instructions for sealings

*Continued*

#### Flange sealings and static sealings

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

	Action
1	Check the flange surfaces. They must be even and free from pores. It is easy to check flatness using a gauge on the fastened joint (without sealing compound). If the flange surfaces are defective, the parts may not be used because leakage could occur.
2	Clean the surfaces properly in accordance with the recommendations of ABB.
3	Distribute the sealing compound evenly over the surface, 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, or deformation.	Defective o-rings, including damaged or deformed 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.	
4	Lubricate the o-ring with grease.	
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	
7	Make sure that no grease is left on the robot surface.	

## 4.2.2 Cut the paint or surface on the robot before replacing parts

## 4.2.2 Cut the paint or surface on the robot before replacing parts

## General

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

For robots with protection type Clean Room



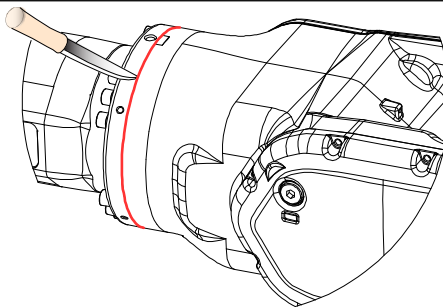
For robots with food grade lubrication

When replacing parts on the robot, it is important to make sure that after the replacement, no particles will be emitted from the joint between the structure and the new part, and that the easy cleaned surface is retained.

## Required equipment

Equipment	Spare parts	Note
Sealing compound	3HAC026759-001	Sikaflex 521 FC. Color white.
Tooling pin		Width 6-9 mm, made of wood.
Cleaning agent		Ethanol
Knife		
Lint free cloth		
Touch up paint Clean Room/Hygienic	3HAC036639-001	White
Touch up paint Standard/Foundry Plus	3HAC067974-001	Graphite White
Touch up paint Standard/Foundry Plus	3HAC037052-001	ABB Orange

## Removing

	Action	Description
1	<p>Cut the paint with a knife in the joint between the part that will be removed and the structure, to avoid that the paint cracks.</p> <p> <b>CAUTION</b></p> <p>Be careful not to damage the plastic covers when cutting.</p> <p> <b>CAUTION</b></p> <p>Seal glue is filled in the gap between lower arm cover and lower arm (axis 3 timing belt side). The glue should be removed and the surface cleaned.</p>	 <p>xx0900000121</p>
2	Carefully grind the paint edge that is left on the structure to a smooth surface.	

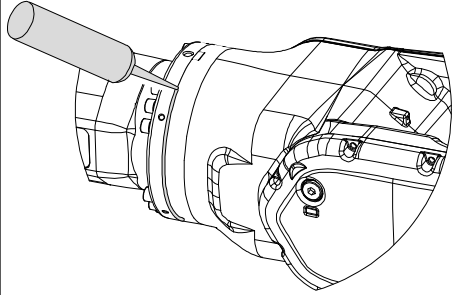
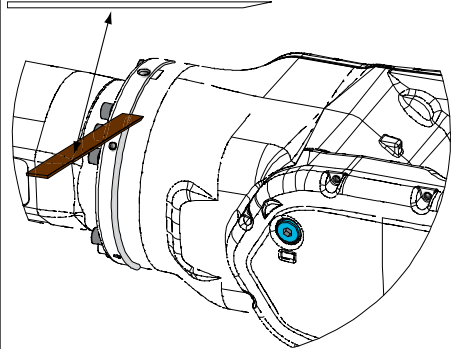

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## 4 Repair

### 4.2.2 Cut the paint or surface on the robot before replacing parts

Continued

#### Refitting

	Action	Description
1	Before the parts are refitted, clean the joint so that it is free from oil and grease.	Use ethanol on a lint free cloth.
2	Place the tooling pin in hot water.	
3	Seal all refitted joints with sealing compound.	 <p>xx0900000122</p>
4	Use the tooling pin to even out the surface of the sealing compound.	 <p>xx0900000125</p>
5	<p>For robots with protection type Clean Room For robots with food grade lubrication Wait 10 minutes.</p>	<p>For robots with protection type Clean Room For robots with food grade lubrication Sikaflex 521FC skin dry time (10 minutes).</p>
6	<p>Use Touch up paint Clean Room/Hygienic, white to paint any damaged surfaces.</p> <p> <b>Note</b></p> <p>Always read the instruction in the product data sheet in the paint repair kit for Clean Room/Hygienic.</p>	3HAC036639-001

 **Note**

After all repair work, wipe the robot free from particles with spirit on a lint free cloth.

## 4.3 Cable harness

### 4.3.1 Removing the cable harness

#### Introduction

These procedures describes how to remove the complete cable harness in:

- 1 the wrist - [Removing the cable harness in the wrist on page 116](#)
- 2 the upper arm housing - [Removing the cable harness in the upper arm housing on page 121](#)
- 3 the lower arm and swing plate - [Removing the cable harness in the lower arm on page 123](#)
- 4 the base - [Removing the cable harness in the base on page 125.](#)



#### Note

It is necessary to perform the removal in the order as listed above!

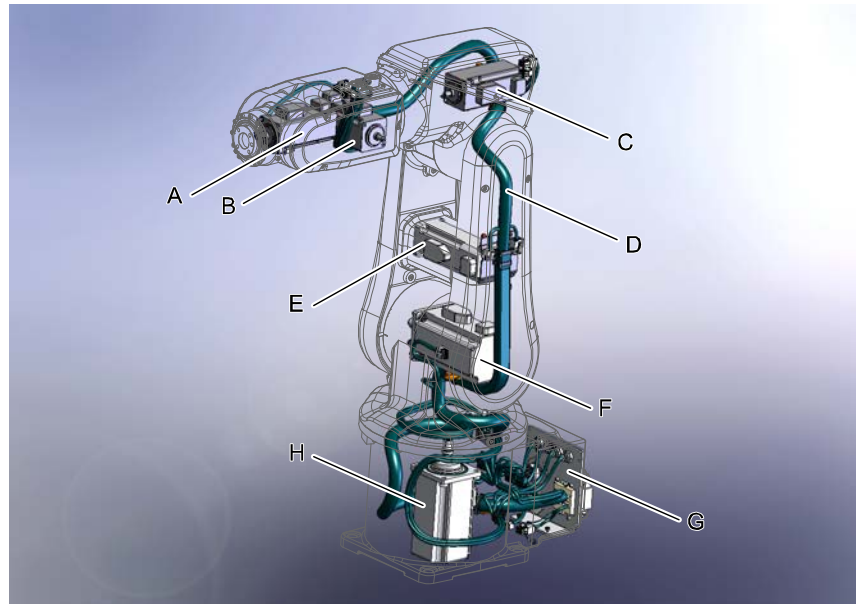


#### CAUTION

Always read the section "General procedures" before doing any repair work.  
[Cut the paint or surface on the robot before replacing parts on page 113](#)

#### Location of the cable harness.

The cable harness is located as shown in the figure.



xx090000905

A	Motor axis 6
B	Motor axis 5

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## 4 Repair

### 4.3.1 Removing the cable harness

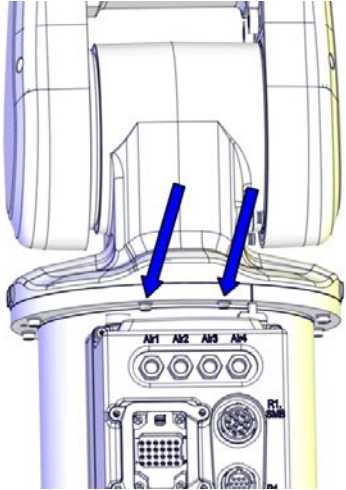
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C	Motor axis 4
D	Cable harness
E	Motor axis 3
F	Motor axis 2
G	Plate (part of the cable harness)
H	Motor axis 1

#### Required equipment



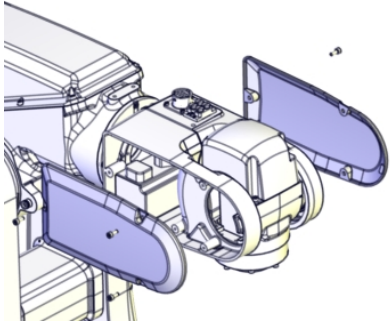
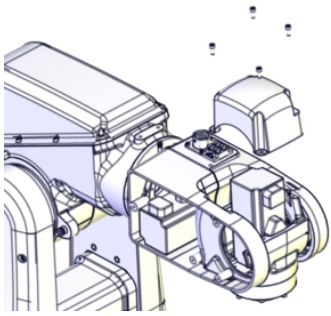
Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Flange sealant	for example Loctite 574
Cable grease	Shell Gadus S2
Cable grease, for food grade lubrication	LUBRIPLATE SYNXTREME FG-0. Used for lubrication of cable contact areas for robots with food grade lubrication.

#### Removing the cable harness in the wrist

	Action	Information
1	Jog axis 1 to 90° position.	
2	Unscrew <i>two attachment screws</i> securing the swing housing to the base, not possible to reach with axis 1 in 0° position.	 <p>xx1300001598</p>
3	Jog <ul style="list-style-type: none"> <li>• axis 1 to 0° position</li> <li>• axis 2 to -50° position</li> <li>• axis 3 to +50° position</li> <li>• axis 4 to 0° position</li> <li>• axis 5 to +90° position</li> <li>• axis 6 - no significance</li> </ul>	

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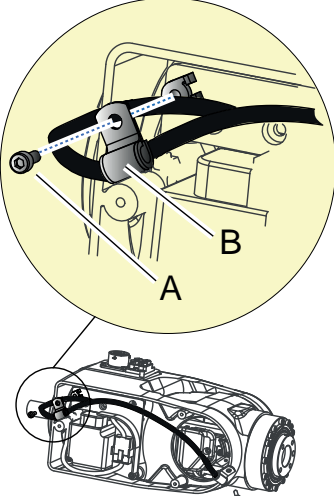
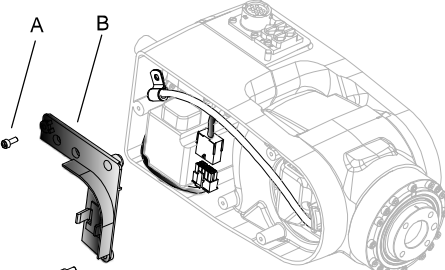
	Action	Information
4	 <p><b>DANGER</b></p> <p>Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!</p>	
5	 <p><b>CAUTION</b></p> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113.</a></p>	
6	<p>Remove the <i>wrist side covers</i> on both sides.</p>	 <p>xx1400002899</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• Wrist side covers (2 pcs)</li> <li>• Attachment screws (6 pcs)</li> </ul>
7	<p>Remove the <i>tilt cover</i>.</p>	 <p>xx1400002900</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• Attachment screws(4 pcs)</li> <li>• Tilt cover</li> </ul>

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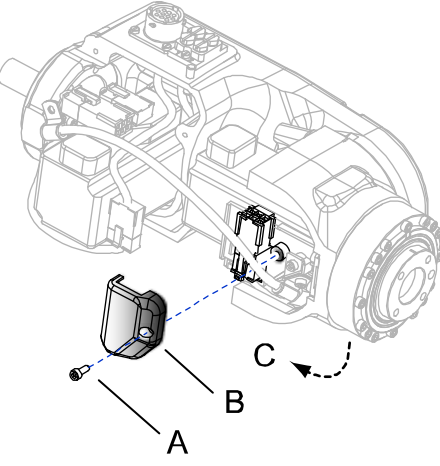
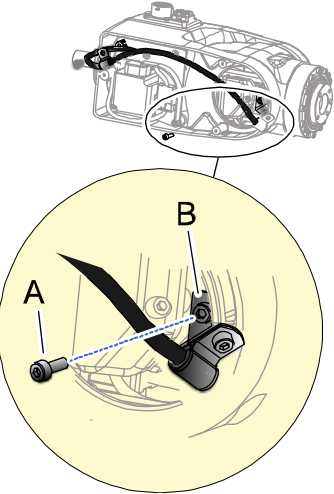
## 4 Repair

### 4.3.1 Removing the cable harness

Continued

	Action	Information
8	Unscrew the <i>attachment screw</i> securing the <i>clamp</i> at motor axis 5.	 <p>xx0900000912</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Attachment screw</li><li>• B: Clamp</li></ul>
9	Disconnect customer contact R2.CP/CS	
10	Remove the <i>connector support</i> at axis 5.	 <p>xx0900000888</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Attachment screws (2 pcs)</li><li>• B: Connector support</li></ul>

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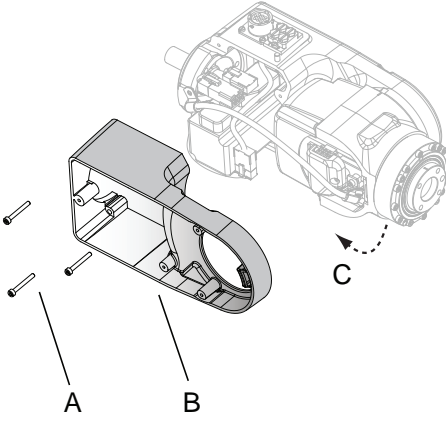
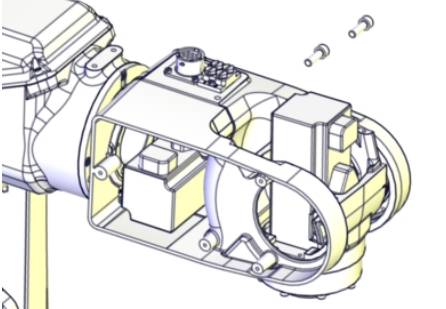
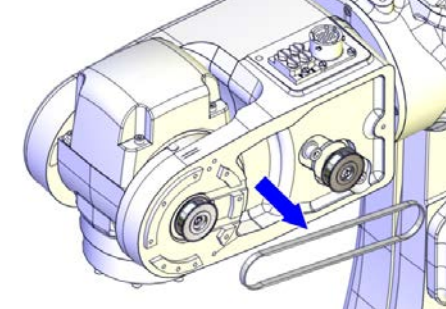
	Action	Information
11	Remove the <i>connector cover</i> .	 <p>xx0900000902</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Attachment screw</li> <li>• B: Connector cover</li> <li>• C: Axis 5 shall be in 90° position</li> </ul>
12	Unscrew the <i>attachment screw</i> securing the <i>clamp</i> at motor axis 6.	 <p>xx0900001000</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Attachment screw</li> <li>• B: Clamp</li> </ul>
13	Disconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP5 and R2. ME5, motor axis 5</li> <li>• R2.MP6 and R2. ME6, motor axis 6.</li> </ul>	
14	Gently pull the cables from motor axis 5 and motor axis 6 out of the wrist housing.	

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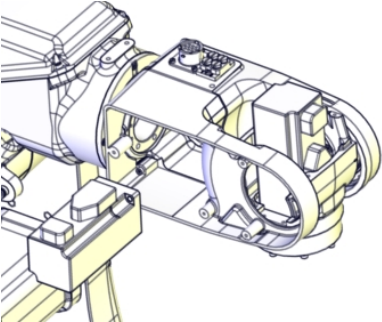
## 4 Repair

### 4.3.1 Removing the cable harness


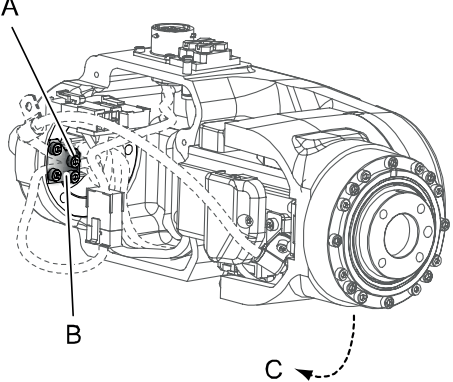
Continued

	Action	Information
15	<p>Remove the <i>wrist housing (plastic)</i>.</p> <p> <b>CAUTION</b></p> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>.</p>	 <p>xx090000900</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Attachment screws (3 pcs)</li> <li>• B: Wrist housing (plastic)</li> <li>• (C: Axis 5 shall be in 90° position)</li> </ul>
16	<p>Unscrew the <i>attachment screws</i> securing <i>motor axis 5</i>.</p>	 <p>xx1400002901</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• Attachment screws and washers (2 pcs)</li> </ul>
17	<p>Tilt the <i>motor axis 5</i> to be able to remove the <i>timing belt</i>.</p>	 <p>xx0900001019</p>

Continues on next page

	Action	Information
18	Carefully remove <i>motor axis 5</i> .	 <p>xx1400002906</p>
19	Disconnect air hoses.	

#### Removing the cable harness in the *upper arm housing*

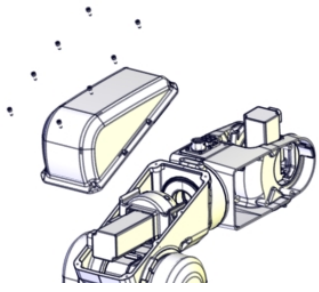
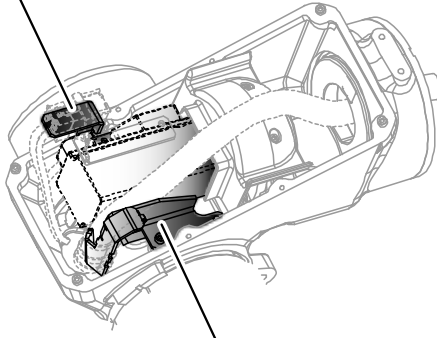
	Action	Information
1	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <i>Cut the paint or surface on the robot before replacing parts on page 113</i> .	
2	Unscrew the <i>two attachment screws</i> securing the <i>cable harness</i> in the bracket. Leave the bracket fastened in the housing.	 <p>xx0900001018</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Attachment screws (4 pcs)</li> <li>• B: Cable bracket</li> <li>• (C: Axis 5 shall be in 90° position)</li> </ul>

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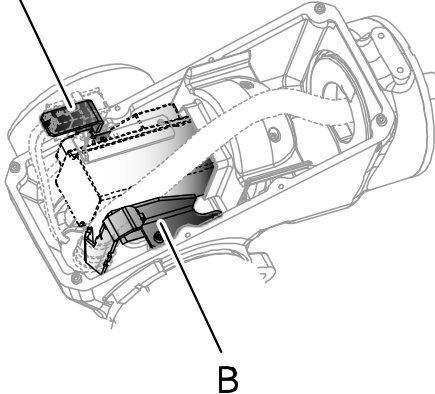
## 4 Repair

### 4.3.1 Removing the cable harness


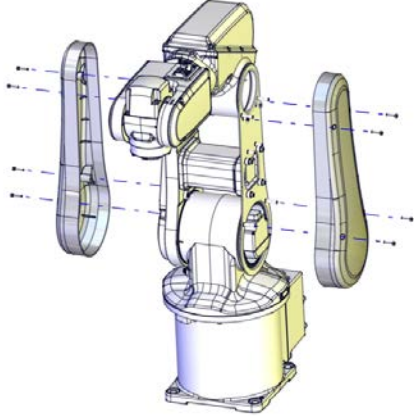
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	Action	Information
3	Remove the housing cover.	 <p>xx1400002909</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• Housing cover</li><li>• Attachment screws (8 pcs)</li></ul>
4	Carefully pull the cable harness out of the wrist housing to axis 4.	
5	Cut cable ties at cable bracket A.	 <p>xx0900001023</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Cable bracket</li><li>• B: Cable bracket</li></ul>
6	Disconnect connectors: <ul style="list-style-type: none"><li>• R2.MP4</li><li>• R2.ME4.</li></ul>	

Continues on next page

	Action	Information
7	Cut cable ties at cable bracket B.	<p data-bbox="986 306 1011 342">A</p>  <p data-bbox="1209 728 1235 763">B</p> <p data-bbox="986 772 1093 790">xx0900001023</p> <p data-bbox="986 808 1054 835">Parts:</p> <ul data-bbox="1018 835 1246 896" style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Cable bracket</li> </ul>
8	Carefully pull the cable harness out of the upper arm housing.	

#### Removing the cable harness in the *lower arm*

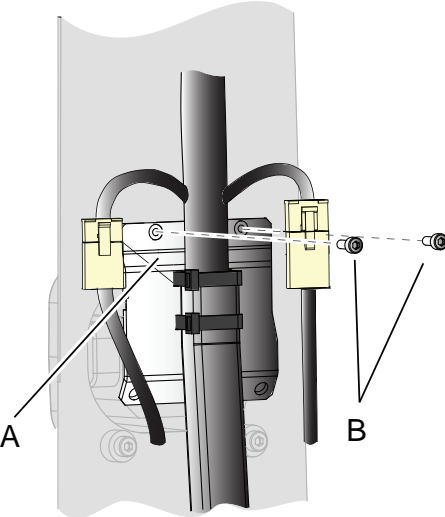
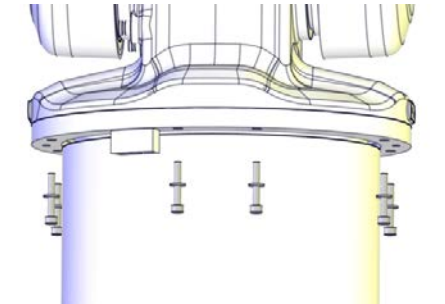

	Action	Information
1	<p data-bbox="507 1126 707 1182">  <b>CAUTION</b> </p> <p data-bbox="501 1198 970 1305">Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>.</p>	
2	Remove the <i>lower arm cover</i> .	 <p data-bbox="986 1780 1093 1798">xx0900000848</p>
3	Cut <i>cable ties</i> for motor axis 3 cables.	
4	Pull the <i>cable harness</i> out through the upper arm housing to axis 3.	

*Continues on next page*

## 4 Repair

### 4.3.1 Removing the cable harness

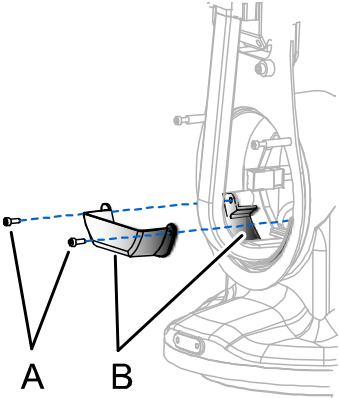
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	Action	Information
5	Disconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP3</li> <li>• R2.ME3.</li> </ul>	
6	Detach the <i>cable bracket</i> from the lower arm plate.	 <p>xx0900000879</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Attachment screws (2 pcs)</li> </ul>
7	Remove six remaining <i>attachment screws</i> between swing housing and base.	 <p>xx1300001604</p>
8	Carefully lift the robot and put it down close to the base of the robot.  <b>CAUTION</b> Do not stretch the cable harness.	
9	Cut <i>cable ties</i> at motor axis 2.	
10	Disconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP2</li> <li>• R2.ME2</li> </ul>	


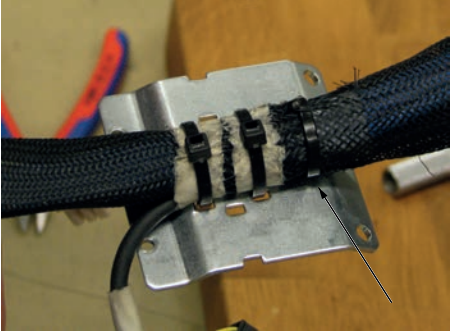

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4.3.1 Removing the cable harness  
Continued

	Action	Information
11	Remove <i>cable guide</i> .	 <p>xx0900000857</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (2 pcs)</li> <li>• B: Cable guide</li> </ul>

Removing the cable harness in the *base*

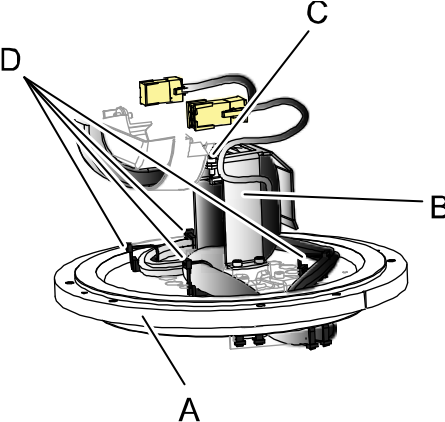
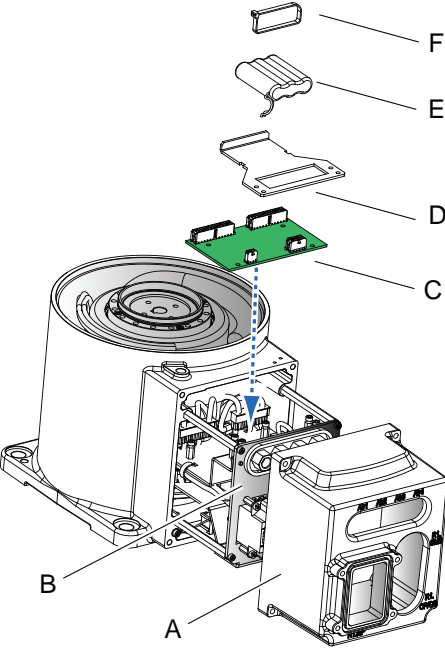
	Action	Information
1	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	
2	If the cable harness is being reused: <ul style="list-style-type: none"> <li>• Take a picture of the bracket (from the wrist) mounted on the harness</li> <li>• Place a cable tie close to the bracket</li> <li>• Cut old cable ties</li> </ul>	The picture will be good help when assembling the bracket again.  <p>xx1500000001</p>
3	Remove the bracket (from the wrist) on the cable harness.	
4	Tighten the screw after removal of bracket.	
5	Guide the cable harness and pull it carefully in below motor in axis 2.	
6	 <b>Tip</b> Take a picture of cable harness placement in the swing housing before removal.	

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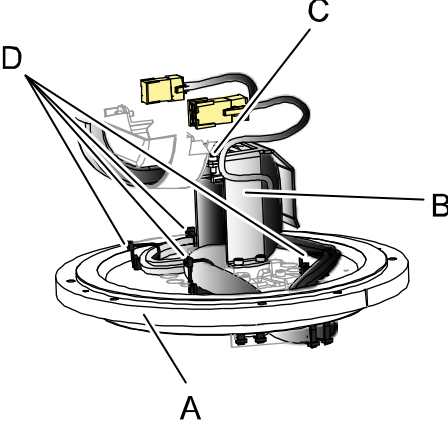
## 4 Repair

### 4.3.1 Removing the cable harness

Continued

	Action	Information												
7	Cut the <i>cable ties</i> securing the cable harness and the air hoses on the <i>swing plate</i> at motor axis 1.	 <p>xx0900000884</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Swing plate</li> <li>• B: Cable holder</li> <li>• C: Attachment screws (2 pcs)</li> <li>• D: Cable ties (4 pcs)</li> </ul>												
8	Remove the <i>base cover</i> from the robot by removing its attachment screws.	 <p>xx0900000842</p> <table border="1" data-bbox="957 1635 1404 1904"> <tbody> <tr> <td>A</td> <td>Base cover</td> </tr> <tr> <td>B</td> <td>Plate</td> </tr> <tr> <td>C</td> <td>Encoder Interface Board (EIB board)</td> </tr> <tr> <td>D</td> <td>Bracket</td> </tr> <tr> <td>E</td> <td>Battery pack</td> </tr> <tr> <td>F</td> <td>Cable tie</td> </tr> </tbody> </table>	A	Base cover	B	Plate	C	Encoder Interface Board (EIB board)	D	Bracket	E	Battery pack	F	Cable tie
A	Base cover													
B	Plate													
C	Encoder Interface Board (EIB board)													
D	Bracket													
E	Battery pack													
F	Cable tie													

Continues on next page

	Action	Information
9	Disconnect connector cables from the power source, motor cables and SMB. <ul style="list-style-type: none"> <li>• R1.A1</li> <li>• R1.A2</li> <li>• R1.A3</li> <li>• R1.A4</li> </ul>	
10	Disconnect the battery cables.	
11	Remove attachment screws securing <i>bracket with the battery pack</i> .	D in figure above. Do not remove the battery pack from the bracket.
12	Remove attachment screws securing the <i>plate</i> .	
13	Disconnect connectors from EIB board: <ul style="list-style-type: none"> <li>• R1.ME4-6 (J4)</li> <li>• R1.ME1-3 (J3)</li> <li>• R2.EIB</li> </ul>	
14	Remove the <i>EIB board</i> .  <b>ELECTROSTATIC DISCHARGE (ESD)</b> Put the board in an ESD protective bag.	
15	Cut <i> cable tie</i> .	
16	Disconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP1</li> <li>• R2.ME1.</li> </ul>	
17	Disconnect <i> earth connection</i> .	
18	Unscrew the <i> attachment screws</i> securing the cable harness to the <i> cable holder</i> .	 <p>xx0900000884</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Swing plate</li> <li>• B: Cable holder</li> <li>• C: Attachment screws (2 pcs)</li> <li>• D: Cable ties (4 pcs)</li> </ul>


*Continues on next page*

## 4 Repair

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### 4.3.1 Removing the cable harness

*Continued*

	Action	Information
19	 <b>CAUTION</b> Cable harness and hoses are sensitive equipment. Use caution when handling cable harness.	
20	Carefully push and pull the <i>complete cable harness</i> past motor axis 1.	

## 4.3.2 Refitting the cable harness

### Introduction

These procedures describes how to refit the complete cable harness in:

- 1 the base - [Refitting the cable harness in the base on page 130](#)
- 2 the lower arm - [Refitting the cable harness in the lower arm on page 133](#)
- 3 the upper arm housing and swing plate - [Refitting the cable harness in the upper arm housing on page 136](#)
- 4 the wrist - [Refitting the cable harness in the wrist on page 137](#).



#### Note

It is necessary to perform the refitting in the order as listed above!



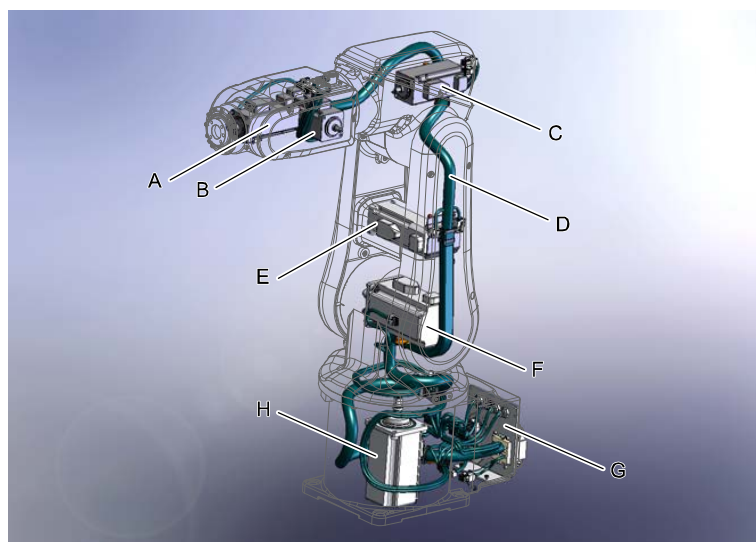
#### CAUTION

Always read the section "General procedures" before doing any repair work.

[Cut the paint or surface on the robot before replacing parts on page 113](#)

### Location of the cable harness

The cable harness is located as shown in the figure.



xx090000905

A	Motor axis 6
B	Motor axis 5
C	Motor axis 4
D	Cable harness
E	Motor axis 3
F	Motor axis 2

*Continues on next page*

## 4 Repair

### 4.3.2 Refitting the cable harness

*Continued*

G	Plate (part of the cable harness)
H	Motor axis 1

#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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.
Flange sealant	For example Loctite 574
Cable grease	Shell Gadus S2
Cable grease, for food grade lubrication	LUBRIPLATE SYNXTREME FG-0. Used for lubrication of cable contact areas for robots with food grade lubrication.

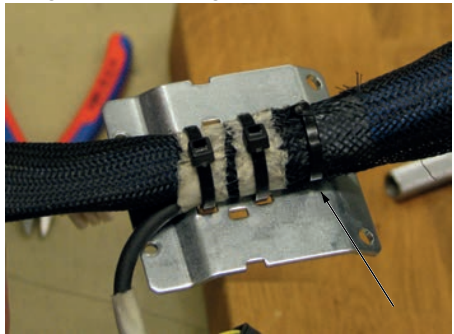


#### Note


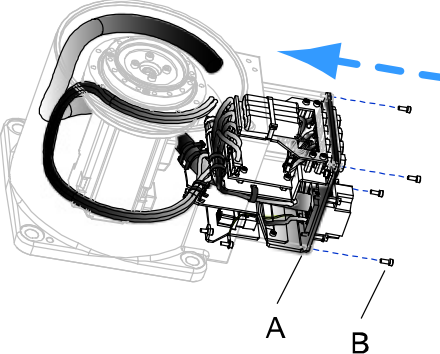
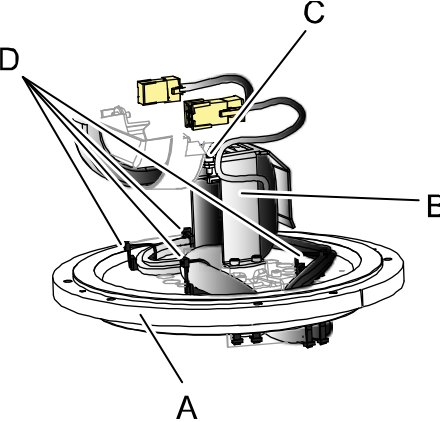

Apply some cable grease on the cable harness where wear exists and also on the plastic parts of the robot.

#### Refitting the cable harness in the *base*

Use this procedure to refit the cable harness in the *base*.

	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Check that: <ul style="list-style-type: none"> <li>the cable harness and its parts are clean and without damage.</li> </ul>	
3	Remove the bracket from the cable harness and mark the position. <ul style="list-style-type: none"> <li>Take a picture of the bracket mounted on the harness</li> <li>Place a cable tie close to the bracket</li> <li>Cut old cable ties</li> </ul>	<p>The picture will be good help when assembling the bracket again.</p>  <p>xx150000001</p>
4	Refit the <i>plate</i> with EIB board.	

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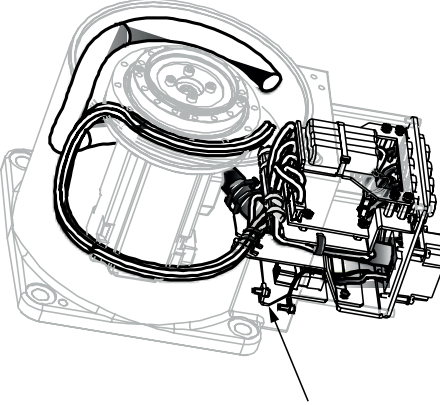


	Action	Information
5	<p>Carefully pull the cable harness through the swing plate.</p> <p> <b>CAUTION</b></p> <p>Cable harness and hoses are sensitive equipment. Use caution when handling cable harness.</p>	
6	<p>Place the <i>cables</i> from cable harness on the right side in frame, and the <i>air hoses</i> on the left side in the frame.</p>	 <p>xx0900000836</p>
7	<p>Secure the cable harness to the <i>cable holder</i> with the <i>attachment screws</i>.</p>	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000884</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Swing plate</li> <li>• B: Cable holder</li> <li>• C: Attachment screws (2 pcs)</li> <li>• D: Cable ties (4 pcs)</li> </ul>
8	<p>Carefully push and pull the cable harness out from the frame.</p> <p> <b>CAUTION</b></p> <p>Cable harness and hoses are sensitive equipment. Use caution when handling cable harness.</p>	
9	<p>Put some cable grease on the cable harness (including air hoses).</p>	

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## 4 Repair

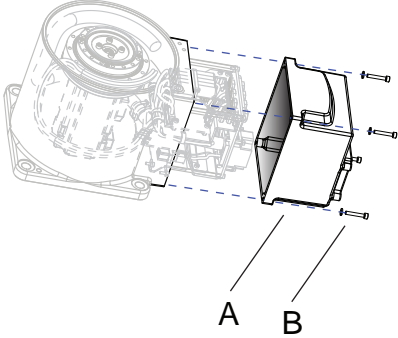

### 4.3.2 Refitting the cable harness

Continued


	Action	Information
10	Place the cable harness inside the cable holder.	
11	Loosen the <i>cable bracket</i> next to motor axis 1.	 <p data-bbox="959 792 1066 808">xx150000002</p>
12	Reconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP1</li> <li>• R2.ME1.</li> </ul>	
13	Secure the <i>motor cables</i> to the cable bracket with cable ties.	
14	Fasten <i>cable bracket</i> .	M3x8 (2 pcs)
15	Refit the <i>PE cable</i> .	Är detta earth connection? Om inte, vad är det för kabel?
16	Refit the <i>EIB board</i> .  <b>Note</b> Use ESD protective equipment.	Attachment screw (4 pcs) M3x8
17	Connect <i>board</i> . <ul style="list-style-type: none"> <li>• R1.ME4-6 (J4)</li> <li>• R1.ME1-3 (J3)</li> <li>• R2.EIB.</li> </ul>	
18	Connect <i>battery cables</i> .	
19	Refit the <i>battery plate</i> .	Attachment screw (4 pcs) M3x8
20	Refit the <i>EIB plate</i> .  <b>CAUTION</b> Cables are sensitive equipment. Use caution when handling cables.	Attachment screw (4 pcs) M3x8

Continues on next page



	Action	Information
21	Refit the <i>base cover</i> .	<p>Tightening torque: 4 Nm</p>  <p>xx0900000829</p>
22	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	

#### Refitting the cable harness in the *lower arm*



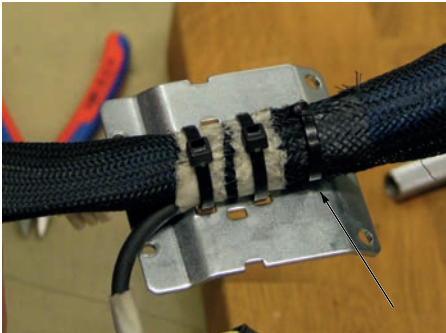
	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	<p>Place the <i>cable harness</i> in the <i>holder</i> on the <i>swing plate</i>.</p> <ul style="list-style-type: none"> <li>• Put cable R2.MP2 towards back</li> <li>• Put cable R2.ME2 towards front</li> </ul>	
3	Tighten screws in bracket.	Attachment screw M3x8 (2 pcs)
4	Secure <i>air hoses</i> on the <i>swing plate</i> with <i>cable ties</i> .	
5	Secure the <i>cable harness</i> on the <i>swing plate</i> with <i>cable ties</i> .	
6	Put cable ties on the motor connections to ease the mounting in axis-2 motor.	 <p>xx1500000003</p>

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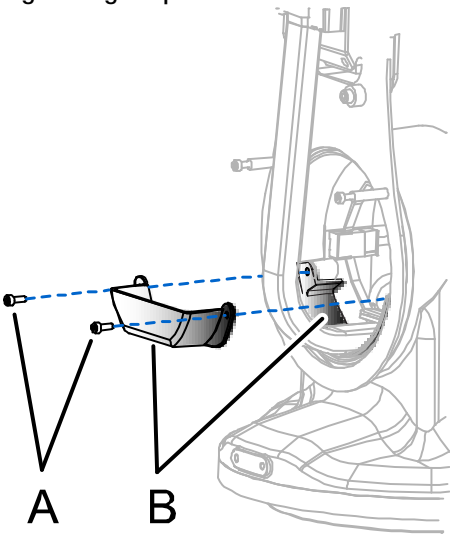
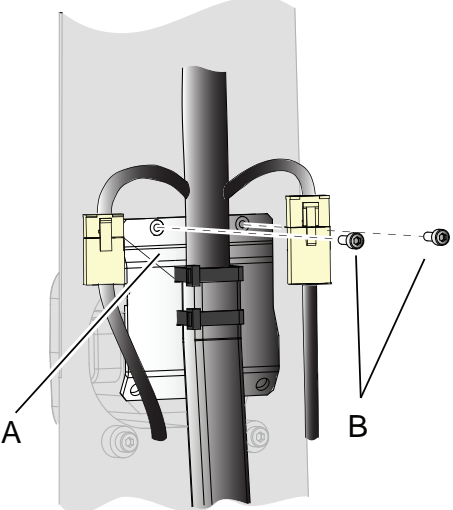
## 4 Repair

### 4.3.2 Refitting the cable harness

Continued

	Action	Information
7	Carefully push and pull cable harness past the axis-2 motor.   <b>CAUTION</b>  Cables are sensitive equipment. Use caution when handling cables.	
8	Fit lower arm on the swing plate while pulling the cable harness out.   <b>CAUTION</b>  Be careful not to squeeze the cables.	
9	Tighten attachment screws on the swing plate.	M4x25 (6 pcs)
10	Refit the <i>cable bracket</i> on the cable harness. Use the picture to localize the correct position.	 xx1500000001
11	Fasten the bracket at axis-3 motor.	M3x8 (2 pcs)
12	Remove the cable ties on the motor connectors at axis-2 motor.	
13	Reconnect connectors: <ul style="list-style-type: none"><li>• R2.MP3</li><li>• R2.ME3.</li></ul>	
14	Place the connector cables by the motor and fasten the connectors with cable ties around the motor.	

Continues on next page


	Action	Information
15	<p>Fit the <i>cable guide</i>.</p> <p> <b>CAUTION</b></p> <p>The plastic will crack if screws are tightened too hard.</p>	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000857</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (2 pcs)</li> <li>• B: Cable guide</li> </ul>
16	<p>Reconnect the motor connections, axis-3 motor</p> <ul style="list-style-type: none"> <li>• R2.ME3</li> <li>• R2.MP3.</li> </ul>	
17	<p>Fasten <i>motor cables</i> with cable ties on the cable bracket.</p>	
18	<p>Fit the <i>cable bracket</i> to the lower arm plate.</p>	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000879</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Attachment screws (2 pcs)</li> </ul>
19	<p>Pull the <i>cable harness</i> through the upper arm housing.</p>	
20	<p>Verify that the cable harness is not twisted.</p>	

Continues on next page

## 4 Repair

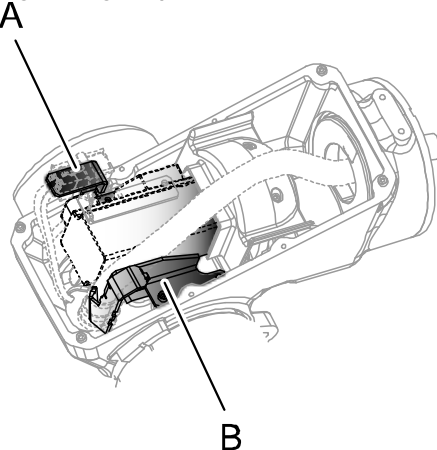
### 4.3.2 Refitting the cable harness

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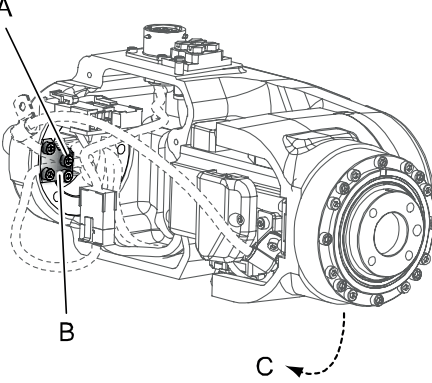

	Action	Information
21		
22	Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>   <b>Note</b>  After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

#### Refitting the cable harness in the upper arm housing

Use this procedure to refit the cable harness in the upper arm housing.


	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Reconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP4</li> <li>• R2.ME4.</li> </ul>	
3	Fasten motor cables with a cable tie.	
4	Fasten the cable harness with cable ties on the cable bracket. Adjust the length on the cable harness so the motor cables reaches its connectors.	Tightening torque: 1 Nm.   xx0900001023  <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Cable bracket</li> </ul>
5	Push the <i>cable harness</i> in through the <i>wrist housing</i> .	

Continues on next page

	Action	Information
6	Refit the <i>cable bracket</i> in the housing with its <i>attachment screws</i> .	<p>Tightening torque: 1 Nm.</p>  <p>xx0900001018</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (2 pcs)</li> <li>• B: Cable bracket</li> </ul>
7	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	

### Refitting the cable harness in the *wrist*

Use this procedure to refit the cable harness in the *wrist*.

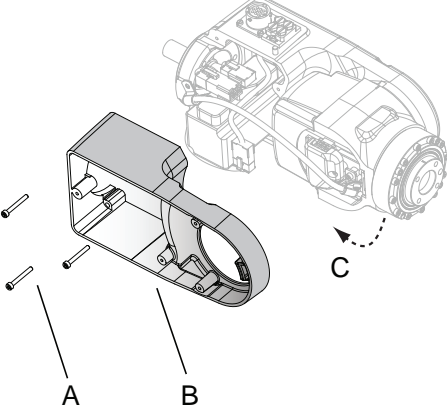
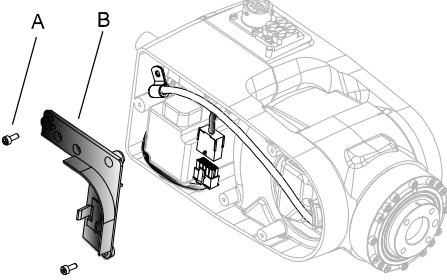
	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Reconnect <i>air hoses</i> . Put them flat to make room for the motor.	
3	Reconnect customer contact R2.CS	
4	Place the <i>motor</i> in axis 5.	
5	Refit the <i>timing belt</i> .	
6	Fasten the motor just enough to still be able to move the motor.	M5x16 (2 pcs) and washers
7	<p>Tension the timing belt to 7.6 - 8.4 Nm.</p> <p> <b>Note</b></p> <p>Do not stretch the timing belt too much!</p>	For details about how to adjust the timing belt, see <a href="#">Adjusting axis-5 timing belt on page 95</a> .
8	Tighten motor <i>attachment screws</i> .	Tightening torque: 5.5 Nm

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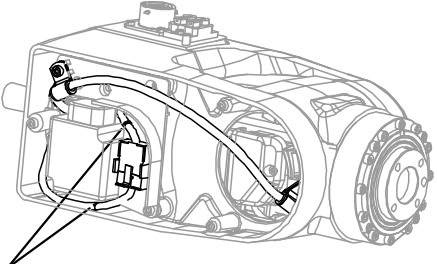

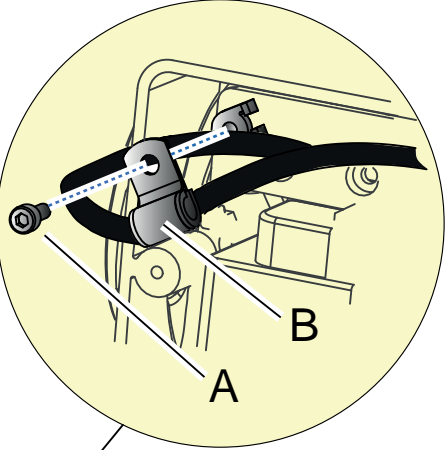
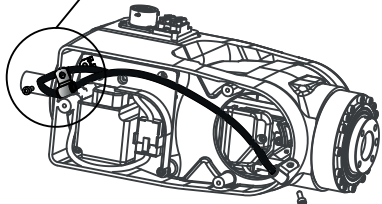
## 4 Repair

### 4.3.2 Refitting the cable harness

Continued

	Action	Information
9	Refit the <i>wrist housing (plastic)</i> .	<p>Tightening torque: 2 Nm</p>  <p>xx0900000900</p> <ul style="list-style-type: none"><li>• A: Attachment screws, M3x25 (3 pcs)</li><li>• B: Wrist housing (plastic)</li><li>• C: (Axis 5 shall be in 90° position)</li></ul>
10	Reconnect connectors: <ul style="list-style-type: none"><li>• R2.MP5</li><li>• R2.ME5.</li></ul>	
11	Put the cables around the motor.	
12	Refit <i>connector support (plastic)</i> .	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000888</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Attachment screws, M3x8 (2 pcs)</li><li>• B: Connector support (plastic)</li></ul>
13	Fasten <i>cables</i> to axis 6 in the connector support.	

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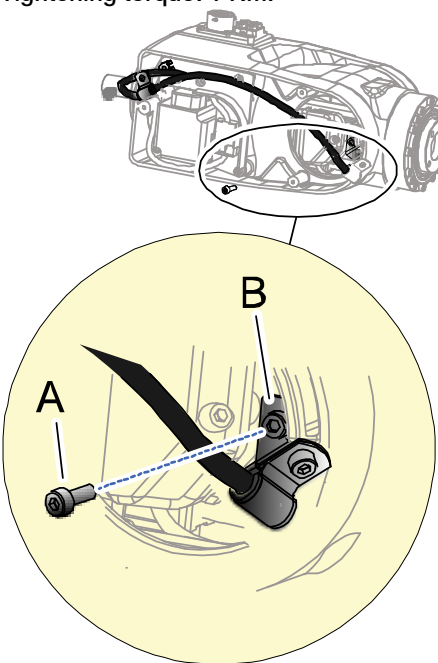
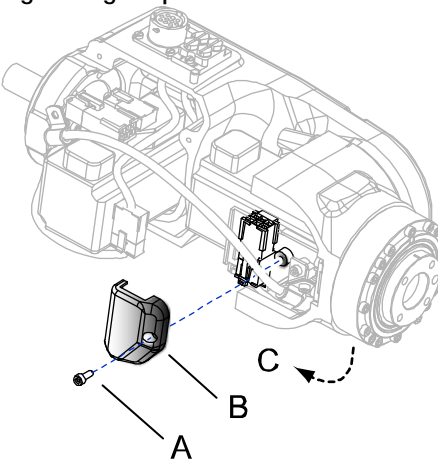
	Action	Information
14	Secure the cable harness with <i>cable ties</i> .	 <p>A xx0900001009</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Cable ties</li> </ul>
15	<p>Refit the <i>attachment screw</i> securing the <i>clamp</i> at motor axis 5.</p> <p> <b>CAUTION</b></p> <p>Make sure that the cables run loose from the circular edge into motor axis 6.</p>	<p>Tightening torque: 1 Nm.</p>   <p>xx0900000912</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screw</li> <li>• B: Clamp</li> </ul>
16	<p>Reconnect connectors:</p> <ul style="list-style-type: none"> <li>• R2.MP6</li> <li>• R2.ME6.</li> </ul>	

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## 4 Repair

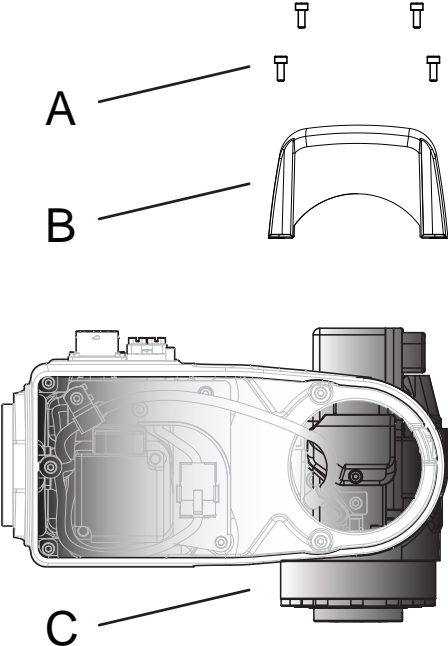

### 4.3.2 Refitting the cable harness

Continued

	Action	Information
17	Refit the <i>attachment screw</i> securing the <i>clamp</i> at motor axis 6.	<p>Tightening torque: 1 Nm.</p>  <p>xx0900001000</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screw</li> <li>• B: Clamp</li> </ul>
18	Refit the <i>connector cover</i> .	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000902</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screw M3x8 (1 pcs)</li> <li>• B: Connector cover</li> <li>• C: (Axis 5 shall be in 90° position)</li> </ul>
19	Put <i>cable grease</i> on the cable harness in the wrist.	
20	Clean all the <i>covers</i> if they are dirty.	
21	Put <i>cable grease</i> inside the covers.	

Continues on next page





	Action	Information
22	Refit the <i>wrist side covers</i> .	Tightening torque: 1 Nm. Attachment screw M3x8 (3 pcs)
23	Refit the <i>tilt cover</i> .	Tightening torque: 1 Nm.    xx0900000901  <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Attachment screw M3x8 (4 pcs)</li> <li>• B: Tilt cover</li> <li>• C: Motor axis 6</li> </ul>
24	Put cable grease on the sleeve in axis 4.	
25	Refit the <i>housing cover</i> at axis 4. <ul style="list-style-type: none"> <li>• <i>housing cover</i> and</li> <li>• <i>lower arm cover</i>.</li> </ul>	Tightening torque: 1 Nm Attachment screw M3x8 (8 pcs)
26	Put cable grease on the cable harness and sleeve in lower arm.	
27	Refit the <i>lower arm cover</i> at axis 4.	Tightening torque: 1 Nm Attachment screw M3x8 (4 pcs)
28	Connect the robot to the <i>power source</i> .   <b>DANGER</b>  Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51</a> .	
29	Jog the robot to 90° in axis 1.	
30	Fasten the two remaining screws at swing plate/base.	

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## 4 Repair

### 4.3.2 Refitting the cable harness

*Continued*

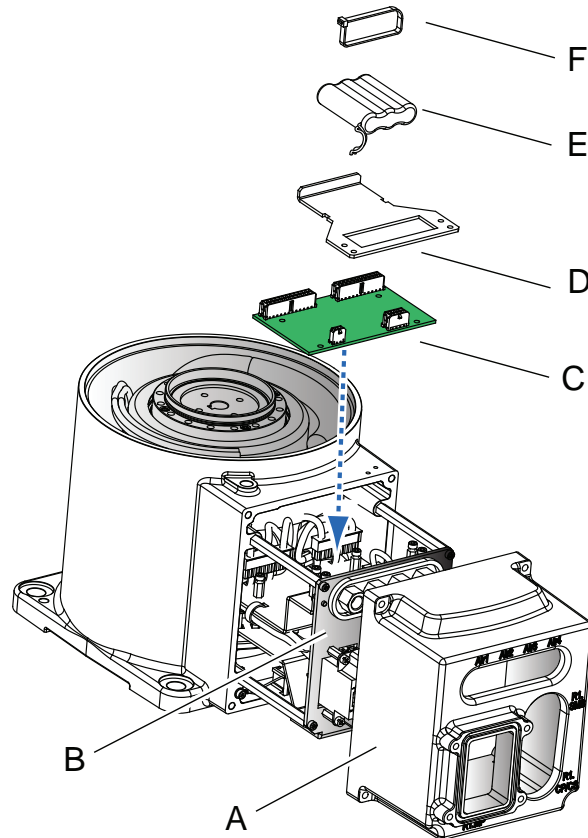
	Action	Information
31	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	
32	<p>Recalibrate the robot.</p>	<p>See chapter:</p> <ul style="list-style-type: none"><li>• <a href="#">Calibration</a></li></ul>
33	<p> <b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51</a>.</p>	

### 4.3.3 Replacing the Encoder Interface board

#### Introduction

This procedure describes how to replace the Encoder Interface board.

#### Location of the Encoder Interface board



xx090000842

A	Base cover
B	Plate
C	Encoder Interface Board (EIB board)
D	Bracket
E	Battery pack
F	Cable strap

#### Required equipment

Equipment	Note
Standard tools	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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*



## 4 Repair

### 4.3.3 Replacing the Encoder Interface board

*Continued*

#### Removing the EIB board

Use this procedure to remove the EIB board.




	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	
3	Remove the <i>base cover</i> .	See the figure in : <ul style="list-style-type: none"><li>• <a href="#">Location of the Encoder Interface board on page 143</a></li></ul>
4	Remove the attachment screws securing the <i>plate</i> .	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the Encoder Interface board on page 143</a></li></ul>
5	Pull carefully out the cable harness main a little in order to reach the EIB board.	
6	Disconnect the battery cable.	
7	Remove the <i>bracket</i> where the battery is fitted.	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the Encoder Interface board on page 143</a></li></ul>
8	Disconnect connectors: <ul style="list-style-type: none"><li>• R1.ME1-3</li><li>• R1.ME4-6</li><li>• R2.EIB.</li></ul>	
9	Remove the <i>EIB board</i> .	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the Encoder Interface board on page 143</a></li></ul>

#### Refitting the EIB board

Use this procedure to refit the EIB board.

	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Fit the EIB board.	Tightening torque: 2 Nm. See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of the Encoder Interface board on page 143</a></li></ul>
3	Reconnect connectors: <ul style="list-style-type: none"><li>• R1.ME1-3</li><li>• R1.ME4-6</li><li>• R2.EIB.</li></ul>	

*Continues on next page*

	Action	Information
4	Fit the <i>plate</i> where the battery is fitted.	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of the Encoder Interface board on page 143</a></li> </ul>
5	Reconnect the battery cable.	
6	Push the cable harness main carefully into the <i>base</i> .	 <b>CAUTION</b> Arrange the cable harness inside correctly in a way that: <ul style="list-style-type: none"> <li>• it is not damaged in the continued refitting process</li> <li>• extra wear will not occur after production is restarted, which will shorten the life of the harness.</li> </ul> See section <ul style="list-style-type: none"> <li>• <a href="#">Refitting the cable harness on page 129.</a></li> </ul>
7	Secure the <i>plate</i> with its attachment screws.	Tightening torque: 2 Nm. See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of the Encoder Interface board on page 143</a></li> </ul>
8	Refit the <i>base cover</i> .	Tightening torque: 4 Nm. See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of the Encoder Interface board on page 143</a></li> </ul>
9	Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>   <b>Note</b> After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
10	Recalibrate the robot.	See chapter: <ul style="list-style-type: none"> <li>• <a href="#">Calibration on page 219</a></li> </ul>
11	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51.</a>	

## 4 Repair

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### 4.4.1 Replacing plastic covers

## 4.4 Plastic covers

### 4.4.1 Replacing plastic covers

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#### Introduction

The section describes how to replace the plastic covers on the robot.



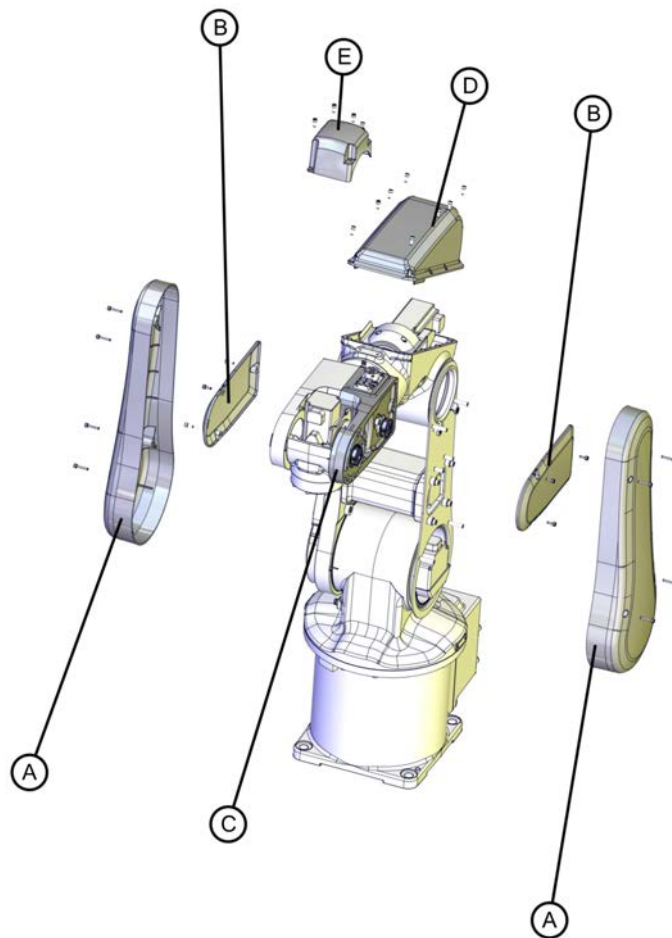
#### CAUTION

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

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Location of the plastic covers



xx0900000607

A	Lower arm cover (2 pcs.)
B	Wrist side cover (2 pcs.)
C	Wrist housing (plastic)
D	Housing cover
E	Tilt cover

Required equipment

Equipment	Note
Standard tools	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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

## 4 Repair

### 4.4.1 Replacing plastic covers

Continued



#### Attachment screws and tightening torques

The table shows what attachment screws and tightening torques to be used.

Cover	Attachment screw	Screw quality	Qty.	Tightening torque
Lower arm cover	M3x16	Steel 12.9 Black oxide	4+4	1 Nm
Wrist side cover	M3x8	Steel 12.9 Black oxide	3+3	1 Nm
Wrist housing (plastic)	M3x25	Steel 12.9 Black oxide	3	1 Nm
Housing cover	M3x8	Steel 12.9 Black oxide	8	1 Nm
Tilt cover	M3x8	Steel 12.9 Black oxide	4	1 Nm

#### Removing plastic covers

Use this procedure to remove the plastic covers.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	
3	Remove the attachment screws securing the plastic cover.	
4	Remove the plastic cover.	
5	If the cover shall be reused, keep it clean and put in a safe place.	


#### Refitting plastic covers

Use this procedure to refit the plastic covers.

	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Before fitting the plastic cover, check it for cracks or any other damage.	If the plastic cover is cracked or has any other damage it must be replaced with a new one.
3	Fit the plastic cover and secure it with its <i>attachment screws</i> . Which attachment screws to use is described in the table: <ul style="list-style-type: none"><li><a href="#">Attachment screws and tightening torques on page 148</a></li></ul>	

Continues on next page



	Action	Information
4	For <i>tightening torques</i> , see the table: <ul style="list-style-type: none"> <li>• <a href="#">Attachment screws and tightening torques on page 148</a></li> </ul>	
5	Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>   <b>Note</b> After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

## 4 Repair

### 4.5.1 Replacing the upper arm

## 4.5 Upper arm

### 4.5.1 Replacing the upper arm

#### Introduction

This procedure describes how to replace the upper arm.



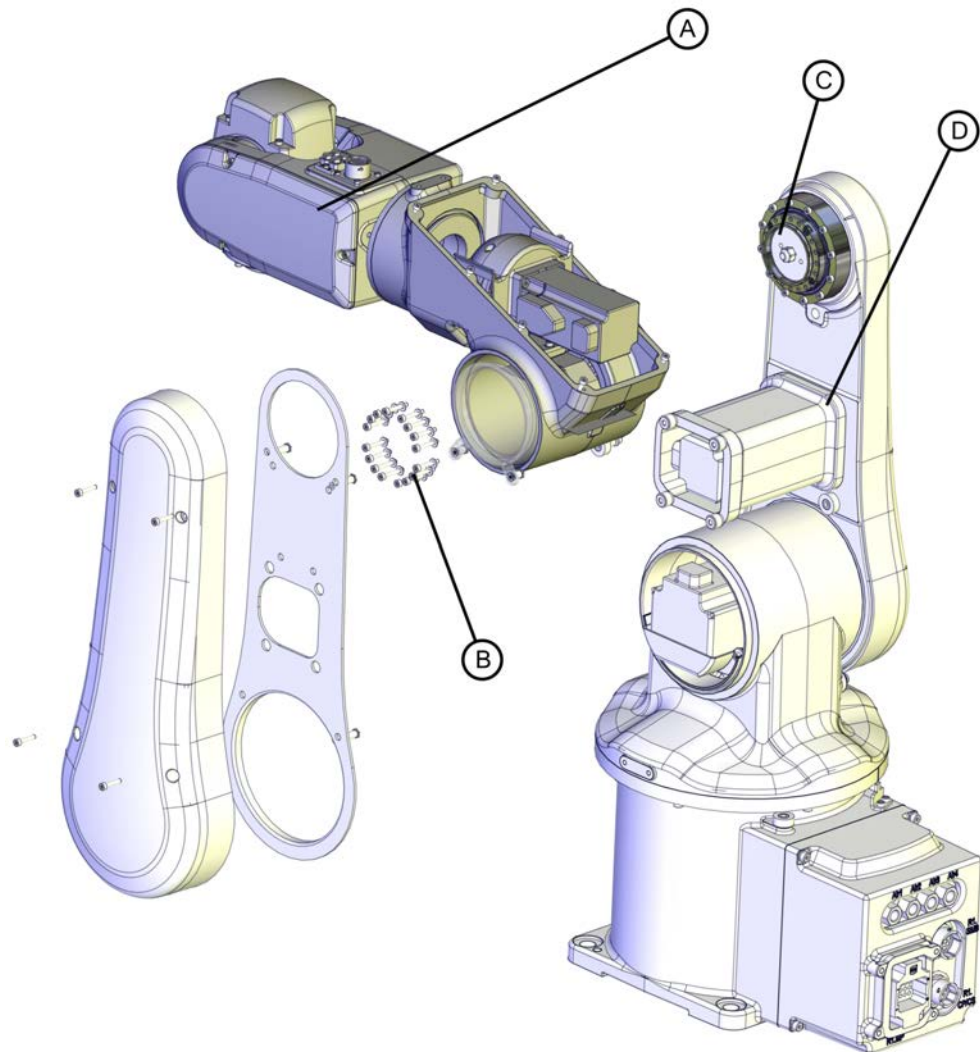
#### CAUTION

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

#### Location of upper arm

The upper and lower arms are located as shown in the figure.



xx0900000924

A	Upper arm, complete with wrist
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*Continues on next page*



B	Attachment screws (16 pcs)
C	Gearbox, axis 3
D	Lower arm

#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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.
Loctite 7063	For removing residues of Loctite.
Loctite 574	

#### Removing the upper arm

Use this procedure to remove the upper arm.

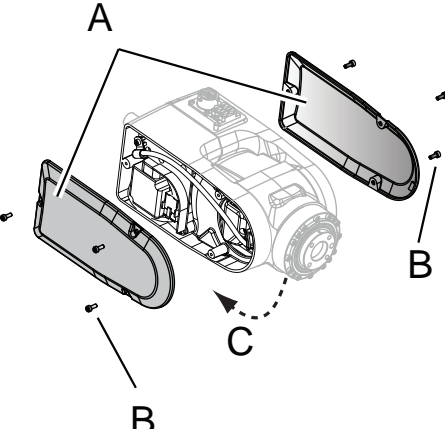
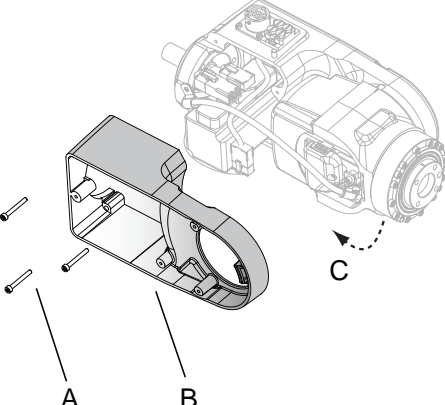
	Action	Information
1	Move axis 5 to a 90° position.	
2	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
3	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	

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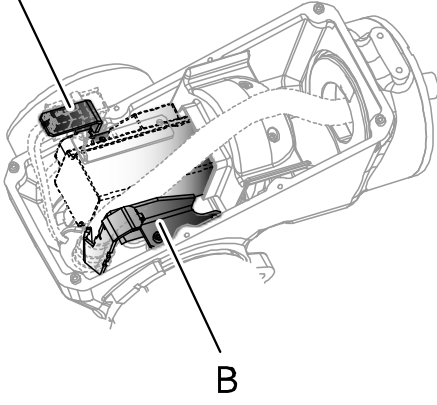
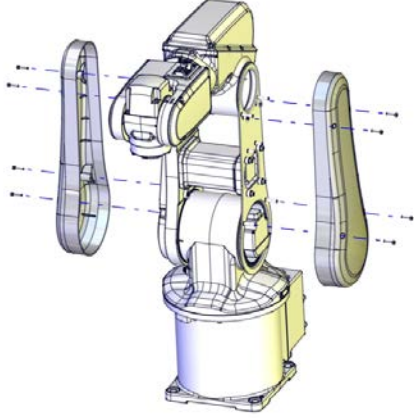
## 4 Repair

### 4.5.1 Replacing the upper arm

Continued

	Action	Information
4	Remove the <i>wrist covers</i> .	 <p>xx0900000999</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Wrist covers (2 pcs)</li> <li>• B: Attachment screws (3+3 pcs)</li> <li>• C: Axis 5 shall be in 90° position</li> </ul>
5	Remove <i>motor axis 5</i> .	See section <ul style="list-style-type: none"> <li>• <a href="#">Replacing motor axis 5 on page 206</a></li> </ul>
6	Remove the <i>cable harness</i> in the wrist.	See section <ul style="list-style-type: none"> <li>• <a href="#">Removing the cable harness on page 115.</a></li> </ul>
7	Pull the <i>cable harness</i> out of the wrist housing.	
8	Remove the <i>wrist housing (plastic)</i> .	 <p>xx0900000900</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (3 pcs)</li> <li>• B: Wrist housing (plastic)</li> <li>• C: Axis 5 shall be in 90° position</li> </ul>
9	Remove the <i>cable harness</i> in the upper arm housing.	See section <ul style="list-style-type: none"> <li>• <a href="#">Removing the cable harness on page 115.</a></li> </ul>

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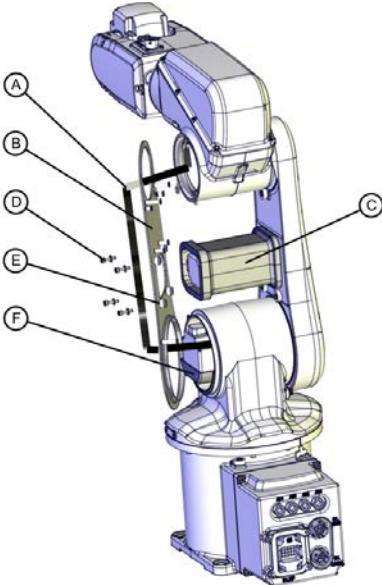
	Action	Information
10	Unscrew the attachment screws securing the <i>cable brackets</i> on both sides of motor axis 4.	<p data-bbox="986 309 1013 342"><b>A</b></p>  <p data-bbox="1209 728 1236 761"><b>B</b></p> <p data-bbox="986 772 1093 795">xx0900001023</p> <p data-bbox="986 806 1053 840"><b>Parts:</b></p> <ul data-bbox="1013 840 1244 896" style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Cable bracket</li> </ul>
11	Remove the <i>lower arm covers</i> on both sides of the robot.	 <p data-bbox="986 1355 1093 1377">xx0900000848</p>
12	Remove the <i>cable harness</i> in the <i>lower arm</i> .	<p data-bbox="986 1411 1117 1444">See section</p> <ul data-bbox="1013 1444 1412 1489" style="list-style-type: none"> <li>• <a href="#">Removing the cable harness on page 115.</a></li> </ul>

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## 4 Repair

### 4.5.1 Replacing the upper arm

Continued

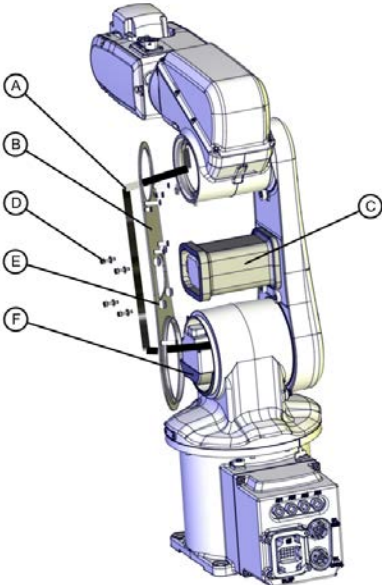
	Action	Information
13	Unscrew the <i>attachment screws</i> securing the <i>lower arm plate</i> to the <i>motor cover</i> .	 <p data-bbox="956 927 1059 943">xx0900000851</p> <p data-bbox="956 965 1023 987">Parts:</p> <ul data-bbox="987 994 1406 1211" style="list-style-type: none"> <li>A: Cable harness</li> <li>B: Lower arm plate</li> <li>C: Motor cover</li> <li>D: Attachment screws (4 pcs)</li> <li>E: Holes for attachment screws (4 pcs)</li> <li>F: Cable guide</li> </ul>
14	Pull out the cable harness through the upper arm housing.	
15	Secure the upper arm by holding it firmly.	
16	Unscrew the <i>attachment screws</i> securing the <i>upper arm with wrist</i> to <i>gearbox axis 3</i> .	See the figure in: <ul style="list-style-type: none"> <li><a href="#">Location of upper arm on page 150</a></li> </ul>
17	Remove the upper arm.	

### Refitting the upper arm

Use this procedure to refit the upper arm.

	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Check that: <ul style="list-style-type: none"> <li>All assembly surfaces are clean and without damage.</li> </ul>	
3	Remove old residues of Loctite from the assembly surfaces on gearbox axis 3 and upper arm, using <i>Loctite 7063</i> .	Also see <ul style="list-style-type: none"> <li><a href="#">Required equipment on page 151</a></li> </ul>
4	Apply <i>Loctite 574</i> on the assembly surfaces on <i>gearbox axis 3</i> and the <i>upper arm</i> .	

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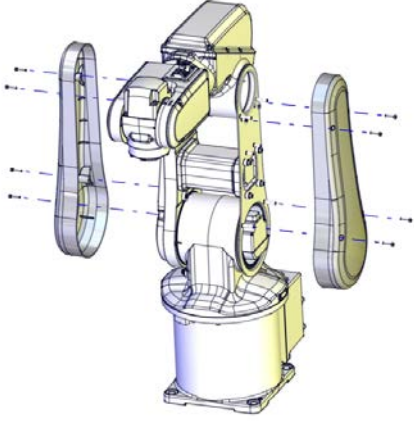
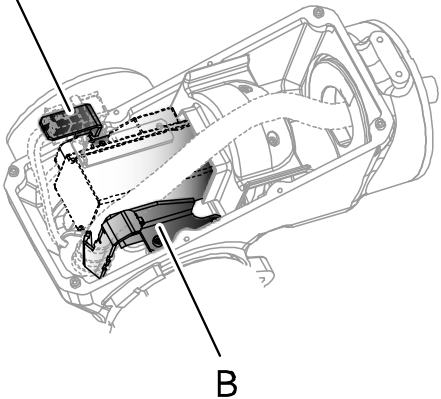
	Action	Information
5	Secure the <i>upper arm including wrist</i> to <i>gearbox axis 3</i> with its <i>attachment screws</i> .	Tightening torque: 2 Nm. Attachment screws M3x20 q12.9 and washers (16 + 16 pcs) See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of upper arm on page 150</a></li> </ul>
6	Push the <i>cable harness</i> into the <i>upper arm housing</i> .	See section <ul style="list-style-type: none"> <li>• <a href="#">Refitting the cable harness on page 129</a></li> </ul>
7	Refit the <i>lower arm plate</i> .	Tightening torque: 4 Nm.    xx0900000851  <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Cable harness</li> <li>• B: Lower arm plate</li> <li>• C: Motor cover</li> <li>• D: Attachment screws M4x16 q12.9 and washers (4 + 4 pcs)</li> <li>• E: Holes for attachment screws (4 pcs)</li> <li>• F: Cable guide</li> </ul>
8	Secure the <i>cable harness</i> to the <i>lower arm plate</i> .	See section <ul style="list-style-type: none"> <li>• <a href="#">Refitting the cable harness on page 129</a></li> </ul>

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## 4 Repair

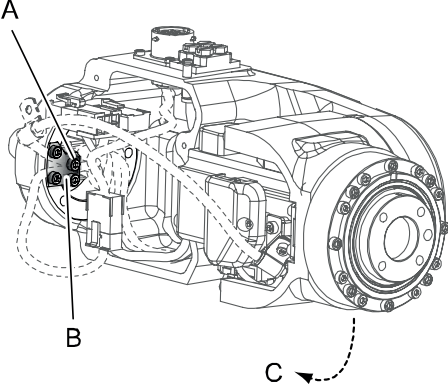
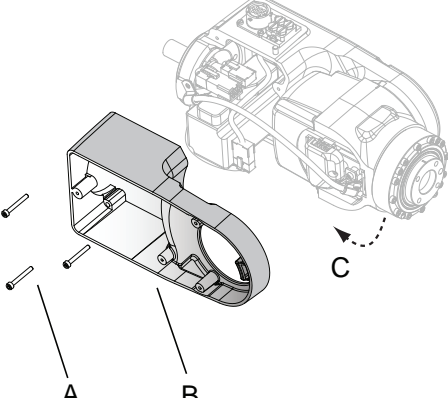

### 4.5.1 Replacing the upper arm

Continued

	Action	Information
9	Refit the <i>lower arm covers</i> .	Tightening torque: 1 Nm.  xx0900000848
10	Secure the <i>cable harness</i> in the <i>upper arm housing</i> .	See section • <a href="#">Refitting the cable harness on page 129</a>
11	Refit the two <i>cable brackets</i> on either side of motor axis 4.	Tightening torque: 1 Nm. A  xx0900001023 Parts: • A: Cable bracket • B: Cable bracket
12	Push the cable harness into the wrist.	

Continues on next page



	Action	Information
13	Refit the <i>cable bracket</i> .	<p>Tightening torque: 1 Nm.</p>  <p>xx0900001018</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (4 pcs)</li> <li>• B: Cable bracket</li> <li>• C: Axis 5 shall be in 90° position</li> </ul>
14	Refit the <i>cable harness</i> in the wrist.	<p>See section</p> <ul style="list-style-type: none"> <li>• <a href="#">Refitting the cable harness on page 129</a></li> </ul>
15	Refit the <i>wrist housing (plastic)</i> .	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000900</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• Attachment screws (3 pcs)</li> <li>• B: Wrist housing (plastic)</li> <li>• C: Axis 5 shall be in 90° position</li> </ul>
16	Refit <i>motor axis 5</i> .	<p>See section</p> <ul style="list-style-type: none"> <li>• <a href="#">Replacing motor axis 5 on page 206</a></li> </ul>
17	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	


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## 4 Repair

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### 4.5.1 Replacing the upper arm

*Continued*

	Action	Information
18	Recalibrate the robot.	See chapter: <ul style="list-style-type: none"><li>• <a href="#">Calibration on page 219</a>.</li></ul>
19	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51</a> .	

## 4.6 Lower arm

### 4.6.1 Replacing the lower arm

#### Introduction

This procedure describes how to replace the lower arm.

Gearbox axis 3 is included in the lower arm.



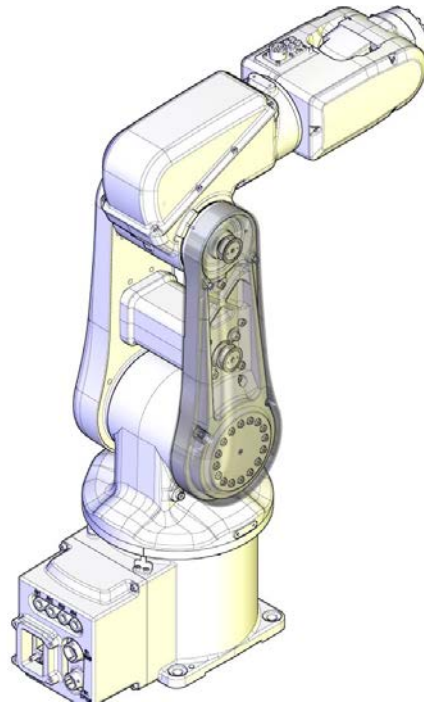
#### CAUTION

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

#### Location of the lower arm

The lower arm is located as shown in the figure.



xx110000961

#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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.
Flange sealant	for example Loctite 574

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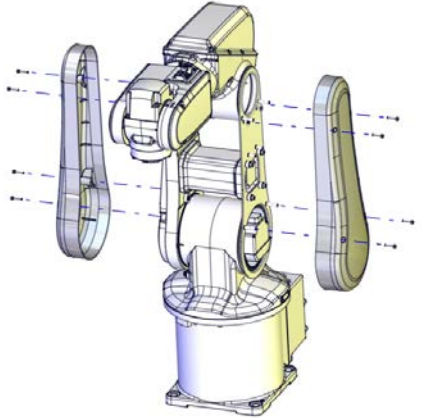
## 4 Repair

### 4.6.1 Replacing the lower arm

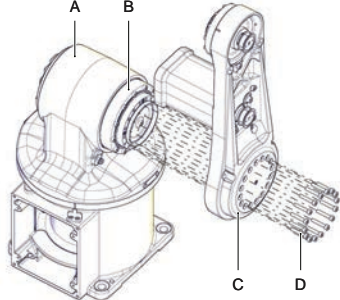
*Continued*

#### Removing the lower arm

Use this procedure to remove the lower arm.

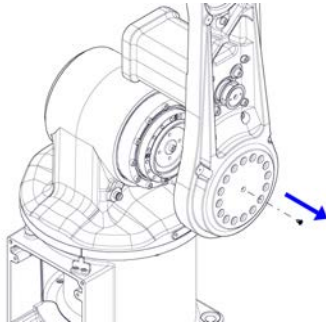
	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	
3	Remove the <i>lower arm covers</i> on both sides of the robot.	 <small>xx0900000848</small>
4	Remove the <i>cable harness</i> in the <i>lower arm</i> .	See section • <a href="#">Removing the cable harness in the wrist on page 116</a>
5	Unscrew the attachment screws securing the lower and upper arms and separate the two.	
6	Unscrew the attachment screws securing the motor cover to the lower arm plate.	

*Continues on next page*

	Action	Information
7	Unscrew the <i>attachment screws</i> securing the <i>lower arm</i> to <i>axis-2 gearbox</i> .	 <p>xx0900000859</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Swing housing</li> <li>• B: Gearbox axis 2</li> <li>• C: Lower arm</li> <li>• D: Attachment screws (16 pcs)</li> </ul>
8	Remove the <i>lower arm</i> .	
9	Remove <i>axis-3 motor</i> and <i>timing belt</i> .	See section <ul style="list-style-type: none"> <li>• <a href="#">Replacing axis-3 motor with gearbox on page 197</a></li> </ul>

### Refitting the lower arm

Use this procedure to refit the lower arm.

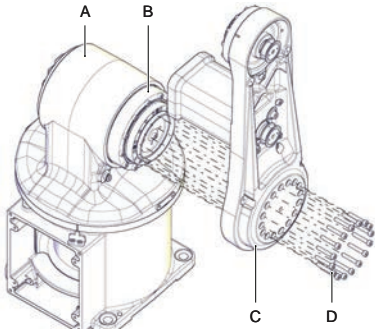
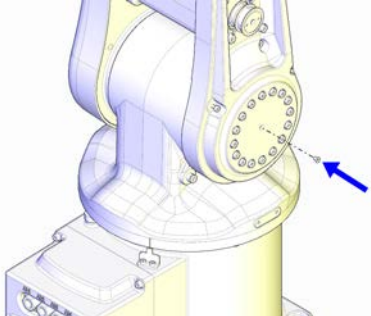
	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Check that: <ul style="list-style-type: none"> <li>• all assembly surfaces are clean and without damage.</li> </ul>	
3	Remove old residues of Loctite from the assembly surfaces on gearbox axis 2 and lower arm, using <i>Loctite 7063</i> .	Also see <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 159</a></li> </ul>
4	Apply <i>flange sealant</i> on the assembly surfaces on axis-2 gearbox and lower arm.	
5	Remove the screw from the air release hole of lower arm housing.	 <p>xx1700000766</p>

*Continues on next page*

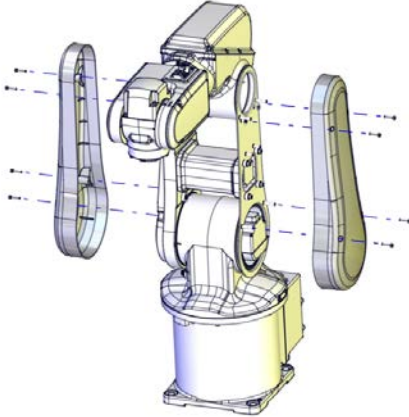


## 4 Repair

### 4.6.1 Replacing the lower arm

Continued

	Action	Information
6	Refit the <i>lower arm</i> to <i>axis-2 gearbox</i> with its <i>attachment screws</i> .	<p>Tightening torque: 4 Nm.</p>  <p>xx170000767</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Swing housing</li> <li>• B: Gearbox axis 2</li> <li>• C: Lower arm</li> <li>• D: Attachment screws M4x25 q12.9 and washers (16 + 16 pcs)</li> </ul>
7	Refit the screw in the air release hole on the lower arm housing, and apply Loctite 243 on this screw.	 <p>xx170000768</p>
8	Refit the <i>motor cover</i> .	Tightening torque: 4 Nm.
9	Refit <i>axis-3 motor</i> .	<p>See section</p> <ul style="list-style-type: none"> <li>• <a href="#">Replacing axis-3 motor with gearbox on page 197</a></li> </ul>
10	Secure the <i>upper and lower arms</i> with the attachment screws (16 pcs).	Tightening torque: 2 Nm.
11	Refit the <i>cable harness</i> in the <i>lower arm</i> .	<p>See section</p> <ul style="list-style-type: none"> <li>• <a href="#">Refitting the cable harness on page 129</a></li> </ul>

Continues on next page

	Action	Information
12	Refit the <i>lower arm covers</i> .	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000848</p>
13	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	
14	Recalibrate the robot.	<p>See chapter:</p> <ul style="list-style-type: none"> <li>• <a href="#">Calibration on page 219</a>.</li> </ul>
15	<p> <b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51</a>.</p>	

## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

## 4.7 Motors and motors with gearboxes

### 4.7.1 Replacing axis-1 motor with gearbox

#### Introduction

This procedure describes how to replace:

- axis-1 motor with gearbox.

Axis-1 gearbox is part of axis-1 motor when ordered as a spare part. The procedure below describes the replacement of axis-1 motor and gearbox as one unit. For further information, please **contact ABB**.



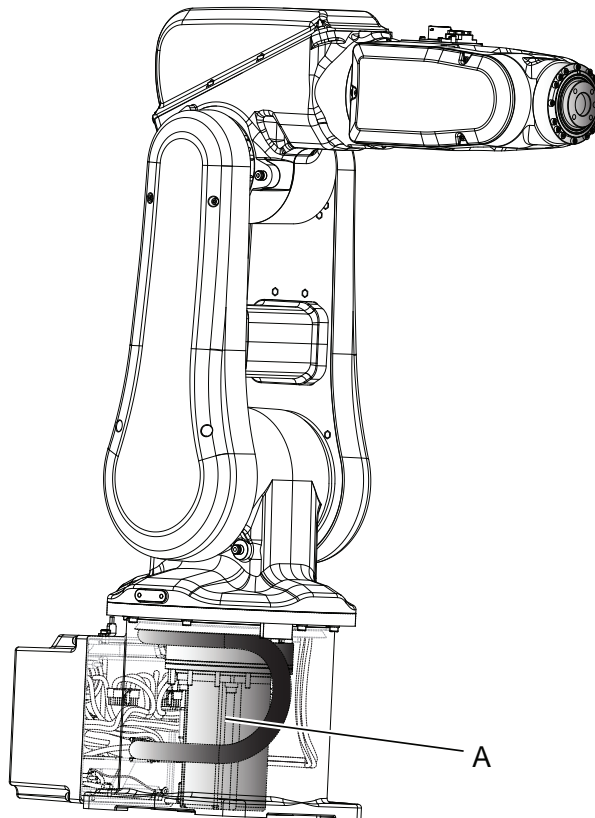
#### CAUTION

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

#### Location of axis-1 motor with gearbox

The axis-1 motor with gearbox is located as shown in the figure.



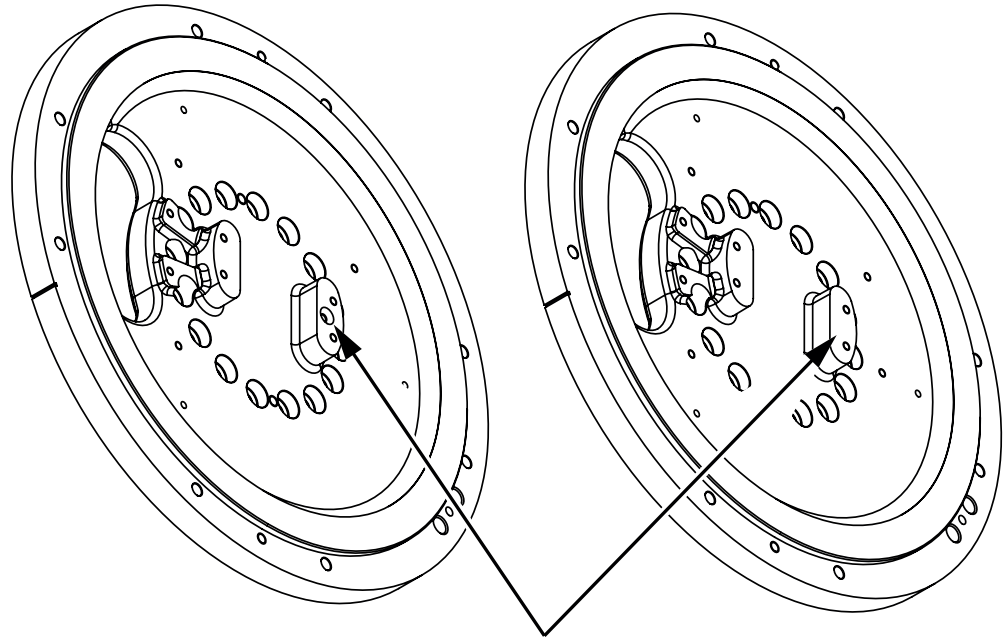
xx0900000871

A	Axis-1 motor with gearbox
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There are two different designs of the swing plate, inside the base. One of the designs has an air release hole and the other does not.



xx150000112

**Required equipment**

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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.
Flange sealant, for example Loctite 574	Amount 2 ml
Cable grease	Shell Gadus S2
Cable grease, for food grade lubrication	LUBRIPLATE SYNXTREME FG-0. Used for lubrication of cable contact areas for robots with food grade lubrication.
Loctite 243	

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## 4 Repair



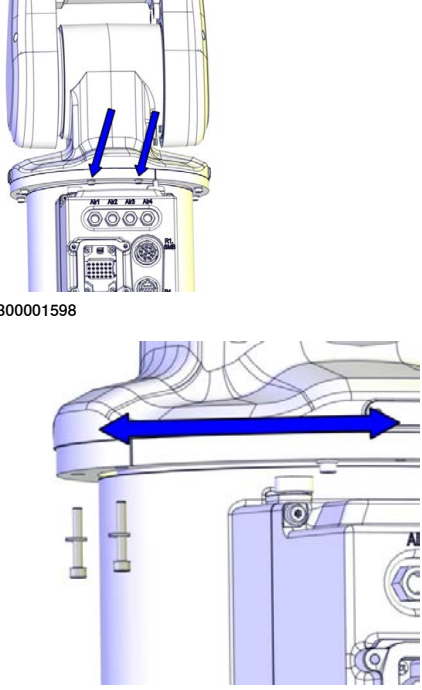
### 4.7.1 Replacing axis-1 motor with gearbox

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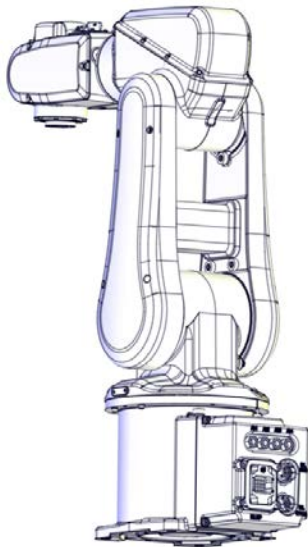


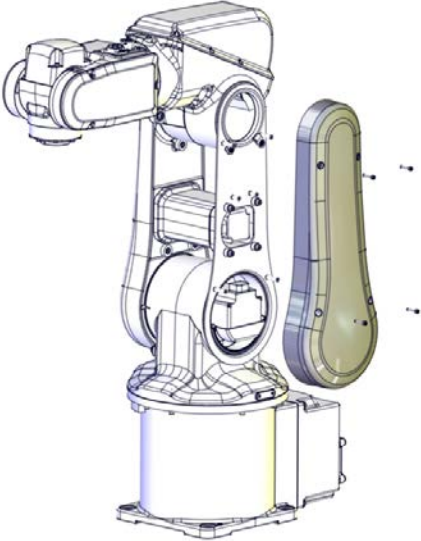
#### Removing the axis-1 motor with gearbox

Use these procedures to remove the axis-1 motor, with gearbox.

#### Removal, step 1 - Preparations

	Action	Information
1	 <b>Note</b> If the robot is fitted in any other position than floor mounted, it must first be removed from this position. The replacing procedure of the axis-1 motor with gearbox is best performed with the robot in an upright position.	
2	 <b>CAUTION</b> Use caution performing these procedures. The cable harness will still be fitted or partly fitted during the procedures.	
3	The two most back screws that secure the swing house, are difficult to reach with axis-1 in calibration position. Therefore jog axis-1 to be able to reach those screws.	
4	Jog axis 1 to 90° position.	
5	Remove the two attachment screws securing the swing housing to the base. (Not possible to reach with axis 1 in 0° position.)	 <p>xx1300001598</p> <p>xx1300001599</p>

*Continues on next page*

	Action	Information
6	<p>Jog</p> <ul style="list-style-type: none"> <li>• axis 1 to 0° position</li> <li>• axis 2 to -50° position</li> <li>• axis 3 to +50° position</li> <li>• axis 4 to 0° position</li> <li>• axis 5 to +90° position</li> <li>• axis 6 - no significance</li> </ul>	 <p>xx1300001600</p>
7	<p> <b>DANGER</b></p> <p>Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!</p>	
8	<p> <b>CAUTION</b></p> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>.</p>	
9	<p>Remove the lower arm cover on the side of the lower arm plate.</p>	 <p>xx1300001124</p>


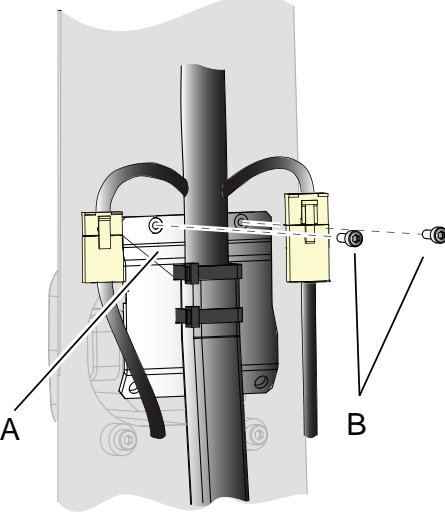
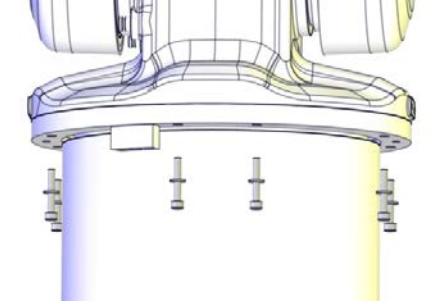
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## 4 Repair

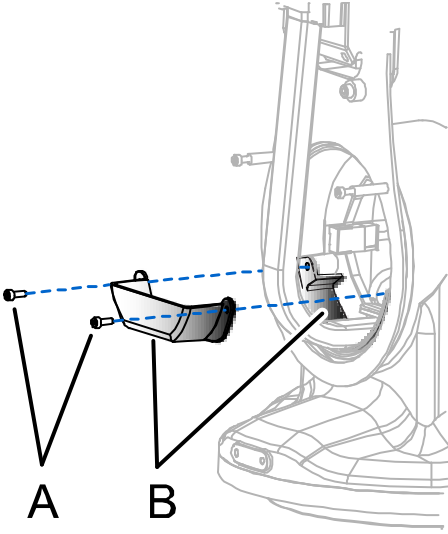


### 4.7.1 Replacing axis-1 motor with gearbox

*Continued*

#### Removal, step 2 - Swing housing

Action	Information				
<p>1</p> <p> <b>CAUTION</b></p> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>.</p>					
<p>2 Remove the <i>cable bracket</i> from the lower arm.</p>	 <p>xx0900000879</p> <table border="1" data-bbox="957 1153 1404 1243"> <tr> <td>A</td> <td>Bracket</td> </tr> <tr> <td>B</td> <td>Attachment screws (2 pcs)</td> </tr> </table>	A	Bracket	B	Attachment screws (2 pcs)
A	Bracket				
B	Attachment screws (2 pcs)				
<p>3 Cut <i>cable ties</i> at motor axis 2.</p>					
<p>4 Disconnect <i>connectors</i>:</p> <ul style="list-style-type: none"> <li>• R2.MP2</li> <li>• R2.ME2</li> </ul>					
<p>5 Remove the remaining <i>attachment screws</i> securing the swing housing.</p>	 <p>xx1300001604</p>				
<p>6 If needed, use two screws to press the swing housing out.</p>					


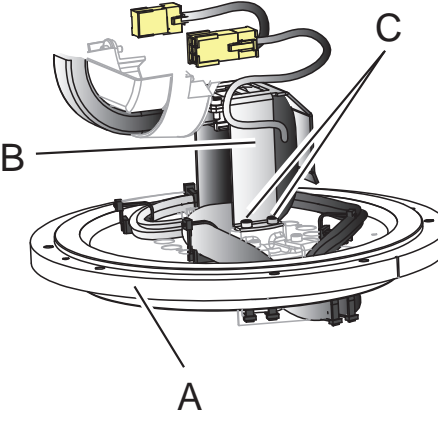

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	Action	Information				
7	Remove both <i>cable guides</i> .	 <p>xx0900000857</p> <table border="1" data-bbox="986 891 1436 981"> <tr> <td>A</td> <td>Attachment screws (2 pcs)</td> </tr> <tr> <td>B</td> <td>Cable guides (2 pcs)</td> </tr> </table>	A	Attachment screws (2 pcs)	B	Cable guides (2 pcs)
A	Attachment screws (2 pcs)					
B	Cable guides (2 pcs)					
8	Carefully pull the axis 2 motor cables out as long as possible.					
9	Guide the cable harness and carefully push/pull it in below motor in axis2, as long as possible, without damaging any cables.					
10	<p>Carefully <i>lift the upper arm, lower arm, and swing housing</i> and put it down close to the base of the robot as far as the (still connected) cable harness permit.</p> <p> <b>CAUTION</b> Do not stretch the cable harness.</p>	<p> <b>Tip</b> Use a solid box in a suitable size made of a material that will not damage the robot in any way. Some plastic in the bottom of the box makes a good "bed" for the robot to rest on.</p>				


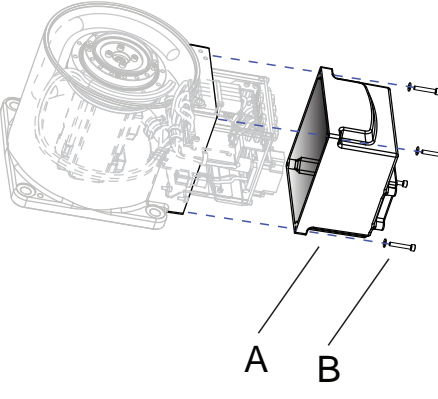
## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

Continued

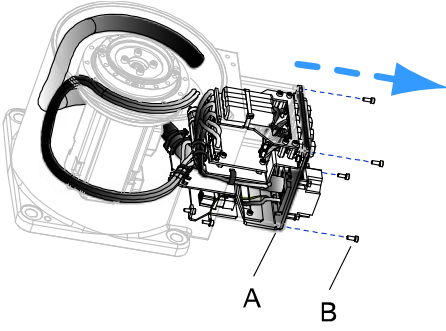

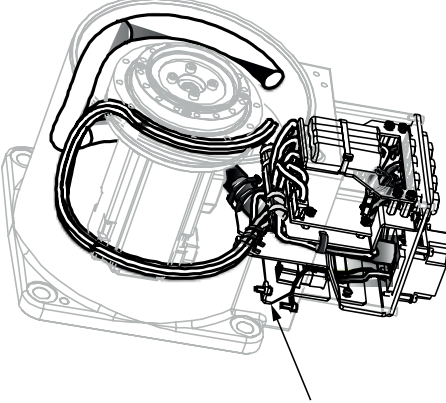
Action	Information						
<p>11 Remove the attachment screws securing the cable bracket on the swing plate.</p> <p> <b>Note</b></p> <p>Leave cable ties and clamps fitted!</p>	 <p>xx1300001596</p> <table border="1" data-bbox="954 779 1404 913"> <tr> <td>A</td> <td>Swing plate</td> </tr> <tr> <td>B</td> <td>Cable bracket</td> </tr> <tr> <td>C</td> <td>Attachment screws (2+2 pcs)</td> </tr> </table>	A	Swing plate	B	Cable bracket	C	Attachment screws (2+2 pcs)
A	Swing plate						
B	Cable bracket						
C	Attachment screws (2+2 pcs)						
<p>12  <b>CAUTION</b></p> <p>Make sure the cable harness is not damaged in the process!</p>							

### Removal, step 3 - Base


Action	Information				
<p>1  <b>CAUTION</b></p> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>.</p>					
<p>2 Remove the <i>base cover</i>.</p>	 <p>xx0900000829</p> <table border="1" data-bbox="954 1892 1404 1982"> <tr> <td>A</td> <td>Base cover</td> </tr> <tr> <td>B</td> <td>Attachment screws (4 pcs)</td> </tr> </table>	A	Base cover	B	Attachment screws (4 pcs)
A	Base cover				
B	Attachment screws (4 pcs)				

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4.7.1 Replacing axis-1 motor with gearbox  
Continued

	Action	Information				
3	Remove the plate with the EIB board and battery fitted, and pull it out in order to reach the connector of the battery cable.	 <p>xx0900000831</p> <table border="1" data-bbox="986 678 1434 768"> <tr> <td>A</td> <td>Plate</td> </tr> <tr> <td>B</td> <td>Attachment screws (4 pcs)</td> </tr> </table>	A	Plate	B	Attachment screws (4 pcs)
A	Plate					
B	Attachment screws (4 pcs)					
4	 <b>CAUTION</b> Disconnect the battery cable connector very carefully! If too much force is used there is a risk of damaging the connector!					
5	Loosen <i>attachment screws</i> holding cable bracket with connectors.	 <p>xx1500000002</p>				
6	Cut the cable ties connecting the axis-1 motor cables to the base.					
7	Disconnect the axis-1 motor cables.					

Removal, step 4 - Axis-1 motor with gearbox

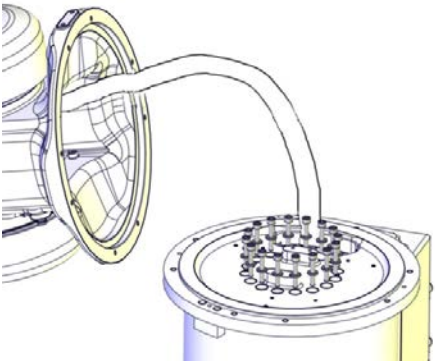

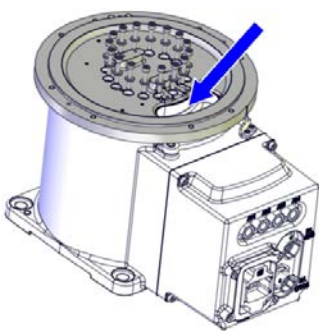

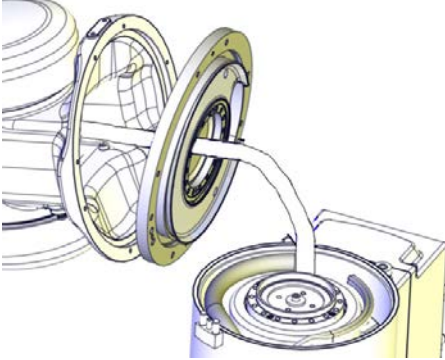

	Action	Information
1	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	

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## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

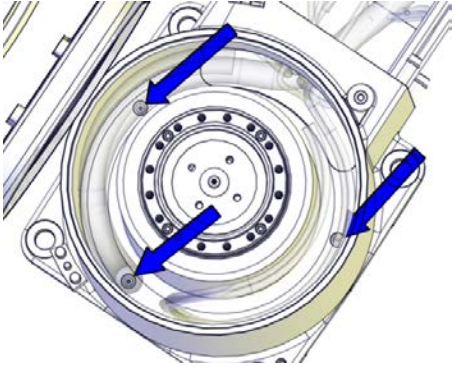

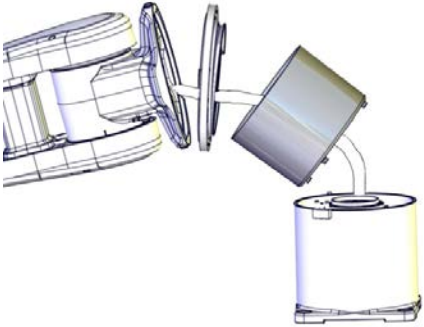
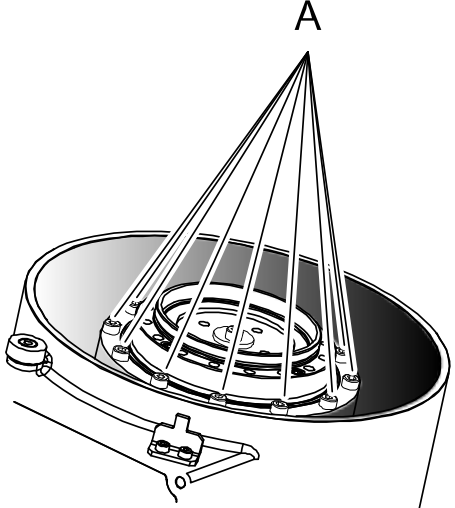
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	Action	Information						
2	Remove the attachment screws securing the swing plate.	 <p>xx1300001605</p> <table border="1" data-bbox="954 719 1406 887"> <tr> <td data-bbox="954 719 1002 792">A</td> <td data-bbox="1002 719 1406 792">Attachment screws and washers (16 + 16 pcs)</td> </tr> <tr> <td data-bbox="954 792 1002 842">B</td> <td data-bbox="1002 792 1406 842">Swing plate</td> </tr> <tr> <td data-bbox="954 842 1002 887">C</td> <td data-bbox="1002 842 1406 887">Base</td> </tr> </table>	A	Attachment screws and washers (16 + 16 pcs)	B	Swing plate	C	Base
A	Attachment screws and washers (16 + 16 pcs)							
B	Swing plate							
C	Base							
3	 <b>Tip</b> Make a note of the position of the swing plate before removing it.	 <p>xx1400002558</p>						
4	Use caution and lift the swing plate up and put it close to the rest of the removed arm system of the robot. Use the protrude holes to force the swing plate loose.   <b>CAUTION</b> Do not damage the cable harness!	 <p>xx1300001606</p>						
5	 <b>CAUTION</b> Protect the gearbox from dust and/or foreign particles.							
6	Remove screw from swing plate centre.							

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4.7.1 Replacing axis-1 motor with gearbox  
Continued



	Action	Information		
7	Remove the attachment screws securing the cable guide.	 <p>xx1300001607</p>		
8	<p>Use caution and lift the cable guide up, moving it over the cable harness and placing it close to the rest of the removed parts of the robot.</p> <p> <b>CAUTION</b></p> <p>Do not damage the cable harness in the process!</p>	 <p>xx1300001608</p>		
9	Remove the attachment screws securing the axis-1 motor with gearbox.	 <p>xx0900001054</p> <table border="1" data-bbox="984 1715 1434 1760"> <tr> <td data-bbox="984 1715 1034 1760">A</td> <td data-bbox="1034 1715 1434 1760">Attachment screws (12 pcs)</td> </tr> </table>	A	Attachment screws (12 pcs)
A	Attachment screws (12 pcs)			

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## 4 Repair


### 4.7.1 Replacing axis-1 motor with gearbox

Continued

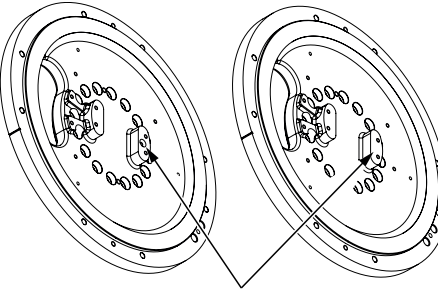
	Action	Information
10	<p>Use caution and push the axis-1 motor cables through the recess, while at the same time lifting the the axis-1 motor with gearbox up.</p> <p> <b>CAUTION</b></p> <p>Lift with a firm grip on both motor and gearbox, in order not to damage any parts.</p>	<p> <b>CAUTION</b></p> <p>Connectors can get stuck in the cramp space through the recess!</p>

#### Refitting the motor and gearbox axis 1

Use these procedures to refit both motor and gearbox axis 1.

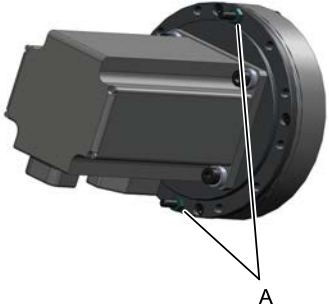

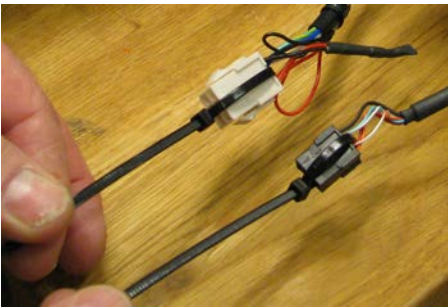
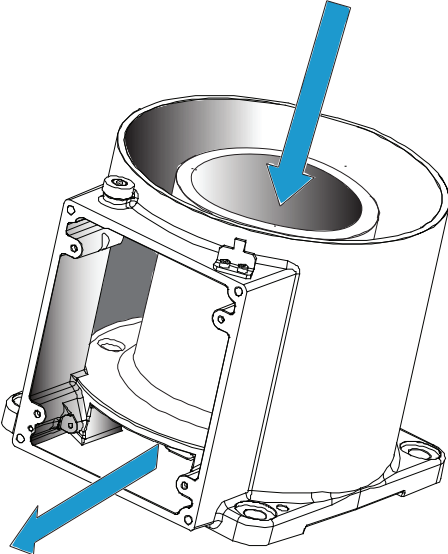
<p> <b>CAUTION</b></p> <p>Use extreme caution performing these procedures. The cable harness will still be fitted or be partly fitted during the procedures.</p>
---

#### Refitting, step 1 - Axis-1 motor with gearbox

	Action	Information
1	<p>Wipe the contact surfaces between motor flange and base clean from old residues of Loctite and other contamination.</p> <p>Make sure that:</p> <ul style="list-style-type: none"> <li>• all assembly surfaces are clean from old residues of Loctite and other contamination, and are without damage</li> <li>• motor and gearbox are clean and without damage.</li> </ul>	
2	<p>Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p>	
3	<p>If robot has an air release hole: Remove the screw in the air release hole on the swing plate to release pressure inside the base.</p>	 <p>xx1500000112</p>

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4.7.1 Replacing axis-1 motor with gearbox  
Continued

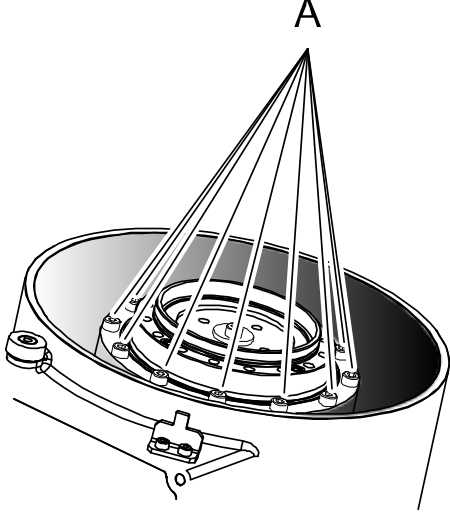

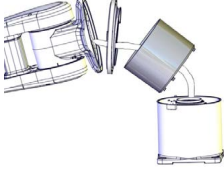
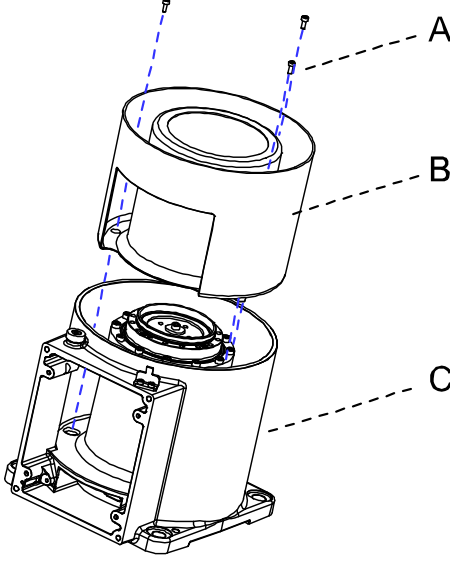
	Action	Information		
4	Remove the two screws with nuts securing the axis-1 motor and gearbox during transport.	 <p>xx0900001050</p> <table border="1" data-bbox="986 680 1436 757"> <tr> <td data-bbox="986 680 1034 757">A</td> <td data-bbox="1034 680 1436 757">Securing screws and nuts (2 pcs), used during transport</td> </tr> </table>	A	Securing screws and nuts (2 pcs), used during transport
A	Securing screws and nuts (2 pcs), used during transport			
5	 <b>Tip</b> Extend the motor connection cables with cable ties to ease pulling the cables through the base.	 <p>xx1500000003</p>		
6	Hold the axis-1 motor, and carefully push the motor cables through the recess in the bottom of the base.	 <p>xx1300001117</p>		
7	Before fitting the axis-1 motor with gearbox, find the position for the attachment screws, where the motor cables reaches out as long as possible into the base. With motor and gearbox fitted and motorcables out of the hole, remove the cable ties.			

Continues on next page

## 4 Repair

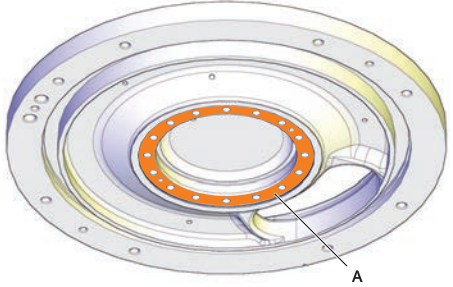
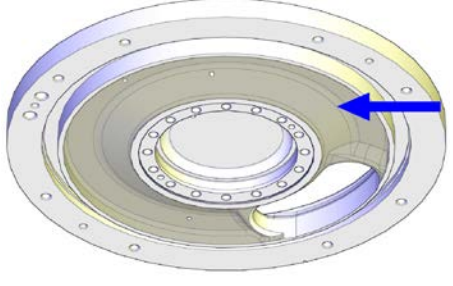
### 4.7.1 Replacing axis-1 motor with gearbox

Continued

	Action	Information						
8	Secure the axis-1 motor with gearbox.	<p>Tightening torque: 4 Nm</p>  <p>xx0900001054</p> <table border="1" data-bbox="954 907 1406 981"> <tr> <td>A</td> <td>Attachment screw, M4x40 q12.9 (12 pcs)</td> </tr> </table>	A	Attachment screw, M4x40 q12.9 (12 pcs)				
A	Attachment screw, M4x40 q12.9 (12 pcs)							
9	<p>Use caution and move the cable guide over the cable harness and fit it in the base.</p> <p> <b>CAUTION</b></p> <p>Make sure not to damage the cable package.</p>  <p>xx1300001608</p>	 <p>xx0900000800</p> <table border="1" data-bbox="954 1612 1406 1780"> <tr> <td>A</td> <td>Attachment screws M3x8 q12.9 (3 pcs)</td> </tr> <tr> <td>B</td> <td>Cable guide</td> </tr> <tr> <td>C</td> <td>Base</td> </tr> </table>	A	Attachment screws M3x8 q12.9 (3 pcs)	B	Cable guide	C	Base
A	Attachment screws M3x8 q12.9 (3 pcs)							
B	Cable guide							
C	Base							
10	Secure the cable guide with its attachment screws.	Tightening torque: 2 Nm.						
11	Apply cable grease on the inside surfaces of the cable guide.							

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Refitting, step 2 - Base

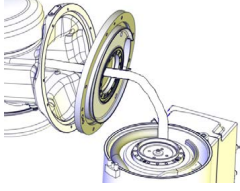
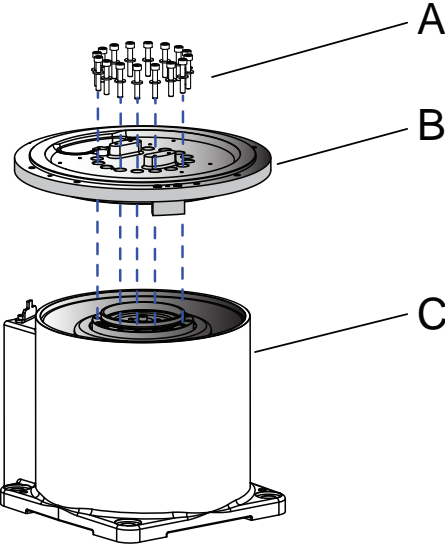
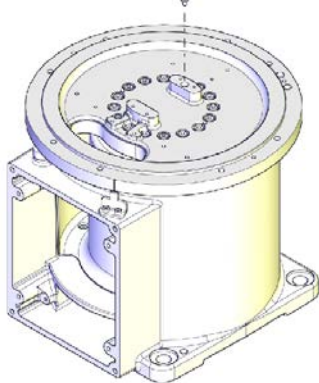

	Action	Information		
1	Clean the joints that have been opened. See <i>Cut the paint or surface on the robot before replacing parts on page 113</i>			
2	Wipe clean the contact surfaces between base and swing plate from old residues of Loctite and other contamination.			
3	Wipe clean countersink hole in swing plate and screw.			
4	Apply flange sealant (Loctite 574) on the assembly surfaces on swing plate and gear.	 <p data-bbox="986 958 1098 981">xx0900000835</p> <table border="1" data-bbox="986 1003 1441 1048"> <tr> <td data-bbox="986 1003 1034 1048">A</td> <td data-bbox="1034 1003 1441 1048">Area where to apply Loctite 574</td> </tr> </table>	A	Area where to apply Loctite 574
A	Area where to apply Loctite 574			
5	Apply a thin layer of cable grease on the plastic surface of the part of the cable guide fitted on the swing plate.	 <p data-bbox="986 1400 1098 1422">xx1300001125</p>		
6	Apply cable grease on cables and hoses before running the package in through the cable guide.			

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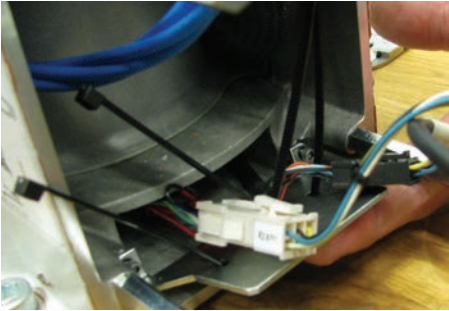



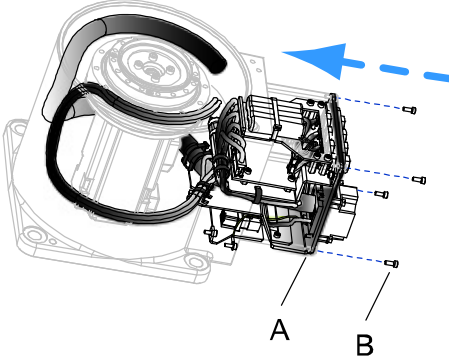
## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

Continued

	Action	Information						
7	<p>Fit the swing plate while at the same time arranging the cable harness in the cable guide.</p>  <p>xx1300001606</p> <p><b>!</b> <b>CAUTION</b> Be careful not to damage the cable harness.</p>	<p>Tightening torque: 4 Nm.</p>  <p>A B C</p> <p>xx0900000799</p> <table border="1" data-bbox="957 929 1404 1108"> <tr> <td>A</td> <td>Attachment screws and washers M4x25 q 12.8 (16+16 pcs)</td> </tr> <tr> <td>B</td> <td>Swing plate</td> </tr> <tr> <td>C</td> <td>Base</td> </tr> </table>	A	Attachment screws and washers M4x25 q 12.8 (16+16 pcs)	B	Swing plate	C	Base
A	Attachment screws and washers M4x25 q 12.8 (16+16 pcs)							
B	Swing plate							
C	Base							
8	<p>Refit the screw in the air release hole on the swing plate, and apply Loctite 243 on this screw.</p>	 <p>xx1700000769</p>						
9	<p>Connect connectors:</p> <ul style="list-style-type: none"> <li>• R2.MP1</li> <li>• R2.ME1</li> </ul>							
10	<p> <b>Tip</b></p> <p>To facilitate assembly of cable ties, loosen the screws holding the plate a little bit.</p>							

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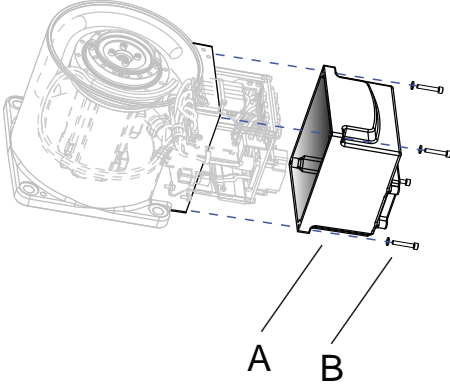
Action	Information
<p>11 Secure the connectors to the plate with cable ties.</p>	 <p>xx1400002559</p>
<p>12 Refit the attachment screws that secure the cable plate, if removed.</p>	
<p>13 Use caution and reconnect the battery cable connector.</p> <p> <b>CAUTION</b></p> <p>If too much force is used when the battery cable is connected, there is a risk of damaging the connector.</p> <p> <b>Tip</b></p> <p>Leaving the attachment screws securing the bracket with battery unscrewed, will make it easier to connect the battery cable.</p>	
<p>14 Secure the bracket with battery (if it has been removed).</p>	
<p>15 Make sure the earth cable is connected and undamaged.</p>	
<p>16 Use caution and push in the plate with the EIB board and battery into the base.</p> <p> <b>Note</b></p> <p>Make sure that the cables are placed correctly and that no cables are damaged!</p>	 <p>xx0900000836</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Plate</li> <li>• B: Attachment screws M3x8 q12.8 (4 pcs)</li> </ul>
<p>17 Secure the plate with its attachment screws.</p>	<p>Tightening torque: 2 Nm.</p>

Continues on next page


## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

Continued

	Action	Information
18	<p>Use caution and refit the base cover.</p> <p> <b>CAUTION</b></p> <p>Make sure not to damage the cables in the process.</p>	<p>Tightening torque: 4 Nm.</p>  <p>xx0900000829</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Base cover</li> <li>• B: Attachment screws M4x25 q12.8 (4 pcs)</li> </ul>

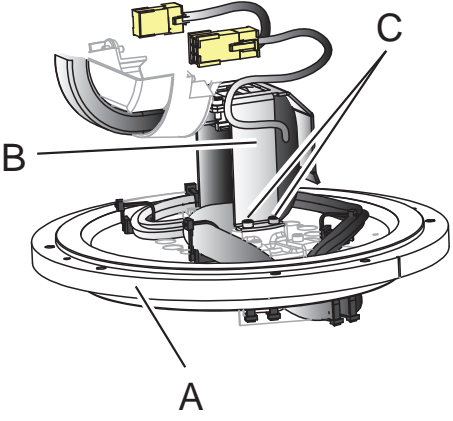

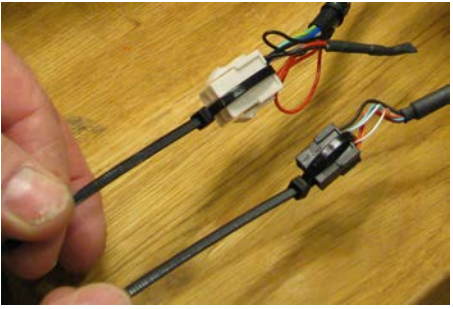
### Refitting, step 3 - Swing house

	Action	Information
1	<p>Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p>	
2	<p>Lift swing house and armsystem (upper and lower arms) and hold the parts in an angle in order to be able to fit the cable holder on the swing plate.</p> <p> <b>Tip</b></p> <p>The easiest and most safe way to do this, is with two persons working together:</p> <ul style="list-style-type: none"> <li>• Person 1 holding the armsystem in an angle</li> <li>• Person 2 fitting the cable holder.</li> </ul>	

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4.7.1 Replacing axis-1 motor with gearbox  
Continued

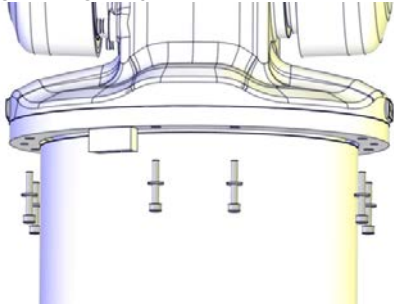
	Action	Information						
3	Secure the cable holder.	 <p>xx1300001596</p> <table border="1" data-bbox="986 779 1441 947"> <tr> <td>A</td> <td>Swing plate</td> </tr> <tr> <td>B</td> <td>Cable bracket</td> </tr> <tr> <td>C</td> <td>Attachment screws M4x25 q12.8 (2+2 pcs)</td> </tr> </table>	A	Swing plate	B	Cable bracket	C	Attachment screws M4x25 q12.8 (2+2 pcs)
A	Swing plate							
B	Cable bracket							
C	Attachment screws M4x25 q12.8 (2+2 pcs)							
4	While still holding the armsystem lifted in an angle, use caution and push the axis-2 motor cables into the swing house, one on each side of the motor.							
5	 <b>Tip</b> Extend the motor connection cables with cable ties to ease pulling the cables through the base.	 <p>xx1500000003</p> <p>Figure 4.1:</p>						
6	Use caution and push the rest of the cables into the swing house.							
7	Wipe clean the contact surfaces between swing plate and swing house from old residues of Loctite and other contamination.							
8	Use caution and move the swing house over the cable harness and put it into fitting position.							

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## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

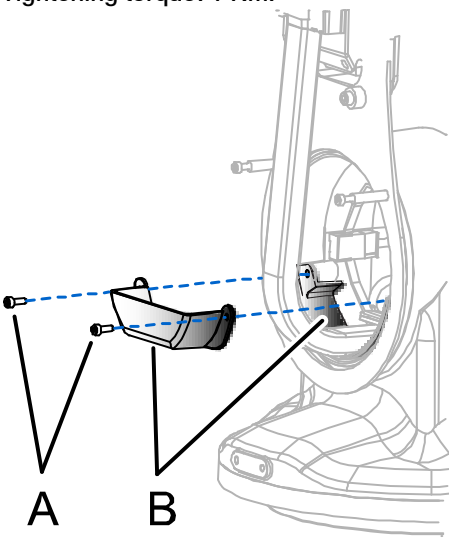
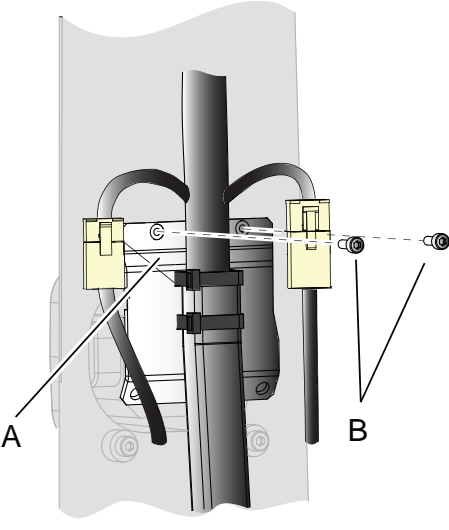
Continued

	Action	Information
9	Secure the swing house with the six attachment screws possible to reach at this point.	<p>Tightening torque: 4 Nm.</p>  <p>xx1300001604</p> <p>M4x25 (6 pcs) Attachment screws M4x25 q12.9 (6 pcs)</p>

#### Refitting, step 4 - Concluding procedure

	Action	Information
1	<p>Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p> <p> <b>Note</b></p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	
2	<p>Connect connectors:</p> <ul style="list-style-type: none"> <li>• R2.MP2</li> <li>• R2.ME2</li> </ul>	
3	<p>Arrange the axis-2 motor cables so that they will not be damaged.</p>	
4	<p>Secure the motor cables around the axis-2 motor with a cable tie.</p>	

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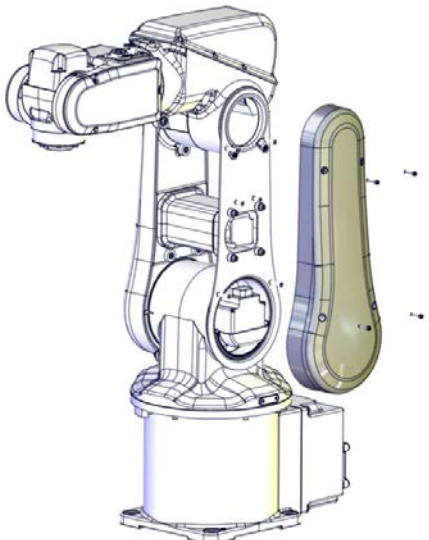


	Action	Information				
5	Fit the two cable guides.	<p>Tightening torque: 1 Nm.</p>  <p>xx0900000857</p> <table border="1" data-bbox="986 918 1437 1019"> <tr> <td>A</td> <td>Attachment screws M3x8 (2 pcs)</td> </tr> <tr> <td>B</td> <td>Cable guides (2 pcs)</td> </tr> </table>	A	Attachment screws M3x8 (2 pcs)	B	Cable guides (2 pcs)
A	Attachment screws M3x8 (2 pcs)					
B	Cable guides (2 pcs)					
6	Fit the cable bracket on the lower arm plate.	 <p>xx0900000879</p> <table border="1" data-bbox="986 1601 1437 1702"> <tr> <td>A</td> <td>Cable bracket</td> </tr> <tr> <td>B</td> <td>Attachment screws M3x8 (2 pcs)</td> </tr> </table>	A	Cable bracket	B	Attachment screws M3x8 (2 pcs)
A	Cable bracket					
B	Attachment screws M3x8 (2 pcs)					
7	Lubricant the inside of the lower arm cover with cable grease.					

*Continues on next page*

## 4 Repair

### 4.7.1 Replacing axis-1 motor with gearbox

Continued

	Action	Information
8	Fit the lower arm cover.	<p>Tightening torque: 2 Nm</p>  <p>xx1300001124</p>
9	Power up the robot.	
10	Turn on the controller and jog the robot to calibration position.	
11	 <p><b>DANGER</b></p> <p>Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!</p>	
12	Jog axis-1 to 90° position in order to be able to reach the remaining two attachment screws securing the swing house.	
13	Recalibrate the robot.	<p>See chapter:</p> <ul style="list-style-type: none"> <li>• <a href="#">Calibration on page 219.</a></li> </ul>
14	 <p><b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51.</a></p>	

## 4.7.2 Replacing axis-2 motor with gearbox

### Introduction

This procedure describes how to replace:

- motor axis 2 with gearbox.

Gearbox axis 2 is a part of motor axis 2 when ordered as a spare part. The procedure below describes the replacement of motor and gearbox axis 2 as one unit. For information how to replace gearbox axis 2, please contact **ABB**.



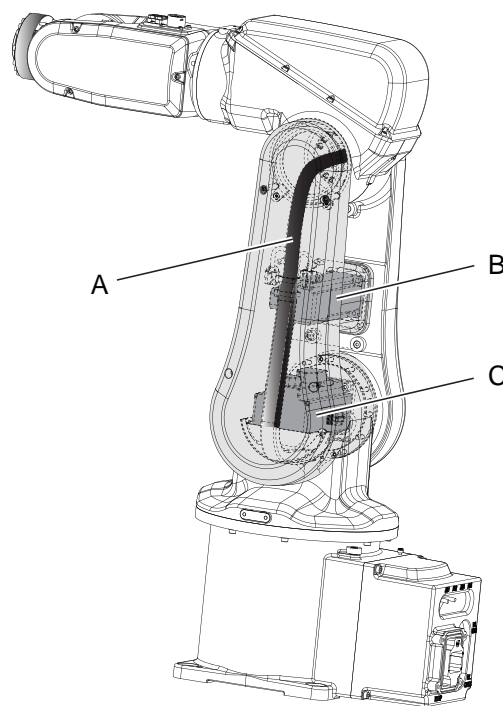
### CAUTION

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

### Location of motor axis-2 with gearbox

Axis-2 motor with gearbox is located as shown in the figure.



xx0900000847

A	Cable harness
B	Motor axis-3
C	Motor axis-2 with gearbox

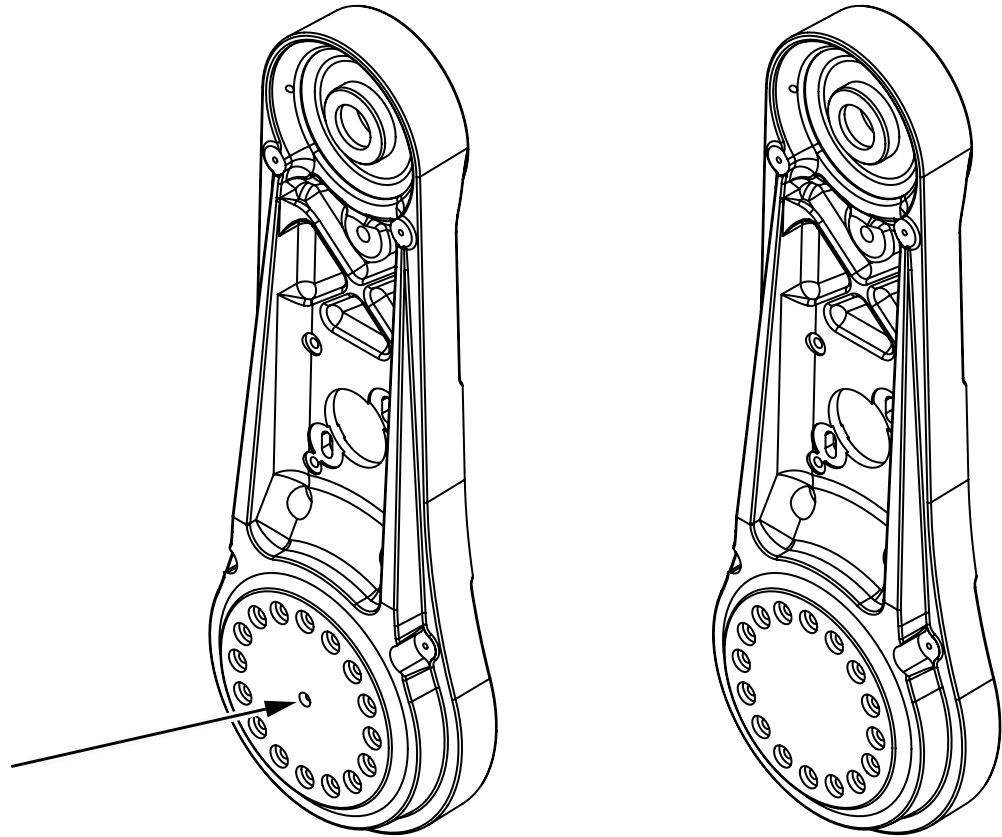
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## 4 Repair

### 4.7.2 Replacing axis-2 motor with gearbox

Continued

There are two different designs of the lower arm housing. One of the designs has an air release hole and the other does not.



xx1500000113

#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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.
Loctite 7063	For removing residues of Loctite.
Loctite 574	Amount: 2 ml.

#### Removing axis-2 motor with gearbox

Use this procedure to remove axis-2 motor with gearbox.



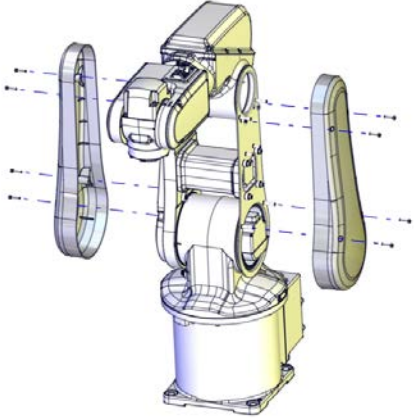
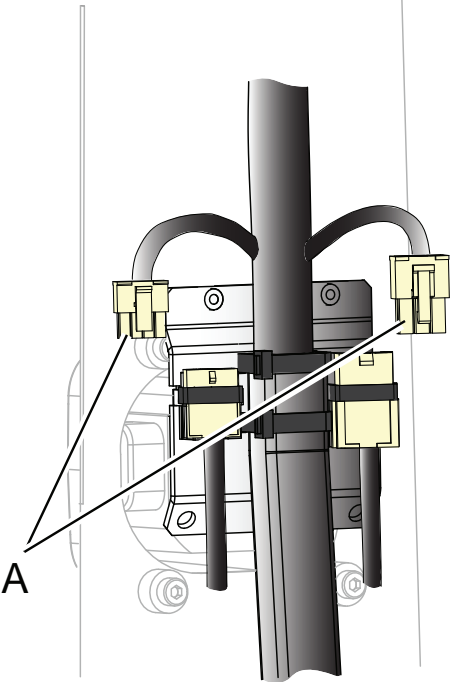


#### CAUTION

Use extreme caution performing these procedures. The cable harness will still be fitted or be partly fitted during the procedures.

	Action	Information
1	Jog the robot to calibration position.	

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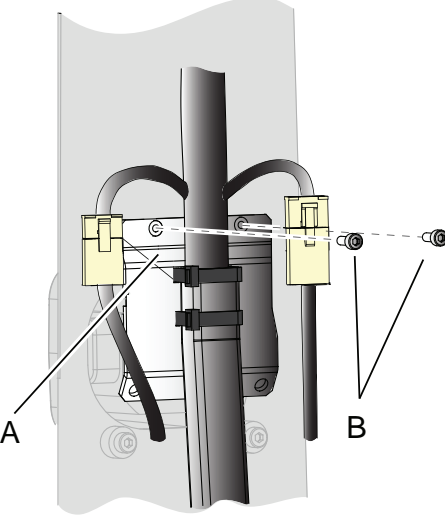
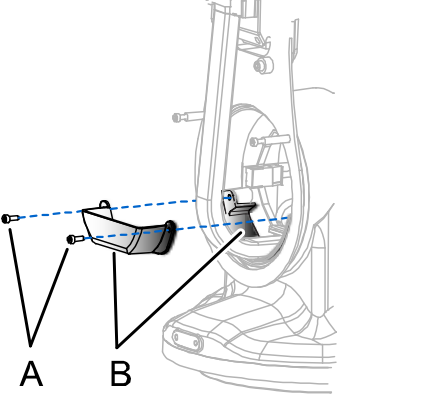
	Action	Information
2	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
3	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <i>Cut the paint or surface on the robot before replacing parts on page 113.</i>	
4	Remove the lower arm covers on both sides of the lower arm.	 <p>xx0900000848</p>
5	Disconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP3</li> <li>• R2.ME3</li> </ul>	 <p>xx0900000850</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Connectors</li> </ul>

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## 4 Repair

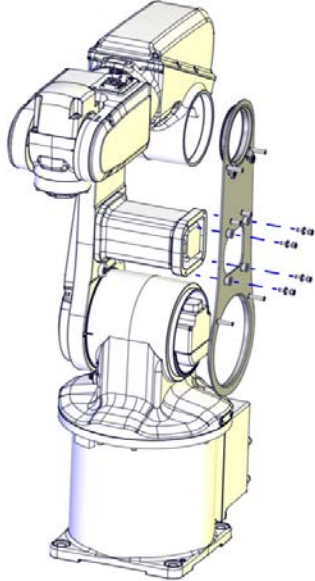
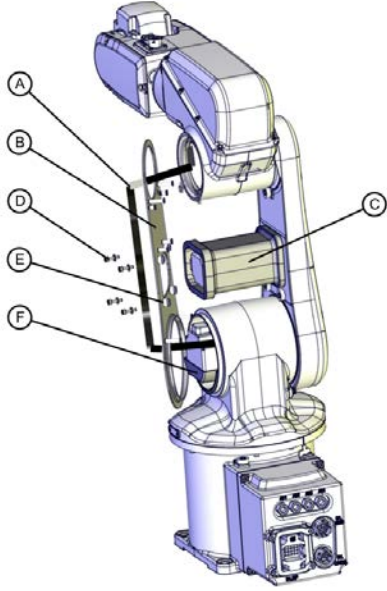
### 4.7.2 Replacing axis-2 motor with gearbox

Continued

	Action	Information
6	Unscrew the attachment screws securing the cable bracket in order to disconnect the cable harness from the lower arm.	 <p>xx0900000879</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Cable bracket</li><li>• B: Attachment screws (2 pcs)</li></ul>
7	Remove both cable guides.	 <p>xx0900000857</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Attachment screws (2+2 pcs)</li><li>• B: Cable guides (2 pcs)</li></ul>

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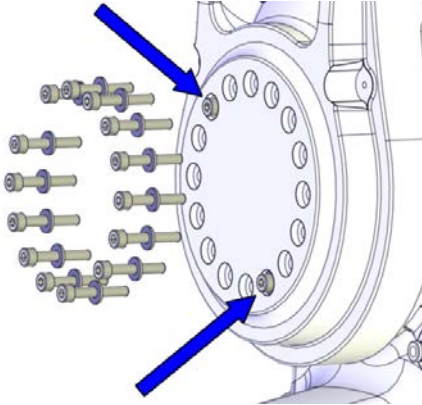
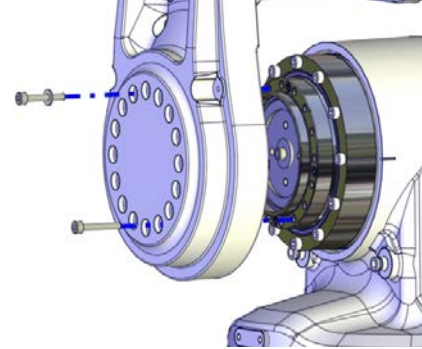

	Action	Information
8	Unscrew the attachment screws securing the lower arm plate to the motor cover.	 <p>xx1300001123</p>
9	Use caution, pull out the cable harness as far as possible without causing damage and put the lower arm plate in an angle.	 <p>xx0900000851</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Cable harness</li> <li>• B: Lower arm plate</li> <li>• C: Motor cover</li> <li>• D: Attachment screws (4 pcs)</li> <li>• E: Holes for attachment screws (4 pcs)</li> <li>• F: Cable guide</li> </ul>

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## 4 Repair


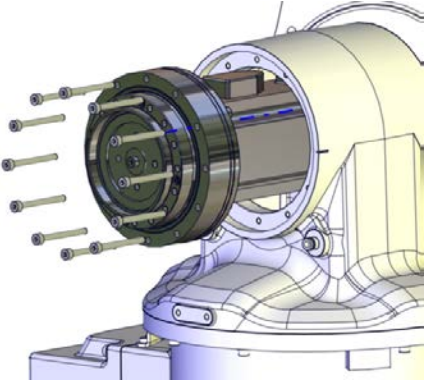
### 4.7.2 Replacing axis-2 motor with gearbox

Continued

	Action	Information
10	Leave two attachment screws fitted and unscrew the remaining screws, that secure the lower arm to the axis-2 gearbox.	 <p>xx1300001121</p>
11	Take a hold of the upper and lower arm in a firm grip.	
12	Use caution and unscrew the two remaining attachment screws that secure the lower arm to the axis-2 gearbox.	 <p>xx1300001119</p>
13	<b>Air hole design:</b> Remove screw from swing plate.	
14	Use caution and put the lower and upper arms beside the swing housing and base, making sure not to damage the cable harness.   <b>Tip</b>  Place the armsystem on some plastic or in a box with soft edges. The armsystem must be placed in a way that it will not be able to move or be moved.	
15	Disconnect connectors: <ul style="list-style-type: none"><li>• R2.MP2</li><li>• R2.ME2</li></ul>	


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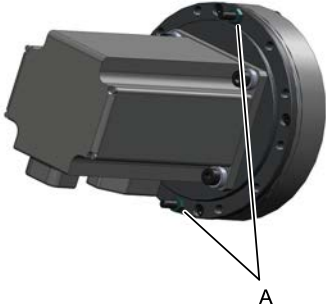
4.7.2 Replacing axis-2 motor with gearbox  
Continued

	Action	Information
16	<p>Unscrew the attachment screws and plain washers that secure the axis-2 motor with gearbox to the swing housing, use caution and remove the axis-2 motor.</p> <p> <b>CAUTION</b></p> <p>In order not to damage any parts, hold the two parts in a firm grip when removing the motor with gearbox.</p>	 <p>xx1300001120</p>

Refitting motor axis 2 with gearbox

Use this procedure to refit motor axis 2 with gearbox.

<p> <b>CAUTION</b></p> <p>Use extreme caution performing these procedures. The cable harness will still be fitted or be partly fitted during the procedures.</p>
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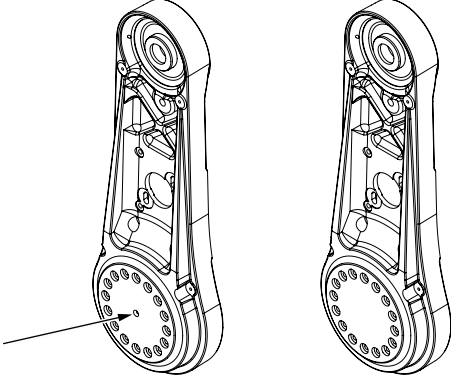

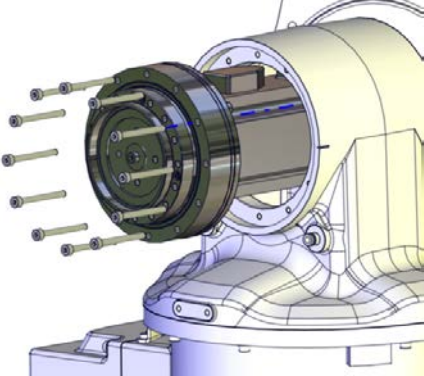
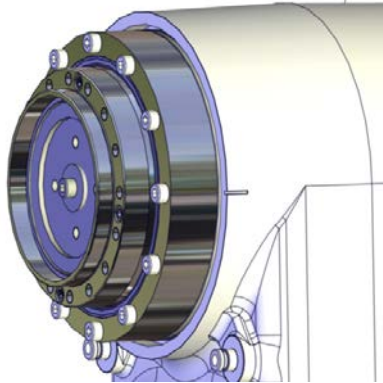
	Action	Information
1	<p>Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a></p>	
2	<p>Before refitting, make sure that:</p> <ul style="list-style-type: none"> <li>• all assembly surfaces are clean and without damage</li> <li>• motor and gearbox are clean and without damage.</li> </ul>	<p> <b>Tip</b></p> <p>Use Loctite 7063 (Superclean).</p>
3	<p>Remove the two screws with nuts securing motor axis 2 with gearbox while being transported.</p>	 <p>xx0900001050</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Screws with nuts, used during transport (2 pcs)</li> </ul>
4	<p>Remove old residues of Loctite and other contamination, from the assembly surfaces of the lower arm.</p>	
5	<p>Wipe clean screw and countersink hole on swing plate.</p>	

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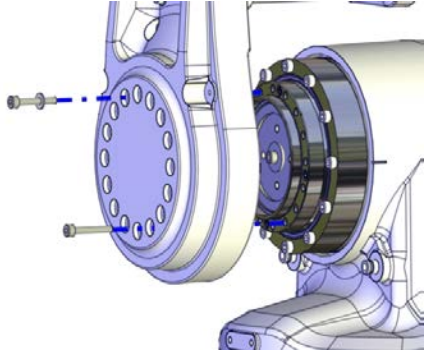
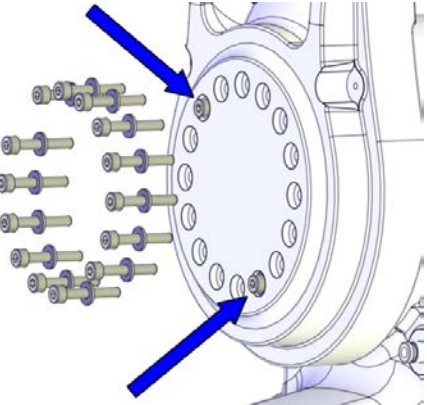
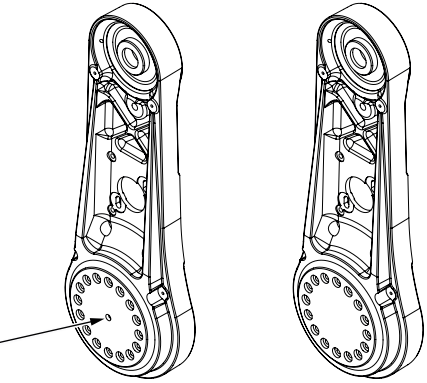
## 4 Repair

### 4.7.2 Replacing axis-2 motor with gearbox

Continued

	Action	Information
6	Refill the same amount of grease in the gearbox, that has been wiped off.	
7	If the robot has an air release hole: Remove the screw in the air release hole on the lower arm housing to release pressure inside the lower arm.	 <p>xx150000113</p>
8	Apply flange sealant (Loctite 574) on the assembly surfaces of the lower arm and gearbox.	
9	Place the axis-2 motor with gearbox in the swing housing.   <b>CAUTION</b>  In order not to damage any parts, hold the two parts in a firm grip when refitting the motor with gearbox.	 <p>xx1300001120</p>
10	Secure the axis-2 motor with gearbox to the swing housing with its attachment screws.	Tightening torque: 4 Nm.   <p>xx1300001122</p> <p>Attachment screws M4x20 q12.9 (12 pcs)</p>

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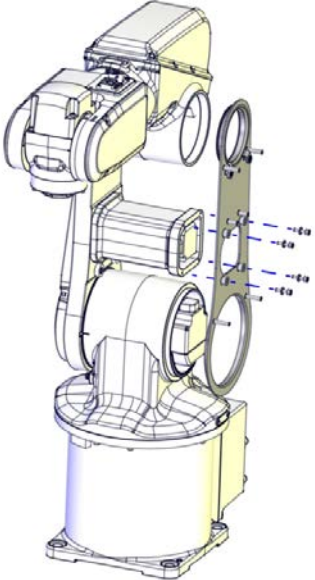

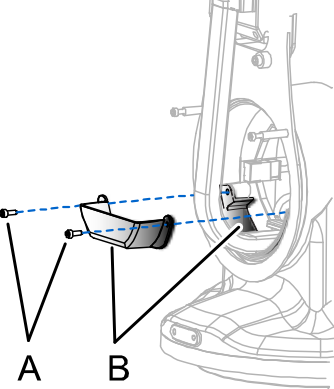
	Action	Information
11	While holding the upper and lower arms, secure the lower arm to the axis-2 motor with gearbox with two of the attachment screws.	 <p>xx1300001119</p>
12	Secure the axis-2 motor with gearbox to the lower arm with the remaining attachment screws. Tighten all screws.	<p>Tightening torque: 4 Nm.</p>  <p>xx1300001121</p> <p>Attachment screws M4x25 q12.9 and washers (16 + 16 pcs)</p>
13	If the robot has an air release hole: Add Loctite 243 and refit the screw in the air release hole on the lower arm housing.	 <p>xx1500000113</p>

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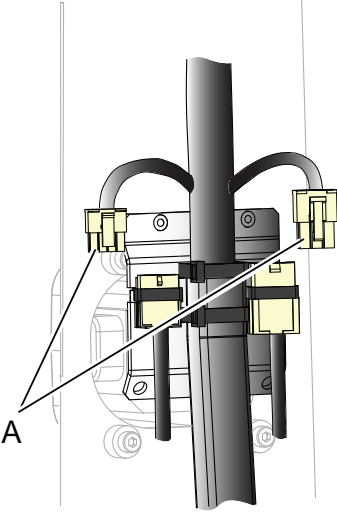
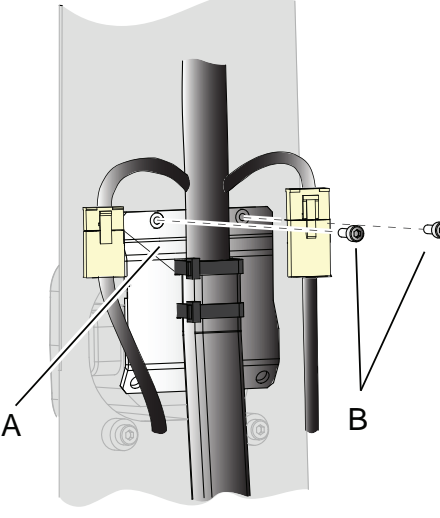

## 4 Repair

### 4.7.2 Replacing axis-2 motor with gearbox

Continued

	Action	Information
14	<p>Refit the lower arm plate.</p> <p> <b>Note</b></p> <p>Make sure that the lower arm plate is centered!</p>	<p>Tightening torque: 4 Nm.</p>  <p>xx1300001123</p> <p>Attachment screws M4x16 q12.9 and washers (4 + 4 pcs)</p>
15	<p>Reconnect the axis-2 motor cables:</p> <ul style="list-style-type: none"><li>• R2.MP2</li><li>• R2.ME2</li></ul>	
16	<p>Secure the motor cables around the axis-2 motor with cable ties.</p> <p> <b>Note</b></p> <p>Put the tie on the side in order to make the lower arm cover fit well.</p>	
17	<p>Refit the two cable guides.</p>	<p>Tightening torque : 1 Nm.</p>  <p>xx0900000857</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Attachment screws M3x8 (2 pcs)</li><li>• B: Cable guides (2 pcs)</li></ul>

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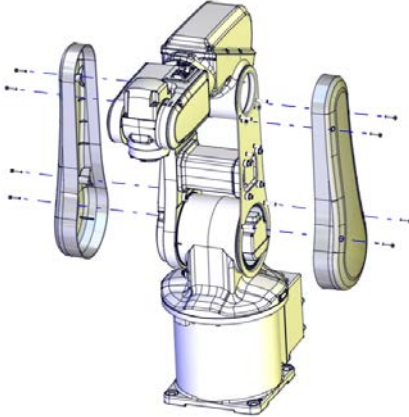


	Action	Information
18	Reconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP3</li> <li>• R2.ME3.</li> </ul>	 <p>xx0900000850</p> <p>Connectors:</p> <ul style="list-style-type: none"> <li>• A: R2.ME3</li> <li>• B: R2.MP3</li> </ul>
19	Refit the cable bracket on the lower arm.	 <p>xx0900000879</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Attachment screws M3x8 (2 pcs)</li> </ul>
20	 <p><b>DANGER</b></p> <p>Check that the cable harness is intact and connected correctly on all axes!</p>	

Continues on next page

## 4 Repair

### 4.7.2 Replacing axis-2 motor with gearbox

Continued

	Action	Information
21	Refit the <i>lower arm covers</i> .	Tightening torque: 2 Nm.  xx0900000848
22	Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>  <b>Note</b> After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
23	Recalibrate the robot.	See chapter: <ul style="list-style-type: none"><li>• <a href="#">Calibration on page 219.</a></li></ul>
24	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51.</a>	



### 4.7.3 Replacing axis-3 motor with gearbox

#### Introduction

This procedure describes how to replace axis-3 motor.

How to replace axis-3 gearbox, see section:

- [Replacing gearbox axis 3 on page 215](#)



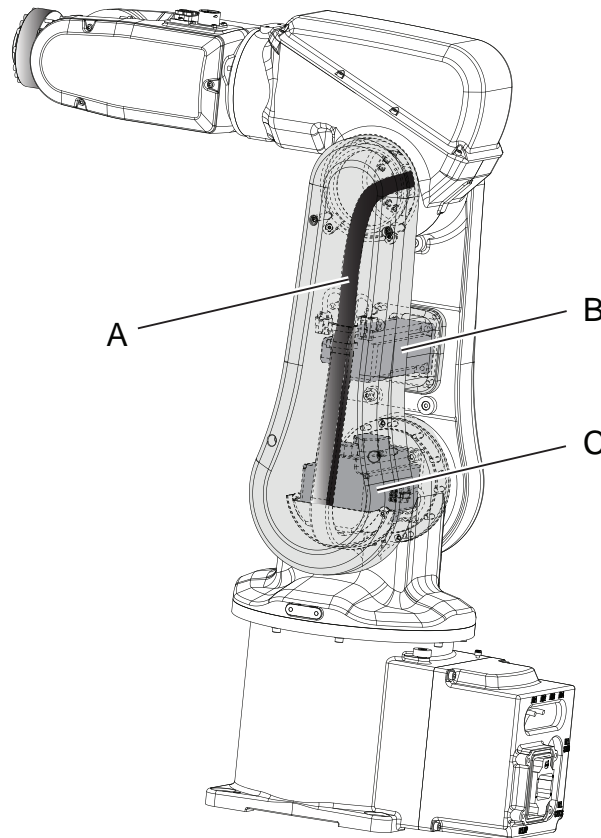
#### CAUTION

Always read the section "General procedures" before doing any repair work.

[Cut the paint or surface on the robot before replacing parts on page 113](#)

#### Location of axis-3 motor

The axis-3 motor is located as shown in the figure.



xx0900000847

A	Cable harness
B	Motor axis 3
C	Motor axis 2

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## 4 Repair

### 4.7.3 Replacing axis-3 motor with gearbox



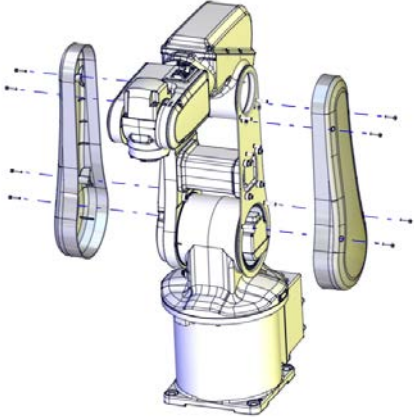
*Continued*

#### Required equipment

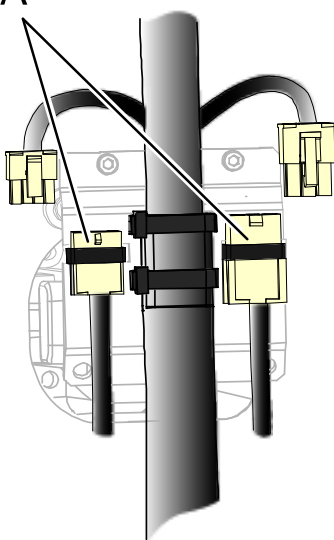
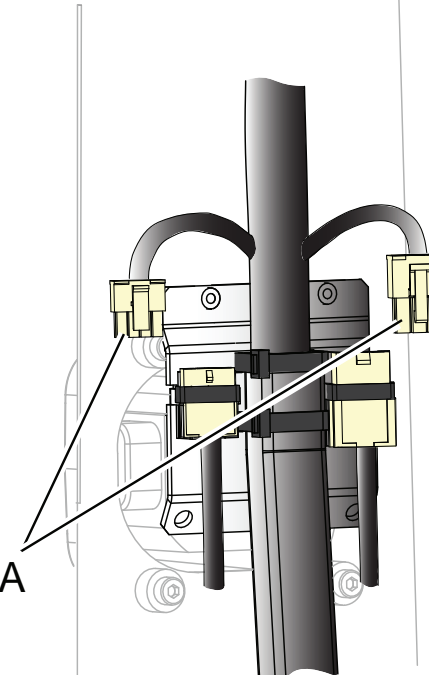
Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.
Flange sealant (Loctite 574)	Amount: 2 ml.

#### Removing axis-3 motor

Use this procedure to replace axis-3 motor.

	Action	Information
1	Secure the arm system before removing motor axis 3.	
2	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
3	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a> .	
4	Remove the <i>lower arm covers</i> on both sides of the of the lower arm.	 <p>xx0900000848</p>

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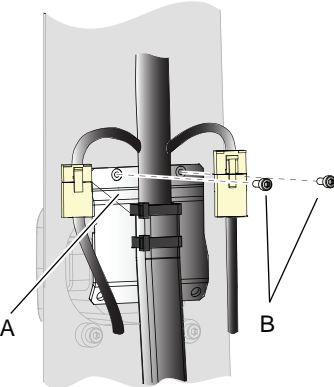
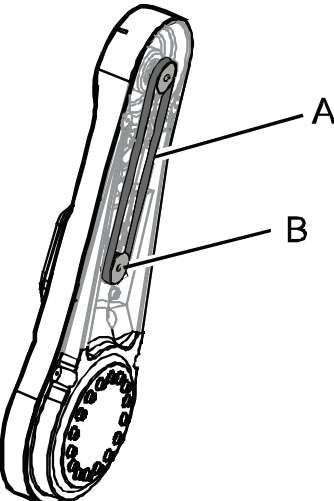
	Action	Information
5	Cut the <i>cable straps</i> securing the connectors.	<p>A</p>  <p>xx0900000849</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Cable straps (2 pcs)</li> </ul>
6	Disconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP3</li> <li>• R2.ME3.</li> </ul>	 <p>xx0900000850</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Connectors R2.MP3 and R2.ME3</li> </ul>

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## 4 Repair

### 4.7.3 Replacing axis-3 motor with gearbox

Continued

	Action	Information
7	Unscrew the <i>attachment screws</i> securing the <i>cable bracket</i> .	 <p data-bbox="956 705 1061 728">xx0900000879</p> <p data-bbox="956 743 1021 766">Parts:</p> <ul data-bbox="986 770 1353 831" style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Attachment screws (2 pcs)</li> </ul>
8	Move the <i>cable harness</i> a little to the side.	
9	Unscrew the <i>attachment screws</i> securing the <i>motor axis 3</i> .	
10	Remove the <i>timing belt</i> from the <i>pulleys</i> on the motor axis.	 <p data-bbox="956 1467 1061 1489">xx0900000876</p> <p data-bbox="956 1505 1021 1527">Parts:</p> <ul data-bbox="986 1532 1220 1592" style="list-style-type: none"> <li>• A: Timing belt</li> <li>• B: Pulleys (2 pcs)</li> </ul>
11	Remove the motor.	

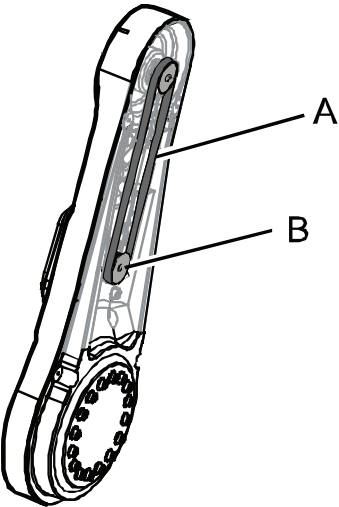

#### Refitting axis-3 motor

Use this procedure to refit axis-3 motor.

	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	

Continues on next page

4.7.3 Replacing axis-3 motor with gearbox  
Continued

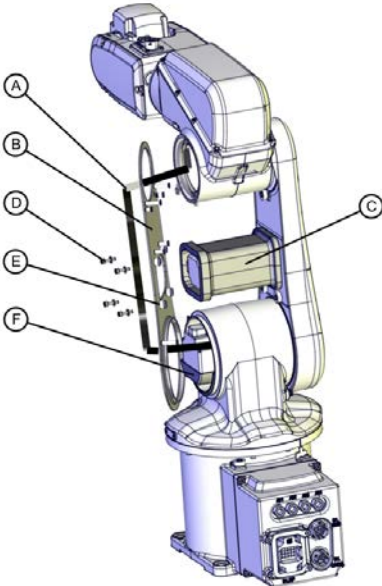
	Action	Information
2	Make sure that: <ul style="list-style-type: none"> <li>• all assembly surfaces are clean and without damage</li> <li>• motor and gearbox are clean and undamaged.</li> </ul>	
3	Place the <i>axis-3 motor</i> in the <i>motor cover</i> .	
4	Refit the <i>timing belt</i> on the <i>pulleys</i> .	 <p data-bbox="986 1021 1091 1039">xx0900000876</p> <p data-bbox="986 1061 1054 1079">Parts:</p> <ul style="list-style-type: none"> <li>• A: Timing belt</li> <li>• B: Pulleys (2 pcs)</li> </ul>
5	Tighten the <i>attachment screws</i> and <i>washers</i> securing the motor, just enough to still be able to move the motor.	
6	Move the motor to a position where a good <i>timing belt tension</i> is reached.   <b>Note</b> Do not stretch the timing belt too much!	For details about how to adjust the timing belt, see <a href="#">Adjusting axis-3 timing belt on page 94</a> . New belt: F = 18-19.7N Used belt: F = 12.5-14.3N
7	Secure the <i>axis-3 motor</i> with its <i>attachment screws</i> and <i>washers</i> .	Tightening torque: 4 Nm.

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## 4 Repair

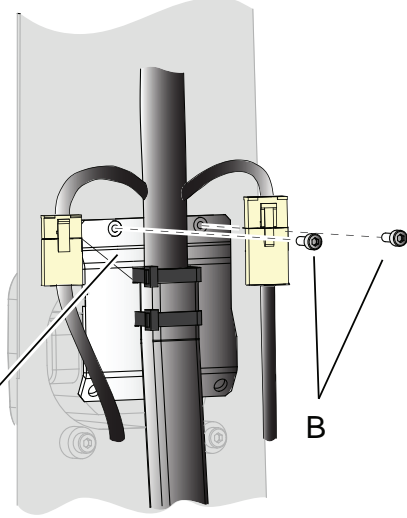

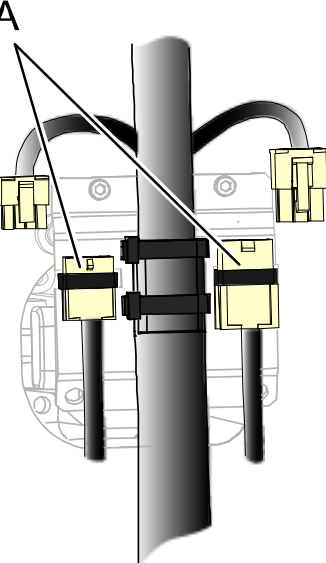
### 4.7.3 Replacing axis-3 motor with gearbox

*Continued*

	Action	Information
8	Refit the <i>lower arm plate</i> .	<p>Tightening torque: 4 Nm.</p>  <p>xx090000851</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Cable harness</li><li>• B: Lower arm plate</li><li>• C: Motor cover</li><li>• D: Attachment screws (4 pcs)</li><li>• E: Holes for attachment screws (4 pcs)</li><li>• F: Cable guide</li></ul>
9	Reconnect connectors: <ul style="list-style-type: none"><li>• R2.MP3</li><li>• R2.ME3.</li></ul>	

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4.7.3 Replacing axis-3 motor with gearbox  
Continued

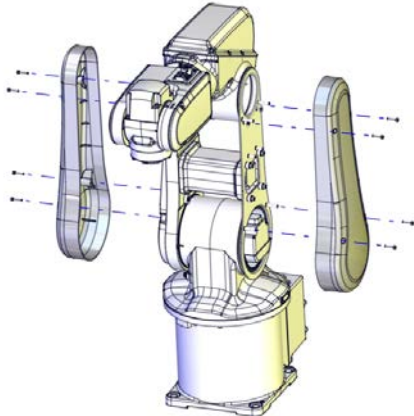


	Action	Information
10	Secure the cable harness by refitting the <i>cable bracket</i> to the lower arm plate.	Tightening torque: 1 Nm.  <p>xx0900000879</p> Parts: <ul style="list-style-type: none"> <li>• A: Cable bracket</li> <li>• B: Attachment screws (2 pcs)</li> </ul>
11	Secure the connectors with <i>cable ties</i> .  <b>Note</b> Put the strap tie on the side in order to make the lower arm cover fit well.	 <p>xx0900000849</p> Parts: <ul style="list-style-type: none"> <li>• A: Cable ties (2 pcs)</li> </ul>

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## 4 Repair

### 4.7.3 Replacing axis-3 motor with gearbox

Continued

	Action	Information
12	Refit the <i>lower arm covers</i> .	Tightening torque: 1 Nm.  xx0900000848
13	Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>  <b>Note</b> After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
14	Recalibrate the robot.	See chapter: <ul style="list-style-type: none"><li>• <a href="#">Calibration on page 219.</a></li></ul>
15	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51.</a>	



#### 4.7.4 Replacing motor axis 4, with gearbox

##### Introduction

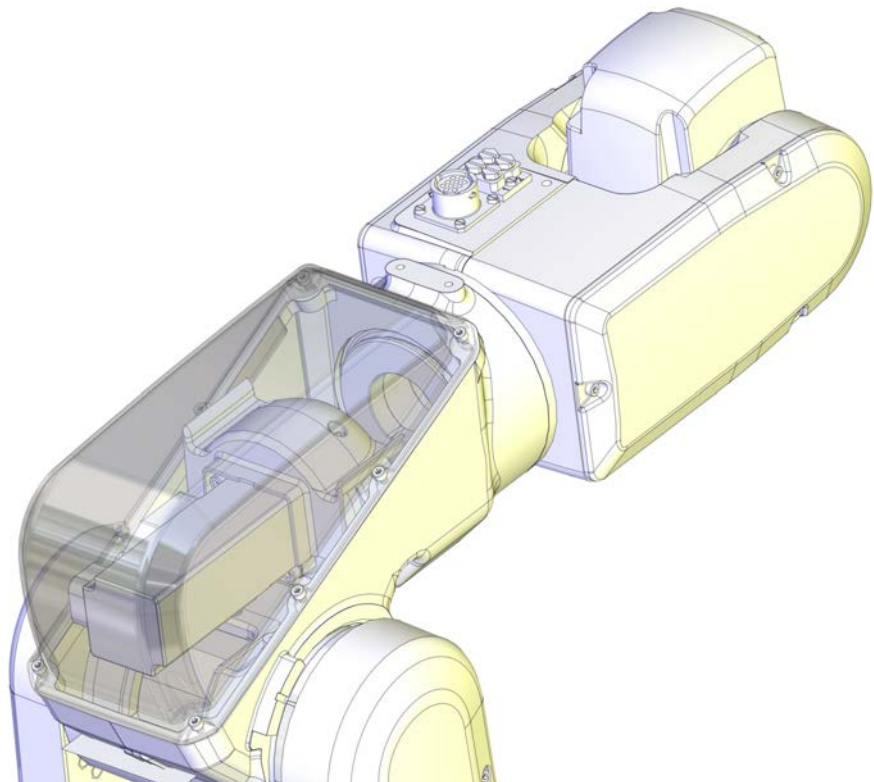
Motor axis 4 is delivered as part of the upper arm when ordered as a spare part.

How to replace the complete upper arm is described in section:

- [Replacing the upper arm on page 150](#)

##### Location of motor axis 4, with gearbox

Motor axis 4, with gearbox is located as shown in the figure:



xx090000785

## 4 Repair

### 4.7.5 Replacing motor axis 5

### 4.7.5 Replacing motor axis 5

#### Introduction

This procedure describes how to replace:

- motor axis 5 with pulley.



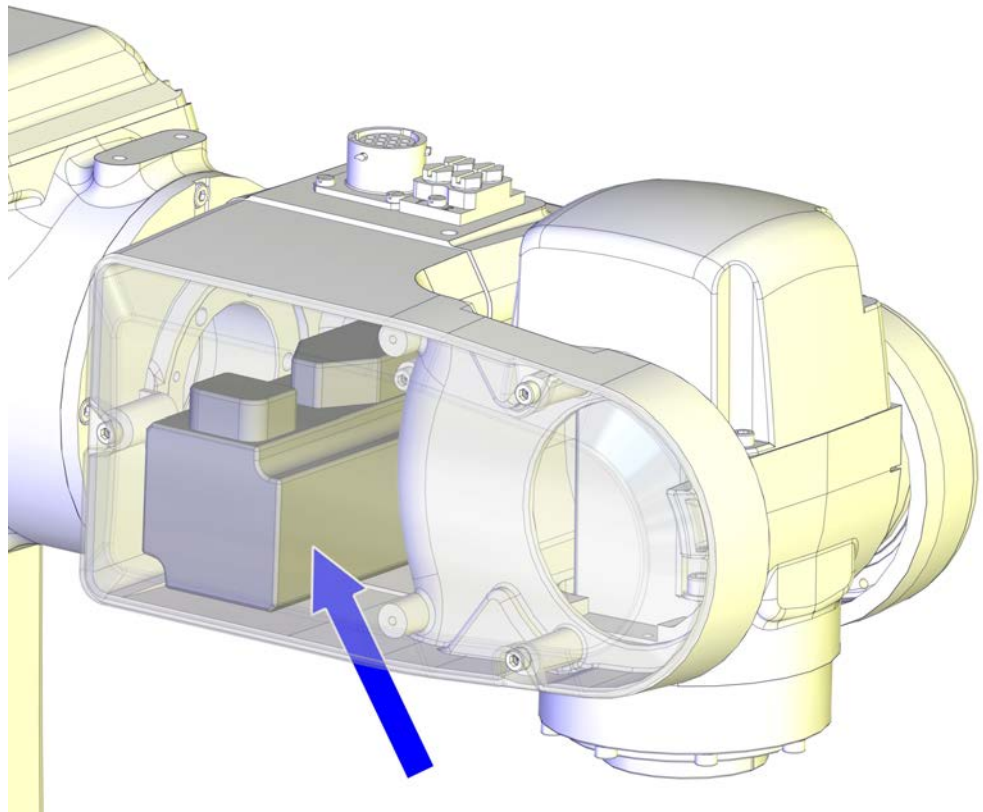
#### CAUTION

Always read the section "General procedures" before doing any repair work.

*Cut the paint or surface on the robot before replacing parts on page 113*

#### Location of motor axis 5

The motor axis 5 is located as shown in the figure.



xx0900000890



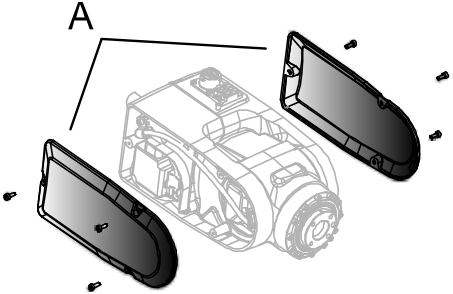
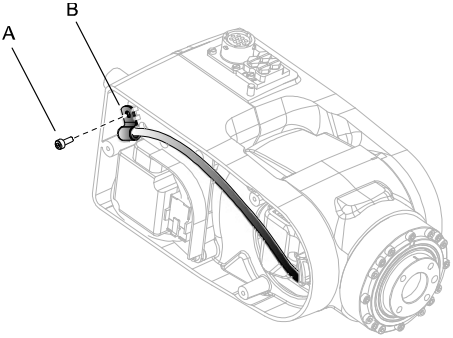
#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
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 motor axis 5 with pulley

Use this procedure to remove motor axis 5 with pulley.

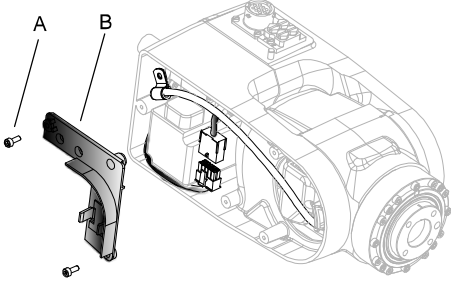
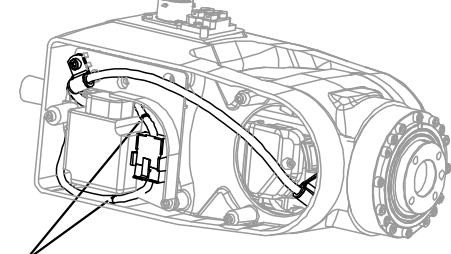
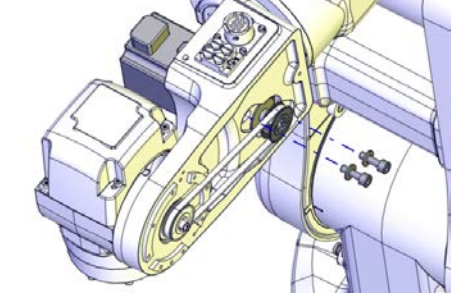
	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts. See <i>Cut the paint or surface on the robot before replacing parts on page 113</i> .	
3	Remove the <i>wrist side covers</i> on both sides of the wrist.	 <p>xx0900000886</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Wrist side covers (2 pcs)</li> </ul>
4	Loosen the <i>attachment screw</i> securing the <i>clamp</i> .	 <p>xx0900000887</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screw</li> <li>• B: Clamp</li> </ul>

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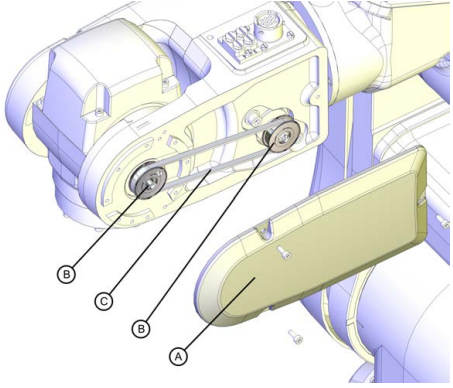
## 4 Repair

### 4.7.5 Replacing motor axis 5

Continued

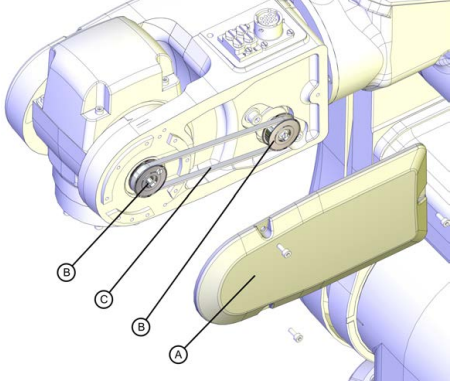
	Action	Information
5	Remove the <i>connector support</i> .	 <p>xx0900000888</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"><li>• A: Attachment screws (2 pcs)</li><li>• B: Connector support</li></ul>
6	Cut the <i>cable straps</i> .	 <p>A</p> <p>xx0900001009</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"><li>• A: Cable straps (2 pcs)</li></ul>
7	Disconnect connectors for motor axis 5: <ul style="list-style-type: none"><li>• R2.MP5</li><li>• R2.ME5</li></ul>	
8	Unscrew the <i>attachment screws</i> securing motor axis 5.	 <p>xx1100000960</p>

Continues on next page

	Action	Information
9	Remove the <i>timing belt</i> from the <i>pulleys</i> .	 <p>xx0900000611</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Wrist side cover</li> <li>• B: Pulley (2 pcs)</li> <li>• C: Timing belt</li> </ul>
10	Remove the motor with pulley.	

### Refitting motor axis 5

Use this procedure to refit motor axis 5.

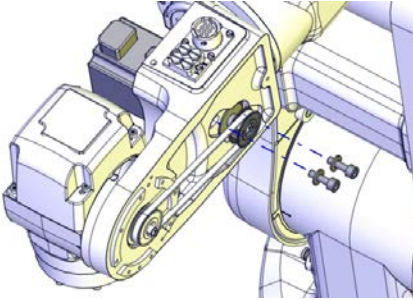

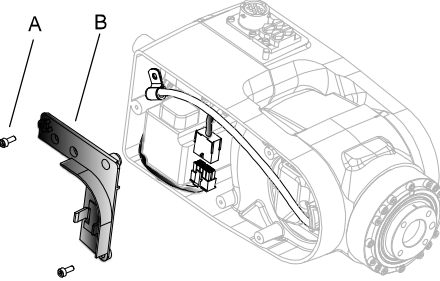
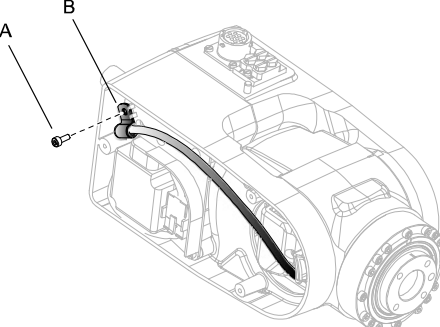
	Action	Information
1	Clean the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
2	Check that: <ul style="list-style-type: none"> <li>• all assembly surfaces are clean and without damage</li> <li>• the motor is clean and undamaged.</li> </ul>	
3	Place the motor in the wrist housing.	
4	Reconnect connectors: <ul style="list-style-type: none"> <li>• R2.MP5</li> <li>• R2.ME5</li> </ul>	
5	Refit the <i>timing belt</i> on the <i>pulleys</i> .	 <p>xx0900000611</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Wrist side cover</li> <li>• B: Pulley (2 pcs)</li> <li>• C: Timing belt</li> </ul>

Continues on next page

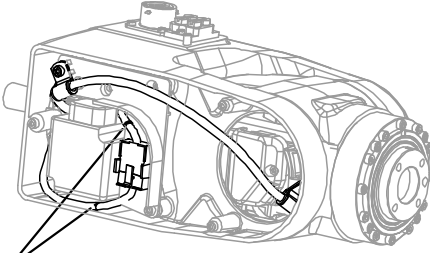
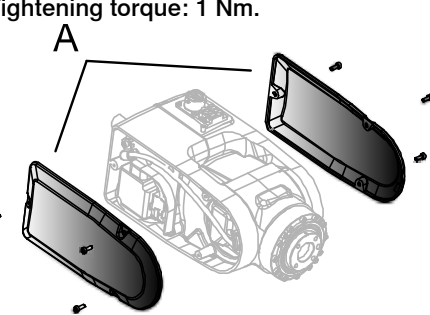


## 4 Repair

### 4.7.5 Replacing motor axis 5

Continued

	Action	Information
6	Tighten the <i>attachment screws</i> and <i>washers</i> securing the <i>motor</i> , just enough (2 Nm) to still be able to move the motor.	 <p>xx1100000960</p> <p>Attachment screws M5x16 q12.9 and washers (2 + 2 pcs)</p>
7	Move the motor to a position where a good timing belt tension is reached.   <b>Note</b> Do not stretch the timing belt too much!	For details about how to adjust the timing belt, see <a href="#">Adjusting axis-5 timing belt on page 95</a> . New belt: F = 7.6-8.4N Used belt: F = 5.3-6.1N
8	Secure <i>motor axis 5</i> with its <i>attachment screws</i> and <i>washers</i> .	Tightening torque: 4 Nm.
9	Refit the <i>connector support</i> .	Tightening torque: 1 Nm.   <p>xx0900000888</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (2 pcs)</li> <li>• B: Connector support</li> </ul>
10	Refit the <i>clamp</i> with its <i>attachment screw</i> .	Tightening torque: 1 Nm.   <p>xx0900000887</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screw</li> <li>• B: Clamp</li> </ul>

Continues on next page

	Action	Information
11	Secure the cables with <i>cable straps</i> .	 <p>A xx0900001009</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Cable straps (2 pcs)</li> </ul>
12	Refit the <i>wrist side covers</i> .	<p>Tightening torque: 1 Nm.</p>  <p>A xx0900000886</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Wrist side covers (2 pcs)</li> </ul>
13	Seal and paint the joints that have been opened. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 113</a>	
	 <b>Note</b> After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
14	Recalibrate the robot.	See chapter: <ul style="list-style-type: none"> <li><a href="#">Calibration on page 219.</a></li> </ul>
15	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">Test run after installation, maintenance, or repair on page 51.</a>	



## 4 Repair

### 4.7.6 Replacing motor axis 6

### 4.7.6 Replacing motor axis 6

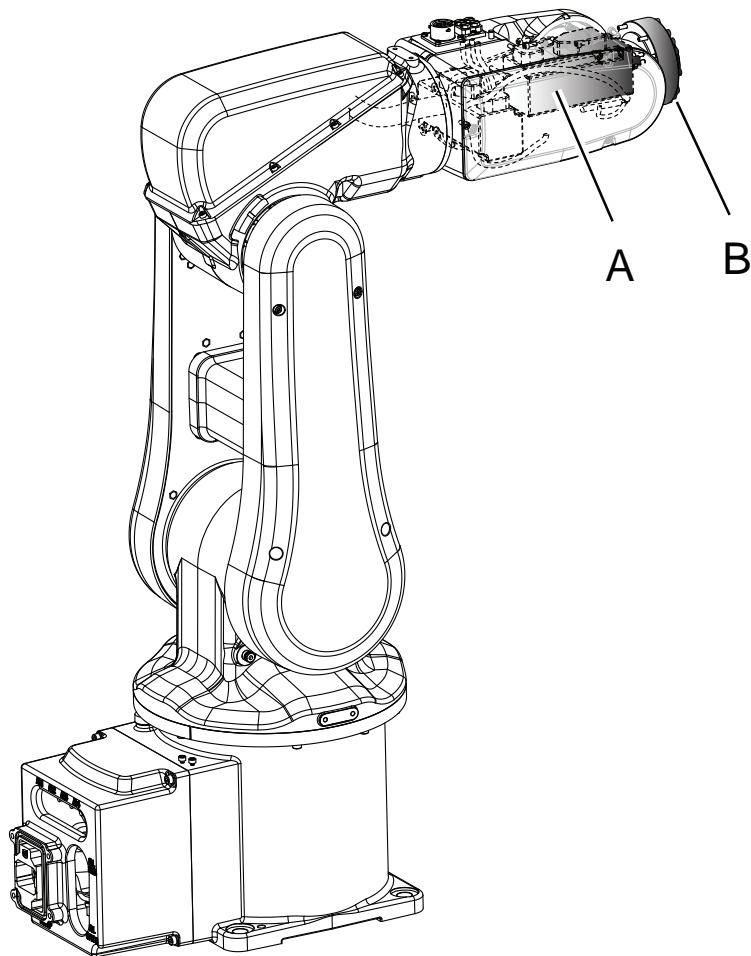
#### Introduction

The motor axis 6 is delivered as part of the upper arm. How to replace the upper arm see section [Replacing the upper arm on page 150](#).

Motor axis 6 is a part of the upper arm when ordered as a spare part. For more information how to replace motor axis 6, please **contact ABB**.

#### Location of motor axis 6

Motor axis 6 is located as shown in the figure.



xx0900000910

A	Motor axis 6
B	Gearbox axis 6



## 4.8 Gearboxes

### 4.8.1 Replacing gearbox axis 1

---

#### Introduction

The gearbox axis 1 is delivered as a part of motor axis 1. For information how to replace motor with gearbox axis 1, see section [Replacing axis-1 motor with gearbox on page 164](#).

## 4 Repair

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### 4.8.2 Replacing gearbox axis 2

### 4.8.2 Replacing gearbox axis 2

---

#### Introduction

The gearbox axis 2 is delivered as a part of motor axis 2. For information how to replace motor with gearbox axis 2, see section [Replacing axis-2 motor with gearbox on page 185](#).

### 4.8.3 Replacing gearbox axis 3

#### Overview

Gearbox axis 3 is delivered as a part of the lower arm. For more information how to replace gearbox axis 3, please **contact ABB**.

#### Location of gearbox axis 3

Gearbox axis 3 is located as shown in the figure.



xx0900001040

A	Gearbox axis 3
B	Lower arm

## 4 Repair

---

### 4.8.4 Replacing gearbox axis 4

#### 4.8.4 Replacing gearbox axis 4

---

##### Introduction

Gearbox axis 4 is delivered as a part of the upper arm.

How to replace the upper arm see:

- [Replacing the upper arm on page 150](#)

For more information how to replace gearbox axis 4, please **contact ABB**.

## 4.8.5 Replacing gearbox axis 5

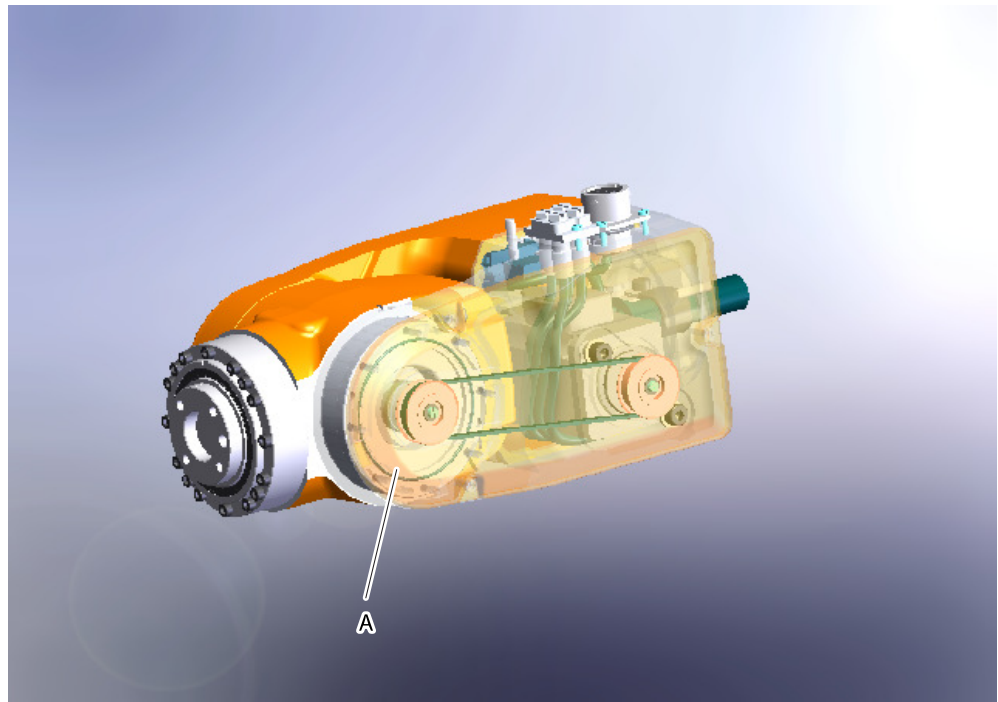
### Overview

Gearbox axis 5 is delivered as a part of the upper arm. How to replace the upper arm is described in section [Replacing the upper arm on page 150](#).

For more information how to replace gearbox axis 5, please contact **ABB**.

### Location of gearbox axis 5

Gearbox axis 5 is located as shown in the figure.



xx0900001041

A	Gearbox axis 5
---	----------------

## 4 Repair

### 4.8.6 Replacing gearbox axis 6

### 4.8.6 Replacing gearbox axis 6

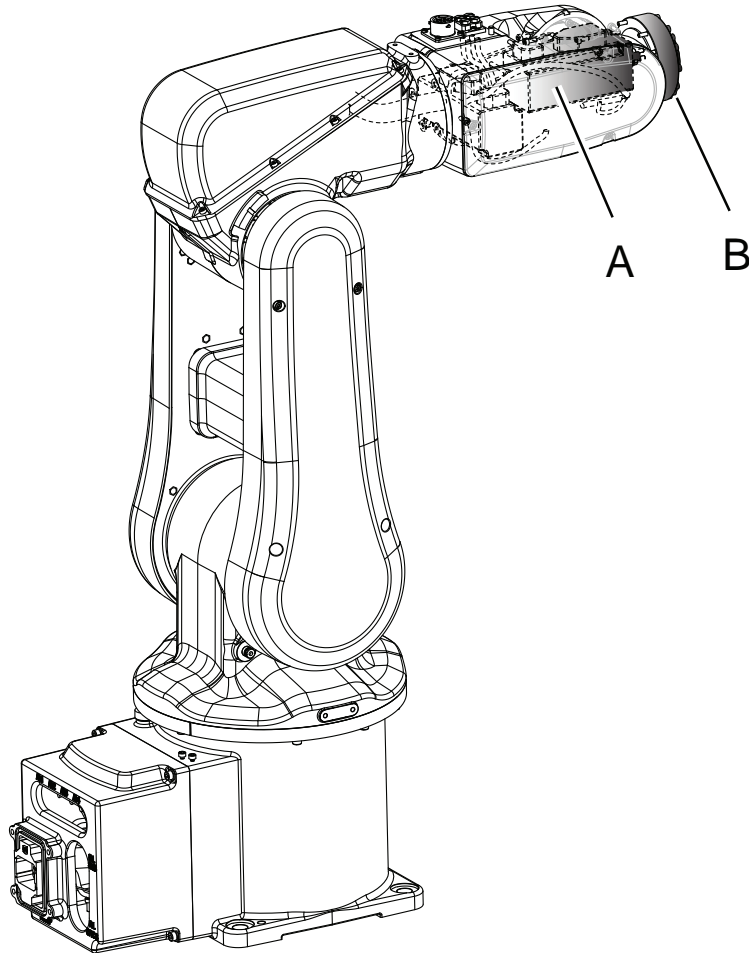
#### Introduction

The gearbox axis 6 is delivered as part of the upper arm. How to replace the upper arm is described in section [Replacing the upper arm on page 150](#).

For more information how to replace gearbox axis 6, please contact **ABB**.

#### Location of gearbox axis 6

Gearbox axis 6 is located as shown in the figure:



xx0900000910

A	Motor axis 6
B	Gearbox axis 6

## 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 229](#).

##### 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	<p>A calibration routine that in the first step generates a reference to current zero position of the robot. The same calibration routine can later on be used to recalibrate the robot back to the same position as when the reference was stored.</p> <p>This routine is more flexible compared to fine calibration and is used when tools and process equipment are installed.</p> <p>Requires that a reference is created before being used for recalibrating the robot.</p> <p>Requires that the robot is dressed with the same tools and process equipment during calibration as during creation of the reference values.</p>
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, <code>calib.cfg</code> , supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.	Axis Calibration or manual calibration <sup>i</sup>

<sup>i</sup> The robot is calibrated by either manual calibration 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, manual calibration is used as default.

---

#### Brief description of calibration methods

##### Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 120. 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

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 229](#).

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.

##### Manual calibration method

Manual calibration method is a method based on releasing the motor brakes of the robot and manually moving the robot into a calibration position. The manual calibration is using the manual methods for fine calibration and updating revolution counters. See [Calibrating with manual calibration method on page 234](#).

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#### References

Article numbers for the calibration tools are listed in the section [Special tools on page 253](#).

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### 5.1.3 When to calibrate

#### When to calibrate

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

#### The resolver values are changed

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

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 225](#). This will occur when:

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

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

#### The robot is rebuilt

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

#### Robot is not floor mounted

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

## 5 Calibration

### 5.2.1 Synchronization marks and synchronization position for axes

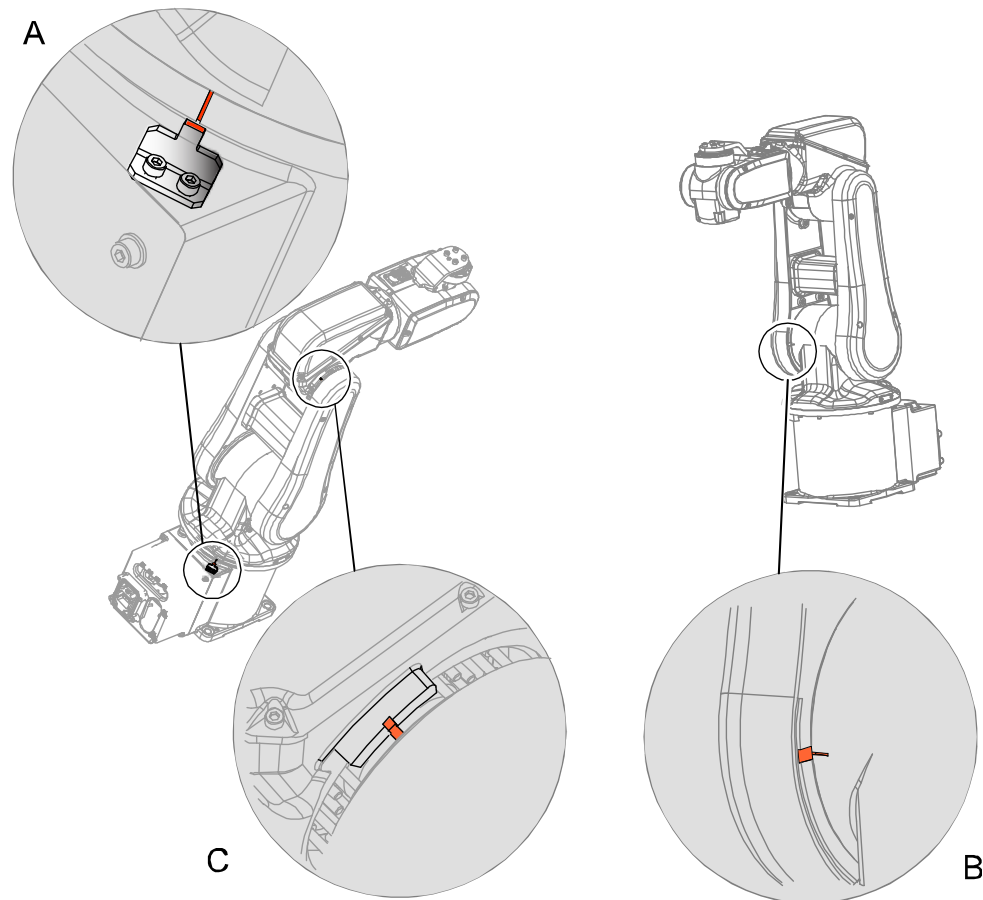
## 5.2 Synchronization marks and axis movement directions

### 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 120



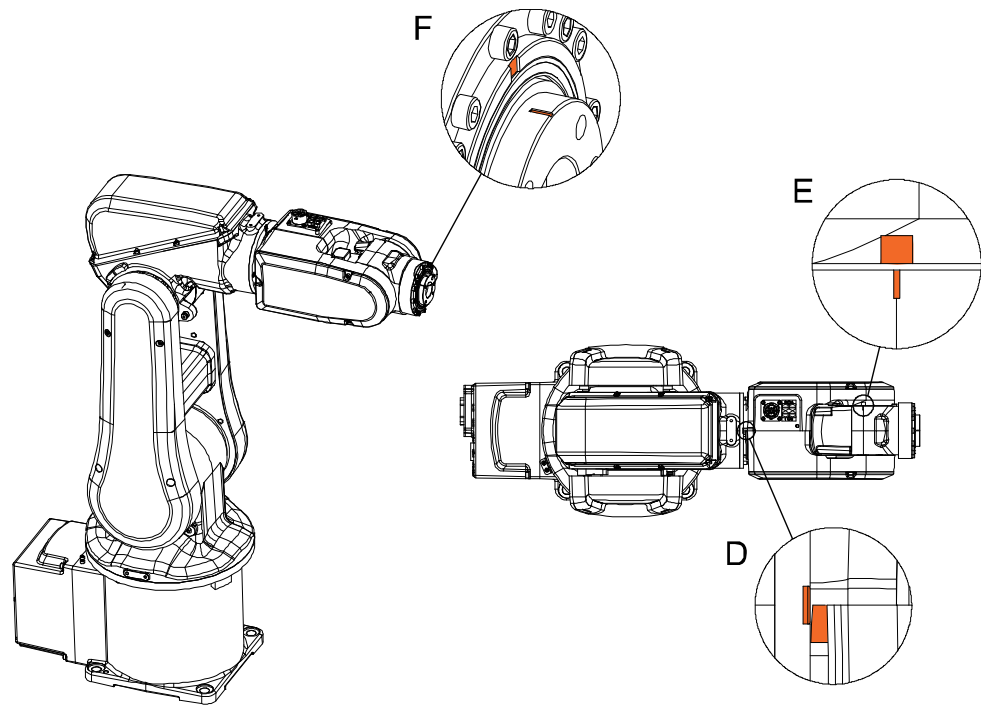
xx0900000574

A	Calibration mark axis 1
B	Calibration mark axis 2
C	Calibration mark axis 3

*Continues on next page*

5.2.1 Synchronization marks and synchronization position for axes

*Continued*



xx0900000575

D	Calibration marks axis 4
E	Calibration marks axis 5
F	Calibration marks axis 6

## 5 Calibration

### 5.2.2 Calibration movement directions for all axes

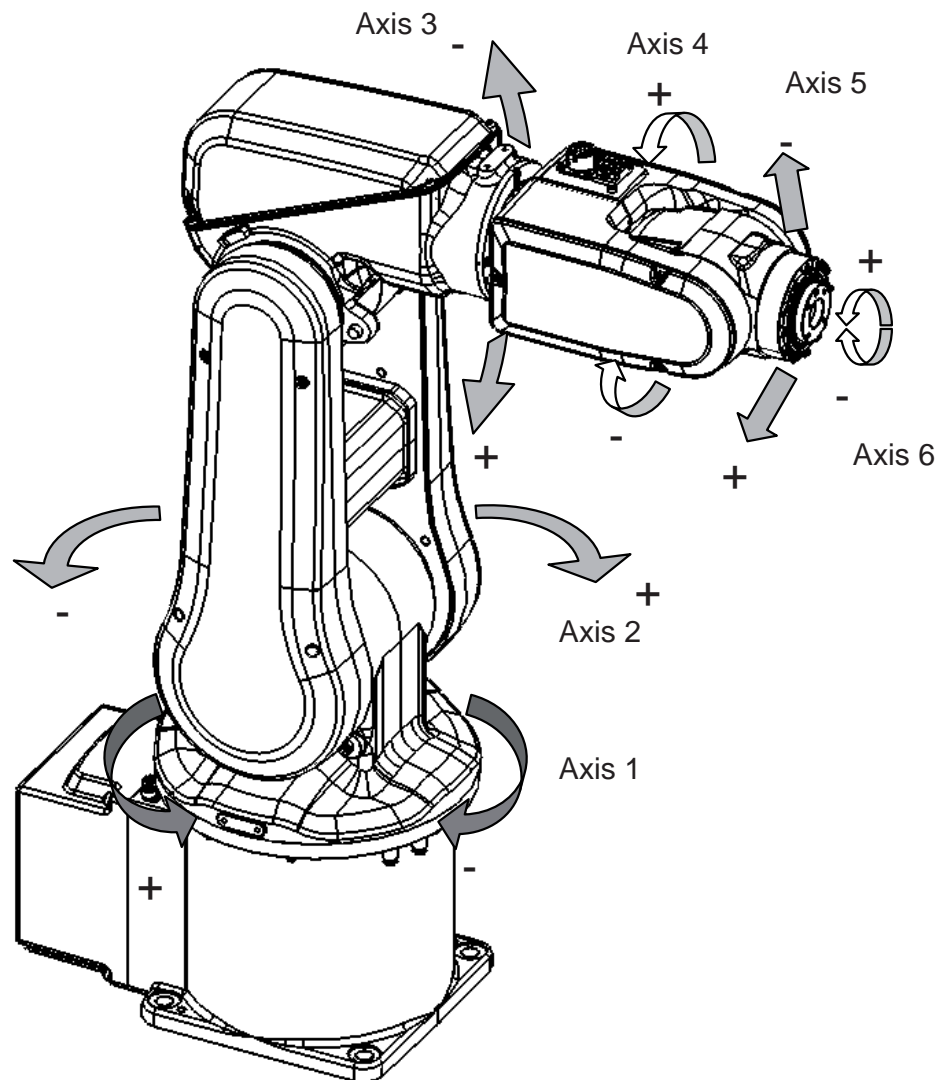
### 5.2.2 Calibration movement directions for all axes

#### 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



xx090000262

## 5.3 Updating revolution counters

### 5.3.1 Updating revolution counters on IRC5 robots

#### Introduction

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

#### Step 1 - Manually running the manipulator to the synchronization position

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

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See <a href="#">Synchronization marks and synchronization position for axes on page 222</a> .
3	When all axes are positioned, update the revolution counter.	<a href="#">Step 2 - Updating the revolution counter with the FlexPendant on page 226</a> .

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

Manipulator variant	Axis 4	Axis 6
IRB 120	No	Yes

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

*Continues on next page*

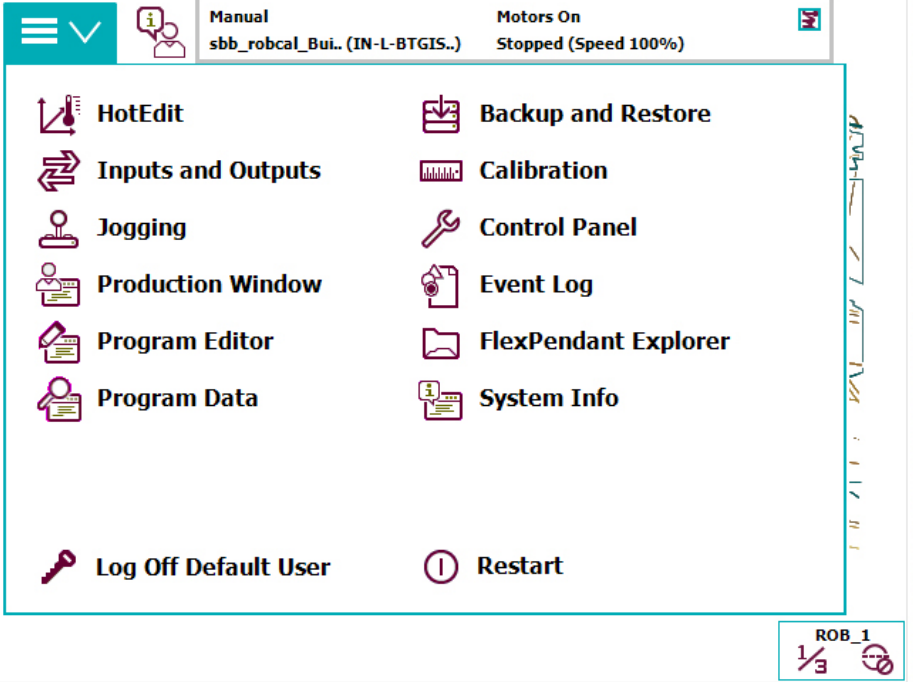
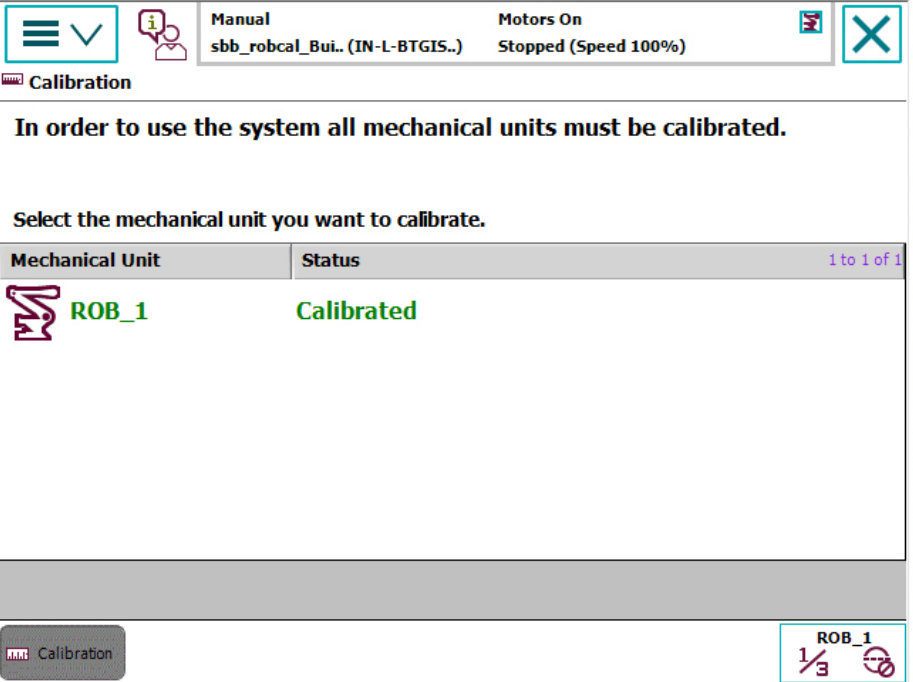
## 5 Calibration

### 5.3.1 Updating revolution counters on IRC5 robots

Continued

#### Step 2 - Updating the revolution counter with the FlexPendant

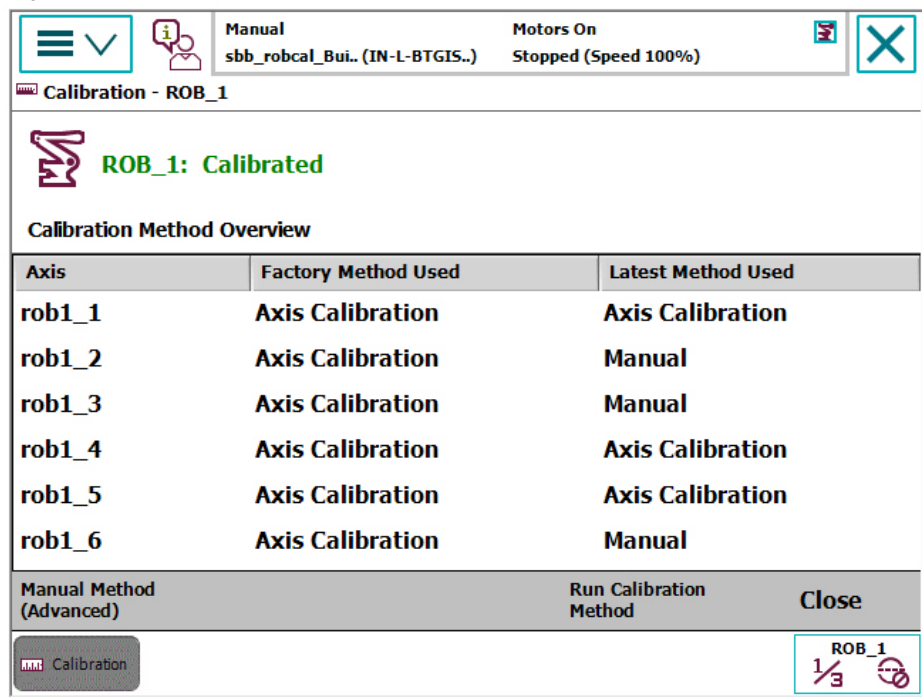
Use this procedure to update the revolution counter with the FlexPendant (IRC5).

	Action
1	<p>On the <b>ABB</b> menu, tap <b>Calibration</b>.</p>  <p>The screenshot shows the ABB FlexPendant menu. At the top, there is a status bar with 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below this is a grid of menu items: HotEdit, Backup and Restore, Inputs and Outputs, Calibration, Jogging, Control Panel, Production Window, Event Log, Program Editor, FlexPendant Explorer, Program Data, System Info, Log Off Default User, and Restart. The 'Calibration' option is highlighted with a red box. At the bottom right, there is a 'ROB_1' status indicator.</p> <p>xx150000942</p>
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. At the top, there is a status bar with 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below this is a title bar 'Calibration' and a message: 'In order to use the system all mechanical units must be calibrated.' Below the message is a prompt: 'Select the mechanical unit you want to calibrate.' Below the prompt is a table with two columns: 'Mechanical Unit' and 'Status'. The table has one row: 'ROB_1' with status 'Calibrated'. At the bottom right, there is a 'ROB_1' status indicator.</p> <p>xx150000943</p>

Continues on next page

**Action**

3 This step is valid for RobotWare 6.02 and later.  
 Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration.  
 Tap **Manual Method (Advanced)**.



Manual sbb\_robcal\_Bui.. (IN-L-BTGIS..) Motors On Stopped (Speed 100%)

Calibration - ROB\_1

**ROB\_1: Calibrated**

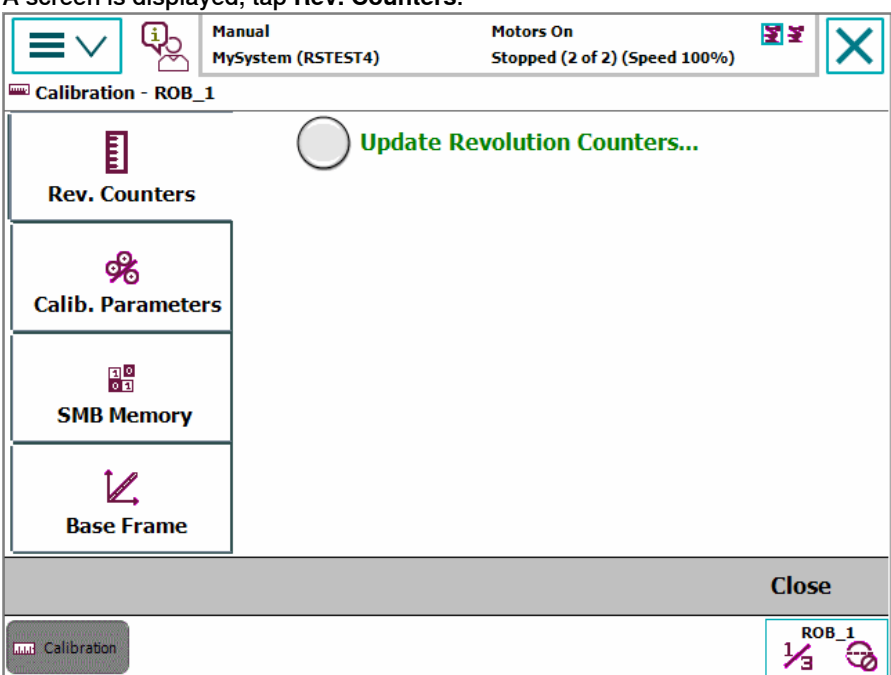
Calibration Method Overview

Axis	Factory Method Used	Latest Method Used
rob1_1	Axis Calibration	Axis Calibration
rob1_2	Axis Calibration	Manual
rob1_3	Axis Calibration	Manual
rob1_4	Axis Calibration	Axis Calibration
rob1_5	Axis Calibration	Axis Calibration
rob1_6	Axis Calibration	Manual

Manual Method (Advanced) Run Calibration Method Close

xx1500000944

4 A screen is displayed, tap **Rev. Counters**.



Manual MySystem (RSTEST4) Motors On Stopped (2 of 2) (Speed 100%)

Calibration - ROB\_1

**Update Revolution Counters...**

Rev. Counters

Calib. Parameters

SMB Memory

Base Frame

Close


en0400000771

Continues on next page

## 5 Calibration

### 5.3.1 Updating revolution counters on IRC5 robots

*Continued*

	Action
5	<p>Tap <b>Update Revolution Counters...</b></p> <p>A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions:</p> <ul style="list-style-type: none"><li>• Tap <b>Yes</b> to update the revolution counters.</li><li>• Tap <b>No</b> to cancel updating the revolution counters.</li></ul> <p>Tapping <b>Yes</b> displays the axis selection window.</p>
6	<p>Select the axis to have its revolution counter updated by:</p> <ul style="list-style-type: none"><li>• Ticking in the box to the left</li><li>• Tapping <b>Select all</b> to update all axes.</li></ul> <p>Then tap <b>Update</b>.</p>
7	<p>A dialog box is displayed, warning that the updating operation cannot be undone:</p> <ul style="list-style-type: none"><li>• Tap <b>Update</b> to proceed with updating the revolution counters.</li><li>• Tap <b>Cancel</b> to cancel updating the revolution counters.</li></ul> <p>Tapping <b>Update</b> updates the selected revolution counters and removes the tick from the list of axes.</p>
8	<p> <b>CAUTION</b></p> <p>If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury!</p> <p>Check the synchronization position very carefully after each update. See <a href="#">Checking the synchronization position on page 241</a>.</p>



## 5.4 Calibrating with Axis Calibration method

### 5.4.1 Description of Axis Calibration

---

#### Instructions for Axis Calibration procedure given on the FlexPendant

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

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

---

#### Overview of the Axis Calibration procedure

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

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

The Axis Calibration procedure described roughly:

- 1 The calibration tool/element is prepared by the operator. Any protection needs to be removed prior to starting calibration.
- 2 During the calibration procedure, RobotWare moves the robot axis chosen for calibration so that the calibration tools get into contact. RobotWare records values of the axis position and repeats the coming-in-contact procedure several times to get an exact value of the axis position.



#### WARNING

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

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

---

#### 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.

##### Update revolution counters

Choose this routine to make a rough calibration of each manipulator axis by updating the revolution counter for each axis, using the FlexPendant.

##### Validation

In the mentioned routines, it is also possible to validate the calibration data.

*Continues on next page*

## 5 Calibration

### 5.4.1 Description of Axis Calibration

*Continued*

#### Position of robot axes

The robot axes should be positioned close to 0 degrees before commencing the calibration program. The axis chosen for calibration is then automatically run by the calibration program to its exact calibration position during the calibration procedure.

It is possible to position some of the other axes in positions different from 0 degrees. Information about which axes are allowed to be jogged is given on the FlexPendant. These axes are marked with **Unrestricted** in the FlexPendant window. Also the following table shows the dependencies between the axes.

#### Requirements for axis positioning during calibration

Required position of axis	Axis to calibrate					
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
Axis 1	-	*	*	*	*	*
Axis 2	0	-	0	*	*	*
Axis 3	0	X	-	*	*	*
Axis 4	*	*	*	-	*	*
Axis 5	*	*	*	*	-	X
Axis 6	*	*	*	*	X	-

-	Axis to be calibrated
*	Unrestricted. Axis is allowed to be jogged to other position than 0 degrees.
0	Axis must be put in position 0 degrees.
X	Special requirement

#### How to calibrate a suspended or wall mounted robot

The IRB 120 is fine calibrated floor standing in factory, prior to shipping.

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.

## 5.4.2 Axis Calibration - Running the calibration procedure

### Required tools

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance and durability.



#### 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 set	3HAC037305-001	Includes: <ul style="list-style-type: none"> <li>• Calibration tool axes 5 and 6</li> <li>• Attachment screws M5x12 quality Steel 8.8-A2F (4 pcs)</li> <li>• Guide pin</li> </ul>

### Required consumables

Consumable	Article number	Note
Clean cloth	-	

### Spare parts

Spare part	Article number	Note
N/A		

### Overview of the calibration procedure on the FlexPendant

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

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

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

- 1 Choose calibration routine. The routines are described in [Routines in the calibration procedure on page 229](#).
- 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.

Axes 1, 2 and 3 are fitted with dampers that need to be removed.

*Continues on next page*

## 5 Calibration

### 5.4.2 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.  
Refit the dampers on axes 1, 2 and 3.
- 9 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	 <b>DANGER</b> While conducting the calibration, the robot needs to be connected to power. Make sure that the robot's working area is empty, as the robot can make unpredictable movements.	
2	Wipe the calibration tool clean.  <b>Note</b> The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.

#### Starting the calibration procedure

Use this procedure to start the Axis Calibration routine on the FlexPendant.

	Action	Note
1	Tap the calibration icon and enter the calibration main page.	
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.	
3	The calibration method used at ABB factory for each axis is shown, as well as calibration method used for the robot during last field calibration.	The FlexPendant will give all information needed to proceed with Axis Calibration.
4	<b>Valid for RobotWare 6</b> Tap <b>Call Calibration Method</b> . The software will automatically call for the procedure for the valid calibration method. If not, tap <b>Call Routine</b> and then tap <b>Axis calibration</b> .	
5	Follow the instructions given on the FlexPendant.	A brief overview of the sequence that will be run on the FlexPendant is given in <a href="#">Overview of the calibration procedure on the FlexPendant on page 231</a> .

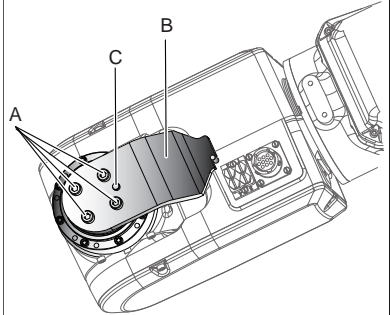
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**Restarting an interrupted calibration procedure**

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 <b>Play</b> .
The RobotWare program is terminated with <b>PP to Main</b> .	Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See <i>Starting the calibration procedure</i> .  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 <a href="#">Calibration movement directions for all axes on page 224</a>

**After calibration**

	Action	Note
1	Check that all dampers are refitted on axes 1, 2 and 3.	
2	Remove the tool on axis 6.	 <p>xx1000000005</p> <p>Parts:  <b>A</b> Attachment screws (4 pcs)  <b>B</b> Calibration tool  <b>C</b> Guide pin</p>

## 5 Calibration

### 5.5 Calibrating with manual calibration method

### 5.5 Calibrating with manual calibration method

#### Introduction

This section describes how to calibrate the robot manually and how to use the calibration pins when calibrating.



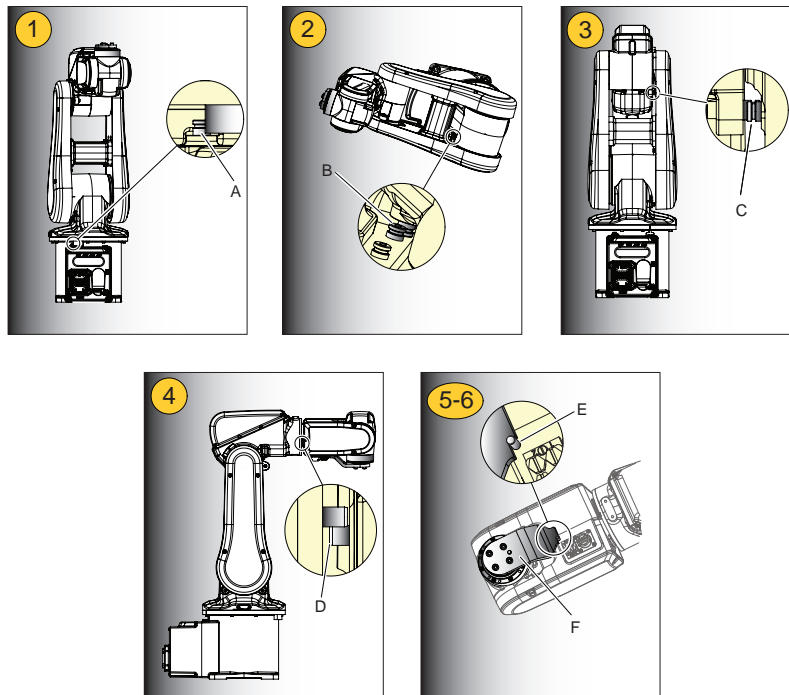
#### Note

Calibration can be done in the following ways:

- axis 1, 2 and 3 at the same time using the FlexPendant
- axis 4, 5 and 6 at the same time using the FlexPendant
- each axis separately.

#### Location of calibration pins

The figure shows the position of the calibration pins on axes 1 - 6.



xx0900000627

1	Calibration, axis 1. (Rotate axis 1 -170.2°)
A	Calibration pins, axis 1
2	Calibration, axis 2. (Rotate axis 2 -115.1°)
B	Calibration pins, axis 2
3	Calibration, axis 3. (Rotate axis 3 75.8°)
C	Calibration pins, axis 3
4	Calibration, axis 4. (Rotate axis 4 -174.7°)
D	Calibration pins, axis 4
5-6	Calibration, axis 5-6. (Rotate axis 5 -90° and axis 6 90°)

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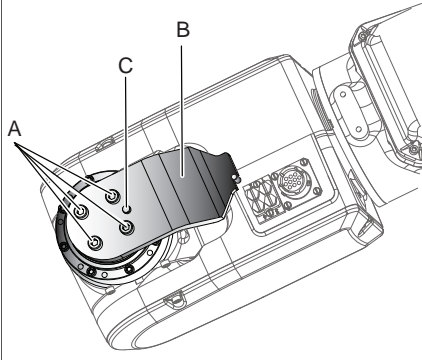
E	Calibration pin, axis 5-6
F	Calibration tool, axis 5-6

#### Required equipment

Equipment	Note
Standard toolkit	The content is defined in the section <a href="#">Standard toolkit on page 252</a> .
Calibration tool set	3HAC037305-001 Includes: <ul style="list-style-type: none"> <li>• Calibration tool axes 5 and 6</li> <li>• Attachment screws M5x12 quality Steel 8.8-A2F (4 pcs)</li> <li>• Guide pin</li> </ul>

#### Calibration using the FlexPendant

This procedure describes how to calibrate the robot using the FlexPendant.

	Action	Note
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Remove all dampers from the <i>calibration pins</i> .	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
3	Fit the <i>calibration tool</i> on axis 6.	 <p>xx1000000005</p> <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Attachment screws (4 pcs)</li> <li>• B: Calibration tool</li> <li>• C: Guide pin</li> </ul>
4	Release the brakes.	How to release the brakes see section: <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 55</a></li> </ul>
5	Rotate axes 4, 5 and 6 manually until the two calibration pins of each axis are in contact with each other.	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
6	Choose <b>fine calibration</b> from <b>Calib</b> menu.	
7	Choose <b>Calibrate</b> on the FlexPendant.	

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## 5 Calibration


### 5.5 Calibrating with manual calibration method

Continued

	Action	Note
8	Choose axes 4, 5 and 6 on the FlexPendant and Calibrate.	
9	After calibration is done, use the FlexPendant to jog each axis to zero degree.	
10	Rotate axes 1, 2 and 3 manually until the two calibration pins of each axis are in contact with each other.	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
11	Choose fine calibration from Calib menu.	
12	Choose axes 1, 2 and 3 on the FlexPendant and Calibrate.	
13	The <i>synchronisation marks</i> on each axis shall now be matched.	See section <ul style="list-style-type: none"> <li>• <a href="#">Synchronization marks and synchronization position for axes on page 222</a></li> </ul>
14	Choose <i>Update Revolution counters</i> from the Calib menu.	
15	Choose Axis 1 to 6 on the FlexPendant and update the revoultion counters.	

#### Calibration of axis 1 separately

Use this procedure when calibrating axis 1 separately.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Remove the dampers from the <i>calibration pins</i> .	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
3	Release the brakes.	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 55</a></li> </ul>
4	Rotate axis 1 manually until the two <i>calibration pins</i> are in contact with each other.	See figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
5	Choose fine calibration from Calib menu.	
6	Choose Calibrate on the the FlexPendant.	
7	Choose axis 1 on the FlexPendant and Calibrate.	
8	After calibration is done use the FlexPendant to jog each axis to zero degree.	
9	The <i>synchronisation marks</i> on axis 1 shall now be matched.	See section <ul style="list-style-type: none"> <li>• <a href="#">Synchronization marks and synchronization position for axes on page 222</a></li> </ul>
10	Choose <i>Update Revolution counters</i> from the Calib menu.	


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	Action	Information
11	Choose <i>Axis 1</i> on the FlexPendant and <b>update the revoultion counters.</b>	


### Calibration of axis 2 separately

Use this procedure when calibrating axis 2 separately.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Remove the dampers from the <i>calibration pins</i> .	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
3	Release the brakes.	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 55</a></li> </ul>
4	Rotate axis 2 manually until the two <i>calibration pins</i> are in contact with each other.	See figure 2 in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
5	Choose fine calibration from Calib menu.	
6	Choose Calibrate on the the FlexPendant.	
7	After calibration is done use the FlexPendant to jog each axis to zero degree.	
8	The <i>synchronisation marks</i> on axis 2 shall now be matched	See section <ul style="list-style-type: none"> <li>• <a href="#">Synchronization marks and synchronization position for axes on page 222</a></li> </ul>
9	Choose <i>Update Revolution counters</i> from the <i>Calib menu</i> .	
10	Choose <i>Axis 2</i> on the FlexPendant and <b>update the revoultion counters.</b>	

### Calibration of axis 3 separately

Use this procedure when calibrating axis 3 separately.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Remove the dampers from the <i>calibration pins</i> .	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
3	Release the brakes.	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 55</a></li> </ul>

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## 5 Calibration


### 5.5 Calibrating with manual calibration method

Continued

	Action	Information
4	Rotate axis 3 manually until the two <i>calibration pins</i> are in contact with each other.	See figure 3 in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
5	Choose fine calibration from Calib menu.	
6	Choose Calibrate on the the FlexPendant.	
7	After calibration is done use the FlexPendant to jog each axis to zero degree.	
8	The <i>synchronisation marks</i> on axis 3 shall now be matched.	See section <ul style="list-style-type: none"> <li>• <a href="#">Synchronization marks and synchronization position for axes on page 222</a></li> </ul>
9	Choose <i>Update Revolution counters</i> from the <i>Calib menu</i> .	
10	Choose <i>Axis 3</i> on the FlexPendant and <b>update the revoultion counters.</b>	

### Calibration of axis 4 separately


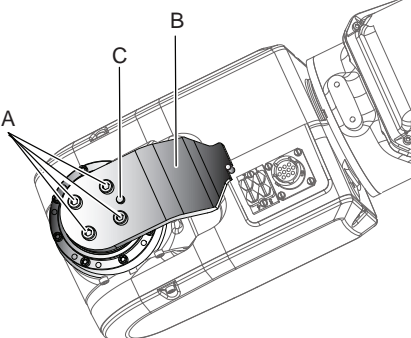
Use this procedure when calibrating axis 4 separately.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Release the brakes.	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 55</a></li> </ul>
3	Rotate axis 4 manually until the two <i>calibration pins</i> are in contact with each other.	See the figure 4 in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
4	Choose fine calibration from Calib menu.	
5	Choose Calibrate on the the FlexPendant.	
6	After calibration is done use the FlexPendant to jog each axis to zero degree	
7	The <i>synchronisation marks</i> on axis 4 shall now be matched.	See section <ul style="list-style-type: none"> <li>• <a href="#">Synchronization marks and synchronization position for axes on page 222</a></li> </ul>
8	Choose <i>Update Revolution counters</i> from the <i>Calib menu</i> .	
9	Choose <i>Axis 4</i> on the FlexPendant and <b>update the revoultion counters.</b>	

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## Calibration of axes 5 and 6 using the calibration tool

Use this procedure when calibrating axes 5 and 6 separately.

	Action	Information
1	 <b>DANGER</b> Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	Fit the <i>calibration tool</i> on the wrist with its <i>attachment screws</i> .	 <p>xx100000005</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (4 pcs)</li> <li>• B: Calibration tool</li> <li>• C: Guide pin</li> </ul>
3	Release the brakes.	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 55</a></li> </ul>
4	Rotate axes 5 and 6 manually until the <i>calibration pin</i> on the wrist and the <i>fork</i> of the tool are in contact with each other.	See figure 5-6 in: <ul style="list-style-type: none"> <li>• <a href="#">Location of calibration pins on page 234</a></li> </ul>
5	Choose fine calibration from Calib menu.	
6	Choose Calibrate on the the FlexPendant.	
7	After calibration is done use the FlexPendant to jog each axis to zero degree.	
8	The <i>synchronisation marks</i> on axes 5 and 6 shall now be matched.	See section <ul style="list-style-type: none"> <li>• <a href="#">Synchronization marks and synchronization position for axes on page 222</a></li> </ul>
9	Choose <i>Update Revolution counters</i> from the <i>Calib menu</i> .	
10	Choose <i>Axis 5 to 6</i> on the FlexPendant and <b>update the revoultion counters</b> .	

## 5 Calibration

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### 5.6 Verifying the calibration

### 5.6 Verifying the calibration

---

#### Introduction

Always verify the results after calibrating *any* robot axis to verify that all calibration positions are correct.

---

#### Verifying the calibration

Use this procedure to verify the calibration result.

	Action	Note
1	Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See <a href="#">Checking the synchronization position on page 241</a> .
2	Adjust the <i>synchronization marks</i> when the calibration is done, if necessary.	This is detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 222</a> .
3	Write down the values on a new label and stick it on top of the calibration label. xx	

## 5.7 Checking the synchronization position

### Introduction

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

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

### 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 <b>Program editor</b> .	
2	Create a new program.	
3	Use <b>MoveAbsJ</b> in the <b>Motion&amp;Proc</b> 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 <a href="#">Synchronization marks and synchronization position for axes on page 222</a> and <a href="#">Updating revolution counters on page 225</a> .

### Using the jogging window

Use this procedure to jog the robot to the synchronization position of all axes.

	Action	Note
1	On the <b>ABB</b> menu, tap <b>Jogging</b> .	
2	Tap <b>Motion mode</b> 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 <a href="#">Synchronization marks and synchronization position for axes on page 222</a> and <a href="#">Updating revolution counters on page 225</a> .

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# 6 Decommissioning

## 6.1 Introduction to decommissioning

### Introduction

This section contains information to consider when taking a product, robot or controller, out of operation.

It deals with how to handle potentially dangerous components and potentially hazardous materials.



#### Note

The decommissioning process shall be preceded by a risk assessment.

### General

All used grease/oils and dead batteries **must** be disposed of in accordance with the current legislation of the country in which the robot and the control unit are installed.

If the robot or the control unit is partially or completely disposed of, the various parts **must** be grouped together according to their nature (which is all iron together and all plastic together), and disposed of accordingly. These parts **must** also be disposed of in accordance with the current legislation of the country in which the robot and control unit are installed.

## 6 Decommissioning

### 6.2 Environmental information

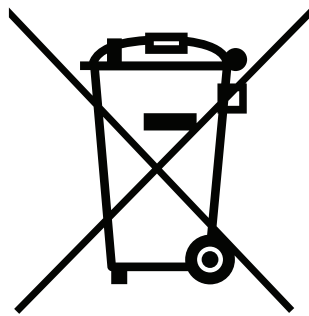
## 6.2 Environmental information

### Introduction

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

### Symbol

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



xx180000058

### Materials used in the product

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

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

Material	Example application
Aluminium	Structure
Batteries, Lithium	Encoder Interface Board
Cast iron/nodular iron	Upper arm
Copper	Cables, motors
Neodymium	Brakes, motors
Oil, grease	Gearboxes
Plastic/rubber	Cables, connectors, drive belts, covers, and so on.
Steel	Gears, screws, shafts, brackets, and so on.

*Continues on next page*



#### Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

- Spills can form a film on water surfaces causing damage to organisms. Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

## 6 Decommissioning

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### 6.3 Scrapping of robot

### 6.3 Scrapping of robot



#### Note

The decommissioning process shall be preceded by a risk assessment.

---

#### Important when scrapping the robot



#### DANGER

The risk assessment should consider hazards arising in the decommissioning, such as, but not limited to:

- Always remove all batteries. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.
- A used robot does not have the same performance as on delivery. Springs, brakes, bearings, and other parts might be worn or broken.

# 7 Reference information

## 7.1 Introduction

---

### General

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

## 7 Reference information

### 7.2 Applicable standards

### 7.2 Applicable standards



#### Note

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

#### General

The product is designed in accordance with ISO 10218-1:2011, Robots for industrial environments - Safety requirements -Part 1 Robots, and applicable parts in the normative references, as referred to from ISO 10218-1:2011. In case of deviations from ISO 10218-1:2011, these are listed in the declaration of incorporation which is part of the product delivery.

#### Normative standards as referred to from ISO 10218-1

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

#### Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13732-1:2006	Ergonomics of the thermal environment - Part 1
IEC 60974-1:2012 <sup>i</sup>	Arc welding equipment - Part 1: Welding power sources
IEC 60974-10:2014 <sup>j</sup>	Arc welding equipment - Part 10: EMC requirements
ISO 14644-1:2015 <sup>ii</sup>	Classification of air cleanliness
IEC 60529:1989 + A2:2013	Degrees of protection provided by enclosures (IP code)

<sup>i</sup> Only valid for arc welding robots. Replaces IEC 61000-6-4 for arc welding robots.

<sup>ii</sup> Only robots with protection Clean Room.

## 7.3 Unit conversion

### Converter table

Use the following table to convert units used in this manual.

Quantity	Units		
Length	1 m	3.28 ft.	39.37 in
Weight	1 kg	2.21 lb.	
Weight	1 g	0.035 ounces	
Pressure	1 bar	100 kPa	14.5 psi
Force	1 N	0.225 lbf	
Moment	1 Nm	0.738 lbf-ft	
Volume	1 L	0.264 US gal	

## 7 Reference information

### 7.4 Screw joints

### 7.4 Screw joints

#### General

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

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

#### UNBRAKO screws

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

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

#### Gleitmo treated screws

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

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

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

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

#### Screws lubricated in other ways

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

In such cases, proceed as follows:

- 1 Apply lubricant to the screw thread.
- 2 Apply lubricant between the plain washer and screw head.
- 3 Tighten to the torque as described in the procedures.

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

## 7.5 Weight specifications


### Definition

In installation, repair, and maintenance procedures, weights of the components handled are sometimes specified. All components exceeding 22 kg (50 lbs) are highlighted in this way.

To avoid injury, ABB recommends the use of a lifting accessory when handling components with a weight exceeding 22 kg. A wide range of lifting accessories and devices are available for each manipulator model.

### Example

Following is an example of a weight specification in a procedure:

Action	Note
 <b>CAUTION</b> The arm weighs 25 kg. All lifting accessories used must be sized accordingly.	

## 7 Reference information

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### 7.6 Standard toolkit

### 7.6 Standard toolkit

---

#### General

All service (repairs, maintenance, and installation) procedures contains lists of tools required to perform the specified activity.

All special tools required are listed directly in the procedures while all the tools that are considered standard are gathered in the standard toolkit and defined in the following table.

This way, the tools required are the sum of the standard toolkit and any tools listed in the instruction.

---

#### Contents, standard toolkit

Qty	Tool
1	Socket head cap 2.5-17 mm
1	Torque wrench 0.5-10 Nm
1	Small screwdriver
1	Plastic mallet
1	Ratchet head for torque wrench 1/2
1	Socket head cap no. 2.5, socket 1/2" bit L 110 mm
1	Small cutting plier
1	T-handle with ball head



## 7.7 Special tools

### General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section [Standard toolkit on page 252](#), and of special tools, listed directly in the instructions and also gathered in this section.

### Calibration tool set

The following table specifies the calibration equipment needed when calibrating axes 5 and 6 of the robot.

Equipment, etc.	Article number	Note
Calibration tool set	3HAC037305-001	Includes: <ul style="list-style-type: none"> <li>• Calibration tool axes 5 and 6</li> <li>• Attachment screws M5x12 quality Steel 8.8-A2F (4 pcs)</li> <li>• Guide pin</li> </ul>

### Lifting tool set

The following table specifies the lifting tool set needed when lifting the complete robot.

Description	Art. no.	Note
Lifting tool set	3HAC037304-001	Includes: <ul style="list-style-type: none"> <li>• Bracket</li> <li>• Attachment screws (wrist) M5x12 quality steel 8.8-A2F (2 pcs)</li> <li>• Spring washers, conical (wrist) 5.3x11x1.2 quality Steel-mZn12c (2 pcs)</li> <li>• Attachment screws DIN912 (swing housing) M4x8 quality Steel 8.8-ELZN (2 pcs)</li> <li>• Conical spring washers 4 mm (swing housing) 4.3x9x1.3 quality Steel-MZn12C (2 pcs)</li> </ul>

## 7 Reference information

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### 7.8 Lifting equipment and lifting instructions

### 7.8 Lifting equipment and lifting instructions

---

#### General

Many repair and maintenance activities require different pieces of lifting equipment, which are specified in each procedure.

The use of each piece of lifting equipment is *not* detailed in the activity procedure, but in the instruction delivered with each piece of lifting equipment.

This implies that the instructions delivered with the lifting equipment should be stored for later reference.

## 8 Spare parts

### 8.1 Spare part lists and illustrations

#### Location

Spare parts and exploded views are not included in the manual but delivered as a separate document for registered users on myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).



#### Tip

All documents can be found via myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).

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## 9 Circuit diagrams

### 9.1 Circuit diagrams

#### Overview

The circuit diagrams are not included in this manual, but are available for registered users on myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).

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 - Euromap 67, design 14</i>	<i>3HAC024120-005</i>
<i>Circuit diagram - Spot welding cabinet</i>	<i>3HAC057185-001</i>

#### Manipulators

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 6620</i>	<i>3HAC025090-001</i>
<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>

*Continues on next page*

## 9 Circuit diagrams

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### 9.1 Circuit diagrams

*Continued*

<b>Product</b>	<b>Article numbers for circuit diagrams</b>
<i>Circuit diagram - IRB 6700 / IRB 6790</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>
<i>Circuit diagram - IRB 910SC</i>	<i>3HAC056159-002</i>

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