



# Product manual

## IRB 6640 Foundry Prime

**Trace back information:**

**Workspace R17-1 version a7**

**Checked in 2017-03-22**

**Skribenta version 5.1.011**

**Product manual**

**IRB 6640 Foundry Prime - 235/2.55  
IRB 6640 Foundry Prime - 185/2.8**

**IRC5**

**Document ID: 3HAC040586-001**

**Revision: L**

The information in this manual is subject to change without notice and should not be construed as a commitment by ABB. ABB assumes no responsibility for any errors that may appear in this manual.

Except as may be expressly stated anywhere in this manual, nothing herein shall be construed as any kind of guarantee or warranty by ABB for losses, damages to persons or property, fitness for a specific purpose or the like.

In no event shall ABB be liable for incidental or consequential damages arising from use of this manual and products described herein.

This manual and parts thereof must not be reproduced or copied without ABB's written permission.

Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

© Copyright 20112017 ABB. All rights reserved.

ABB AB, Robotics  
Robotics and Motion  
Se-721 68 Västerås  
Sweden

# Table of contents

Overview of this manual .....	9
Product documentation, IRC5 .....	13
How to read the product manual .....	15
Important information about robots with protection type Foundry Prime .....	16
<b>1 Safety</b>	<b>17</b>
1.1 Introduction to safety information .....	17
1.2 General safety information .....	18
1.2.1 Introduction to general safety information .....	18
1.2.2 Safety in the manipulator system .....	19
1.2.3 Protective stop and emergency stop .....	21
1.2.4 Safety risks .....	22
1.2.4.1 Safety risks during installation and service work on robots .....	22
1.2.4.2 CAUTION - Hot parts may cause burns! .....	25
1.2.4.3 Safety risks related to tools/work pieces .....	26
1.2.4.4 Safety risks related to pneumatic/hydraulic systems .....	27
1.2.4.5 Safety risks during operational disturbances .....	28
1.2.4.6 Risks associated with live electric parts .....	29
1.2.5 Safety actions .....	31
1.2.5.1 Safety fence dimensions .....	31
1.2.5.2 Fire extinguishing .....	32
1.2.5.3 Emergency release of the robot arm .....	33
1.2.5.4 Brake testing .....	34
1.2.5.5 Risk of disabling function "Reduced speed 250 mm/s" .....	35
1.2.5.6 Safe use of the jogging device .....	36
1.2.5.7 Work inside the working range of the robot .....	37
1.2.5.8 Signal lamp (optional) .....	38
1.3 Safety signals and symbols .....	39
1.3.1 Safety signals in the manual .....	39
1.3.2 Safety symbols on product labels .....	41
1.4 Safety related instructions .....	47
1.4.1 DANGER - Moving robots are potentially lethal! .....	47
1.4.2 DANGER - First test run may cause injury or damage! .....	48
1.4.3 WARNING - The brake release buttons may be jammed after service work .....	49
1.4.4 DANGER - Make sure that the main power has been switched off! .....	50
1.4.5 WARNING - The unit is sensitive to ESD! .....	52
1.4.6 WARNING - Safety risks during handling of batteries .....	54
1.4.7 WARNING - Safety risks during work with gearbox lubricants (oil or grease) .....	55
<b>2 Installation and commissioning</b>	<b>57</b>
2.1 Introduction .....	57
2.2 Installation and operational requirements for Foundry Prime robots .....	58
2.3 Design 1 and Design 2 of IRB 6640 .....	62
2.4 Robot transportation precautions .....	64
2.5 Securing the robot with a transport support .....	68
2.6 Unpacking .....	70
2.6.1 Pre-installation procedure .....	70
2.6.2 Working range and type of motion .....	73
2.6.3 Risk of tipping/stability .....	76
2.7 On-site installation .....	77
2.7.1 Lifting the robot with fork lift accessory .....	77
2.7.1.1 Fitting the fork lift accessory .....	77
2.7.1.2 Lifting the robot with fork lift truck .....	80
2.7.2 Lifting robot with roundslings .....	83
2.7.3 Manually releasing the brakes .....	85
2.7.4 Lifting the base plate .....	87

## Table of contents

---

2.7.5	Securing the base plate .....	88
2.7.6	Orienting and securing the robot .....	93
2.7.7	Fitting equipment on robot .....	96
2.7.8	Surface inspection before start-up - Foundry Prime .....	102
2.7.9	Loads fitted to the robot, stopping time and braking distances .....	103
2.7.10	Installation of signal lamp (option) .....	104
2.8	Restricting the working range .....	105
2.8.1	Axes with restricted working range .....	105
2.8.2	Mechanically restricting the working range of axis 1 .....	106
2.8.3	Mechanically restricting the working range of axis 2 .....	108
2.8.4	Mechanically restricting the working range of axis 3 .....	110
2.9	Electrical connections .....	113
2.9.1	Robot cabling and connection points .....	113
<b>3</b>	<b>Maintenance</b>	<b>115</b>
3.1	Introduction for Foundry Prime robots .....	115
3.2	Maintenance schedule and expected component life .....	117
3.2.1	Specification of maintenance intervals .....	117
3.2.2	Maintenance schedule .....	118
3.2.3	Expected component life .....	121
3.3	Inspection activities .....	123
3.3.1	Inspecting the oil level in axis-1 gearbox .....	123
3.3.2	Inspecting the oil level in axis-2 gearbox .....	125
3.3.3	Inspecting the oil level in axis-3 gearbox .....	127
3.3.4	Inspecting the oil level in axis-4 gearbox .....	130
3.3.5	Inspecting the oil level in axis-5 gearbox .....	132
3.3.6	Inspecting the oil level in axis-6 gearbox .....	135
3.3.7	Inspecting the balancing device .....	140
3.3.8	Inspecting the cable harness .....	146
3.3.9	Inspection of air hoses (Foundry Prime) .....	151
3.3.10	Inspection of surface treatment (Foundry Prime) .....	152
3.3.11	Inspecting the information labels .....	153
3.3.12	Inspecting the axis-1 mechanical stop pin .....	155
3.3.13	Inspecting the additional mechanical stops .....	157
3.3.14	Inspecting the damper on axes 2-5 .....	160
3.3.15	Inspecting the signal lamp (option) .....	162
3.4	Changing activities .....	164
3.4.1	Type of lubrication in gearboxes .....	164
3.4.2	Changing oil, axis-1 gearbox .....	166
3.4.3	Changing oil, axis-2 gearbox .....	169
3.4.4	Changing oil, axis-3 gearbox .....	172
3.4.5	Changing oil, axis-4 gearbox .....	175
3.4.6	Changing oil, axis-5 gearbox .....	178
3.4.7	Changing oil, axis-6 gearbox .....	181
3.4.8	Replacing the SMB battery .....	184
3.5	Analysis activities .....	188
3.5.1	Analysing the water content in gearbox oil .....	188
3.6	Lubrication activities .....	189
3.6.1	Lubrication of spherical roller bearing, balancing device .....	189
3.6.2	Rust preventive measures, bearing axis 1 (Foundry Prime) .....	193
3.6.3	Rust preventive measures, sealing axis 4 (Foundry Prime) .....	196
3.6.4	Rust preventive measures, support bearing in wrist (Foundry Prime) .....	199
3.6.5	Apply Mercasol on output shaft axis 2 .....	201
3.6.6	Apply Mercasol on output shaft axis 3 .....	203
3.7	Cleaning activities .....	205
3.7.1	Cleaning the IRB 6640 Foundry Prime .....	205
<b>4</b>	<b>Repair</b>	<b>209</b>
4.1	Introduction .....	209

<b>4.2</b>	<b>General procedures .....</b>	<b>210</b>
4.2.1	Performing a leak-down test .....	210
4.2.2	Mounting instructions for bearings .....	211
4.2.3	Mounting instructions for seals .....	213
4.2.4	Replacing parts on the robot .....	215
<b>4.3</b>	<b>Complete robot .....</b>	<b>217</b>
4.3.1	Replacing cable harness, axes 1-6 .....	217
4.3.2	Replacement of cabling, axis 5 motor .....	231
4.3.3	Replacement of complete arm system .....	234
4.3.4	Replacement of air nipple and hose (Foundry Prime) .....	246
4.3.5	Replacement of over pressure unit .....	253
<b>4.4</b>	<b>Upper and lower arm .....</b>	<b>255</b>
4.4.1	Replacing the turning disk .....	255
4.4.2	Replacement of complete wrist unit .....	259
4.4.3	Replacement of support shaft with bearing axis 5 .....	265
4.4.4	Replacement of upper arm .....	269
4.4.5	Replacement of complete lower arm .....	277
<b>4.5</b>	<b>Frame and base .....</b>	<b>283</b>
4.5.1	Replacing the SMB unit .....	283
4.5.2	Replacing the brake release board .....	288
4.5.3	Replacement of spherical roller bearing, balancing device .....	292
4.5.4	Replacement of balancing device .....	297
4.5.4.1	Replacing the balancing device (design 1) .....	297
4.5.4.2	Replacing balancing device (design 2) .....	306
4.5.4.3	Unloading the balancing device using distance tool .....	321
4.5.4.4	Restoring the balancing device using distance tool .....	325
4.5.4.5	Unloading the balancing device using hydraulic press tool .....	327
4.5.4.6	Restoring the balancing device using a hydraulic press tool .....	330
<b>4.6</b>	<b>Motors .....</b>	<b>333</b>
4.6.1	Replacing motor axis 1 .....	333
4.6.2	Replacing motor axis 2 .....	340
4.6.3	Replacing motor axis 3 .....	348
4.6.4	Replacing motor axis 4 .....	356
4.6.5	Replacing motor axis 5 .....	363
4.6.6	Replacing motor axis 6 .....	372
<b>4.7</b>	<b>Gearboxes .....</b>	<b>380</b>
4.7.1	Replacing gearbox axis 1 .....	380
4.7.2	Replacing gearbox axis 2 .....	398
4.7.3	Replacing gearbox axis 3 .....	413
4.7.4	Replacing gearbox axis 6 .....	425
<b>5</b>	<b>Calibration information .....</b>	<b>431</b>
5.1	When to calibrate .....	431
5.2	Calibration methods .....	432
5.3	Synchronization marks and synchronization position for axes .....	434
5.4	Calibration movement directions for all axes .....	435
5.5	Updating revolution counters .....	436
5.6	Checking the synchronization position .....	439
<b>6</b>	<b>Decommissioning .....</b>	<b>441</b>
6.1	Introduction .....	441
6.2	Environmental information .....	442
6.3	Scraping of robot .....	443
6.4	Decommissioning of balancing device .....	444
<b>7</b>	<b>Reference information .....</b>	<b>447</b>
7.1	Introduction .....	447
7.2	Applicable standards .....	448

## Table of contents

---

7.3	Unit conversion .....	450
7.4	Screw joints .....	451
7.5	Weight specifications .....	454
7.6	Standard tools .....	455
7.7	Special tools .....	456
7.8	Dismounting and mounting tool 3HAC028920-001 .....	459
7.9	Lifting accessories and lifting instructions .....	475
<b>8</b>	<b>Spare parts</b>	<b>477</b>
8.1	Spare part lists and illustrations .....	477
<b>9</b>	<b>Circuit diagrams</b>	<b>479</b>
9.1	Circuit diagrams .....	479
<b>Index</b>		<b>481</b>

# Overview of this manual

## About this manual

This manual contains instructions for:

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

The robot described in this manual has the protection type *Foundry Prime*.

## Usage

This manual should be used during:

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

## Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

## Prerequisites

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

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

## Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety	Safety information that must be read through before performing any installation or service work on 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.
Calibration information	Procedures that do not require specific calibration equipment. General information about calibration.
Decommissioning	Environmental information about the robot and its components.

*Continues on next page*

## Overview of this manual

*Continued*

Chapter	Contents
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 manual - IRB 6640</i>	3HAC026876-001
<i>Product manual, spare parts - IRB 6640</i>	3HAC038330-001
<i>Product specification - IRB 6640</i>	3HAC028284-001
<i>Circuit diagram - IRB 6640</i>	3HAC025744-001
<i>Product manual - DressPack/SpotPack IRB 6640</i>	3HAC028638-001
<i>Operating manual - General safety information</i> <sup>i</sup>	3HAC031045-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC 639.	3HAC021313-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC1000.	3HAC047136-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - Calibration Pendulum</i>	3HAC16578-1
<i>Operating manual - Service Information System</i>	3HAC050944-001
<i>Application manual - Additional axes and stand alone controller</i>	3HAC051016-001
<i>Technical reference manual - Lubrication in gearboxes</i>	3HAC042927-001
<i>Technical reference manual - System parameters</i>	3HAC050948-001
<i>Application manual - Electronic Position Switches</i>	3HAC050996-001
<i>Application manual - CalibWare Field 5.0</i>	3HAC030421-001
List of approved cleaners and detergents for Foundry Prime robots	Contact ABB local sales organization

<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 updates: <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 15</a>.</li><li>• Robot designations are adjusted in sub-headings in section <a href="#">Robot transportation precautions on page 64</a>.</li></ul>

*Continues on next page*

Revision	Description
	<ul style="list-style-type: none"> <li>• Some general tightening torques have been changed/added, see updated values in <a href="#">Screw joints on page 451</a>.</li> <li>• Added <b>WARNING - Safety risks during handling of batteries on page 54</b>.</li> <li>• The maximum allowed deviation in levelity of the base plate is changed, see <a href="#">Securing the base plate on page 88</a>.</li> <li>• Changed name definition of rust preventive agent from being Mercasol 3106 to be only Mercasol, throughout the manual.</li> <li>• Reference to Hilti standard added to the foundation recommendation for the base plate and class designation for foundation is changed to european standard C25/C30 (previously Swedish standard K25/K30), see <a href="#">Securing the base plate on page 88</a>.</li> <li>• The section for replacement of wrist unit is completed with gaskets, see <a href="#">Replacement of complete wrist unit on page 259</a>.</li> <li>• All data about type of lubrication in gearboxes is moved from the manual to a separate lubrication manual, see <a href="#">Type and amount of oil in gearboxes on page 164</a>.</li> <li>• Corrected dimension data and changed article number for attachment screw, see <a href="#">Replacing gearbox axis 3 on page 413</a>.</li> <li>• Corrected the method of inspecting oil level in the axis-6 gearbox, see <a href="#">Inspecting the oil level in axis-6 gearbox on page 135</a>.</li> <li>• Changed the length of guide pins used to guide the complete arm system when refitting it, see the list of required equipment in <a href="#">Replacement of complete arm system on page 234</a>. Also added an alternate method of lifting the arm system and made some other minor changes to the procedure.</li> <li>• Changed the length of guide pins and changed pictures of the gearbox, see <a href="#">Replacing gearbox axis 1 on page 380</a>.</li> <li>• Added guide pins and added an alternate method of lifting the arm system, see <a href="#">Replacing gearbox axis 2 on page 398</a>.</li> <li>• The interval for inspecting the balancing device is changed, see <a href="#">Maintenance schedule on page 118</a>.</li> </ul>
B	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>• Removed row with axis-1 sealing from maintenance schedule, see <a href="#">Maintenance schedule on page 118</a>.</li> <li>• Added a recommendation to analyze the water content in the gearbox oil in <a href="#">Maintenance schedule on page 118</a>, and added the instruction <a href="#">Analysing the water content in gearbox oil on page 188</a> as a separate section that is valid for all axes.</li> <li>• A new SMB unit and battery is introduced, with longer battery lifetime.</li> <li>• Updated the list of approved detergents, see <a href="#">Approved cleaners and detergents on page 207</a>.</li> </ul>
C	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>• Minor corrections in section <a href="#">Performing a leak-down test on page 210</a>.</li> <li>• Corrected part numbers in section <a href="#">Replacing gearbox axis 2 on page 398</a>.</li> <li>• The list of approved cleaners and detergents is updated more frequently than the manual is updated, therefore the information is removed from the manual and instead referenced. See <a href="#">Approved cleaners and detergents on page 207</a>.</li> <li>• Corrected the article number for grease and corrected figures of the gearbox in the procedures, section <a href="#">Replacing gearbox axis 1 on page 380</a>.</li> <li>• Changed article number 3HAA1001-294 to 3HAC042534-001 throughout manual.</li> </ul>

Continues on next page

## Overview of this manual

*Continued*

Revision	Description
D	This revision includes the following updates: <ul style="list-style-type: none"><li>Added information about risks when scrapping a decommissioned robot, see <a href="#">Scraping of robot on page 443</a>.</li></ul>
E	This revision includes the following updates: <ul style="list-style-type: none"><li>The maximum allowed deviation in levelness of the base plate and foundation is changed, see <a href="#">Securing the base plate on page 88</a>.</li><li>Minor corrections.</li></ul>
F	This revision includes the following updates: <ul style="list-style-type: none"><li>Changed spare part number for axis-6 motor gasket.</li><li>The instructions for the fork lift accessory is split into two sections.</li><li>The inspection of oil level in gearboxes is removed from the maintenance schedule and moved to the cleaning section.</li><li>The instructions for inspection of oil level in gearboxes are updated, see <a href="#">Inspection activities on page 123</a>.</li><li>Illustrations of SMB battery RMU improved.</li><li>Updated section of 'Replacement of air nipple and hose (Foundry prime)', table and figures.</li></ul>
G	This revision includes the following updates: <ul style="list-style-type: none"><li>Turning disk fixture is removed from special tools for Levelmeter calibration.</li><li>Rust preventive actions for output shaft on axis 2 and 3 added.</li><li>Replacement of support shaft with bearing axis 5 added.</li></ul>
H	This revision includes the following updates: <ul style="list-style-type: none"><li>Minor corrections in brake release section.</li></ul>
J	This revision includes the following updates: <ul style="list-style-type: none"><li>Information regarding air flow added.</li></ul>
K	Published in release R16.2. This revision includes the following updates: <ul style="list-style-type: none"><li>New activities in maintenance schedule.</li><li>Minor changes</li><li>Corrections due to updates in SAP terminology.</li></ul>
L	Published in release R17.1. The following updates are made in this revision: <ul style="list-style-type: none"><li>Drying time for Mercasol added.</li><li>Removed article number for press fixture (for pressing the pinion of the axis-5 motor). The fixture is not sold by ABB.</li><li>Reference added from general information to installation regarding pressurized components.</li><li>Text regarding maximum pressure in pressurized components, in warning added.</li></ul>

# Product documentation, IRC5

## Categories for user documentation from ABB Robotics

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

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

### Product manuals

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

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

### Technical reference manuals

The technical reference manuals describe reference information for robotics products.

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

*Continues on next page*

---

## Application manuals

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

An application manual generally contains information about:

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

---

## Operating manuals

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

The group of manuals includes (among others):

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

# How to read the product manual

### Reading the procedures

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

#### References to figures

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

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

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

	Action	Note/Illustration
8.	Remove the <i>rear attachment screws, gearbox</i> .	Shown in the figure <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 17](#).

---

### Illustrations

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

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

# Important information about robots with protection type Foundry Prime

### Introduction

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

### Warranty claims

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

### Robot models available with the protection type Foundry Prime

The following robot variants are currently available with the protection type Foundry Prime:

Robot variant
IRB 6640 Foundry Prime

### Pressurized components

Motors, balancing device and the serial measurement board cavity shall be pressurized on Foundry Prime robots during operation and shut down. The overpressure can be dropped when atmospheric humidity has reached the same level as the surrounding environment.

For more information, see [Pressurized components on page 58](#).

### Cleaning

Special procedures are needed when cleaning the Foundry Prime robot. See section [Cleaning the IRB 6640 Foundry Prime on page 205](#).

# 1 Safety

## 1.1 Introduction to safety information

---

### Overview

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

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

# 1 Safety

---

## 1.2.1 Introduction to general safety information

## 1.2 General safety information

### 1.2.1 Introduction to general safety information

---

#### Definitions

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

---

#### Sections

The general safety information is divided into the following sections.

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

## 1.2.2 Safety in the manipulator system

### Validity and responsibility

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

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

- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - General safety information*<sup>1</sup>
- *Product manual*

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

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

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

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

### Connection of external safety devices

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

### Limitation of liability

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

### Related information

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

*Continues on next page*

## 1 Safety

---

### 1.2.2 Safety in the manipulator system

*Continued*

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

### **1.2.3 Protective stop and emergency stop**

---

#### **Overview**

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

# 1 Safety

---

## 1.2.4.1 Safety risks during installation and service work on robots

### 1.2.4 Safety risks

#### 1.2.4.1 Safety risks during installation and service work on robots

---

##### Overview

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

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

---

##### General risks during installation and service

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

---

##### Spare parts and special equipment

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

---

##### Personal protective equipment

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

---

##### Nation/region specific regulations

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

---

##### Non-voltage related risks

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

*Continues on next page*

## 1.2.4.1 Safety risks during installation and service work on robots

*Continued*

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

**To be observed by the supplier of the complete system**

When integrating the robot with external devices and machines:

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

**Complete robot**

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

*Continues on next page*

# 1 Safety

## 1.2.4.1 Safety risks during installation and service work on robots

*Continued*

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

## Cabling

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

## Gearboxes and motors

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

## Balancing device

Safety risk	Description
Dangerous balancing device!	 <b>WARNING</b> <i>Do not</i> , under any circumstances, deal with the balancing device in any other way than that described in the product documentation! For example, attempting to open the balancing device is potentially lethal!

## 1.2.4.2 CAUTION - Hot parts may cause burns!

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

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

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

**Elimination**

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

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

# 1 Safety

---

## 1.2.4.3 Safety risks related to tools/work pieces

### 1.2.4.3 Safety risks related to tools/work pieces

#### Safe handling

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

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

#### Safe design

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

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



#### CAUTION

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

#### 1.2.4.4 Safety risks related to pneumatic/hydraulic systems

---

##### General

Special safety regulations apply to pneumatic and hydraulic systems.



##### Note

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

---

##### Residual energy

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

---

##### Safe design

- Gravity may cause any parts or objects held by these systems to drop.
- Dump valves should be used in case of emergency.
- Shot bolts should be used to prevent tools, etc., from falling due to gravity.

# **1 Safety**

---

## **1.2.4.5 Safety risks during operational disturbances**

---

### **General**

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

---

### **Qualified personnel**

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

---

### **Extraordinary risks**

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

## 1.2.4.6 Risks associated with live electric parts

---

### Voltage related risks, general

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

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

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

All work must be performed:

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

---

### Voltage related risks, IRC5 controller

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

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

*Continues on next page*

## **1 Safety**

---

### **1.2.4.6 Risks associated with live electric parts**

*Continued*

---

#### **Voltage related risks, robot**

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

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

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

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

### 1.2.5 Safety actions

#### 1.2.5.1 Safety fence dimensions

---

##### General

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

---

##### Dimensioning

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

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

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

## **1 Safety**

---

### **1.2.5.2 Fire extinguishing**



#### **Note**

**Use a CARBON DIOXIDE (CO<sub>2</sub>) extinguisher in the event of a fire in the robot or controller!**

### 1.2.5.3 Emergency release of the robot arm

#### Description

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

How to release the brakes is detailed in the section:

- [Manually releasing the brakes on page 85.](#)

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

#### Increased injury

Before releasing the brakes, make sure that the weight of the arms does not increase the pressure on the trapped person, further increasing any injury!



#### DANGER

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

Make sure no personnel is near or beneath the robot arm.

# 1 Safety

---

## 1.2.5.4 Brake testing

### 1.2.5.4 Brake testing

---

#### When to test

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

---

#### How to test

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

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

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

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



### Note

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

# 1 Safety

---

## 1.2.5.6 Safe use of the jogging device

### 1.2.5.6 Safe use of the jogging device

#### Three-position enabling device

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

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



#### Note

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

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

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

---

#### Hold-to-run function

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

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

### 1.2.5.7 Work inside the working range of the robot



#### WARNING

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

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



#### WARNING

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

## **1 Safety**

---

### **1.2.5.8 Signal lamp (optional)**

#### **1.2.5.8 Signal lamp (optional)**

---

##### **Description**

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

---

##### **Function**

The lamp is active in MOTORS ON mode.

---

##### **Further information**

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

## 1.3 Safety signals and symbols

### 1.3.1 Safety signals in the manual

#### Introduction to safety signals

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

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

#### Danger levels

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

Symbol	Designation	Significance
 xx0200000022	DANGER	Warns that an accident <i>will</i> occur if the instructions are not followed, resulting in a serious or fatal injury and/or severe damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, and so on.
 xx0100000002	WARNING	Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc.
 xx0200000024	ELECTRICAL SHOCK	Warns for electrical hazards which could result in severe personal injury or death.
 xx0100000003	CAUTION	Warns that an accident <i>may</i> occur if the instructions are not followed that can result in injury and/or damage to the product. It also applies to warnings of risks that include burns, eye injury, skin injury, hearing damage, crushing or slipping, tripping, impact, fall from height, etc. Furthermore, it applies to warnings that include function requirements when fitting and removing equipment where there is a risk of damaging the product or causing a breakdown.
 xx0200000023	ELECTROSTATIC DISCHARGE (ESD)	Warns for electrostatic hazards which could result in severe damage to the product.

*Continues on next page*

# 1 Safety

## 1.3.1 Safety signals in the manual

*Continued*

Symbol	Designation	Significance
 xx010000004	NOTE	Describes important facts and conditions.
 xx010000098	TIP	Describes where to find additional information or how to do an operation in an easier way.

## 1.3.2 Safety symbols on product labels

### Introduction to labels

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

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



#### Note

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

### Types of labels

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

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

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

### Symbols on safety labels

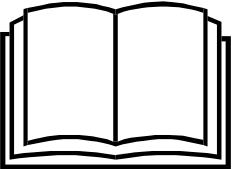
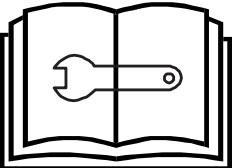
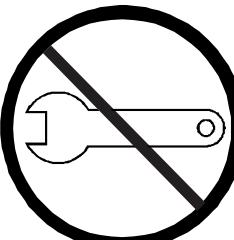
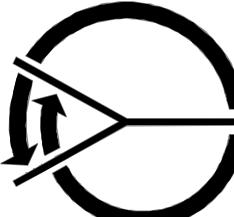
Symbol	Description
	<b>Warning!</b> Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units,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

*Continues on next page*

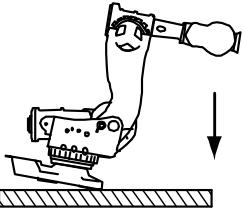
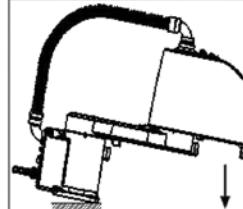
# 1 Safety

## 1.3.2 Safety symbols on product 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 disassemble, 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*

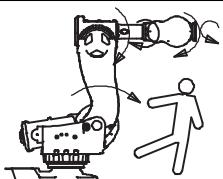
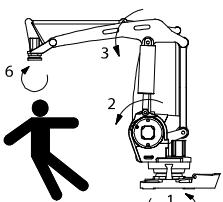
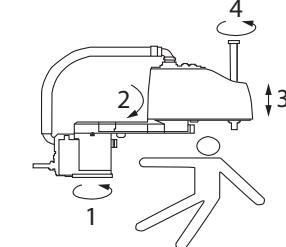
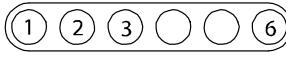
Symbol	Description
 xx0900000810	<b>Tip risk when loosening bolts</b> The robot can tip over if the bolts are not securely fastened.
  3HAC 057068-001	
  xx0900000817	<b>Crush</b> Risk of crush injuries.
 xx0900000818	<b>Heat</b> Risk of heat that can cause burns.

*Continues on next page*

# 1 Safety

## 1.3.2 Safety symbols on product labels

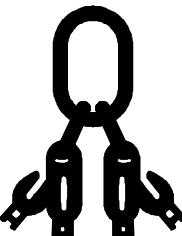
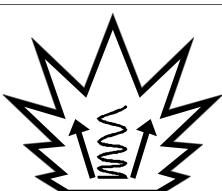
*Continued*

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

*Continues on next page*

## 1.3.2 Safety symbols on product labels

*Continued*

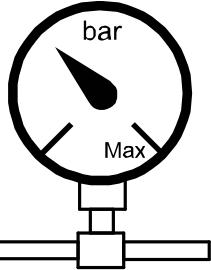
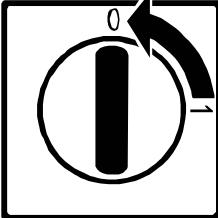
Symbol	Description
 xx1000001242	Chain sling with shortener
 xx0900000822	Lifting of robot
 xx0900000823	<b>Oil</b> Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	Mechanical stop
 xx1000001144	No mechanical stop
 xx0900000825	<b>Stored energy</b> Warns that this part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

*Continues on next page*

# 1 Safety

## 1.3.2 Safety symbols on product labels

*Continued*

Symbol	Description
 xx0900000826	<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.

## 1.4.1 DANGER - Moving robots are potentially lethal!

## 1.4 Safety related instructions

### 1.4.1 DANGER - Moving robots are potentially lethal!

#### Description

Any moving robot is a potentially lethal machine.

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

#### Elimination

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

## 1 Safety

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

#### Description

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

#### Elimination

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



#### DANGER

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

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

#### Collision risks



#### CAUTION

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

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

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

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

**DANGER**

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

**Elimination**

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

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

## 1 Safety

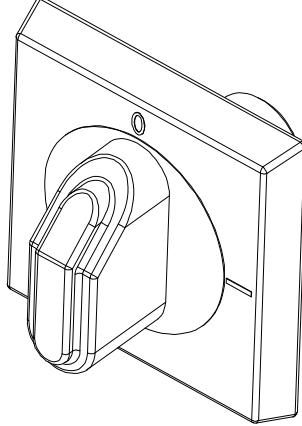
1.4.4 DANGER - Make sure that the main power has been switched off!

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

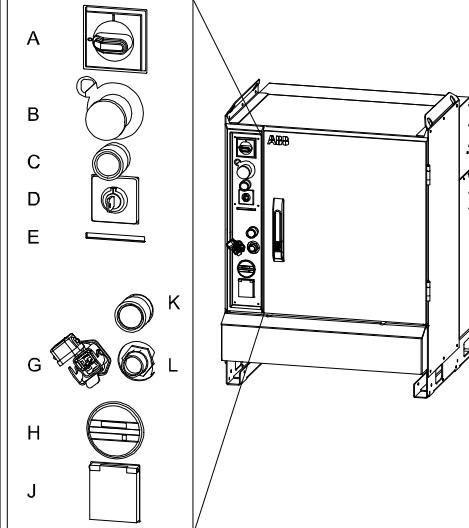
#### Description

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

#### Elimination, IRC5 Panel Mounted Controller

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

#### Elimination, IRC5 Single Cabinet Controller

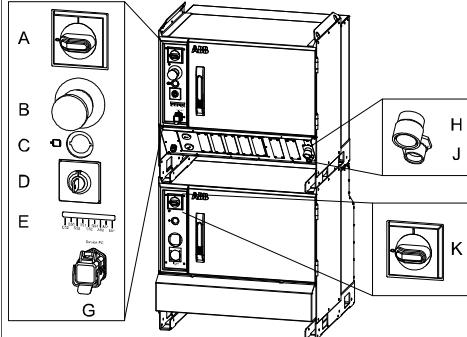
	Action	Note/illustration
1	Switch off the main switch on the controller cabinet.	 xx0600002782 A: Main switch

*Continues on next page*

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

*Continued*

### Elimination, IRC5 Dual Cabinet Controller

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

# 1 Safety

## 1.4.5 WARNING - The unit is sensitive to ESD!

### Description

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

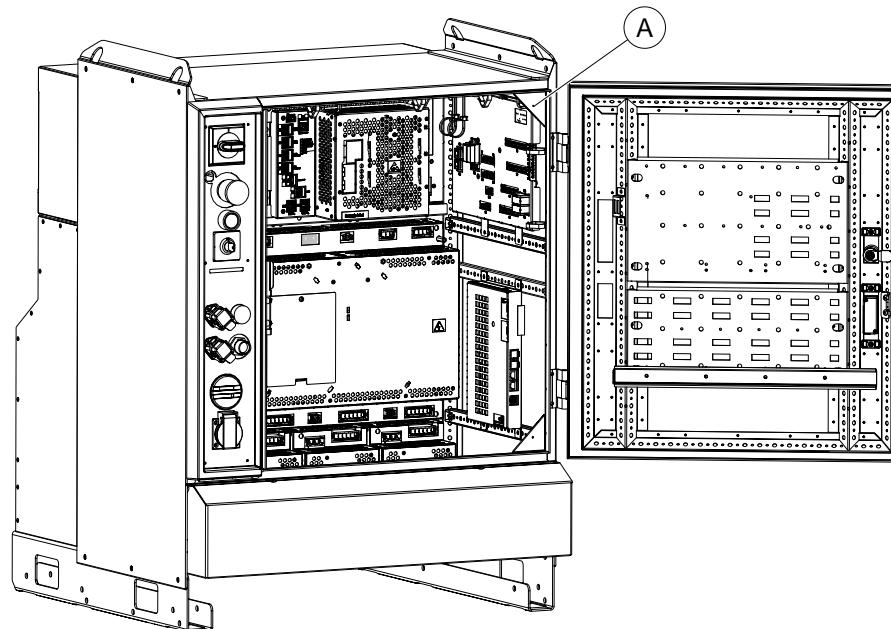
### Elimination

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

### Location of wrist strap button

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

IRC5



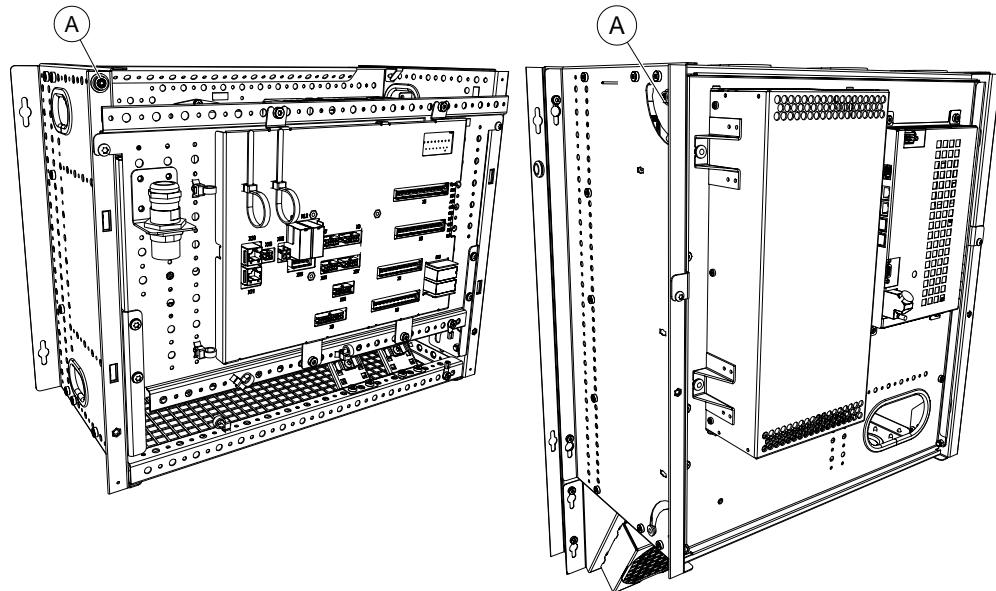
A Wrist strap button

*Continues on next page*

## 1.4.5 WARNING - The unit is sensitive to ESD!

*Continued*

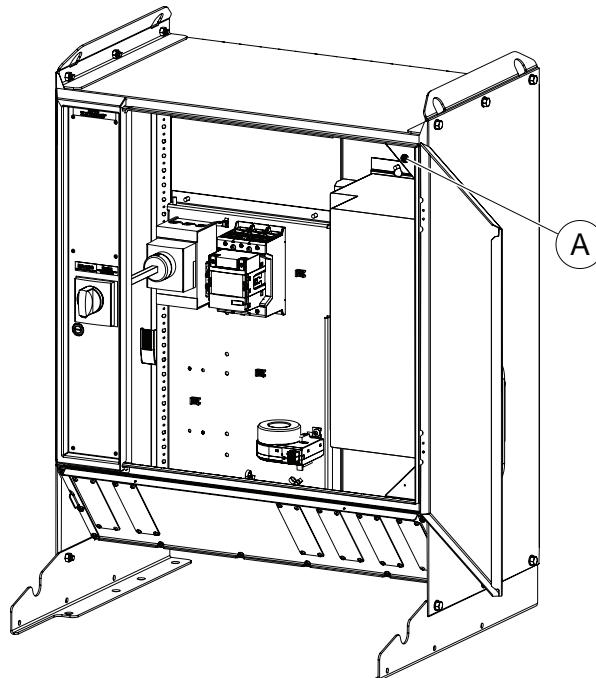
Panel Mounted Controller



xx1300001960

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

Spot welding cabinet



xx1600000253

# 1 Safety

---

## 1.4.6 WARNING - Safety risks during handling of batteries

### Description

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

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



#### Note

Appropriate disposal regulations must be observed.

### Elimination

	Action	Note
1	Do not short circuit, recharge, puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion.	Operating temperatures are listed in <a href="#">Pre-installation procedure on page 70</a> .
2	Use safety glasses when handling the batteries.	
3	In the event of leakage, wear gloves and chemical apron.	
4	In the event of fire, use self-contained breathing apparatus.	

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

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

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

**Note**

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

**Note**

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

**Note**

Appropriate disposal regulations must be observed.

**Note**

Take special care when handling hot lubricants.

**Warnings and elimination**

Warning	Description	Elimination/Action
 xx0100000002 <b>Hot oil or grease</b>	Changing and draining gearbox oil or grease may require handling hot lubricant heated up to 90 °C.	Make sure that protective gear like goggles and gloves are always worn during this activity.
 xx0100000002 <b>Allergic reaction</b>	When working with gearbox lubricant there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 xx0100000002 <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.

*Continues on next page*

# 1 Safety

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

*Continued*

Warning	Description	Elimination/Action
 xx010000002 <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.
 xx010000002 <b>Do not mix types of oil</b>	Mixing types of oil may cause severe damage to the gearbox.	When filling gearbox oil, do not mix different types of oil unless specified in the instructions. Always use the type of oil specified by the manufacturer!
 xx0100000098 <b>Heat up the oil</b>	Warm oil drains quicker than cold oil.	When changing gearbox oil, first run the robot for a time to heat up the oil.
 xx010000004 <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.
 xx010000003 <b>Contaminated oil in gear boxes</b>	When draining the oil make sure that as much oil as possible is drained from the gearbox. The reason for this is to drain as much oil sludge and metal chips as possible from the gearbox. The magnetic oil plugs will take care of any remaining metal chips.	

# 2 Installation and commissioning

## 2.1 Introduction

### General

This chapter contains assembly instructions and information for installing the IRB 6640 Foundry Prime at the working site.

More detailed technical data can be found in the *Product specification* for the IRB 6640 Foundry Prime, such as:

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

### Safety information

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

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



#### Note

If the IRB 6640 Foundry Prime is connected to power, always make sure that the robot is connected to *protective earth* before starting any installation work!

For more information see:

- *Product manual - IRC5*

## 2 Installation and commissioning

### 2.2 Installation and operational requirements for Foundry Prime robots

#### Introduction

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

#### Fluids in the vicinity of the robot

If fluids that can cause rust formation, for example, water etc., are used in the vicinity of the robot it is required to add rust inhibitor to the fluid or take other measures to prevent rust on unpainted joints or other unprotected surfaces of the robot.

#### Activity to lubricate gearbox cavities and gears

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

#### Pressurized components

The motors, the balancing device, and the serial measurement board cavity must be pressurized on Foundry Prime robots during operation and shut down. The overpressure can be dropped when atmospheric humidity has reached the same level as the surrounding environment.

At the installation of the Foundry Prime robot a pressure sensor and pressure relief valve (not included) must be installed in the air supply system to monitor the supply of air pressure in order to secure a correct pressure. See [Pressurizing equipment on page 59](#) for equipment specifications.



#### Note

The overpressure must be kept at  $0.2 - 0.3 \pm 0.0$  bar during 24 hours independent of Motors On/Off mode, start-up, and shut down periods.



#### WARNING

It's important not to exceed the maximum pressure of 0.3 bar. If the air pressure exceeds the specified, it can lead to damage to the gearbox, brake failure in the motors which may cause the robot arms to fall down, leading to personal injury or physical damage.

*Continues on next page*



#### WARNING

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



#### Note

To secure the supply of air pressure, use a pressure sensor.

#### Air quality for pressurizing of robot

The air must be dry and clean, such as instrument air. The following table describes the air specifications.

Parameter	Value
Dew point	<+2 °C at 6 bar
Solid particle size	<5 microns
Oil content	<1 ppm (1 mg/m <sup>3</sup> )
Air flow	>200 L/min

#### Pressurizing equipment

ABB recommends a safety valve set at 0.4 bar, pressure sensor set at 0.2-0.3 bar or regulator set for maximum 0.3 bar to be attached on the pressure side of the air system.

Example of products:

Equipment	Description
Pressure sensor	Festo SDE1-series
Pressure regulator	Festo LRP-series

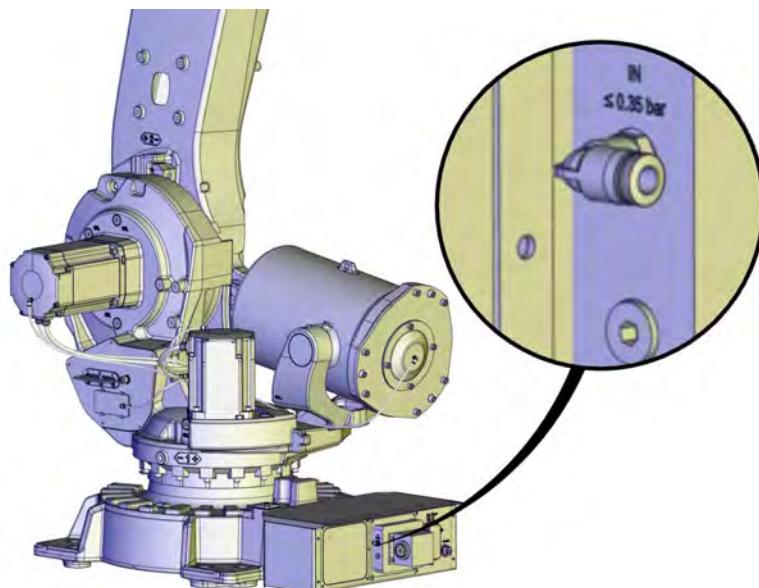
*Continues on next page*

## 2 Installation and commissioning

### 2.2 Installation and operational requirements for Foundry Prime robots

*Continued*

Connect air hose to over pressure unit



xx1700000565

#### Precautionary measures



##### Note

It is strictly forbidden to expose any part of the robot to direct high pressure water jet! The sealing joints between the moving parts on the wrist must not be exposed to high pressure water.

Rebounding high pressure water jet must be avoided. ABB recommends using a tool design with integrated covers that protect the wrist from direct or indirect high pressure water jet.



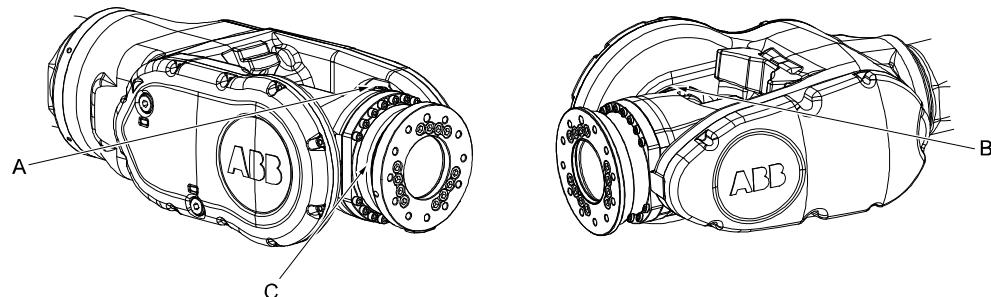
##### Note

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

*Continues on next page*

#### Sensitive points IRB 6640

Illustration shows points that are particularly sensitive to water spray.



xx0600002792

A	Axis 5, bearing support side
B	Axis 5, bearing gear side
C	Axis 6, mounting flange - gear house

#### Shut-down periods

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

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

- The cell must be ventilated during shut-down until the atmospheric humidity in the cell has reached the same level as the surrounding environment.
- Will avoid that humid air is trapped into gearboxes or other cavities due to raised vacuum when cooling down.
- Will give the robot a chance to dry as most rust preventive components in washing detergents have a decaying effect, i.e. the rust preventive effect is reduced after a time. Please refer to the Product Specification of the washing detergent in question for decaying effect. Washing detergent or water without rust inhibitor can give an accelerated corrosion on some robot components.
- **The overpressure must be kept at 0.2 - 0.3 ± 0.0 bar during 24 hours independent of Motors On/Off mode, start-up and shut down periods.**

## **2 Installation and commissioning**

---

### **2.3 Design 1 and Design 2 of IRB 6640**

#### **2.3 Design 1 and Design 2 of IRB 6640**

---

##### **Differences in design**

There are some differences in the two designs of the robot IRB 6640.

Design 1 has:

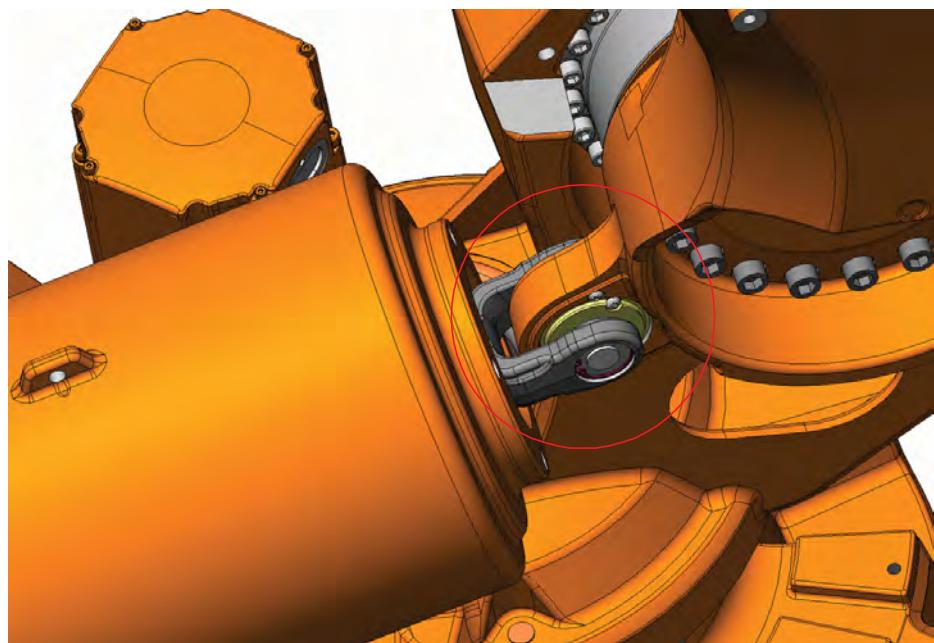
- one ear on the lower arm as shown in the figure for design 1.

Design 2 has:

- two ears on the lower arm as shown in the figure for design 2

---

##### **Design 1**

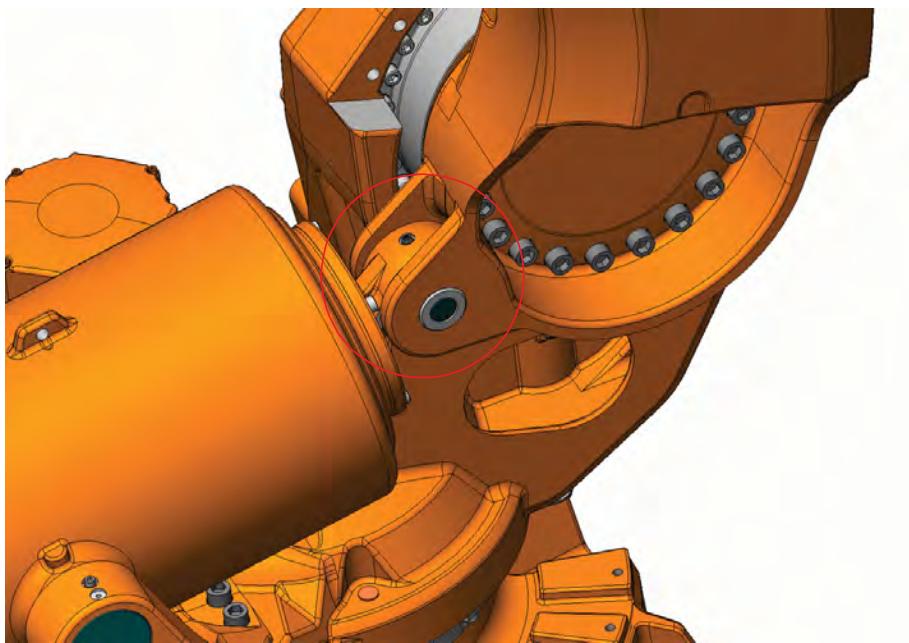


xx0800000401

*Continues on next page*

---

#### Design 2



xx0800000402

## 2 Installation and commissioning

### 2.4 Robot transportation precautions

#### 2.4 Robot transportation precautions

##### General

This section describes ABB approved transportation precautions for ABB robots.



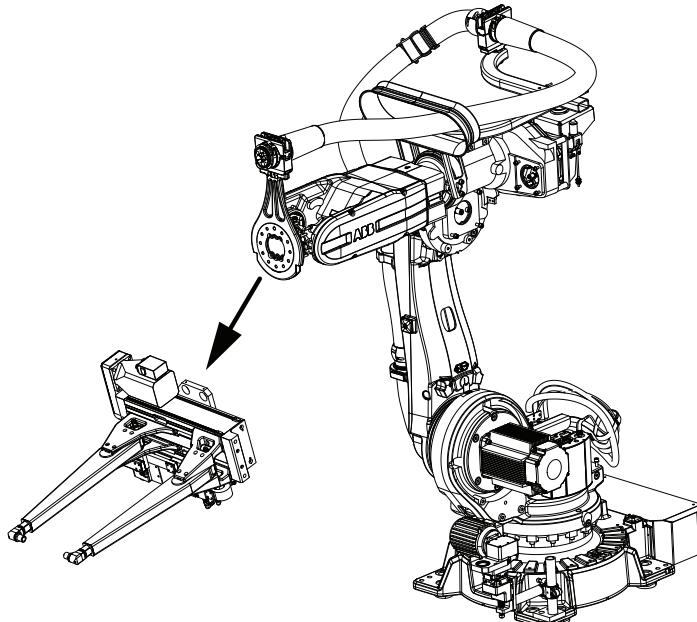
##### CAUTION

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

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

##### Method 1 - recommended method

Transportation according to method 1 is strongly recommended by ABB.



xx0800000030

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

- Always remove the tool before transportation of the robot.
- Always place the robot in the ABB recommended transport position, described in section [Risk of tipping/stability on page 76](#).
- Always read and follow the instructions in section [Pre-installation procedure on page 70](#)

##### Method 2 - transportation with a tool mounted to the robot

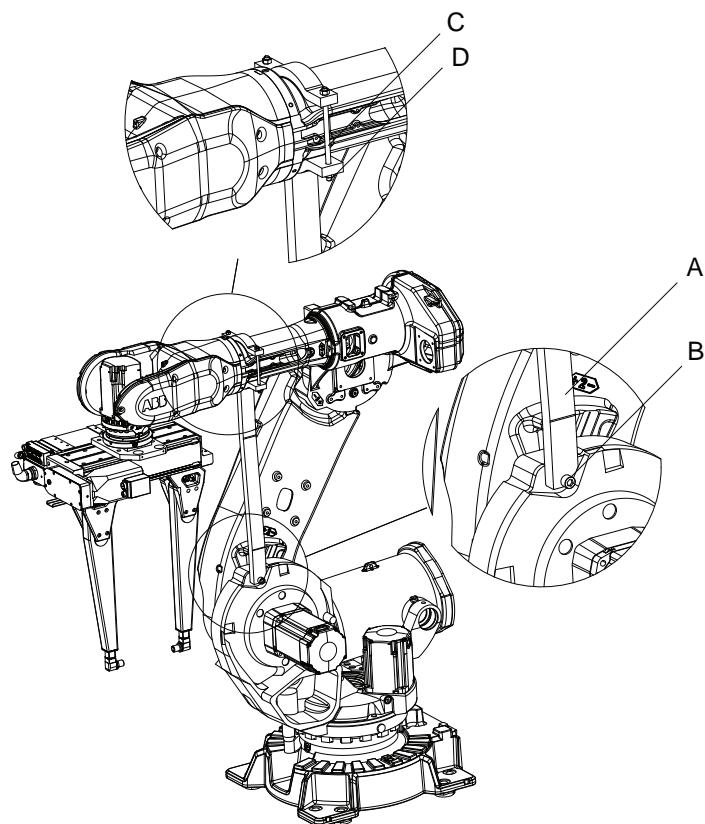
Transportation according to method 2 is approved by ABB, only if use of method 1 is not possible.

Continues on next page

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

- Always read and follow the instructions in section [Securing the robot with a transport support on page 68](#)
- Always place the robot in the ABB recommended transport position for robot with tool, described in sub section [Transport position with a transport support on page 66](#).
- Always use the recommended transport support described in sub section [Recommended transport support on page 67](#).

IRB 6640 Foundry Prime



xx0800000037

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

*Continues on next page*

## **2 Installation and commissioning**

---

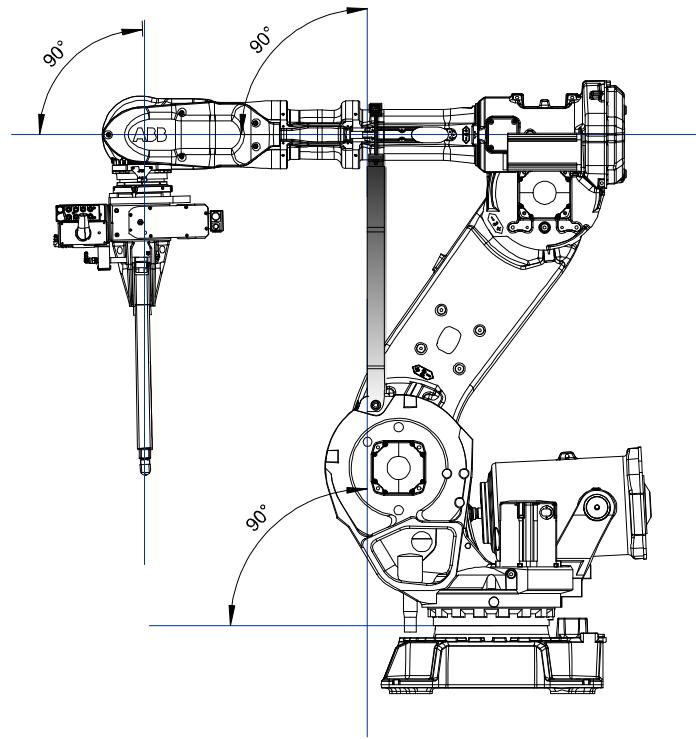
### **2.4 Robot transportation precautions**

*Continued*

#### **Transport position with a transport support**

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

**IRB 6640 Foundry Prime**



xx0800000040

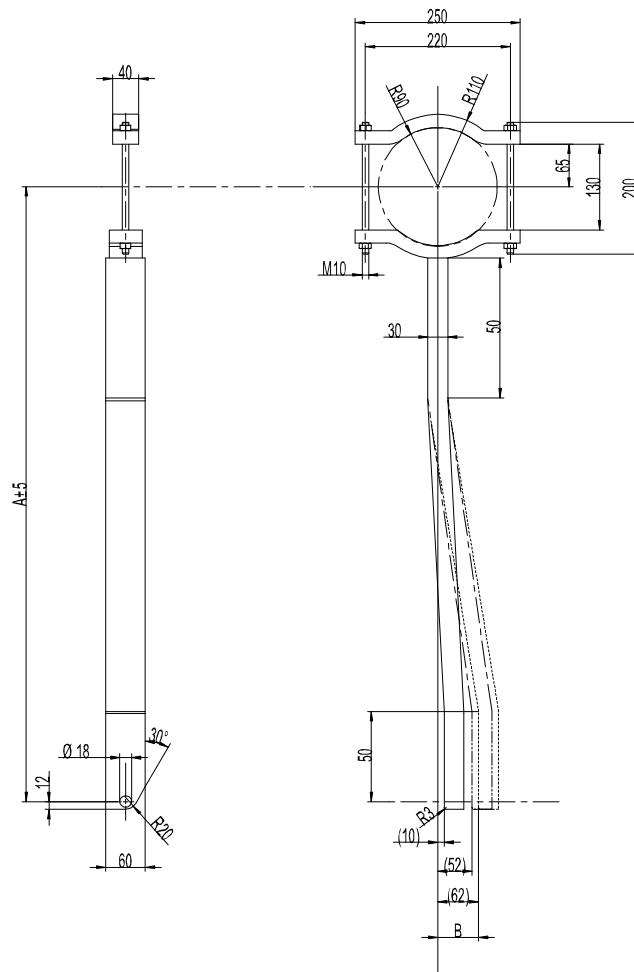
*Continues on next page*

#### Recommended transport support

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

#### IRB 6640 Foundry Prime

	Armlength																	
	IRB6600 IRB6650	2,55	2,75	2,8	3,0	3,0	3,2	IRB6640	2,55	2,75	2,8	3,2	IRB7600	2,3	2,55	2,8	3,05	3,5
Lower arm L	1075 1280	1075	1075	1280				Lower arm L	1075	1280	1075	1280						
A		900	1130	700	570	995	830		940	1160	785	860			890	730	730	600
B		62	62	62	62	62	62		10	10	10	10			52	52	52	52



xx0800000039

## 2 Installation and commissioning

### 2.5 Securing the robot with a transport support

#### General

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

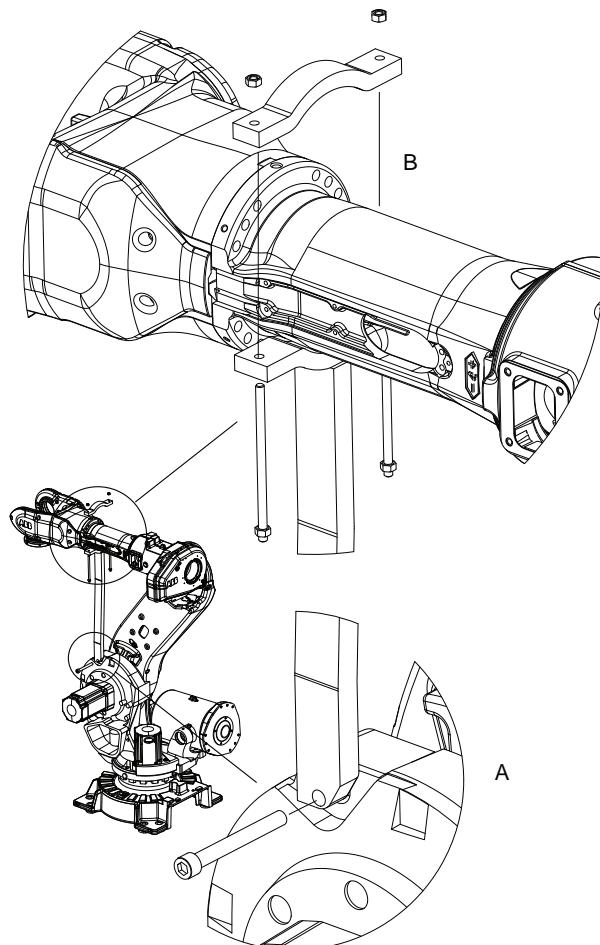


#### DANGER

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

#### Fitting the transport support

##### Illustration for fitting the transport support



xx0800000062

*Continues on next page*

#### Fitting the transport support

	Action	Note
1	Fit the transport support's lower end to the robot using the recommended screw joint, (A) in figure.	Do not tighten the screw. See attachment point for the specific robot in the section <a href="#">Transport position with a transport support on page 66</a> .
2	Jog the robot into a position as near above as possible to the recommended transport position for the specific robot, as specified in section <a href="#">Transport position with a transport support on page 66</a> .	 CAUTION Do not try to jog the robot to the exact position (max distance 1mm).
3	Use the brake release for axis 3 to reach the final resting position on the transport support, see the section <a href="#">Manually releasing the brakes on page 85</a> .	See attachment point for the specific robot in the section <a href="#">Transport position with a transport support on page 66</a>
4	Tighten all the attachment screws, (A) and (B), in the figure with the brake release for axis 3 still activated starting with the lower attachment screw.	 CAUTION Do not attempt to tighten any attachment screws without first releasing the brakes. This can seriously damage the robot.
5	Use the brake release for axis 5 and 6 to reach the final resting position for the tool, see the section <a href="#">Manually releasing the brakes on page 85</a>	

## 2 Installation and commissioning

### 2.6.1 Pre-installation procedure

## 2.6 Unpacking

### 2.6.1 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 is suitable to handle the weight of the robot as specified in: <a href="#">Weight, robot on page 70</a>
6	If the robot is not installed directly, it must be stored as described in: <a href="#">Storage conditions, robot on page 72</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 72</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 71</a></li><li>• <a href="#">Protection classes, robot on page 72</a></li><li>• <a href="#">Requirements, foundation on page 72</a></li></ul>
9	Before moving the robot, please observe the stability of the robot: <a href="#">Risk of tipping/stability on page 76</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 77</a>
11	Install required equipment, if any. <ul style="list-style-type: none"><li>• <a href="#">Installation of signal lamp (option) on page 104</a></li></ul>

#### Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 6640 Foundry Prime	1,340 kg (IRB6640), 1,405 kg (IRB6640ID)

*Continues on next page*



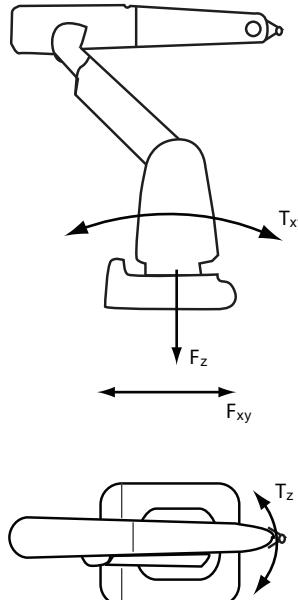
#### Note

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!

#### Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$\pm 8.5$ kN	$\pm 20.4$ kN
Force z	$15.0 \pm 9.0$ kN	$15.0 \pm 20.0$ kN
Torque xy	$\pm 20.1$ kNm	$\pm 45.2$ kNm
Torque z	$\pm 5.1$ kNm	$\pm 10.6$ kNm

*Continues on next page*

## 2 Installation and commissioning

---

### 2.6.1 Pre-installation procedure

*Continued*

---

#### Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Maximum tilt	5°	
Minimum resonance frequency	22 Hz	

---

#### 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	100% at constant temperature (gaseous only)

---

#### Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5° C
Maximum ambient temperature	+50° C
Maximum ambient humidity	100% at constant temperature (gaseous only)

---

#### Protection classes, robot

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

Protection type	Protection class
Manipulator, protection type Foundry Prime	IP 67

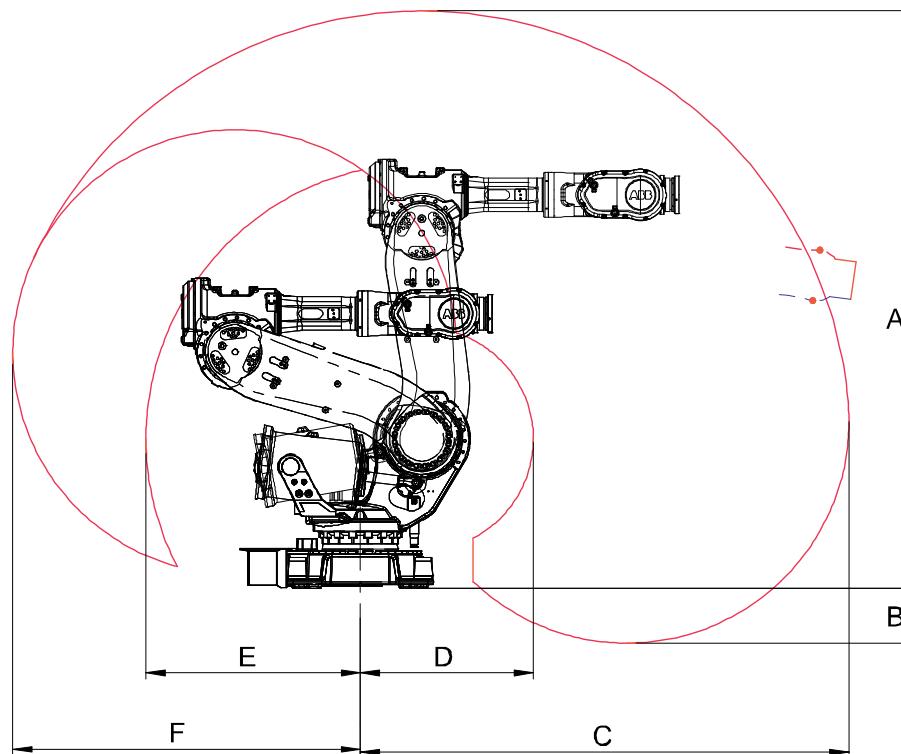
## 2.6.2 Working range and type of motion

### Working range

The following figures show the working ranges of the robot variants. The extreme positions of the robot arm are specified at the wrist center (dimensions in mm).

**IRB 6640 - 180/2.55, 235/2.55, 205/2.75, 185/2.8, 130/3.2 & IRB 6640ID - 200/2.55, 170/2.75**

The illustration below shows the unrestricted working range. Measurements for the different robot variants, are shown as A to F, in the illustration below.



xx0600003396

Robot variant	A	B	C	D	E	F
IRB 6640-2.55	3015 mm	286 mm	2550 mm	903 mm	1119 mm	1814 mm
IRB 6640-2.75	3219 mm	268 mm	2755 mm	961 mm	1252 mm	1999 mm
IRB 6640-2.8	3261 mm	533 mm	2800 mm	1004 mm	1324 mm	2061 mm
IRB 6640-3.2	3665 mm	713 mm	3200 mm	1067 mm	1604 mm	2445 mm
IRB 6640ID-2.55	3015 mm	286 mm	2550 mm	903 mm	1549 mm	1814 mm
IRB 6640ID-2.75	3219 mm	268 mm	2755 mm	961 mm	1682 mm	1999 mm

*Continues on next page*

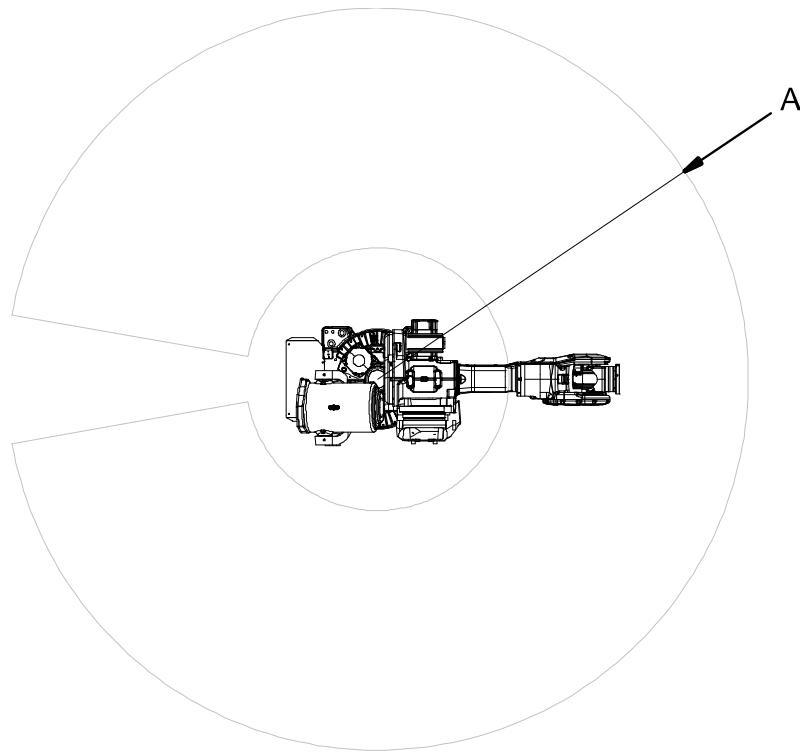
## 2 Installation and commissioning

### 2.6.2 Working range and type of motion

*Continued*

#### Turning radius

The turning radius, shown as A in the figure below, is specified for the different robot variants below the figure.



xx0600003399

IRB 6640 - 2.55	2550 mm
IRB 6640 - 2.75	2755 mm
IRB 6640 - 2.8	2800 mm
IRB 6640 - 3.2	3200 mm
IRB 6640ID - 2.55	2550 mm
IRB 6640ID - 2.75	2755 mm

#### Type of motion

Axis	Type of motion	Range of movement	Note
1	Rotation motion	+170° to -170°	Movement range can be set to: +220° to -220° (option 561-1)
2	Arm motion	+85° to -65°	
3	Arm motion	+70° to -180°	
4	Wrist motion	+300° to -300°	IRB 6640ID: the range of movement is the combined value for axis 4 and 6 together.
5	Bend motion	IRB 6640: +120° to -120° IRB 6640ID: +100° to -100°	

*Continues on next page*

## 2 Installation and commissioning

### 2.6.2 Working range and type of motion

*Continued*

Axis	Type of motion	Range of movement	Note
6	Turn motion	IRB 6640: +360° to -360° (default), ± 96 revolutions IRB 6640ID: +300° to -300° ±300° max <sup>1)</sup>	

<sup>1)</sup> The minimum combination of axes 4 and 6.



#### Note

There are limitations of the range of movement with a DressPack/SpotPack application fitted to the robot! See product manual *SpotPack/DressPack IRB 6640* chapter *Installation* section *DressPack cable package*. Art. no. can be found in section [Working range and type of motion on page 73](#).

## 2 Installation and commissioning

### 2.6.3 Risk of tipping/stability

#### 2.6.3 Risk of tipping/stability

##### Risk of tipping

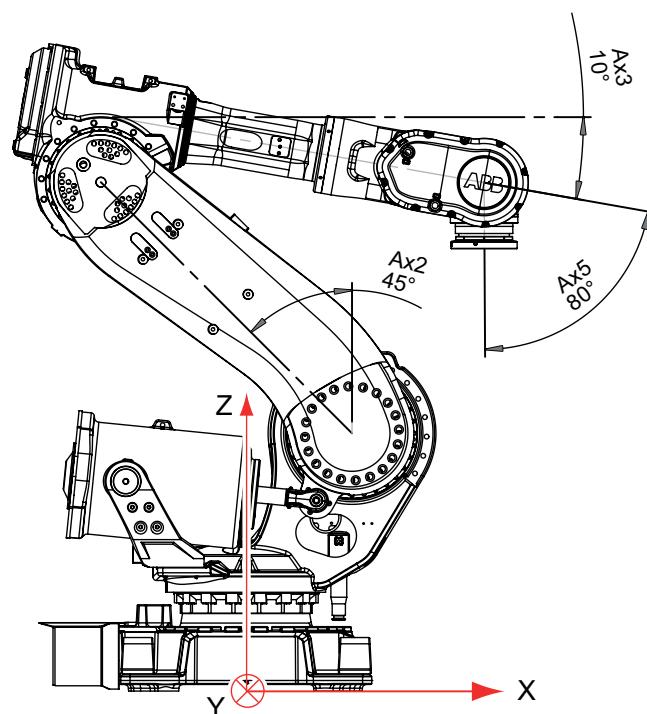
If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

The shipping position is the most stable position.

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

##### Shipping and transportation position

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



xx0600003400



##### WARNING

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

## 2.7 On-site installation

### 2.7.1 Lifting the robot with fork lift accessory

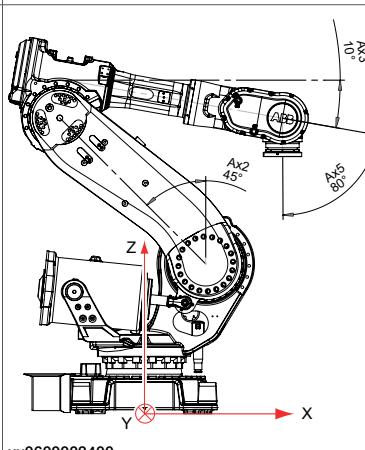
#### 2.7.1.1 Fitting the fork lift accessory

##### Required equipment

The following equipment is required when lifting a robot with the fork lift accessory:

Equipment	Art. no.	Note
Fork lift pocket set	3HAC025040-003	<p>The fork lift accessory set contains:</p> <ul style="list-style-type: none"> <li>• fork lift pocket 3HAC025528-001, with CE-Marking fitted (4 pcs)</li> <li>• attachment screws M20x60 Steel 8.8-A3F (8 pcs)</li> <li>• Drawing Fork lift accessory set</li> <li>• manual <i>Directions for use - Fork lift accessory for IRB 6620, 6640, 460</i></li> </ul>
Fork lift truck	-	The operator must be fully trained and authorized to operate a fork lift truck.

##### Preparations before fitting the fork lift pockets

	Action	Note
1	<p>Remove any tools fitted on the axis-6 turning disk.</p> <p><b>Note</b></p> <p>No tool is permitted to be fitted on the robot when lifting the robot with the fork lift accessory!</p>	DressPack, if used, can stay fitted as long as the tool fitted on the turning disk is removed.
2	<p>Jog the robot to its shipping position. See figures for the different IRB models.</p> <p><b>Note</b></p> <p>The figures shows the shipping position of an <i>undressed</i> robot. If the robot is dressed, this must be taken into consideration when the robot is being lifted.</p>	

Continues on next page

## 2 Installation and commissioning

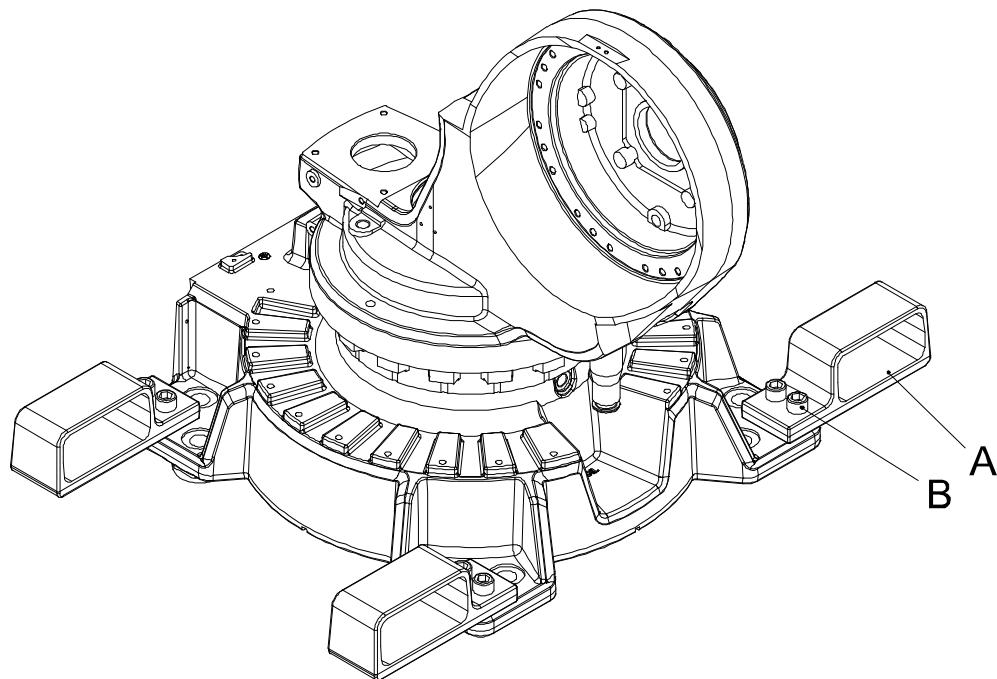
### 2.7.1.1 Fitting the fork lift accessory

*Continued*

	Action	Note
3	<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></ul> <p>to the robot, before entering the robot working area.</p>	

#### Attachment points on the robot

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

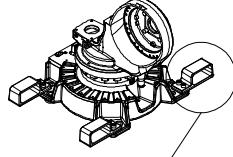
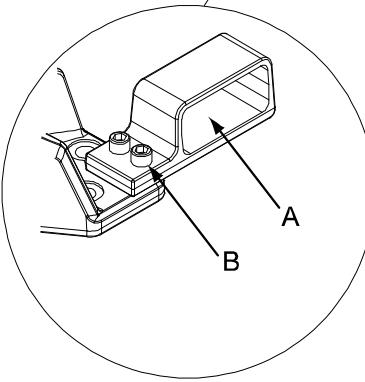


xx0600002910

A	Fork lift pocket
B	Attachment screw M20x60 quality 8.8 (2 pcs x4)

*Continues on next page*

#### Fitting the fork lift accessory set

	Action	Note
1	<p>Fit the four fork lift pockets on the base of the robot with its attachment screws.</p> <p><b>Note</b></p> <p>Before fitting any attachment screws, make sure they are not damaged in any way. Replace damaged screws.</p>	<p>Tightening torque: 300 Nm</p>   <p>xx0600002930</p> <p>A Fork lift pocket (4 pcs) B Attachment screw M20x60 quality 8.8 (2 pcs x4)</p>
2	Verify that all four fork lift pockets are properly secured before lifting.	

## 2 Installation and commissioning

### 2.7.1.2 Lifting the robot with fork lift truck

#### 2.7.1.2 Lifting the robot with fork lift truck

##### General

The robot may be moved using a fork lift truck, provided that a complete fork lift accessory set, aimed for the robot, is used.

This section describes how to lift the robot with a fork lift truck.

##### Required equipment

Equipment	Art. no.	Note
Fork lift accessory	3HAC025040-003	
Fork lift truck		

##### Lifting the robot with fork lift truck

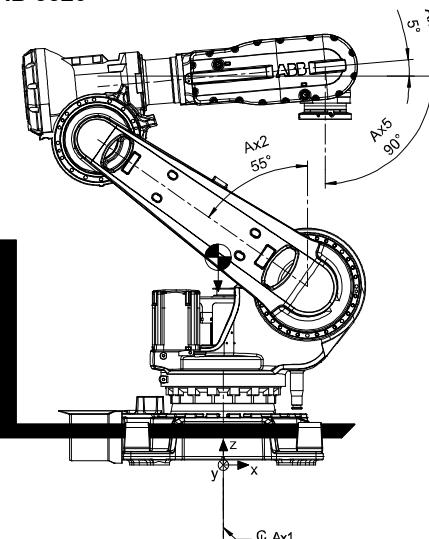
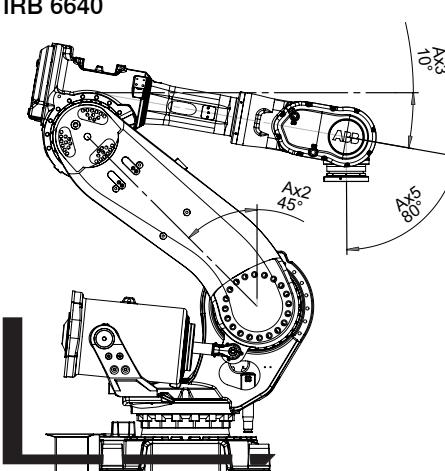
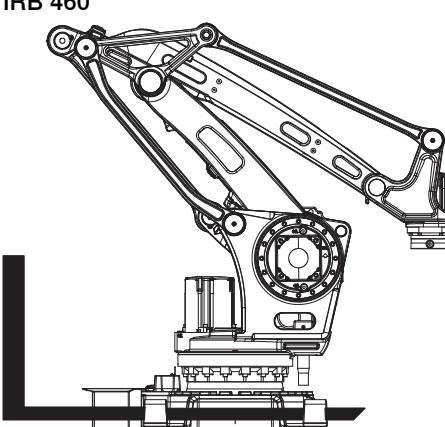
	Action	Note
1	Make sure that the robot is in shipping position!	 Note No load is permitted on the robot!
2	 <b>DANGER</b> Make sure that all supplies for electrical power and hydraulic pressure are turned off.	
3	Verify that all four fork lift pockets are properly secured before lifting.	

*Continues on next page*

## 2 Installation and commissioning

### 2.7.1.2 Lifting the robot with fork lift truck

*Continued*

Action	Note
4 Insert fork lift forks into the pockets.	<p><b>CAUTION</b></p> <p>Lifting the robot with fork lift shall only be done with all four fork lift pockets fitted! If lifting with fewer than four fork lift pockets fitted, there is a risk of accidents!</p>  <p>xx060002911</p> <p><b>IRB 6640</b></p>  <p>xx060003401</p> <p><b>IRB 460</b></p>  <p>xx1000001159</p>

*Continues on next page*

## 2 Installation and commissioning

### 2.7.1.2 Lifting the robot with fork lift truck

*Continued*

	Action	Note
5	Remove the attachment bolts securing the robot to the foundation.	
6	 <b>CAUTION</b> The IRB 6640 Foundry Prime robot weighs 1,340 kg (IRB6640), 1,405 kg (IRB6640ID) All lifting accessories used must be sized accordingly!	
7	Carefully lift the robot.   <b>WARNING</b> Personnel must not, under any circumstances, be present under the suspended load!	
8	Move the robot slowly to its new position.	 <b>Note</b> Move the robot with low speed!
9	Secure the robot to the foundation   <b>DANGER</b> Do not power the robot up until it is secured properly to the foundation.	
10	Remove the fork lift accessories.	

## 2.7.2 Lifting robot with roundslings

### General

The robot can be lifted with roundslings according to this section.

### Sling specification

Sling type	Qty	Lifting capacity	Length / Note
Roundsling, robot	4 pcs	2 000 kg	2.5 m
Roundsling, upper arm	1 pc	2 000 kg	<b>Note!</b> Do not stretch! 2 m Secures against rotation.

### Lifting with roundslings

	Action	Note
1	Position robot in a secure transport position.	
2	Attach roundslings to robot according to figure <a href="#">Attachment points on page 84</a> .	 <b>Note</b> For Cleanroom robots it is important to apply the roundslings: <ul style="list-style-type: none"> <li>between robot harness and lower arm</li> <li>behind the side bracket, balancing cylinder.</li> </ul>
3	 <b>CAUTION</b> The IRB 6640 Foundry Prime robot weighs 1,340 kg (IRB6640), 1,405 kg (IRB6640ID). All lifting accessories used must be sized accordingly!	 <b>Note</b> If the robot is equipped with <i>fork lift pockets</i> an extra weight of 90 kg must be added to the robot weight!
4	 <b>WARNING</b> Personnel must not, under any circumstances, be present under the suspended load!	

*Continues on next page*

## 2 Installation and commissioning

### 2.7.2 Lifting robot with roundslings

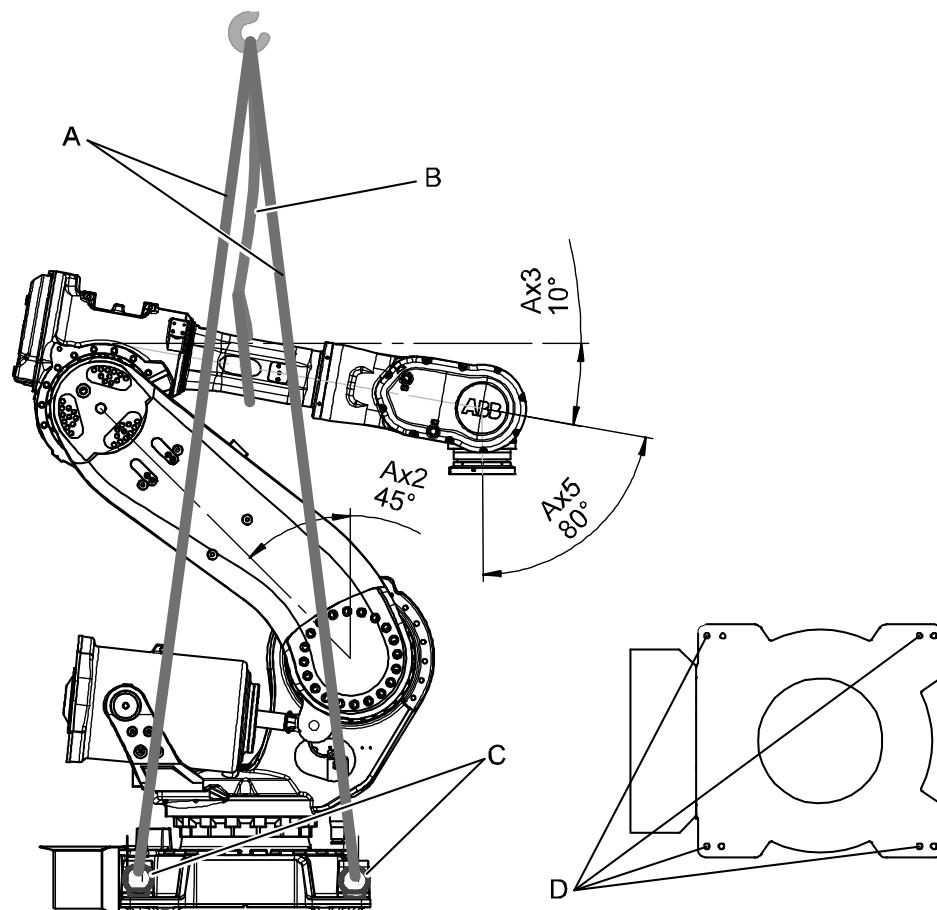
Continued

#### Attachment points

This figure shows how to attach the roundslings to the robot.

The illustration is similar with the label attached to the robot's lower arm.

IRB 6640 standard.



xx0600003455

-	Lifting instruction 3HAC027647-001
A	Roundsling robot, 2.5 m (4 pcs) Capacity: 2.000 kg.
B	Roundsling upper arm, 2 m. <i>Note!</i> Make a loop around the upper arm and wrap the roundsling twice around the upper arm! <i>Do not stretch!</i>
C	Lifting eye M20 (4 pcs). <i>Note!</i> Fit lifting eyes in the rear holes.
D	Holes for lifting eyes in the robotbase. (Rear holes)

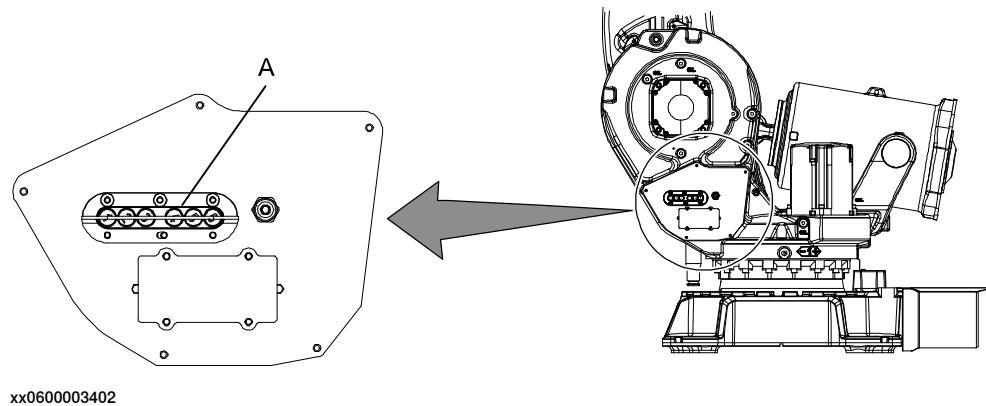
## 2.7.3 Manually releasing the brakes

### Introduction to manually releasing the brakes

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

### Location of brake release unit

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



### Releasing the brakes

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

	Action	Note
1	<p>The internal brake release unit is equipped with buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes.</p> <p>If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section <a href="#">Supplying power to connector R1.MP on page 86</a>.</p>	Buttons are shown in figure <a href="#">Location of brake release unit on page 85</a> .
2	<p> <b>DANGER</b></p> <p>When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways.</p> <p>Make sure no personnel is near or beneath the robot arm.</p>	
3	<p>Release the holding brake on a particular robot axis by pressing the corresponding button on the internal brake release unit.</p> <p>The brake will function again as soon as the button is released.</p>	

*Continues on next page*

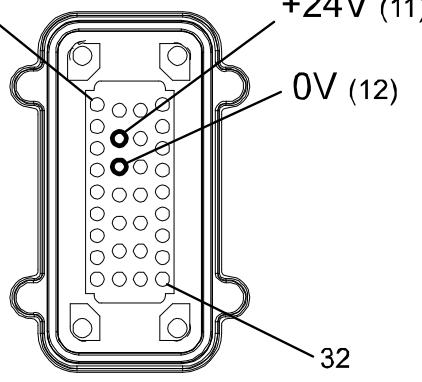
## 2 Installation and commissioning

### 2.7.3 Manually releasing the brakes

*Continued*

#### Supplying power to connector R1.MP

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

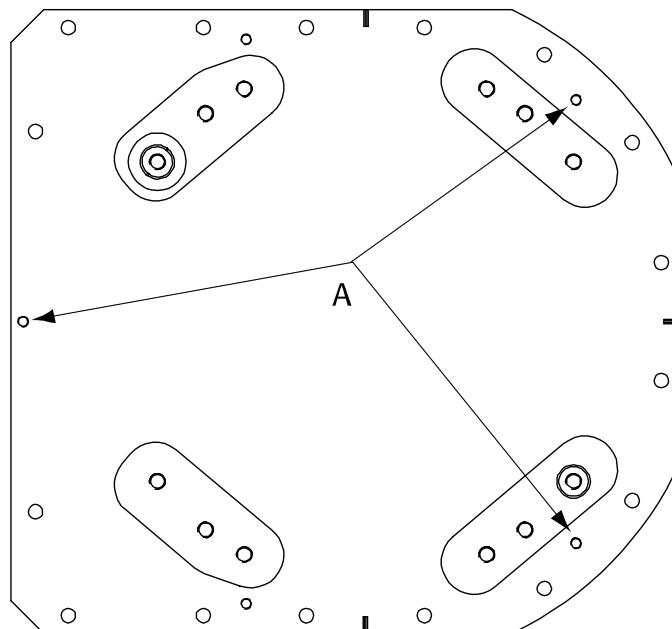
Action	Note
1  <b>DANGER</b> Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	
2 Supply 0V on pin 12 and 24V on pin 11.	 xx0600002937

## 2.7.4 Lifting the base plate

### Required equipment

Equipment	Article number	Note
Lifting eye, M16	3HAC14457-4	3 pcs
Lifting slings		Length: approx. 2 m

### Hole configuration



xx0200000096

A	Attachment holes for lifting eyes (x3)
---	--

### Lifting, base plate

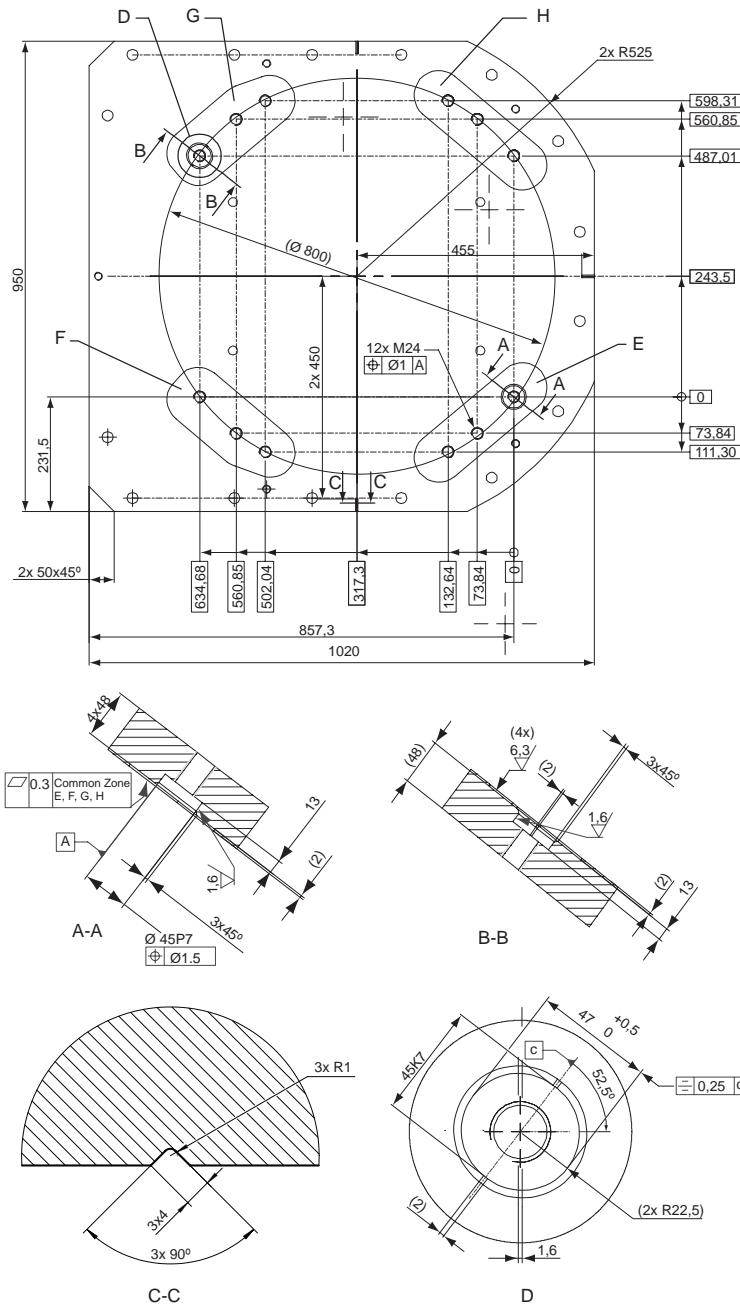
	Action	Note
1	<p><b>!</b> <b>CAUTION</b></p> <p>The base plate weighs 353 kg. All lifting accessories used must be sized accordingly.</p>	
2	Fit lifting eyes in specified holes.	Shown in figure <a href="#">Hole configuration on page 87</a> .
3	<p><b>!</b> <b>CAUTION</b></p> <p>Lift and move the base plate very slowly. If the base plate starts to swing it is a risk for injuries or damage.</p>	

## 2 Installation and commissioning

### 2.7.5 Securing the base plate

#### 2.7.5 Securing the base plate

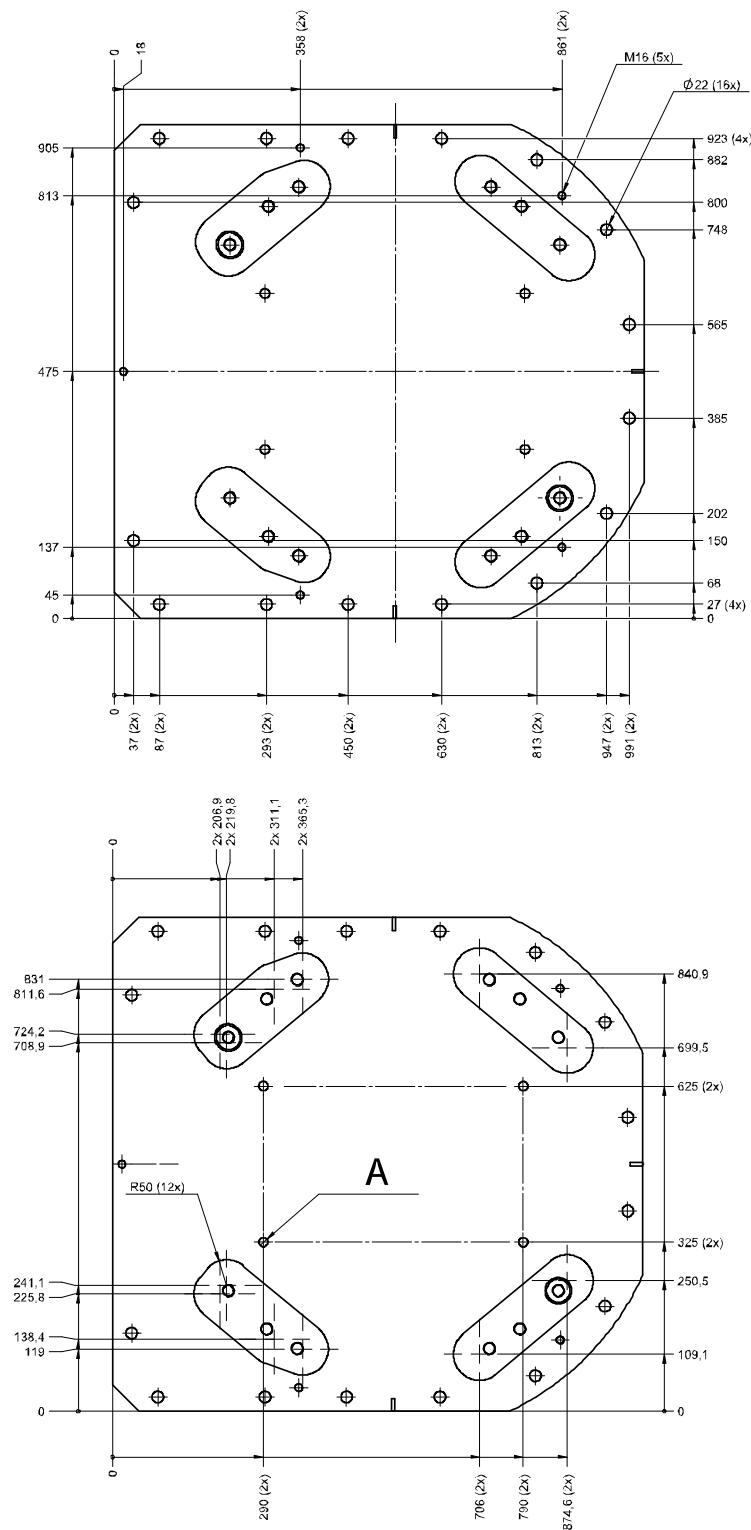
##### Base plate, dimensions



Continues on next page

### 2.7.5 Securing the base plate

*Continued*



xx0400000715

A	Four holes for alternative clamping, 4x Ø18
---	---

*Continues on next page*

## 2 Installation and commissioning

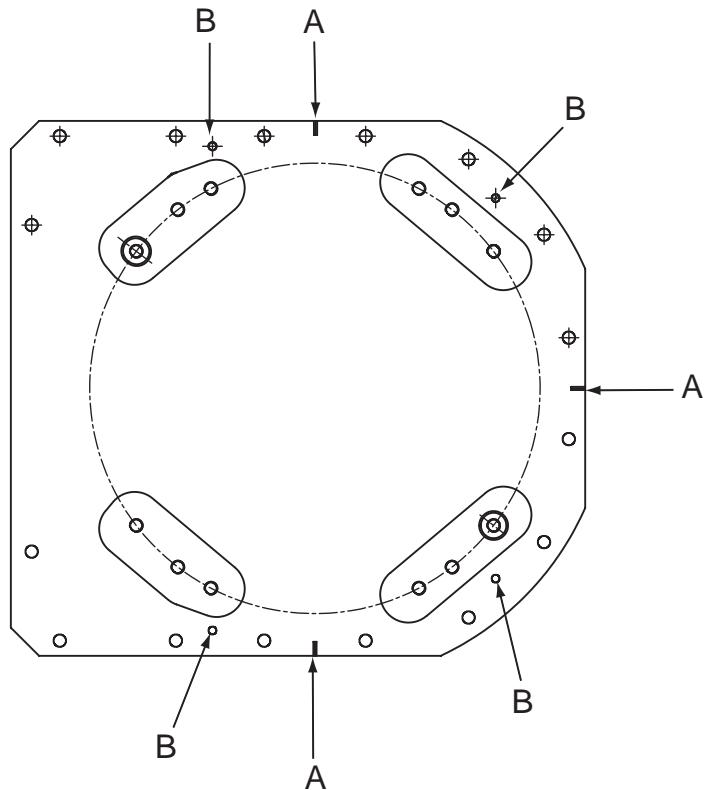
### 2.7.5 Securing the base plate

*Continued*

---

#### Base plate, orienting grooves and leveling bolts

The illustration below shows the orienting grooves and attachment holes for leveling bolts in the base plate.



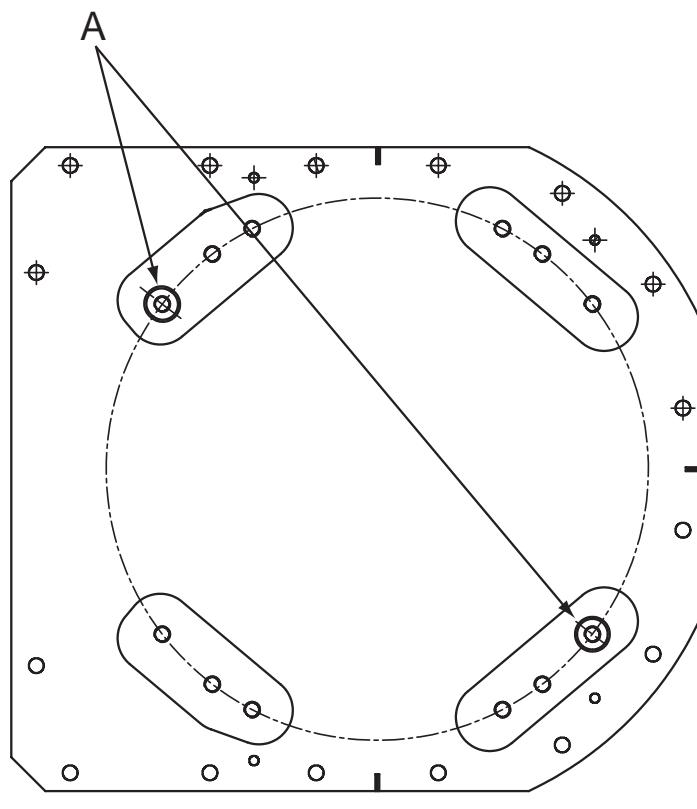
xx1500000312

A	Orienting grooves (3 pcs)
B	Levelling bolts, attachment holes (4 pcs)

*Continues on next page*

**Base plate, guide sleeve holes**

The illustration below shows the orienting grooves and guide sleeve holes in the base plate.



xx030000045

A	Guide sleeve holes (2 pcs)
---	----------------------------

**Required equipment**

Equipment	Article number	Note
Base plate	3HAC12937-9	Includes <ul style="list-style-type: none"> <li>guide sleeves, 3HAC12937-3</li> <li>levelling screws, 9ADA120-79</li> <li>attachment screws and washers for securing the robot to the base plate.</li> </ul>
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

**Base plate**

This section details how to secure the base plate to the foundation.

Action	Note
1 Make sure the foundation is levelled.	

Continues on next page

## 2 Installation and commissioning

### 2.7.5 Securing the base plate

Continued

	Action	Note
2	 <b>CAUTION</b> The base plate weighs 353 kg! All lifting equipment used must be sized accordingly!	
3	Position base plate in relation to the robot work location using the grooves in the base plate.	Shown in figure <a href="#">Base plate, orienting grooves and leveling bolts on page 90</a> .
4	Lift the base plate to its mounting position.	Detailed in section <a href="#">Lifting the base plate on page 87</a> .
5	Use the base plate as a template and drill attachment holes as required by the selected bolt dimension.	Attachment holes: 16 pcs.
6	Fit the base plate and use the levelling bolts to level the base plate.	Shown in figure <a href="#">Base plate, orienting grooves and leveling bolts on page 90</a> .
7	If required, fit strips of sheet metal underneath the base plate to fill any gaps.	
8	Secure the base plate to the foundation with screws and sleeves.	
9	Recheck the four contact surfaces on the base plate to make sure the base plate is levelled and flat. If it is not, use pieces of sheet metal or similar to bring the base plate to a levelled position.	Maximum allowed deviation all over the base plate, from one contact surface to the other: 0.3 mm.

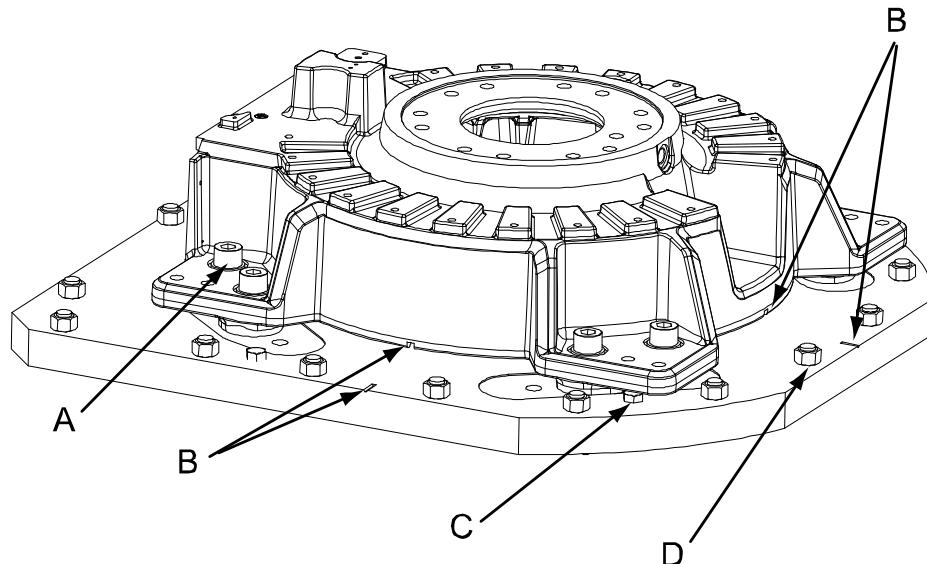
## 2.7.6 Orienting and securing the robot

### General

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

### Illustration, robot fitted to base plate

This illustration shows the robot base fitted to the base plate.



xx0600002933

A	Robot attachment bolts and washers, 8 pcs (M24 x 100)
B	Orienting grooves in the robot base and in the base plate
C	Levelling screws. Note! Remove before the robot base is fitted!
D	Base plate attachment screws

### Attachment screws

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

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

*Continues on next page*

## 2 Installation and commissioning

### 2.7.6 Orienting and securing the robot

*Continued*

#### Securing the robot

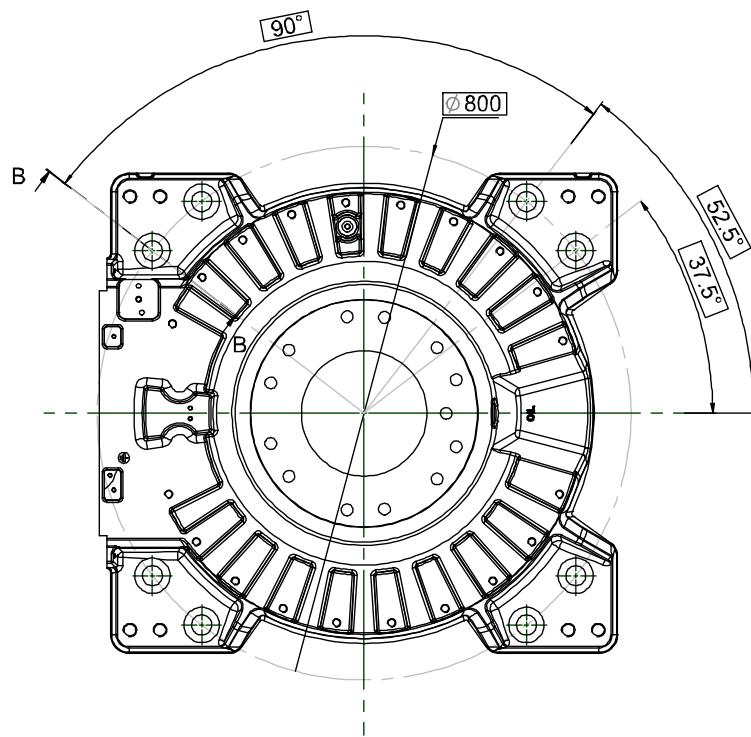
Use this procedure to secure robot to base plate after fitting plate to the foundation.

	Action	Note
1	Lift the robot.	See section <a href="#">Lifting robot with round-slings on page 83</a> .
2	Move robot to the vicinity of its installation location.	
3	Fit two guide sleeves to the <i>guide sleeve holes</i> in the base plate.	Shown in figure <a href="#">Base plate, guide sleeve holes on page 91</a> .   Note One of the guide sleeve holes is elongated!
4	Guide the robot gently using two M24 screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the guide sleeves!
5	Fit the <i>bolts and washers</i> in the base attachment holes.	Specified in <a href="#">Attachment screws on page 93</a> . Shown in figure <a href="#">Illustration, robot fitted to base plate on page 93</a> .   Note Lightly lubricate screws before assembly!
6	Tighten bolts in a criss-cross pattern to ensure that the base is not distorted.	

*Continues on next page*

#### Hole configuration, base

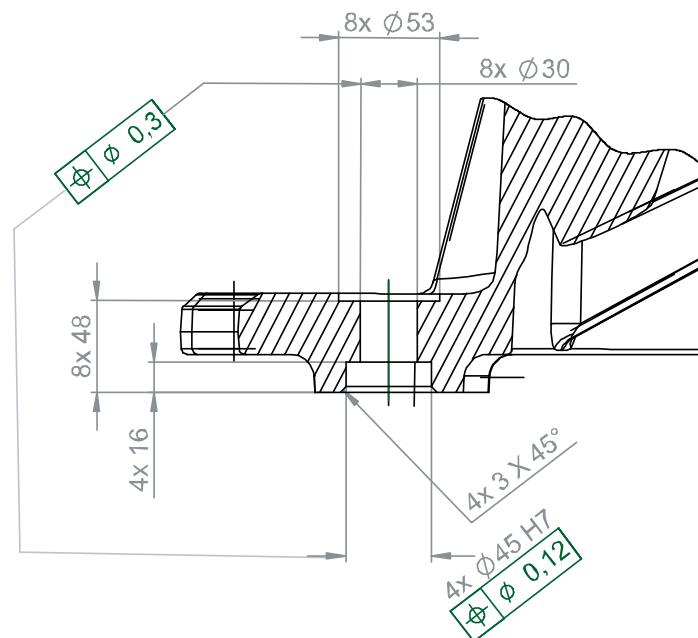
This illustration shows the hole configuration used when securing the robot.



xx0600003403

#### Cross section, guide sleeve hole

This illustration shows the cross section of the guide sleeve holes.



xx0600003404

## 2 Installation and commissioning

### 2.7.7 Fitting equipment on robot

#### General

The robot features mounting holes for additional equipment.

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



#### Note

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

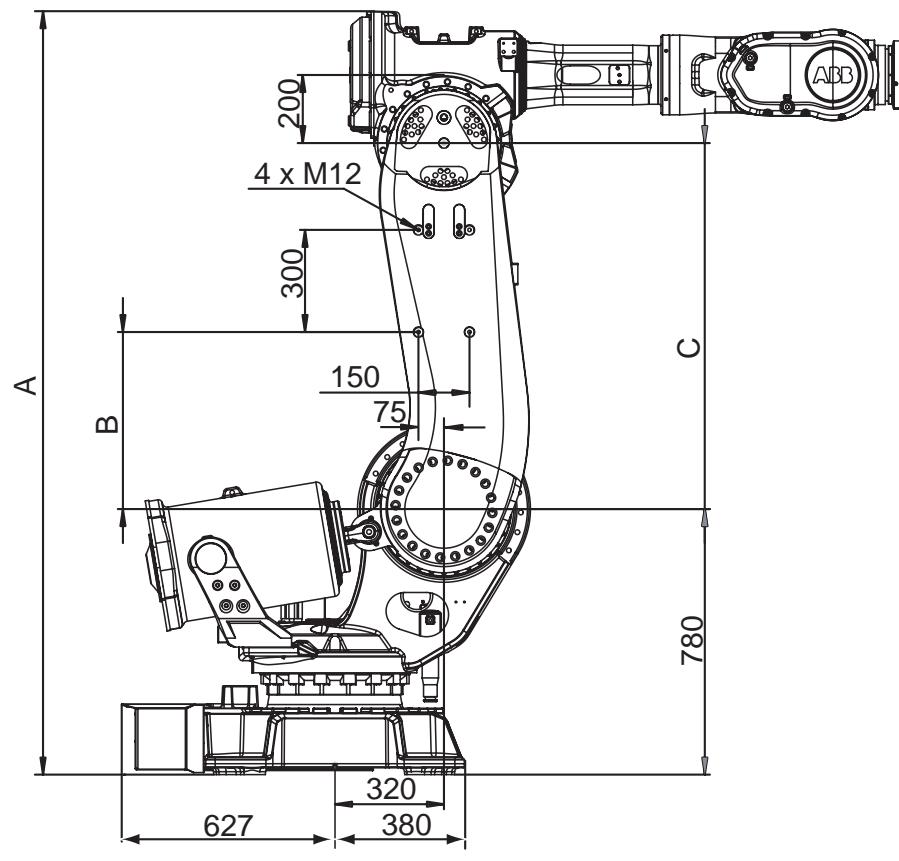
#### Illustration, fitting of extra equipment on lower arm

The illustrations below shows the mounting holes available for fitting extra equipment on the lower arm.

Make sure not to damage the robot cabling on the inside of the lower arm when fitting extra equipment. Always use appropriate attachment screws!

**Note!** Extra equipment may not be mounted on the lower arm of IRB 6640ID!

**Note!** Extra equipment may not be fitted on the lower arm of Cleanroom robots!



xx0600003405

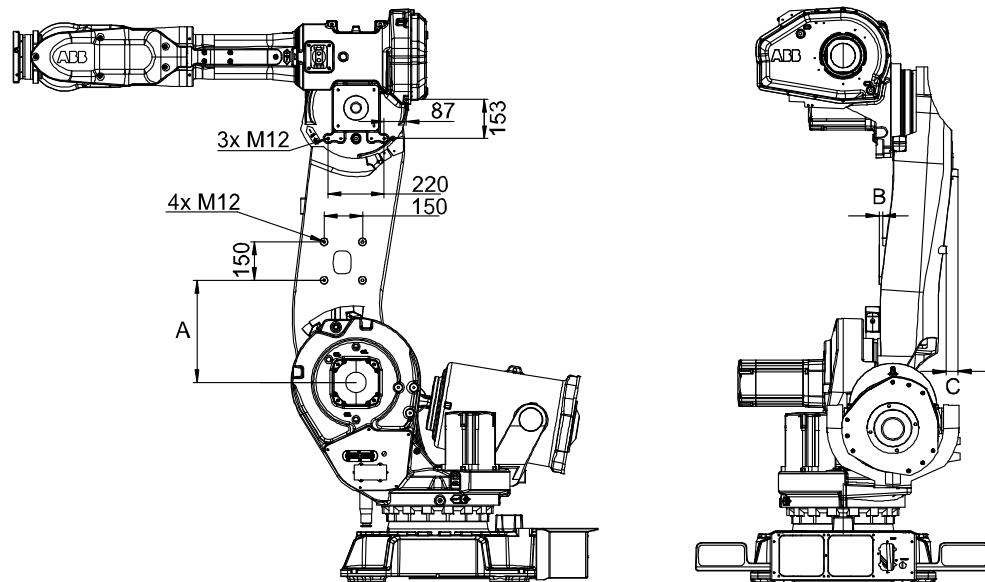
*Continues on next page*

## 2 Installation and commissioning

### 2.7.7 Fitting equipment on robot

*Continued*

Robot variant	A	B	C
IRB 6640 - 2.55	2240 mm	520 mm	1075 mm
IRB 6640 - 2.75	2445 mm	725 mm	1280 mm
IRB 6640 - 2.8	2240 mm	520 mm	1075 mm
IRB 6640 - 3.2	2445 mm	725 mm	1280 mm
IRB 6640ID - 2.55	2240 mm	520 mm	1075 mm
IRB 6640ID - 2.75	2445 mm	725 mm	1280 mm



xx0600003406

Robot variant	A	B	C
IRB 6640 - 2.55	400 mm	13 mm	40 mm
IRB 6640 - 2.75	500 mm	13 mm	30 mm
IRB 6640 - 2.8	400 mm	13 mm	40 mm
IRB 6640 - 3.2	500 mm	13 mm	30 mm
IRB 6640ID - 2.55	400 mm	13 mm	40 mm
IRB 6640ID - 2.75	500 mm	13 mm	30 mm

*Continues on next page*

## 2 Installation and commissioning

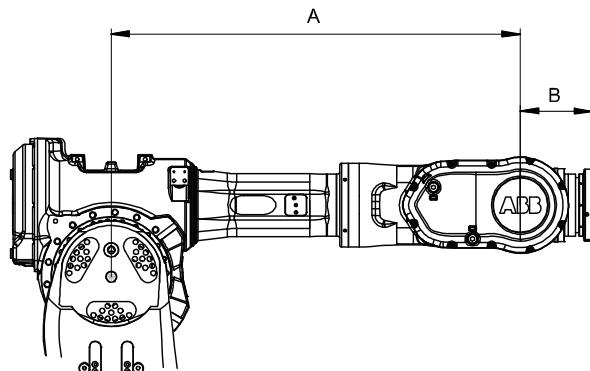
### 2.7.7 Fitting equipment on robot

*Continued*

#### Illustration, fitting of extra equipment on upper arm

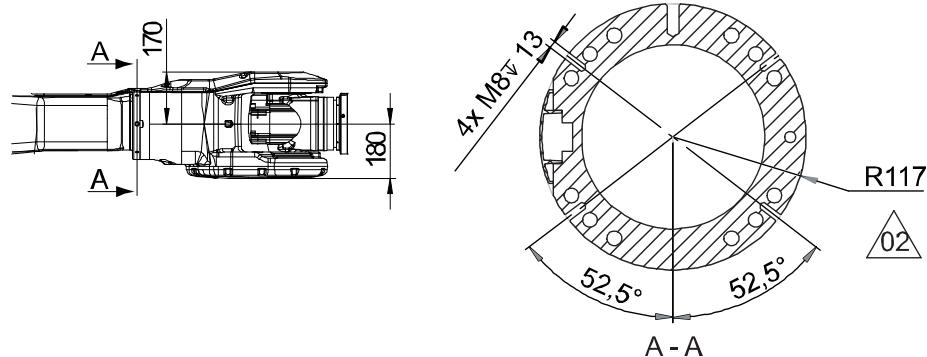
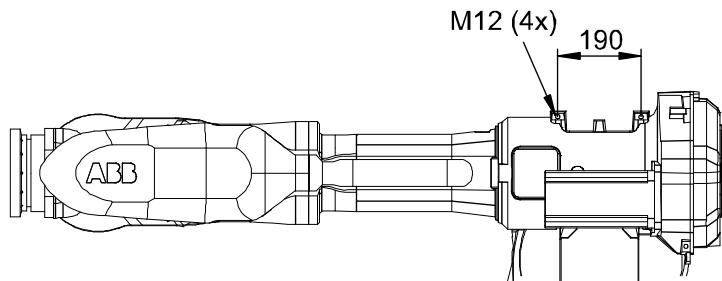
The illustrations below shows the mounting holes available for fitting extra equipment on the upper arm.

**Note!** Extra equipment may not be fitted on the upper arm of IRB 6640ID and Cleanroom robots!



xx0600003414

Robot variant	A	B
IRB 6640 - 2.55	1142 mm	200 mm
IRB 6640 - 2.75	1142 mm	200 mm
IRB 6640 - 2.8	1392 mm	200 mm
IRB 6640 - 3.2	1592 mm	200 mm
IRB 6640ID	1142 mm	290 mm
IRB 6640ID	1142 mm	290 mm

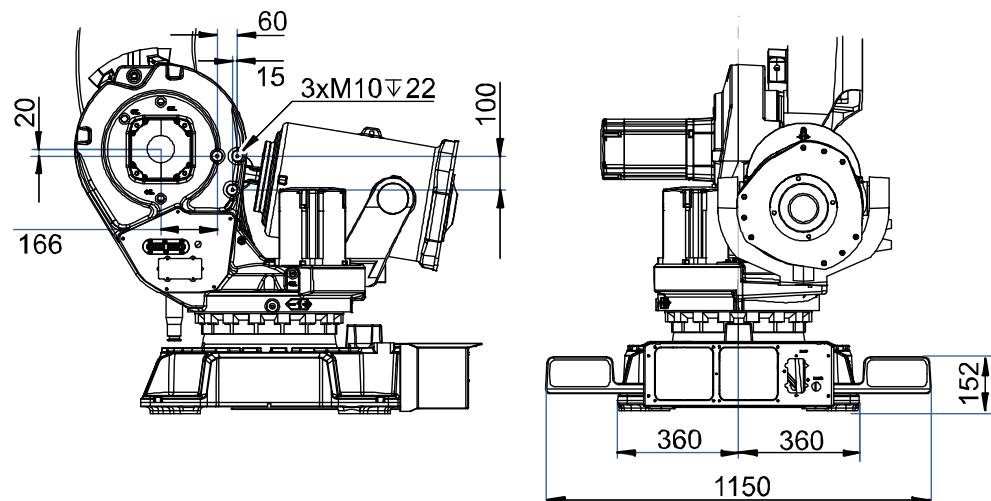


xx1000000158

*Continues on next page*

#### Illustration, fitting of extra equipment on frame

The mounting holes available for fitting extra equipment on the frame are shown below.



xx0600003416

*Continues on next page*

## 2 Installation and commissioning

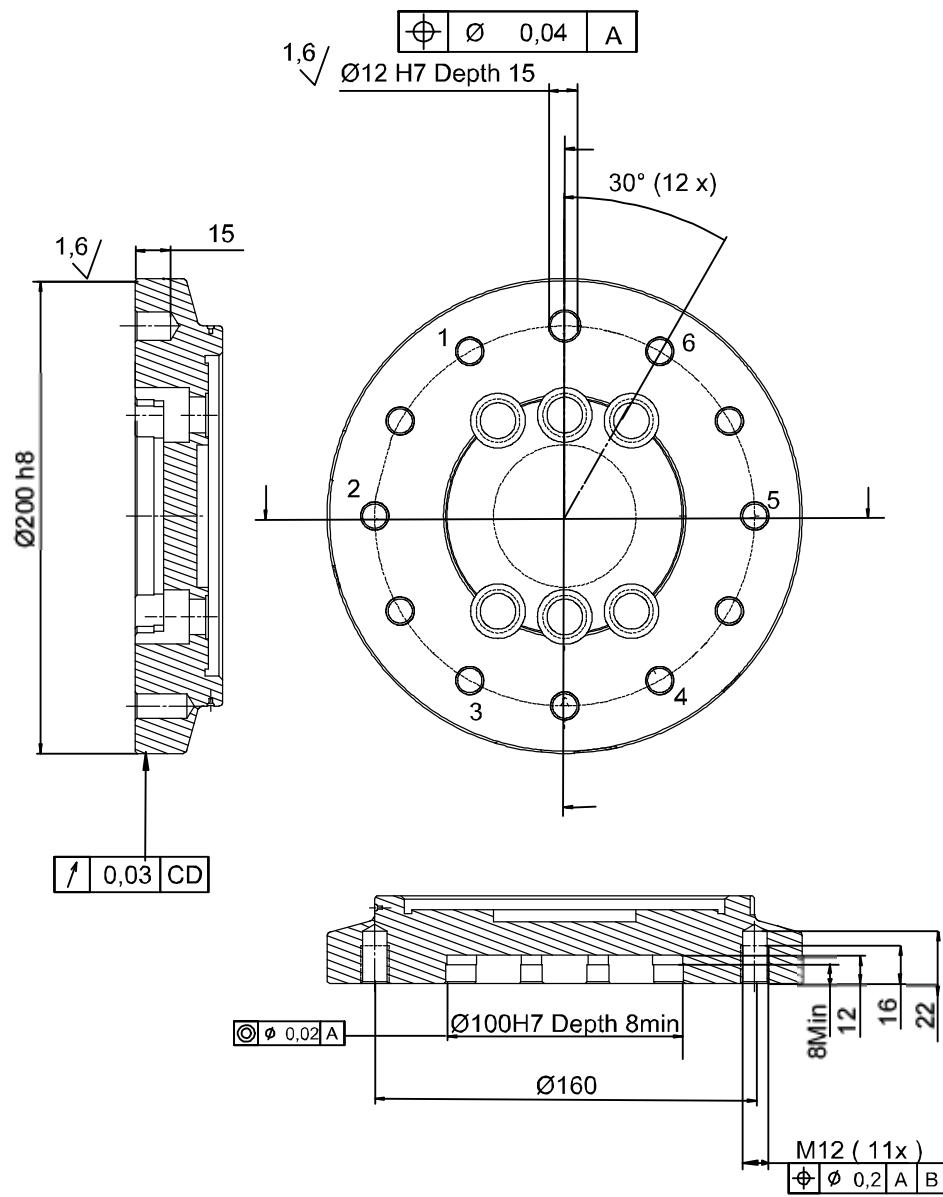
### 2.7.7 Fitting equipment on robot

Continued

#### Illustration, fitting on turning disc

The illustration below shows the mounting holes available for fitting equipment on the turning disc.

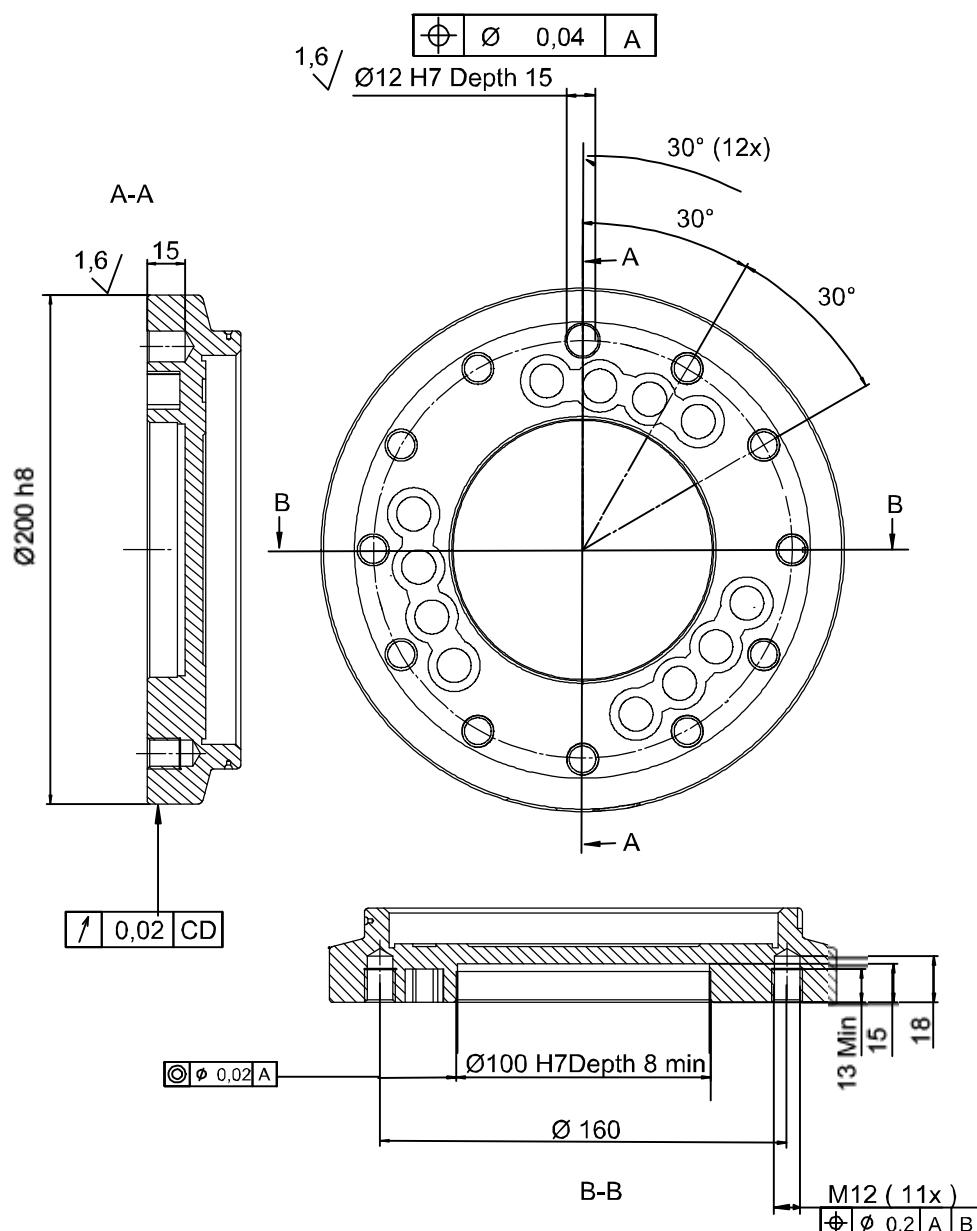
There are different versions of the turning disc, as shown in the illustrations below.



xx0200000397

-	Turning disk type 1
---	---------------------

Continues on next page



xx0200000197

#### Fastener quality

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

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

## **2 Installation and commissioning**

---

### **2.7.8 Surface inspection before start-up - Foundry Prime**

#### **2.7.8 Surface inspection before start-up - Foundry Prime**

##### **Foundry Prime coating**

Make sure that the special Foundry Prime painting of the robot arm surfaces is not broken or there have been any other damages during testing and installation.

Even a small collision during installation can destroy the preventive coating and the corrosion barrier is broken. Use the Touch up kit available for Foundry Prime, 3HAC035355-001, to repair damages to paint surfaces.

---

##### **Pre-installation procedure/ Operation conditions, robot**

Parameter	Value
Minimum ambient temperature	+5° C
Maximum ambient temperature	+50° C
Maximum ambient humidity	100% at constant temperature (gaseous only)

---

##### **Protect attachment bolts and washers at the base**

Protect the attachment bolts and washers (M24x100) at the base from physical obstructions and splashes with appropriate shield.

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

##### General

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



##### CAUTION

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

##### References

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

- *Operating manual - IRC5 with FlexPendant*

##### Stopping time and braking distances

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

## **2 Installation and commissioning**

---

### **2.7.10 Installation of signal lamp (option)**

---

#### **Signal lamp**

See the assembly instruction delivered with the signal lamp.

## 2.8 Restricting the working range

### 2.8.1 Axes with restricted working range

#### General

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

The working range of the following axes may be restricted:

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

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



#### Note

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

## 2 Installation and commissioning

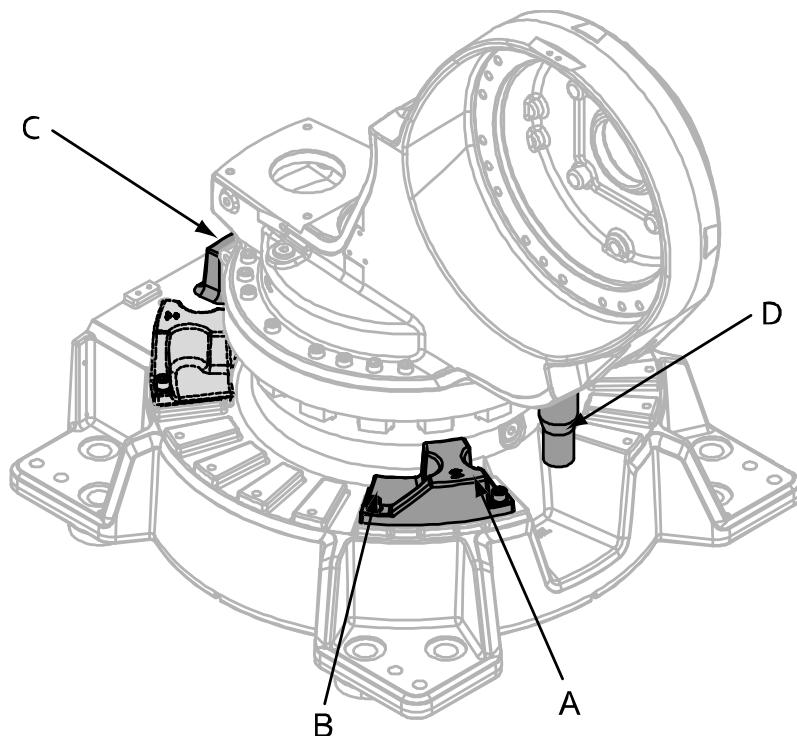
### 2.8.2 Mechanically restricting the working range of axis 1

#### General

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

#### Mechanical stops, axis 1

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



xx0600002938

A	Movable mechanical stop
B	Attachment screw plus washer, M12 x 40 quality 12.9 (2 pcs)
C	Fixed mechanical stop
D	Mechanical stop pin axis 1

*Continues on next page*

### 2.8.2 Mechanically restricting the working range of axis 1

*Continued*

#### Required equipment

Equipment, etc.	Article number	Note
Movable mechanical stop set, axis 1 (+15°/-7.5°)	3HAC025204-003	Includes: <ul style="list-style-type: none"><li>• one stop (+15°/-7.5°), 3HAC025366-001</li><li>• one stop (+7.5°/-15°), 3HAC025367-001</li><li>• attachment screws and washers</li><li>• document for movable mech.stop, 3HAC025204-002</li></ul>
Standard toolkit	-	
<i>Technical reference manual - System parameters</i>	-	Article number is specified in section <a href="#">References on page 10</a> .

#### Installation, mechanical stops axis 1

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

	Action	Note
1	 <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></ul> Before entering the robot working area.	
2	Fit the additional mechanical stop to the frame according to the figure <a href="#">Mechanical stops, axis 1 on page 106</a> .	Tightening torque: 120 Nm.
3	Adjust the software working range limitations (system parameter configuration) to correspond to the mechanical limitations.	The system parameters that must be changed ( <i>Upper joint bound</i> and <i>Lower joint bound</i> ) are described in <i>Technical reference manual - System parameters</i> .
4	 <b>WARNING</b> If the mechanical stop pin is deformed after a hard collision, it must be replaced! <b>Deformed movable stops and/or additional stops as well as deformed attachment screws</b> must also be replaced after a hard collision.	

## 2 Installation and commissioning

### 2.8.3 Mechanically restricting the working range of axis 2

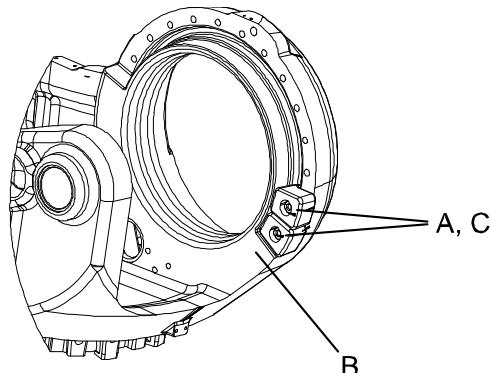
#### General

The working range of axis 2 is limited by fixed mechanical stops and can be reduced by adding up to six additional mechanical stops with 15 graduation in respective direction.

#### Mechanical stops, axis 2

The illustration shows the mounting position of the mechanical stops on axis 2.

The figure shows IRB 7600 but the principle is the same.



xx1000000163

A	Additional stops, axis 2
B	Fixed stop, axis 2
C	Attachment screw + washer M16x50 quality 12.9

#### Required equipment

Equipment, etc.	Art. no.	Note
Mechanical stop set, axis 2	3HAC13787-1	Includes six stops, attachment screws, washers and assembly drawings.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
<i>Technical reference manual - System parameters</i>	-	Art. no. is specified in section <a href="#">References on page 10</a> .

#### Installation, mechanical stops axis 2

Use the procedure to fit the mechanical stops for axis 2 to the robot. An assembly drawing is also enclosed with the product.

	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></ul> Before entering the robot working area.	

Continues on next page

### 2.8.3 Mechanically restricting the working range of axis 2

*Continued*

	Action	Note
2	Fit and tighten the additional stops in a row, starting from the fixed stop.	Tightening torque: 115 Nm. Shown in the figure <a href="#">Mechanical stops, axis 2 on page 108</a> .
3	The software working range limitations must be redefined to correspond to the changes in the mechanical limitations of the working range.	The system parameters that must be changed ( <i>Upper joint bound</i> and <i>Lower joint bound</i> ) are described in <i>Technical reference manual - System parameters</i> .
4	 <b>WARNING</b>  If the <i>mechanical stop pin</i> is deformed after a hard collision, it must be replaced! Deformed <i>movable stops</i> and/or <i>additional stops</i> as well as deformed <i>attachment screws</i> must also be replaced after a hard collision.	

## 2 Installation and commissioning

### 2.8.4 Mechanically restricting the working range of axis 3

#### General

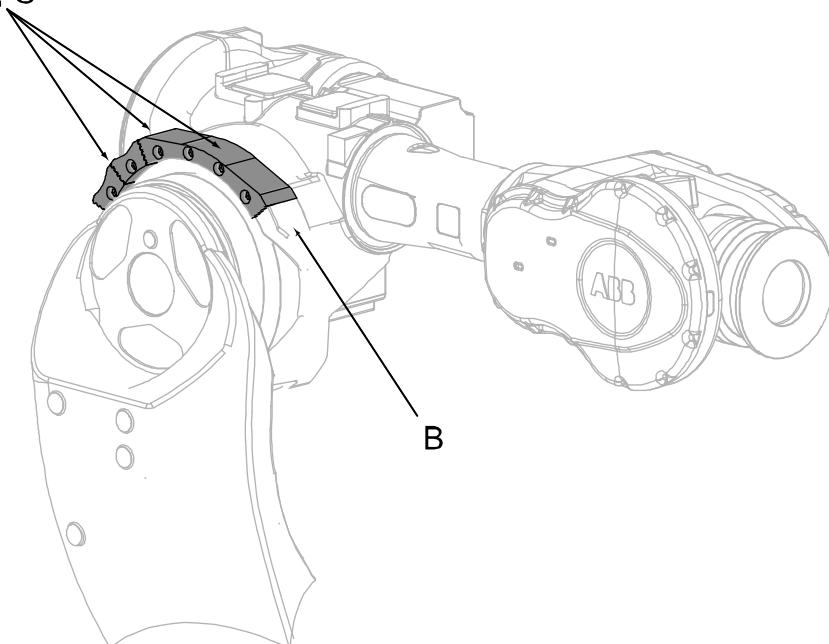
The working range of axis 3 is limited by fixed mechanical stops and can be reduced by adding additional mechanical stops with 20 graduation in respective direction.

#### Mechanical stops, axis 3

The illustration shows the mounting position of the mechanical stops on axis 3.

The figure shows IRB 7600 but the principle is the same.

A, C



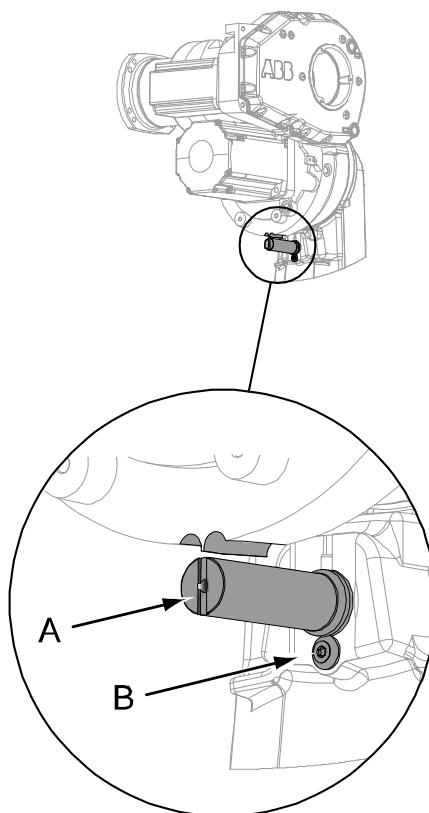
xx0300000048

A	Additional mechanical stops
B	Fixed mechanical stop
C	Attachment screw M16x60 quality 12.9

*Continues on next page*

### 2.8.4 Mechanically restricting the working range of axis 3

*Continued*



xx0600002973

A	Mechanical stop pin, axis 3
B	Attachment screw and washer

#### Required equipment

Equipment, etc.	Art. no.	Note
Mechanical stop set, axis 3	3HAC13128-1	Includes: <ul style="list-style-type: none"><li>• six stops, one with 80° restriction, 3HAC12708-3 (use when limitation angle &gt;=80), and five with 20°, 3HAC12708-1.</li><li>• attachment screws.</li></ul>
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Technical reference manual - System parameters	-	Art. no. is specified in section <a href="#">References on page 10</a> .

*Continues on next page*

## 2 Installation and commissioning

### 2.8.4 Mechanically restricting the working range of axis 3

Continued

#### Installation, mechanical stops axis 3

Use the procedure to fit the mechanical stops for axis 3 to the robot. An assembly drawing is also enclosed with the product.

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></ul> Before entering the robot working area.	
2 Fit and tighten the additional stops in a row, starting from the fixed stop.	Tightening torque: 115 Nm. Shown in the figure <a href="#">Mechanical stops, axis 3 on page 110</a>
3  <b>Note</b> The software working range limitations (system parameters) must be redefined to correspond to the changes in the mechanical limitations of the working range.	The system parameters that must be changed ( <i>Upper joint bound</i> and <i>Lower joint bound</i> ) are described in <i>Technical reference manual - System parameters</i> .
4  <b>WARNING</b> If the <i>mechanical stop pin</i> is deformed after a hard collision, it must be replaced! Deformed <i>movable stops</i> and/or <i>additional stops</i> as well as deformed <i>attachment screws</i> must also be replaced after a hard collision.	

## 2.9 Electrical connections

### 2.9.1 Robot cabling and connection points

#### Introduction

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

#### Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table <a href="#">Robot cables on page 113</a> .
Customer cables (option)	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. See the product manual for the controller, see document number in <a href="#">References on page 10</a> .
External axes cables (option)	Handles power supply to and control of the external axes' motors as well as feedback from the servo system. See the <i>Application manual - Additional axes and stand alone controller (M2004)</i> , see document number in <a href="#">References on page 10</a> .

#### Robot cables

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

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

#### Robot cable, power

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

*Continues on next page*

## 2 Installation and commissioning

### 2.9.1 Robot cabling and connection points

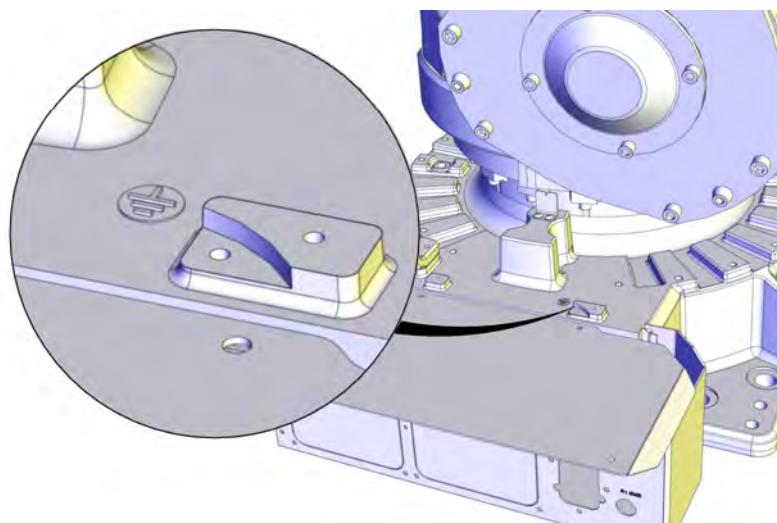
*Continued*

#### Robot cable, signals

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

#### Grounding and bonding point on manipulator

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



xx1500001603

# 3 Maintenance

## 3.1 Introduction for Foundry Prime robots

### Introduction

The Foundry Prime robots are designed for installation and operation in very hard environments. Misuse of the robots, as well as poor installation, cleaning, maintenance, and repair can be harmful for the functioning of the robot.

To eliminate these risks appropriate equipment and procedures are required when installing, cleaning, maintaining, and repairing ABB Foundry Prime robots.

An extended maintenance program including service activities and schedule is required.

Cleaning and maintenance of robots with Foundry Prime protection shall be performed by trained personnel.

### Specific maintenance activities and intervals for Foundry Prime

The Foundry Prime robots have specific maintenance activities and intervals compared to standard robots:

- More comprehensive
- More frequent
- Sample activities for check of lubrication
- Conditional - for example, water content in gearbox control/decide replacement intervals

Preventive measures every 6 months secure the uptime of the robot:

- Inspection of oil level in gearboxes
- Surface treatment
- Cable harness
- Balancing device

### Activity to lubricate gearbox cavities and gears

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

### Non-predictable situations

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



#### Note

Repair damages on painted surfaces as soon as possible. Use the touch-up kit 3HAC035355-001 for Foundry Prime protection.

*Continues on next page*

## **3 Maintenance**

---

### **3.1 Introduction for Foundry Prime robots**

*Continued*

---

#### **Warranty claims**

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

## 3.2 Maintenance schedule and expected component life

### 3.2.1 Specification of maintenance intervals

---

#### Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 6640 Foundry Prime:

- Calendar time: specified in months regardless of whether the system is running or not.
- Operating time: specified in operating hours. More frequent running means more frequent maintenance activities.
- SIS: specified by the robot's SIS (Service Information System). A typical value is given for a typical work cycle, but the value will differ depending on how hard each part is run. The SIS used in M2004 is further described in the *Operating manual - Service Information System*.

### 3 Maintenance

#### 3.2.2 Maintenance schedule

##### 3.2.2 Maintenance schedule

###### General

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

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

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

Values for these are specified in the section [Expected component life on page 121](#)



###### Note

For best reliability, it is of highest importance that the special maintenance instructions for the Foundry Prime robot are followed and documented.

###### Activities and intervals, Foundry Prime

The following table specifies the required maintenance activities and intervals for robots with protection type Foundry Prime.

Maintenance activity	Equipment	Interval
Inspection	Surface treatment	Every: <ul style="list-style-type: none"><li>• 6 months <sup>i</sup></li></ul>
Inspection	Balancing device	Every: <ul style="list-style-type: none"><li>• 2 months</li></ul>
Inspection	Cable harness (Including rubber blocks and straps)	Every: <ul style="list-style-type: none"><li>• 6 months</li></ul> If required <sup>ii</sup>
Replacement	Cable harness	If required <sup>ii</sup>
Inspection	Air hoses	Every: <ul style="list-style-type: none"><li>• 6 months</li></ul>
Inspection	Inspect for corrosion on support shaft with bearing axis5	Every: <ul style="list-style-type: none"><li>• 6 months</li></ul> If corroded: Replace support shaft with bearing. See <a href="#">Replacement of support shaft with bearing axis 5 on page 265</a> .
Inspection	Information labels	Every: <ul style="list-style-type: none"><li>• 12 months</li></ul>
Inspection	Dampers	Every: <ul style="list-style-type: none"><li>• 12 months</li></ul>
Inspection	Mechanical stop, axis 1	Every: <ul style="list-style-type: none"><li>• 12 months</li></ul>
Inspection	Oil level in gearbox axis 1-6	Every: <ul style="list-style-type: none"><li>• 2 months at start up</li><li>• 6 months</li></ul>

Continues on next page

3.2.2 Maintenance schedule  
*Continued*

Maintenance activity	Equipment	Interval
Analysis	Oil gearbox axis 1-6	Every: • 6 months
Changing <sup>iii</sup>	Oil in axis-1 gearbox	Every: • 6 months
Changing <sup>iii</sup>	Oil in axis-2 gearbox	Every: • 6 months
Changing <sup>iii</sup>	Oil in axis-3 gearbox	Every: • 6 months
Changing <sup>iii</sup>	Oil in axis-4 gearbox	Every: • 6 months
Changing <sup>iii</sup>	Oil in axis-5 gearbox	Every: • 6 months
Changing <sup>iii</sup>	Oil in axis-6 gearbox	Every: • 6 months <sup>iv</sup>
Changing	Support shaft with bearing axis 5	Every: • 12 months
Changing	Balancing device, bearings (Standard bearings, rear and front)	Every: • 12 months
Changing	Balancing device, bearings (Solid oil bearings, rear and front)	Every: • 24 months
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert <sup>v</sup>
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert <sup>vi</sup>
Overhaul	Robot	40,000 hours
Overhaul	Axis-6 gearbox	Every: • 24 months
Lubrication	Balancing device, bearings (Standard bearings, rear and front)	Every: • 6 months
Lubrication	Balancing device, bearings (Solid-oil bearings, rear and front)	No re-greasing needed
Rust preventing	Apply Mercasol on output shaft Axis-2 gear	Every: • 6 months
Rust preventing	Apply Mercasol on output shaft Axis-3 gear	Every: • 6 months
Rust preventing	Apply Mercasol on support shaft with bearing axis 5	Every: • 6 months
Rust preventing	Axis-1 sealing	Every: • 6 months
Rust preventing	Axis-4 sealing	Every: • 6 months
Rust preventing	Axis-5 sealing	Every: • 6 months

<sup>i</sup> Damage to painted surfaces must be repaired as soon as possible to avoid corrosion.

<sup>ii</sup> The warranty does not apply to effects or wear caused by environmental factors.

*Continues on next page*

### 3 Maintenance

---

#### 3.2.2 Maintenance schedule

*Continued*

- iii Before changing oil, always check the oil level. Always analyze the water content in the exchanged oil, according to [Analysing the water content in gearbox oil on page 188](#), to determine the condition of each gearbox.  
If the water content in oil is more than 3%, analyze the new oil within 2 months. Repeatedly high water content in oil indicates wear of radial sealing in the gearbox.
- iv If the robot is working in cleaning cells that are not emptied when the robot is switched off, the oil may be replaced more frequently.  
See also [Analysing the water content in gearbox oil on page 188](#).
- v 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.
- vi 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.

### 3.2.3 Expected component life

#### General

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



#### Note

For expected component life of Foundry Prime robots see [Expected component life - protection type Foundry Prime on page 121](#).

#### Expected component life - protection type Standard

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

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

<sup>ii</sup> Severe chemical or thermal environments, or similar environments, can result in shortened life expectancy.

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

<sup>iv</sup> The given life for the balancing device is based on a test cycle of 4,000,000 cycles that starts from the initial position and goes to maximum extension, and back. Deviations from this cycle will result in differences in expected life!

<sup>v</sup> Depending on application, the lifetime can vary. The Service Information System (SIS) that is integrated in the robot software can be used as guidance when planning gearbox service for the individual robot. This applies to gearboxes on axes 1, 2, 3 and 6. The lifetime of gearbox axes 4 and 5 is not calculated by SIS (See the *Operating manual - Service Information System*). In some applications, such as Foundry or Washing, the robot can be exposed to chemicals, high temperature or humidity, which can have an effect on the lifetime of the gearboxes. Contact the local *ABB Robotics Service team* for more information.

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

#### Expected component life - protection type Foundry Prime

The demanding nature of using Foundry Prime robots in a washing application, can shorten the life of the robot's components compared to that of standard robots in a typical robotic application. See [Expected component life - protection type Standard on page 121](#)for standard robots. Depending on the actual washing application, the life of an individual robot can vary or being reduced.

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

- the washing detergent used

*Continues on next page*

### **3 Maintenance**

---

#### **3.2.3 Expected component life**

*Continued*

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

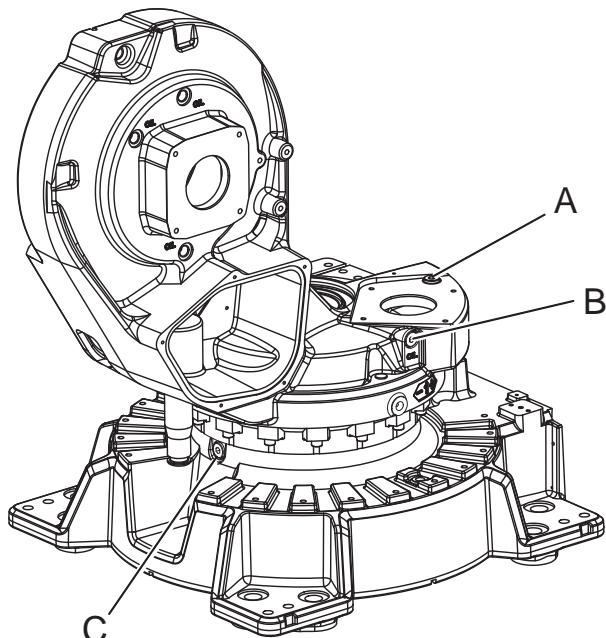
## 3.3.1 Inspecting the oil level in axis-1 gearbox

## 3.3 Inspection activities

## 3.3.1 Inspecting the oil level in axis-1 gearbox

## Location of gearbox

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



xx0600003449

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

## Required equipment

Equipment	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	Note Do not mix with other oils!
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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

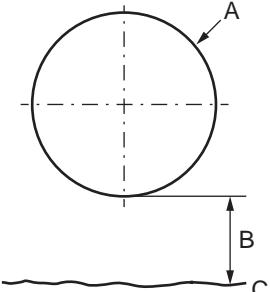
### 3 Maintenance

#### 3.3.1 Inspecting the oil level in axis-1 gearbox

Continued

##### Inspecting the oil level in axis-1 gearbox

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

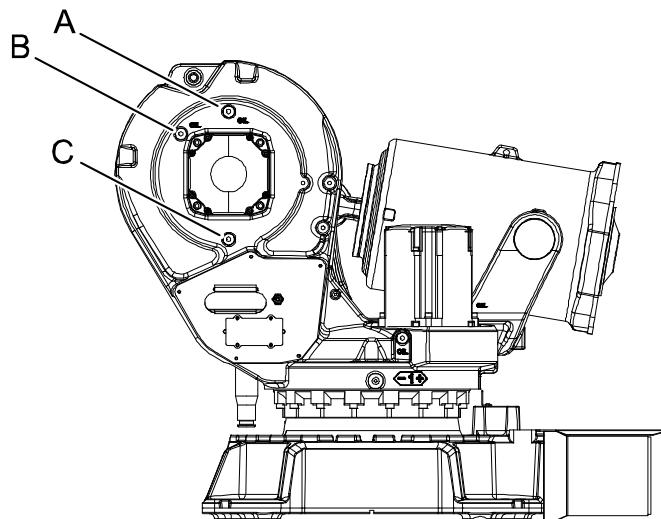
Action	Note
1  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
2  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
3 Make sure that the oil temperature is $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ .	This is a precaution to reduce the temperature dependency of the measurement.
4 Open the <i>oil plug, inspection.</i>	Shown in figure <a href="#">Location of gearbox on page 123</a> .
5 Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
6 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#">Type of lubrication in gearboxes on page 164</a> . Further information about how to fill with oil is found in section <a href="#">Changing oil, axis-1 gearbox on page 166</a> .
7 Refit the oil plug.	Tightening torque: 24 Nm

## 3.3.2 Inspecting the oil level in axis-2 gearbox

## 3.3.2 Inspecting the oil level in axis-2 gearbox

## Location of gearbox

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



xx0600003451

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

## Required equipment

Equipment, etc.,	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	<b>Note!</b> Do not mix with other oils!
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

## Inspecting the oil level in axis-2 gearbox

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

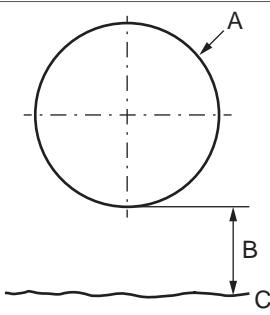
Action	Note
<p>1</p> <p> <b>WARNING</b></p> <p>Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a>.</p>	

Continues on next page

### 3 Maintenance

#### 3.3.2 Inspecting the oil level in axis-2 gearbox

*Continued*

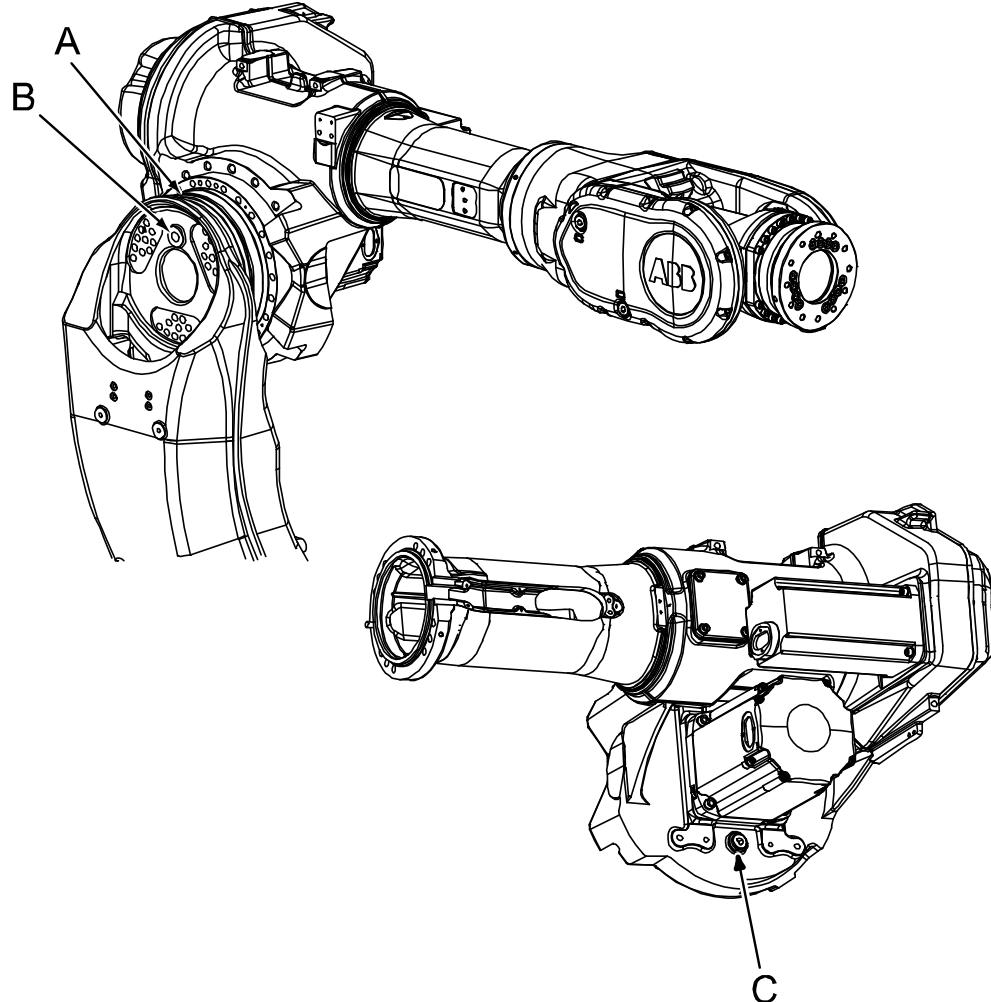
Action	Note
<p>2</p>  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Make sure that the oil temperature is +25°C ±10°C. This is a precaution to reduce the temperature dependency of the measurement.
4	Open the <i>oil plug, filling and inspection.</i> Shown in the figure <a href="#">Location of gearbox on page 125</a> .
5	Measure the oil level. Required oil level: 0-15 mm  xx1400002785 <p>A Oil plug hole B Required oil level C Gearbox oil</p>
6	Adjust the oil level, if required. Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> . Filling of oil is detailed further in the section <a href="#">Filling, oil on page 170</a> .
7	Refit the oil plug. Tightening torque: 24 Nm.

## 3.3.3 Inspecting the oil level in axis-3 gearbox

## 3.3.3 Inspecting the oil level in axis-3 gearbox

## Location of gearbox

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



xx0200000230

A	Gearbox axis 3
B	Oil plug, filling and inspection
C	Oil plug, draining

## Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	<b>Note!</b> Do not mix with other oils!
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455.</a>

Continues on next page

### 3 Maintenance

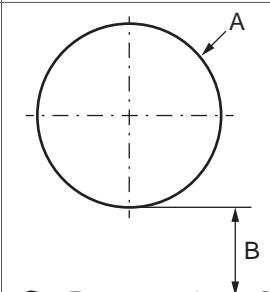
#### 3.3.3 Inspecting the oil level in axis-3 gearbox

Continued

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

#### Inspecting the oil level in axis-3 gearbox

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

Action	Note
1  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
2 Move the robot to a position according to the illustration in <a href="#">Location of gearbox on page 127</a> .	Detailed in the section <a href="#">Synchronization marks and synchronization position for axes on page 434</a> .
3  <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></ul> Before entering the robot working area.	
4 Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5 Open the <i>oil plug, filling and inspection</i> .	Shown in the figure <a href="#">Location of gearbox on page 127</a> .
6 Measure the oil level. Required oil level: 0-20 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil

Continues on next page

#### 3.3.3 Inspecting the oil level in axis-3 gearbox

*Continued*

	Action	Note
7	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#"><i>Type and amount of oil in gearboxes on page 164.</i></a> Further information about how to fill the oil may be found in the section <a href="#"><i>Filling, oil on page 174.</i></a>
8	Refit the oil plug.	Tightening torque:24 Nm

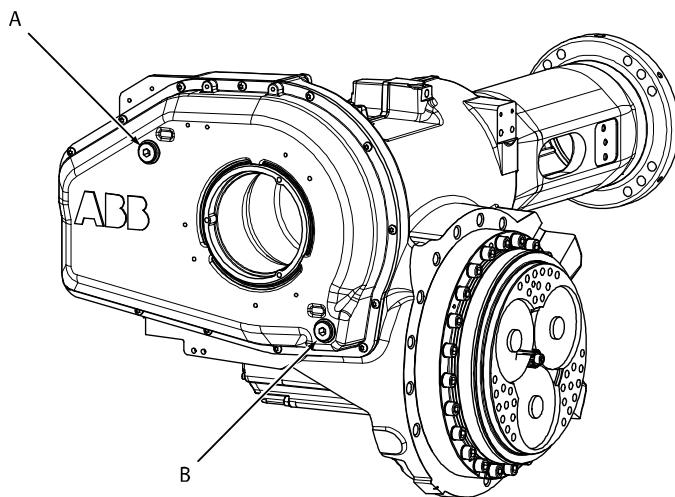
### 3 Maintenance

#### 3.3.4 Inspecting the oil level in axis-4 gearbox

#### 3.3.4 Inspecting the oil level in axis-4 gearbox

##### Location of gearbox

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



xx0200000231

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

##### Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

##### Inspecting the oil level in axis-4 gearbox

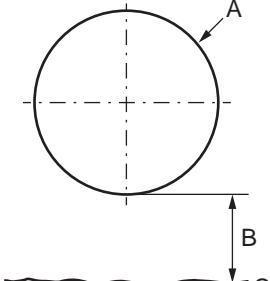
Use this procedure to inspect the oil level in the axis-4 gearbox.

	Action	Note
1	 <b>WARNING</b>  Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	

Continues on next page

## 3.3.4 Inspecting the oil level in axis-4 gearbox

Continued

Action	Note
2 Move the robot to the calibration position.	This is detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 434</a> .
3  <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></ul> Before entering the robot working area.	
4 Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5 Open the <i>oil plug, filling and inspection</i> .	Shown in the figure <a href="#">Location of gearbox on page 130</a> .
6 Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
7 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> . Further information about how to fill the oil may be found in the section <a href="#">Filling, oil on page 176</a> .
8 Refit the oil plug.	Tightening torque: 24 Nm

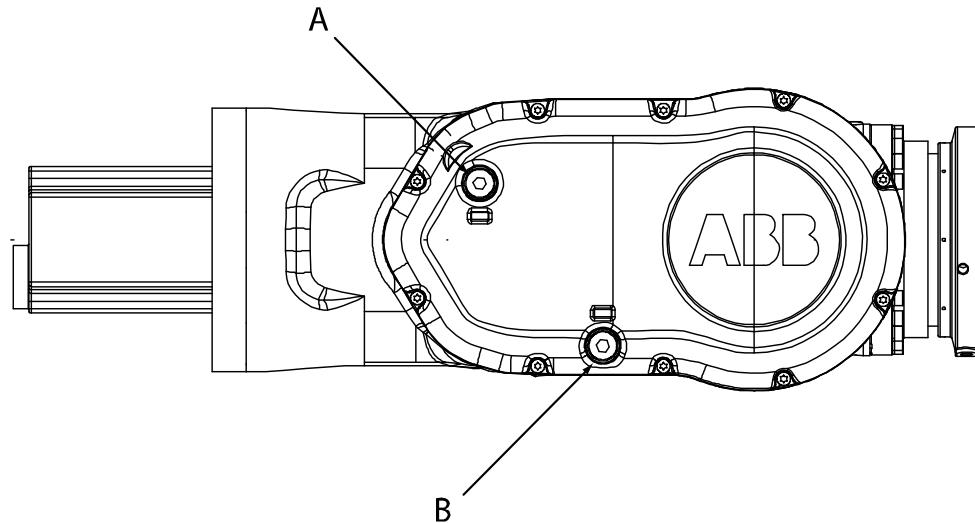
### 3 Maintenance

#### 3.3.5 Inspecting the oil level in axis-5 gearbox

#### 3.3.5 Inspecting the oil level in axis-5 gearbox

##### Location of gearbox

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



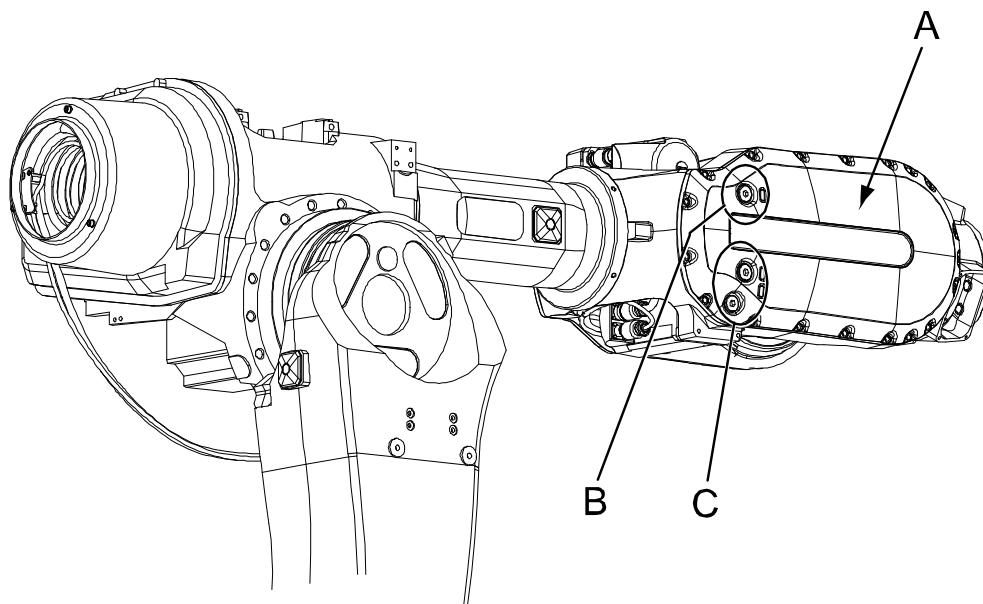
xx0200000232

-	The figure above shows the wrist unit of IRB 6600 and IRB 6650
A	Oil plug, filling and inspection
B	Oil plug, draining

*Continues on next page*

## 3.3.5 Inspecting the oil level in axis-5 gearbox

Continued



xx0500002013

-	The figure above shows the wrist unit of IRB 6640ID
A	Wrist unit, axis 5
B	Oil plug, filling and inspection
C	Oil plugs, draining

## Required equipment

Equipment etc.	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

## Inspecting the oil level in axis-5 gearbox

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

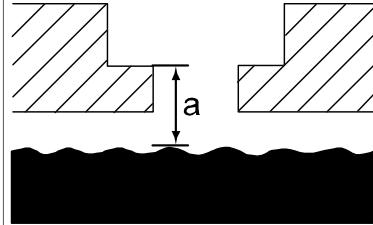
Action	Note
1 <b>WARNING</b>  Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
2 Move the robot upper arm to a horizontal position.	

Continues on next page

### 3 Maintenance

#### 3.3.5 Inspecting the oil level in axis-5 gearbox

*Continued*

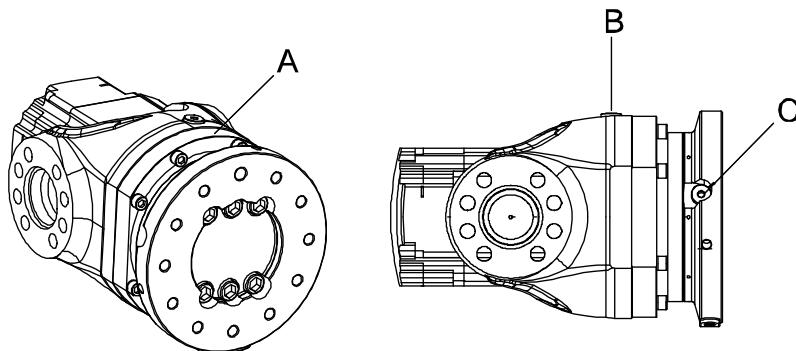
	Action	Note
3	Turn the wrist unit in a way that both oil plugs are facing upwards.	
4	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> </ul> Before entering the robot working area.	
5	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
6	Open the <i>oil plug, filling and inspection</i> .	Shown in the figure <a href="#">Location of gearbox on page 132</a> .
7	Measure the oil level. Required oil level to the upper edge of the filling and inspection oil plug hole (a): 24-36 mm	 xx0500002222
8	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> . Further information about how to fill the oil may be found in the section <a href="#">Filling, oil, axis 5 on page 179</a> .
9	Refit the oil plug.	Tightening torque:24 Nm

## 3.3.6 Inspecting the oil level in axis-6 gearbox

## 3.3.6 Inspecting the oil level in axis-6 gearbox

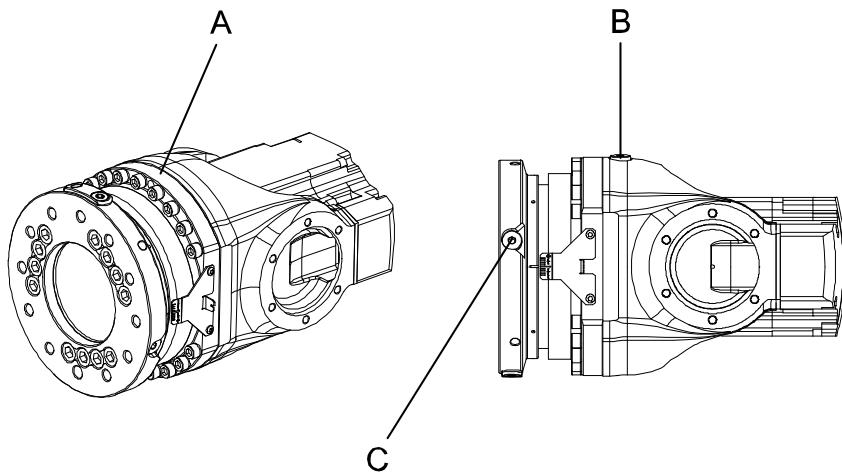
## Location of gearbox

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



xx0600002964

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



xx0400001092

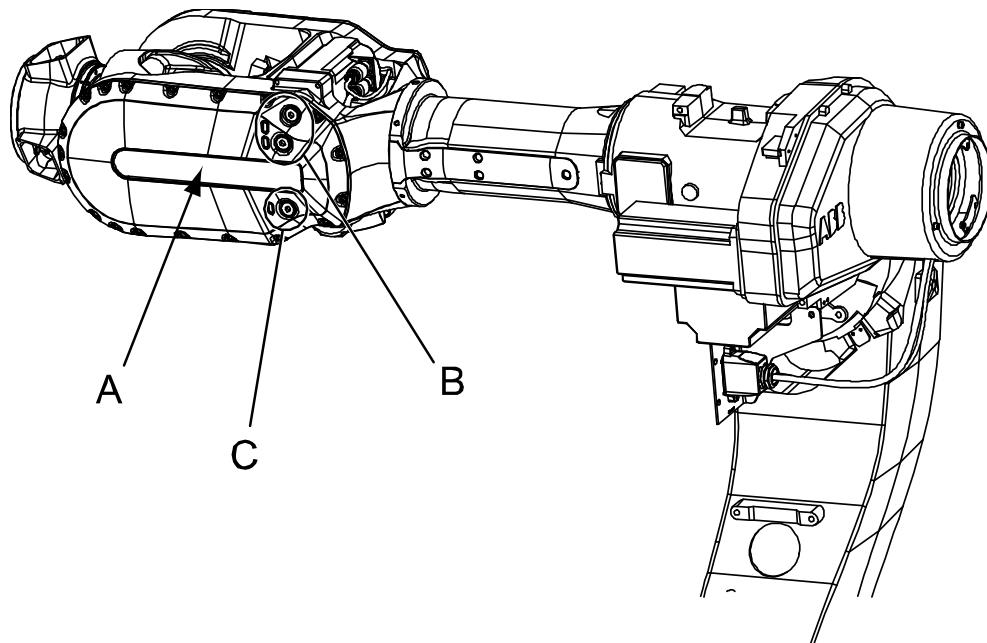
	Type 2
A	Axis-6 gearbox
B	Oil plug, filling and inspection
C	Oil plug, draining

*Continues on next page*

### 3 Maintenance

#### 3.3.6 Inspecting the oil level in axis-6 gearbox

*Continued*



xx0500002017

-	The figure above shows the wrist unit of IRB 6640ID
A	Axis-6 gearbox
B	Oil plugs, draining
C	Oil plug, filling

#### Inspection depending on type of wrist

To inspect oil level for wrist type 1, see *Inspecting the oil level in axis-6 gearbox, wrist type 1 on page 137*.

To inspect oil level for wrist type 2, see *Inspecting the oil level in axis-6 gearbox, wrist type 2 on page 138*.

#### Required equipment

Equipment	Art. no.	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 164</i> .	
Standard toolkit	-	Content is defined in section <i>Standard tools on page 455</i> .
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.

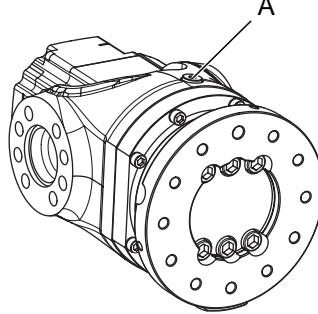
*Continues on next page*

## 3.3.6 Inspecting the oil level in axis-6 gearbox

Continued

**Inspecting the oil level in axis-6 gearbox, wrist type 1**

Use this procedure to inspect the oil level in the axis-6 gearbox, for wrist type 1.

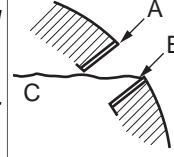
Action	Note
<p>1  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a>.</p>	
2 Move axes 3 and 5 to a horizontal position, and make sure that the <i>oil plug, filling and inspection</i> is facing upwards.	
<p>3  <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> </ul>Before entering the robot working area.</p>	
4 Make sure that the oil temperature is $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ . This is a precaution to reduce the temperature dependency of the measurement.	
5 Open the <i>oil plug, filling and inspection</i> .	 xx1300000244
6 Turn axis 6 so that the <i>oil plug, draining</i> faces upwards.	
7 Open the <i>oil plug, draining</i> .	<p>This is a precaution to avoid vacuum effects by allowing air to enter at the top of the gearbox.</p> <p> <b>Note</b></p> <p>If equipment that covers the <i>oil plug, draining</i> is fitted on the robot so that the oil plug cannot be opened, then this step can be skipped.</p>
8 Slowly turn axis 4, while adjusting axis 6 so that the oil plug, draining always faces upwards. Turn axis 4 until the axis-4 angle reads $-45^{\circ}$ to $-55^{\circ}$ .	

Continues on next page

### 3 Maintenance

#### 3.3.6 Inspecting the oil level in axis-6 gearbox

*Continued*

Action	Note
<p>9 Inspect the oil level in the hole for the <i>oil plug, filling and inspection</i>. The oil should reach all the way up to the external edge of the thread for the <i>oil plug, filling and inspection</i>.</p> <p> <b>Note</b> If the <i>oil plug, draining</i> is not opened, then use a clean, narrow object, for example an oil stick or a cable tie, to gently poke the oil surface. This will avoid surface tension from stopping air to enter into the gearbox.</p>	 xx1400002786 A Oil plug hole B Required oil level C Gearbox oil
10 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> . Further information about how to fill the oil may be found in the section <a href="#">Filling, oil, axis 6 on page 182</a> .
11 Refit the oil plugs.	Tightening torque: 24 Nm.
<p>12  <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i>.</p>	

#### Inspecting the oil level in axis-6 gearbox, wrist type 2

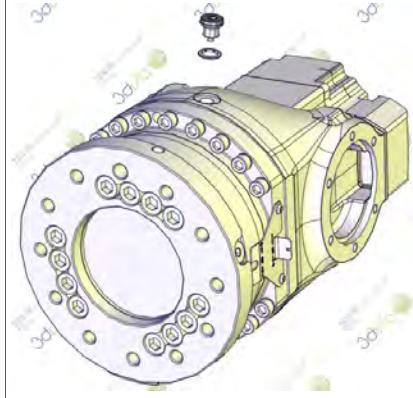
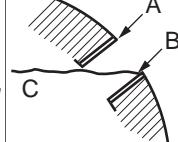
Use this procedure to inspect the oil level in the axis-6 gearbox, for wrist type 2.

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

*Continues on next page*

## 3.3.6 Inspecting the oil level in axis-6 gearbox

Continued

Action	Note
4 Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5 Remove the <i>oil plug, filling and inspection.</i>	 xx1300002447
6 Slowly turn axis 4 until the axis-4 angle reads +72.5° to +77.5°.	
7 Inspect the oil level in the hole for the <i>oil plug, filling and inspection.</i> The oil should reach all the way up to the external edge of the thread for the <i>oil plug, filling and inspection.</i>	 xx1400002786 <p><b>Note</b></p> <p>If needed, use a clean, narrow object, for example an oil stick or a cable tie, to gently poke the oil surface. This will avoid surface tension from stopping air to enter into the gearbox.</p>
8 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> . Further information about how to fill the oil may be found in the section <a href="#">Filling, oil, axis 6 on page 182</a> .
9 Refit the oil plug.	Tightening torque: 24 Nm.
10  <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	

### 3 Maintenance

#### 3.3.7 Inspecting the balancing device

#### 3.3.7 Inspecting the balancing device

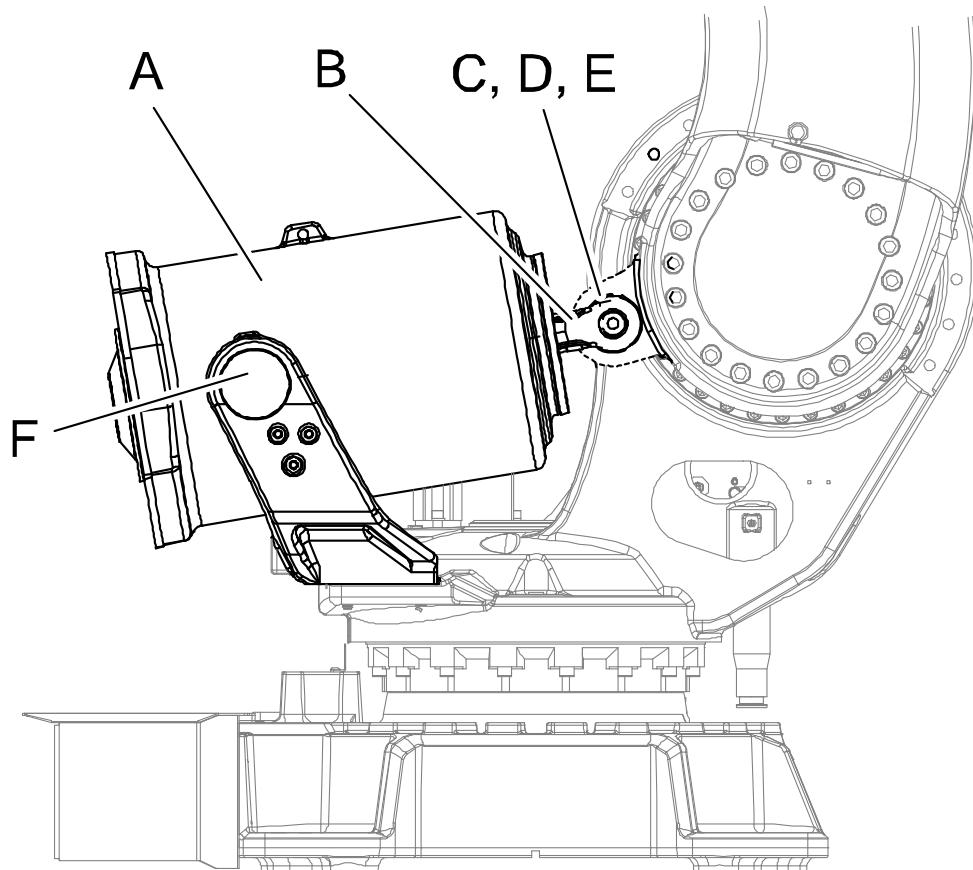
##### General

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

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

##### Inspection points, balancing device

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



xx0600003431

A	Balancing device
B	Piston rod (inside balancing device)
C	Fork / Link ear
D	Shaft
E	Retaining ring, bore
F	Attachments in cradle (rear bearing)

Continues on next page

**Required equipment**

Equipment, etc.	Spare part no.	Art. no.	Note
<b>Design 1:</b> Maintenance parts, shaft	3HAC029054-001		For maintenance of balancing device. Includes: <ul style="list-style-type: none"><li>• bearings, o-rings and seals (<i>Front bearing</i>).</li></ul>
<b>Design 2:</b> Maintenance parts, shaft	3HAC033411-001		For maintenance of balancing device. Includes: <ul style="list-style-type: none"><li>• bearings, o-rings and seals (<i>Front bearing</i>).</li></ul>
<b>Design 1:</b> Maintenance parts, cradle	3HAC029288-001		For maintenance of balancing device. Includes: <ul style="list-style-type: none"><li>• bearing, o-ring and sealing (<i>Rear bearing</i>).</li></ul>
<b>Design 2:</b> Maintenance parts, cradle	3HAC033413-001		For maintenance of balancing device. Includes: <ul style="list-style-type: none"><li>• bearing, o-ring and sealing (<i>Rear bearing</i>).</li></ul>
Securing screw			Securing screw in the shaft. M16 x 180 Locking liquid must be used when fitting the screw (Loctite 243)!
Toolkit for maintenance		3HAC028920-001	
Standard toolkit		3HAC15571-1	Content is defined in section <a href="#">Standard tools on page 455</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.

**Check for dissonance**

The check points are shown in the figure [Inspection points, balancing device on page 140](#).

	Check for dissonance from...	If dissonance is detected...
1	<ul style="list-style-type: none"> <li>• bearing at the link ear</li> <li>• bearings at the balancing devices attachments.</li> </ul>	... perform maintenance according to given instructions in Maintenance kit, bearings and seals. The replacement of the bearing at the ear is also detailed in section <a href="#">Replacement of spherical roller bearing, balancing device on page 292</a> . Art. no. for the kit and the documentation are specified in section <a href="#">Required equipment on page 141</a> .

*Continues on next page*

### 3 Maintenance

#### 3.3.7 Inspecting the balancing device

Continued

	Check for dissonance from...	If dissonance is detected...
2	<ul style="list-style-type: none"><li>balancing device (a tapping sound, caused by the springs inside the cylinder).</li></ul>	...replace the balancing device or consult ABB Robotics. How to replace the device is detailed in section <a href="#">Replacing the balancing device (design 1) on page 297</a> . This section also specifies the spare part number!
3	<ul style="list-style-type: none"><li>piston rod (squeaking may indicate worn plain bearings, internal contamination or insufficient lubrication).</li></ul>	... perform maintenance according to given instructions in Maintenance kit, complete. Art. no. for the kit and the documentation are specified in section <a href="#">Required equipment on page 141</a> .

#### Check for damage

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

The check points are shown in the figure [Inspection points, balancing device on page 140](#).

	Check for damage on...	If damage is detected...
1	<ul style="list-style-type: none"><li>the piston rod (part of the piston rod that is visible at the front of the balancing device).</li></ul>	... perform maintenance according to given instructions in Maintenance kit, complete. Art. no. for the kit and the documentation are specified in section <a href="#">Required equipment on page 141</a> .

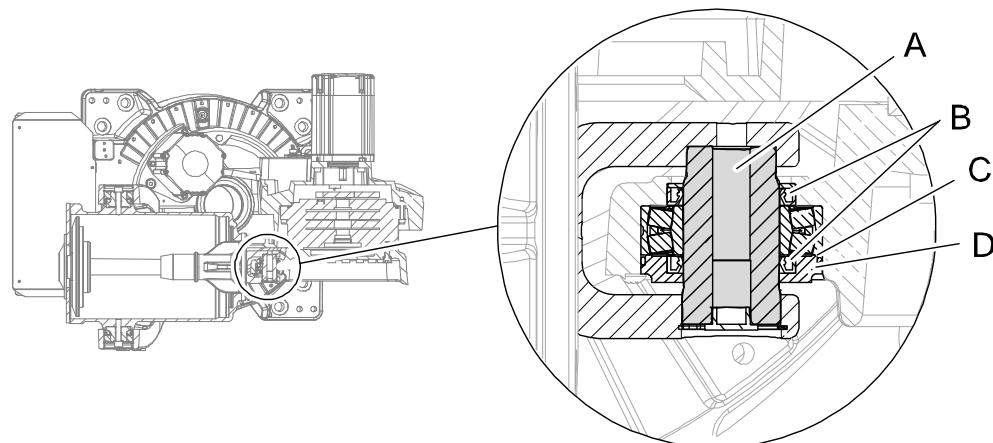
#### Check for leakage - Design 1

The front ear of the balancing device is lubricated with grease. After filling, excessive grease may normally be forced out between the shaft and the sealing ring in the sealing spacer. This is normal behaviour and must not be confused with incorrect leaks from the ear.

Leaks at the o-rings and/or sealings, are not acceptable and must be attended to immediately in order to avoid any damage to the bearing!

Continues on next page

Check the o-rings in the front ear of the balancing device for leaks, as shown and detailed below.



xx0700000111

A	Shaft
B	Sealing ring (radial) 2 pcs
C	O-ring
D	Sealing spacer

	Action	Note
1	Clean the area at the front ear from old grease.	
2	Run the robot for some minutes, in order to move the balancing device piston.	
3	Check the o-rings at the front ear for leakage. Replace the o-rings, if any leaks are detected. Excessive grease from between the shaft and the sealing ring is normal and is not considered as a leak!	The o-rings are included in the <i>Maintenance kit, bearings and seals</i> , already assembled with sealing spacers and sealing rings. Art. no. for the kit is specified in <a href="#">Required equipment on page 141</a> . The replacement of the complete bearing is also detailed in section <a href="#">Replacement of spherical roller bearing, balancing device on page 292</a> .

#### Check for leakage - Design 2

The front ear of the balancing device is lubricated with grease.

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

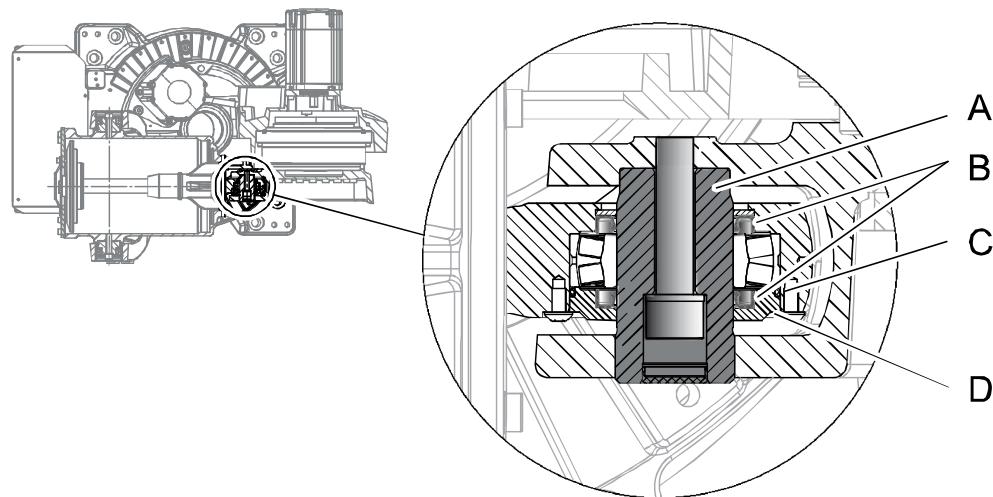
*Continues on next page*

### 3 Maintenance

#### 3.3.7 Inspecting the balancing device

*Continued*

Check the o-rings and sealings in the front ear of the balancing device for leaks.



xx1000000207

A	Shaft
B	Sealing ring (radial (2 pcs)
C	O-ring
D	Sealing spacer

	Action	Note
1	Clean the area at the front ear from contamination.	
2	Run the robot for some minutes, in order to move the balancing device piston.	
3	 <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></ul> Before entering the robot working area.	
4	Check the o-rings at the front ear for leakage.	
5	Replace o-rings if leaks are detected.	The o-rings are included in the Maintenance kit, bearings and seals already assembled with sealing spacers and sealing rings. Art. no. for the kit is specified in <a href="#">Required equipment on page 141</a> . Replacement of the complete bearing is also described in section <a href="#">Replacement of spherical roller bearing, balancing device on page 292</a> .

*Continues on next page*

##### Check for contamination / lack of free space

Action	
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></ul> Before entering the robot working area.
2	Check that there are no obstacles inside the frame, that could prevent the balancing device from moving freely. See the figure <i>Inspection points, balancing device on page 140</i> . Keep the areas around the balancing device clean and free from objects, such as service tools.

## **3 Maintenance**

---

### **3.3.8 Inspecting the cable harness**

---

#### **Introduction**

This section describes how to inspect the cable harness. The procedure is divided in two parts:

- Inspection of axes 1-4 is described in: [\*Location of cable harness, axes 1-4 on page 147\*](#) and [\*Inspection, cable harness 1-4 on page 148\*](#).
- Inspection of axes 5-6 is described in: [\*Location of cabling axes 5-6 on page 149\*](#) and [\*Inspection, cable harness, axes 5-6 on page 149\*](#).

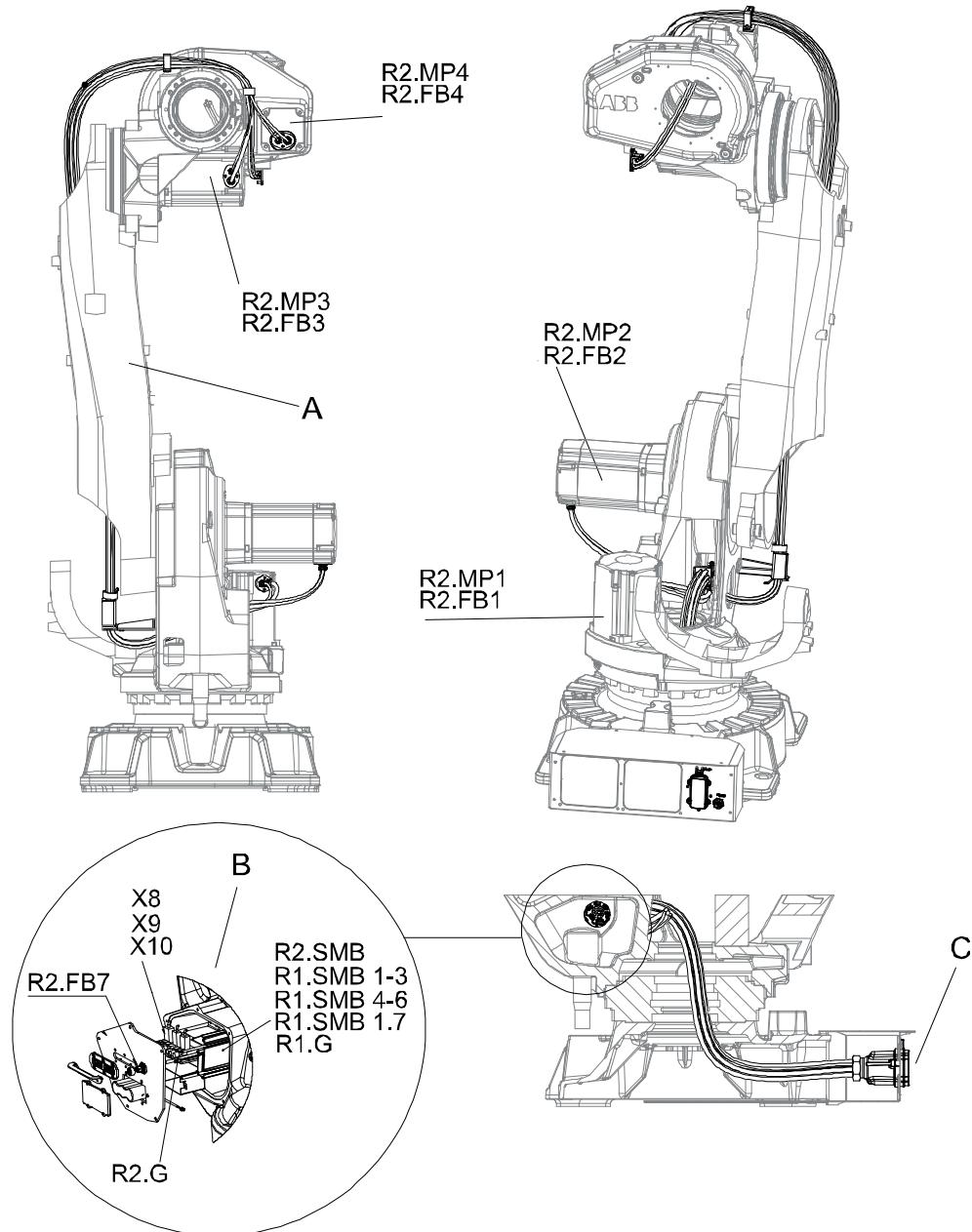
---

*Continues on next page*

**Location of cable harness, axes 1-4**

The robot cable harness, axes 1-4, is located as shown in the figure below.

IRB 6640 Standard



xx0600003434

A	Lower arm
B	SMB/BU unit (battery pack RMU 3HAC16831-1 is shown, note that there are different battery versions)
C	Connectors at base

*Continues on next page*

### 3 Maintenance

#### 3.3.8 Inspecting the cable harness

*Continued*

##### Required equipment

Equipment, etc.	Art. no.	Note
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.
Circuit diagram		See chapter <a href="#">Circuit diagrams on page 479</a> .

##### Inspection, cable harness 1-4

The procedure below details how to inspect the cable harness of axes 1-4.

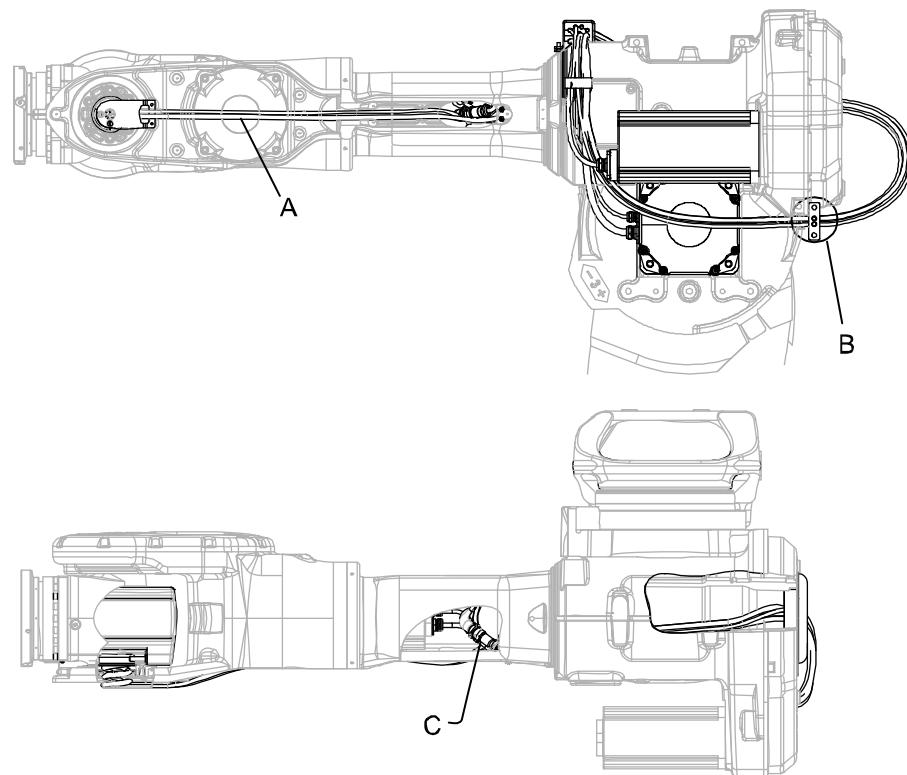
	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
2	Make an overall visual inspection of the cable harness, in order to detect wear and damage.	
3	Check the <i>connectors at the base</i> .	Shown in the figure <a href="#">Location of cable harness, axes 1-4 on page 147</a> .
4	 <b>Note</b> If the robot is used in a Foundry Prime application, check the <i>cables</i> for cracks in insulation.	
5	Check that <i>velcro straps</i> are properly attached to the <i>side bracket balancing cylinder</i> .   <b>Note</b> For Clean Room robots, check all cable attachments as well as <i>velcro straps</i> . Make sure the cable harness is properly attached to the robot and isn't damaged.	Location shown in the figure <a href="#">Location of cable harness, axes 1-4 on page 147</a> .
6	Replace the cable harness if wear, cracks or damage is detected.	Detailed in section <a href="#">Replacing cable harness, axes 1-6 on page 217</a> .

*Continues on next page*

**Location of cabling axes 5-6**

The robot cable harness, axes 5-6, is located as shown in the figure.

IRB 6640 standard



xx0600003435

A	Cable harness axes 5-6
B	Cable attachment, rear of upper arm
C	Cable attachment, upper arm tube

**Inspection, cable harness, axes 5-6**

The procedure below details how to inspect the cable harness of axes 5-6.

	Action	Note
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> </ul> <p>to the robot, before entering the robot working area.</p>	
2	Make an overall visual inspection of the cable harness, in order to detect wear and damage.	
3	Check the <i>attachments at the rear of the upper arm and in the upper arm tube.</i>	Shown in the figure <a href="#">Location of cabling axes 5-6 on page 149</a> .

*Continues on next page*

### 3 Maintenance

#### 3.3.8 Inspecting the cable harness

*Continued*

	Action	Note
4	 <b>Note</b>  If the robot is used in a Foundry Prime application, check the <i>cables</i> for cracks in insulation.	Shown in the figure <a href="#">Location of cable harness, axes 1-4 on page 147</a> .
5	Replace the cable harness if wear, cracks or damage is detected.	See <a href="#">Replacing cable harness, axes 1-6 on page 217</a> . See <a href="#">Replacement of cabling, axis 5 motor on page 231</a> .

### 3.3.9 Inspection of air hoses (Foundry Prime)

#### General

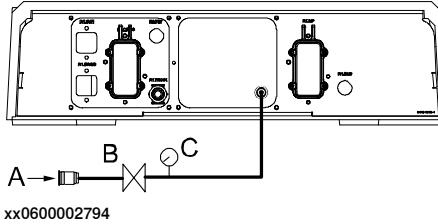
The air hoses on Foundry Prime robots must be inspected for leakage every six months.

#### Required equipment

Equipment, etc.	Art. no.
Leak detection spray	-
Pressure gauge	-
Cut off valve	-

#### Procedure

For this test it is recommended that the air supply to the robot has a pressure gauge and a cut-off valve connected.

	Action	Note
1	Apply compressed air to the air connector on robot base, and raise the pressure with the knob until the correct value is shown on the pressure gauge.	<p>Recommended pressure: 0.2-0.3 bar</p>  <ul style="list-style-type: none"> <li>A: Air Connection</li> <li>B: Cut off valve</li> <li>C: Pressure gauge</li> </ul>
2	Close the cut off valve.	It should take at least 5 seconds for the pressure to reach 0 bar.
3	The time is < 5 seconds: <ul style="list-style-type: none"> <li>If the answer is YES: Localize the leakage by following the procedures below.</li> <li>If the answer is NO: The system is OK. Remove the leak testing equipment.</li> </ul>	
4	Pressurize by opening the cut off valve.	
5	Spray suspected leak areas with <i>leak detection spray</i> . Bubbles indicate a leak.	
6	When the leak is localized: correct the leak.	

### 3 Maintenance

#### 3.3.10 Inspection of surface treatment (Foundry Prime)

#### 3.3.10 Inspection of surface treatment (Foundry Prime)

##### Introduction to inspection of surface treatment

Damage to painted surfaces must be repaired as soon as possible to avoid corrosion. All painted surfaces on the robot must be inspected.

##### Required equipment

Equipment, etc.	Note
Touch up paint Foundry Prime 2, grey	See Touch up paint for Foundry Prime robots in partlist <a href="#">Standard tools on page 455</a> .

##### Additional equipment - Foundry Prime

Equipment	Article number	Note
Rust preventive	3HAC034903-001	Mercasol. Recommended drying time is 24h.
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

##### Inspection and repair of surface treatment

Use this procedure to inspect the surface treatment on Foundry Prime robots.

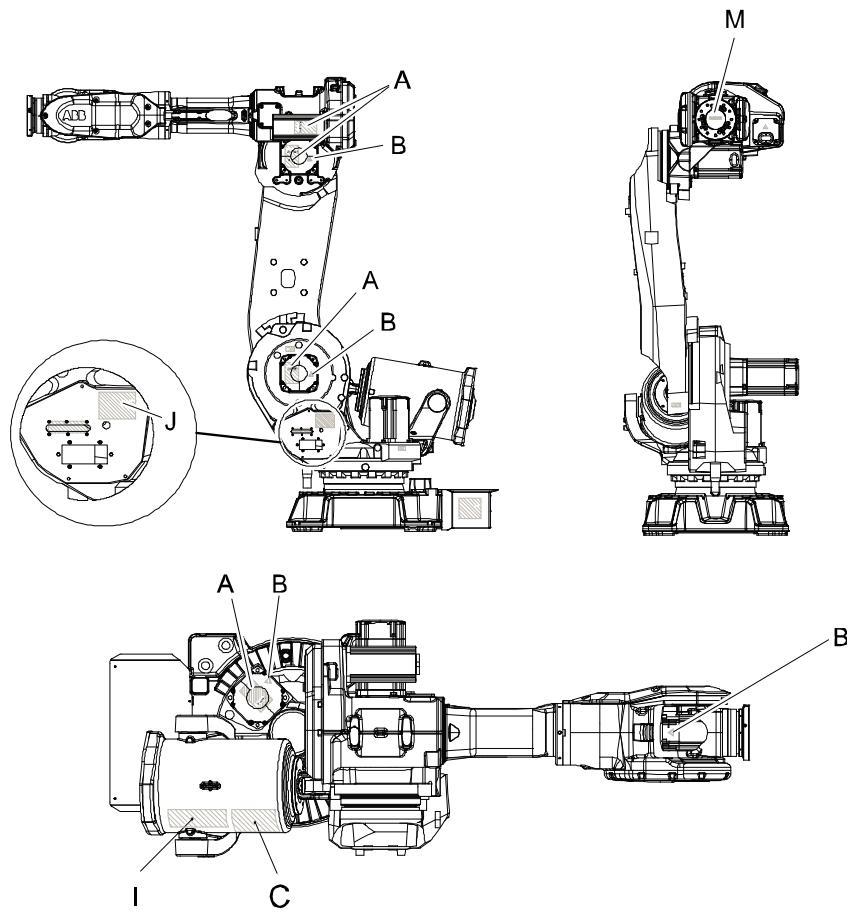
	Action	Information
1	Inspect all painted surfaces for damages.	
2	Repair damages as described in the instruction included in the spare part kit.	

## 3.3.11 Inspecting the information labels

## 3.3.11 Inspecting the information labels

## Location of labels

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



xx0600003457

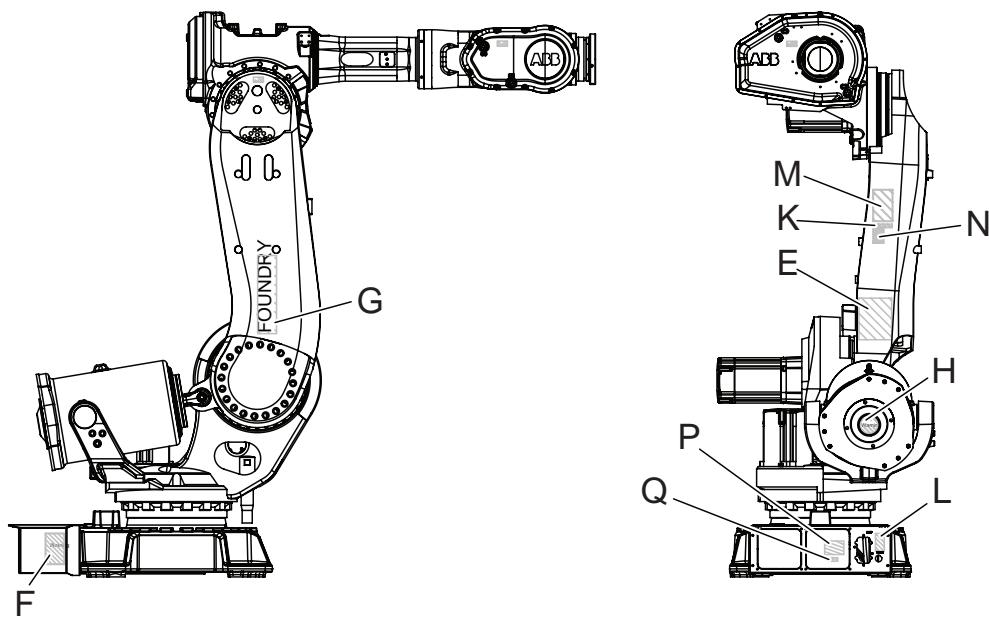
A	Warning label concerning high temperature (4 pcs)
B	Warning sign, symbol of flash (located on motor cover) (5 pcs)
C	Instruction label
I	Warning label, tools are not allowed around the balancing device during operation
J	Warning label concerning shutting off power
M	Serial no. from rating label
-	Information labels about type of oil, at gearboxes and at robot base

Continues on next page

### 3 Maintenance

#### 3.3.11 Inspecting the information labels

*Continued*



xx0600003456

E	Instructional label concerning lifting the robot
F	Warning label concerning risk of tipping
G	Foundry logotype
H	Warning label concerning stored energy
K	Abs-Acc information sign
L	UL-label
M	Serial no. from rating label
N	Label calibration
P	Warning label
Q	Label Max air pressure

#### Required tools and equipment

Visual inspection, no tools are required.

#### Inspecting, labels

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></ul> to the robot, before entering the robot working area.	
2 Inspect the labels, located as shown in the figures.	
3 Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in <a href="#">Spare parts on page 477</a> .

### 3.3.12 Inspecting the axis-1 mechanical stop pin

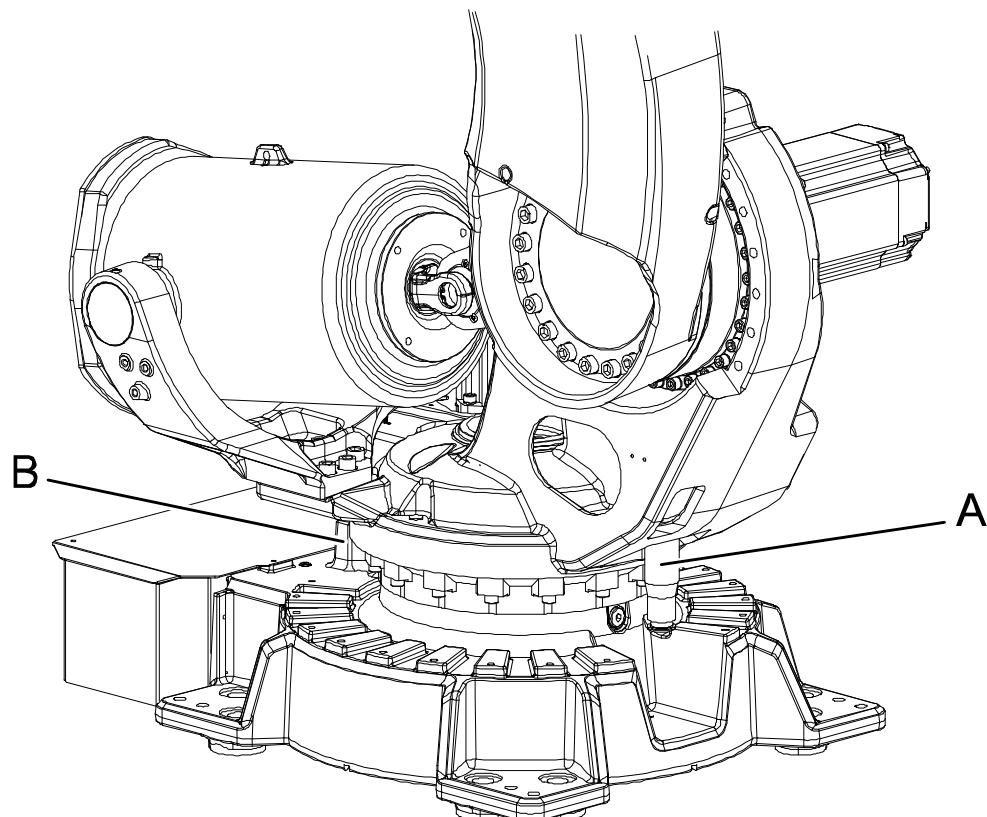


#### WARNING

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

#### Location of mechanical stop pin

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



xx0600003436

A	Mechanical stop pin, axis 1
B	Fixed mechanical stop

#### Required equipment

Visual inspection, no tools are required.

*Continues on next page*

### 3 Maintenance

#### 3.3.12 Inspecting the axis-1 mechanical stop pin

*Continued*

##### Inspecting, mechanical stop pin

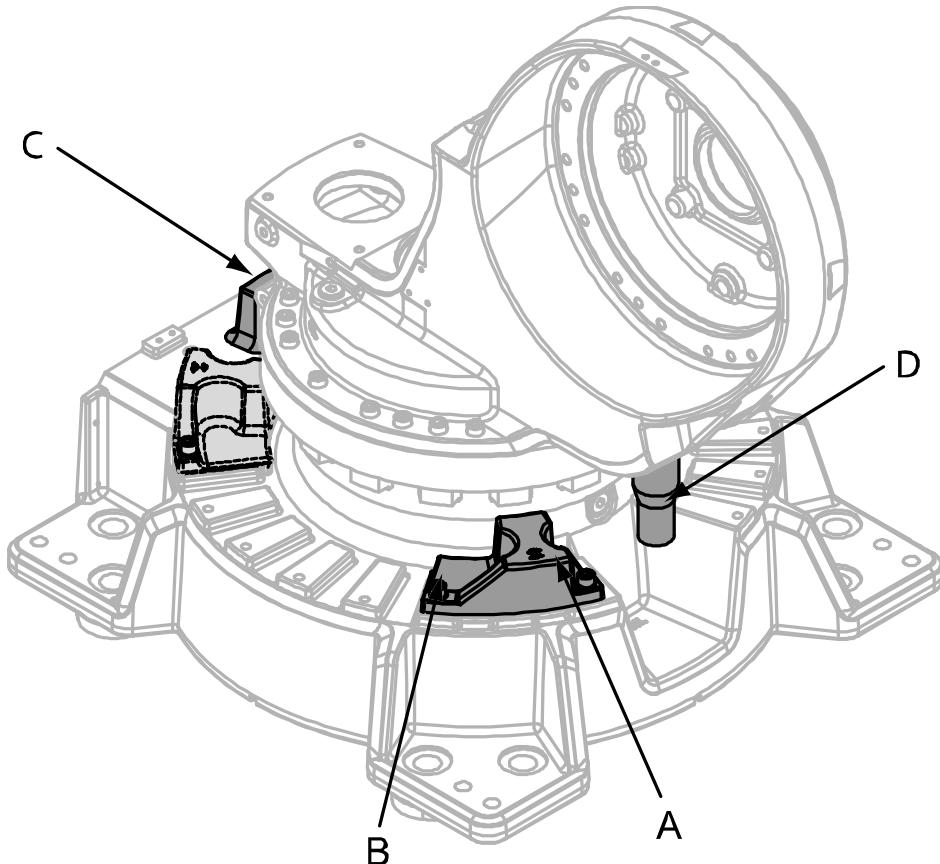
Use this procedure to inspect the axis-1 mechanical stop pin.

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

## 3.3.13 Inspecting the additional mechanical stops

**3.3.13 Inspecting the additional mechanical stops****Location of mechanical stops**

The figures shows the location of the additional mechanical stops on axes 1, 2 and 3.



xx0600002938

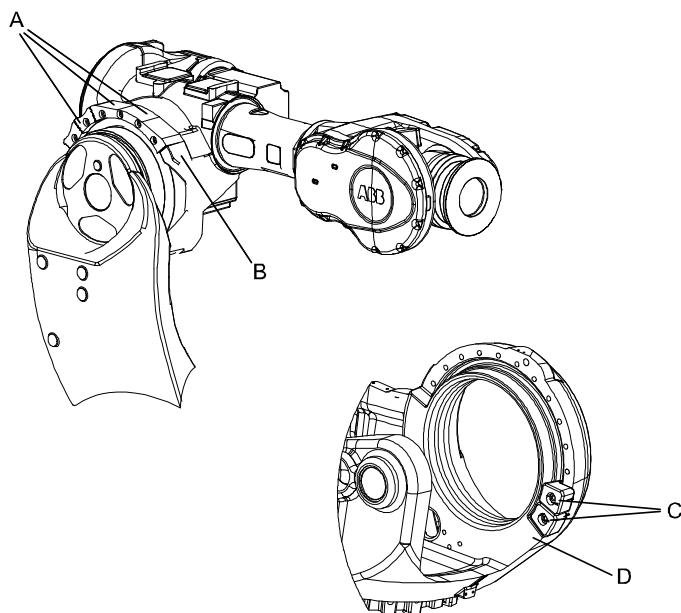
A	Additional stop, axis 1
B	Attachment screws and washers (2 pcs)
C	Fixed stop
D	Mechanical stop pin, axis 1

*Continues on next page*

### 3 Maintenance

#### 3.3.13 Inspecting the additional mechanical stops

*Continued*



xx0600003438

A	Additional stops, axis 3
B	Fixed stop, axis 3
C	Additional stops, axis 2
D	Fixed stop, axis 2

#### Required equipment

Equipment etc.	Article number	Note
Mechanical stop set, axis 1	3HAC025204-003	Includes: <ul style="list-style-type: none"><li>Stop +15°/-7.5°</li><li>Stop +7.5°/-15°</li><li>Attachment screws plus washers</li><li>Document for movable mechanical stop</li></ul>
Mechanical stop axis 2	3HAC13787-1	Includes: <ul style="list-style-type: none"><li>Mechanical stop</li><li>Attachment screw and washer</li><li>Document for mechanical stop</li></ul>
Mechanical stop set, axis 3	3HAC025290-003	Includes: <ul style="list-style-type: none"><li>Mechanical stop pin</li><li>Attachment screw and washer</li><li>Document for mechanical stop pin</li></ul>
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

*Continues on next page*

**Inspecting, mechanical stops**

Use this procedure to inspect the additional mechanical stops.

	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> </ul> to the robot, before entering the robot working area.	
2	Make sure no additional stops are damaged.	Shown in figure <a href="#">Location of mechanical stops on page 157</a> .
3	Make sure the stops are properly attached. Correct tightening torque, additional mechanical stops: <ul style="list-style-type: none"> <li>• Axis 1 = 120 Nm</li> </ul>	
4	If any damage is detected, the mechanical stops must be replaced! Correct attachment screws: <ul style="list-style-type: none"> <li>• Axis 1: M12 x 40, quality 12.9.</li> <li>• Axis 2: M16 x 50</li> <li>• Axis 3: M16 x 60</li> </ul>	Article number is specified in <a href="#">Required equipment on page 158</a> .

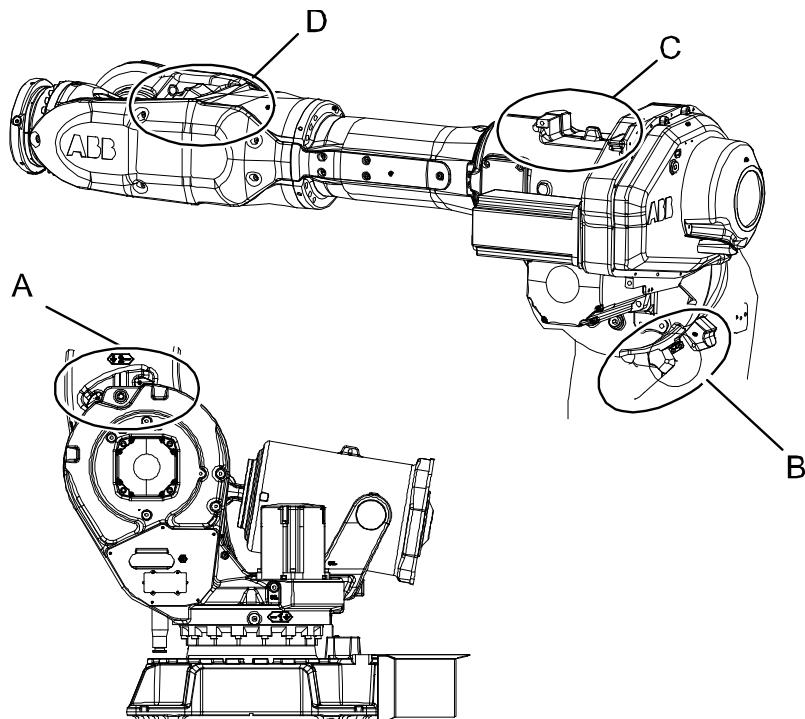
### 3 Maintenance

#### 3.3.14 Inspecting the damper on axes 2-5

#### 3.3.14 Inspecting the damper on axes 2-5

##### Location of dampers

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



xx0600003440

A	Damper, axis 2 (2 pcs)
B	Damper, axis 3 (2 pcs)
C	Damper, axis 4 (1 pc)
D	Damper, axis 5 (2 pcs) (IRB 6640ID: 4 pcs)

##### Required equipment

A damper must be replaced if damaged!

Equipment	Spare part/ art. no.	Note
Damper axis 2	3HAC12991-1	
Damper axis 3	3HAC12320-1	
Damper axis 4	3HAC13564-1	
Damper axis 5	3HAB4337-2	
Damper 1, axis 5	3HAC021325-001	IRB 6640ID (2 pcs)
Damper 2, axis 5	3HAC021675-001	IRB 6640ID (2 pcs)
Standard toolkit	3HAC15571-1	Content is defined in section <a href="#">Standard tools on page 455</a> .

Continues on next page

##### Inspection, dampers

The procedure below details how to inspect the dampers, axes 2-5.

	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></ul> Before entering the robot working area.	
2	Check all <i>dampers</i> for damage, and for cracks or existing impressions larger than 1 mm.  To inspect the damper axis 4, remove the two covers on top of the upper arm!	Shown in the figure <a href="#">Location of dampers on page 160</a> .
3	Check attachment screws for deformation.	
4	If any damage is detected, the damper must be replaced with a new one!	Art. no. is specified in <a href="#">Required equipment on page 160</a> .

### 3 Maintenance

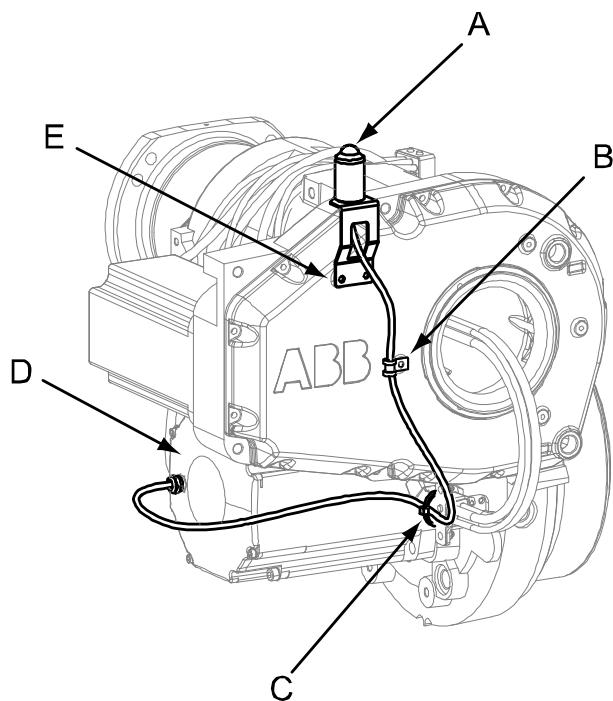
#### 3.3.15 Inspecting the signal lamp (option)

#### 3.3.15 Inspecting the signal lamp (option)

##### Location of signal lamp

The signal lamp is located as shown in this figure.

Note that the position can differ depending on how the customer harness for axis 4-6 is mounted. See assembly drawing on the current harness for alternative positioning.



xx0600003071

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

##### Required tools and equipment

Equipment	Article number	Note
Signal lamp kit	See <a href="#">Spare parts on page 477</a> .	To be replaced if damage is detected.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

*Continues on next page*

**Inspecting, signal lamp**

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

	Action	Note
1	Inspect that signal lamp is lit when motors are put in operation ("MOTORS ON").	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	If the lamp is not lit, trace the fault by: <ul style="list-style-type: none"> <li>• inspecting whether the signal lamp is broken. If so, replace it.</li> <li>• inspecting cable connections.</li> <li>• measuring the voltage in the connectors of motor axis 3 (=24V).</li> <li>• inspecting the cabling. Replace the cabling if a fault is detected.</li> </ul>	Article number is specified in <a href="#">Required tools and equipment on page 162</a> .

## 3 Maintenance

---

### 3.4.1 Type of lubrication in gearboxes

## 3.4 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.



#### CAUTION

Always read the specific instructions for Foundy Prime robots before doing any repair work, see [Replacing parts on the robot on page 215](#).

#### Type and amount of oil in gearboxes

Information about the *type of lubrication*, *article number* as well as the *amount* in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* on the Documentation DVD (released twice a year). The revision of the manual published on the Documentation DVD, will contain the latest updates when the Documentation DVD is released.

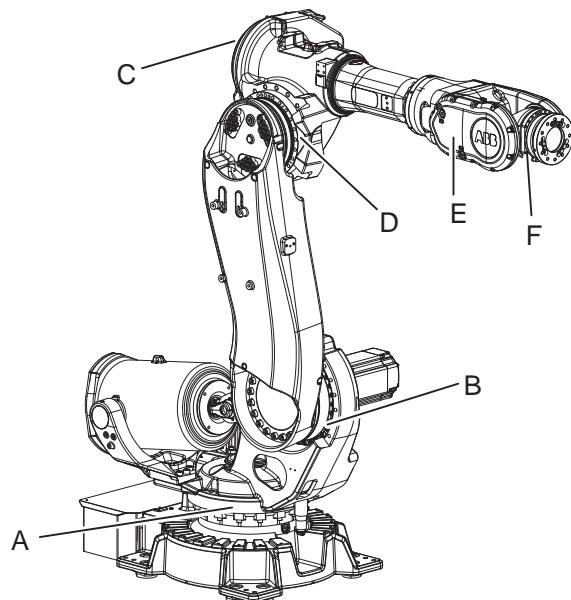
Before starting any inspection, maintenance, or changing activities of lubrication, **always** contact the local ABB Service organization for more information.

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

*Continues on next page*

##### Location of gearboxes

The figure shows the location of the gearboxes.



xx0600003442

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

##### Equipment

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

### 3 Maintenance

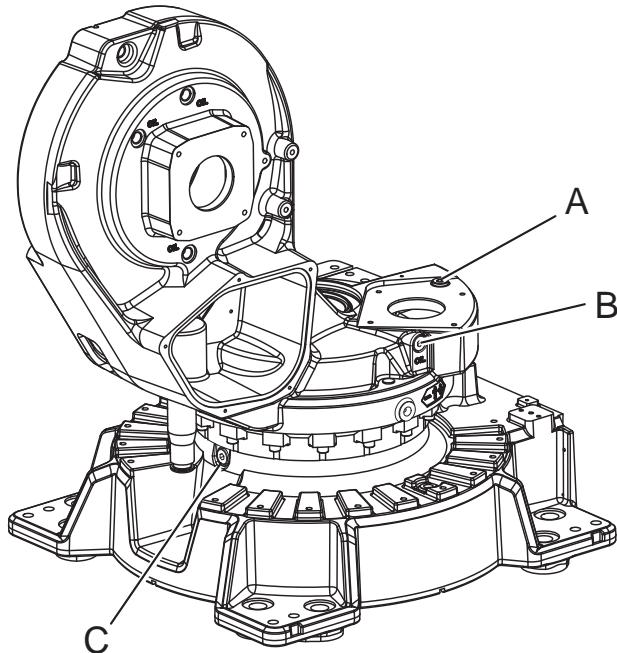
#### 3.4.2 Changing oil, axis-1 gearbox

#### 3.4.2 Changing oil, axis-1 gearbox

##### Location of oil plugs

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

falseThe oil is drained through a hose, which is located at the rear of the robot base.



xx0600003449

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

##### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	 Note Do not mix with other oils!
Oil collecting vessel	-		Capacity: 8,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 456.</a>
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 455.</a>

Continues on next page

**Draining oil, axis-1 gearbox**

Use this procedure to drain the oil in gearbox axis 1.

When using oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 166](#).

Action	Note
<p>1  <b>DANGER</b> Turn off all:<ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul>to the robot, before entering the robot working area.</p>	
<p>2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a>.</p>	
3 Collect drained oil in an oil vessel.	Vessel capacity is specified in <a href="#">Required equipment on page 166</a> .
4 Remove <i>oil plug, filling</i> in order to drain oil quicker!	Shown in figure <a href="#">Location of oil plugs on page 166</a> .
<p>5 Open the oil plug for draining and drain the oil into a vessel.  <b>CAUTION</b> Drain as much oil as possible. See <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a>.</p>	 <b>Note</b> Draining is time-consuming. Elapsed time depends on the temperature of the oil.
6 Refit the <i>oil plug, draining</i> .	

**Filling oil, axis-1 gearbox**

Use this procedure to fill gearbox axis 1 with oil.

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

*Continues on next page*

### 3 Maintenance

#### 3.4.2 Changing oil, axis-1 gearbox

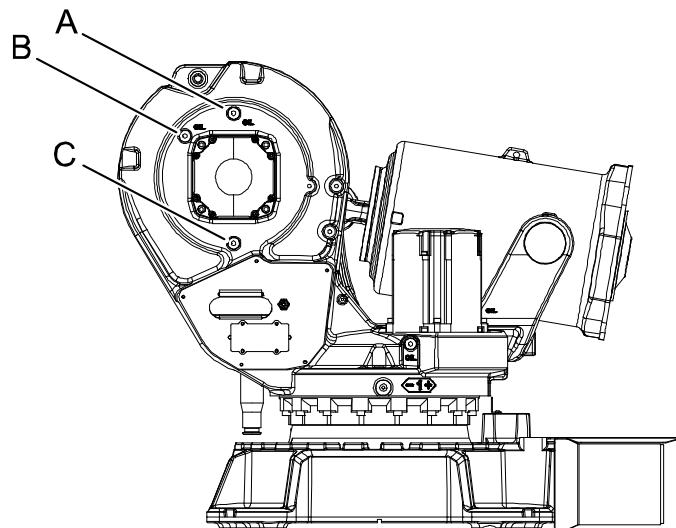
*Continued*

	Action	Note
2	 <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
3	Open the <i>oil plug, filling</i> .	Shown in figure <a href="#">Location of oil plugs on page 166</a> .
4	Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-1 gearbox on page 123</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> .
5	 <b>Note</b> Do not mix Kyodo Yushi TMO 150 with other oil types!	
6	Refit the oil plug, filling.	Tightening torque: 24 Nm.

### 3.4.3 Changing oil, axis-2 gearbox

#### Location of oil plugs

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



xx0600003451

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

#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	<b>Note!</b> Do not mix with other oil types!
Oil collecting vessel	-		Capacity: 6,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 456</a> .
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 455</a> .

Continues on next page

### 3 Maintenance

#### 3.4.3 Changing oil, axis-2 gearbox

Continued

##### Draining, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 169](#).

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></ul> Before entering the robot working area.	
2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
3 Remove the plug of the <i>filling/inspection hole</i> .	Shown in the figure <a href="#">Location of oil plugs on page 169</a> .
4 Remove the <i>oil plug, draining</i> , and drain the gearbox oil using a hose with nipple and an oil collecting vessel.   <b>CAUTION</b> Drain as much oil as possible. See <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	Shown in the figure <a href="#">Location of oil plugs on page 169</a> . Vessel capacity is specified in <a href="#">Required equipment on page 169</a> .   <b>Note</b> Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
5 Refit the oil plug.	Tightening torque: 24 Nm.

##### Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 169](#).

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></ul> Before entering the robot working area.	

Continues on next page

Action	Note
2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
3 Remove the <i>oil plug for filling</i> and the <i>oil plug for inspection</i> .	Shown in the figure <a href="#">Location of oil plugs on page 169</a> .
4 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-2 gearbox on page 125</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> .
5  <b>Note</b> Don't mix Kyodo Yushi TMO 150 with other oil types!	
6 Refit the oil plug.	Tightening torque: 24 Nm.

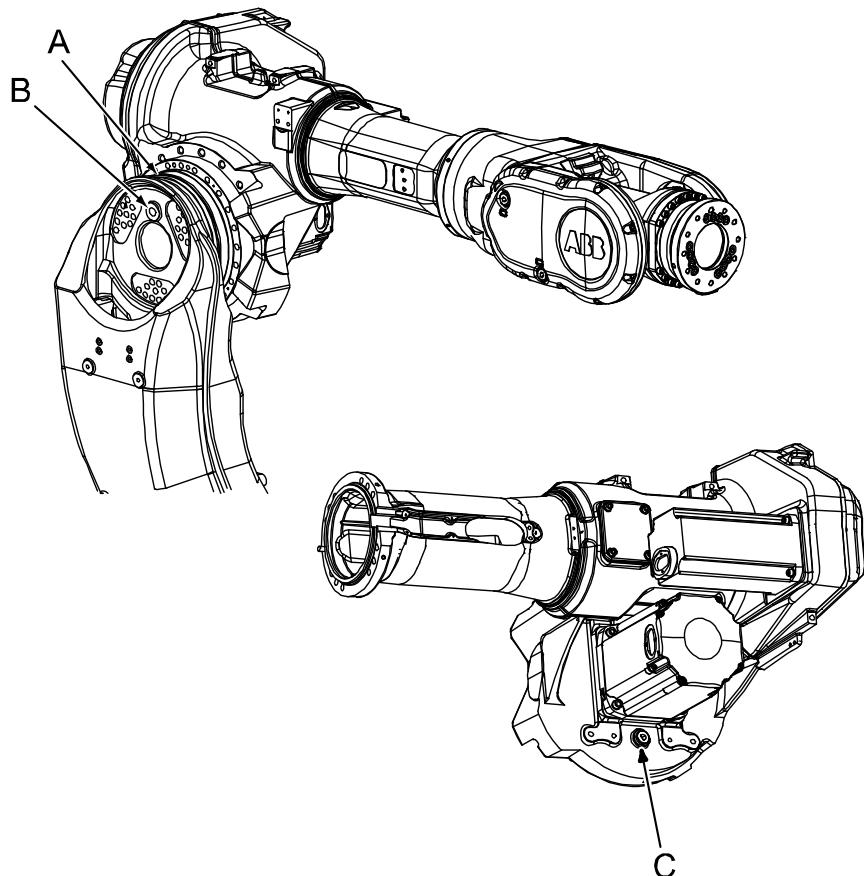
### 3 Maintenance

#### 3.4.4 Changing oil, axis-3 gearbox

#### 3.4.4 Changing oil, axis-3 gearbox

##### Location of gearbox

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



xx0200000230

A	Gearbox axis 3
B	Oil plug, filling
C	Oil plug, draining

##### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	Note! Do not mix with other oil types!
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 456.</a>
Oil collecting vessel	-		Capacity: 3,000 ml.

Continues on next page

Equipment, etc.	Art. no.	Amount	Note
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 455</a> .

**Draining, oil**

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 172](#).

	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> </ul> Before entering the robot working area.	
2	 <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
3	Remove the <i>oil plug, filling</i> .	
4	Remove the <i>oil plug, draining</i> , and drain the gearbox oil using a hose with nipple and an oil collecting vessel.  <b>CAUTION</b> Drain as much oil as possible. See <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	Shown in the figure <a href="#">Location of gearbox on page 172</a> . Vessel capacity is specified in <a href="#">Required equipment on page 172</a> .  <b>Note</b> Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
5	Refit the oil plug.	Tightening torque: 24 Nm.

Continues on next page

### 3 Maintenance

#### 3.4.4 Changing oil, axis-3 gearbox

Continued

##### Filling, oil

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

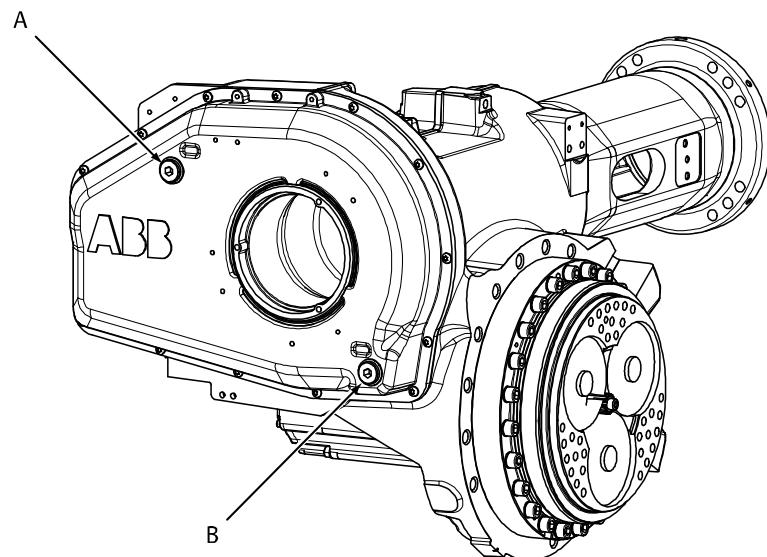
When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 172](#).

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></ul> Before entering the robot working area.	
2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
3 Remove the <i>oil plug, filling</i> .	Shown in the figure <a href="#">Location of gearbox on page 172</a> .
4 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-3 gearbox on page 127</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> .
5  <b>Note</b> Do not mix Kyodo Yushi TMO 150 with other oil types!	
6 Refit the oil plug.	Tightening torque: 24 Nm.

### 3.4.5 Changing oil, axis-4 gearbox

#### Location of gearbox

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



xx0200000231

A	Oil plug, filling
B	Oil plug, draining

#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	See <a href="#">Type and amount of oil in gearboxes on page 164</a> .	
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 456</a> .
Oil collecting vessel	-		Capacity: 9,000 ml.
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 455</a> .

#### Draining, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 175](#).

	Action	Note
1	Run the upper arm -45° from the calibration position.	

*Continues on next page*

### 3 Maintenance

#### 3.4.5 Changing oil, axis-4 gearbox

Continued

Action	Note
2  <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></ul> Before entering the robot working area.	
3  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
4 Remove the <i>oil plug, filling</i> .	
5 Drain the oil from the gearbox into a vessel by opening the <i>oil plug, draining</i> .	Shown in the figure <a href="#">Location of gearbox on page 175</a> . Vessel capacity is specified in <a href="#">Required equipment on page 175</a> .
6 Run the upper arm back to its calibration position (horizontal position).	This is detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 434</a> .
7 Refit the oil plug, draining.	Tightening torque: 24 Nm.

#### Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 175](#).

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></ul> Before entering the robot working area.	
2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	

Continues on next page

Action	Note
3 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section <i>Inspecting the oil level in axis-4 gearbox on page 130</i> .	Shown in the figure <a href="#">Location of gearbox on page 175</a> . Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> .
4 Refit the oil plug, filling.	Tightening torque: 24 Nm.

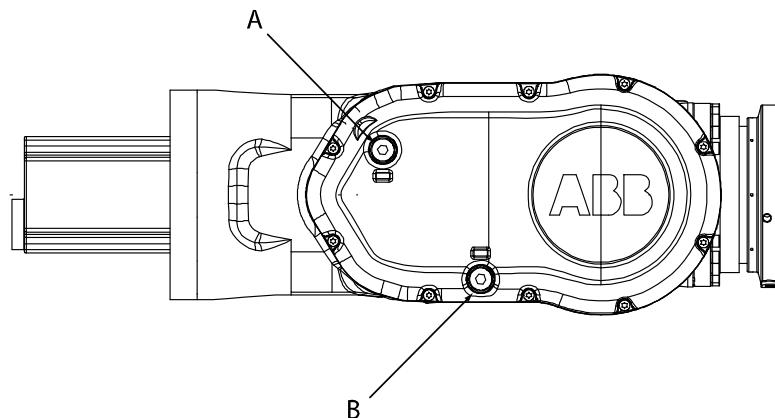
### 3 Maintenance

#### 3.4.6 Changing oil, axis-5 gearbox

#### 3.4.6 Changing oil, axis-5 gearbox

##### Location of gearbox

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



xx0200000232

-	Wrist unit of IRB 6600 and IRB 6650
A	Oil plug, filling
B	Oil plug, draining

##### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 456.</a>
Oil collecting vessel	-		Capacity: 7,000 ml.
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 455.</a>

##### Draining, oil, axis 5

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 178.](#)

	Action	Note
1	Run axis 4 to a position where the oil plug for draining is facing downwards.	

Continues on next page

Action	Note
2  <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></ul> Before entering the robot working area.	
3  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
4 Remove the <i>oil plug, filling</i> .	
5 Drain the oil from the gearbox by opening the <i>oil plug, draining</i> .	Shown in the figure <a href="#">Location of gearbox on page 178</a> . Vessel capacity is specified in <a href="#">Required equipment on page 178</a> .
6 Refit the oil plug, draining.	Tightening torque: 24 Nm.

**Filling, oil, axis 5**

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 178](#).

Action	Note
1 Run axis 4 to a position where the oil plug, filling, is facing upwards.	
2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
3  <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></ul> Before entering the robot working area.	

Continues on next page

### 3 Maintenance

---

#### 3.4.6 Changing oil, axis-5 gearbox

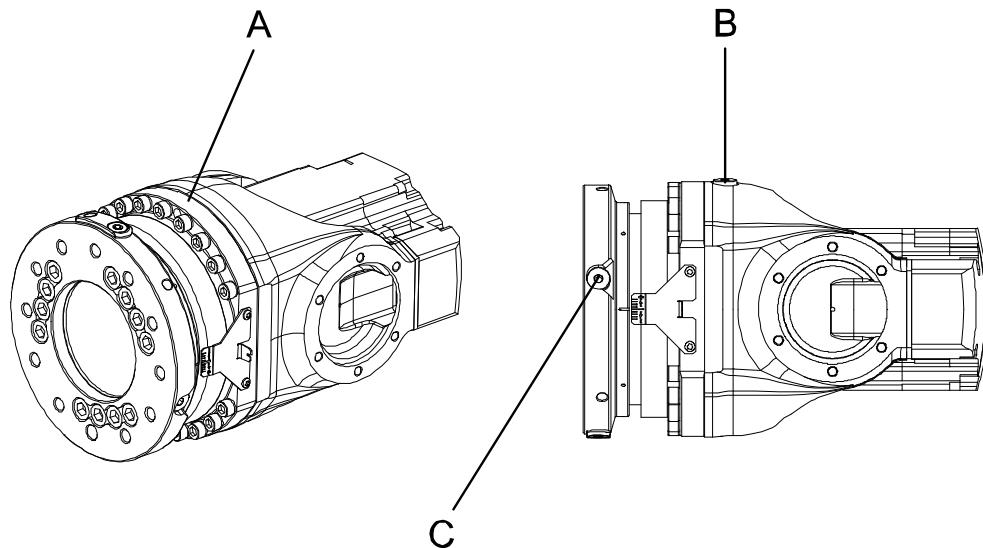
*Continued*

	Action	Note
4	Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-5 gearbox on page 132</a> .	Shown in the figure <a href="#">Location of gearbox on page 178</a> . Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164</a> .
5	Refit the oil plug, filling.	Tightening torque: 24 Nm.

### 3.4.7 Changing oil, axis-6 gearbox

#### Location of gearbox

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



xx0400001092

-	The figure above shows the wrist unit .
A	Gearbox, axis 6
B	Oil plug, filling
C	Oil plug, draining

#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	See <a href="#">Type and amount of oil in gearboxes on page 164.</a>	 Note Do not mix with other oils!
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 456.</a>
Oil collecting vessel	-		Vessel capacity: 500 ml 7,000 ml (IRB 6640ID)
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 455.</a>

Continues on next page

### 3 Maintenance

#### 3.4.7 Changing oil, axis-6 gearbox

Continued

##### Draining, oil, axis 6

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 181](#).

	Action	Note
1	IRB 6640: Run the robot to a position where the <i>oil plug, filling</i> of axis 6 gearbox is facing downwards. IRB 6640ID: Run axis 4, to calibration position, and lower the upper arm to a comfortable position.	Shown in the figure <a href="#">Location of gearbox on page 181</a> .
2	 <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></ul> Before entering the robot working area.	
3	 <b>WARNING</b>  Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</a> .	
4	Drain the oil from the gearbox into a vessel by removing the oil plug.	Vessel capacity is specified in <a href="#">Required equipment on page 181</a> .
	Measure the amount of oil drained.	The amount of oil to be refilled depends on the amount previously drained.
5	Refit the <i>oil plug, draining</i> .	Tightening torque: 24 Nm.

##### Filling, oil, axis 6

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 181](#).

	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></ul> Before entering the robot working area.	

Continues on next page

Action	Note
2  <b>WARNING</b> Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <a href="#">WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55.</a>	
3 Remove the <i>oil plug, filling.</i>	Shown in the figure <a href="#">Location of gearbox on page 181.</a>
4 Refill the gearbox with clean <i>lubricating oil.</i> The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-6 gearbox on page 135.</a>	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 164.</a>
5  <b>Note</b> Do not mix Kyodo Yushi TMO 150 with other oil types!	Detailed in the section <a href="#">Type of lubrication in gearboxes on page 164.</a>
6 Refit the oil plug.	Tightening torque: 24 Nm.
Inspect the oil level.	Detailed in the section <a href="#">Inspecting the oil level in axis-6 gearbox on page 135.</a>

### 3 Maintenance

#### 3.4.8 Replacing the SMB battery

#### 3.4.8 Replacing the SMB battery



##### Note

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

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

For a SMB board with 2-pole battery contact (DSQC), the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.



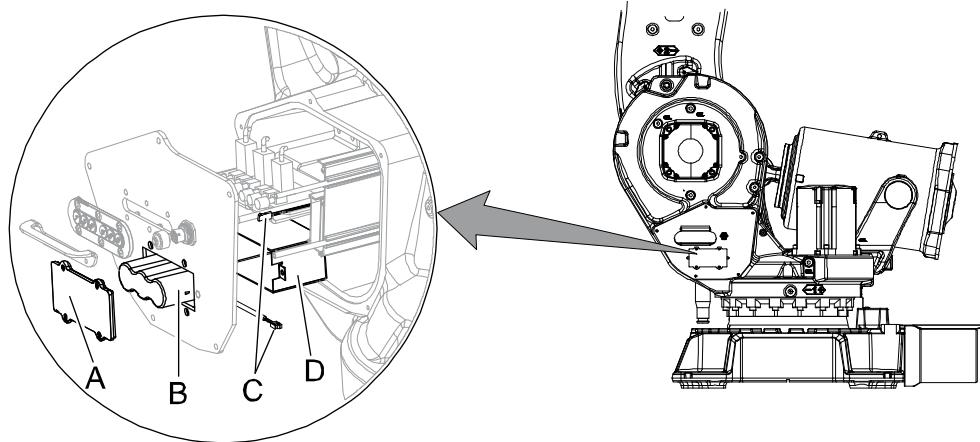
##### WARNING

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

#### Location of SMB battery

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

#### Battery pack with a 2-pole battery contact (DSQC)

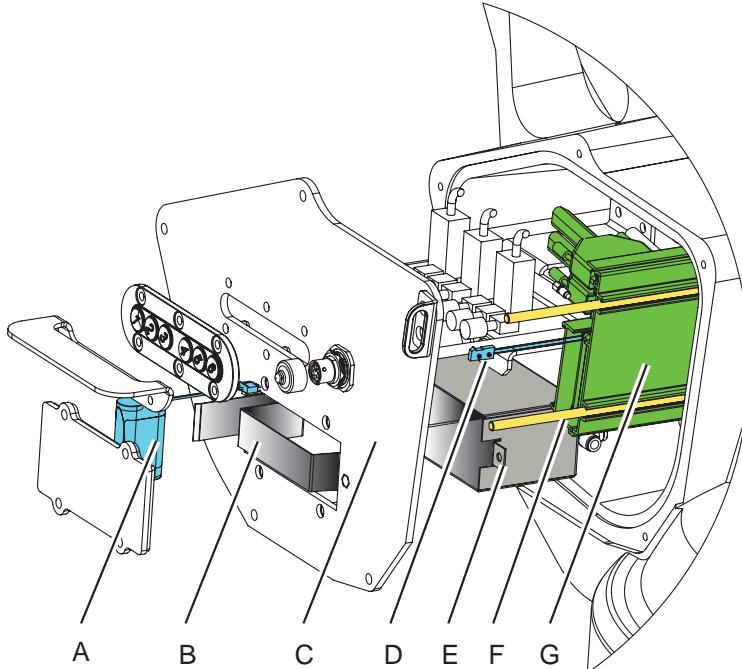


xx0600003444

A	Cover, battery box
B	SMB battery pack with 2-pole battery contact.
C	Cable, battery
D	Battery holder

Continues on next page

## Battery pack with a 3-pole battery contact (RMU)



xx1400002574

A	Battery pack RMU
B	Holder for battery
C	SMB cover
D	Battery cable
E	Battery holder
F	Guide pin (2 pcs)
G	SMB unit

## Required equipment



## Note

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

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

Equipment, etc.	Spare part no.	Note
Battery unit	For spare part no. see: • <a href="#">Spare parts on page 477</a>	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

Continues on next page

### 3 Maintenance

#### 3.4.8 Replacing the SMB battery

Continued

Equipment, etc.	Spare part no.	Note
Circuit diagram	-	See chapter <a href="#">Circuit diagrams on page 479</a> .

#### Removing, battery

Use this procedure to remove the SMB battery.

Action	Note
1 Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
3  <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
4  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
5 Remove the <i>SMB battery cover</i> by unscrewing the attachment screws.	Shown in figure <a href="#">Location of SMB battery on page 184</a> .
6 Pull out the battery and disconnect the <i>battery cable</i> .	Shown in figure <a href="#">Location of SMB battery on page 184</a> .
7 Remove the <i>SMB battery</i> . Battery includes protection circuits. Only replace with a specified spare part or with an ABB-approved equivalent.	Shown in figure <a href="#">Location of SMB battery on page 184</a> .

#### Refitting, battery

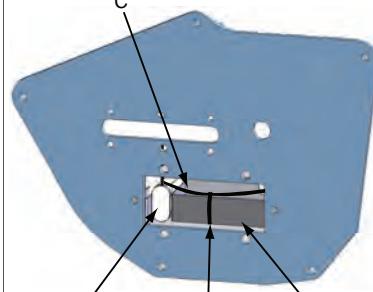
Use this procedure to refit the SMB battery.

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></ul> to the robot, before entering the robot working area.	

Continues on next page

## 3.4.8 Replacing the SMB battery

Continued

Action	Note
2  <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
3 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
4 Reconnect the <i>battery cable</i> and install the battery pack into the SMB/battery recess.   <b>Note</b> RMU batteries are installed together with a battery holder to be properly secured inside the recess. See figure. Strap the battery cable to the holder.	Art. no. is specified in <a href="#">Required equipment on page 185</a> . Shown in figure <a href="#">Location of SMB battery on page 184</a> .   xx1300000307  A Battery pack RMU B Battery holder C Battery cable D Strap
5 Secure the <i>SMB battery cover</i> with its attachment screws.	Shown in figure <a href="#">Location of SMB battery on page 184</a> .
6 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
7 Update the revolution counters.	Detailed in chapter Calibration - section <a href="#">Updating revolution counters on page 436</a> .
8  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

### 3 Maintenance

#### 3.5.1 Analysing the water content in gearbox oil

### 3.5 Analysis activities

#### 3.5.1 Analysing the water content in gearbox oil

##### Analysis of the water content

It is recommendable (not a requirement) to check for water content in the exchanged oil.

##### Effect on gearbox replacement

The table shows what effect the analyse result has on the replacement interval of the gearbox.

	If:	Then....
1	<p>More than 3% water in oil:</p> <ul style="list-style-type: none"><li>With more than 3% water content there is a risk for corrosion in the gearbox and reduced viscosity in the oil.</li></ul>	<p>Replacement of gearbox required every two years</p> <p>xx0600003155</p> <ul style="list-style-type: none"><li>A: Water content in gearbox oil</li><li>B: Months or hours in operation</li><li>C: Replacement of gearbox</li></ul>
2	Less than 3% water in oil.	<p>Normal replacement interval is required for the gearbox.</p> <p>See <a href="#">Analysing the water content in gearbox oil on page 188</a>.</p> <ul style="list-style-type: none"><li><a href="#">Activities and intervals, Foundry Prime on page 118</a></li></ul> <p>xx0600003156</p> <ul style="list-style-type: none"><li>A: Water content in gearbox oil</li><li>B: Months or hours in operation</li></ul>

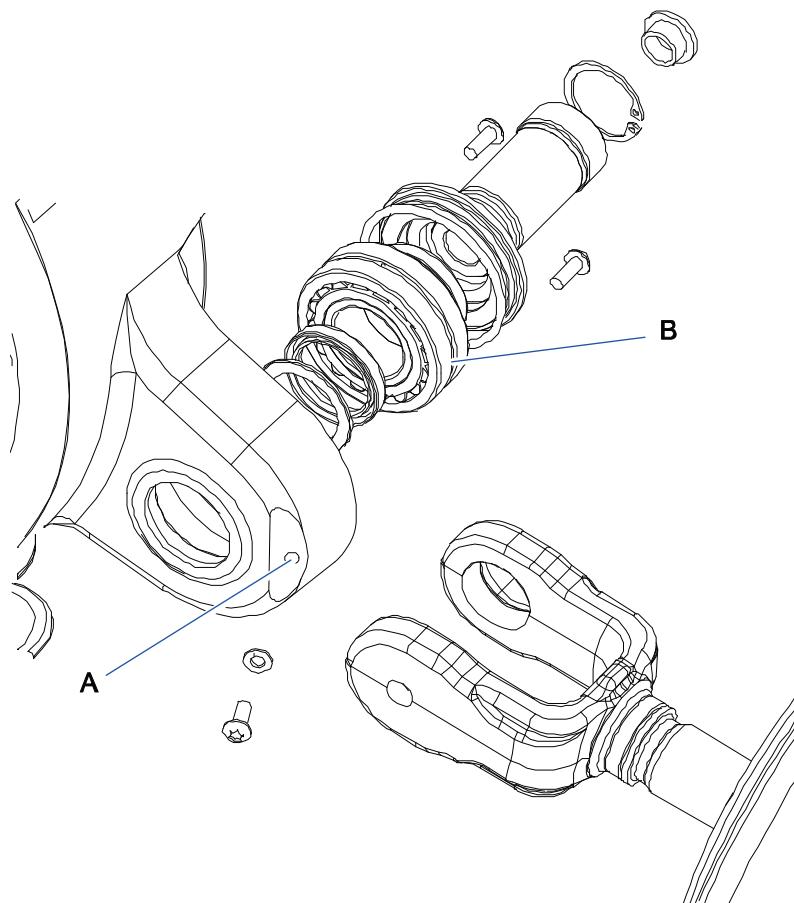
## 3.6 Lubrication activities

## 3.6.1 Lubrication of spherical roller bearing, balancing device

## Location of bearing (Design 1)

The spherical roller bearing is located at the front ear of the balancing device, as shown in the figure below.

**Note!** The balancing device must be mounted on the robot when lubricating the bearing!



xx0700000731

A	Securing screw and lubricating hole
B	Roller bearing

## Location of bearing (Design 2)



## Note

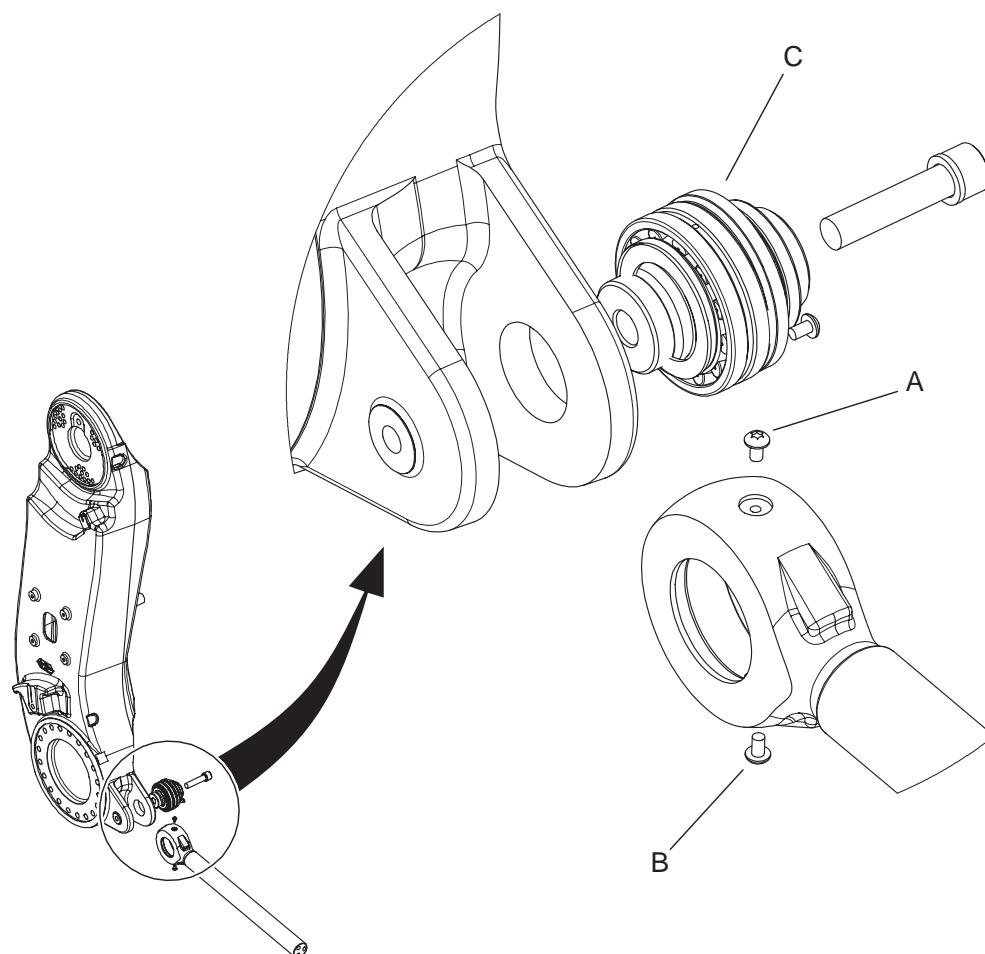
The spherical roller bearing of design 2 balancing device does not need any scheduled lubrication. However the bearing should always be lubricated if the shaft of the balancing device is refitted.

Continues on next page

### 3 Maintenance

#### 3.6.1 Lubrication of spherical roller bearing, balancing device

*Continued*



xx0700000361

A	Upper securing screw/Lubrication hole
B	Lower securing screw
C	Spherical roller bearing

#### Required equipment

Equipment, etc.	Art. no.	Note
Grease	3HAC042534-001	Optimol PDO, 20 ml
Lubrication nipple		M6. Normally not fitted to the link ear at delivery.
Grease pump	-	

*Continues on next page*

## 3.6.1 Lubrication of spherical roller bearing, balancing device

Continued

**Lubrication, balancing device bearing (Design 1)**

The procedure below details how to lubricate the spherical roller bearing.

Action	Note
<p>1</p>  <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> </ul> Before entering the robot working area.	
2	Replace the securing screw at the link ear with a lubrication nipple. M6
3	Lubricate the spherical roller bearing through the lubrication nipple in the ear with <i>grease</i> . Fill until excessive grease is forced out between the shaft and the sealing spacer. Art. no. and amount is specified in <a href="#">Required equipment on page 190!</a> Shown in the figure <a href="#">Location of bearing (Design 1) on page 189!</a> The balancing device must be mounted on the robot when lubricating the bearing!
4	Remove the lubrication nipple and refit the securing screw and washer. M6 x 10, washer: D=6,4/12 T=1,6 Tightening torque: 6 Nm.
5	Clean the area from any excessive grease and check the area once again after operation of the robot, in order to make sure there is no incorrect leakage from the o-rings. Read more about the inspection in section Inspection, balancing device - <a href="#">Check for leakage - Design 1 on page 142.</a>

**Lubrication, balancing device bearing (Design 2)**

The procedure below details how to lubricate the spherical roller bearing.

Action	Note
<p>1</p>  <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> </ul> Before entering the robot working area.	
2	Replace the upper securing screw at the link ear with a lubrication nipple. M6
3	Remove the lower securing screw M6
4	Lubricate the spherical roller bearing through the lubrication nipple in the ear with <i>grease</i> . Fill until excessive grease is forced out through the hole of the lower securing screw. Art. no. and amount is specified in <a href="#">Required equipment on page 190!</a> Shown in the figure <a href="#">Location of bearing (Design 1) on page 189!</a> The balancing device must be mounted on the robot when lubricating the bearing!
5	Remove the lubrication nipple, and refit the upper securing screw and washer. M6 x 10, washer: D=6,4/12 T=1,6 Tightening torque: 6 Nm.

Continues on next page

### 3 Maintenance

---

#### 3.6.1 Lubrication of spherical roller bearing, balancing device

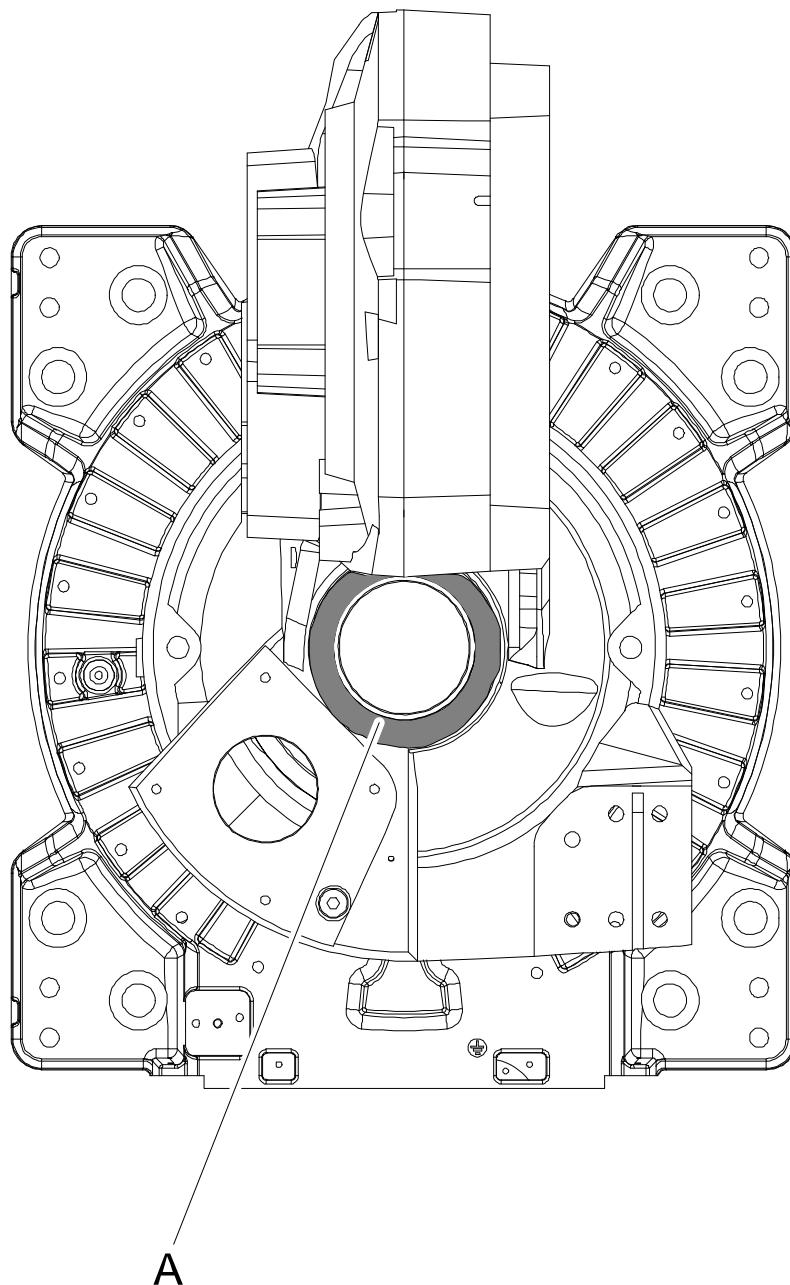
*Continued*

	Action	Note
	Refit the lower securing screw and washer.	M6 x 10, washer: D=6,4/12 T=1,6 Tightening torque: 6 Nm.
6	Clean the area from any excessive grease and check the area once again after operation of the robot, in order to make sure there is no incorrect leakage from the o-rings.	Read more about the inspection in section Inspection, balancing device - <a href="#"><i>Check for leakage - Design 1 on page 142.</i></a>

### 3.6.2 Rust preventive measures, bearing axis 1 (Foundry Prime)

#### Location of bearing axis 1

The bearing axis 1 is located as shown in the illustration. (View from above).



xx0700000445

A	Cable guide
---	-------------

#### Required equipment

Equipment	Art. no.	Note
Brush	-	

*Continues on next page*

### 3 Maintenance

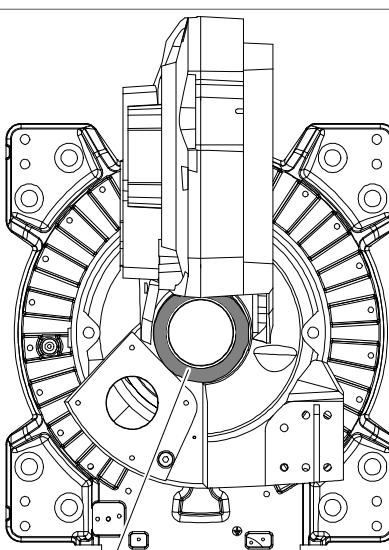
#### 3.6.2 Rust preventive measures, bearing axis 1 (Foundry Prime)

*Continued*

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Equivalent: <ul style="list-style-type: none"><li>Mercasol</li></ul>
Sikaflex 521FC	3HAC026759-001	Option Foundry Prime
Standard toolkit		Content is defined in section <a href="#">Standard tools on page 455</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.

#### Procedure

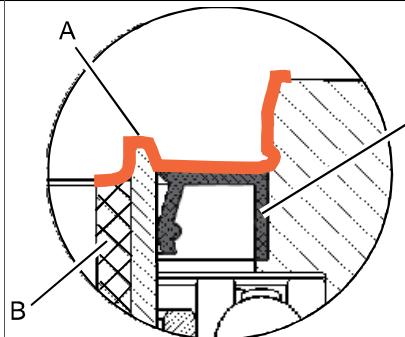
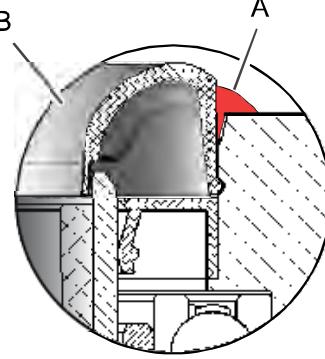
The following procedure details how to apply the rust preventive on bearing axis 1.

	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></ul> to the robot, before entering the robot working area.	
2	Remove the cable guide.   xx0700000445 Parts: <ul style="list-style-type: none"><li>A: Cable guide</li></ul>	
3	Wipe the surface under the cable guide.	

*Continues on next page*

## 3.6.2 Rust preventive measures, bearing axis 1 (Foundry Prime)

Continued

Action	Note
4 Apply rust preventive on the radial sealing with a brush.	 <p>xx1000000370</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Mercasol</li> <li>• B: Protection pipe</li> <li>• C: Radial sealing</li> </ul>
5 Refit the cable guide.	
6 Apply Sikaflex 521FC outside the cable guide as shown in the figure.	 <p>xx1000000372</p> <ul style="list-style-type: none"> <li>• A: Sikaflex 521FC</li> <li>• B: Cable guide</li> </ul>

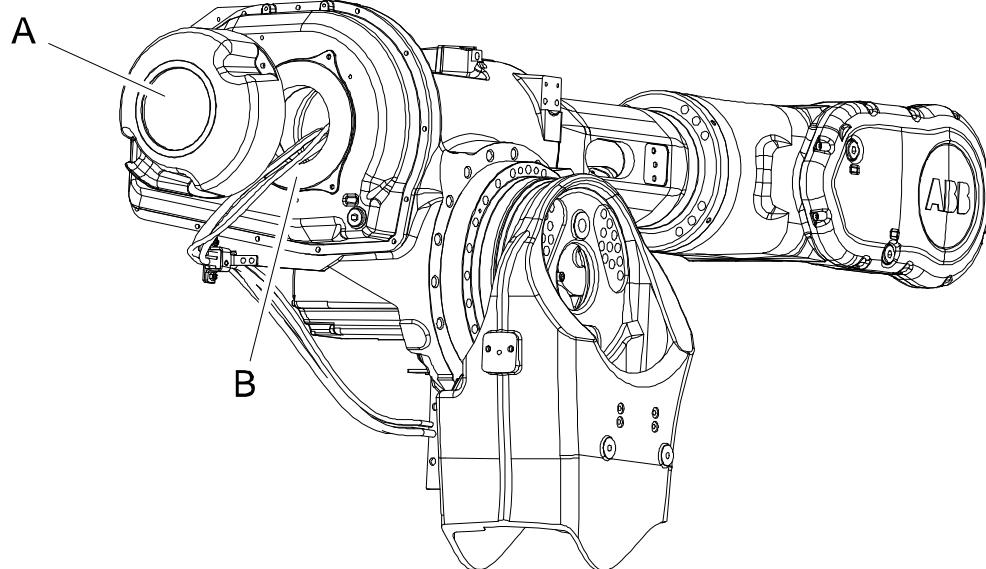
### 3 Maintenance

#### 3.6.3 Rust preventive measures, sealing axis 4 (Foundry Prime)

#### 3.6.3 Rust preventive measures, sealing axis 4 (Foundry Prime)

##### Overview

The sealing axis 4 is located as shown in the illustration.



xx0600002869

A	Cover
B	Cable guide

##### Required equipment

Equipment	Art. no.	Note
Brush	-	
Rust preventive	3HAC034903-001	Equivalent: <ul style="list-style-type: none"><li>Mercasol</li></ul>
Standard toolkit		Content is defined in section <a href="#">Standard tools on page 455</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.

##### Procedure

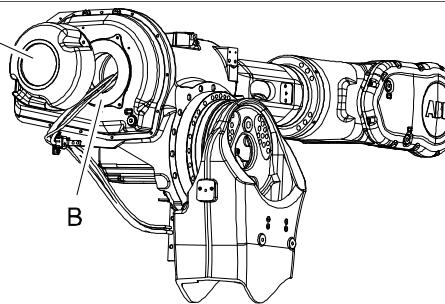
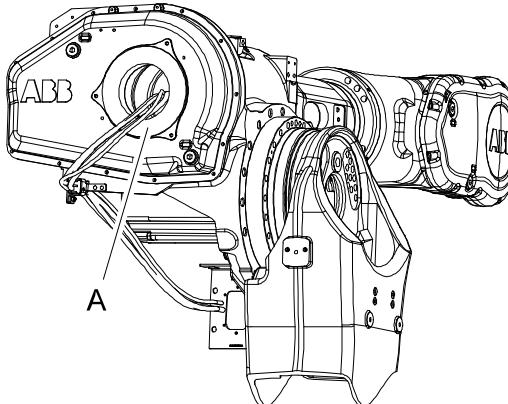
The procedure describes how to apply rust preventive on sealing axis 1.

	Action	Note
1	Put the robot in a suitable position.	

*Continues on next page*

## 3.6.3 Rust preventive measures, sealing axis 4 (Foundry Prime)

Continued

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></ul> to the robot, before entering the robot working area.	
3 Remove the <i>cover</i> at the rear end of the upper arm.	A  xx0600002872 Parts: <ul style="list-style-type: none"><li>• A: Cover</li><li>• B: Cable guide</li></ul>
4 Remove the <i>cable guide</i> that covers the sealing.	 xx0600002871 Parts: <ul style="list-style-type: none"><li>• A: Cable guide</li></ul>
5 Wipe the surface under the <i>cable guide</i> .	

Continues on next page

### 3 Maintenance

#### 3.6.3 Rust preventive measures, sealing axis 4 (Foundry Prime)

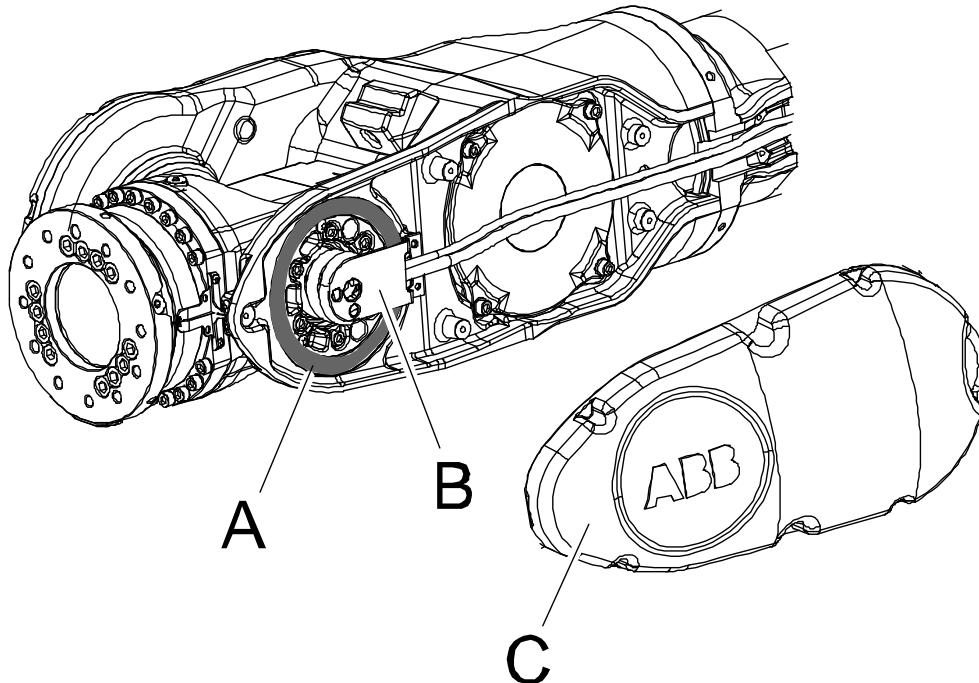
*Continued*

Action	Note
6 Apply rust preventive on the <i>radial sealing and the rear part of the tube</i> with a brush.	 xx0600002868 <b>Parts:</b> <ul style="list-style-type: none"><li>• A: Radial sealing and rear part of tube</li><li>• B: Cable guide</li></ul>
7 Refit the <i>radial sealing and cable guide</i> .	

## 3.6.4 Rust preventive measures, support bearing in wrist (Foundry Prime)

**3.6.4 Rust preventive measures, support bearing in wrist (Foundry Prime)****Location of bearing**

The support bearing in the wrist is located as shown in the illustration.



xx0600002863

A	Bearing
B	Cable bracket
C	Cover

**Required equipment**

Equipment	Article number	Note
Brush	-	
Rust preventive	3HAC034903-001	Equivalent: • Mercasol
Standard toolkit		Content is defined in section <a href="#">Standard tools on page 455</a> .
Other tools and procedures may be required. See refer- ences to these procedures in the step-by-step instructions below.		These procedures include refer- ences to the tools required.

*Continues on next page*

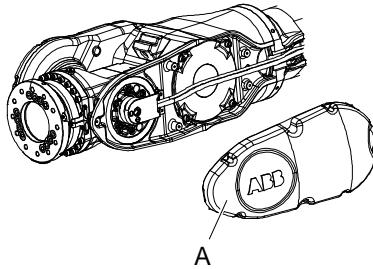
### 3 Maintenance

#### 3.6.4 Rust preventive measures, support bearing in wrist (Foundry Prime)

*Continued*

##### Greasing bearings

The procedure describes how to apply rust preventive on the support bearing.

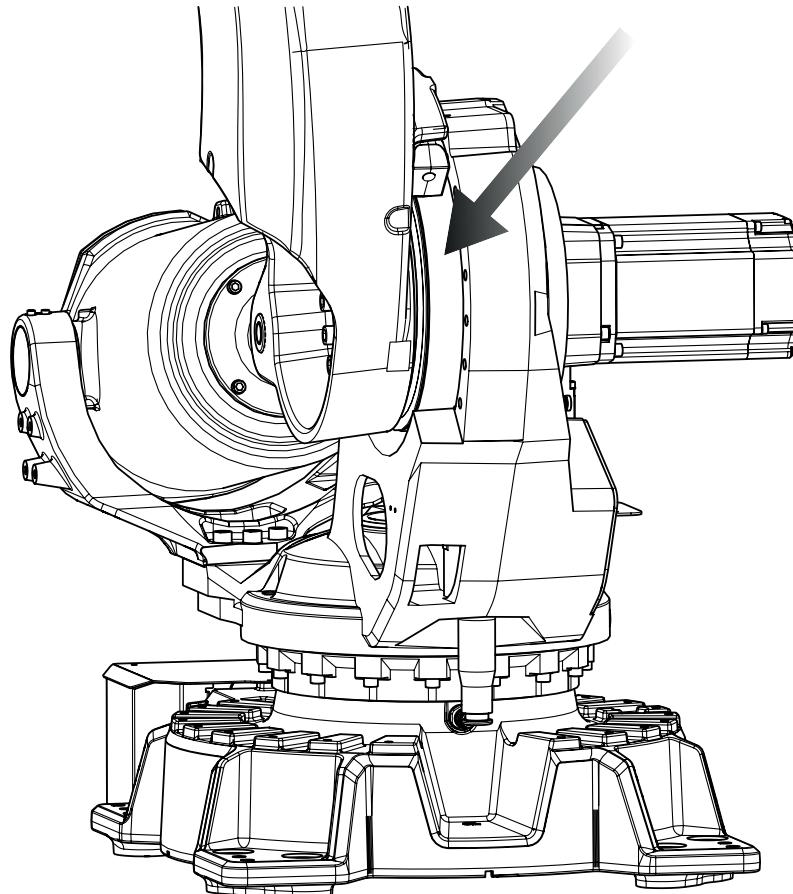
Action	Note
1 Put the robot and the upper arm in a suitable position.	
2  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
3 Disconnect the air hose from motor axis 6.	
4 Remove the hose clamp on motor axis 6, and remove the air hose.	
5 Remove the <i>cover</i> with gasket.	 xx0600002864 <ul style="list-style-type: none"><li>• A: Cover</li></ul>
6 Apply rust preventive on the <i>bearing</i> and <i>cable bracket</i> with the brush.	See <a href="#">Location of bearing on page 199</a> .
7 Refit the <i>cover</i> with gasket.  <b>Note</b> Replace gasket if damaged.	
8 Refit the hose clamp.	
9 Connect the air hose to motor axis 6.	
10 Perform a leakdown test.	See <a href="#">Inspection of air hoses (Foundry Prime) on page 151</a> .

## 3.6.5 Apply Mercasol on output shaft axis 2

### 3.6.5 Apply Mercasol on output shaft axis 2

#### Location of the gear axis 2

The gear axis 2 is located as shown in the illustration.



xx1500001662

#### Required tools and equipment

Equipment	Article number	Note
Brush		

#### Required consumables

Consumable	Article number	Note
Rust preventive	3HAC034903-001	Equivalent: <ul style="list-style-type: none"><li>• Mercasol</li></ul>
isopropyl alcohol		

*Continues on next page*

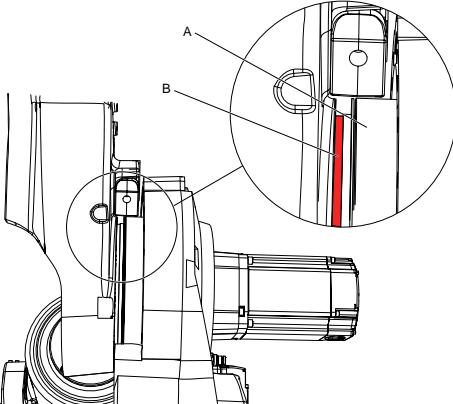
### 3 Maintenance

#### 3.6.5 Apply Mercasol on output shaft axis 2

*Continued*

##### Procedure

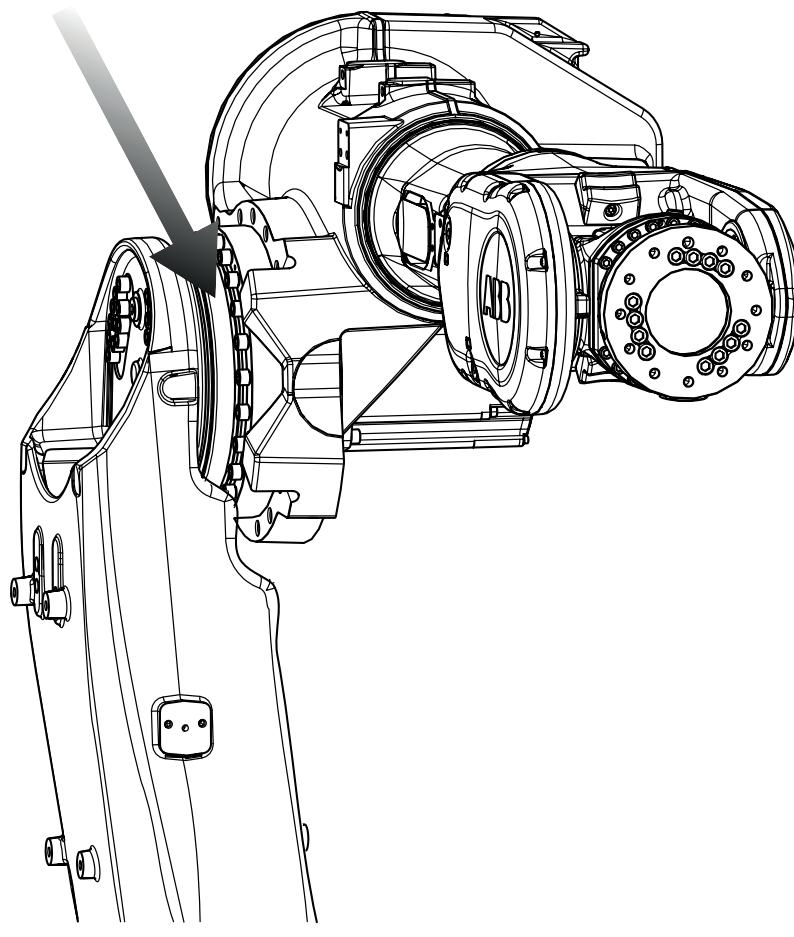
The procedure describes how to remove and apply rust preventive output shaft axis 2.

Action	Note
1 Put the robot in a suitable position.	
2  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
3 clean the surface on the output shaft with isopropanol.	 <p>xx1500001660</p> <p>A Gear axis 2 B Output shaft</p>
4 Apply rust preventive on the out put shaft with a brush.	

### 3.6.6 Apply Mercasol on output shaft axis 3

#### Location of the gear axis 3

The gear axis 2 is located as shown in the illustration.



#### Required tools and equipment

Equipment	Article number	Note
Brush		

#### Required consumables

Consumable	Article number	Note
Rust preventive	3HAC034903-001	Equivalent: • Mercasol

#### Procedure

The procedure describes how to remove and apply rust preventive output shaft axis 3.

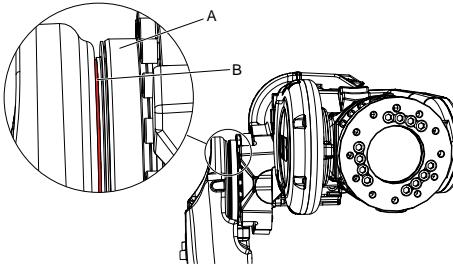
	Action	Note
1	Put the robot in a suitable position.	

*Continues on next page*

### 3 Maintenance

#### 3.6.6 Apply Mercasol on output shaft axis 3

*Continued*

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></ul> to the robot, before entering the robot working area.	
3 clean the surface on the output shaft with isopropanol.	 xx1500001661 A Gear axis 2 B Output shaft
4 Apply rust preventive on the out put shaft with a brush.	

## 3.7 Cleaning activities

### 3.7.1 Cleaning the IRB 6640 Foundry Prime



#### WARNING

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

#### General

To secure high uptime it is important that the IRB 6640 Foundry Prime is cleaned regularly. The frequency of cleaning depends on the environment in which the manipulator works.

Different cleaning methods are allowed depending on the type of protection of the IRB 6640 Foundry Prime.



#### Note

Always verify the protection type of the robot before cleaning.

#### Oil spills

##### Oil spills from gearboxes

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

- 1 Inspect that the oil level in the suspected gearbox is according to the recommendations, see [Inspection activities on page 123](#).
- 2 Write down the oil level.
- 3 Inspect the oil level again after, for example, 6 months.
- 4 If the oil level is decreased then replace the gearbox.

##### Oil spills discolors painted surfaces

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



#### Note

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

#### Dos and don'ts!

This section specifies some special considerations when cleaning the robot.

##### Always!

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

*Continues on next page*

### 3 Maintenance

---

#### 3.7.1 Cleaning the IRB 6640 Foundry Prime

*Continued*

##### Never!

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

---

#### Cleaning methods

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

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Foundry Prime	Yes	Yes. With cleaning detergent approved by ABB, spirit or isopropyl alcohol. See <a href="#">Approved cleaners and detergents on page 207</a> .	Yes. It is highly recommended that the water contains a rust-prevention solution.	Yes <sup>i</sup> . It is highly recommended that the water and steam contains rust preventive. If cleaning detergents are used they must be approved by ABB for Foundry Prime robots. See <a href="#">Approved cleaners and detergents on page 207</a> .

<sup>i</sup> Perform according to section [Cleaning with water and steam on page 206](#).

---

#### Cleaning with water and steam

##### Instructions for rinsing with water

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 700 kN/m<sup>2</sup> (7 bar)<sup>1</sup>
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum flow: 20 liters/min<sup>1</sup>

<sup>1</sup> Typical tap water pressure and flow

##### Instructions for steam or high pressure water cleaning

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2500 kN/m<sup>2</sup> (25 bar)
- Fan jet nozzle should be used, min. 45° spread

<sup>1</sup> See [Cleaning methods on page 206](#) for exceptions.

<sup>2</sup> See [Cleaning methods on page 206](#) for exceptions.

*Continues on next page*

- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum water temperature: 80° C

#### Additional cleaning instructions for Foundry Prime robots

##### Washing detergents

- Only washing detergents approved by ABB shall be used.
- The washing detergent must be cleansed continuously.
- The washing detergent must contain rust inhibitor.
- The detergent pH value and concentration must be checked regularly.
- Maximum allowed pH of the washing detergent is 9.0, if not stated otherwise.
- The user must follow the recommendations regarding detergent concentration and pH value.
- No other additive than water is guaranteed without prior testing or agreement with ABB. Other additives than water may have a harmful effect on the life of the robot and its components.
- Recommendations given by the detergent manufacturer for the specific detergent in question must be followed.



##### Note

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

##### Approved cleaners and detergents

All cleaners and detergents must be approved by ABB before use. Contact ABB Robotics Sales Support to get the latest released list of approved cleaners and detergents.

##### Temperature of cleaning bath

- Maximum temperature <60°C.
- Ambient temperature must not be higher than +50° C.



##### Note

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

##### Washing without detergent

If the washing is performed without detergent, the water must contain rust inhibitor.

#### Cables

Movable cables need to be able to move freely:

- Remove waste material, such as sand, dust and chips, if it prevents cable movement.

*Continues on next page*

### **3 Maintenance**

---

#### **3.7.1 Cleaning the IRB 6640 Foundry Prime**

*Continued*

- Clean the cables if they have a crusty surface, for example from dry release agents.

# 4 Repair

## 4.1 Introduction

### Structure of this chapter

This chapter describes all repair activities recommended for the IRB 6640 Foundry Prime and any external unit.

It is made up of separate procedures, each describing a specific repair activity. Each procedure contains all the information required to perform the activity, for example spare parts numbers, required special tools, and materials.



### WARNING

Repair activities not described in this chapter must only be carried out by ABB. Otherwise damage to the mechanics and electronics may occur.

### Required equipment

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

The details of equipment are also available in different lists in the chapter [Reference information on page 447](#).

### Safety information

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



### Note

If the IRB 6640 Foundry Prime is connected to power, always make sure that the IRB 6640 Foundry Prime is connected to earth before starting any repair work.

For more information see:

- *Product manual - IRC5*

## 4 Repair

### 4.2.1 Performing a leak-down test

## 4.2 General procedures

### 4.2.1 Performing a leak-down test

#### When to perform a leak-down test

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

#### Required equipment

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

#### Performing a leak-down test

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

## 4.2.2 Mounting instructions for bearings

### General

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

### Equipment

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

### Assembly of all bearings

Follow the following instructions while mounting a bearing on the robot.

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

### Assembly of tapered bearings

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

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

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

### Greasing of bearings

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

- The bearings must not be completely filled with grease. However, if space is available beside the bearing fitting, the bearing may be totally filled with grease when mounted, as excessive grease will be pressed out from the bearing when the robot is started.

*Continues on next page*

## 4 Repair

---

### 4.2.2 Mounting instructions for bearings

*Continued*

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

Grease the different types of bearings as following description:

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

## 4.2.3 Mounting instructions for seals

### General

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

### Equipment

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

### Rotating seals

The procedure below describes how to fit rotating seals.



#### CAUTION

Please observe the following before commencing any assembly of seals:

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

	Action	Note
1	Check the seal to ensure that: <ul style="list-style-type: none"> <li>• The seal is of the correct type (provided with cutting edge).</li> <li>• There is no damage to the sealing edge (feel with a fingernail).</li> </ul>	
2	Inspect the sealing surface before mounting. If scratches or damage are found, the seal must be replaced since it may result in future leakage.	
3	Lubricate the seal with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the seal.)  Fill 2/3 of the space between the dust tongue and sealing lip with grease. The rubber coated external diameter must also be greased, unless otherwise specified.	Article number is specified in <a href="#">Equipment on page 213</a> .
4	Mount the seal correctly with a mounting tool. Never hammer directly on the seal as this may result in leakage.	

*Continues on next page*

## 4 Repair

### 4.2.3 Mounting instructions for seals

*Continued*

#### Flange seals and static seals

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

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

#### O-rings

The following procedure describes how to fit o-rings.

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

## 4.2.4 Replacing parts on the robot

### General

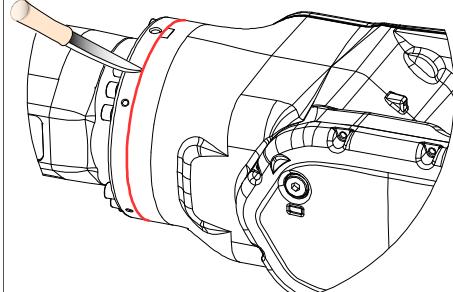
Follow the procedures in this section whenever breaking the surface paint of the robot during replacement of parts.

When replacing parts on a robot with protection type Foundry Prime, it is important to make sure that after the replacement, no surface without paint is exposed to the aggressive working environment.

### Required equipment

Equipment	Spare parts	Note
Sealing compound		Sikaflex 521 FC. Color white.
Tooling pin		Width 6-9 mm, made of wood.
Cleaning agent		Ethanol
Knife		
Lint free cloth		
Rust preventive		Mercasol
Brush		
Touch up paint Foundry Prime 2, Grey	3HAC035355-001	The grey touch up paint is used on all Foundry Prime robots, regardless of the original color of the robot.

### Removing

	Action	Description
1	Cut the paint with a knife in the joint between the part that will be removed and the structure, to avoid that the paint cracks.	 xx0900000121
2	Carefully grind the paint edge that is left on the structure to a smooth surface.	

### Refitting

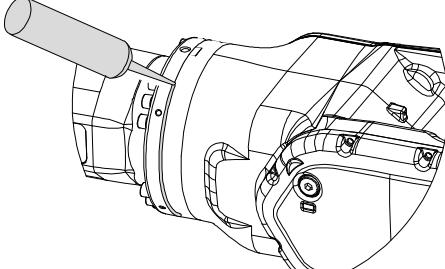
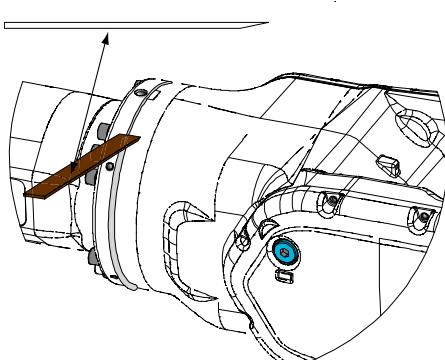
	Action	Description
1	Before the parts are refitted, clean the joint so that it is free from oil and grease.	Use ethanol on a lint free cloth.
2	Place the tooling pin in hot water.	

*Continues on next page*

## 4 Repair

### 4.2.4 Replacing parts on the robot

*Continued*

Action	Description
3 Seal all refitted joints with Sikaflex 521FC.	 xx0900000122
4 Use the tooling pin to even out the surface of the Sikaflex seal.	 xx0900000125
5 Wait 15 minutes.	Sikaflex 521FC skin dry time (15 minutes).
6 Use Touch up paint Foundry Prime 2, grey to paint the joint.	3HAC035355-001   <b>Note</b>  Always read the instruction in the product data sheet in the paint repair kit for Foundry Prime.
7 Apply Mercasol on all screw heads and set screws after tightening.	

## 4.3 Complete robot

## 4.3.1 Replacing cable harness, axes 1-6

## 4.3 Complete robot

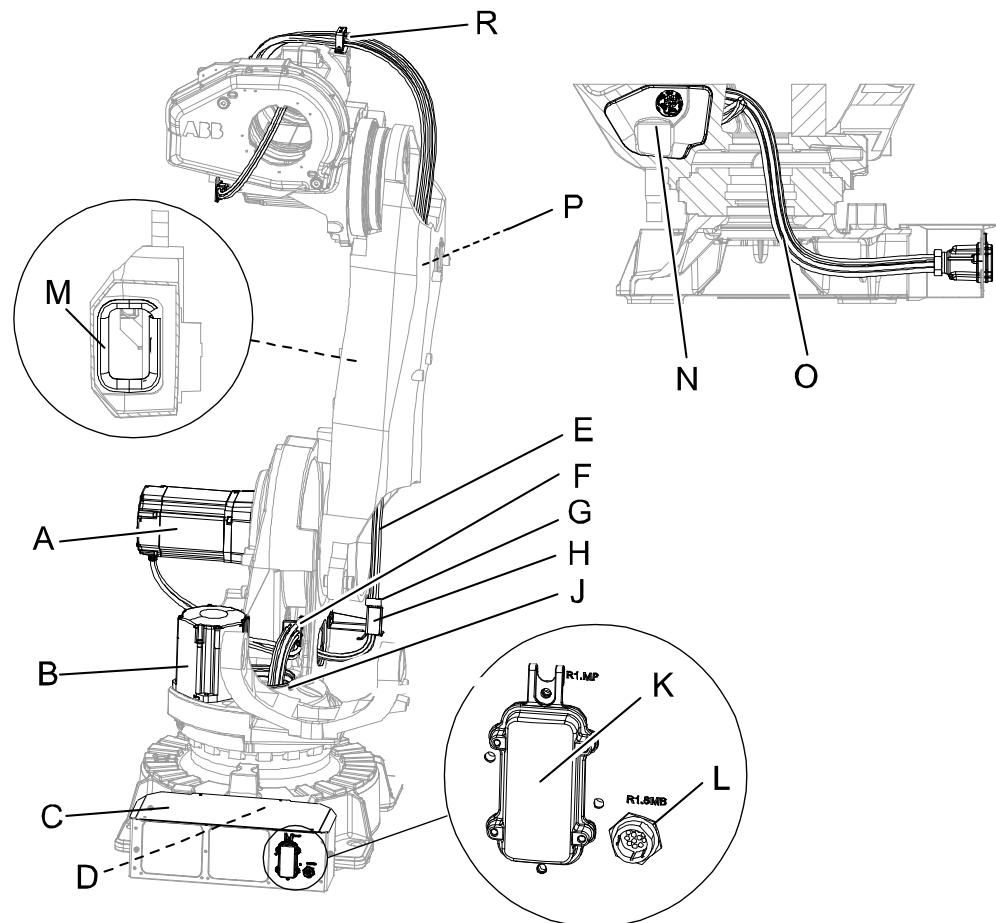
## 4.3.1 Replacing cable harness, axes 1-6

## General

Use this section to replace the cable harness that runs undivided from axis 1 to axis 6.

## Location of cable harness

The cable harness of axes 1-6 is run throughout the robot as shown in the figure below.



xx0700000102

A	Connectors at motor, axis 2 (R2.FB2, R2.MP2)
B	Connectors at motor, axis 1 (R2.FB1, R2.MP1)
C	Rear cover plate
D	Earth (attachment point is placed under the cover plate)
E	Cable harness

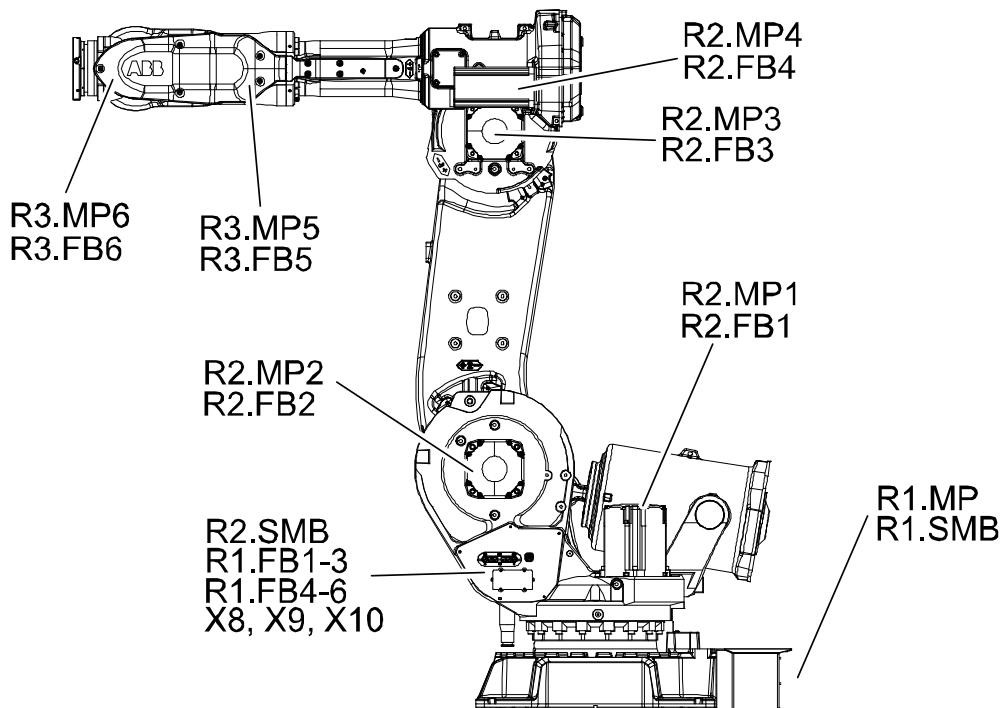
Continues on next page

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

*Continued*

F	Cable holder
G	Velcro strap
H	Guide plate ax 2
J	Cable guide
K	Connector R1.MP
L	Connector R1.SMB
M	Cable protector (placed inside the lower arm)
N	Position for SMB and brake release units
O	Cable harness (cut away view)
P	Velcro strap (inside lower arm on metal clamp)
R	Cable gland (armhouse)



xx0700000107

### Required parts

Equipment	Spare part no.	Note
Cable harness, axes 1-6	See Spare parts chapter.	Includes: • Gaskets axes 1-5
Gasket	3HAC3438-1	Motors axes 1-5
Gasket, cover	3HAC033489-001	Motor axis 6

*Continues on next page*

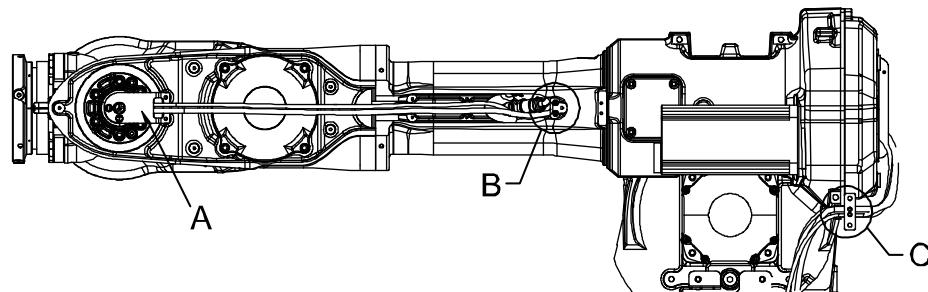
**Required equipment - tools etc.**

For Foundry Prime robots also see [Additional equipment - Foundry Prime on page 219](#).

Equipment	Note
Locking screw	M16x60 quality 12.9 Gleitmo For securing the lower arm
Standard toolkit	Content is defined in section <a href="#">Standard tools on page 455</a> .
Circuit diagram	See chapter: • <a href="#">Circuit diagram</a>

**Additional equipment - Foundry Prime**

Equipment	Art. no.	Note
Rust preventive	3HAC026621-001	Equivalent: • Mercasol
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Brush	-	

**Cable brackets of the upper arm**

xx0500002293

A	Cable bracket, wrist unit
B	Cable bracket, upper arm tube
C	Cable attachment, rear

**Removing the cable harness - upper arm**

Use this procedure to remove the cable harness from the upper arm of the robot.

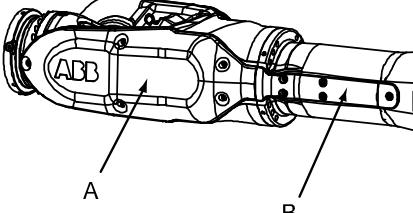
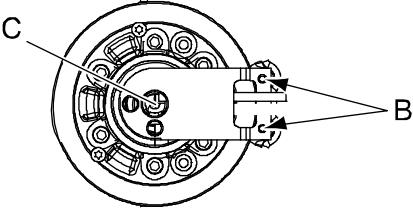
	Action	Note
1	In order to facilitate refitting of the cable harness, run the robot to the specified position: • Axis 1: 0 ° • Axis 2: 0 ° • Axis 3: 0 ° • Axis 4: 0 ° • Axis 5: +90 ° • Axis 6: no significance	Axes 2 and 3 may be tilted slightly to improve access.

*Continues on next page*

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

*Continued*

	Action	Note
2	 <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> </ul> Before entering the robot working area.	
3	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
4	Remove the <i>cover, wrist unit</i> and the <i>cover, upper arm tube</i> .	 xx0200000214 A Cover, wrist unit B Cover, upper arm tube
5	 <b>Note</b> Axis 5 must be oriented in the correct position (+90°) to allow the motor 6 cover to open!	
6	Remove the cover of motor, axis 6 and disconnect all connectors beneath.	
7	Loosen the <i>cable bracket, wrist unit</i> by unscrewing its attachment screws. Two of the attachment screws are visibly located at the rear of the bracket and the third is located at the bottom of the cable bracket, in the center.	Shown in the figure <a href="#">Cable brackets of the upper arm on page 219</a> .  xx0200000254 <ul style="list-style-type: none"> <li>• B: Attachment screws, rear of cable bracket (2 pcs)</li> <li>• C: Attachment screw, bottom of cable bracket</li> </ul>
8	Pick out the cabling from motor, axis 6.	
9	Loosen the <i>cable bracket, upper arm tube</i> by unscrewing the two screws on top of the tube.	Shown in the figure <a href="#">Cable brackets of the upper arm on page 219</a> .
10	Disconnect the two connectors (R3.FB5 and R3.MP5) inside the tube.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .

*Continues on next page*

## 4.3.1 Replacing cable harness, axes 1-6

Continued

Action	Note
11 Remove cable straps from the harness, if any.	
12 Remove the <i>cable attachment, rear.</i>	Shown in the figure <a href="#">Cable brackets of the upper arm on page 219</a> .
13 Remove the covers of motors axes 3 and 4 and disconnect all connectors beneath. Pick out the cabling from the motors.	
14 Gently pull the cable harness out from the upper arm tube.	
15 Tie the connectors into bundles, to avoid damaging them during further removal.	
16 Continue removing the cable harness in lower arm, frame and base.	

**Removing the cable harness - frame and base**

Use this procedure to remove the cable harness from the frame and base.

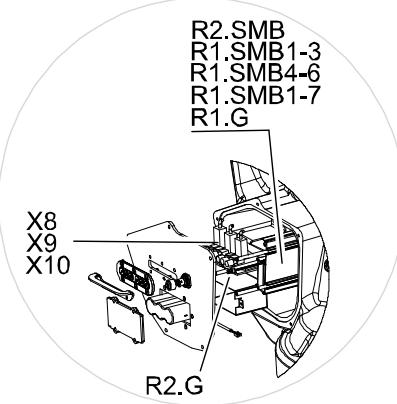
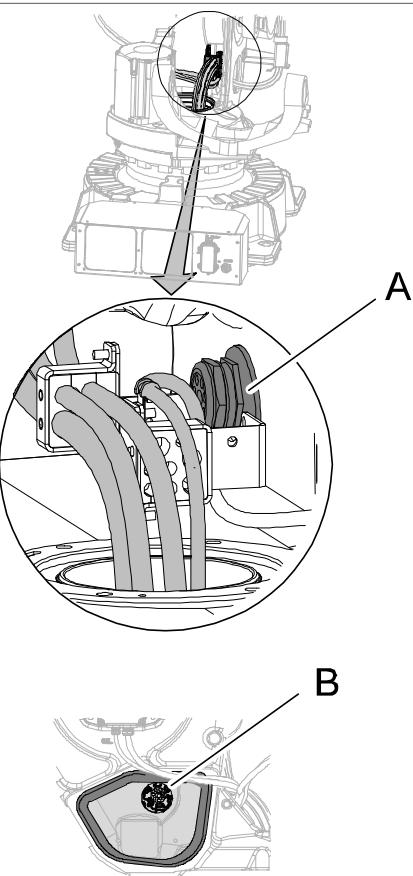
Action	Note
1  <b>CAUTION</b>  Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
2 Remove the <i>rear cover plate</i> from the robot by removing its attachment screws.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
3 Disconnect the <i>earth cable</i> beneath the rear cover plate.	Position shown in the figure <a href="#">Location of cable harness on page 217</a> .
4 Disconnect connectors <i>R1.MP</i> and <i>R1.SMB</i> .	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
5 Remove the cable holder on the frame securing the cable harness.	
6 Pull the cable and connectors up through the cable guide in the center of the frame.	
7 Disconnect all connectors at motors 1 and 2.	
8 Open the SMB cover carefully.  The cable between the battery and the SMB-unit can stay connected, in order to avoid an update of the revolution counter. Be careful not to let the weight of the cover strain the cable!   <b>Note</b>  In order to remove the cover completely, the connector R1.G must be disconnected! This causes a necessary updating of the revolution counter!	

Continues on next page

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

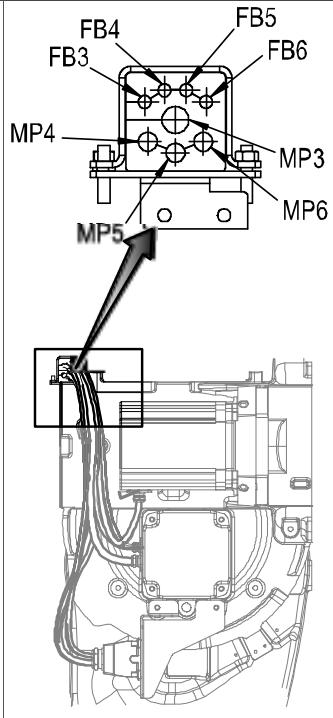
*Continued*

Action	Note
9 Disconnect connectors R2.SMB, R1.SMB1-3, R1.SMB4-6 from the SMB unit. Disconnect X8, X9 and X10 from the brake release unit.	 xx0700000104
10 Remove the <i>cable gland</i> by removing the <i>attachment screws</i> from inside the SMB recess.	 xx0700000109 <ul style="list-style-type: none"> <li>• A: Cable gland</li> <li>• B: Attachment screws, inside SMB recess (4 pcs)</li> </ul>
11 Remove the velcro strap and cable gland.	

*Continues on next page*

**Removing the cable harness - lower arm**

Use this procedure to remove the cable harness from the lower arm.

Action	Note
1 Remove the cable gland that secures the cables to the arm house.	 xx0100000143
2 Remove the <i>velcro strap</i> from the harness at the guide plate ax 2 at the lower arm.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
3 Remove the cable harness from the axis-2 cable guide plate.	
4 Disconnect all connectors at the axis-3 and axis-4 motors.	
5 Gently pull the cable harness out.	

**Refitting the cable harness - lower arm, frame and base**

Use this procedure to refit the cable harness on the lower arm, frame and base of the robot.

How to refit on the upper arm is described in section [Refitting the cable harness - upper arm on page 227](#).

Action	Note
 <b>Note</b>  Apply rust preventive around all dismantled covers and attachment screws with a brush.	For art. no. see: • <a href="#">Additional equipment - Foundry Prime on page 219</a>

*Continues on next page*

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

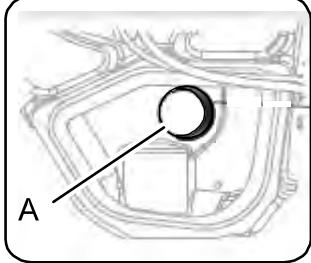
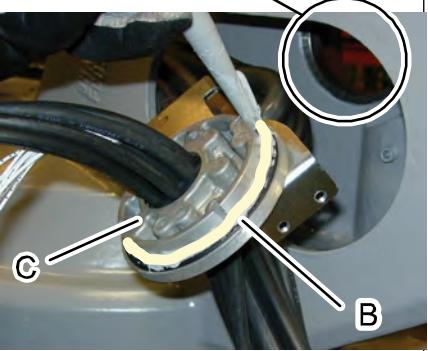
Continued

	Action	Note
2	 <b>Note</b>  Always apply rust preventive (Mercasol) on covers, attachment plates and screws after refitting these components.	
3	Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
4	Push the cable and connectors down through the <b>cable guide</b> in the center of the frame. <ul style="list-style-type: none"><li>• Make sure the cables are not twisted with each other or with customer harnesses if any</li><li>• Make a note of the correct positions of the connectors.</li></ul>	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
5	Reconnect connectors <b>R1.MP</b> and <b>R1.SMB</b> at the base.	Tightening torque for R1.SMB: 10 Nm. Shown in the figure <a href="#">Location of cable harness on page 217</a> . Make a note of the correct positions of the connectors!
6	Reconnect the <b>earth cable</b> .	Position shown in the figure <a href="#">Location of cable harness on page 217</a> .
7	Refit the <b>rear cover plate</b> to the robot with its attachment screws.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
8	Reconnect all connectors at motors axes 1 and 2.	
9	 <b>Note</b>  On Foundry Prime robots: When dismantling the cables from the motors, the gasket must be replaced.	For art. no. see <ul style="list-style-type: none"><li>• <a href="#">Required parts on page 218</a></li></ul>

Continues on next page

## 4.3.1 Replacing cable harness, axes 1-6

Continued

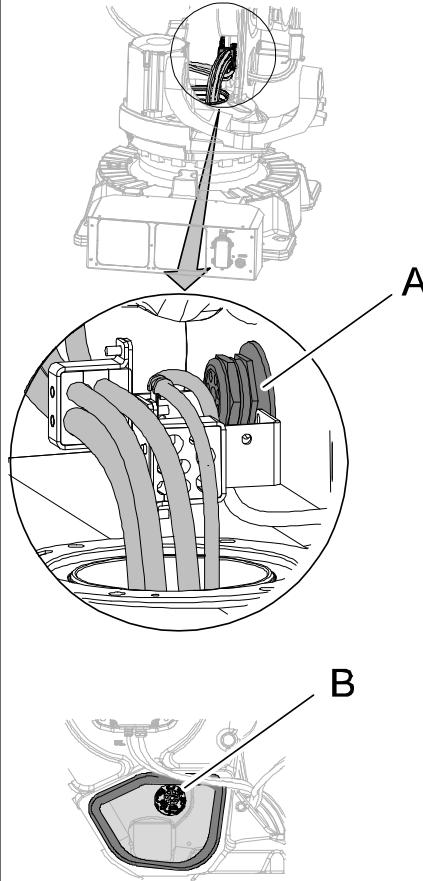
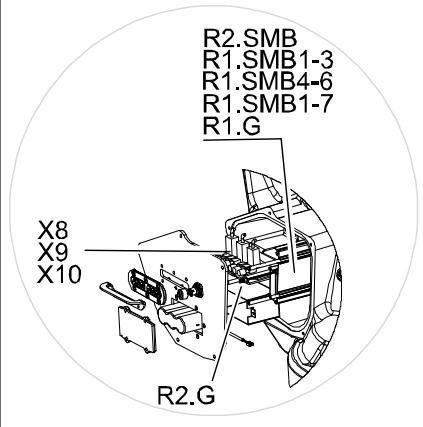
Action	Note
10 <i>Foundry Prime robots:</i> Apply Sikaflex 521FC on the cover located on the cable harness at the SMB/BU units before the harness is fitted.	  <p>xx1000000386</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Position for cover in SMB recess</li> <li>• B: Sikaflex 521FC</li> <li>• C: Cover</li> </ul>

Continues on next page

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

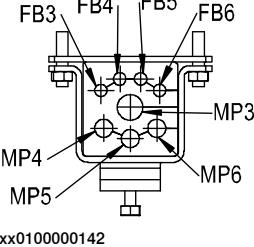
*Continued*

Action	Note
<p>11 Secure the <i>cable gland</i> with its <i>attachment screws</i> from inside the SMB recess. Refit the <i>velcro strap</i>. (Shown in the figure <a href="#">Location of cable harness on page 217</a>.)</p>	 <p>xx0700000109</p> <ul style="list-style-type: none"> <li>A: Cable gland</li> <li>B: Attachment screws, inside SMB recess (4 pcs)</li> </ul>
<p>12 Reconnect connectors to the SMB unit:</p> <ul style="list-style-type: none"> <li>R2.SMB</li> <li>R1.SMB1-3</li> <li>R1.SMB4-6</li> </ul> <p>Reconnect connectors to the Brake release unit:</p> <ul style="list-style-type: none"> <li>X8</li> <li>X9</li> <li>X10</li> </ul> <p>Reconnect R1.G if it has been disconnected.</p>	 <p>xx0700000104</p>
<p>13 Secure the SMB cover with its attachment screws. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.</p>	

*Continues on next page*

## 4.3.1 Replacing cable harness, axes 1-6

Continued

Action	Note
14  <b>WARNING</b> Before continuing any service work, please observe the safety information in section <b>WARNING - The brake release buttons may be jammed after service work on page 49!</b>	
15 Push the cable harness gently through the lower arm.	
16 Refit the <i>metal clamp</i> on the inside of the lower arm. Then refit the cable harness to the metal clamp with the velcro strap and cable gland.	
17 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

**Refitting the cable harness - upper arm**

Use this procedure to refit the cable harness on the upper arm of the robot.

How to refit the cable harness on lower arm, frame and base is described in section [Refitting the cable harness - lower arm, frame and base on page 223](#).

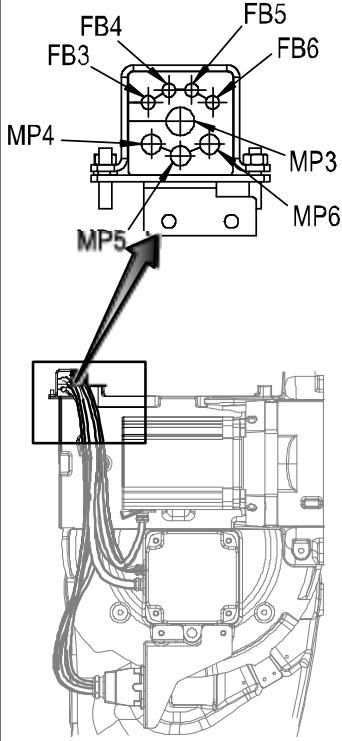
Action	Note
1 Before refitting the upper end of the cable harness, the lower end must first be refitted.	How to refit see section <a href="#">Refitting the cable harness - lower arm, frame and base on page 223</a> .
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

*Continues on next page*

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

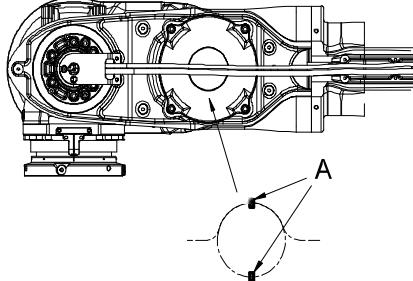
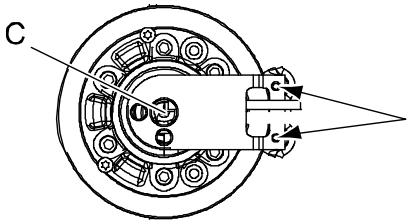
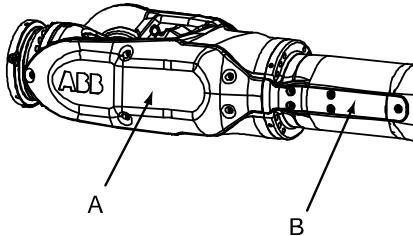
*Continued*

Action	Note
3 Refit the <i>cable gland</i> securing the cables in the armhouse.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .   xx0100000143
4 Reconnect all connectors on motors axes 3 and 4.	
5 Secure the cable harness to the <i>guide plate</i> axis 2.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
6 Refit the <i>velcro strap</i> at the guide plate axis 2.	Shown in the figure <a href="#">Location of cable harness on page 217</a> .
7 Gently insert the cable harness from the rear into the upper arm.	
8 Connect the two connectors inside the upper arm tube, R2.FB5 and R3.MP5 and secure the <i>cable bracket</i> with its two attachment screws to the tube.	Shown in the figure <a href="#">Cable brackets of the upper arm on page 219</a> .
9  Note The position of axis 6 must be +90° for a correct installation of the cable harness.	

*Continues on next page*

## 4.3.1 Replacing cable harness, axes 1-6

Continued

Action	Note
10 Place the cabling to motor axis 6 correctly on the upper arm and gently pull the connectors through the hole on top of the wrist unit to motor axis 6.  In case of excess of cable length: <ul style="list-style-type: none"><li>• put the excess cable in a loop in the area shown in the figure and secure with cable straps. Cables are longer in order to fit different upper arm lengths.</li></ul>	 xx0200000185 <ul style="list-style-type: none"><li>• A: Cable straps</li></ul>
11 Fasten the cable bracket, wrist unit with its <i>attachment screws</i> . Two screws are visible at the <i>rear attachment point</i> of the bracket and the third is located at the <i>bottom of the cable bracket</i> , in the center.   <b>Note</b>  Do not use stainless attachment screws! There is a potential risk of galvanic corrosion.	 xx0200000254 <ul style="list-style-type: none"><li>• B: Attachment screws, rear attachment point of cable bracket (2 pcs)</li><li>• C: Attachment screw, bottom of cable bracket (1 pc)</li></ul>
12 Reconnect the connectors to motor, axis 6 and refit the motor cover.	<b>Foundry robots:</b> It is recommended to use a new gasket on cover.
13 Refit the cover, upper arm tube and the cover, <i>wrist unit</i> .  Make sure the cabling is placed correctly when refitting the covers, and does not get jammed.	 xx0200000214 <b>Parts:</b> <ul style="list-style-type: none"><li>• A: Cover, wrist unit</li><li>• B: Cover, upper arm tube</li></ul>
14 If any cable straps have been removed, refit them to the harness.	
15 Refit the <i>cable attachment, rear</i> .	Shown in the figure <a href="#">Cable brackets of the upper arm on page 219</a> .
16 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
17 If the connection between the SMB battery and the SMB unit has been broken, the revolution counters now must be updated!	Detailed in section <a href="#">Updating revolution counters on page 436</a> .

Continues on next page

## 4 Repair

### 4.3.1 Replacing cable harness, axes 1-6

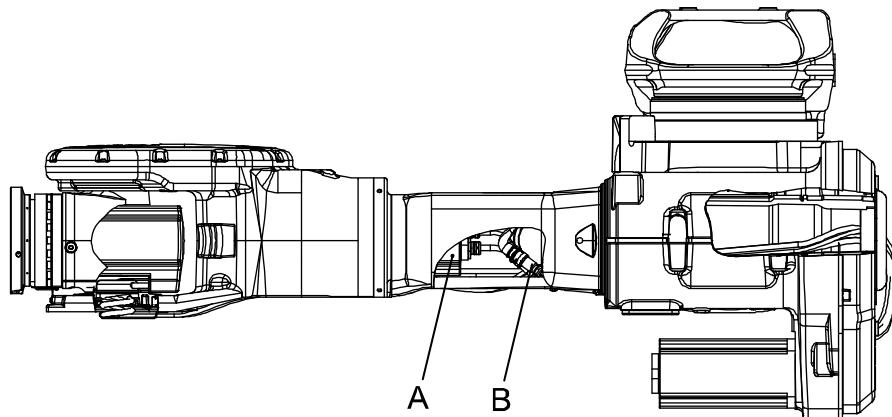
*Continued*

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

### 4.3.2 Replacement of cabling, axis 5 motor

#### Location of cabling

The separate cables for the axis 5 motor are located inside the upper arm tube, as shown in the figure below.



xx0500002294

A	Motor axis 5 with connectors R4.FB5 and R4.MP5
B	Connectors R3.FB5 and R3.MP5

#### Required equipment

Equipment	Spare part no.	Note
Cable harness axis 5	See <a href="#">Spare parts on page 477</a> .	
Circuit diagram	3HAC025744-001	
Standard toolkit		Content is defined in section <a href="#">Standard tools on page 455</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.

#### Removal, cabling axis 5 motor

The procedure below details how to remove the cabling from the axis 5 motor.

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

*Continues on next page*

## 4 Repair

### 4.3.2 Replacement of cabling, axis 5 motor

Continued

Action	Note
2  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3 Remove the complete wrist unit.	Detailed in section: <ul style="list-style-type: none"><li>IRB 6640: <a href="#">Removal, wrist unit on page 261</a>.</li></ul>
4 Remove the cover of motor, axis 5.	
5 Disconnect all connectors at motor, axis 5.	
6 Remove the cable gland cover at the cable exit by unscrewing its two attachment screws.	
7 Remove the cable, axis 5.	

#### Refitting, cabling axis 5 motor

The procedure below details how to refit the cabling to the motor of axis 5.

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></ul> Before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3 Reconnect all connectors at motor, axis 5.	
4 Refit the cable gland cover at the cable exit with its two attachment screws.	
5 Refit the cover of motor, axis 5.	
6 Refit the complete wrist unit.	Detailed in section: <ul style="list-style-type: none"><li>IRB 6640: <a href="#">Refitting, wrist unit on page 262</a>.</li></ul>
7 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
8 Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .

Continues on next page

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

## 4 Repair

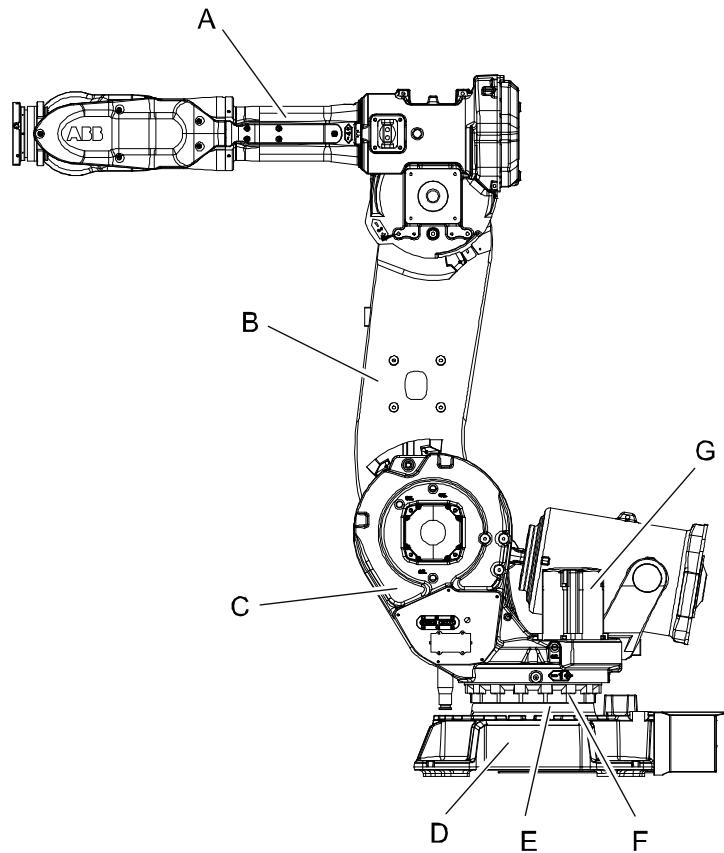
### 4.3.3 Replacement of complete arm system

#### 4.3.3 Replacement of complete arm system

##### Location of arm system

The complete arm system is defined as the complete robot except for the base and axis-1 gearbox. This is shown in the figure below.

A more detailed view of the component and its position may be found in [Spare parts on page 477](#).



xx0700000352

A	Upper arm
B	Lower arm
C	Frame
D	Base
E	Gearbox, axis 1
F	Attachment screws base M12x80, quality 12.9 Gleitmo (16 pcs)
G	Motor, axis 1

##### Required equipment

Equipment, etc.	Art. no.	Note
Holder for bits	3HAC029090-001	Bits SW10 included

*Continues on next page*

## 4.3.3 Replacement of complete arm system

Continued

Equipment, etc.	Art. no.	Note
Guide pins M12 x 130	3HAC022637-001	Used to guide the complete arm system when lifting it. Always use the guide pins in pairs! In order to make the refitting easier, it is recommended to use two guide pins of different lengths. Notice that longer guide pins than 140 mm will not be possible to remove from the frame because lack of space after refitting!
Roundsling 2 m		Lifting capacity 2,000 kg
Roundsling 1,5 m		Lifting capacity 1,000 kg
Hoisting block	-	Lifting capacity 500 kg Used to adjust the length of the lifting chain.
Lifting chain	-	Used together with the hoisting block.
Isopropanol	-	Used for cleaning mounting surfaces.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

**Deciding calibration routine**

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

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

*Continues on next page*

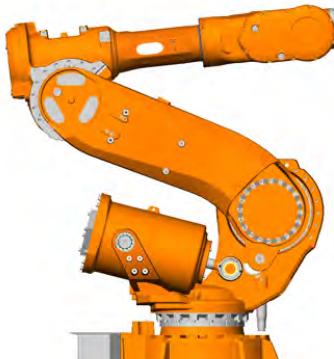
## 4 Repair

### 4.3.3 Replacement of complete arm system

*Continued*

#### Removal, arm system

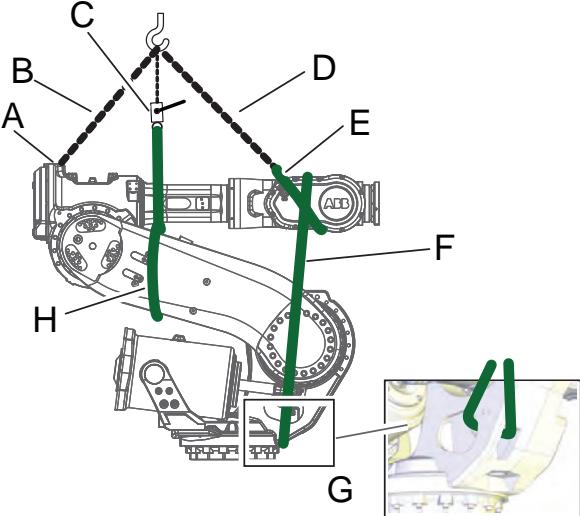
Use this procedure to lift and remove the complete arm system.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Run the robot to the position shown in the figure to the right.	<p>Release the brakes if necessary, as detailed in section <a href="#">Manually releasing the brakes on page 85</a>.</p>  <p>xx0700000351</p>
3 Run the overhead crane to a position above the robot.	

*Continues on next page*

## 4.3.3 Replacement of complete arm system

Continued

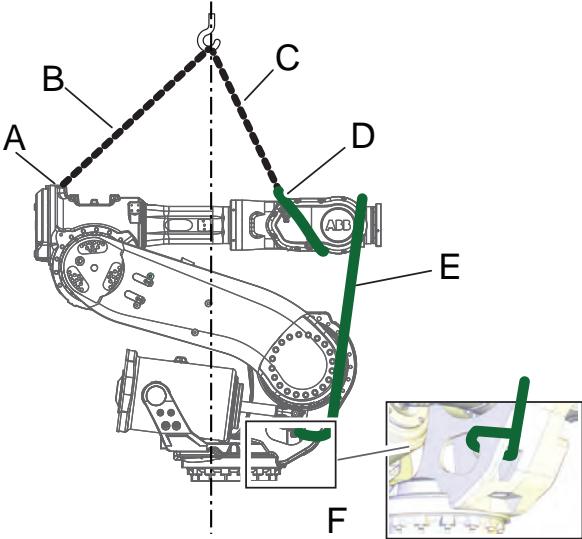
Action	Note
<p>4 Fit the <i>lifting accessory</i>. Also fit a <i>hoisting block</i> to the <i>roundsling</i> put around the lower arm. Used to adjust the balance of the arm system in order to lift it completely level.</p> <p><b>Note</b> There is an alternate method of lifting the complete armsystem described below.</p>	<p>Make sure the lift is done completely level!</p>  <p>xx0700000349</p> <p>A: Lifting eye (on arm house)      B: Lifting chain      C: Hoisting block      D: Lifting chain      E: Roundsling (put in a loop around the wrist on the inside)      F: Roundsling (used to eliminate any load through the brake on motor axis 3)      G: Position for roundsling F, inserted through hole in the frame      H: Roundsling (put in a loop around the lower arm)</p>

Continues on next page

## 4 Repair

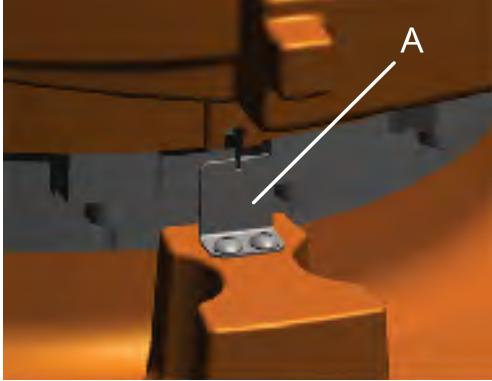
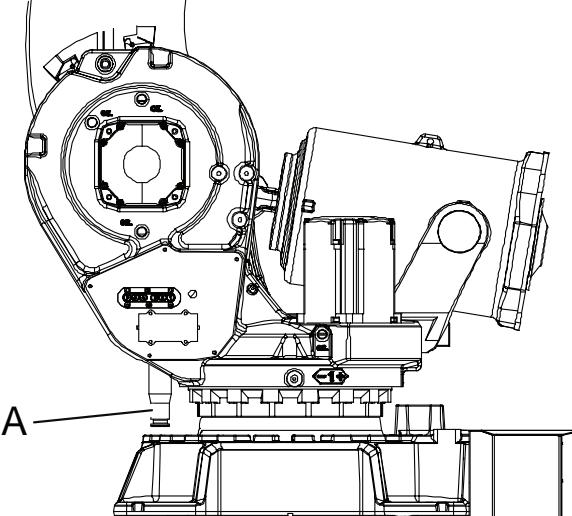
### 4.3.3 Replacement of complete arm system

*Continued*

Action	Note
5 Alternate lifting method, with no need of using a hoisting block. 1 Run axis 2 to -60° and axis 3 to approximately +60°. 2 Fit the lifting accessories according to the figure to the right. 3 Run axis 3 so that the roundsling E is stretched. 4 Raise the lifting accessories to tension the chains and verify that the center of gravity is approximately 75 mm behind of the axis-1 center.	 <p>xx1200000670</p> <ul style="list-style-type: none"> <li>A: Lifting eye (on arm house)</li> <li>B: Lifting chain</li> <li>C: Lifting chain</li> <li>D: Roundsling (put in a loop around the wrist on the inside)</li> <li>E: Roundsling (used to eliminate any load through the brake on motor axis 3)</li> <li>F: Position for roundsling E, inserted through hole in the frame</li> </ul>
6  <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> </ul> Before entering the robot working area.	
7  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
8 Drain the oil from gearbox axis 1.	Detailed in section <a href="#">Changing oil, axis-1 gearbox on page 166</a> .
9 Disconnect the cabling in the rear of the robot base and remove the cable support plate inside the base.	

*Continues on next page*

4.3.3 Replacement of complete arm system  
*Continued*

Action	Note
10 Pull the disconnected cabling up through the center of the axis-1 gearbox.	How to replace the cabling is detailed in <a href="#">Replacing cable harness, axes 1-6 on page 217</a> .
11 Remove the motor, axis 1.	Detailed in section <a href="#">Replacing motor axis 1 on page 333</a> .
12 Remove the <i>calibration plate</i> from the bottom of the frame.	 <p>xx0700000380</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Calibration plate</li> </ul>
13 Remove the mechanical stop pin from the frame.	 <p>xx1200000668</p> <p>A Mechanical stop pin</p>

*Continues on next page*

## 4 Repair

### 4.3.3 Replacement of complete arm system

*Continued*

Action	Note
14 Unfasten the arm system from the base by unscrewing its 16 attachment screws.	<p>Shown in the figure <a href="#">Location of arm system on page 234</a>.</p> <p>xx0600003070</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Serrated lock washer</li> <li>B: Gearbox axis 1</li> <li>C: Attachment screws M12x80</li> </ul>
15 Fit two <i>guide pins</i> in two opposite screw holes.	Art. no. is specified in section <a href="#">Required equipment on page 234</a> .
16  <b>CAUTION</b> The complete arm system weighs 1250 kg! All lifting equipment used must be sized accordingly!	
17 Lift the arm system carefully and secure it in a safe area. Always move the robot at very low speeds, making sure it does not tip. Continue lifting even if the arm system turns out to be unbalanced despite earlier adjustments! The risk of damaging the interfaces is bigger if the load is lowered unbalanced!	Make sure all hooks and attachments stay in the correct position while lifting the arm system and that the lifting accessory does not wear against sharp edges.

### Refitting, arm system

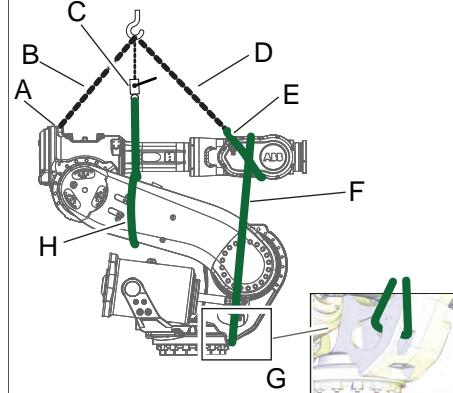
The procedure describes how to lift and refit the complete arm system.

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> </ul> Before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

*Continues on next page*

## 4.3.3 Replacement of complete arm system

Continued

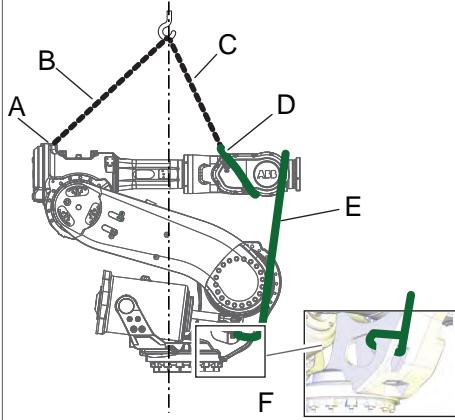
Action	Note
<p>3 Fit the lifting accessory as detailed in the figure to the right. Also fit a <i>hoisting block</i> to the <i>roundsling</i> put around the lower arm. (Used to adjust the balance of the arm system in order to lift it completely level!)</p> <p><b>Note</b> There is an alternate method of lifting the complete armsystem described below!</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 234</a>.</p> <p>Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting accessory! <b>Follow the instructions before lifting!</b></p> <p>Releasing the brakes are detailed in section <a href="#">Manually releasing the brakes on page 85</a>.</p>  <p>xx0700000349</p> <ul style="list-style-type: none"> <li>• A: Lifting eye (on arm house)</li> <li>• B: Lifting chain</li> <li>• C: Hoisting block</li> <li>• D: Lifting chain</li> <li>• E: Roundsling (put in a loop around the wrist on the inside)</li> <li>• F: Roundsling (used to eliminate any load through the brake on motor axis 3)</li> <li>• G: Position for roundsling F, inserted through hole in the frame</li> <li>• H: Roundsling (put in a loop around the lower arm)</li> </ul>

Continues on next page

## 4 Repair

### 4.3.3 Replacement of complete arm system

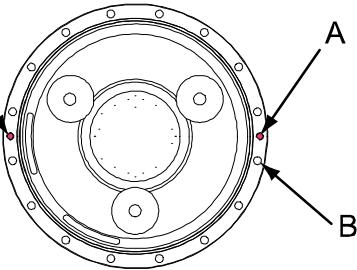
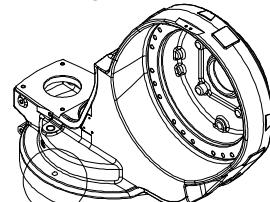
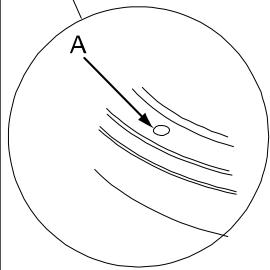
*Continued*

Action	Note
<p>4 Alternate lifting method, with no need of using a hoisting block.</p> <ol style="list-style-type: none"> <li>1 Run axis 2 to -60° and axis 3 to approximately +60°.</li> <li>2 Fit the lifting accessories according to the figure to the right.</li> <li>3 Run axis 3 so that all the roundslings are stretched.</li> <li>4 Verify that the center of gravity is approximately 75 mm behind of the axis-1 center.</li> </ol>	 <p>xx1200000670</p> <ul style="list-style-type: none"> <li>• A: Lifting eye (on arm house)</li> <li>• B: Lifting chain</li> <li>• C: Roundsling (used to pick up the load of the arm system)</li> <li>• D: Lifting chain</li> <li>• E: Roundsling (put in a loop around the wrist on the inside)</li> <li>• F: Roundsling (used to eliminate any load through the brake on motor axis 3)</li> <li>• G: Position for roundsling F, inserted through hole in the frame</li> <li>• H: Roundsling (put in a loop around the lower arm)</li> </ul>
<p>5</p> <p><b>!</b> <b>CAUTION</b></p> <p>The complete arm system weighs 1250 kg! All lifting equipment used must be sized accordingly!</p>	
<p>6</p> <p>Lift the complete arm system and move it at very low speed, making sure it does not tip! Make sure the lift is done completely level. Adjust the length of the chains as detailed in enclosed instruction or with a hoisting block.</p>	
<p>7</p> <p>Clean the mounting surfaces with isopropanol.</p>	

*Continues on next page*

### 4.3.3 Replacement of complete arm system

*Continued*

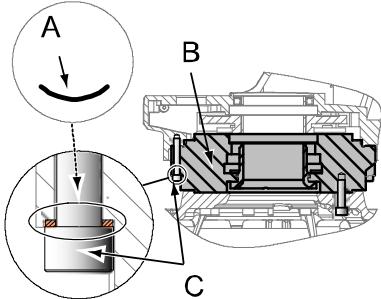
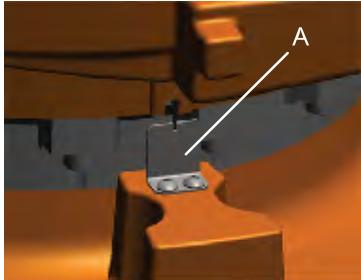
Action	Note
<p>8 Fit two <i>guide pins</i> in the holes in the axis-1 gearbox, as shown in the figure to the right. If using guide pins of different lengths, fit the pin with maximal length of 130 mm on the right side of the gearbox (seen from behind).</p> <p><b>Note</b></p> <p>Lubricate the guide pins for easier fitting of the arm system.</p>	<p>Dimension is specified in <i>Required equipment on page 234</i>.</p>  <p>xx0600003095</p> <p>The figure below shows the gearbox, axis 1.</p> <p>A Attachment holes for guide pins, M12 in gearbox axis 1. B Hole for attachment screw.</p>
<p>9 Lubricate the outer surface of the gearbox for easier mating of the gearbox and arm system.</p>	
<p>10 Look through the empty mounting hole of motor 1 to assist in aligning the assembly during refitting of the arm system. Lower the arm system with guidance from the guide pins previously fitted to the axis-1 gearbox axis 1. Fit the guide pins in the corresponding holes in the frame as shown in the figure to the right.</p> <p><b>Note</b></p> <p>The refitting must be made completely level! Make sure the lifting accessory is adjusted prior to refitting of arm system.</p>	<p>This is a complex task to be performed with utmost care in order to avoid injury or damage!</p>   <p>xx0600003093</p> <ul style="list-style-type: none"> <li>A : Holes in frame for guide pins, shown from above.</li> </ul>

*Continues on next page*

## 4 Repair

### 4.3.3 Replacement of complete arm system

*Continued*

Action	Note
11  <b>Note</b> Check that the <i>serrated lock washers</i> are turned the correct way. See figure!	 xx0600003070 <b>Parts:</b> <ul style="list-style-type: none"> <li>A: Serrated lock washer</li> <li>B: Gearbox axis 1</li> <li>C: Attachment screws M12x80</li> </ul>
12 Refit 14 of the 16 attachment screws before the arm system is completely lowered.	 <b>Note</b> Use a torque wrench with a holder for bits recommended in <a href="#">Replacement of complete arm system on page 234</a> .
13 Remove the guide pins and secure the arm system to the base with its 16 <i>attachment screws and washers</i> .	Shown in the figure <a href="#">Location of arm system on page 234</a> . M12 x 80, 12.9 quality gleitmo. Tightening torque: 105 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 451</a> before fitting.
14 Refit the <i>calibration plate</i> at the bottom of the frame.	 xx0700000380 <b>Parts:</b> <ul style="list-style-type: none"> <li>A: Calibration plate</li> </ul>
15 Refit the mechanical stop pin to the frame.	
16 Refit the <i>axis-1 motor</i> .	Detailed in section <a href="#">Replacing motor axis 1 on page 333</a> .
17 Perform a <i>leak-down test</i> of the axis-1 gearbox.	Detailed in section <a href="#">Performing a leak-down test on page 210</a> .
18 Refit the <i>cabling</i> in the base.	Detailed in section <a href="#">Replacing cable harness, axes 1-6 on page 217</a> .
19 Refill the gearbox with lubricating oil.	Detailed in section <a href="#">Changing oil, axis-1 gearbox on page 166</a> .

*Continues on next page*

## 4.3.3 Replacement of complete arm system

*Continued*

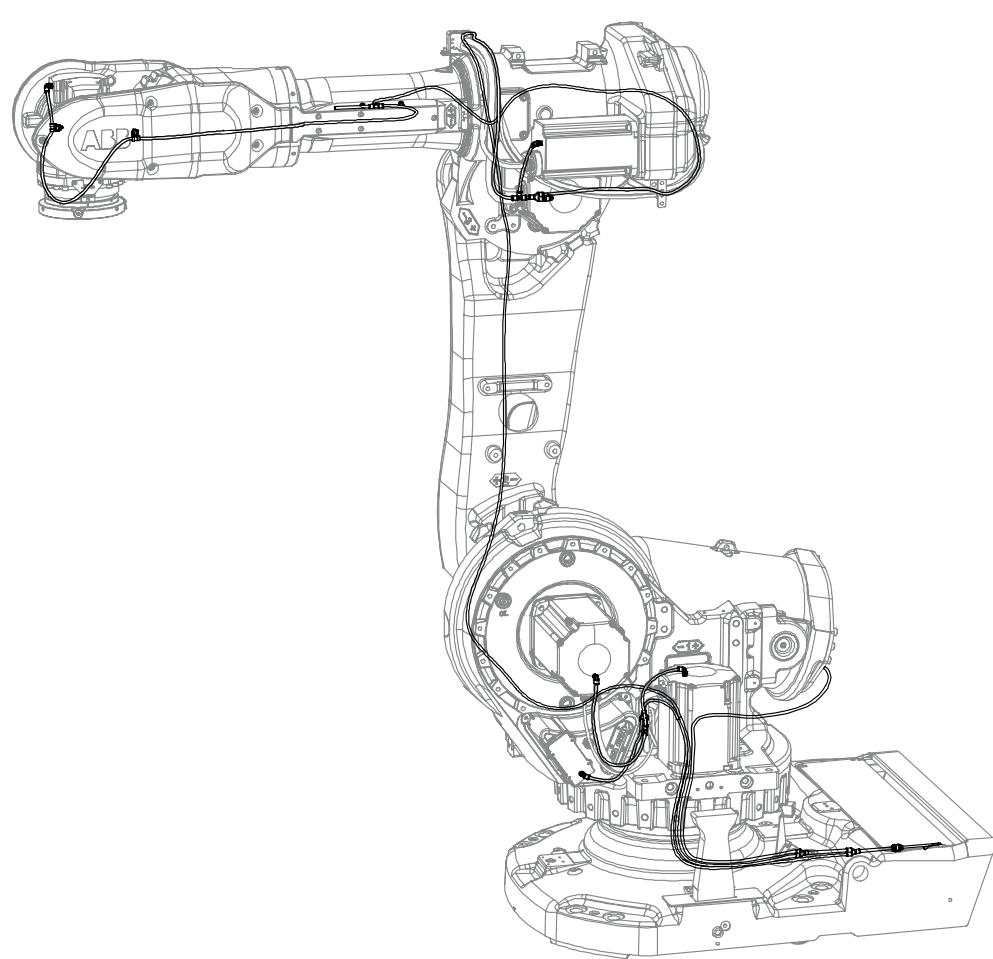
Action	Note
20 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
21 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
22  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4 Repair

### 4.3.4 Replacement of air nipple and hose (Foundry Prime)

#### Location

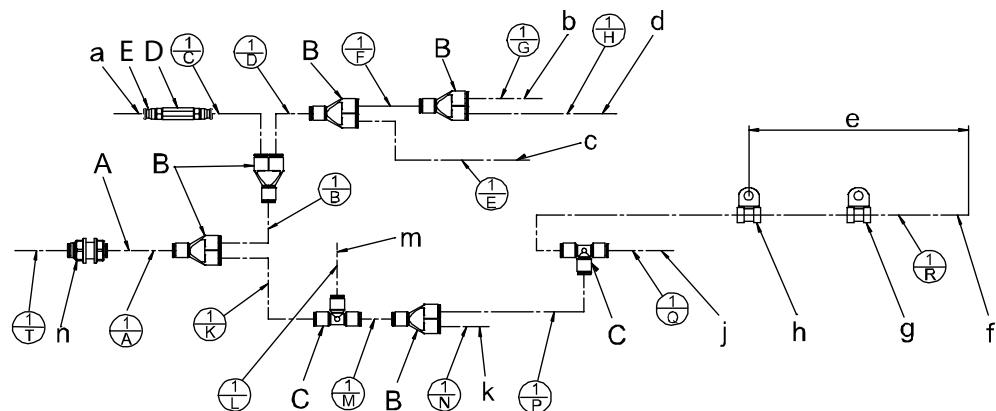
The illustration below shows the routing of the Foundry Prime air hose.



xx0600003025

#### Hose lengths and parts

See hose lengths and parts in the figure and the following tables.



xx0700000449

Continues on next page

## 4.3.4 Replacement of air nipple and hose (Foundry Prime)

*Continued*

## Hose lengths

1A	Hose length 50 mm
1B	Hose length 50 mm
1C	Hose length 1520 mm
1D	Hose length 1090 mm
1E	Hose length 310 mm
1F	Hose length 45 mm
1G	Hose length 250 mm
1H	Hose length 540 mm
1K	Hose length 4020 mm
1L	Hose length 195 mm
1M	Hose length 50 mm
1N	Hose length 40 mm
1P	Hose length 1605 mm
1Q	Hose length 100 mm (for option 2.8 m/185 kg: 350 mm)
1R	Hose length 1490 mm (for option 2.8 m/185 kg: 1740 mm)
1S	Hose length 570 mm
1T	Hose length 100 mm
1U	Hose length 50 mm

## Parts

A	Pneumatic hose
B	Y-plug connector
C	T-plug connector
D	Check valve
E	Straight fitting

## Location on the robot

a	Balancing cylinder, rear end
b	Motor axis 1
c	Battery cover
d	Motor axis 2
e	Length = Pos 1S
f	Motor axis 6
g	Rubber clamp on attachment plate (tilthouse)
h	Rubber clamp on wrist cover
j	Motor axis 5
k	Motor axis 3
m	Motor axis 4
n	Bulkhead plug connector in plate at base

*Continues on next page*

## 4 Repair

### 4.3.4 Replacement of air nipple and hose (Foundry Prime)

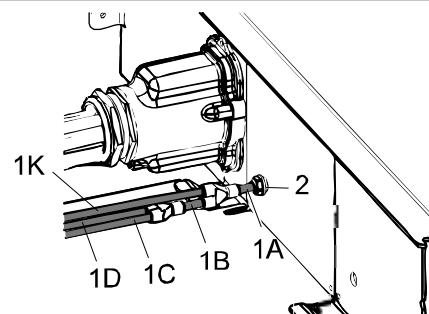
*Continued*

#### Required equipment

Equipment	Art. no.	Pos. in illustration
Velcro strap	3HAC12625-1	9 (only in illustrations below)
Cable straps	21662055-3	8 (only in illustrations below)
Elbow fitting	3HAC026511-001	6 (only in illustrations below)
Rubber clamp	3HAC026523-001	5
T-plug connector	3HAC026515-001	4
Y-plug connector	3HAC026514-001	3
Bulkhead plug connector	3HAC026513-001	2
Hose	3HAC026526-001	1

#### Procedure

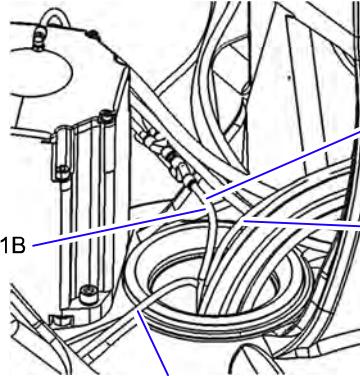
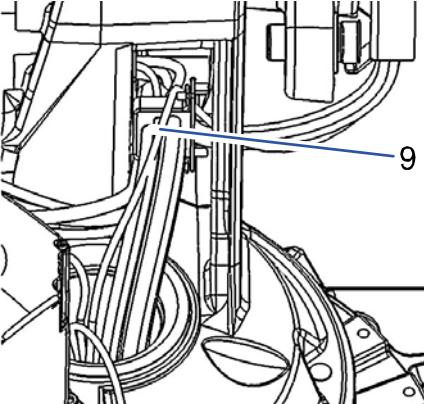
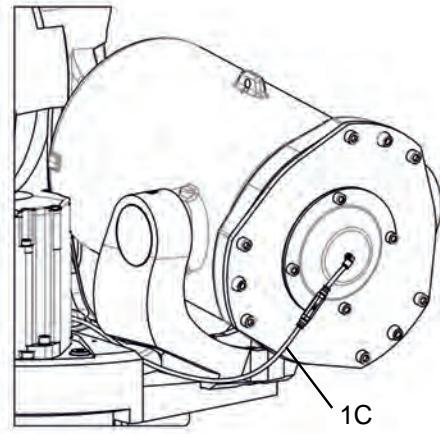
The following procedures details how to replace the Foundry Prime air nipples and hose. The pos. no. in following procedures correspond to the illustration in [Hose lengths and parts on page 246](#) and the table in [Required equipment on page 248](#)

	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></ul> Before entering the robot working area.	
2	Locate the damaged hose or air connector, and continue to replace the damaged hose. Route the hose according to the illustrations in the procedure below.	
3	Connection at base.	 <p>xx0600003042</p> <p>Items in illustration are detailed in <a href="#">Required equipment on page 248</a> and <a href="#">Hose lengths and parts on page 246</a>.</p>

*Continues on next page*

## 4.3.4 Replacement of air nipple and hose (Foundry Prime)

*Continued*

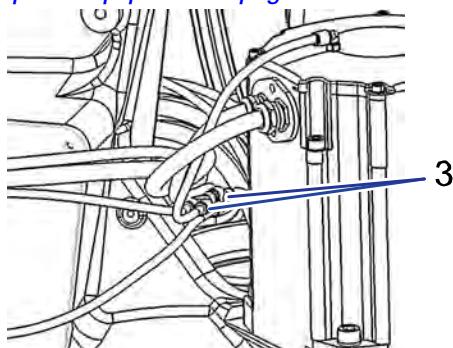
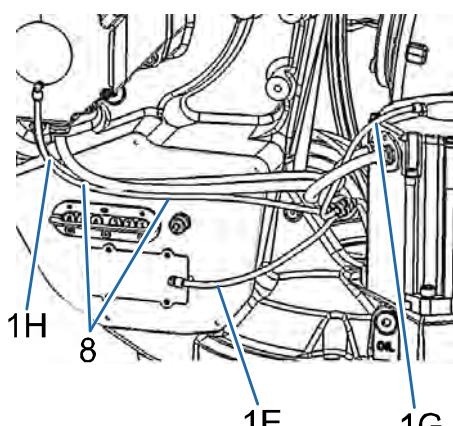
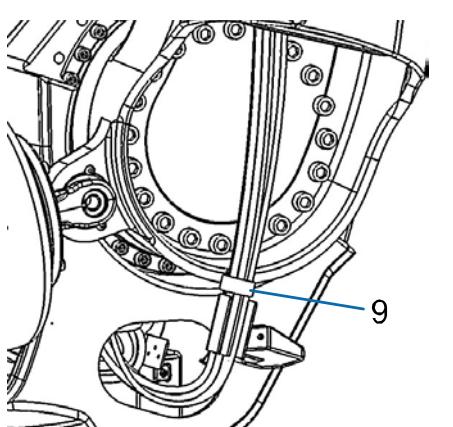
	Action	Note
4	Axis 1	 <p>xx070000458</p> <p>Items in illustration are detailed in <a href="#">Required equipment on page 248</a> and <a href="#">Hose lengths and parts on page 246</a>.</p>  <p>xx070000459</p> <p>Item in illustration is detailed in <a href="#">Required equipment on page 248</a>.</p>
5	<p>Balancing device.</p> <p> <b>Note</b></p> <p>Always install the check valve with the arrow pointing upwards.</p>	 <p>xx150000355</p> <p>Item in illustration is detailed in <a href="#">Hose lengths and parts on page 246</a>.</p>

*Continues on next page*

## 4 Repair

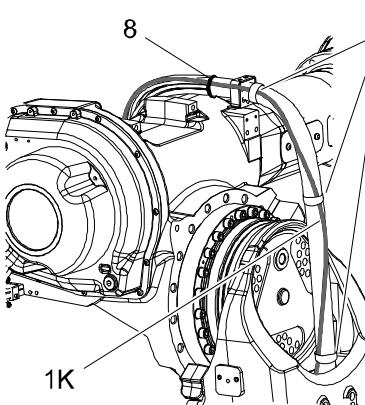
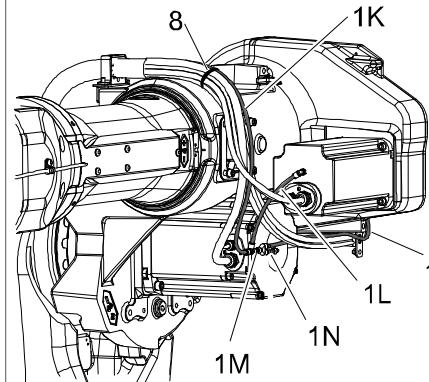
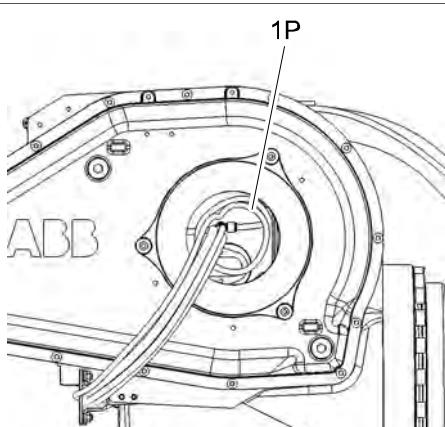
### 4.3.4 Replacement of air nipple and hose (Foundry Prime)

*Continued*

Action	Note
6 Axis 1-2	<p>Items in illustrations are detailed in <i>Hose lengths and parts on page 246</i> and <i>Required equipment on page 248</i>.</p>  <p>xx0700000460</p>  <p>xx0700000461</p>  <p>xx0700000462</p> <ul style="list-style-type: none"> <li>• A: Air hose beneath velcro strap</li> </ul>

*Continues on next page*

4.3.4 Replacement of air nipple and hose (Foundry Prime)  
*Continued*

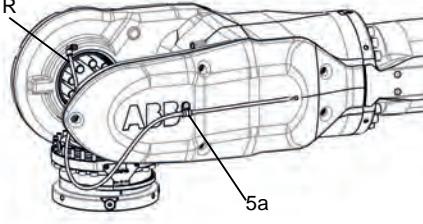
Action	Note
7 Upper arm housing.	 xx0600003046  xx0600003047
8 Tube shaft.	 Replace_hose <ul style="list-style-type: none"> <li>• 1P: Lay the hose in a spiral in the tube shaft.</li> </ul>

*Continues on next page*

## 4 Repair

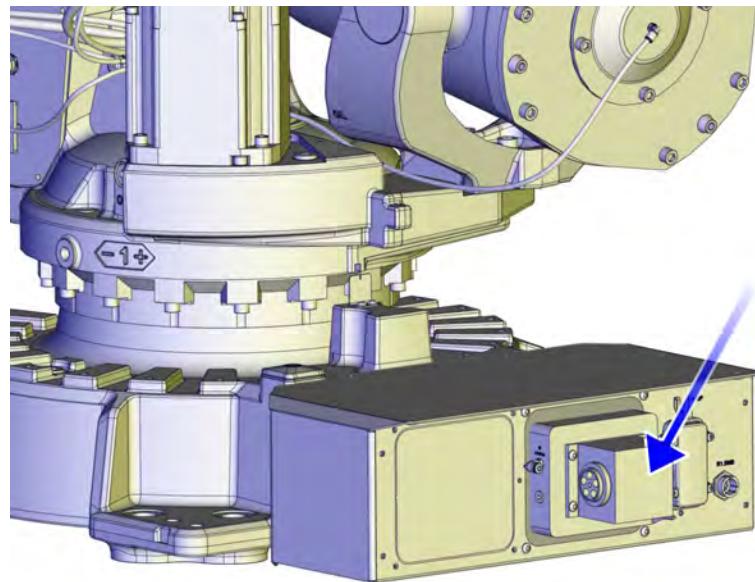
### 4.3.4 Replacement of air nipple and hose (Foundry Prime)

*Continued*

	Action	Note
9	Wrist.   <b>Note</b>  Make sure the cable length from 5a to the nipple of axis 6 = S, see <a href="#">Replacement of air nipple and hose (Foundry Prime) on page 246</a> .	 xx1500000356

### 4.3.5 Replacement of over pressure unit

#### Location of the over pressure unit



xx1700000562

#### Required equipment

Equipment, etc.	Art. no.	Note
Over pressure unit	For spare part no. see: • <a href="#">Spare parts on page 477</a>	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

#### Replacing the over pressure unit

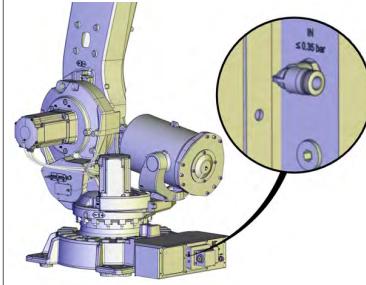
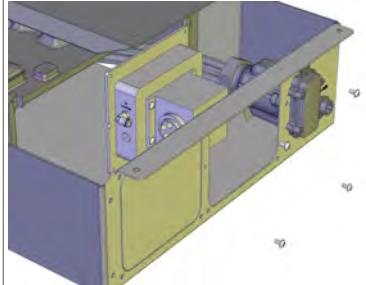
	Action	Note
1	<p><b>!</b> <b>CAUTION</b></p> <p>Make sure that all supplies for electrical power are turned off.</p> <p><b>!</b> <b>DANGER</b></p> <p>Make sure that all supplies for electrical power and hydraulic pressure are turned off.</p>	

Continues on next page

## 4 Repair

### 4.3.5 Replacement of over pressure unit

*Continued*

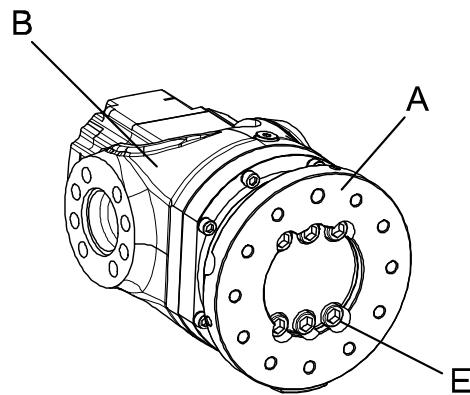
	Action	Note
2	 <b>CAUTION</b> For robots with protection type Foundry Prime: Always cut the paint with a knife and grind the paint edge when disassembling parts of the robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3	Disconnect air hose from air connector.	 xx1700000565
4	Remove attachment screws and open cover on manipulator base.	
5	Remove the four attachment screws, and remove the unit.	 xx1700000563
6	Remove the four attachment screws holding the unit on plate.	 xx1700000564
7	Replace the over pressure unit and refit all screws and air hose.	

## 4.4 Upper and lower arm

### 4.4.1 Replacing the turning disk

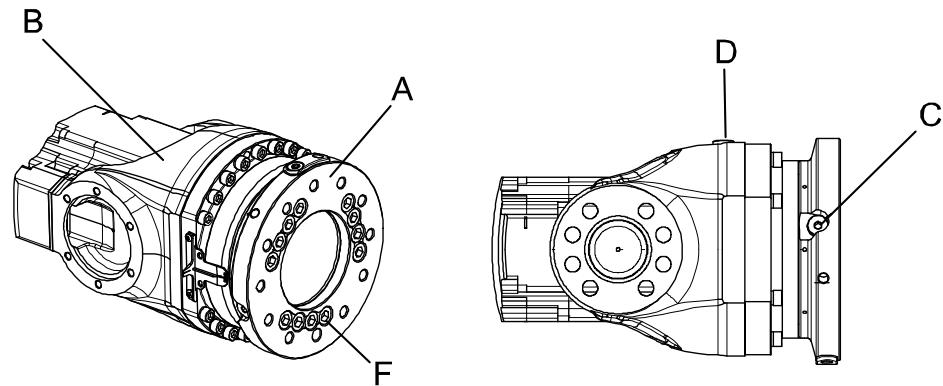
#### Location of turning disk

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



xx0300000473

A	Turning disk (type 1)
B	Wrist unit
E	Attachment screws (6 pcs), turning disk



xx0200000217

A	Turning disk (type 2)
B	Wrist unit
C	Oil plug, draining
D	Oil plug, filling
F	Attachment screws (12 pcs)

*Continues on next page*

## 4 Repair

### 4.4.1 Replacing the turning disk

Continued

#### Required equipment

Equipment, etc.	Art. no.	Note
Turning disk	For spare part no. see: <a href="#">Spare parts on page 477</a> .	O-rings are not included!
O-ring Wrist, type 1	3HAB3772-65 (1pc) 21520431-20 (6 pcs)	Must be replaced when replacing the turning disk!
O-ring Wrist, type 2	3HAB3772-64 (1 pc) 3HAB3772-61 (12 pcs)	Must be replaced when replacing the turning disk!
Grease	3HAB3537-1	Used to lubricate the o-rings.
Flange sealant	3HAC034903-001	Loctite 574
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

#### Removing, turning disk

Use this procedure to remove the turning disk.

	Action	Note
1	Run the robot to a position where the <i>oil plug, drain</i> -ing of axis 6 gearbox faces downwards.	Shown in the figure <a href="#">Location of turning disk on page 255</a> .
2	 <b>DANGER</b>  Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
3	 <b>CAUTION</b>  Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
4	Remove any equipment fitted to the turning disk.	
5	Drain the axis 6 gearbox.	See section <ul style="list-style-type: none"><li>• <a href="#">Changing oil, axis-6 gearbox on page 181</a></li></ul>
6	Remove the <i>attachment screws</i> that secure the turning disk.	Shown in the figure <a href="#">Location of turning disk on page 255</a> .
7	Remove the <i>turning disk</i> .	
8	<b>Foundry Plus:</b> Remove old flange sealant residues and other contamination from the contact surfaces.	

Continues on next page

## Refitting, turning disk

Use this procedure to refit the turning disk.

	Action	Note
1	Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2	Lubricate the <i>o-ring</i> of the turning disk with <i>grease</i> and fit it to the turning disk. Also fit the 12 <i>o-rings</i> , when refitting the attachment screws.	Art. no. is specified in <a href="#">Required equipment on page 256</a> .   • A: Sealing surface, o-ring
3	<b>Foundry Plus:</b> Apply Loctite 574 flange sealant on the contact surface.	
4	Secure the turning disk with its <i>attachment screws</i> .	The number of attachment screws depends on which wrist type is used: 6 pcs, M14 x 25 <b>Tightening torque: 174 Nm.</b> 12 pcs, M12 x 30, 12.9 quality Gleitmo. <b>Tightening torque: 100 Nm.</b> Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 451</a> before fitting.

Continues on next page

## 4 Repair

### 4.4.1 Replacing the turning disk

Continued

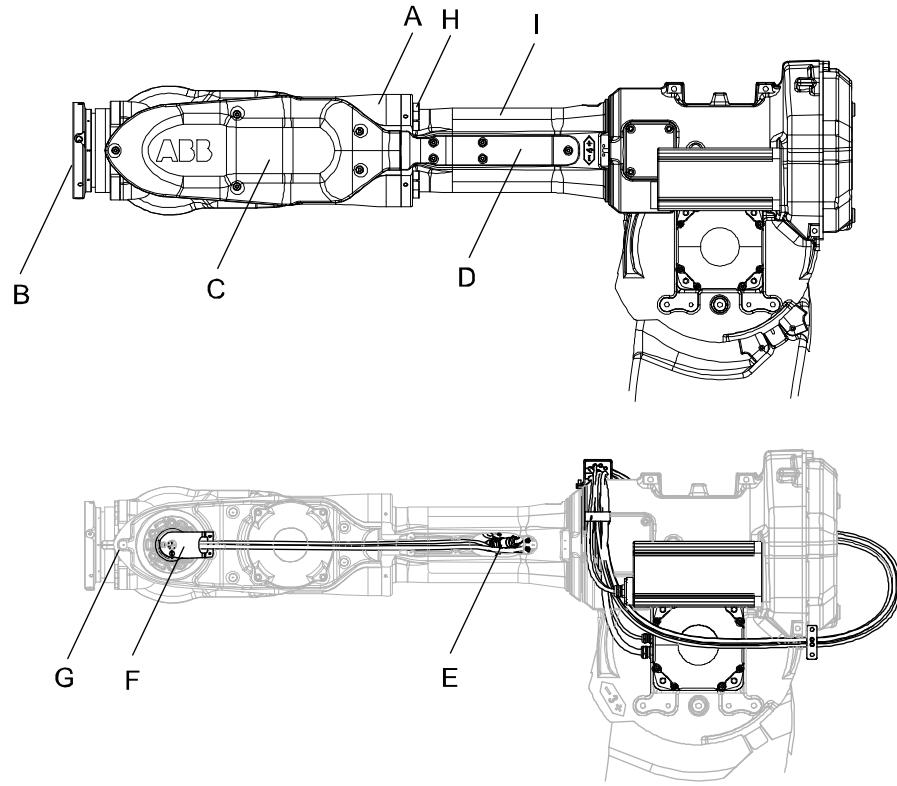
Action	Note
5 Perform a <i>leak-down test</i> of the gearbox axis 6.	Detailed in the section <a href="#">Performing a leak-down test on page 210</a> .
6 Refill the axis 6 gearbox with oil.	See section <ul style="list-style-type: none"><li>• <a href="#">Changing oil, axis-6 gearbox on page 181</a></li></ul>
7 Refit any equipment removed during disassembly to the turning disk.	
8 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
9  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4.4.2 Replacement of complete wrist unit

### Location of wrist unit

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

A more detailed view of the component and its position may be found in [Spare parts on page 477](#).



xx0700000343

<b>A</b>	Wrist unit
<b>B</b>	Turning disk
<b>C</b>	Cover, wrist unit
<b>D</b>	Cover, upper arm tube
<b>E</b>	Connectors, upper arm tube, with cable bracket (R3.FB5, R3.MP5)
<b>F</b>	Cable bracket
<b>G</b>	Attachment point for lifting tool, wrist unit
<b>H</b>	Wrist unit attachment screws and washers
<b>I</b>	Upper arm tube

*Continues on next page*

## 4 Repair

### 4.4.2 Replacement of complete wrist unit

*Continued*

#### Required equipment

Equipment etc.	Art. no.	Note
Wrist unit	For spare part number, see <a href="#">Spare parts on page 477</a> .	
Cover for wrist unit	For spare part number, see <a href="#">Spare parts on page 477</a> .	
Gasket for wrist house cover	3HAC043225-001	For robots with protection Foundry Plus and Foundry Prime.
Gasket for cable cover on upper arm tube	3HAC043224-001	For robots with protection Foundry Plus and Foundry Prime.
Gasket for small cover on upper arm tube	3HAC043303-001	Should be installed for robots with protection Foundry Plus and Foundry Prime.
Gasket for cable cover on arm extender 250 mm	3HAC043302-001	Should be installed for robots with protection Foundry Plus and Foundry Prime.
Gasket for cable cover on arm extender 450 mm	3HAC043398-001	Should be installed for robots with protection Foundry Plus and Foundry Prime.
Guide pins M12 x 200	3HAC13056-3	Always use guide pins in pairs!
Lifting accessory, wrist unit	3HAC13605-1	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.
Circuit diagram		See chapter <a href="#">Circuit diagrams on page 479</a> .

#### Deciding calibration routine

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

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

*Continues on next page*

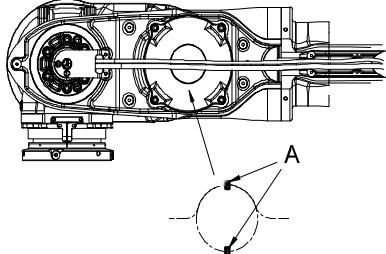
## 4.4.2 Replacement of complete wrist unit

Continued

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

**Removal, wrist unit**

The procedure below details how to remove the complete wrist unit.

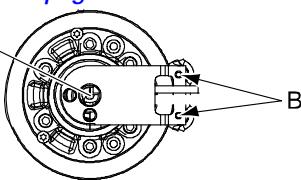
Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Remove all equipment fitted to the turning disk.	
3 Turn axis 4 to a position where the <i>cover, upper arm tube and wrist unit</i> , faces upwards. Turn axis 5 to +90°.	 xx0200000185
4  <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></ul> Before entering the robot working area.	
5  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
6 Remove the <i>cover, wrist unit</i> .	Shown in the figure <a href="#">Location of wrist unit on page 259</a> .
7 Remove the <i>cover, upper arm tube</i> .	Shown in the figure <a href="#">Location of wrist unit on page 259</a> .

Continues on next page

## 4 Repair

### 4.4.2 Replacement of complete wrist unit

*Continued*

Action	Note
8 Remove the cover of motor, axis 6 and disconnect all connectors beneath.	
9 Loosen the <i>cable bracket, wrist unit</i> on top of the wrist by undoing the three attachment screws.  Two of the <i>attachment screws</i> are visibly located at the rear of the bracket and the third located at the bottom of the cable bracket, in the center.	Shown in the figure <a href="#">Location of wrist unit on page 259</a> .   xx0200000254 <ul style="list-style-type: none"> <li>• B: Attachment screws, rear of cable bracket (2 pcs)</li> <li>• C: Attachment screw, bottom of cable bracket</li> </ul>
10 Pick out the cabling from motor, axis 6 and place it safely on the tube.	
11 Fit the <i>lifting accessory</i> to the wrist unit.	Art. no. is specified in <a href="#">Required equipment on page 260</a> .
12  <b>CAUTION</b>  The complete wrist unit weighs 130 kg! All lifting equipment used must be sized accordingly!	
13 Slightly raise the wrist unit to unload the screw joint, facilitating removing the attachment screws.	
14 Remove the <i>wrist unit attachment screws and washers</i> .	Shown in the figure <a href="#">Location of wrist unit on page 259</a> .
15 Pull the wrist unit out, lift it away and place it on a secure surface.	
16 Disconnect the <i>motor axis 5</i> by disconnecting the two connectors in the upper arm tube (R3.FB5, R3.MP5).	Shown in the figure <a href="#">Location of wrist unit on page 259</a> .

### Refitting, wrist unit

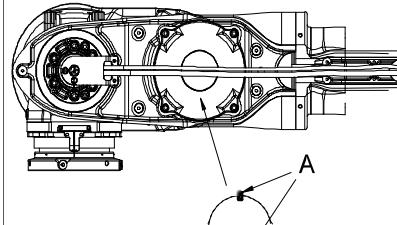
The procedure below details how to refit the complete wrist unit.

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> </ul> Before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

*Continues on next page*

## 4.4.2 Replacement of complete wrist unit

Continued

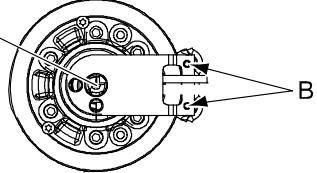
	Action	Note
3	Fit two <i>guide pins</i> , M12 in the upper arm tube, in two of the holes for the <i>wrist unit attachment screws</i> .	Art. no. is specified in <a href="#">Required equipment on page 260</a> . Shown in the figure <a href="#">Location of wrist unit on page 259</a> .
4	Fit the <i>lifting tool</i> to the wrist unit.	Art. no. is specified <a href="#">Location of wrist unit on page 259</a> .
5	<p style="text-align: center;"><b>!</b> <b>CAUTION</b></p> <p>The complete wrist unit weighs 130 kg! All lifting equipment used must be sized accordingly!</p>	
6	Lift the wrist unit and guide it to the upper arm tube with help of the guide pins. Make sure the cabling from motor, axis 5 is safely run into the arm tube and does not get jammed.	
7	Reconnect the motor axis 5 by connecting the two <i>connectors inside the upper arm tube</i> (R3.FB5, R3.MP5) and secure the cable bracket with the two attachment screws to the tube.	Shown in the figure <a href="#">Location of wrist unit on page 259</a> .
8	Secure the wrist unit with 10 of the 12 <i>attachment screws and washers</i> .	Shown in the figure <a href="#">Location of wrist unit on page 259</a> . 12 pcs: M12 x 50, 12.9 quality Gleitmo. Tightening torque: 115 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 451</a> before fitting.
9	Remove the guide pins and secure the two remaining attachment screws as detailed above.	
10	Remove the lifting tool from the wrist unit.	
11	<p style="text-align: center;"><b>i</b> <b>Note</b></p> <p>Axis 5 must be oriented in the correct position (+90°) to allow the motor 6 cover to open!</p>	
12	<p>Place the cabling to motor axis 6 correctly on the upper arm and gently pull the connectors through the hole on top of wrist unit to motor, axis 6.</p> <p>In case of excess of cable length:</p> <ul style="list-style-type: none"> <li>• put the excess cable in a loop in the area shown in the figure and secure with <i>cable straps</i>. Cables are longer in order to fit different upper arm lengths.</li> </ul>	 xx0200000185 Parts: • A: Cable straps

Continues on next page

## 4 Repair

### 4.4.2 Replacement of complete wrist unit

*Continued*

	Action	Note
13	<p>Fasten the <i>cable bracket</i> at top of the wrist unit with three <i>attachment screws</i>. Two of them are visible at the <i>rear attachment point</i> and the third is located on the <i>bottom</i> of the cable bracket, in the center.</p>	<p>Shown in the figure <a href="#">Location of wrist unit on page 259</a>.</p>  <p>xx0200000254</p> <ul style="list-style-type: none"> <li>B: Attachment screws, rear attachment point of cable bracket (2 pcs)</li> <li>C: Attachment screw, bottom of cable bracket</li> </ul>
14	Reconnect the connectors to the axis-6 motor and refit the motor cover.	
15	<p>Refit the <i>cover, upper arm tube</i>. For robots with protection type Foundry Plus and Foundry Prime: check the gasket. If damaged, or not previously installed, fit a new gasket.</p>	<p>Shown in the figure <a href="#">Location of wrist unit on page 259</a>. Article number for the gasket is specified in <a href="#">Required equipment on page 260</a>.</p>
16	<p>Refit the <i>cover, wrist unit</i>. For robots with protection type Foundry Plus and Foundry Prime: check the gasket. If damaged, or not previously installed, fit a new gasket.</p>	<p>Shown in the figure <a href="#">Location of wrist unit on page 259</a>. Article number for the gasket is specified in <a href="#">Required equipment on page 260</a>.</p>
17	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
18	Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
19	Refit any equipment previously removed from the turning disk.	
20	 <b>DANGER</b> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#">DANGER - First test run may cause injury or damage! on page 48</a>.</p>	

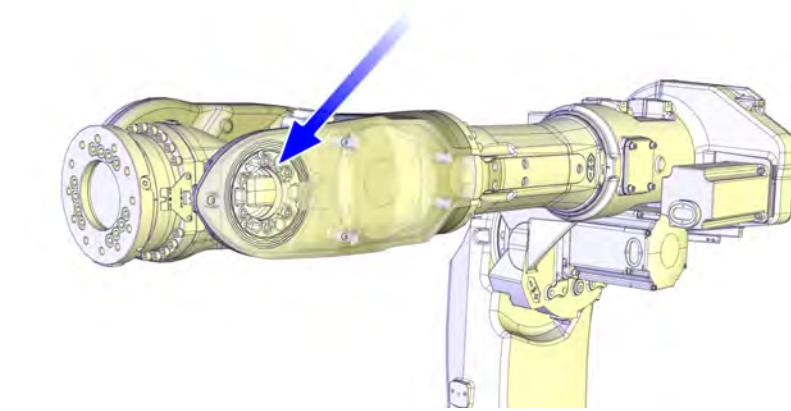
## 4.4.3 Replacement of support shaft with bearing axis 5

**4.4.3 Replacement of support shaft with bearing axis 5****Introduction**

This section describes how to replace bearing on support shaft axis 5.

**Location of support shaft axis 5**

The support shaft with bearing is located as shown in the figure below.



xx1500001690

**Required equipment**

Equipment	Art. no.	Note
Support shaft unit	See chapter: • <i>Spare parts</i>	Includes: • support shaft • ball bearing • sealing ring
Brush	-	-
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

**Consumables**

Consumable	Article number	Note
Rust preventive	3HAC034903-001	Mercasol
Locking liquid	3HAB7116-1	Loctite 243
Sealant	1234 0011-116	Loctite 574

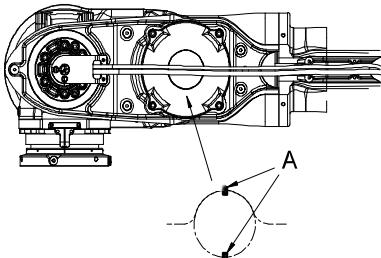
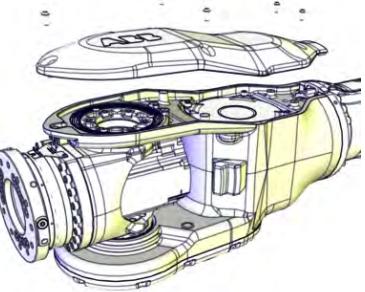
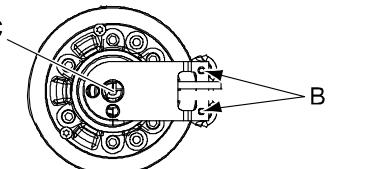
*Continues on next page*

## 4 Repair

### 4.4.3 Replacement of support shaft with bearing axis 5

*Continued*

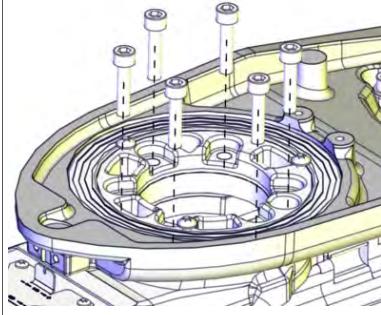
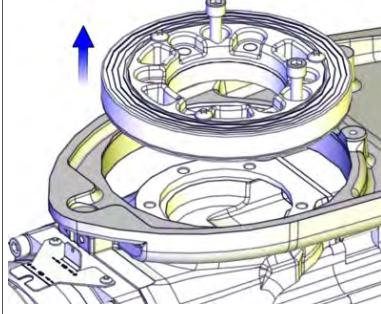
#### Removing support shaft

	Action	Note
1	Turn axis 4 to a position where the <i>cover, upper arm tube and wrist unit</i> , faces upwards. Turn axis 5 to +90°.	 xx0200000185
2	Relieve the pressure from the support shaft.   <b>CAUTION</b>  If there is a tool attached to the turning disk, be sure to place the tool in a safe manner.	
3	 <b>DANGER</b>  Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
4	Remove the <i>cover, wrist unit</i> with gasket.   <b>Note</b>  Disconnect the air hose from axis 6 motor.	 xx1500001685
5	Loosen the <i>cable bracket, wrist unit</i> on top of the wrist by undoing the three attachment screws.  Two of the <i>attachment screws</i> are visibly located at the rear of the bracket and the third located at the bottom of the cable bracket, in the center.	 xx0200000254 <ul style="list-style-type: none"><li>• B: Attachment screws, rear of cable bracket (2 pcs)</li><li>• C: Attachment screw, bottom of cable bracket</li></ul>
6	Open the cover on top of the axis 6 motor, and disconnect cable connectors.	
7	Pick out the cabling from motor axis 6 through the support shaft, and place it safely on the tube.	

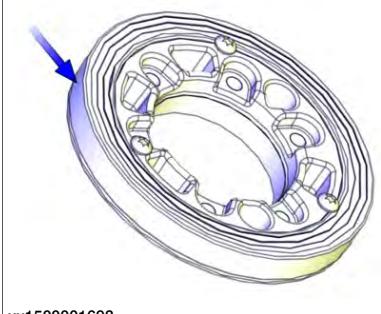
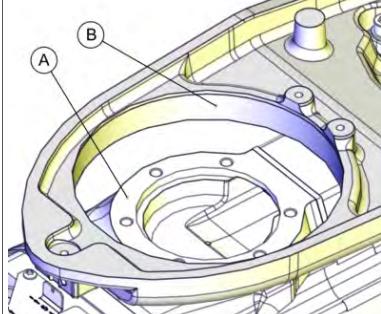
*Continues on next page*

## 4.4.3 Replacement of support shaft with bearing axis 5

*Continued*

Action	Note
8 Remove the six attachment screws.	
9 Install two screws in the threaded holes to pull the support shaft with bearing out.	

**Refitting support shaft**

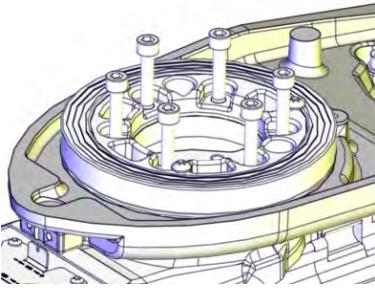
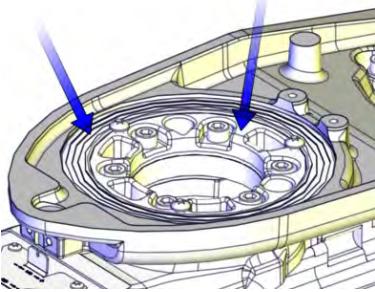
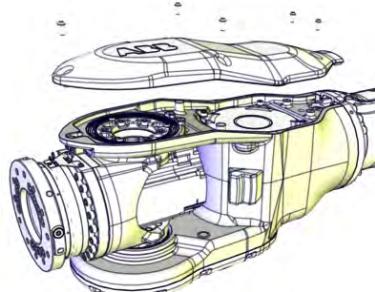
Action	Note
1 Apply rust protection Mercasol on the edge on the new support shaft with bearing.	
2 Apply Loctite on surface A and Mercasol on surface B.	 A Loctite 574 B Mercasol

*Continues on next page*

## 4 Repair

### 4.4.3 Replacement of support shaft with bearing axis 5

*Continued*

Action	Note
3 Place the new support shaft with bearing in place.	
4 Align the bolt pattern.	
5 Pull down the screws alternately until the shaft is seated.	Tightening torque: 24 Nm.
6 Apply rust protection Mercasol on the support shaft and bearing.	
7 Reconnect cabling.	
8 Refit cover to axis 6 motor.	
9 Refit cover with gasket to wrist unit. Use M6x20 in hole closest to robot axis-6.  <span style="color: blue; background-color: black; padding: 2px 10px; border-radius: 5px;">Note</span> Reconnect the "over pressure" air hose to axis 6 motor before tightening the cover.  <span style="color: blue; background-color: black; padding: 2px 10px; border-radius: 5px;">Note</span> Replace gasket if damaged.	

#### 4.4.4 Replacement of upper arm

##### Location of upper arm

The upper arm is located on top of the robot as shown in the following figure. The complete upper arm includes the wrist unit but this section also describes how to remove the upper arm when there is no wrist unit mounted.



##### Note

The lifting accessory is attached differently depending on whether the wrist unit is mounted on the upper arm or not. The attachment points are shown in the following figure.

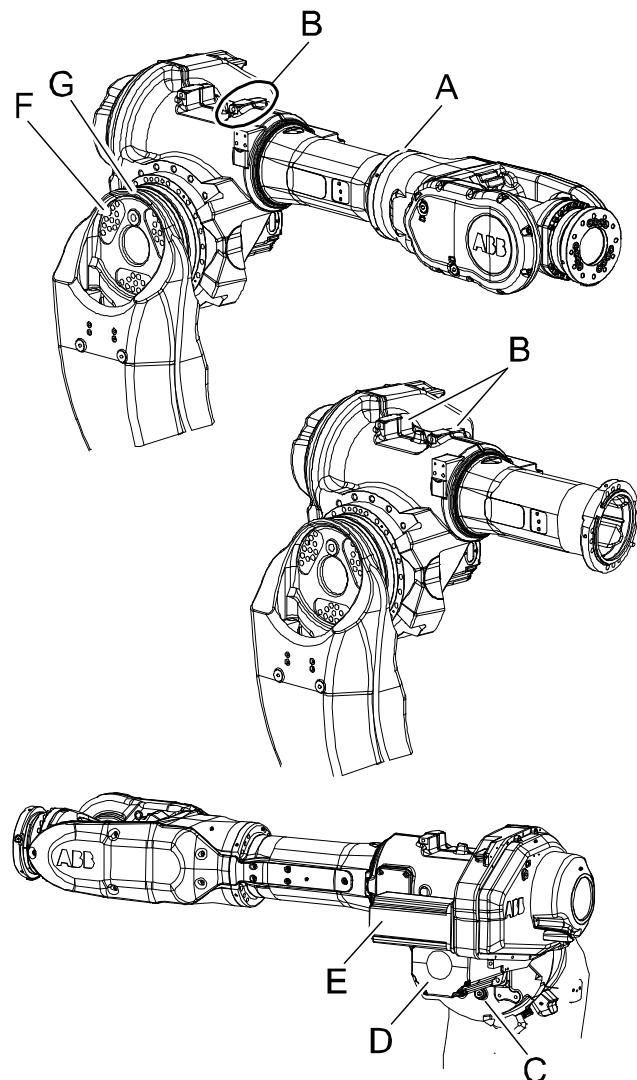
*Continues on next page*

## 4 Repair

### 4.4.4 Replacement of upper arm

*Continued*

A more detailed view of the component and its position may be found in [Spare parts on page 477](#).



xx0700000345

A	Attachment hole for lifting eye, M12 (if the wrist unit is mounted)
B	Attachment for lifting accessory, upper arm, 2 pcs (if there is no wrist unit mounted)
C	Oil plug, draining, gearbox axis 3
D	Motor, axis 3
E	Motor, axis 4
F	Attachment screws and washers, upper arm
G	Sealing, axes 2/3 (between lower arm and gearbox axis 3)

#### Required equipment

Equipment	Art. no.	Note
Sealing, axis 3	3HAC17212-1	Always use a new sealing when refitting the upper arm!

*Continues on next page*

## 4.4.4 Replacement of upper arm

*Continued*

Equipment	Art. no.	Note
Washer, axis 3 (3 pcs) Foundry Prime (grey)	3HAC038648-001	To be replaced if damaged.
Standard and Foundry Plus (ABB Orange)	3HAC038648-002	To be replaced if damaged.
Standard and Foundry Plus (Graphite White)	3HAC038648-003	To be replaced if damaged.
Guide pins, sealing axis 2/3 80 mm	3HAC14628-1	For guiding the axis-3 sealing.
Guide pins, sealing axis 2/3 100 mm	3HAC14628-2	For guiding the axis-3 sealing.
Power supply	-	24 VDC, max 1,5A For releasing the brakes.
Rotation tool	3HAC17105-1	Used to rotate the motor shaft beneath the motor cover, when brakes are released with 24 VDC power supply.
Lifting eye VLBG M12	3HAC16131-1	
Lifting accessory, upper arm	3HAC15994-1	
Lifting tool (chain)	3HAC15556-1	To be used together with lifting eye, M12 and lifting accessory, upper arm.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.

**Deciding calibration routine**

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

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

*Continues on next page*

## 4 Repair

### 4.4.4 Replacement of upper arm

Continued

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

#### Removal, upper arm

The procedure below details how to remove the upper arm.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Remove all equipment fitted to turning disk.	
3 Move the upper arm to a horizontal position. Rotate axis 4 so that the <i>attachment hole for lifting eye</i> is faced upwards!	Shown in the figure <a href="#">Location of upper arm on page 269</a> .
4 Rotate axis 5 to position +90°.	
5  <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></ul> Before entering the robot working area.	
6  <b>CAUTION</b>  Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
7 <b>Upper arm including wrist unit:</b> Fit the <i>lifting eye</i> , VLBG M12 to the <i>attachment hole for lifting eye</i> on the upper arm tube.	<p>Art. no. is specified in <a href="#">Required equipment on page 270</a>. Shown in the figure <a href="#">Location of upper arm on page 269</a>.</p>

Continues on next page

#### 4.4.4 Replacement of upper arm

*Continued*

Action	Note
8 <b>Upper arm including wrist unit:</b> Fit one of the pieces included in <i>lifting accessory, upper arm</i> to the front <i>attachment for lifting accessory</i> on the upper arm. <b>Upper arm without wrist unit:</b> Fit the <i>lifting accessory, upper arm</i> to both <i>attachments for lifting accessory</i> .	Art. no. is specified in <a href="#">Required equipment on page 270</a> . Attachment point is shown in the figure <a href="#">Location of upper arm on page 269</a> .   <b>Note</b> The different attachment points, depends on whether the wrist unit is mounted or not!
9 Fasten the <i>lifting tool (chain)</i> onto the lifting eye, the lifting accessory and an overhead crane.	Art. no. is specified in <a href="#">Required equipment on page 270</a> .
10 Drain the oil from gearbox axis 3.	Detailed in section <a href="#">Changing oil, axis-3 gearbox on page 172</a> .
11 Remove the cover on top of the motors, axis 3 and 4 and disconnect all connectors inside the motors.	
12 Remove the <i>cable harness upper arm</i> and place it in a way that it will not be damaged in the proceeding procedure of removing the upper arm.	Detailed in section <a href="#">Removing the cable harness - upper arm on page 219</a> .
13  <b>CAUTION</b>  The complete upper arm weighs 380 kg without any additional equipment fitted! Use a suitable lifting accessory to avoid injury to personnel!	
14 Raise the lifting equipment to take the weight of the upper arm.	
15 In order to release the brake of the axis 3 motor, connect the 24 VDC power supply.   <b>Note</b>  When releasing the brake, the position of the upper arm is adjusted to the position given by the lifting equipment.	Connect to connector R2.MP3 • +: pin 2 • -: pin 5
16 Remove the axis-3 motor.	See <a href="#">Replacing motor axis 3 on page 348</a> .
17 Carefully remove the <i>attachment screws and washers, upper arm</i> .	Shown in the figure <a href="#">Location of upper arm on page 269</a> .
18 Lift the upper arm and place it on a secure surface. Make sure the lift is done completely level! In case of necessary adjustments, use the shortening loops on the lifting tool (chain), but make sure to place the chain the right way through the loops!	
19 Remove the <i>sealing, axis 2/3</i> from the lower arm.	Shown in the figure <a href="#">Location of upper arm on page 269</a> .

*Continues on next page*

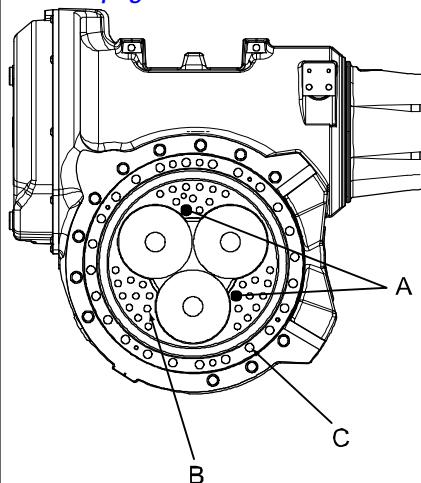
## 4 Repair

### 4.4.4 Replacement of upper arm

Continued

#### Refitting, upper arm

The procedure below details how to refit the upper arm.

Action	Note
1 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2 Fit the new <i>sealing, axis 2/3</i> onto the axis-3 gearbox and keep it in place by also fitting the two <i>guide pins, sealing axis 2/3</i> in two of the attachment screw holes on the gearbox, see figure to the right.	Always use a new sealing when reassembling! Art. no. is specified in <a href="#">Required equipment on page 270</a> .  xx0200000166 <ul style="list-style-type: none"><li>A Holes for the guide pins (sealing axis 2/3).</li><li>B Holes for the upper arm attachment screws (33 pcs).</li><li>C Holes for the gearbox attachment screws (not affected in this instruction).</li></ul>
3 <b>Upper arm including wrist unit:</b> Fit the <i>lifting eye, VLBG M12</i> to the <i>attachment hole, lifting eye</i> on the wrist unit.	Art. no. is specified in <a href="#">Required equipment on page 270</a> . Shown in the figure <a href="#">Location of upper arm on page 269</a> .
4 <b>Upper arm including wrist unit:</b> Fit one of the pieces included in the <i>lifting accessory, upper arm</i> to the <i>front attachment for the lifting accessory</i> on the upper arm. <b>Upper arm without wrist unit:</b> Fit the <i>lifting accessory, upper arm</i> to the <i>both attachments for the lifting accessory</i> on the upper arm.	Art. no. is specified in <a href="#">Required equipment on page 270</a> . Attachment points are shown in the figure <a href="#">Location of upper arm on page 269</a> .  <b>Note</b> The different attachment points, depends on whether the wrist unit is mounted or not!
5 Fasten the <i>lifting tool (chain)</i> onto the lifting eye, the lifting accessory and an overhead crane.	Art. no. is specified in <a href="#">Required equipment on page 270</a> .

Continues on next page

4.4.4 Replacement of upper arm  
*Continued*

Action	Note
6  <b>CAUTION</b>  The complete upper arm weighs 380 kg without any additional equipment fitted! Use a suitable lifting accessory to avoid injury to personnel!	
7 Lift the upper arm and move to its mounting position.   <b>CAUTION</b>  Make sure the lift is done completely level!	
8 Fit in the gearbox attachment holes with the attachment holes on the lower arm with the guide pins.	Art. no. is specified in <a href="#">Required equipment on page 270</a> .
9 Fit the three washers to be placed beneath the attachment screws.	Shown in the figure <a href="#">Location of upper arm on page 269</a> .
10 Insert 31 of the 33 <i>attachment screws, upper arm</i> into the attachment holes in the lower arm. Do not remove the guide pins until the attachment screws are tightened as detailed below.	Shown in the figure <a href="#">Location of upper arm on page 269</a> .  Removing the plastic mechanical stops may be required before fitting the upper arm.  If guide pins are removed before the screws are tightened, the sealing can be involuntarily moved into wrong position.
11 Secure the lower arm to gearbox axis 3, with the attachment screws.	33 pcs: M12 x 50; 12.9 quality UN-BRAKO, tightening torque: 120 Nm.  Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 451</a> before fitting.
12 Remove the guide pins and fit the two remaining attachment screws. Tighten them as detailed above!	
13 Refit the axis-3 motor.	See <a href="#">Replacing motor axis 3 on page 348</a> .
14 Remove the lifting accessories.	
15 Refit any cabling removed during the removal process.	
16 Reconnect all connectors inside motors, axis 3 and 4. Refit the motor covers.	
17 Perform a leakdown test.	Detailed in section <a href="#">Performing a leakdown test on page 210</a> .
18 Refill the gearbox with oil.	Detailed in section <a href="#">Changing oil, axis-3 gearbox on page 172</a> .
19 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

*Continues on next page*

## 4 Repair

### 4.4.4 Replacement of upper arm

*Continued*

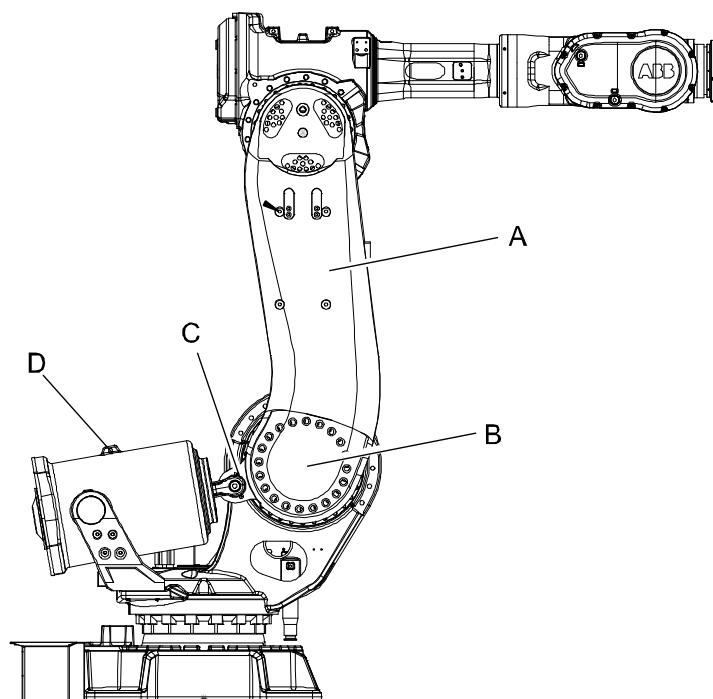
	Action	Note
20	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section <a href="#"><i>Calibration information on page 431</i></a> .
21	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <a href="#"><i>DANGER - First test run may cause injury or damage! on page 48</i></a> .	

## 4.4.5 Replacement of complete lower arm

### Location of lower arm

The lower arm is located as shown in the figure below.

A more detailed view of the component and its position may be found in [Spare parts on page 477](#).



xx0700000347

A	Lower arm
B	Pivot point, axis 2
C	Front shaft, balancing device
D	Attachment for lifting equipment, balancing device

### Required equipment

Equipment, etc.	Art. no.	Note
Lifting accessory, lower arm	3HAC027794-001	Tool that may be rented from ABB Robotics.
Rotation tool	3HAC17105-1	Used to rotate the motor pinion and gear if necessary, when brakes are released.
Grease	3HAB3537-1	For lubrication of the shaft hole.
Isopropanol	11771012-208	For cleaning of the shaft.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

*Continues on next page*

## 4 Repair

### 4.4.5 Replacement of complete lower arm

Continued

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

#### Deciding calibration routine

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

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

#### Removal, lower arm

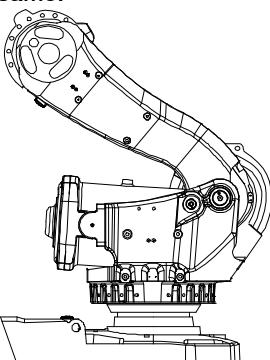
The procedure below details how to remove the complete lower arm.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 <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></ul> Before entering the robot working area.	

Continues on next page

## 4.4.5 Replacement of complete lower arm

Continued

	Action	Note
3	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
4	Remove the <i>upper arm</i> .	Detailed in section <a href="#">Removal, upper arm on page 272</a> .
5	Disconnect and remove the <i>cables</i> from inside the lower arm. Release any cable attachments.	Detailed in section <a href="#">Replacing cable harness, axes 1-6 on page 217</a> .
6	Apply the <i>shackle</i> to the balancing device and raise to unload the weight of the device.	Art. no. is specified in <a href="#">Required equipment on page 277</a> . Attachment is shown in the figure <a href="#">Location of lower arm on page 277</a> .
7	Unload the balancing device in order to make the piston rod and front ear adjustable when pulling the front shaft out.	Method 1 detailed in section <a href="#">Unloading the balancing device using hydraulic press tool on page 327</a> Method 2 detailed in section <a href="#">Unloading the balancing device using distance tool on page 321</a> .
8	Remove the securing screw from the balancing device <i>front shaft</i> .	Shown in the figure <a href="#">Location of lower arm on page 277</a> .
9	Lower the balancing device until it rests safely against the bottom of the frame.	
10	Move the lower arm backwards to the lowest position possible.	The figure shows IRB 6600 but the position of the lower arm shall be the same.  xx0300000015
11	Apply the <i>lifting accessory</i> to the lower arm.	Art. no. is specified in <a href="#">Required equipment on page 277</a> .
12	Drain the oil from gearbox 2.	Detailed in section <a href="#">Changing oil, axis-2 gearbox on page 169</a> .
13	 <b>CAUTION</b> The lower arm weighs 160 kg! All lifting equipment used must be sized accordingly!	

Continues on next page

## 4 Repair

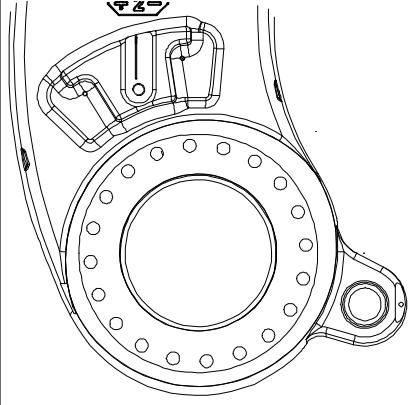
### 4.4.5 Replacement of complete lower arm

Continued

Action	Note
14 Raise the tool to unload the lower arm.	
15 Remove the <i>attachment screws and washers</i> that attach the lower arm to the gearbox axis 2.	
16 Lift the lower arm and place it on a secure surface.	

#### Refitting, lower arm

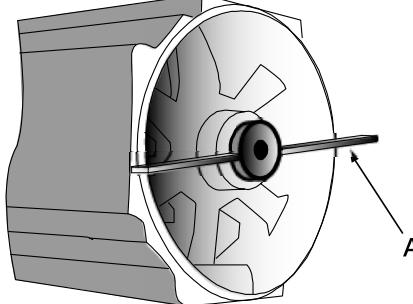
The procedure below details how to refit the lower arm.

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></ul> Before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3 Fit two guideing pins in two opposite attachment holes of the lower arm.	 xx0700000348
4 Apply the <i>lifting tool</i> to the lower arm.	Art. no. is specified in <a href="#">Required equipment on page 277</a> .
5  <b>CAUTION</b> The lower arm weighs 160 kg! All lifting equipment used must be sized accordingly!	
6 Lift the lower arm and move it to its mounting position.	

Continues on next page

## 4.4.5 Replacement of complete lower arm

Continued

Action	Note
7 In case the hole pattern of the lower arm and the gearbox axis 2 does not match, use power supply to release the motor axis 2 brakes and rotate the pinion and gear with the <i>rotational tool</i> .	Connect power supply to connector R2.MP2 <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>  xx0200000165 The rotation tool (A) is used beneath the motor cover, directly on the motor shaft as shown in figure above. Art. no. is specified in <a href="#">Required equipment on page 277</a> .
8 Disconnect the power supply, if used.	
9 Secure the lower arm with 18 of the <i>20attachment screws and washers</i> in gearbox, axis 2.	20 pcs: M16 x 50, tightening torque: 300 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 451</a> before fitting.
10 Remove the guidings and secure the two remaining screws as detailed above!	
11 Remove the lifting tool from the lower arm.	
12 Refit and restore the balancing device.	See section <a href="#">Replacing the balancing device (design 1) on page 297</a> .
13 Refit the upper arm.	See section <a href="#">Refitting, upper arm on page 274</a> .
14 Perform a leak-down test.	See section <a href="#">Performing a leak-down test on page 210</a> .
15 Refill the gearbox with oil.	See section <a href="#">Changing oil, axis-2 gearbox on page 169</a> .
16 Refit and reconnect all cables inside the lower arm. Resecure any cable attachments.	Detailed in section <a href="#">Replacing cable harness, axes 1-6 on page 217</a> .
17 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
18 Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .

Continues on next page

## 4 Repair

### 4.4.5 Replacement of complete lower arm

*Continued*

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

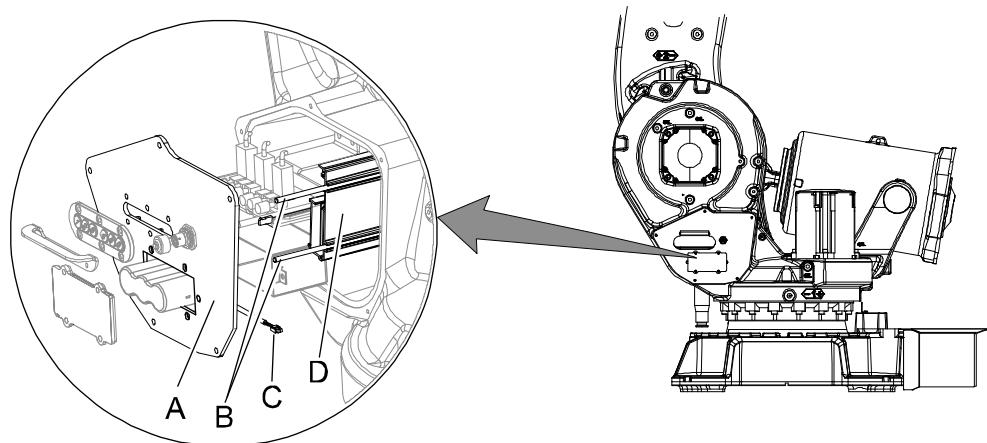
## 4.5 Frame and base

### 4.5.1 Replacing the SMB unit

#### Location of SMB unit

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

SMB unit DSQC633A with battery pack 3HAC16831-1 (with 2-pole battery contact)



xx0700000121

A	SMB cover
B	Guide pins (2 pcs)
C	Battery cable (2-pole contact)
D	SMB unit DSQC633A

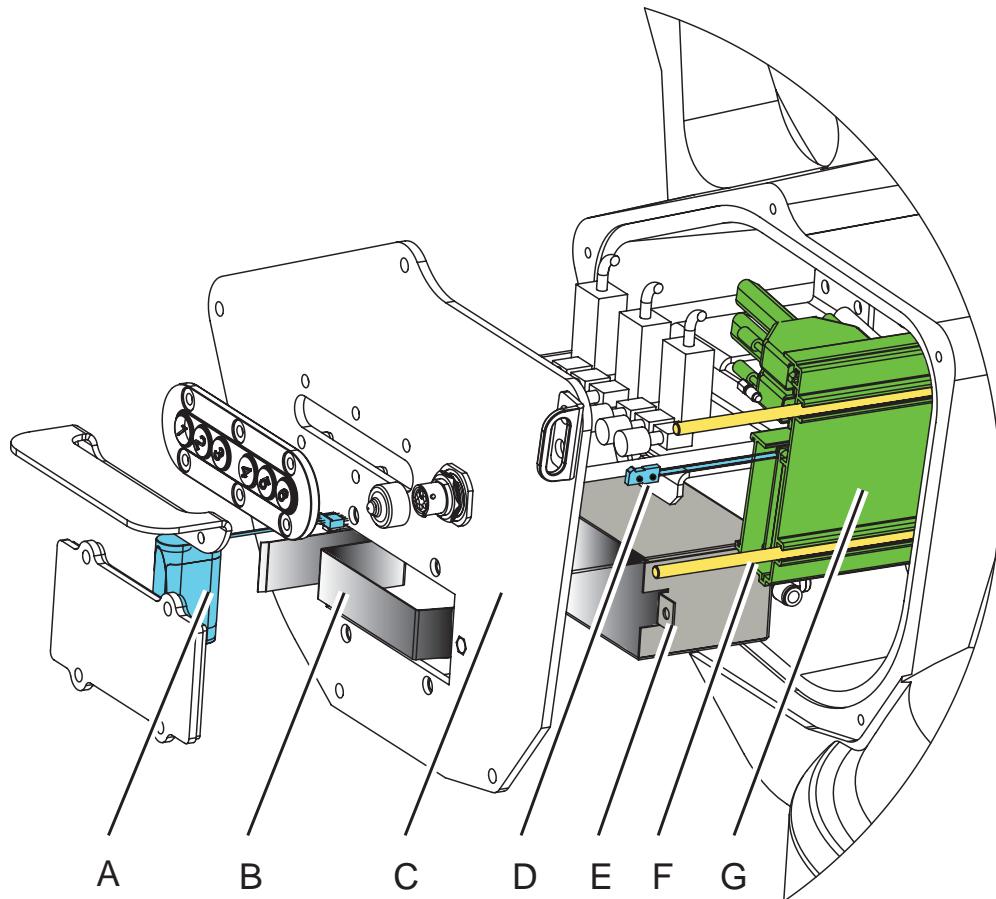
*Continues on next page*

## 4 Repair

### 4.5.1 Replacing the SMB unit

*Continued*

SMB unit RMU with battery pack 3HAC044075-001 (with 3-pole battery contact)



xx1400002574

A	Battery pack (3-pole battery contact)
B	Battery holder RMU
C	Cover
D	Battery cable (3-pole battery contact)
E	Battery holder
F	Guide pins (2 pcs)
G	SMB unit RMU

### Required equipment



#### Note

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

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

*Continues on next page*

Equipment, etc.	Art. no.	Note
SMB unit	For spare part number, see: <a href="#">Spare parts on page 477</a> .	
Brush	-	Option: Foundry prime
Rust preventive	3HAC026621-001	Option: Foundry prime Equivalent: • Mercasol
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Circuit diagram	-	See chapter <a href="#">Circuit diagrams on page 479</a> .

**Removing, SMB unit**

Use this procedure to remove the SMB unit.

	Action	Note
1	Move the robot to the calibration position.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
4	 xx0200000023 <b>WARNING!</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
5	Remove the <i>SMB cover</i> by unscrewing its attachment screws.	Shown in the figure <a href="#">Location of SMB unit on page 283</a> .
6	Use caution and remove the connectors X8, X9 and X10 from the brake release board, if need of more space.	
7	Remove the nuts and washers from the <i>guide pins</i> that secure the board.	Shown in the figure <a href="#">Location of SMB unit on page 283</a> .
8	Use caution and disconnect the connectors from the SMB unit when pulling the board out.	Connectors R1.SMB1-3, R1.SMB4-6 and R2.SMB
9	Disconnect the <i>battery cable</i> from the SMB unit.	Shown in the figure <a href="#">Location of SMB unit on page 283</a> .

Continues on next page

## 4 Repair

### 4.5.1 Replacing the SMB unit

Continued

#### Refitting, SMB unit

Use this procedure to refit the SMB unit.

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></ul> to the robot, before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3  xx0200000023 <b>WARNING!</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
4 Connect the <i>battery cable</i> to the SMB unit.	Shown in the figure <a href="#">Location of SMB unit on page 283</a> .
5 Connect all connectors to the SMB board: R1.SMB1-3, R1.SMB4-6 and R2.SMB	Art. no. is specified in <a href="#">Required equipment on page 284</a> . Shown in the figure <a href="#">Location of SMB unit on page 283</a> .
6 Fit the <i>SMB unit</i> onto the <i>guide pins</i> .	
7 Secure the SMB unit to the pins with the nuts and washers.	
8 If disconnected, reconnect the connectors X8, X9 and X10 to the brake release board.	
9 Secure the <i>SMB cover</i> with its attachment screws. If cabling is used for 7th axis (option), refit the 7th axis connector to the SMB cover and tighten with 6 Nm.	Shown in the figure <a href="#">Location of SMB unit on page 283</a> .
10 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
11 Update the revolution counter!	See <a href="#">Updating revolution counters on page 436</a> .
12  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

Continues on next page

---

**Replacement of SMB unit (Foundry Prime)**

Robots working with Foundry Prime and that have the special tightness for this application require special repair routines to maintain the tightness level.

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

Action	Note
 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	
 xx0200000023   <b>WARNING</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
3 Remove the SMB unit as detailed in <a href="#">Removing, SMB unit on page 285</a>	
4 Refit the new SMB unit according to step 3 - 6 in <a href="#">Refitting, SMB unit on page 286</a>	
 <b>Note</b> Make sure that the gasket under the SMB cover is not damaged! Secure the SMB cover with its attachment screws.	
6 Apply rust preventive on the surface around the SMB cover and under/on top of the screw heads.	
7 Perform a leakdown test according to <a href="#">Inspection of air hoses (Foundry Prime) on page 151</a> .	
8 Update the revolution counter!	See <a href="#">Updating revolution counters on page 436</a> .
 <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

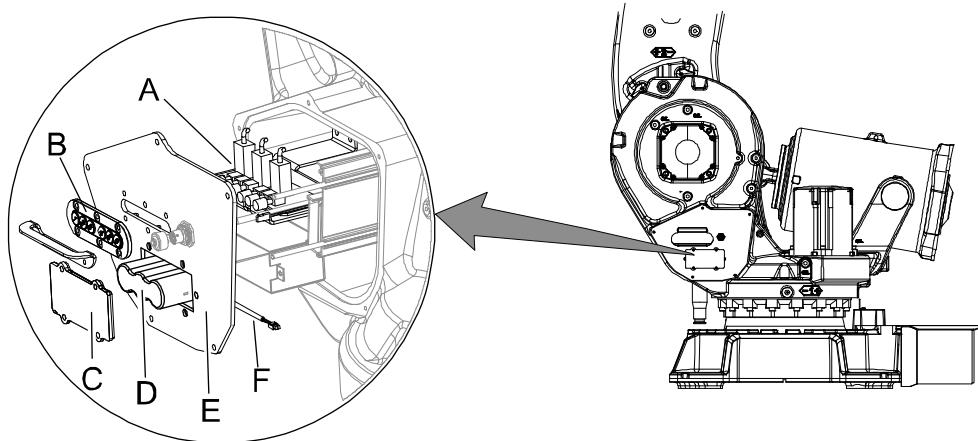
## 4 Repair

### 4.5.2 Replacing the brake release board

#### 4.5.2 Replacing the brake release board

##### Location of brake release board

The brake release unit is located together with the SMB unit on the left hand side of the frame, right next to the gearbox, axis 2, as shown in figure below.



xx0700000123

A	Brake release unit
B	Push button guard
C	Battery cover
D	Battery
E	SMB cover
F	Battery cable

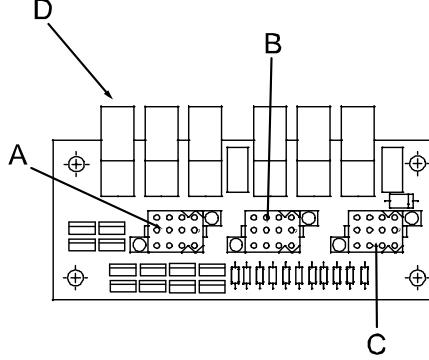
##### Required equipment

Equipment, etc.	Art. no.	Note
Brake release board with buttons	For spare part no. see: • <a href="#">Spare parts on page 477</a>	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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

**Removing, brake release board**

Use this procedure to remove the brake release board.

	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> </ul> Before entering the robot working area.	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
4	Remove the <i>push button guard</i> from the SMB cover.	Shown in the figure <a href="#">Location of brake release board on page 288</a> . The guard must be removed to ensure a correct refitting of the brake release board.
5	Let the battery stay connected, to avoid the need of synchronization of the robot!	Shown in the figure <a href="#">Location of brake release board on page 288</a> .
6	Disconnect the connectors X8, X9 and X10 from the <i>brake release board</i> .	 xx0200000129 <ul style="list-style-type: none"> <li>• A: Connector X8</li> <li>• B: Connector X9</li> <li>• C: Connector X10</li> <li>• D: Push buttons</li> </ul> Location of the brake release unit is shown in the figure <a href="#">Location of brake release board on page 288</a> .

*Continues on next page*

## 4 Repair

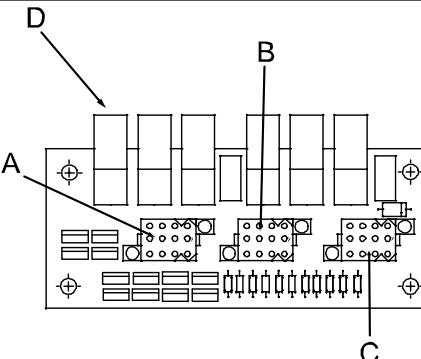
### 4.5.2 Replacing the brake release board

*Continued*

Action	Note
7 Remove the brake release board from the bracket by removing the four attachment screws.	

#### Refitting, brake release board

Use this procedure to refit the brake release board.

Action	Note
1 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2  ELECTROSTATIC DISCHARGE (ESD)  The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">WARNING - The unit is sensitive to ESD! on page 52</a>	
3 Fasten the <i>brake release board</i> on the bracket with the attachment screws. Make sure the board is positioned as straight as possible on the bracket! The push buttons can otherwise get jammed when the SMB cover is refitted.	Shown in the figure <a href="#">Location of brake release board on page 288</a> . Art. no. is specified in <a href="#">Required equipment on page 288</a> .
4 Connect the connectors X8, X9 and X10 to the brake release board.	 xx0200000129 <ul style="list-style-type: none"> <li>• A: Connector X8</li> <li>• B: Connector X9</li> <li>• C: Connector X10</li> <li>• D: Push buttons</li> </ul>
5 Refit the <i>SMB cover</i> with its attachment screws. The push button guard must not be mounted on the cover before the check described in following warning is made!	Shown in the figure <a href="#">Location of brake release board on page 288</a> .
6  <b>WARNING</b>  Before continuing any service work, please observe the safety information in section <a href="#">WARNING - The brake release buttons may be jammed after service work on page 49!</a>	

*Continues on next page*

## 4.5.2 Replacing the brake release board

Continued

	Action	Note
7	Refit the <i>push button guard</i> to the SMB cover.	Shown in the figure <a href="#">Location of brake release board on page 288</a> .
8	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
9	If the battery has been disconnected the revolution counter must be updated.	Detailed in the Calibration chapter - section <a href="#">Updating revolution counters on page 436</a> .
10	 <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4 Repair

### 4.5.3 Replacement of spherical roller bearing, balancing device

#### 4.5.3 Replacement of spherical roller bearing, balancing device

##### Overview

There are some differences in the two designs of the robot IRB 6640, design 1 has:

- one ear on the lower arm as shown in the figure for design 1.

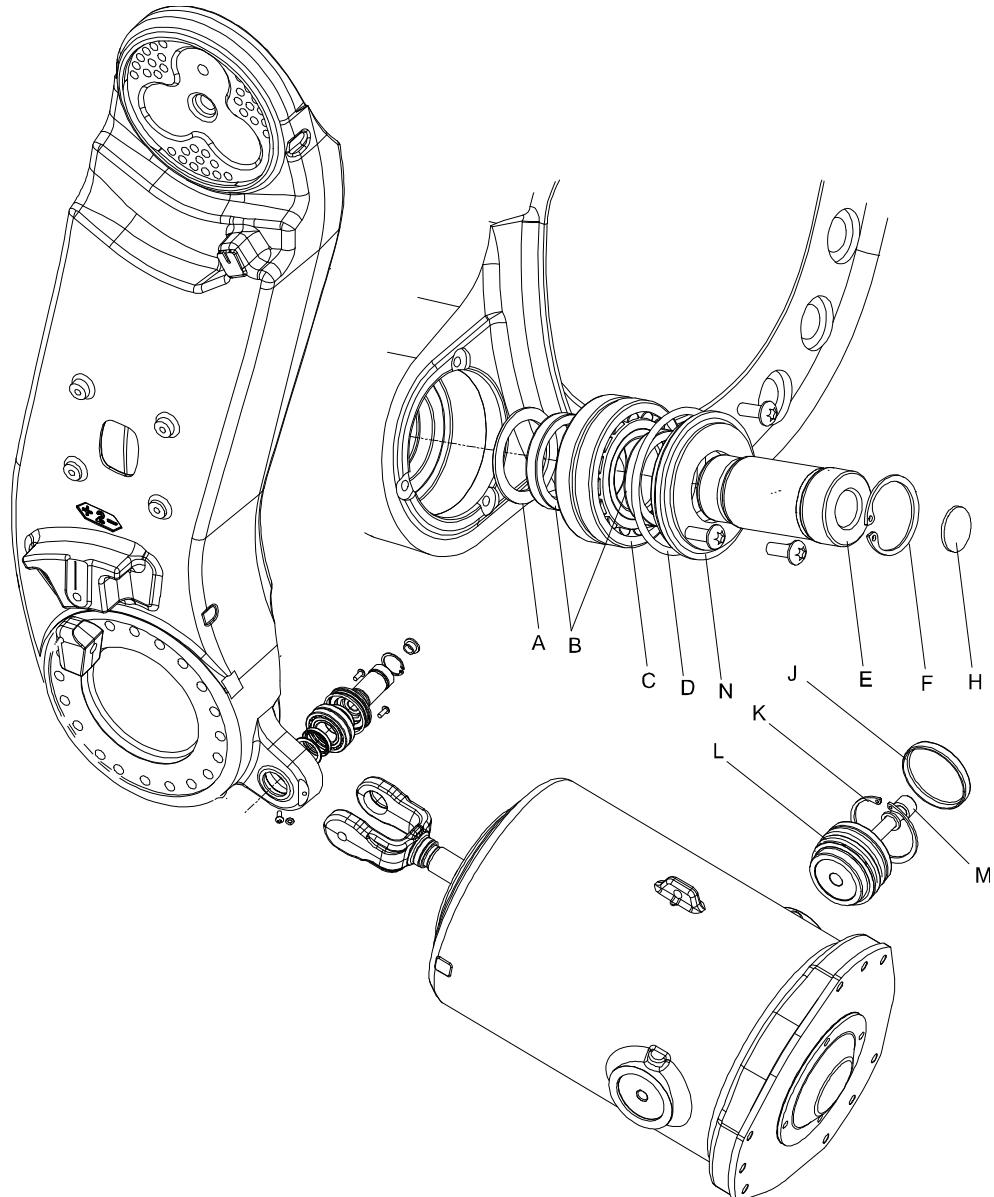
Design 2 has:

- two ears on the lower arm as shown in the figure for design 2

The difference is described in section *Design 1 and Design 2 of IRB 6640 on page 62*.

##### Location of bearing, Design 1

The bearings are located in the balancing device, as shown in the figure below.



xx0900000072

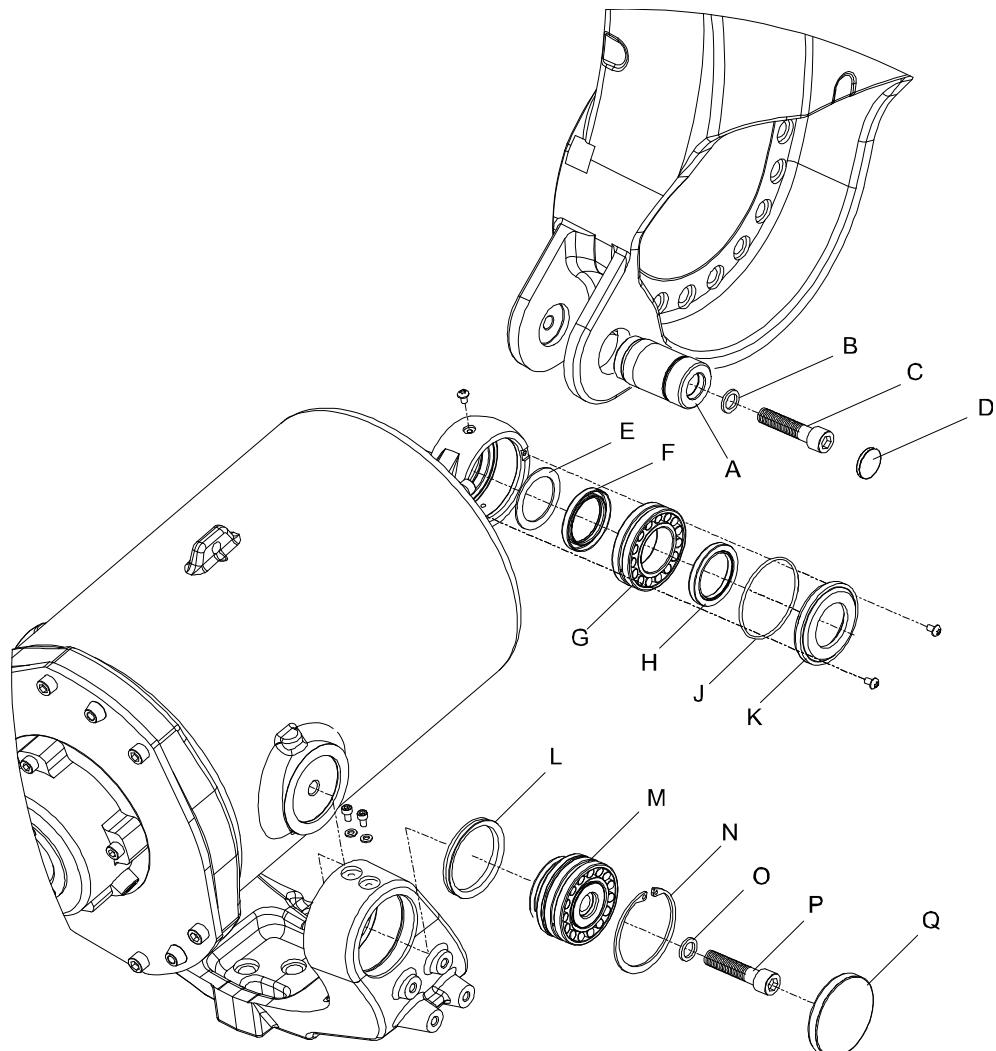
Continues on next page

4.5.3 Replacement of spherical roller bearing, balancing device  
*Continued*

A	Washer
B	Sealing ring, radial (2 psc)
C	Spherical roller bearing
D	O-ring
E	Shaft
F	Retaining ring, bore
H	VK-cover
J	VK-cover
K	Retaining ring, bore
L	Cradle bearing kit
M	Hex socket head cap screw M16x70
N	Sealing washer

**Location of bearing, Design 2**

The bearings are located in the balancing device, as shown in the figure below.



xx0900000066

*Continues on next page*

## 4 Repair

### 4.5.3 Replacement of spherical roller bearing, balancing device

*Continued*

A	Shaft
B	Washer
C	Hex socket head cap screw M16x70
D	VK-cover
E	Washer
F	Radial sealing with dust lip 50x68x8
G	Spherical roller bearing
H	Radial sealing with dust lip 50x68x8
J	O-ring
K	End cover
L	Radial sealing (not used in clean room applications)
M	Cradle bearing kit
N	Retaining ring, bore
O	Washer
P	Hex socket head cap screw M16x70
Q	VK-cover

#### Required equipment

Equipment	Spare part no.	Art. no.	Note
Maintenance parts, shaft	See Spare parts		Includes the parts shown in the figure above.
Grease		3HAB3537-1	For lubrication of the components.
Toolkit		3HAC028920-001	The tools in the set are shown in the section <a href="#">Dismounting and mounting tool 3HAC028920-001 on page 459</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.

#### Tool set up 3HAC028920-001

The set up of the press tool used for the process of removal and refitting of spherical bearing is described in section [Dismounting and mounting tool 3HAC028920-001 on page 459](#).

*Continues on next page*

## 4.5.3 Replacement of spherical roller bearing, balancing device

Continued

**Removal, spherical roller bearing**

Use this procedure to remove the spherical roller bearing from the balancing device front ear.

	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> </ul> Before entering the robot working area.	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3	Remove the balancing device from the robot.	Detailed in section <a href="#">Replacing the balancing device (design 1) on page 297</a> or in <a href="#">Replacing balancing device (design 2) on page 306</a> .
4	Remove the both <i>sealing spacers</i> with a screwdriver or any equal tool.	Shown in the figure <a href="#">Location of bearing, Design 1 on page 292</a> and <a href="#">Location of bearing, Design 2 on page 293</a>
5	Remove the spherical roller bearing, using the dismounting and mounting tool 3HAC028920-001.	Described in section <a href="#">Removal front bearing Design 1 on page 465</a> or <a href="#">Removal front bearing Design 2 on page 468</a> .

**Refitting, spherical roller bearing**

Use this procedure to refit the spherical roller bearing to the balancing device front ear.

	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> </ul> Before entering the robot working area.	
2	Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3	Grease the inside walls of the front ear.	

Continues on next page

## 4 Repair

### 4.5.3 Replacement of spherical roller bearing, balancing device

*Continued*

Action	Note
4 Press in the sealing washer and the sealing.	 xx0900000115
5 Refit the new bearing and sealings.	Described in section <a href="#">Refitting front bearing and sealing Design 1 on page 467</a> or in <a href="#">Refitting front bearing with sealing Design 2 on page 470</a> .
6 Apply grease to the new sealing rings and o-rings and fit them.	Sealing and o-ring are showed in the figure <a href="#">Location of bearing, Design 1 on page 292</a> and <a href="#">Location of bearing, Design 2 on page 293</a> .
7 Refit the end cover.	End cover shown in figure <a href="#">Location of bearing, Design 1 on page 292</a> or <a href="#">Location of bearing, Design 2 on page 293</a> .
8 Refit the balancing device to the robot.	Detailed in section <a href="#">Replacing the balancing device (design 1) on page 297</a> or <a href="#">Replacing balancing device (design 2) on page 306</a> .
9 Lubricate the spherical roller bearing in the ear.   <b>Note</b>  The balancing device must be mounted on the robot when lubrication is performed!	Detailed in section <a href="#">Lubrication of spherical roller bearing, balancing device on page 189</a>
10 Make sure no incorrect leakage occurs. It could indicate damaged o-rings.	This is detailed in section <a href="#">Check for leakage - Design 1 on page 142</a> .
11 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
12  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4.5.4.1 Replacing the balancing device (design 1)

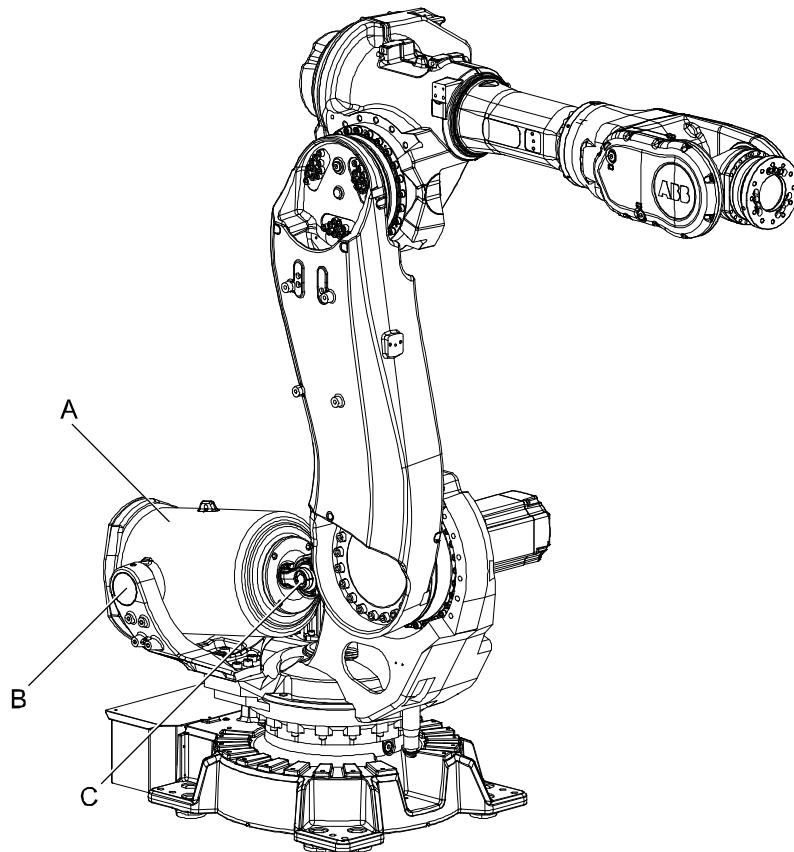
**4.5.4 Replacement of balancing device****4.5.4.1 Replacing the balancing device (design 1)****Introduction**

This section describes how to replace balancing device (design 1).

Replacement of design 2 of the balancing device is described in [Replacing balancing device \(design 2\) on page 306](#).

**Location of balancing device**

The balancing device is located on the rear top of the frame as shown in the figure.



xx080000477

A	Balancing device
B	Cradle bearing
C	Spherical roller bearing

**Required equipment**

Equipment	Spare part no.	Art. no.	Note
Balancing device	See Spare parts chapter		

*Continues on next page*

## 4 Repair

### 4.5.4.1 Replacing the balancing device (design 1)

*Continued*

Equipment	Spare part no.	Art. no.	Note
Mainteance parts, shaft	See Spare parts chapter		
Mainteance parts, cradle	See Spare parts chapter		
Locking screw			M16x60 quality 12.9 Gleitmo For securing the lower arm.
Bearing grease		3HAB3537-1	
Grease		3HAC042534-001	
Grease pump		-	To lubricate spherical roller bearing.
Lifting tool (chain)		3HAC15556-1	
Shackle		3HAC020997-001	
Press tool, balancing device		3HAC020902-001	For unloading and restoring the balancing device.
Distance tool		3HAC030662-001	
Dismantle and mounting tool		3HAC028920-001	For dismantling and mounting of shaft and bearings.
Hydraulic cylinder		3HAC11731-1	To be used with these tools: • 3HAC028920-001 • 3HAC020902-001
Hydraulic pump, 80 MPa		3HAC13086-1	To be used with the hydraulic cylinder 3HAC11731-1.
Standard toolkit.			Content is defined in section <a href="#">Standard tools on page 455</a> .
Brush		-	Option: Foundry Prime
Rust preventive		3HAC034903-001	Option: Foundry Prime Equivalent: • Mercasol
Loctite 577		12340011-116	Option: Foundry Prime
Sikaflex 521FC		3HAC026759-001	Option: Foundry Prime

### Removing balancing device (design 1)

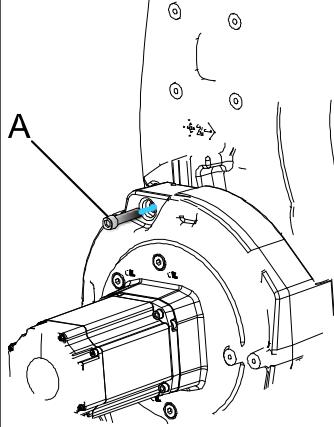
Use this procedure to remove balancing device, design 1.

Action	Information
1  <b>CAUTION</b>  Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
2 Remove all equipment if any, on or close to the balancing device.	

*Continues on next page*

## 4.5.4.1 Replacing the balancing device (design 1)

Continued

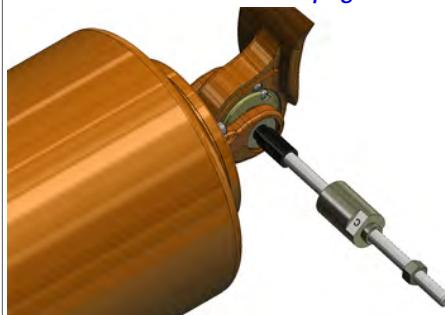
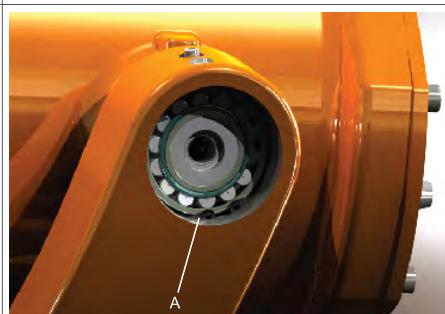
Action	Information
3 Fit the <i>lifting tool</i> with <i>shackle</i> to the balancing device and raise to unload the device.  ! <b>CAUTION</b> The balancing device weighs 210 kg! All lifting equipment used must be sized accordingly!	 xx0900000092
4 Secure the lower arm using a lifting sling or using the <i>locking screw</i> in the frame.	 xx0800000249 • A: Locking screw
5 Use one of the methods to unload the balancing device in order to make the piston rod and front ear adjustable when pulling the shaft out: <ul style="list-style-type: none"><li>• Method 1: Unload the balancing device with the <i>press tool</i>.</li><li>• Method 2: Unload the balancing device with the <i>distance tool</i>.</li></ul>	For art. no. see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment on page 297</a></li></ul> The methods are described in sections: <ul style="list-style-type: none"><li>• Method 1: <a href="#">Unloading the balancing device using hydraulic press tool on page 327</a></li><li>• Method 2: <a href="#">Unloading the balancing device using distance tool on page 321</a></li></ul>
6  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	

Continues on next page

## 4 Repair

### 4.5.4.1 Replacing the balancing device (design 1)

*Continued*

Action	Information
7 Remove the <i>VK cover</i> in order to reach the shaft.  Tip Hit the <i>VK cover</i> gently at the bottom part of it with a plastic hammer or similar and tilt it out.	
8 Remove the <i>retaining ring bore</i> .	
9 Remove the front shaft using the <i>dismantle and mounting tool</i> .  For art. no. see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment on page 297</a></li></ul> How to use the tool, see: <ul style="list-style-type: none"><li>• <a href="#">Dismantling and mounting tool 3HAC028920-001 on page 459</a></li></ul>	 xx0900000095
10 Remove the <i>VK cover</i> in order to reach the shaft holding the balancing device.  Tip Hit the <i>VK cover</i> gently at the bottom part of it with a plastic hammer or similar and tilt it out.	
11 Wipe off all residual grease inside the hole.	
12 Remove the hex socket head cap screw (M16x70) securing the piston rod shaft.	
13 Remove the <i>retaining ring bore</i> securing the shaft.	 xx0900000079 <ul style="list-style-type: none"><li>• A: Retaining ring bore</li></ul>

*Continues on next page*

## 4.5.4.1 Replacing the balancing device (design 1)

Continued

Action	Information
14 Remove both the cradle bearings and the balancing device shafts using the <i>dismantle and mounting tool</i> .	For art. no. see: • <a href="#">Required equipment on page 297</a>  xx0900000074
15 Perform this procedure of pulling out the shafts on both sides of the cradle.	
16 Lift the balancing device gently backwards to a secure area.	

**Refitting balancing device (design 1), standard**

Use this procedure to refit balancing device (design 1) on a standard robot.

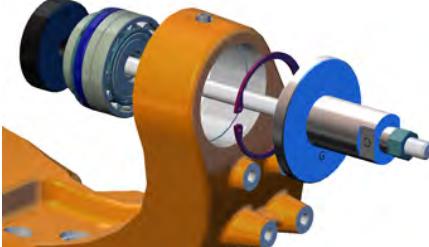
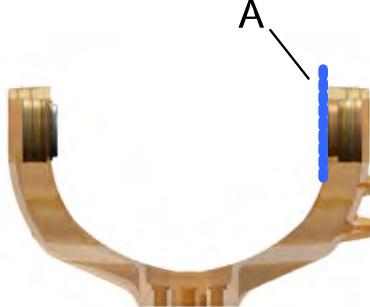
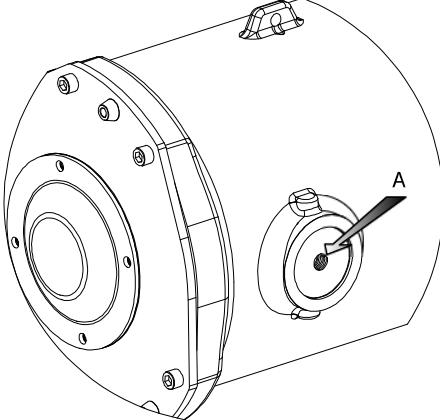
Action	Information
1 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2 Fit the <i>shackle</i> to the balancing device.	For art. no. see: • <a href="#">Required equipment on page 297</a>  xx0900000094
3  <b>CAUTION</b> The balancing device weighs 210 kg! All lifting equipment used must be sized accordingly!	
4 Refit one of the two <i>retaining ring bore</i> .	
5 Grease the cradle.	

Continues on next page

## 4 Repair

### 4.5.4.1 Replacing the balancing device (design 1)

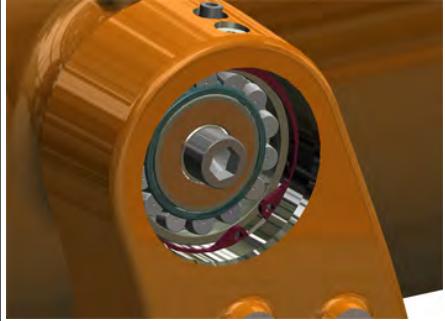
*Continued*

Action	Information
6 Refit the cradle bearings and the balancing device shafts with the <i>dismantle and mounting tool</i> .	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 297</a></li> </ul> <p>How to use the tool see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Dismantling and mounting tool 3HAC028920-001 on page 459</a></li> </ul>  <p>xx0900000060</p>
7 Perform this on the side where the retaining ring bore is mounted: <ul style="list-style-type: none"> <li>• Refit the <i>cradle bearings</i> and the <i>balancing device shafts</i> to the <i>retaining ring bore</i>.</li> </ul>	
8 Perform this on the side where the retaining ring bore is <b>not</b> mounted: <ul style="list-style-type: none"> <li>• Refit the <i>cradle bearings</i> and <i>balancing device shafts completely</i>.</li> </ul>	
9 It should look like this. See figure!	 <p>xx0900000083</p> <ul style="list-style-type: none"> <li>• A: Shows a correct fitting</li> </ul>
10 Use <i>Loctite 577</i> on the threads on the balancing device.	<p><b>CAUTION</b></p> <p>Do not use Loctite on the threads of the hex socket head cap screw M16x70.</p>  <p>xx0900000088</p> <ul style="list-style-type: none"> <li>• A: Loctite 577</li> </ul>

*Continues on next page*

## 4.5.4.1 Replacing the balancing device (design 1)

Continued

Action	Information
11 Perform the following procedure of refitting the shafts on both sides of the cradle before refitting of the shaft at the piston rod shaft front eye.	
12 Lift the balancing device to the back of the robot.	
13 Fit the balancing device on the side where the shaft is in final position and fix it lightly using the hex socket head cap screw M16x70.	Tightening torque: 300 Nm.
14 On the other side, use the hex socket head cap screw M16x70 to refit the cradle bearings and the balancing device shafts to the final position.	Tightening torque: 300 Nm.
15 Lock the cradle bearings with the <i>retaining ring bore</i> .	 xx0900000089
16 Fit new VK covers on both sides.	
17 Raise the balancing device to a position where the shafts shall be fitted.	
18 Lubricate the shaft with <i>grease</i> . Amount: 40 ml.	
19 Refit the front shaft using the dismantle and mounting tool. For art. no. see: • <a href="#">Required equipment on page 297</a>	
20 Secure the shaft with its <i>attachment screw</i> . Tightening torque: 300 Nm. M16x70 quality 12.9 Gleitmo	
21 Refit the retaining ring bore.	
22 Refit the VK cover.	
23 Lubricate the bearing in the ear with <i>grease</i> through the lubricating nipple, with a <i>grease pump</i> . Fill until excessive grease pierces between the shaft and the sealing spacer. Amount: 20 ml.	
24 Restore the balancing device depending on which method used.	<ul style="list-style-type: none"> <li>• Method 1: <a href="#">Restoring the balancing device using a hydraulic press tool on page 330</a></li> <li>• Method 2: <a href="#">Restoring the balancing device using distance tool on page 325</a></li> </ul>
25 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

Continues on next page

## 4 Repair

### 4.5.4.1 Replacing the balancing device (design 1)

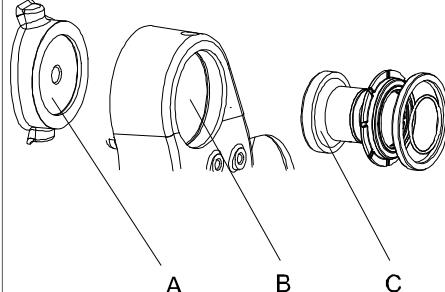
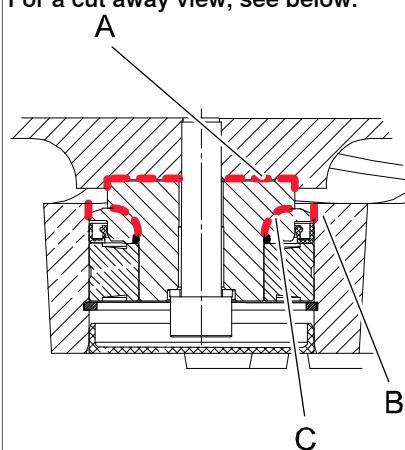
*Continued*

#### Refitting balancing device (design 1), Foundry Prime

Use this procedure to refit balancing device (design 1) on a Foundry Prime robot.

Robots working with Foundry Prime and that have the special tightness for this application require special repair routines to maintain the tightness level.

The repair must be done according to the previous repair procedures with the following additions when refitting the balancing device.

Action	Information
<p>1</p> <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></ul> <p>to the robot, before entering the robot working area.</p>	
<p>2</p> <p>Apply <i>Mercasol</i> to the shafts and holes.</p>	<p>For art. no. see:</p> <ul style="list-style-type: none"><li>• <i>Required equipment on page 297</i></li></ul>  <p>xx0700000452</p> <p>For a cut away view, see below.</p>  <p>xx0700000453</p> <ul style="list-style-type: none"><li>• A: Mercasol - surface on the balancing device</li><li>• B: Mercasol - on hole in the shaft</li><li>• C: Mercasol - on shaft.</li></ul>

*Continues on next page*

## 4.5.4.1 Replacing the balancing device (design 1)

Continued

Action	Information
3 Apply Mercasol on these machined surfaces of the balancing device: <ul style="list-style-type: none"> <li>• holes in the lower arm ear</li> <li>• holes in the rod bracket</li> <li>• shaft.</li> </ul>	<p>xx0700000454</p> <ul style="list-style-type: none"> <li>• A: Machined surfaces in lower arm ear</li> <li>• B: Machined surfaces in rod bracket</li> <li>• C: Machined surfaces on shaft.</li> </ul>
4  <b>DANGER</b>  Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <b>DANGER - First test run may cause injury or damage!</b> <i>on page 48.</i>	

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

#### 4.5.4.2 Replacing balancing device (design 2)

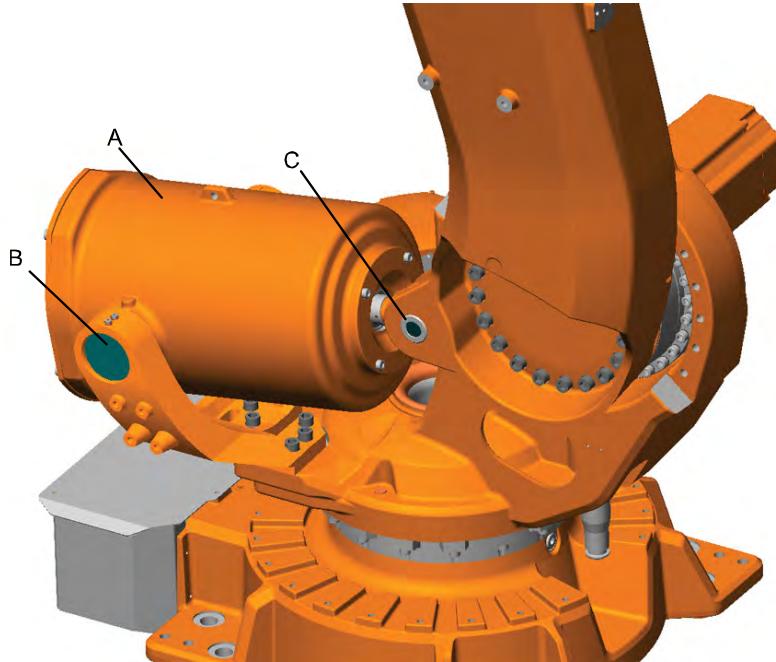
##### Introduction

This section describes how to replace balancing device (design 2).

Replacement of design 1 of the balancing device is described in [Replacing the balancing device \(design 1\) on page 297](#).

##### Location of balancing device

The balancing device is located on rear top of the frame as shown in the figure below.



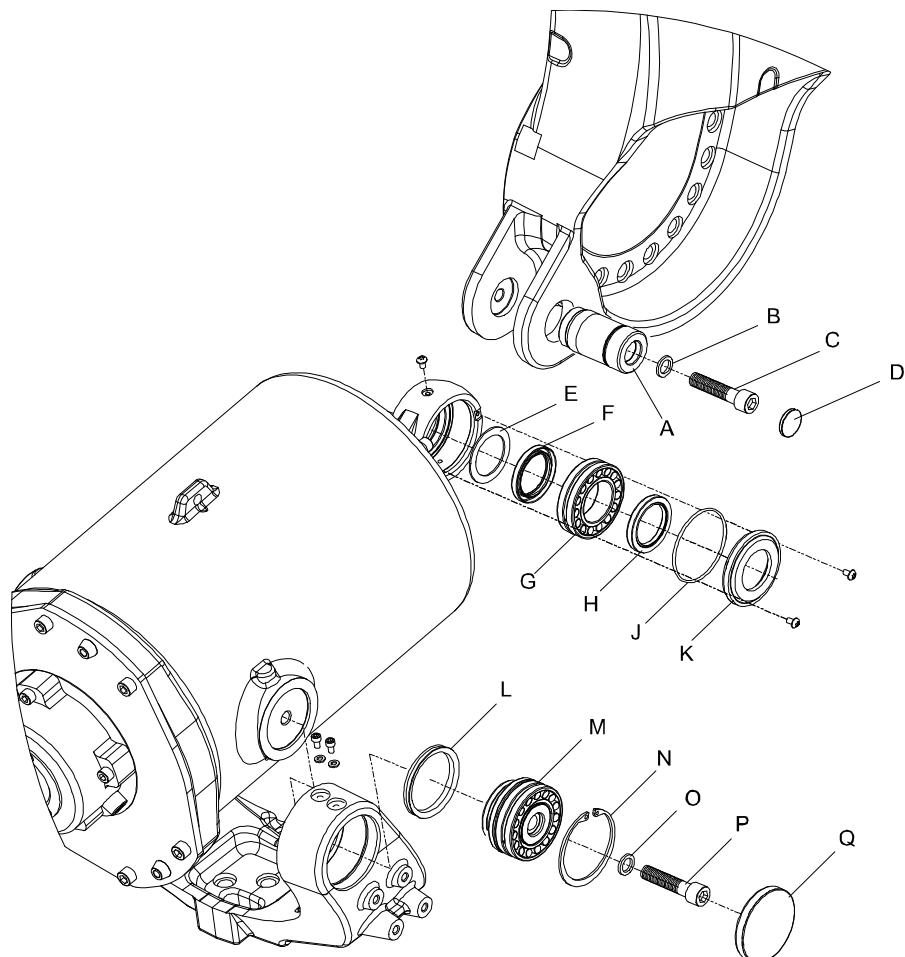
xx0900000075

A	Balancing device
B	Cradle bearing
C	Spherical roller bearing

Continues on next page

**Location of parts in maintenance sets, cradle and shaft**

The figure shows the maintenance sets for the cradle and for the shaft.



xx0900000066

<b>Maintenance set - Shaft</b>	
A	Shaft
B	Washer, M16x70 quality 8.8 steel
C	Hex socket head cap screw M16x70 quality 8.8 steel
D	VK-cover
E	Washer
F	Radial sealing with dust lip 50x68x8
G	Spherical roller bearing
H	Radial sealing with dust lip 50x68x8
J	O-ring
K	End cover
<b>Maintenance set - Cradle</b>	
L	Radial sealing (Not used in Clean Room applications)
M	Cradle bearing kit

*Continues on next page*

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

*Continued*

N	Retaining ring, bore
O	Washer, M16x70 quality 8.8 steel
P	Hex socket head cap screw M16x70
Q	VK-cover

#### Required parts

Equipment	Art. no.	Note
Balancing device	See chapter: • <i>Spare parts</i>	
Maintenance parts, shaft	See chapter: • <i>Spare parts</i>	For content see the figure in : • <i>Location of parts in maintenance sets, cradle and shaft on page 307</i>
Maintenance parts, cradle	See chapter: • <i>Spare parts</i>	For content see the figure in: • <i>Location of parts in maintenance sets, cradle and shaft on page 307</i>
Front shaft	3HAC037916-001	
VK cover	3HAA2166-12	

#### Required equipment - tools etc.

Equipment	Art. no.	Note
Loctite 2701	-	Used to lock the screw that hold the shaft in the front ear.
Loctite 577	12691907-001	
Locking screw	-	M16x60 quality 12.9 Gleitmo. For securing of the lower arm.
Bearing grease	3HAB3537-1	
Grease	3HAC042534-001	
Grease pump	-	
Lifting tool (chain)	3HAC15556-1	
Shackle	3HAC020997-001	
Press tool, balancing device	3HAC020902-001	For unloading and restoring the balancing device, (Method 1).
Distance tool	3HAC030662-001	For unloading and restoring the balancing device, (Method 2).
Dismantle and mounting tool	3HAC028920-001	For dismantling and mounting of shaft and bearings.
Hydraulic cylinder	3HAC11731-1	To be used with these tools: • 3HAC028920-001 • 3HAC020902-001
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with the hydraulic cylinder 3HAC11731-1.

*Continues on next page*

Equipment	Art. no.	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	-	These procedures include references to the tools required.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

**Additional equipment - Foundry Prime**

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 577	12691907-001	
Brush	-	

**Removing balancing device, (design 2)**

Use this procedure to remove the balancing device (design 2).

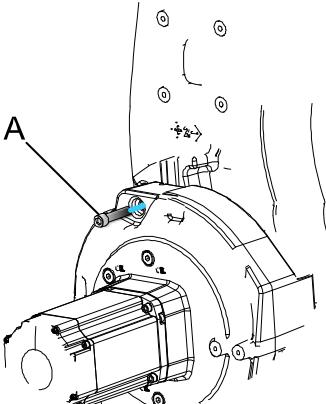
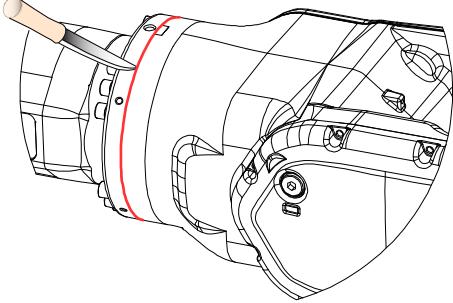
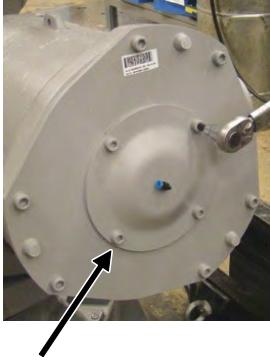
	Action	Note
1	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
2	Remove all equipment, if any, on or close to the balancing device.	
3	<b>CAUTION</b> Fit the <i>lifting tool</i> to the balancing device and raise to unload the weight.  The balancing device weighs 210 kg! All lifting equipment used must be sized accordingly!	For art. no. see: • <a href="#">Required equipment - tools etc. on page 308</a>  xx0900000092

*Continues on next page*

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

*Continued*

Action	Note
4 Secure the lower arm using a lifting sling or using the <i>locking screw</i> in the frame.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 308</a></li> </ul>  <p>xx0800000249</p> <ul style="list-style-type: none"> <li>• A: Locking screw</li> </ul>
5 <b>Foundry Prime robots:</b> Cut the paint layer with a knife in the joint between the rear cover and the <i>balancing housing</i> and remove the cover.   <b>Note</b>  Keep the cover for the refitting.	<p>The figure shows the principal method.</p>  <p>xx0900000121</p>  <p>A xx1000000554</p> <ul style="list-style-type: none"> <li>• A: Joint between rear cover and balancing housing</li> </ul>
6 Unload the balancing device in order to make the ear of the piston rod adjustable when pulling the front shaft out.  Use one of the two methods described.	<p><b>Method 1:</b> The <b>press tool</b> must be used if the balancing device shall be replaced with a new one.</p> <p><b>Method 2:</b> The <b>distance tool</b> can be used:</p> <ul style="list-style-type: none"> <li>• when the front shaft is replaced</li> <li>• when the spherical bearing at the front shaft is replaced</li> <li>• during service work on axis 2.</li> </ul>

*Continues on next page*

## 4.5.4.2 Replacing balancing device (design 2)

Continued

Action	Note
7 <b>Method 1:</b> <i>Unload</i> the balancing device with the <i>press tool</i> in order to make the piston rod and front ear adjustable when pulling the shaft out.	Described in section <a href="#">Unloading the balancing device using hydraulic press tool on page 327</a>
8 <b>Method 2:</b> <i>Unload</i> the balancing device with the <i>distance tool</i> in order to make the piston rod and front ear adjustable when pulling the shaft out.	Described in section <a href="#">Unloading the balancing device using distance tool on page 321</a>
9  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
10 Remove the <i>protection plug</i> covering the shaft in the center of the front eye of the piston rod shaft.	Cleanroom robots:  Note The protection plug used in Cleanroom applications must also be refitted after the refitting of the balancing device! Do not loose it!
11 Remove the hex socket head cap screw M16x70 securing the front eye of the piston rod shaft.	

Continues on next page

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

*Continued*

Action	Note
12 Remove the front shaft using the <i>dismantle and mounting tool</i> .	<p>For art. no. see:        • <a href="#">Required equipment - tools etc. on page 308</a>        See section: <a href="#">Dismounting and mounting tool 3HAC028920-001 on page 459</a>.</p> <p>xx0900000080</p> <ul style="list-style-type: none"> <li>• A: Protection plug</li> <li>• B: Hex socket head cap screw M16x70</li> <li>• C: Washer</li> <li>• D: Front shaft</li> <li>• E: Press tool or Distance tool</li> </ul>
13 Remove the <i>VK cover</i> in order to reach the <i>shafts</i> holding the balancing device. Hit the VK-cover at the bottom part of it with a hammer or similar and tilt it out	<p> Note        It is almost impossible to remove the VK-cover without damage. New VK-covers are needed.</p>
14 Remove the <i>hex socket head cap screw M16x70</i> securing the shaft.	<p>See the figure in:        • <a href="#">Location of parts in maintenance sets, cradle and shaft on page 307</a></p>
15 Wipe off all residual grease inside the hole.	
16 Remove the <i>retaining ring, bore</i> securing the shaft and bearing.	<p>xx0900000079</p> <ul style="list-style-type: none"> <li>• A: Retaining ring, bore</li> </ul>

*Continues on next page*

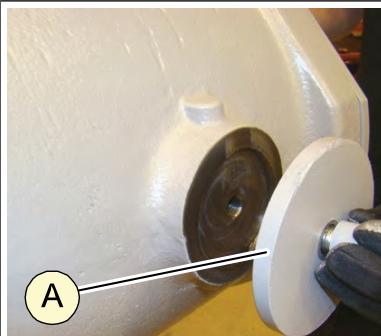
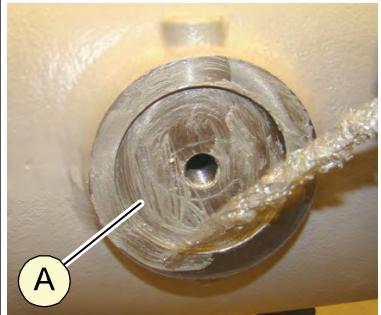
## 4.5.4.2 Replacing balancing device (design 2)

Continued

Action	Note
17 Remove both rear shaft units using the <i>dismounting and mounting tool</i> . For tool configuration see section: <i>Removal rear shafts Design 1 and 2 on page 471</i>	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 308</a></li> </ul>  xx0900000074
18 Remove the balancing device.	

**Preparation of the spare part**

Use this procedure for the preparation of the spare part.

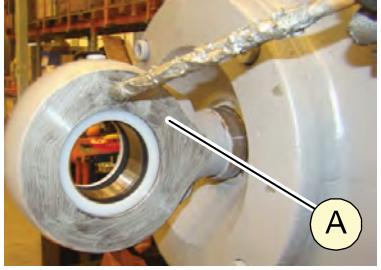
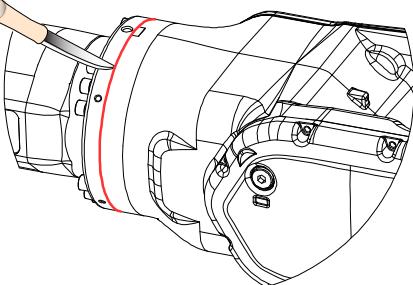
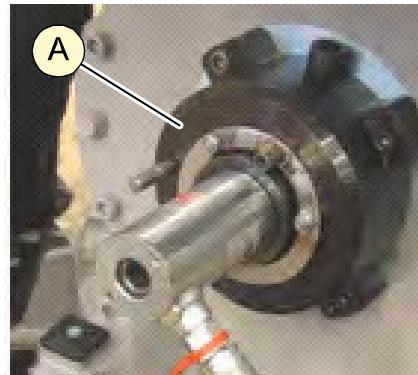
Action	Note
1 Remove the <i>transport protection</i> at the location of the rear shafts.	 xx1000000627 <ul style="list-style-type: none"> <li>• A: Transport protection</li> </ul>
2 Apply <i>rust protection (Mercasol)</i> on the machined surface.	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 309</a></li> </ul>  xx1000000628 <ul style="list-style-type: none"> <li>• A: Mercasol</li> </ul>

*Continues on next page*

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

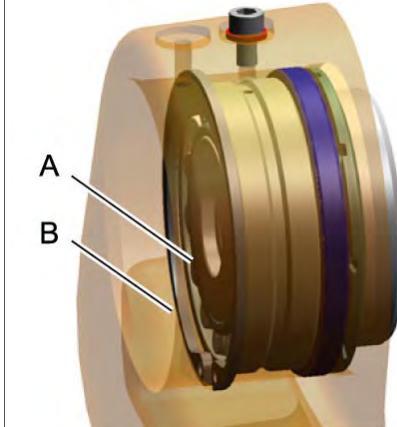
*Continued*

Action	Note
3 Apply <i>rust protection (Mercasol)</i> on the machined surfaces of the piston rod ear.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <i>Additional equipment - Foundry Prime on page 309</i></li> </ul>  <p>xx1000000629</p> <ul style="list-style-type: none"> <li>• A: Mercasol</li> </ul>
4 Cut the paint with a knife in the joint between the <i>rear cover</i> and the <i>balancing unit housing</i> .	<p>The figure shows the principal method.</p>  <p>xx0900000121</p>
5 Remove the cover with the air nipple.	<p> Note</p> <p>Keep the cover for refitting on the new balancing unit.</p>
6 Fit the <i>press tool</i> , <i>balancing device</i> and unload the balancing device. See section <ul style="list-style-type: none"> <li>• <i>Unloading the balancing device using hydraulic press tool on page 327</i></li> </ul>	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <i>Required equipment - tools etc. on page 308</i></li> </ul>  <p>xx1000000630</p> <ul style="list-style-type: none"> <li>• A: Press tool, balancing device</li> </ul>

*Continues on next page*

### Refitting balancing device, Design 2

Use this procedure to refit the balancing device, design 2.

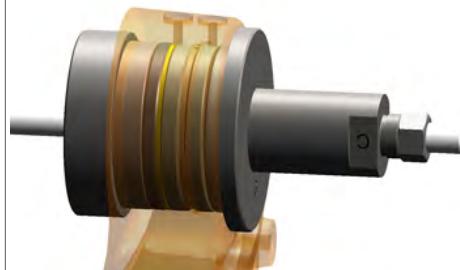
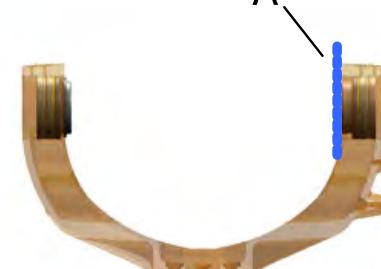
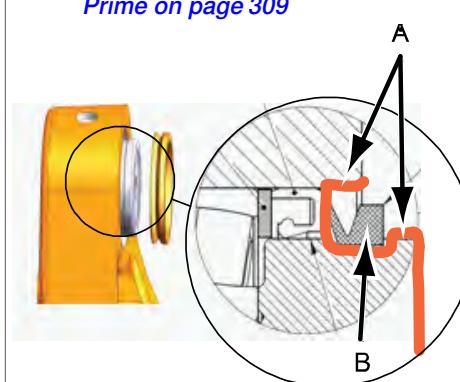
	Action	Note
1	Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2	Clean the machined holes in the cradle and lubricate with grease.	
3	Refit one of the two <i>retaining rings</i> .	Use new parts (maintenance parts cradle).
4	<p>Use the <i>dismantle and mounting tool</i> and refit new rear shaft units in both locations.</p> <p> Note</p> <p>Adjust the shaft unit in order to get one of the lubrication holes in the bearing facing downwards in the cradle!</p>	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 308</a></li> </ul> <p>How to use the tool, see section: <a href="#">Dismantling and mounting tool 3HAC028920-001 on page 459</a>.</p>  <p>xx0900000061</p> <ul style="list-style-type: none"> <li>• A: Lubrication hole facing down</li> <li>• B: Cradle</li> </ul>
5	On the side where the <i>retaining ring, bore</i> is fitted, the <i>rear shaft unit</i> shall be pressed against the retaining ring, bore.	 <p>xx0900000084</p> <ul style="list-style-type: none"> <li>• A: Rear shaft unit</li> <li>• B: Retaining ring, bore</li> </ul>

Continues on next page

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

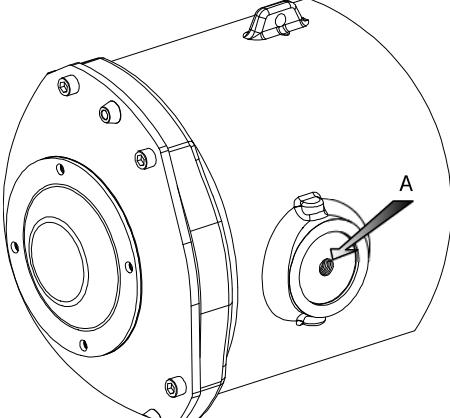
*Continued*

Action	Note
6 On the side where the retaining ring, bore is <i>not</i> fitted, refit the rear shaft unit completely into the frame.	 xx0900000085
7 The rear shaft unit to the right shows a correct fitting.	 xx0900000083
8 <b>Foundry Prime robots:</b> Apply <i>rust preventive (Mercasol)</i> on the shaft journals and on the unpainted surfaces in the holes.   <b>Note</b>  Use a thin layer of Mercasol 3106 on the surface for the position of the <i>sealing ring</i> .	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 309</a></li> </ul>  xx1000000558 <ul style="list-style-type: none"> <li>• A: Surfaces where Mercasol is applied</li> <li>• B: Sealing ring</li> </ul>

*Continues on next page*

## 4.5.4.2 Replacing balancing device (design 2)

Continued

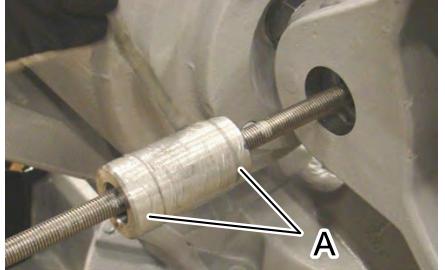
	Action	Note
9	Fit new <i>radial sealings</i> on both shafts.   <b>Note</b>  The radial sealings are not used in Cleanroom applications.	 xx0900000093
10	Fit the <i>lifting tool</i> to the balancing device.	For art. no. see: <ul style="list-style-type: none"> <li>Required equipment - tools etc. on page 308</li> </ul>  xx0900000094 <p> <b>CAUTION</b></p> <p>The balancing device weighs 210 kg! All lifting equipment used must be sized accordingly!</p>
11	Use Loctite 577 on the threads in the balancing device in order to seal the hole.   <b>Note</b>  This procedure eliminates the risk to get Loctite in the M20 threads on the shaft end. The M20 thread is used by the dismantling tool.	 xx0900000088 <ul style="list-style-type: none"> <li>A: Loctite 577</li> </ul>

Continues on next page

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

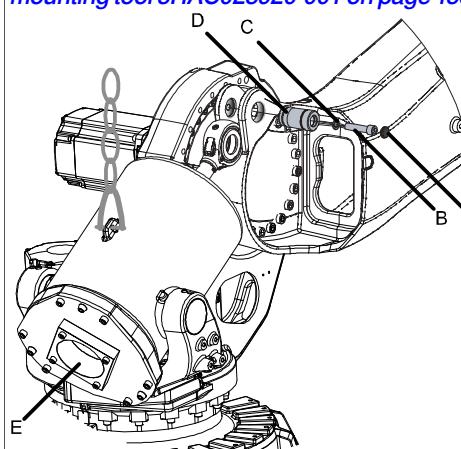
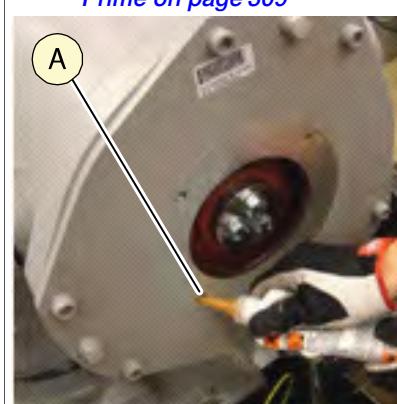
*Continued*

Action	Note
12 Perform the following procedure of refitting the shafts on both sides of the cradle before refitting of the shaft at the piston rod shaft front eye.	
13 Lift the balancing device in to the cradle.	
14 Fit the balancing device on the side where the shaft is in final position and fix it lightly using the hex socket head cap screw M16x70 quality 8.8 steel.	
15 On the other side, use the hex socket head cap screw M16x70 quality 8.8 steel, to refit the rear shaft unit to its final position.	
16 Lock the shaft unit by fitting the retaining ring, bore.	 xx0900000089
17 Secure both M16x70 screws.	Tightening torque: 300 Nm
18 Fit new VK- covers on both sides.	
19 Apply <i>rust preventive (Mercasol)</i> on the front shaft.	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 309</a></li> </ul>  xx1000000559 <ul style="list-style-type: none"> <li>• A: Mercasol</li> </ul>

*Continues on next page*

## 4.5.4.2 Replacing balancing device (design 2)

Continued

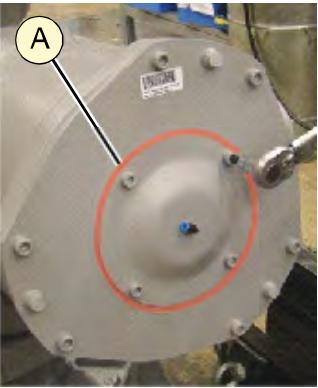
	Action	Note
20	<p>Refit the front shaft using the <b>dismantle and mounting tool</b>.</p> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>• Apply rust preventive (Mercasol) on the shaft.</li> </ul>	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 308</a></li> </ul> <p>Described in section <a href="#">Dismantling and mounting tool 3HAC028920-001 on page 459</a>.</p>  <p>xx0900000080</p> <ul style="list-style-type: none"> <li>• A: Protection plug</li> <li>• B: Hex socket head cap screw M16x70</li> <li>• C: Washer</li> <li>• D: Shaft</li> <li>• E: Press tool or Distance tool</li> </ul>
21	Refit the hex socket head cap screw M16x70 quality 8.8 steel. Use Loctite 2701.	Tightening torque: 200 Nm.
22	Restore the balancing device in one of the methods.	<p><b>Method 1:</b> Described in section <a href="#">Restoring the balancing device using a hydraulic press tool on page 330</a></p> <p><b>Method 2:</b> Described in section <a href="#">Restoring the balancing device using distance tool on page 325</a>.</p>
23	Apply Loctite 577 in the attachment holes of the cover.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 309</a></li> </ul>  <p>xx1000000631</p> <ul style="list-style-type: none"> <li>• A: Loctite 577 in holes (4 pcs)</li> </ul>

Continues on next page

## 4 Repair

### 4.5.4.2 Replacing balancing device (design 2)

*Continued*

	Action	Note
24	If the balancing device is reused, check that the gasket on the cover is not damaged.	
25	Fit the old cover with the air nipple	
26	Apply <i>rust preventive (Mercasol)</i> around the edge of the cover as a protection of the broken paint layers.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 309</a></li> </ul>  <p>xx1000000632</p> <ul style="list-style-type: none"> <li>• A: Mercasol</li> </ul>
27	Fill the cradle bearings with 70 ml, Optimol PDO.  <span style="background-color: #0070C0; color: white; padding: 2px 10px; border-radius: 5px;">i</span> <b>Note</b>  The <i>inner hole</i> is used for lubrication. The <i>outer hole</i> is used for air outlet.	 <p>xx0900000090</p>
28	Fill the spherical roller bearing at the front shaft with 20 ml, Optimol PDO.  <span style="background-color: #0070C0; color: white; padding: 2px 10px; border-radius: 5px;">i</span> <b>Note</b>  Open the ventilation screw M6 at the opposite side of the link ear. Refit the M6 screw with sealing washers.	 <p>xx0900000102</p>
29	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

## 4.5.4.3 Unloading the balancing device using distance tool

**4.5.4.3 Unloading the balancing device using distance tool****Overview**

This section details how to unload the balancing device using a distance tool 3HAC030662-001. This method is used when the balancing device is reusable.

**DANGER**

There is a high tensioned spring inside the balancing device, incorrect handling may cause injuries and damage property.

**DANGER**

Do not remove the distance tool from a dismounted balancing device.

*Continues on next page*

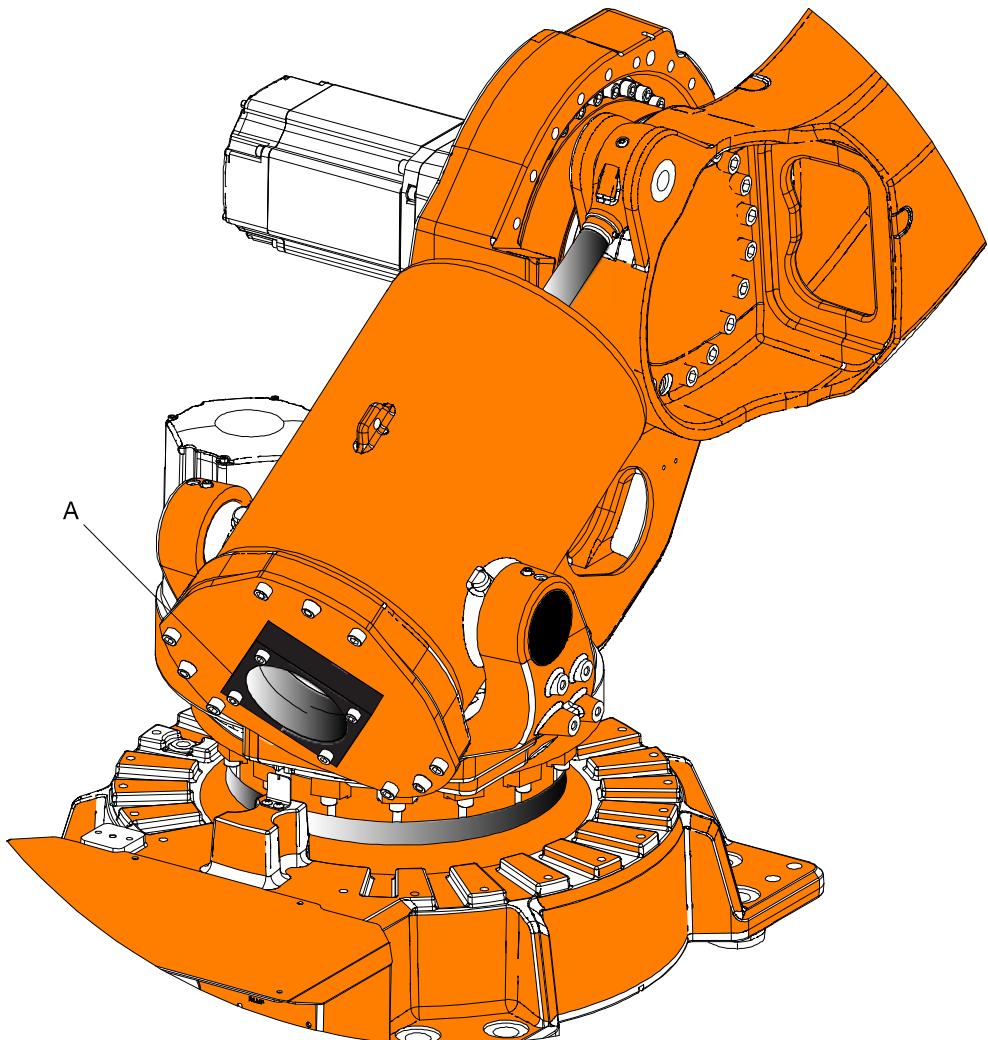
## 4 Repair

### 4.5.4.3 Unloading the balancing device using distance tool

*Continued*

---

#### Distance tool



xx0800000478

A

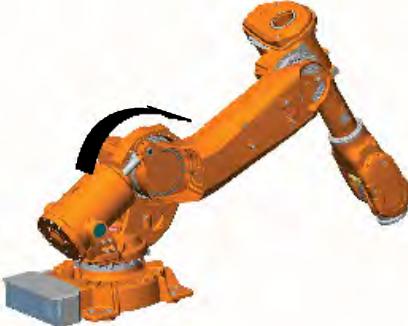
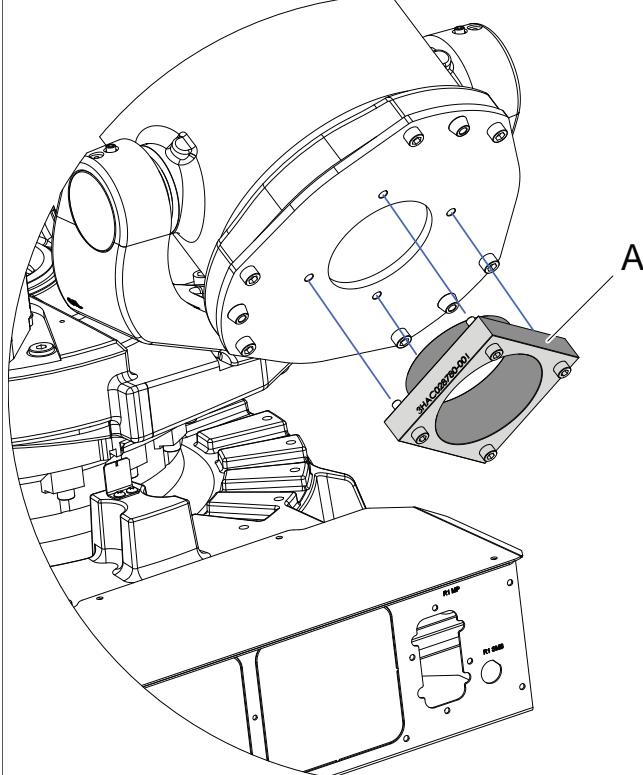
Distance tool 3HAC030662-001

---

*Continues on next page*

4.5.4.3 Unloading the balancing device using distance tool  
*Continued*

**Unloading procedure**

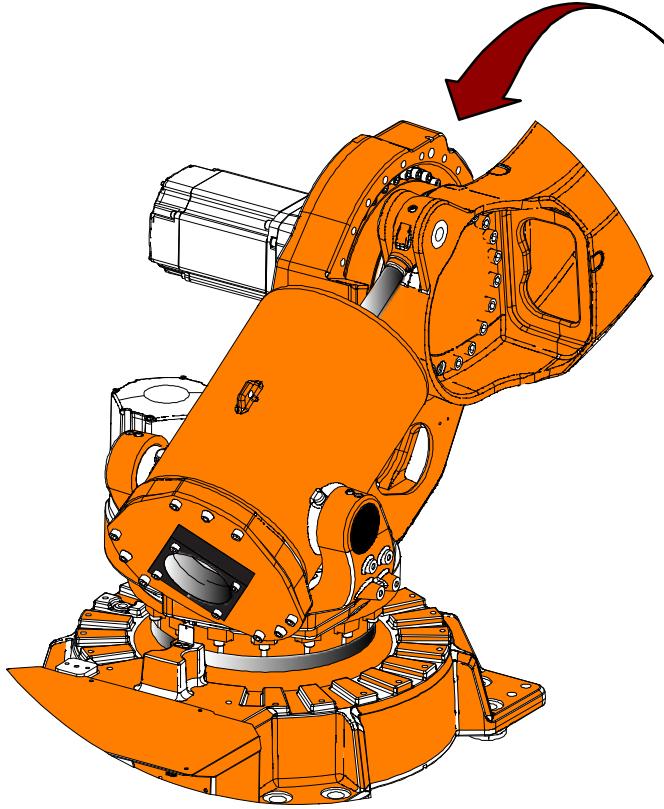
	Action	Note/Illustration
1	Jog the robot lower arm to a maximal forward position.	 xx0800000479
2	Remove the cover plate on the back of the balancing device.	
3	Fit the <i>distance tool</i> on the back of the balancing device using the four screws.	 xx0800000480 <ul style="list-style-type: none"> <li>• A . Distance tool</li> </ul>

*Continues on next page*

## 4 Repair

### 4.5.4.3 Unloading the balancing device using distance tool

*Continued*

Action	Note/Illustration
4 Jog the robot lower arm backward to calibration position (0°).	 xx0800000481

## 4.5.4.4 Restoring the balancing device using distance tool

## 4.5.4.4 Restoring the balancing device using distance tool

**DANGER**

There is a high tensioned spring inside the balancing device, incorrect handling may cause injuries and damage property.

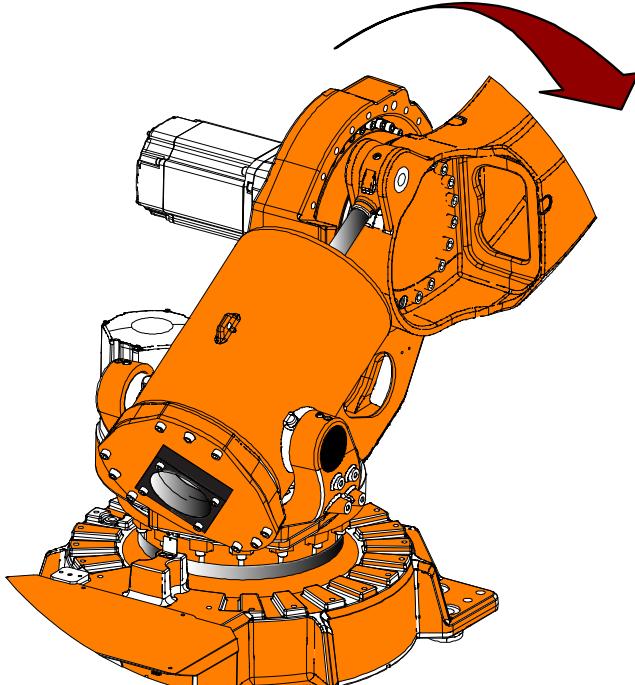
**DANGER**

Do not remove the distance tool 3HAC030662-001 from a dismounted balancing device.

**Required equipment**

Equipment	Spare part no.	Art. no.	Note
End Cover Gasket	See Spare parts		To be replaced if damaged!
Distance tool		3HAC030662-001	For unloading and restoring the balancing device, (Method 2)
Standard toolkit			
Loctite 577			
Sikaflex 521FC			

**Restoring procedure**

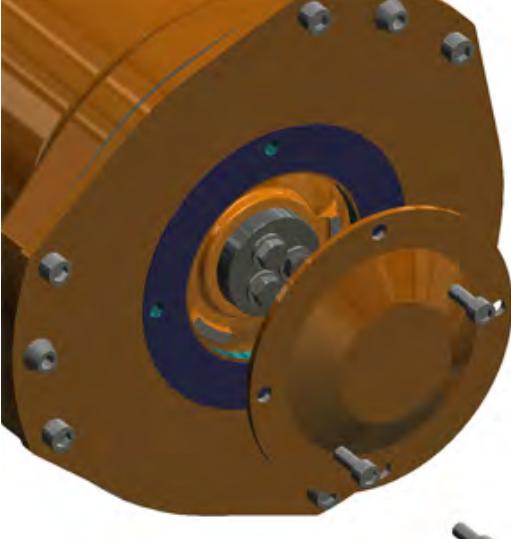
	Action	Note/Illustration
1	Jog the lower arm forward to release the pressure from the distance tool.	 xx0800000482

*Continues on next page*

## 4 Repair

### 4.5.4.4 Restoring the balancing device using distance tool

*Continued*

	Action	Note/Illustration
2	Remove the distance tool.	
3	Fit a new end cover gasket if needed.	
4	Fit the cover on the back of the cylinder with the four screws.	<p>Apply Sikaflex 521FC on the end cover gasket.</p>  <p>xx0900000104</p>
5	Use Loctite 577 on the four screws.	<b>Tightening torque 47Nm</b>

## 4.5.4.5 Unloading the balancing device using hydraulic press tool

**4.5.4.5 Unloading the balancing device using hydraulic press tool****Prerequisite**

This section details how to unload the balancing device using the hydraulic press tool.

The lower arm must be secured before unloading the balancing device! How to secure the lower arm is detailed in the current repair activity, for example removal of the balancing device.

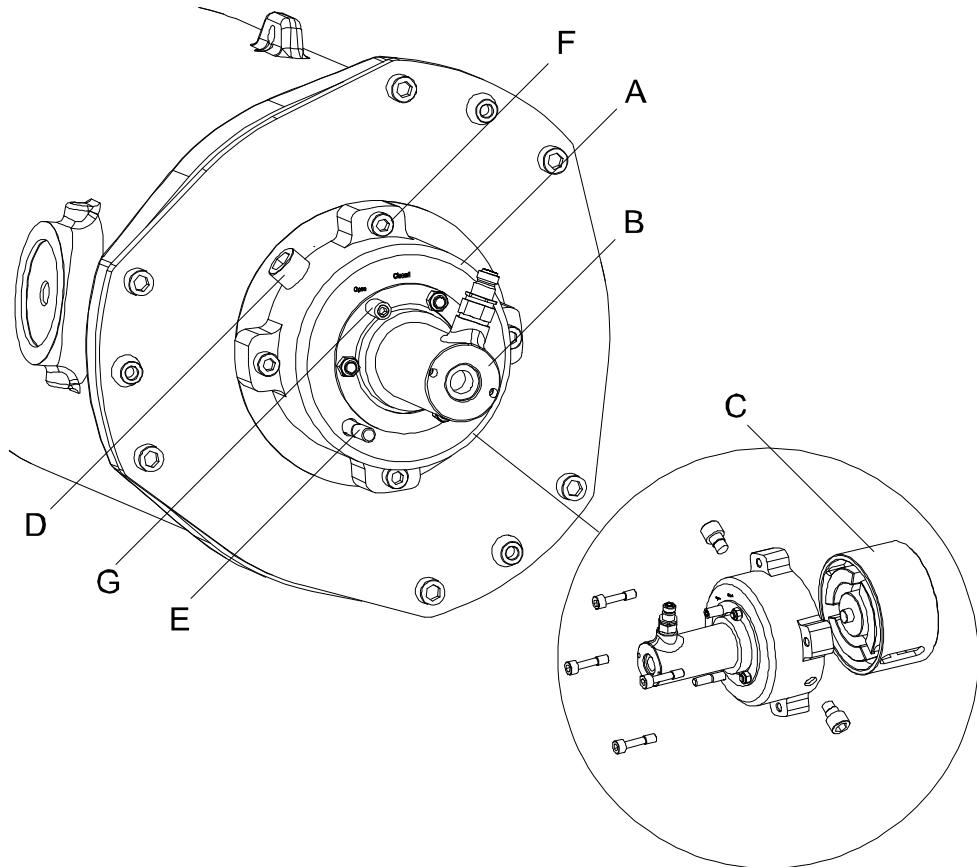
**DANGER**

There is a high tensioned spring inside the balancing device, incorrect handling may cause injuries and damage property.

**Press tool and hydraulic cylinder**

The figure below shows the hydraulic cylinder mounted on the press tool.

The press tool includes two press devices that are used to different models of the balancing device.



xx0200000174

A	Press block
B	Hydraulic cylinder

*Continues on next page*

## 4 Repair

### 4.5.4.5 Unloading the balancing device using hydraulic press tool

*Continued*

C	Press device
D	Bolt, press device
E	Moving pin with marking
F	Bolt (4 pcs)
G	Pin, attached to the fix plate

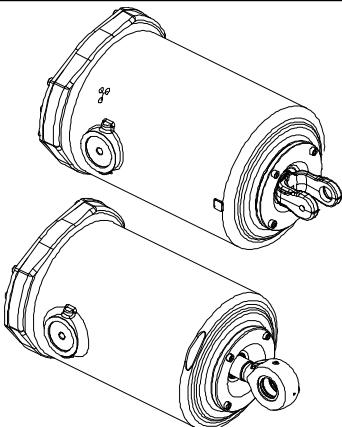
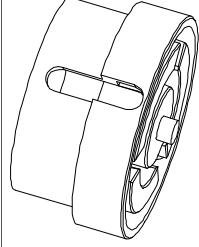
#### Required equipment

Equipment, etc.	Art. no.	Note
Press tool, balancing device	3HAC020902-001	Includes <ul style="list-style-type: none"><li>• press device 3HAC15767-2</li><li>• press device 3HAC18100-1</li></ul> Choose the correct device, depending on model of balancing device.
Hydraulic cylinder	3HAC11731-1	To be used with the press tool.
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with the hydraulic cylinder.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .

#### Using the correct press device

The different designs of the balancing device require different versions of the press device, included in the complete press tool. The table below specifies which press device to use to which balancing device.

The article number of the balancing device may be found on a label at the rear of the balancing device.

Balancing device	Press device
 xx0700000475	Art. no: 3HAC18100-1  xx0300000599

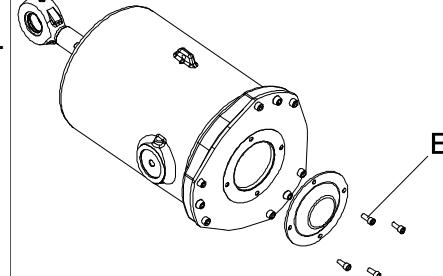
*Continues on next page*

## 4.5.4.5 Unloading the balancing device using hydraulic press tool

Continued

**Unloading the balancing device**

The procedure below details how to use the press tool in order to unload the balancing device. How to remove the press tool, is detailed in section [Restoring the balancing device using a hydraulic press tool on page 330](#).

Action	Note
1 Fit the <i>moving pin</i> to the current press device.	Choose the correct press device, according to the table <a href="#">Using the correct press device on page 328</a> . The moving pin is shown in the figure <a href="#">Press tool and hydraulic cylinder on page 327</a> .
2 Fit the correct press device and moving pin to the press tool. Secure with the <i>bolt</i> , <i>press device</i> .   <b>Note</b>  Make sure the bolt is secured properly!	Shown in the figure <a href="#">Press tool and hydraulic cylinder on page 327</a> .
3 Remove the <i>rear cover</i> of the balancing device, by unscrewing the <i>attachment screws</i> .   <b>DANGER</b>  DO NOT! remove any other screws than the rear cover attachment screws.	 xx0700000422 <ul style="list-style-type: none"> <li>E: Rear cover attachment screws, 4 pcs</li> </ul>
4 Fit the <i>press tool</i> to the rear of the balancing device with enclosed <i>bolts</i> . Tighten them properly!	Art. no. is specified in <a href="#">Required equipment on page 328</a> . See the figure <a href="#">Press tool and hydraulic cylinder on page 327</a> .
5 Fit the <i>hydraulic cylinder</i> to the press tool.	Art. no. is specified in <a href="#">Required equipment on page 328</a> . See the figure <a href="#">Press tool and hydraulic cylinder on page 327</a> .
6 Connect the <i>hydraulic pump</i> to the cylinder.	Art. no. is specified in <a href="#">Required equipment on page 328</a> .
7 Increase the pressure and press until the marking on the <i>moving pin</i> indicates the correct position (in level with the pressure block).	See the figure <a href="#">Press tool and hydraulic cylinder on page 327</a> . Do not apply more pressure than necessary, it could damage bearings and sealings at the shaft.
8 Turn the <i>fix plate</i> to position "Closed" in order to lock the tool in loaded condition.	See the figure <a href="#">Press tool and hydraulic cylinder on page 327</a> .
9 Unload the hydraulic cylinder.	
10 The hydraulic cylinder may now be removed from the tool, when necessary.	

## 4 Repair

### 4.5.4.6 Restoring the balancing device using a hydraulic press tool

#### Overview

This section details how to restore the balancing device and how to remove the press tool from the device.



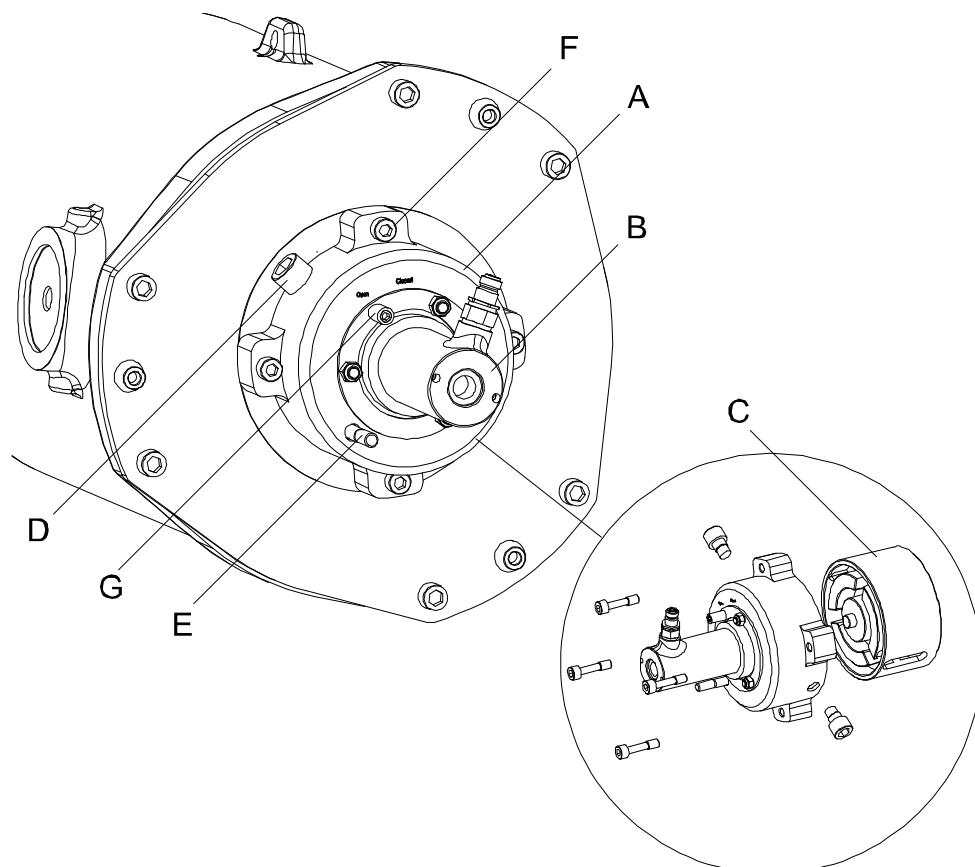
#### DANGER

There is a high tensioned spring inside the balancing device, incorrect handling may cause injuries and damage property.

#### Press tool and hydraulic cylinder

The figure below shows the hydraulic cylinder mounted on the press tool.

The press tool includes two press devices that are used to different models of the balancing device.



xx0200000174

A	Press block
B	Hydraulic cylinder
C	Press device
D	Bolt, press device
E	Moving pin with marking

Continues on next page

## 4.5.4.6 Restoring the balancing device using a hydraulic press tool

*Continued*

F	Bolt (4 pcs)
G	Pin, attached to the fix plate

**Required equipment**

Equipment, etc.	Art. no.	Note
Hydraulic cylinder	3HAC11731-1	To be used with press tool.
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with hydraulic cylinder.
Brush	-	
Rust preventive	3HAC026621-001	Equivalent: • Mercasol
Locking liquid	-	Loctite 577 Used to secure the attachment screws of the rear cover at the end of the balancing device.
Standard toolkit	3HAC15571-1	Content is defined in section <a href="#">Standard tools on page 455</a> .
Sikaflex 521FC		

**Restoring the balancing device**

The procedure below details how to restore the balancing device, that is removing the press tool.

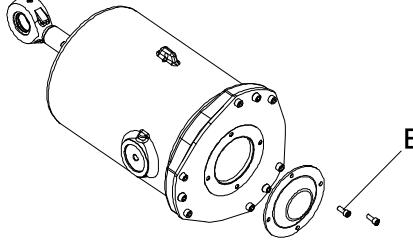
	Action	Note
1	Refit the <i>hydraulic cylinder</i> to the press tool, in case it has been removed.	Shown in the figure <a href="#">Press tool and hydraulic cylinder on page 330</a> .
2	Press with the cylinder and the hydraulic pump until the <i>fix plate</i> is movable again. Turn the pin on the fix plate to position "Open".	Shown in the figure <a href="#">Press tool and hydraulic cylinder on page 330!</a> Do not apply more pressure than necessary, it could damage bearings and sealings at the shaft.
3	Unload the hydraulic cylinder and make sure the <i>moving pin</i> indicates that the tool has returned to its starting position.	Shown in the figure <a href="#">Press tool and hydraulic cylinder on page 330!</a>
4	Remove the hydraulic cylinder.	
5	Remove the press tool by unscrewing the <i>bolts</i> .	Shown in the figure <a href="#">Press tool and hydraulic cylinder on page 330!</a>
6	Refit the gasket to the rear of the balancing device.	

*Continues on next page*

## 4 Repair

### 4.5.4.6 Restoring the balancing device using a hydraulic press tool

*Continued*

Action	Note
7 Refit the rear cover to the balancing device with its attachment screws, using locking liquid. Apply sikaflex 521FX on the cover.	 xx0700000422 <ul style="list-style-type: none"><li>E: 4 pcs: M10x30, tightening torque: 50 Nm.</li></ul> <p>Locking liquid is specified in <a href="#">Required equipment on page 331</a>.</p>
8  <b>DANGER</b> The rear cover of the balancing device is a safety device for the piston rod during operation! Make sure the cover is properly secured before commissioning of the robot!	

## 4.6 Motors

### 4.6.1 Replacing motor axis 1



#### Note

This procedure requires calibration of the robot.

Use the Calibration Pendulum tool 3HAC15716-1.

#### Introduction

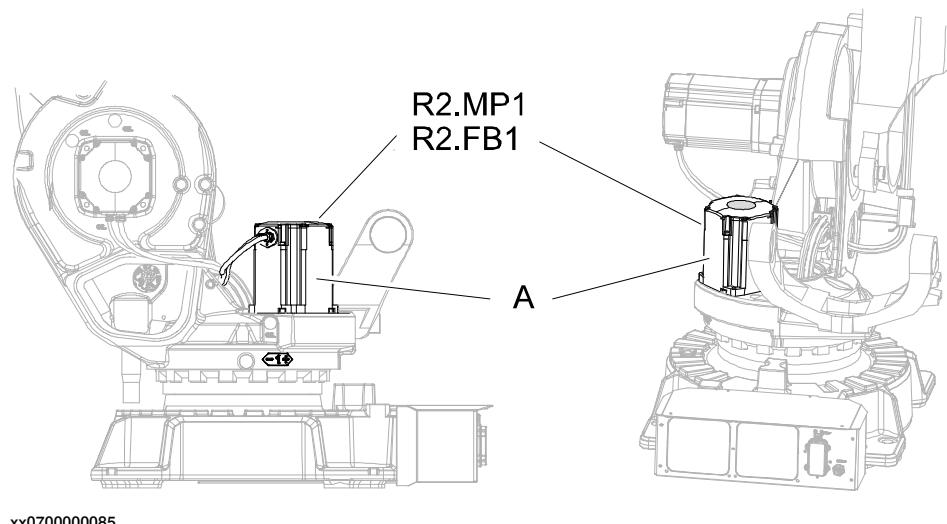
This section describes how to replace motor axis 1.

The section consists of these parts:

- [Removing motor axis 1 on page 334](#)
- [Preparation of the frame before fitting the new motor axis 1 on page 336](#)
- [Refitting motor axis 1 on page 337](#)
- [Connecting motor axis 1 on page 338](#)
- [Refitting the concluding parts on page 339](#)

#### Location of motor axis 1

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



#### Required parts

Part	Spare part no.	Note
Motor axis 1	See chapter: • <i>Spare parts</i>	Includes: • motor • pinion • o-ring

*Continues on next page*

## 4 Repair

### 4.6.1 Replacing motor axis 1

Continued

Part	Spare part no.	Note
O-ring	21522012-430	Must be replaced when refitting the motor.
Gasket	3HAC3438-1	Must be replaced when reassembling the motor.

#### Required equipment - tools etc.

Equipment	Art. no.	Note
Grease	3HAB3537-1	Used to lubricate the o-ring.
Removal tool motor M12x	3HAC14631-1	Always use removal tools in pairs!
Lifting tool, motor axis 1, 4 , 5	3HAC14459-1	
Extension 300 mm for bits 1/2"	3HAC12342-1	
Power supply	-	24 VDC, max. 1.5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit which also includes user manual.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	See <i>Circuit diagram</i> .	

#### Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush	-	

#### Removing motor axis 1

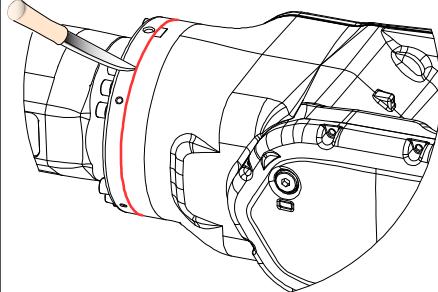
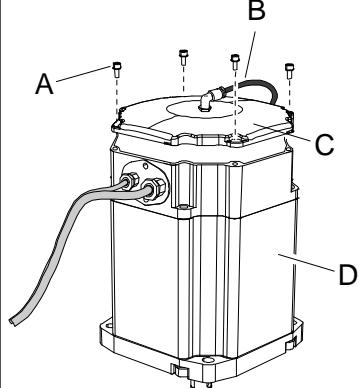
Use this procedure to remove motor axis 1.

	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></ul> to the robot, before entering the robot working area.	

Continues on next page

## 4.6.1 Replacing motor axis 1

Continued

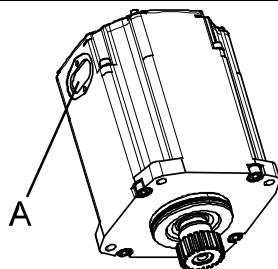
Action	Information
2  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3 Cut the paint with a knife in the joint between the motor and the structure in order to avoid that the paint cracks.	The figure shows the principal method.  xx0900000121
4 Remove the cover for connector access on top of the motor.	The figure shows a Foundry Prime motor.  xx0600002874 <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Attachment screws (4 pcs)</li> <li>• B: Air hose (only Foundry Prime)</li> <li>• C: Cover</li> <li>• D: Motor</li> </ul>
5 <b>Foundry Prime robots:</b>  <b>Note</b> Keep the old cover, with the air nipple fitted.	

Continues on next page

## 4 Repair

### 4.6.1 Replacing motor axis 1

*Continued*

Action	Information
6 Remove the <i>cable gland cover</i> at the cable exit on the motor.	 xx0200000199 <ul style="list-style-type: none"> <li>Part:</li> <li>• A: (Position of) Cable gland cover</li> </ul>
7 Disconnect all connectors in motor axis 1.	
8 Apply the <i>lifting tool, motor axes 1, 4, 5</i> to the motor.	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 334</a></li> </ul>
9 To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP1: <ul style="list-style-type: none"> <li>• + = pin 2</li> <li>• - = pin 5</li> </ul>	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 85</a></li> </ul>
10  <b>CAUTION</b>  The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
11 Unscrew the <i>attachment screws and washers</i> of the motor and lift it in order to get the pinion away from the gear.	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of motor axis 1 on page 333</a></li> </ul>
12 Disconnect the 24 VDC power supply.	
13 Remove the motor by carefully lifting it straight up.	

#### Preparation of the frame before fitting the new motor axis 1

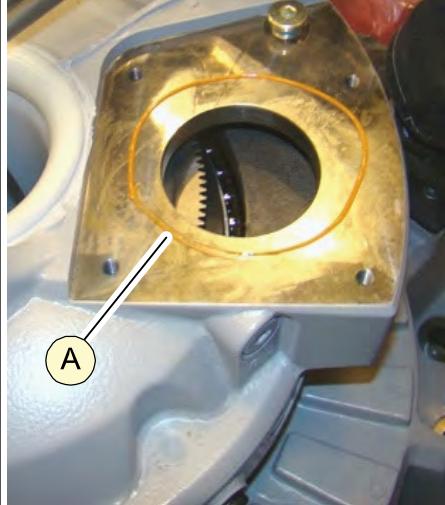
Use this procedure for the preparation of the frame before refitting motor axis 1.

Action	Note
1 Grind the paint on the surface carefully to get a smooth surface.	
2 Clean the surface from contamination such as oil and dirt.	

*Continues on next page*

## 4.6.1 Replacing motor axis 1

Continued

Action	Note
3 Apply <i>Loctite 574</i> on the surface as shown in the figure.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <i>Additional equipment - Foundry Prime on page 334</i></li> </ul>  <p>xx1000000560</p> <p>Part:</p> <ul style="list-style-type: none"> <li>• A: Loctite 574</li> </ul>

**Refitting motor axis 1**

Use this procedure to refit motor axis 1.

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> </ul> to the robot, before entering the robot working area.	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lubricate the o-ring with some grease.	For art. no. see: <ul style="list-style-type: none"> <li>• <i>Required parts on page 333</i></li> </ul>
3  <b>CAUTION</b> The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
4 Apply the <i>lifting tool, motor axes 1, 4, 5</i> to the motor.	For art. no. see: <ul style="list-style-type: none"> <li>• <i>Required equipment - tools etc. on page 334</i></li> </ul>
5 In order to release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP1: <ul style="list-style-type: none"> <li>• + = pin 2</li> <li>• - = pin 5</li> </ul>	See section <ul style="list-style-type: none"> <li>• <i>Manually releasing the brakes on page 85</i></li> </ul>

*Continues on next page*

## 4 Repair

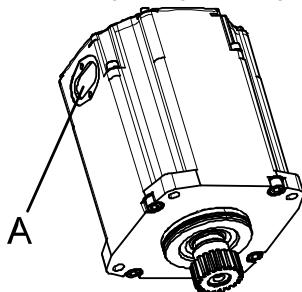
### 4.6.1 Replacing motor axis 1

*Continued*

Action	Note
6 Lower the motor into position, making sure that: <ul style="list-style-type: none"> <li>• the motor pinion is properly mated to the gear of gearbox of axis 1</li> <li>• the motor pinion does not get damaged</li> <li>• the motor is turned the correct way as shown in the figure in <a href="#">Location of motor axis 1 on page 333</a>.</li> </ul>	
7 Secure the motor with its <i>attachment screws</i> and washers. Tightening torque: 50 NM.	M10x40 4 pcs
8 Disconnect the 24 VDC power supply.	

#### Connecting motor axis 1

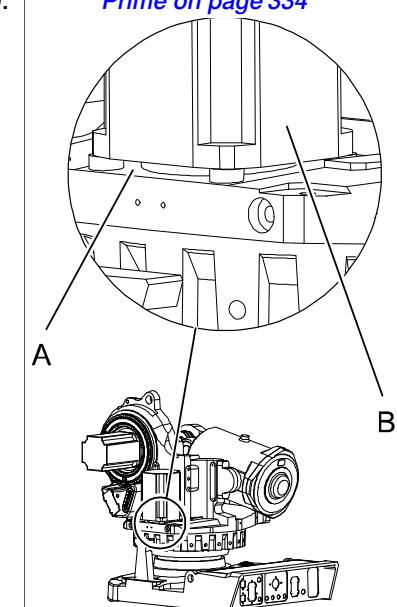
Use this procedure to connect motor axis 1.

Action	Note
1 Fit a new <i>gasket</i> on the cable gland.	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Required parts on page 333</a></li> </ul>  <p>xx0200000199</p> <p>Part:</p> <ul style="list-style-type: none"> <li>• A: (Position of) Cable gland cover.</li> </ul>
2 Reconnect all connectors of motor axis 1.	Connect in accordance with markings on connectors.
3 Refit the <i>cable gland cover</i> at the cable exit with its attachment screws.	Make sure the cover is tightly sealed.
4 Refit the motor cover with its attachment screws.	Make sure the cover is tightly sealed.

*Continues on next page*

### Refitting the concluding parts

Use this procedure to refit the concluding parts.

	Action	Note
1	After fitting motor axis 1 on the robot, the surface between motor and base must be protected with <i>rust preventive (Mercasol)</i> .	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <i>Additional equipment - Foundry Prime on page 334</i></li> </ul>  <p>xx0600002877</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Mercasol on surface between motor and base</li> <li>• B: Motor axis 1</li> </ul>
2	Clean and paint the joints that have been opened. See <i>Replacing parts on the robot on page 215</i>	
3	Perform an air leak test.	<p>See section</p> <ul style="list-style-type: none"> <li>• <i>Inspection of air hoses (Foundry Prime) on page 151</i></li> </ul>
4	Recalibrate the robot.	<p>Calibration is detailed in a separate calibration manual enclosed with the calibration tools.</p> <p>General calibration information is included in section <i>Calibration information on page 431</i>.</p>
5	 <b>DANGER</b> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48</i>.</p>	

## 4 Repair

### 4.6.2 Replacing motor axis 2

#### 4.6.2 Replacing motor axis 2

##### Introduction

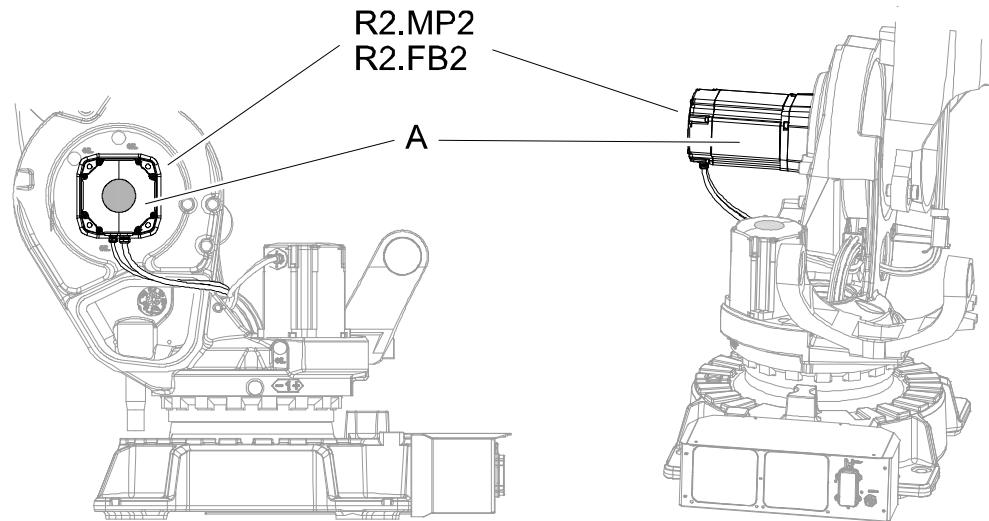
This section describes how to replace motor axis 2.

The section consists of these parts:

- [Removing motor axis 2 on page 342](#)
- [Preparation of the frame before fitting a new motor on page 344](#)
- [Refitting motor axis 2 on page 345](#)
- [Connecting motor axis 2 on page 346](#)
- [Refitting the concluding parts on page 347](#)

##### Location of motor axis 2

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



xx0700000086

A	Motor axis 2
---	--------------

##### Required parts

Equipment	Spare part no.	Note
Motor axis 2	See chapter: • <i>Spare parts</i>	Includes: • motor • pinion • o-ring
O-ring	21522012-430	Must be replaced when reassembling the motor.

Continues on next page

Equipment	Spare part no.	Note
Gasket	3HAC3438-1	Must be replaced if the cabling is dismantled from the motor.

**Required equipment - tools etc.**

Equipment	Art. no.	Note
Grease	3HAB3537-1	For lubricating the o-ring.
Locking screw	3HAA1001-266	M16x60 For securing the lower arm.
Removal tool, motor M12x	3HAC14631-1	Always use the removal tools in pairs.
Guide pins	3HAC15521-2	M10x150 For guiding the motor. Always use guide pins in pairs.
Lifting tool, motor axes 2, 3, 4	3HAC026061-001	
Extension bar for bits 1/2"	3HAC12342-1	300 mm
Power supply	-	24 VDC, max. 1.5 A For releasing the brakes.
Rotation tool	3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with the 24 VDC power supply.
Standard toolkit	-	Content is defined in section <i>Standard tools on page 455</i> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit which also includes user manual.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	See <i>Circuit diagram</i> .	

**Additional equipment - Foundry Prime**

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush	-	

*Continues on next page*

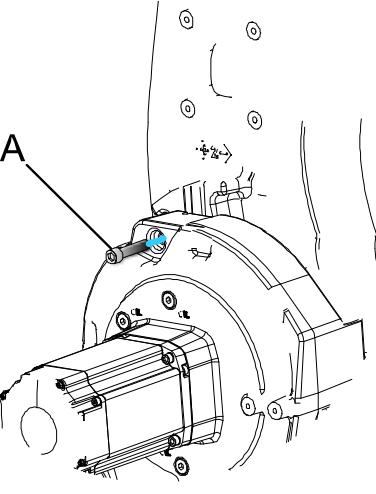
## 4 Repair

### 4.6.2 Replacing motor axis 2

*Continued*

#### Removing motor axis 2

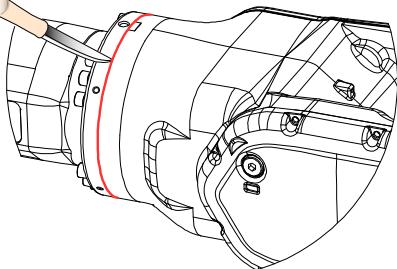
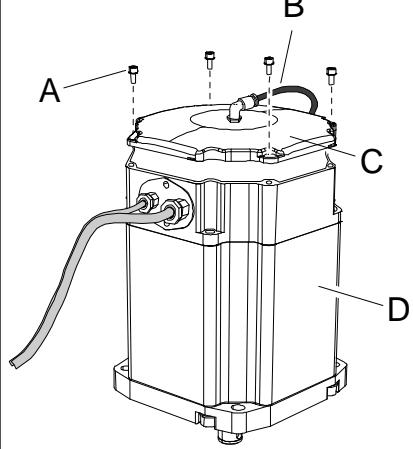
Use this procedure to remove motor axis 2.

	Action	Information
1	<p>Move the robot to a position close to its calibration position to allow the <i>lock screw</i> to be inserted into the hole for lock screw.</p>	 xx0800000249 <p>Part:</p> <ul style="list-style-type: none"> <li>A: Lock screw</li> </ul>
2	<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> </ul> <p>to the robot, before entering the robot working area.</p>	
3	<p> <b>CAUTION</b></p> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a></p>	
4	Lock the lower arm in position by inserting the <i>lock screw</i> into the hole and securing it.	See the figure above! For art. no. and dimension see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 341</a></li> </ul>
5	Drain the oil from gearbox axis 2.	See section <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-2 gearbox on page 169</a></li> </ul>

*Continues on next page*

## 4.6.2 Replacing motor axis 2

Continued

Action	Information
6 Cut the paint layer with a knife in the joint between the motor and the structure to avoid that the paint cracks.	The figure shows the principal method.  xx0900000121
7 Cut the paint layer with a knife in the joint between the <i>cover</i> and the <i>motor housing</i> to avoid the paint layer to crack. See figure below!	
8 Remove the <i>cover</i> of the motor for connector access.	The figure shows a Foundry Prime motor.  xx0600002874 Parts: <ul style="list-style-type: none"> <li>• A: Attachment screws</li> <li>• B: Air hose (only Foundry Prime)</li> <li>• C: Cover</li> <li>• D: Motor</li> </ul>
9  <b>Note</b> Keep the old cover with the air nipple fitted.	
10 Remove the cable gland cover at the cable exit.	Make sure the gasket is not damaged.
11 Disconnect all connectors on motor axis 2.	

Continues on next page

## 4 Repair

### 4.6.2 Replacing motor axis 2

*Continued*

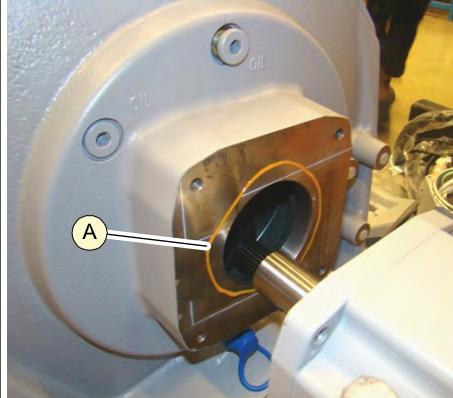
	Action	Information
12	 <b>DANGER</b> Secure the weight of the lower arm properly before releasing the brakes of motor, axis 2! When releasing the holding brakes of the motor, the lower arm will be movable and may fall down!	Use the lock screw to lock the lower arm as described above.
13	To release the brake, connect the 24 VDC power supply. Connect to connector R2.MP2: • + = pin 2 • - = pin 5	See section • <a href="#">Manually releasing the brakes on page 85</a>
14	Remove the attachment screws securing motor axis 2.	
15	Fit <i>guide pins</i> in two of the attachment holes for the motor, opposite each other.	For article number see: • <a href="#">Required equipment - tools etc. on page 341</a>
16	If required, press the motor out of position by fitting the <i>removal tool, motor</i> to the remaining attachment holes for the motor.	For article number see: • <a href="#">Required equipment - tools etc. on page 341</a> Always use the removal tool in pairs.
17	Remove the removal tool motor and fit the <i>lifting tool motor axes 2, 3, 4</i> to the motor.	For article number see: • <a href="#">Required equipment - tools etc. on page 341</a>
18	Remove the motor by carefully lifting it straight up, making sure the motor pinion does not get damaged.	
19	Disconnect the 24 VDC power supply.	

#### Preparation of the frame before fitting a new motor

Use this procedure for the preparation of the frame before fitting motor axis 2.

	Action	Note
1	Grind the paint edge on the surface carefully to get a smooth surface.	
2	Clean the surface from contamination such as oil and dirt.	

*Continues on next page*

Action	Note
3 Apply Loctite 574 on the surface as shown in the figure.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>Additional equipment - Foundry Prime on page 341</li> </ul>  <p>xx1000000561</p> <p>Part:</p> <ul style="list-style-type: none"> <li>A: Loctite 574</li> </ul>

### Refitting motor axis 2

Use this procedure to refit motor axis 2.

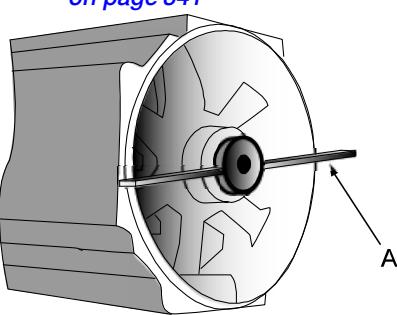
Action	Note
1  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>electric power supply</li> <li>hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lubricate the o-ring with some grease.	For article number see: <ul style="list-style-type: none"> <li><a href="#">Required parts on page 340</a></li> </ul>
4 To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP2: <ul style="list-style-type: none"> <li>+ = pin 2</li> <li>- = pin 5</li> </ul>	See section <ul style="list-style-type: none"> <li><a href="#">Manually releasing the brakes on page 85</a></li> </ul>
5 Fit the <i>lifting tool axes 2, 3, 4</i> to the motor.	For article number see: <ul style="list-style-type: none"> <li><a href="#">Required equipment - tools etc. on page 341</a></li> </ul>
6 Fit two <i>guide pins</i> in the lower motor attachment holes.	For article number see: <ul style="list-style-type: none"> <li><a href="#">Required equipment - tools etc. on page 341</a></li> </ul>

Continues on next page

## 4 Repair

### 4.6.2 Replacing motor axis 2

*Continued*

Action	Note
7 Lift the motor and put it on the guide pins as close as possible without pushing the motor pinion into the gear. Make sure that the motor is turned the right way - that is with cables facing downwards.	
8 Remove the lifting tool and allow the motor to rest on the guide pins.	
9 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it into the gear. When the motor is pushed in position make sure the motor pinion is properly mated to the gear of the gearbox. Be careful not to damage gears in the process.	For article number see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 341</a></li> </ul>  xx0200000165 Part: <ul style="list-style-type: none"> <li>• A: Rotation tool</li> </ul>
10 Remove the guide pins.	
11 Secure the motor with its <i>attachment screws</i> and plain <i>washers</i> . Tightening torque: 50 Nm.	M10x40 4 pcs Reused screws can be used providing they are lubricated as described in section <a href="#">Screw joints on page 451</a> before fitting.
12 Disconnect the 24 VDC power supply.	

### Connecting motor axis 2

Use this procedure to connect all connectors on motor axis 2.

Action	Note
1 Install a new <i>gasket</i> in the cable gland.	For article number see: <ul style="list-style-type: none"> <li>• <a href="#">Required parts on page 340</a></li> </ul>
2 Connect all connectors on motor axis 2.	Connect in accordance with the markings on connectors.
3 Refit the cable gland cover at the cable exit.	
4 Refit the cover of the motor with its attachment screws.	Make sure the cover is tightly sealed.
5 Apply rust protection (Mercasol) on the frame, outside the motor flange as a protection of the broken paint layers.	

*Continues on next page*

---

**Refitting the concluding parts**

Use this procedure to refit the concluding parts on.

	Action	Note
1	Remove the lock screw used to secure the lower arm.	
2	Perform a <i>leak-down test</i> .	See section • <a href="#">Performing a leak-down test on page 210</a>
3	Refill the gearbox with <i>oil</i> .	See section • <a href="#">Changing oil, axis-2 gearbox on page 169</a>
4	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
5	Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
6	 <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4 Repair

### 4.6.3 Replacing motor axis 3

#### 4.6.3 Replacing motor axis 3

##### Introduction

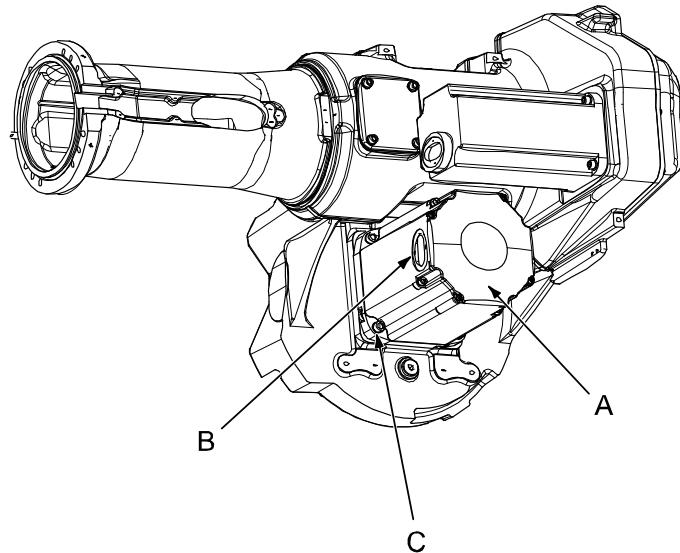
This section describes how to replace motor axis 3.

The section consists of these parts:

- [Removing motor axis 3 on page 349](#)
- [Preparation of the upper arm housing before fitting motor axis 3 on page 352](#)
- [Refitting motor axis 3 on page 352](#)
- [Connecting motor axis 3 on page 354](#)
- [Refitting the concluding parts on page 354](#)

##### Location of motor axis 3

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



xx0200000186

A	Motor axis 3
B	Cable gland cover, motor axis 3
C	Attachment screws (4 pcs)

##### Required parts

Equipment	Spare part no.	Note
Motor	See chapter: • <i>Spare parts</i>	Includes: <ul style="list-style-type: none"><li>• motor</li><li>• pinion</li><li>• o-ring</li></ul>
O-ring	21522012-430	Must be replaced when reassembling motor.
Gasket	3HAC3438-1	

Continues on next page

**Required equipment - tools etc.**

Equipment	Art. no.	Note
Grease	3HAB3537-1	For lubricating the o-ring.
Removal tool, motor M12x	3HAC14631-1	Always use removal tools in pairs.
Lifting tool motor 2-3	3HAC026061-001	
Mechanical stop axis 3	3HAC12708-1	Used to fix axis 3.
Attachment screws	3HAB3409-86	M16x60 For mechanical stop axis 3.
Washers	3HAA1001-186	For mechanical stop axis 3.
Guide pins	3HAC15521-1	M10x100 For guiding the motor.
Guide pins	3HAC15521-2	M10x150 For guiding the motor.
Extension for bits 1/2"	3HAC12342-1	300 mm
Rotation tool	3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with the 24 VDC power supply.
Power supply	-	24 VDC max 1.5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit which also includes user manual.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	See <a href="#">Circuit diagram</a> .	

**Additional equipment - Foundry Prime**

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	

**Removing motor axis 3**

Use this procedure to remove motor axis 3.

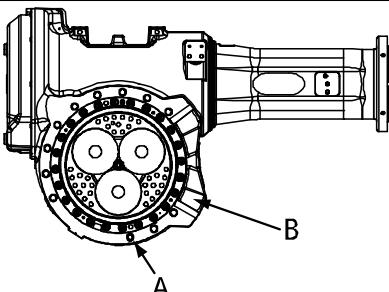
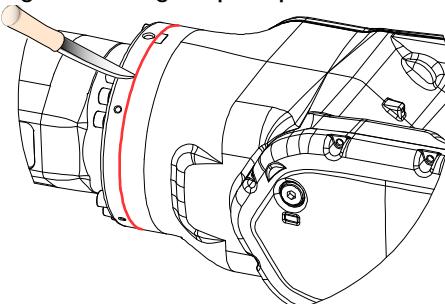
	Action	Information
1	Drain the oil from gearbox axis 3.	See section <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-3 gearbox on page 172</a></li> </ul>

*Continues on next page*

## 4 Repair

### 4.6.3 Replacing motor axis 3

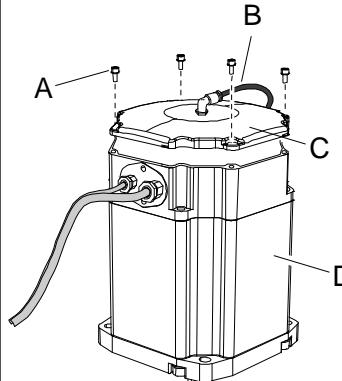
*Continued*

Action	Information
2 Unload the upper arm using one of these methods: <ul style="list-style-type: none"> <li>• Use a fork lift to rest the upper arm onto</li> <li>• Use lifting slings and an overhead crane to rest the upper arm</li> <li>• Use a mechanical stop to rest the upper arm. Fit the <i>mechanical stop</i> in the attachment hole as shown in the figure. Tightening torque: 115 Nm.</li> </ul>	 <p>xx0300000051</p> <p>Part:</p> <ul style="list-style-type: none"> <li>• A: Third and final attachment hole for fitting the mechanical stop</li> <li>• B: Fixed stop</li> </ul>
3  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	
4  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
5 Remove any equipment hindering access to motor axis 3.	
6 Cut the paint with a knife in the joint between the motor and the structure in order to avoid that the paint cracks.	Figure showing the principal method:  <p>xx0900000121</p>
7 Cut the paint layer with a knife in the joint between the <i>cover</i> and the <i>motor housing</i> to avoid the paint layer to crack. See the figure below!	

*Continues on next page*

## 4.6.3 Replacing motor axis 3

Continued

	Action	Information
8	Remove the <i>cover</i> for connector access on the motor.	<p>Figure shows Foundry Prime motor.</p>  <p>xx0600002874</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Attachment screws</li> <li>B: Air hose (only Foundry Prime)</li> <li>C: Cover</li> <li>D: Motor axis 3</li> </ul>
9	 <b>Note</b> Keep the old cover, with the air nipple fitted.	
10	Remove the <i>cable gland cover</i> at the cable exit.	See the figure in: <ul style="list-style-type: none"> <li><a href="#">Location of motor axis 3 on page 348</a></li> </ul> Make sure the gasket is not damaged!
11	Disconnect all connectors on motor axis 3.	
12	To release the brakes, connect the 24 VDC <i>power supply</i> .  Connect to connector R2.MP3: <ul style="list-style-type: none"> <li>+ = pin 2</li> <li>- = pin 5</li> </ul>	See section <ul style="list-style-type: none"> <li><a href="#">Manually releasing the brakes on page 85</a></li> </ul>
13	Unscrew the <i>attachment screws</i> securing the motor.	See the figure in: <ul style="list-style-type: none"> <li><a href="#">Location of motor axis 3 on page 348</a></li> </ul>
14	Fit <i>guide pins</i> in the screw holes for the attachment screws.	For art. no. see: <ul style="list-style-type: none"> <li><a href="#">Required equipment - tools etc. on page 349</a></li> </ul>
15	Press the motor out of position by fitting the <i>removal tool, motor</i> in the remaining attachment holes for the motor.	For art. no. see: <ul style="list-style-type: none"> <li><a href="#">Required equipment - tools etc. on page 349</a></li> </ul> Always use removal tools in pairs.
16	Apply the <i>lifting tool, motor axes 2-3</i> to the motor.	For art. no. see: <ul style="list-style-type: none"> <li><a href="#">Required equipment - tools etc. on page 349</a></li> </ul>
17	 <b>CAUTION</b>  The motor weighs 27 kg! All lifting equipment used must be sized accordingly!	

Continues on next page

## 4 Repair

### 4.6.3 Replacing motor axis 3

Continued

	Action	Information
18	Lift the motor in order to get the motor away from the gear.	
19	Remove the motor by carefully lifting it straight out.	Make sure the motor pinion is not damaged.
20	Disconnect the 24 VDC power supply.	

#### Preparation of the upper arm housing before fitting motor axis 3

Use this procedure for the preparation of the upper arm housing before refitting motor axis 3.

	Action	Note
1	Grind the paint edge on the surface carefully to get a smooth surface.	
2	Clean the surface from contamination such as oil and dirt.	
3	Apply Loctite 574 on the surface as shown in the figure.	<p>For article number see:</p> <ul style="list-style-type: none"><li>• Additional equipment - Foundry Prime on page 349</li></ul>  <p>xx1000000562</p> <p>Part:</p> <ul style="list-style-type: none"><li>• A: Loctite 574</li></ul>

#### Refitting motor axis 3

Use this procedure to refit motor axis 3.

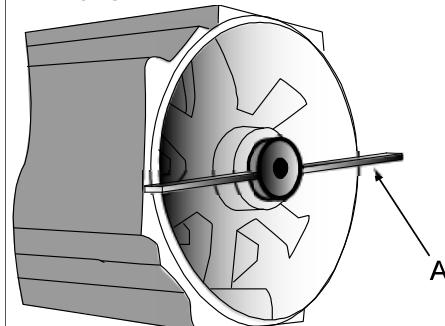
	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	

Continues on next page

## 4.6.3 Replacing motor axis 3

Continued

Action	Note
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lubricate the <i>o-ring</i> with some grease.	For article number see: • <a href="#">Required parts on page 348</a>
4 Fit the <i>lifting tool</i> , <i>motor axes 2, 3, 4</i> to the motor.	For article number see: • <a href="#">Required equipment - tools etc. on page 349</a>
5 Fit <i>guide pins</i> in the two lower holes for <i>motor attachment screws</i> .	For art. no. see: • <a href="#">Required equipment - tools etc. on page 349</a> Shown in the figure in: • <a href="#">Location of motor axis 3 on page 348</a>
6  CAUTION  The motor weighs 27 kg! All lifting equipment used must be sized accordingly!	
7 Lift the motor onto the guide pins and guide it as close to the correct position as possible without pushing the motor all the way into the gear.	
8 Remove the lifting tool and allow the motor to rest on the guide pins.	
9 To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP3: • + = pin 2 • - = pin 5	See section • <a href="#">Manually releasing the brakes on page 85</a>
10 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear.	For article number see: • <a href="#">Required equipment - tools etc. on page 349</a>



xx0200000165

• A: Rotation tool

Continues on next page

## 4 Repair

### 4.6.3 Replacing motor axis 3

Continued

Action	Note
11 Fit the motor into its position making sure that: <ul style="list-style-type: none"><li>• the motor pinion is properly mated to the gear of the gearbox axis 3</li><li>• the motor pinion does not get damaged</li><li>• the motor is turned the right direction, that is cables facing forwards. See the figure in <a href="#">Location of motor axis 3 on page 348</a>.</li></ul>	
12 Remove the guide pins.	
13 Secure the motor with its attachment screws. Tightening torque: 50 Nm.	M10x40 4 pcs
14 Disconnect the 24 VDC power supply.	

#### Connecting motor axis 3

Use this procedure to connect all connectors motor axis 3.

Action	Note
1 Fit a new gasket in the cable gland.	For article number see: <ul style="list-style-type: none"><li>• <a href="#">Required parts on page 348</a></li></ul>
2 Reconnect all connectors on motor axis 3.	Connect in accordance to markings on connectors.
3 Refit the <i>cable gland cover</i> at the cable exit with its attachment screws.	Make sure the cable gland cover is tightly sealed. Shown in the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of motor axis 3 on page 348</a></li></ul>
4 Refit the <i>cover</i> of motor axis 3.	Make sure the cover is tightly sealed.
5 Apply <i>rust preventive (Mercasol)</i> on the upper arm housing outside the motor flange as a protection of the broken paint. layers.	For article number see: <ul style="list-style-type: none"><li>• <a href="#">Additional equipment - Foundry Prime on page 349</a></li></ul>

#### Refitting the concluding parts

Use this procedure to refit the concluding parts.

Action	Note
1 Remove the equipment used to unload the upper arm.	
2 Perform a leak-down test.	See section <ul style="list-style-type: none"><li>• <a href="#">Performing a leak-down test on page 210</a></li></ul>
3 Refill gearbox axis 3 with <i>oil</i> .	See section <ul style="list-style-type: none"><li>• <a href="#">Changing oil, axis-3 gearbox on page 172</a></li></ul>
4 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	

Continues on next page

	Action	Note
5	Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
6	 <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4 Repair

### 4.6.4 Replacing motor axis 4

#### 4.6.4 Replacing motor axis 4

##### Introduction

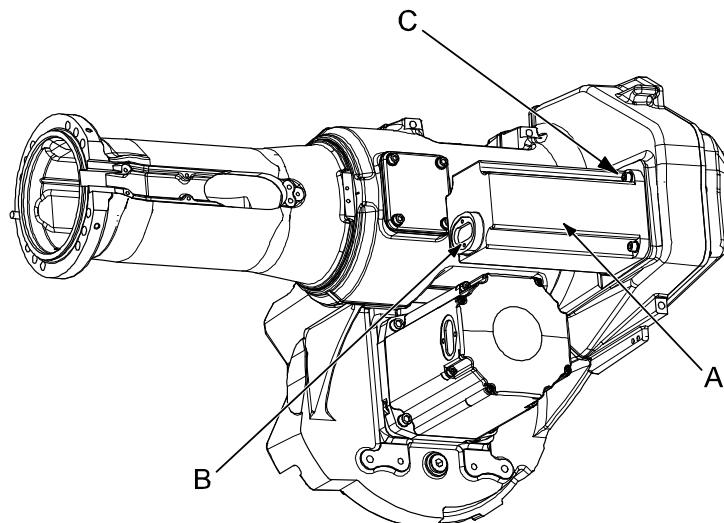
This section describes how to replace motor axis 4.

The section consists of these parts:

- [Removing motor axis 4 on page 357](#)
- [Preparation of the upper arm housing before fitting the motor on page 359](#)
- [Refitting motor axis 4 on page 360](#)
- [Connecting motor axis 4 on page 361](#)
- [Refitting the concluding parts on page 362](#)

##### Location of motor axis 4

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



xx0200000202

A	Motor axis 4
B	Cable gland cover
C	Attachment screws (4 pcs)

##### Required parts

Part	Spare part no.	Note
Motor	See chapter: • <i>Spare parts</i>	Includes: • motor • M10NB pinion • o-ring
O-ring	21522012-430	Must be replaced when reassembling motor.
Gasket	3HAC3438-1	Option Foundry Prime

Continues on next page

**Required equipment - tools etc.**

Equipment	Art. no.	Note
Grease	3HAC3537-1	Used to lubricate o-ring.
Removal tool motor M10x	3HAC14972-1	Always use the removal tools in pairs.
Guide pins	3HAC15520-1	M8x100 For guiding the motor.
Guide pins	3HAC15520-2	M8x150 For guiding the motor.
Extension for bits 1/2"	3HAC12342-1	
Rotoation tool	3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with the 24 VDC power supply.
Power supply	-	24 VDC, max. 1.5 A For releasing brakes.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit which also includes user manual.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	See <i>Circuit diagram</i> .	

**Additional equipment - Foundry Prime**

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	

**Removing motor axis 4**

Use this procedure to remove motor axis 4.

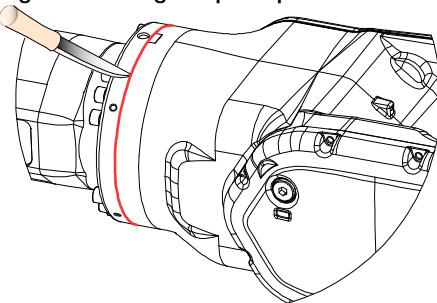
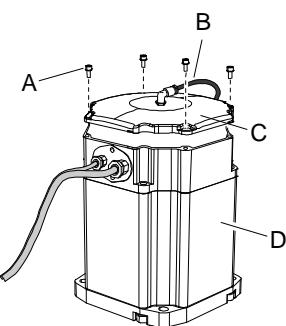
	Action	Note
1	<p>Move the robot to a position where the upper arm is pointing straight up. This position enables the motor to be replaced without draining the oil from gearbox axis 4. This saves time.</p> <p> <b>Note</b></p> <p>If the upper arm is placed in any other position draining of oil from gearbox is required!</p>	<p>If needed, draining of oil is described in section:</p> <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-4 gearbox on page 175</a></li> </ul>

*Continues on next page*

## 4 Repair

### 4.6.4 Replacing motor axis 4

*Continued*

Action	Note
<p>2  <b>DANGER</b> Turn off all:<ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul>to the robot, before entering the robot working area.</p>	
<p>3  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a></p>	
<p>4 Remove the cable gland cover at the cable exit of motor axis 4. Make sure the gasket is not damaged!</p>	<p>See the figure in: • <a href="#">Location of motor axis 4 on page 356</a></p>
<p>5 Cut the paint layer with a knife in the joint between the <i>cover</i> and <i>motor housing</i> to avoid that the paint cracks.</p>	<p>Figure showing the principal method!  xx0900000121  xx0600002874<ul style="list-style-type: none"><li>• A: Attachment screws (4 pcs)</li><li>• B: Air hose (only Foundry Prime)</li><li>• C: Cover</li><li>• D: Motor axis 4</li></ul></p>
<p>6 Cut the paint layer with a knife in the joint between the <i>motor</i> and the <i>upper arm housing</i> to avoid that the paint cracks.</p>	<p>See the figure above!</p>
<p>7 Remove the <i>cover</i> for connector access on top of the motor.</p>	<p>See the figure above!</p>

*Continues on next page*

	Action	Note
8	Keep the old cover with the air nipple fitted.	
9	Disconnect all connectors on motor axis 4.	
10	To release the brake, connect the 24 VDC power supply. Connect to connector R2.MP4: <ul style="list-style-type: none"><li>• + = pin 2</li><li>• - = pin 5</li></ul>  <b>CAUTION</b> Axis 4 might move when the brake is released and the balance of the axis is settled!	See section <ul style="list-style-type: none"><li>• <a href="#">Manually releasing the brakes on page 85</a></li></ul>
11	Unscrew the motors <i>attachment screws</i> with washers.	See the figure in: <ul style="list-style-type: none"><li>• <a href="#">Location of motor axis 4 on page 356</a></li></ul>
12	Fit <i>guide pins</i> in two of the holes.	For article number see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment - tools etc. on page 357</a></li></ul>
13	If required, press the motor out of position by fitting <i>removal tool, motor</i> to the remaining holes.	For article number see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment - tools etc. on page 357</a></li></ul> Always use removal tools in pairs.
14	Lift the motor up to get the pinion away from the gear.	
15	Disconnect the 24 VDC power supply.	
16	Remove the motor by carefully lifting it straight up.	Make sure the motor pinion is not damaged!

#### Preparation of the upper arm housing before fitting the motor

Use this procedure for the preparation of the upper arm housing before refitting motor axis 4.

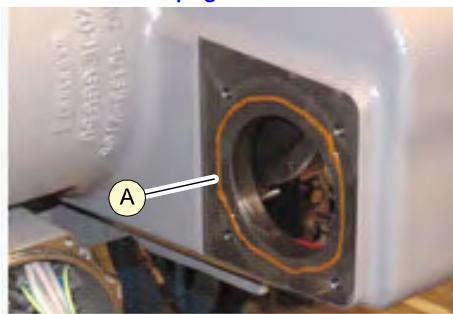
	Action	Note
1	Grind the paint edge on the surface carefully in order to get a smooth surface.	
2	Clean the surface from contamination such as oil and dirt.	

*Continues on next page*

## 4 Repair

### 4.6.4 Replacing motor axis 4

*Continued*

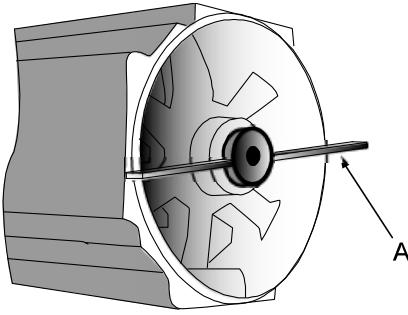
Action	Note
3 Apply Loctite 574 on the surface as shown in the figure.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 357</a></li> </ul>  <p>xx1000000617</p> <p>Part:</p> <ul style="list-style-type: none"> <li>• A: Loctite 574</li> </ul>

### Refitting motor axis 4

Use this procedure to refit motor axis 4.

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> </ul> to the robot, before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
3 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lubricate the <i>o-ring</i> with some <i>grease</i> .	For article number see: <ul style="list-style-type: none"> <li>• <a href="#">Required parts on page 356</a></li> </ul>
4 To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP4: <ul style="list-style-type: none"> <li>• + = pin 2</li> <li>• - = pin 5</li> </ul>	
5 Fit <i>guide pins</i> in two of the holes for the attachment screws of motor axis 4.	For article number see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 357</a></li> </ul> See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of motor axis 4 on page 356</a></li> </ul>
6 Lift the motor onto the guide pins and guide it as close as possible without pushing the motor all the way into the gear.	

*Continues on next page*

Action	Note
7 To release the brakes, connect the 24 VDC power supply. Connect to connector R2.MP4: • + = pin 2 • - = pin 5	See section • <a href="#">Manually releasing the brakes on page 85</a>
8 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear.	For article number see: • <a href="#">Required equipment - tools etc. on page 357</a>  xx0200000165 Part: • A: Rotation tool
9 Fit the motor in its position making sure that: <ul style="list-style-type: none"><li>• the motor pinion is properly mated to the gear of gearbox axis 4</li><li>• the motor pinion does not get damaged</li><li>• the motor is turned the right direction, that is with cable exit hole facing downwards. See the figure in <a href="#">Location of motor axis 4 on page 356</a>.</li></ul>	
10 Remove the guide pins.	
11 Secure the motor with its attachment screws. Tightening torque: 24 Nm.	M8x25 4 pcs
12 Disconnect the 24 VDC power supply.	

#### Connecting motor axis 4

Use this procedure to connect motor axis 4.

Action	Note
1 Fit a new gasket in the cable gland.	For article number see: • <a href="#">Required parts on page 356</a>
2 Reconnect all connectors to motor axis 4.	
3 Refit the cover of the motor.	Make sure the cover is tightly sealed.
4 Refit the cable gland cover at the cable exit.	See the figure in: • <a href="#">Location of motor axis 4 on page 356</a> Make sure the cable gland cover is tightly sealed.

*Continues on next page*

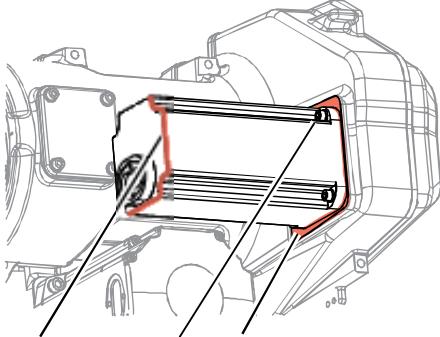
## 4 Repair

### 4.6.4 Replacing motor axis 4

*Continued*

#### Refitting the concluding parts

Use this procedure to refit the concluding parts.

Action	Note
1 Apply rust preventive ( <i>Mercasol</i> ) on the <i>upper arm housing</i> outside the <i>motor flange</i> as a protection of the broken paint layers.	<p>For article number see</p> <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 357</a></li> </ul>  <p>A      B      C</p> <p>xx1000000618</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Mercasol on cover and motor housing</li> <li>• B: Attachment screws (4 pcs)</li> <li>• C: Mercasol on upper arm housing outside motor flange</li> </ul>
2 Apply rust preventive ( <i>Mercasol</i> ) on the <i>attachment screws</i> of the motor.	See the figure above!
3 Apply rust preventive ( <i>Mercasol</i> ) over the joint between the <i>cover</i> and the <i>motor housing</i> as a protection of the broken paint layers.	See the figure above!
4 Only if gearbox has been drained. Perform a leak-down test.	<p>See section</p> <ul style="list-style-type: none"> <li>• <a href="#">Performing a leak-down test on page 210</a></li> </ul>
5 Only if gearbox has been drained. Refill the gearbox with oil.	<p>See section</p> <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-4 gearbox on page 175</a></li> </ul>
6 Recalibrate the robot.	<p>Calibration is detailed in a separate calibration manual enclosed with the calibration tools.</p> <p>General calibration information is included in section <a href="#">Calibration information on page 431</a>.</p>
7  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4.6.5 Replacing motor axis 5

### Introduction

This section describes how to replace motor axis 5.

The section consists of these parts:

- [Removing motor axis 5 on page 365](#)
- [Removing the pinion on motor axis 5 on page 367](#)
- [Refitting the pinion on motor axis 5 on page 368](#)
- [Refitting motor axis 5 on page 369](#)
- [Connecting motor axis 5 on page 370](#)
- [Connecting motor axis 5 on page 370](#)

### Reused pinion

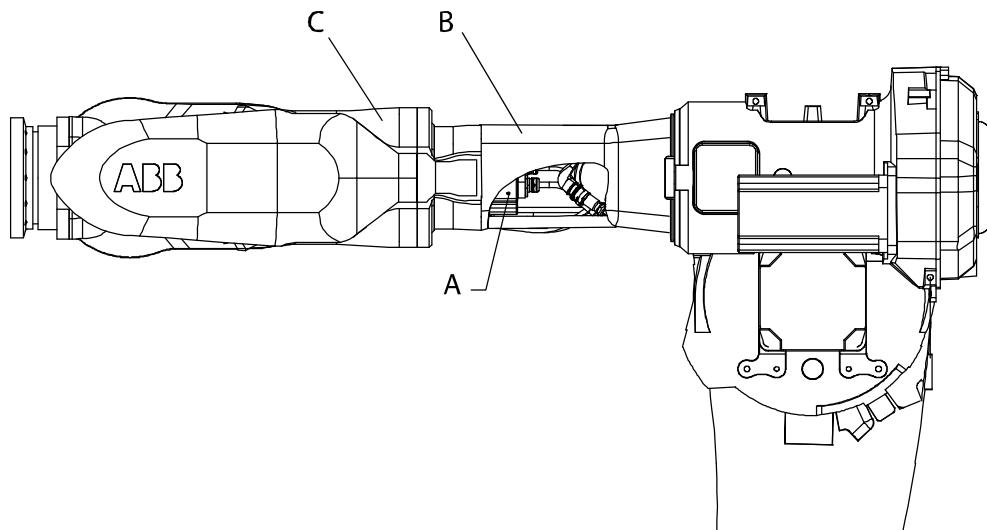


#### Note

The pinion in motor axis 5 is matched with the bevel gear for axis 5. When the motor is replaced the pinion therefore must be removed from the dismounted motor and be fitted to the new motor.

### Location of motor axis 5

The motor axis 5 is located inside the upper arm tube, but attached to the wrist unit. See figure!



xx0200000204

A	Motor axis 5 (inside upper arm tube)
B	Upper arm tube
C	Wrist unit

*Continues on next page*

## 4 Repair

### 4.6.5 Replacing motor axis 5

*Continued*

#### Required parts

Parts	Spare part no.	Note
Motor axis 5	For spare part number, see <a href="#">Spare parts on page 477</a> .	Includes: <ul style="list-style-type: none"><li>• motor</li><li>• o-ring</li></ul> <b>NOTE!</b> Pinion is not included!
O-ring	21522012-430	Must be replaced when reassembling the motor!
Set of shims, motor	3HAC7941-28	Used to obtain the correct distance between motor flange and outer surface of motor pinion.
Gasket	3HAC3438-1	Must be replaced if the cabling is dismantled from the motor.

#### Required equipment - tools etc.

Equipment	Art. no.	Note
Grease	3HAC3537-1	For lubricating the o-ring.
Isopropanol	11771012-208	For cleaning motor pinion shaft and pinion hole.
Mineral oil	CS 320	For lubrication of motor pinion shaft and pinion hole.
Oil injector	3HAC021590-001	500 MPa For pressing out the pinion, motor axis 5.
Press fixture (for pinion)	-	For pressing the pinion on to the new motor.
Measuring tool	6896134-GN	
Removal tool motor	3HAC14972-1	Always use the removal tool in pairs!
Extension bar for bits 1/2"	3HAC12342-1	300 mm
Guide pins	3HAC15520-1	For guiding the motor.
Guide pins	3HAC15520-2	For guiding the motor.
Power supply	-	24 VDC, max. 1.5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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.
Circuit diagram	See <a href="#">Circuit diagram</a> .	

#### Additional equipment - Foundry Prime

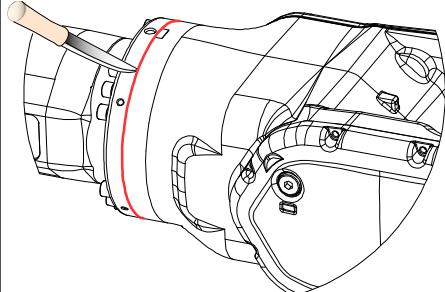
Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	

*Continues on next page*

Equipment	Art. no.	Note
Loctite 574	12340011-116	
Brush	-	

**Removing motor axis 5**

Use this procedure to remove motor axis 5.

	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> </ul> to the robot, before entering the robot working area.	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3	Drain the <i>oil</i> from gearbox axis 5.	See section <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-5 gearbox on page 178</a></li> </ul>
4	Cut the paint layer with a knife in the joint between the wrist unit and the upper arm tube to avoid that the paint cracks.	 xx0900000121
5	Remove the <i>wrist unit</i> .	See section <ul style="list-style-type: none"> <li>• <a href="#">Replacement of complete wrist unit on page 259</a></li> </ul>
6	Place the wrist safely on a workbench, in a fixture or similar.	

*Continues on next page*

## 4 Repair

### 4.6.5 Replacing motor axis 5

*Continued*

Action	Note
7 Cut the paint layer with a knife in the joint between the <i>cover</i> and the <i>motor housing</i> to avoid that the paint cracks.	The figure shows a Foundry Prime motor.  xx0600002904 Parts: <ul style="list-style-type: none"> <li>• A: Cover</li> <li>• B: Air hose (only Foundry Prime)</li> <li>• C: Attachment screws (4 pcs)</li> <li>• D: Motor housing</li> </ul>
8 Remove the cover for connector access on motor axis 5.	See the figure above!
9  <b>Note</b> Keep the old cover with air nipple fitted.	
10 Disconnect all connectors to motor axis 5.	
11 Remove the separate cable of motor axis 5.	
12 To release the brakes connect the 24VDC power supply. Connect in one of these ways: to connector R4.MP5 (in the motor): <ul style="list-style-type: none"> <li>• + = pin 2</li> <li>• - = pin 5</li> </ul> or: to connector R3.MP5 (on the separate cable to motor axis 5, if not removed): <ul style="list-style-type: none"> <li>• + = pin C</li> <li>• - = pin D</li> </ul>	
13 Unscrew the attachment screws of motor axis 5 and remove screws and plain washers.	
14 Fit <i>guide pins</i> in two of the holes for the attachment screws of motor axis 5.	For article number see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment - tools etc. on page 364</a></li> </ul>

*Continues on next page*

	Action	Note
15	If required, press the motor out of position by fitting <i>removal tool, motor M10x</i> to the remaining holes.	For article number see: • <a href="#">Required equipment - tools etc. on page 364</a> Always use the removal tools in pairs and diagonally!
16	Remove motor axis 5 by carefully lifting it straight up in order to get the pinion away from the gear.	Make sure the motor pinion is not damaged!
17	Disconnect the 24 VDC power supply.	
18	 Note  Keep track of the shims between the motor flange and wrist housing!	

### Removing the pinion on motor axis 5

Use this procedure to remove the pinion of motor axis 5

	Action	Note
1	Measure the distance between the motor flange, including shims and the outer surface of the pinion with the <i>measuring tool</i> . Make a note of measured distance!	For article number see: • <a href="#">Required equipment - tools etc. on page 364</a>
2	Press out the pinion from the removed motor with the equipment included in the <i>oil injector kit</i> .	For article number see: • <a href="#">Required equipment - tools etc. on page 364</a>
3	 Note  If the pinion is damaged, the complete wrist unit must be replaced!	See section • <a href="#">Replacement of complete wrist unit on page 259</a>

### Preparation of the wrist housing before fitting motor axis 5

Use this procedure for the preparation of the wrist housing before refitting motor axis 5.

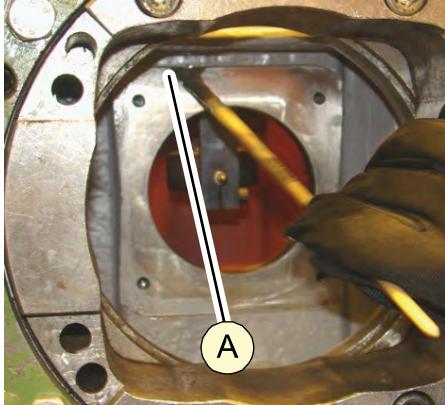
	Action	Note
1	Grind the paint edge on the surface carefully to get a smooth surface.	
2	Clean the surface from contamination such as oil and dirt.	

Continues on next page

## 4 Repair

### 4.6.5 Replacing motor axis 5

*Continued*

Action	Note
3 Apply <i>rust preventive (Mercasol)</i> on the outside of the machined surface.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <i>Additional equipment - Foundry Prime on page 364</i></li> </ul>  <p>xx1000000621</p>

#### Refitting the pinion on motor axis 5

Use this procedure to refit the pinion of motor axis 5

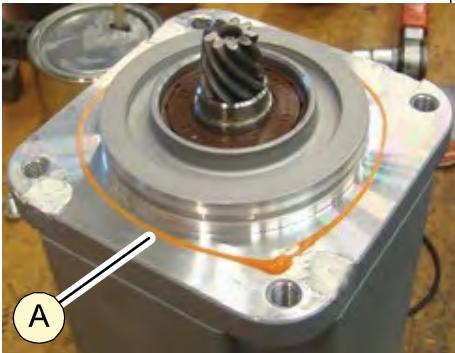
Action	Note
1  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	
2 Clean the pinion and the hole for the pinion on the motor with <i>Isopropanol</i> .	For article number see: <ul style="list-style-type: none"> <li>• <i>Required equipment - tools etc. on page 364</i></li> </ul>
3  <b>Note</b> If the pinion is damaged the complete wrist unit must be replaced!	See section <ul style="list-style-type: none"> <li>• <i>Replacement of complete wrist unit on page 259</i></li> </ul>
4 Apply a thin film of <i>mineral oil</i> to the shaft of the pinion and in the hole for the pinion on the motor to make the pinion run smoothly when being fitted.  This is necessary in order to achieve an even friction torque when fitting the pinion.	For article number see: <ul style="list-style-type: none"> <li>• <i>Required equipment - tools etc. on page 364</i></li> </ul>
5 Place the motor and the pinion in a <i>press fixture</i> .	

*Continues on next page*

Action	Note
6 Press the pinion onto the new motor. Check the pressing force!  For an axis with diameter of 15.5 mm use: • minimum pressing force = 18.5 kN • maximum pressing force = 39.5 kN.	 Note  If the pressing force is outside the given range or if the pinion "jumps" in bit by bit, it must be dismounted, checked and oiled before it is fitted again!
7 Measure the distance between the motor flange and the outer surface of the pinion with the <i>measuring tool</i> .	For article number see: • <a href="#">Required equipment - tools etc. on page 364</a>
8 Modify the distance with <i>shims</i> to obtain the same distance as measured when dismounting the old motor (+0-0.05 mm)	For article number see: • <a href="#">Required parts on page 364</a>

**Refitting motor axis 5**

Use this procedure to refit motor axis 5

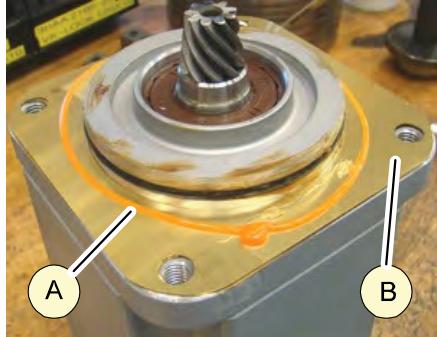
Action	Note
1 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2  Note  The pinion of motor axis 5 is matched with the bevel gear for axis 5. When fitting a new motor the pinion from the old must be fitted on the new motor!	How to remove the pinion is described in: • <a href="#">Removing the pinion on motor axis 5 on page 367</a>  How to fit the pinion is described in: • <a href="#">Refitting the pinion on motor axis 5 on page 368</a>
3 Apply Loctite 574 on the motor flange.	For article number see: • <a href="#">Additional equipment - Foundry Prime on page 364</a>   xx1000000623 Part: • A: Loctite 574

*Continues on next page*

## 4 Repair

### 4.6.5 Replacing motor axis 5

*Continued*

	Action	Note
4	<p>Place the number of <i>shims</i> needed.</p> <p><b>Foundry Prime robots:</b></p> <ul style="list-style-type: none"> <li>• Apply <i>Loctite 574</i> on the top one.</li> </ul> <p> Note</p> <p><b>Do not apply Loctite 574 between the shims!</b></p>	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <i>Additional equipment - Foundry Prime on page 364</i></li> </ul>  <p>xx1000000622</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Loctite 574</li> <li>• B: Shims</li> </ul>
5	<p>In order to release the brake, connect the 24 VDC power supply.</p> <p>Connect in one of these ways:</p> <p>to connector R4.MP5 (in the motor):</p> <ul style="list-style-type: none"> <li>• + = pin 2</li> <li>• - = pin 5</li> </ul> <p>to connector R3.MP5 (on the separate cable to motor axis 5, if not removed):</p> <ul style="list-style-type: none"> <li>• + = pin C</li> <li>• - = pin D</li> </ul>	
6	Fit guide pins in two of the attachment holes for the motor.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <i>Required equipment - tools etc. on page 364</i></li> </ul>
7	Lift the motor onto the guide pins and guide it carefully into the gear making sure that: <ul style="list-style-type: none"> <li>• the motor pinion is properly mated to the gear of gearbox axis 5</li> <li>• the motor pinion does not get damaged.</li> </ul>	
8	Secure the motor with its <i>attachment screws</i> and plain washers. Tightening torque: 24 Nm.	M8x25 4 pcs.
9	Apply rust preventive <i>Mercasol</i> on attachment screws and washers after tightening.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <i>Additional equipment - Foundry Prime on page 364</i></li> </ul>
10	Disconnect the 24 VDC power supply.	

### Connecting motor axis 5

Use this procedure to connect motor axis 5.

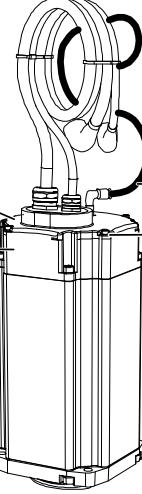
	Action	Note
1	Fit a new gasket on the cable gland.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <i>Required parts on page 364</i></li> </ul>
2	Refit the separate cable of motor axis 5.	

*Continues on next page*

	Action	Note
3	Connect all connectors to motor axis 5.	
4	Refit the cable gland cover at the cable exit.	
5	Refit the motor cover.	Make sure the cover is tightly sealed.

### Refitting the concluding parts

Use this procedure to refit the concluding parts.

	Action	Note
1	<p><b>Foundry Prime robots:</b> Apply rust preventive (Mercasol) over the joint between the cover and housing of motor axis 5 as a protection of the broken paint layers.</p>	 xx0600002904 <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>A: Cover</li> <li>B: Air hose (only Foundry Prime)</li> <li>C: Attachment screws</li> <li>D: Motor housing axis 5</li> </ul>
2	Perform a <i>leak-down test!</i>	See section <ul style="list-style-type: none"> <li><a href="#">Performing a leak-down test on page 210</a></li> </ul>
3	Refit the <i>wrist unit</i> .	See section <ul style="list-style-type: none"> <li><a href="#">Replacement of complete wrist unit on page 259</a></li> </ul>
4	Refill gearbox axis 5 with <i>oil</i> .	See section <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-5 gearbox on page 178</a></li> </ul>
5	Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .

## 4 Repair

### 4.6.6 Replacing motor axis 6

#### 4.6.6 Replacing motor axis 6

##### Introduction

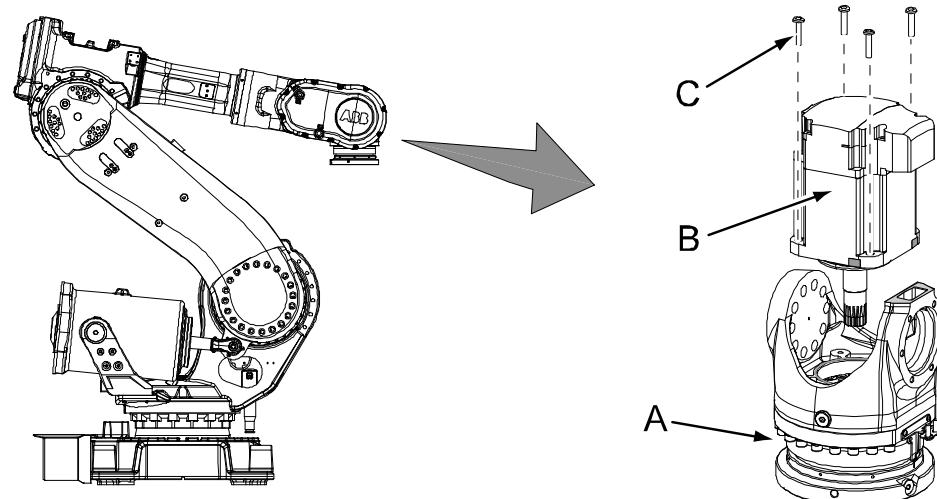
This section describes how to replace motor axis 6.

The section consists of these parts:

- [Removing motor axis 6 on page 373](#)
- [Preparation of the tilthouse before fitting a new motor on page 376](#)
- [Preparation of motor axis 6 before fitting on page 376](#)
- [Refitting motor axis 6 on page 377](#)

##### Location of motor axis 6

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



A	Gearbox axis 6
B	Motor axis 6
C	Attachment screws (4 pcs)

##### Required parts

Part	Spare part no.	Note
Motor, including pinion	See chapter <i>Spare parts</i> .	Includes: <ul style="list-style-type: none"><li>• Motor</li><li>• Pinion</li><li>• O-ring</li></ul>
O-ring	21522012-430	Must be replaced when reassembling the motor.
Gasket	3HAC048560-001	Must be replaced when replacing motor.
Gasket, cover	3HAC033489-001	Must be replaced when opening cover.

Continues on next page

**Required equipment - tools etc.**

Equipment	Art. no.	Note
Grease	3HAB3537-1	For lubricating o-ring
Removal tool, motor M10x	3HAC14972-1	Always use removal tools in pairs!
Extension for bits 1/2"	3HAC12342-1	300 mm
Guide pins	3HAC15520-1	M8x100 For guiding the motor.
Guide pins	3HAC15520-2	M8x150 For guiding the motor.
Power supply	-	24 VDC, max 1.5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that includes user manual.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	-	These procedures include references to the tools required.
Circuit diagram		See chapter <i>Circuit diagram</i> .

**Additional equipment - Foundry Prime**

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush	-	

**Removing motor axis 6**

Use this procedure to remove motor axis 6.

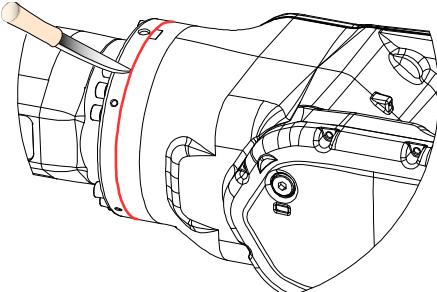
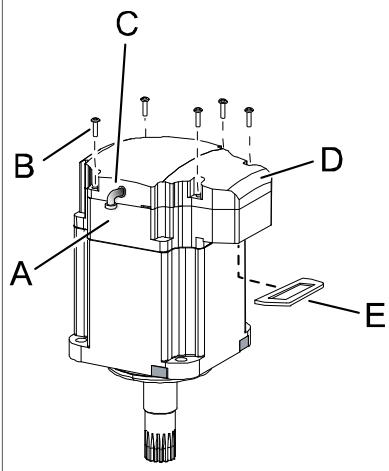
	Action	Note
1	Move the robot to a position where the motor axis 6 is pointing upwards. This position enables the motor to be replaced without draining the oil in gearbox axis 6. This will save time.	See the figure in: • <a href="#">Location of motor axis 6 on page 372</a>
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> </ul> to the robot, before entering the robot working area.	

*Continues on next page*

## 4 Repair

### 4.6.6 Replacing motor axis 6

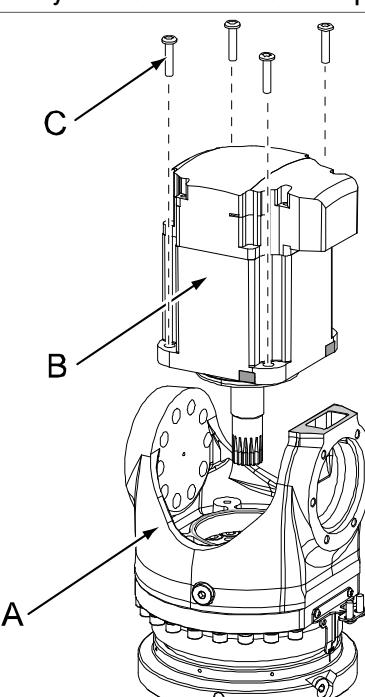
*Continued*

Action	Note
3  <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
4 Cut the paint layer with a knife in the joint between the <i>rear motor cover</i> and <i>motor housing</i> in order to avoid the paint layer cracking.	Figure showing the principal method.  xx0900000121
	 xx0600002885 <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Motor housing</li> <li>• B: Attachment screws (5 pcs)</li> <li>• C: Air nipple (only Foundry Prime)</li> <li>• D: Rear motor cover</li> <li>• E: Gasket</li> </ul>
5 Remove the <i>rear motor cover</i> .	
6 Keep the old <i>rear motor cover</i> with the <i>air nipple</i> .	
7 Disconnect all connectors of motor axis 6.	
8 To release the brakes connect the 24 VDC power supply. Connect to connector R3.MP6: • + = pin 2 • - = pin 5	

*Continues on next page*

## 4.6.6 Replacing motor axis 6

Continued

Action	Note
9 If required, press the motor out of position by fitting the <i>removal tool, motor</i> to the attachment holes of the motor.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>• <i>Required equipment - tools etc. on page 373</i></li> </ul> <p>Always use the removal tools in pairs.</p>
10 Remove the motor by carefully lifting it straight up away from the gear. Make sure the motor pinion is not damaged!	 <p>xx0600003038</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Tilthouse</li> <li>• B: Motor axis 6</li> <li>• C: Attachment screws (4 pcs)</li> </ul>
11 Disconnect the 24 VDC power supply.	

Continues on next page

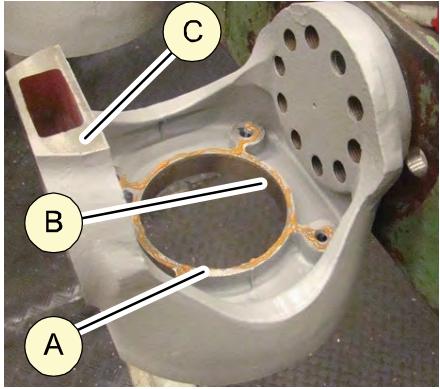
## 4 Repair

### 4.6.6 Replacing motor axis 6

Continued

#### Preparation of the tilthouse before fitting a new motor

Use this procedure for the preparation of the tilthouse before fitting a new motor.

Action	Note
1 Clean the <i>machined surfaces</i> inside the tilthouse as described in the figure.	 xx1000000624 <b>Surfaces to be cleaned:</b> <ul style="list-style-type: none"><li>• A: at the position for the motor flange</li><li>• B: at the position for the o-ring on the motor</li><li>• C: at the position for the gasket.</li></ul>
2 Apply <i>Loctite 574</i> on the machined surface for <i>motor flange</i> previously cleaned.	See A in the figure above! For article number see: <ul style="list-style-type: none"><li>• <a href="#">Additional equipment - Foundry Prime on page 373</a></li></ul>

#### Preparation of motor axis 6 before fitting

Use this procedure for the preparation of a new motor axis 6.

Action	Note
1 Only applicable if a new spare part is used. Fit a new <i>gasket</i> on the motor by removing the protection strip and paste it on the new motor.	For article number see: <ul style="list-style-type: none"><li>• <a href="#">Required parts on page 372</a></li></ul>  xx1000000625 <b>Part:</b> <ul style="list-style-type: none"><li>• A: Gasket</li></ul>

Continues on next page

Action	Note
2 Fit a new <i>gasket cover</i> on the old cover with the air nipple.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>Required parts on page 372</li> </ul>  <p>xx1000000626</p> <ul style="list-style-type: none"> <li>Gasket cover</li> </ul>

### Refitting motor axis 6

Use this procedure to refit motor axis 6.

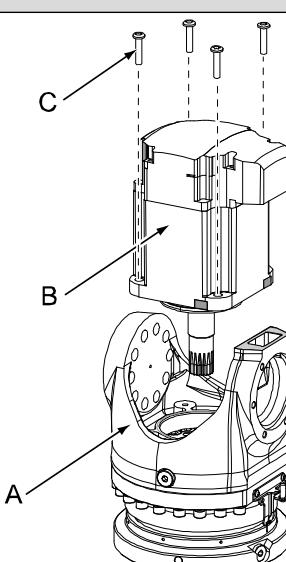
Action	Note
1 Clean Room and Foundry Prime robots: clean the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lubricate the o-ring with grease.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>Required parts on page 372</li> </ul>
3 To release the brake, connect the 24 VDC power supply. Connect the connector R3.MP6: <ul style="list-style-type: none"> <li>+ = pin 2</li> <li>- = pin 5</li> </ul>	
4 Fit <i>guide pins</i> in two of the holes for the motors attachment screws.	<p>For article number see:</p> <ul style="list-style-type: none"> <li>Required equipment - tools etc. on page 373</li> </ul>

Continues on next page

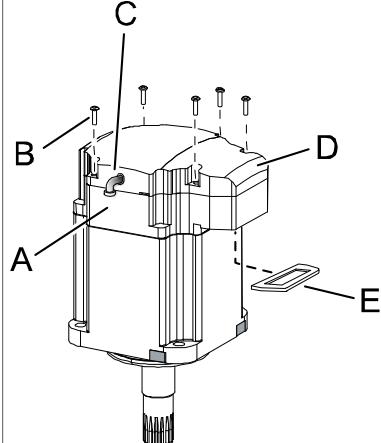
## 4 Repair

### 4.6.6 Replacing motor axis 6

*Continued*

Action	Note
5 Fit the motor with guidance from the guide pins making sure the motor pinion is properly mated with the gear of gearbox axis 6. Make sure the pinion on the motor shaft is not damaged!	 <p>xx0600003038</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Tilthouse</li> <li>• B: Motor axis 6</li> <li>• C: Attachment screws (4 pcs)</li> </ul>
6 Remove the guide pins.	
7 Secure the motor with its <i>attachment screws</i> . Tightening torque: 24 Nm.	M8x25 4 pcs
8 Apply <i>rust preventive (Mercasol)</i> on the attachment screws and plain washers after tightening!	For article number see: <ul style="list-style-type: none"> <li>• <a href="#">Additional equipment - Foundry Prime on page 373</a></li> </ul>
9 Disconnect the 24 VDC power supply.	
10 Reconnect all connectors on motor axis 6.	
11 Refit the cover on top of the motor. Make sure the cover is tightly sealed.	

*Continues on next page*

Action	Note
12 Apply rust preventive (Mercasol) over the joint between the <i>rear motor cover</i> and the <i>motor housing</i> as a protection of the broken paint layers.	 <p>xx0600002885</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Motor housing</li> <li>• B: Attachment screws (5 pcs)</li> <li>• C: Air nipple (only Foundry Prime)</li> <li>• D: Rear motor cover</li> <li>• E: Gasket</li> </ul>
13 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. See <a href="#">Replacing parts on the robot on page 215</a>	
14 Recalibrate the robot.	<p>Calibration is detailed in a separate calibration manual enclosed with the calibration tools.</p> <p>General calibration information is included in section <a href="#">Calibration information on page 431</a>.</p>
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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4 Repair

---

### 4.7.1 Replacing gearbox axis 1

## 4.7 Gearboxes

### 4.7.1 Replacing gearbox axis 1

---

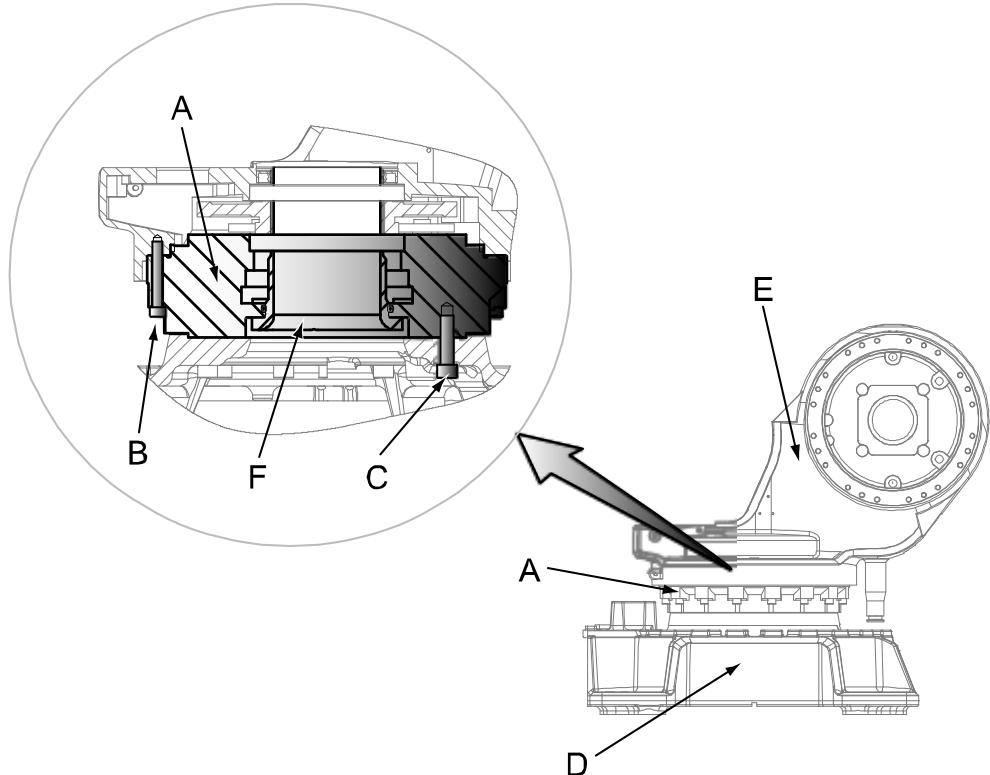
#### Introduction

This section describes how to replace gearbox axis 1.

This section consist of the following parts:

- [\*Removing gearbox axis 1 on page 384\*](#)
- [\*Preparation of the frame before refitting gearbox axis 1 on page 386\*](#)
- [\*Preparation of the base before refitting gearbox axis 1 on page 386\*](#)
- [\*Preparation of the spare part before refitting on page 387\*](#)
- [\*Refitting gearbox axis 1 on the base - Foundry Prime on page 390\*](#)
- [\*Refitting base with gearbox on the mounting site on page 390\*](#)
- [\*Refitting the complete arm system to the base - Foundry Prime on page 391\*](#)
- [\*Refitting protection pipe and cable guide - Foundry Prime on page 394\*](#)
- [\*Refitting the concluding parts - Foundry Prime on page 397\*](#)

*Continues on next page*

**Location of gearbox axis 1**

xx0600003068

A	Gearbox axis 1, RV 320C-191.35
B	Attachment screws M12x80 quality 12.9 Gleitmo (16 pcs)
C	Attachment screws M16x60 quality 12.9 Gleitmo (12 pcs)
D	Base
E	Frame
F	Protection pipe axis 1

**Required equipment**

Equipment	Spare part no.	Art. no.	Note
Gearbox	See <i>Spare parts on page 477</i> .		Includes: <ul style="list-style-type: none"><li>• O-ring 3HAB3772-93</li></ul>
Cable guide	3HAC024286-001		
Radial sealing	3HAC11581-4		
Hex socket head cap screw	3HAB3409-86		M16x60 Gleitmo 12.9 (12 pcs)
Washer	3HAA1001-186		17x215x3 (12 pcs)

*Continues on next page*

## 4 Repair

### 4.7.1 Replacing gearbox axis 1

*Continued*

Equipment	Spare part no.	Art. no.	Note
Hex socket head cap screw	3HAB3409-74		M12x80 Gleitmo 12.9 (16 pcs)
Washer, serrated	3HAC026169-001		12.6x18x1.8 (16 pcs)
O-rings	3HAB3772-97		23x3.6 (3 pcs)
O-ring	3HAB3772-93		380.6x3.53 Replace only if damaged.
Protection pipe, axis 1	3HAC026892-001		Replace only if damaged.
Holder for bits		3HAC029090-001	Bits SW10
Press tool		3HAC026594-001	For radial sealing 3HAC11581-4
Guide pin		3HAC022637-001	M12x130
Guide pin		3HAC13056-2	M12x150
Guide pins		3HAC13120-5	M16x300 Always use the guide pins in pairs.
Guide pins		3HAC13120-4	M16x250 Always use the guide pins in pairs.
Support base and gear axis 1		3HAC15535-1	Consists of four pieces.
Lifting tool		3HAC15556-1	Used to lift gearbox axis 1 and frame.
Lifting eye		3HAC025333-005	(2 pcs) Used together with lifting tool 3HAC15556-1.
Grease		3HAB3537-1	For lubricating o-rings.
Standard tools		-	Content is defined in section <a href="#">Standard tools on page 455</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.

#### Additional equipment option Foundry Prime

Equipment	Spare part no.	Art. no.	Note
Sikaflex 521FC		3HAC026759-001	Option Foundry Prime
Rust preventive		3HAC034903-001	Option Foundry Prime Equivalent: <ul style="list-style-type: none"><li>• Mercasol</li></ul>

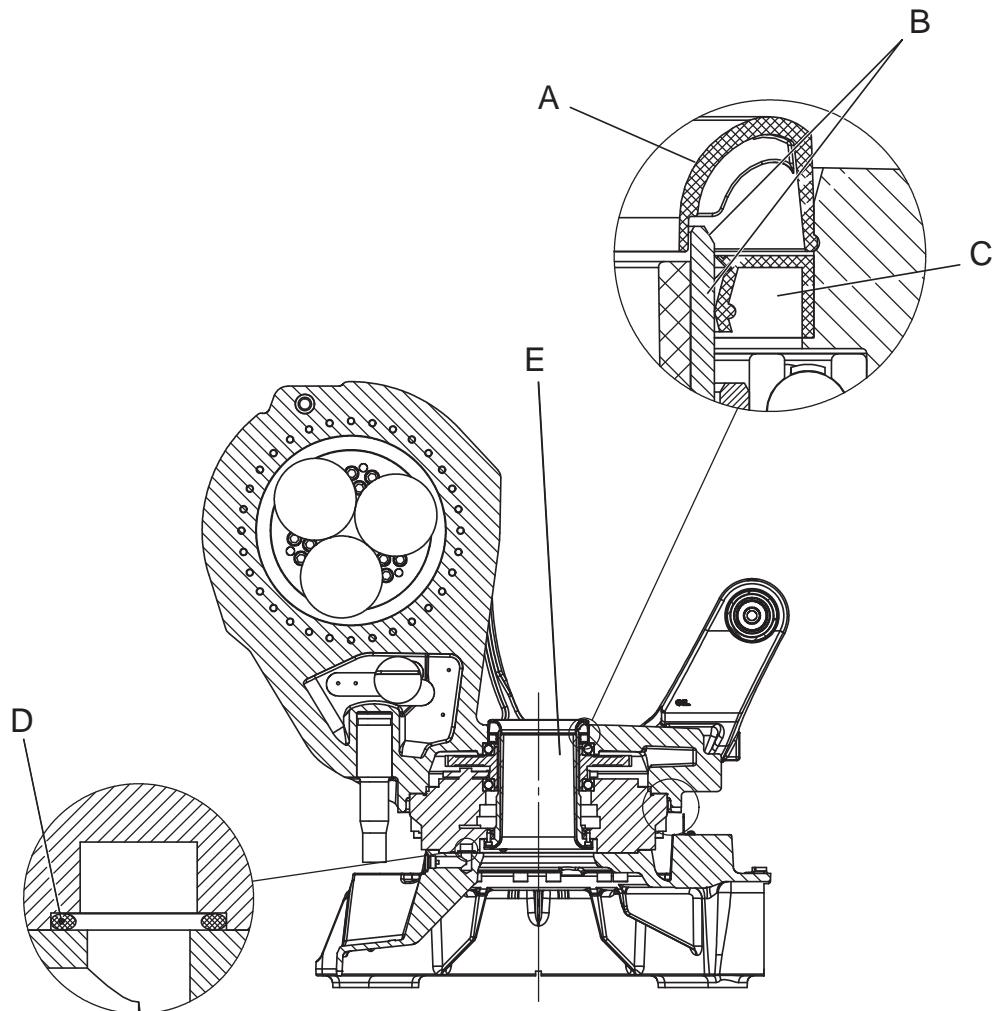
*Continues on next page*

## 4.7.1 Replacing gearbox axis 1

*Continued*

Equipment	Spare part no.	Art. no.	Note
Brush		-	Option Foundry Prime

## Cutaway view of gearbox axis 1



A	Cable guide
B	Surfaces to be lubricated with grease
C	Radial sealing
D	O-ring (3 pcs)
E	Protection pipe axis 1

*Continues on next page*

## 4 Repair

### 4.7.1 Replacing gearbox axis 1

*Continued*

#### Removing gearbox axis 1

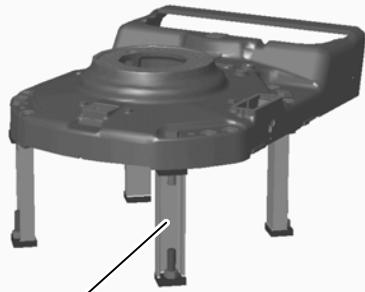
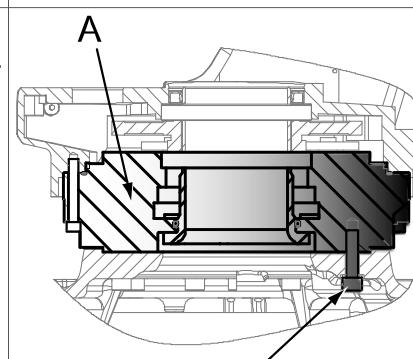
Use this procedure to remove the gearbox for axis 1.

	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></ul> to the robot, before entering the robot working area.	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3	Remove the <i>complete arm system</i> .	See section <ul style="list-style-type: none"><li>• <a href="#">Replacement of complete arm system on page 234</a></li></ul>
4	Remove the robot's <i>attachment bolts</i> , in order to unfasten the base from the foundation.	See section <ul style="list-style-type: none"><li>• <a href="#">Orienting and securing the robot on page 93</a></li></ul>
5	Fit two M12 <i>lifting eyes</i> on each side of the gearbox.	For art. no. see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment on page 381</a></li></ul>
6	Attach the <i>lifting tool</i> to the lifting eyes.	For art. no. see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment on page 381</a></li></ul>
7	 <b>CAUTION</b> The complete gearbox unit and base weighs 241 kg together! (Base: 133 kg, gearbox unit: 108 kg.) All lifting equipment used must be sized accordingly!	

*Continues on next page*

## 4.7.1 Replacing gearbox axis 1

Continued

Action	Information
8 Lift the robot base with gearbox axis 1, to allow fitting of the <i>support, base and gear axis 1</i> on the base.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 381</a></li> </ul> <p>The figure shows IRB 6600 but the principle is the same.</p>  <p>xx1000000364</p> <ul style="list-style-type: none"> <li>• A: Support, base and gear axis 1 (4 pcs)</li> </ul>
9 Fit the support, base and gear axis 1. Make sure the base remains in a stable position before performing any work underneath the base!	
10 Unscrew the 12 <i>attachment screws</i> and <i>washers</i> securing the gearbox to the base.	 <p>xx0600003069</p> <ul style="list-style-type: none"> <li>• A: Gearbox axis 1</li> <li>• B: Attachment screw, M16x60</li> </ul>
11  <b>CAUTION</b> The gearbox weighs 108 kg! All lifting equipment used must be sized accordingly!	
12 Remove the gearbox.	
13 Remove the <i>cable guide</i> and <i>radial sealing</i> .	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Cutaway view of gearbox axis 1 on page 383</a></li> </ul>
14 Remove the <i>protection pipe axis 1</i> from the removed gearbox.	See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Cutaway view of gearbox axis 1 on page 383</a></li> </ul>

Continues on next page

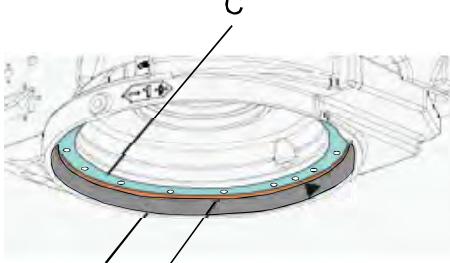
## 4 Repair

### 4.7.1 Replacing gearbox axis 1

Continued

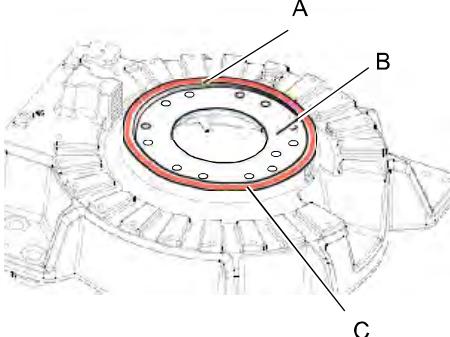
#### Preparation of the frame before refitting gearbox axis 1

Use this procedure for the preparation of the frame before refitting the gearbox axis 1.

Action	Note
1 Remove residues of old sealing (Sikaflex) located between the gearbox unit and the frame as shown in the figure.	 xx1000000335
2 Apply grease on the <i>surface between gearbox unit and frame</i> (A).	<ul style="list-style-type: none"><li>A: Surface between gearbox unit and frame</li></ul>
3 Clean the <i>guidance edges</i> and the <i>joint surface</i> carefully.	<ul style="list-style-type: none"><li>B: Guidance edge</li><li>C: Joint surface</li></ul>

#### Preparation of the base before refitting gearbox axis 1

Use this procedure for preparation of the base before refitting the gearbox axis 1.

Action	Note
1 Clean the <i>joint surface</i> on the base carefully and check that the corresponding surface on the frame also is clean.	 xx1000000336
2 Clean the <i>painted surface</i> outside the guidance edge.	<ul style="list-style-type: none"><li>A: Guidance edge</li><li>B: Joint surface</li><li>C: Mercasol</li></ul>
3 Remove old corrosion coating from the guidance edge carefully.	See the figure above.
4 Apply <i>Mercasol</i> on the surface outside the guidance edge.	See the figure above.
 Note	Make sure there is no Mercasol on the joint surface.

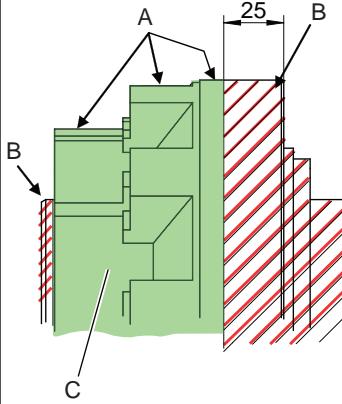
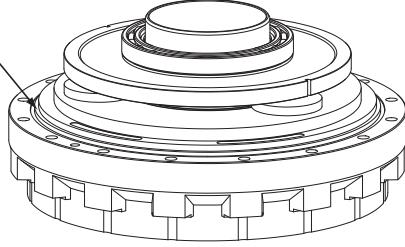
Continues on next page

## 4.7.1 Replacing gearbox axis 1

Continued

**Preparation of the spare part before refitting**

Use this procedure for preparation of the spare part before refitting it on Foundry Prime robots.

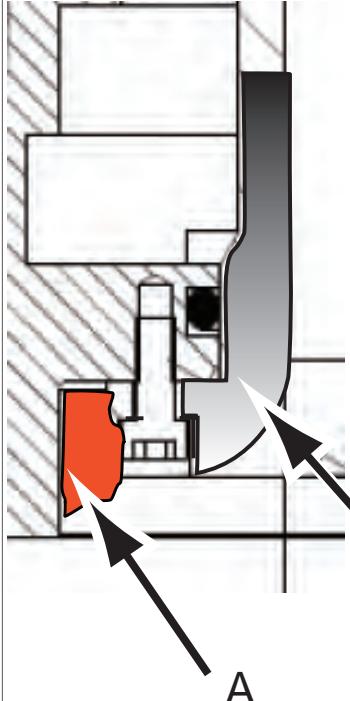
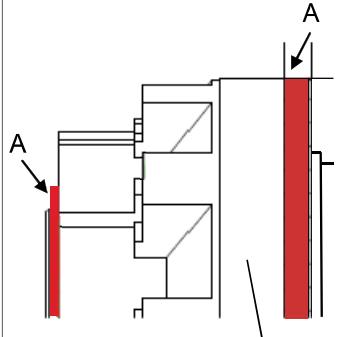
Action	Note
1 Check that the spare part (option Foundry Prime) is painted as shown in the figure.	 <p>xx1000000330</p> <ul style="list-style-type: none"> <li>• A: Painted surfaces</li> <li>• B: Unpainted surface</li> <li>• C: Gearbox</li> </ul>
2 Make sure the <i>o-ring</i> is fitted to the gearbox as shown in the figure to the right. Lightly lubricate the <i>o-ring</i> with grease.	 <p>xx1200000674</p> <p>A O-ring</p>

Continues on next page

## 4 Repair

### 4.7.1 Replacing gearbox axis 1

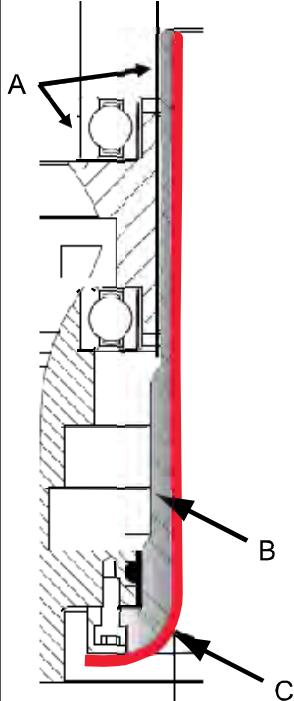
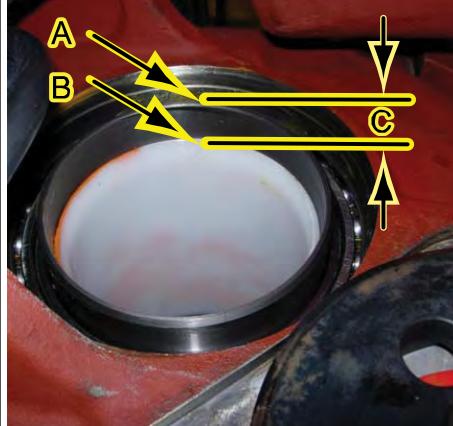
*Continued*

Action	Note
3 Apply <i>Sikaflex 521FC</i> in the gap at the end of the center tube as shown in the figure.	 <p>xx1000000332</p> <ul style="list-style-type: none"> <li>A: Sikaflex 521FC</li> <li>B: Center tube of gearbox</li> </ul>
4 Apply <i>Mercasol</i> on surfaces on the gearbox unit, as described in the figure.	 <p>xx1000000333</p> <ul style="list-style-type: none"> <li>A: Mercasol</li> <li>B: Gearbox</li> </ul>

*Continues on next page*

## 4.7.1 Replacing gearbox axis 1

Continued

Action	Note
5 Apply Mercasol inside the center tube of the gearbox unit as shown in the figure.	 <p>xx1000000334</p> <ul style="list-style-type: none"> <li>A: Grease on surfaces</li> <li>B: Center tube of gearbox</li> <li>C: Mercasol</li> </ul>
6 Pre-assemble the protection pipe axis 1 inside the center tube. The upper edge of the protection pipe shall be about 30 mm below the upper edge of the center tube.	 <p>xx1000000331</p> <ul style="list-style-type: none"> <li>A: Upper edge of center tube</li> <li>B: Upper edge of the protection pipe</li> <li>C: About 30 mm</li> </ul> <p>Use 2x M6x50 screws to fix the protection pipe in this temporary position.</p> <p> <b>Note</b></p> <p>The two M6x50 screws shall be replaced by two stainless M6x16 when the sealing ring has been installed.</p>

Continues on next page

## 4 Repair

### 4.7.1 Replacing gearbox axis 1

Continued

Action	Note
7 Fit the three <i>o-rings</i> in the oil filling holes on the gearbox. Use some grease to secure that they remain in place during the continued assembly.	See the figure in: <ul style="list-style-type: none"><li>• <i>Cutaway view of gearbox axis 1 on page 383</i></li></ul>

#### Refitting gearbox axis 1 on the base - Foundry Prime

Use this procedure to refit gearbox axis 1 on the base of a Foundry Prime robot.

Action	Note
1  Note  Before the start of refitting the gearbox, the necessary preparation procedures must be performed in order to get optimum result.	See <i>Replacing gearbox axis 1 on page 380</i> . <ul style="list-style-type: none"><li>• <i>Preparation of the frame before refitting gearbox axis 1 on page 386</i></li><li>• <i>Preparation of the base before refitting gearbox axis 1 on page 386</i></li><li>• <i>Preparation of the spare part before refitting on page 387</i></li></ul>
2 Check that both <i>joint surfaces</i> are clean. Clean if necessary!	See <i>Replacing gearbox axis 1 on page 380</i> . <ul style="list-style-type: none"><li>• <i>Preparation of the frame before refitting gearbox axis 1 on page 386</i> and <i>Preparation of the base before refitting gearbox axis 1 on page 386</i></li></ul>
3 Fit M16 guide pins in two corresponding attachment holes on the gearbox.	 Note  Make sure that the lifting eyes will not damage the <i>o-ring</i> .   Note  Make sure that the lifting chain will not damage the gear wheel during the lifting procedure.
4 Place the gearbox unit carefully on the guide pins and lower it in position.	
5 Remove the <i>guide pins</i> and secure the gearbox with its <i>attachment screws</i> .	M16x60 quality 12.9 (12 pcs) Tightening torque: 300 Nm   Note  Use new attachment screws and washers!

#### Refitting base with gearbox on the mounting site

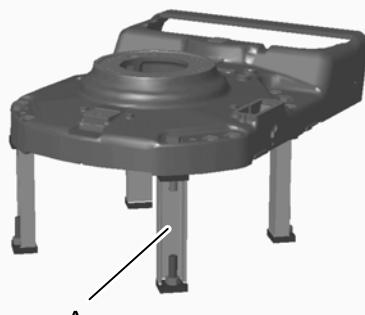
Use this procedure to refit the base with gearbox .

Action	Note
1 Apply Mercasol on <i>washers</i> and <i>screw heads</i> after tightening.	 Note  Make sure that Mercasol is not used on washers and threads of attachment screws before tightening!

Continues on next page

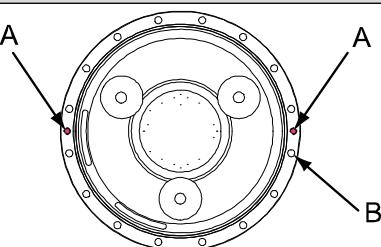
## 4.7.1 Replacing gearbox axis 1

Continued

Action	Note
2  <b>CAUTION</b> The complete gearbox unit and base weighs 241 kg together! (Base: 133 kg, gearbox unit: 108 kg.) All lifting equipment used must be sized accordingly!	
3 Lift the robot base and gearbox 1 in order to allow the removing of the support, base and gear axis 1.	 xx1000000364 <ul style="list-style-type: none"> <li>A: Support base and gear axis 1</li> </ul>
4 Secure the base to the mounting site.	See <a href="#">Replacing gearbox axis 1 on page 380</a> . <ul style="list-style-type: none"> <li>Orienting and securing the robot on page 93</li> </ul>
5 Remove the lifting eyes.	

**Refitting the complete arm system to the base - Foundry Prime**

Use this procedure to refit the complete arm system to the base on Foundry Prime robots.

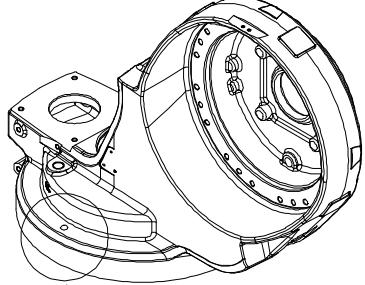
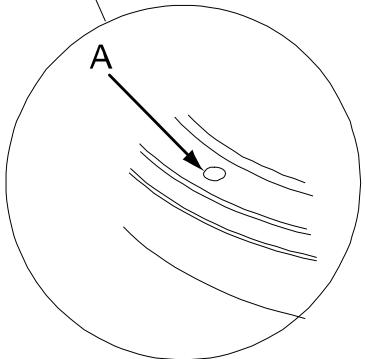
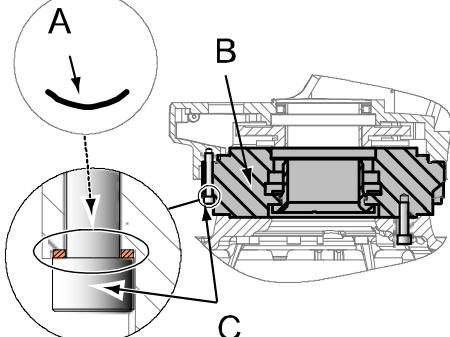
Action	Note
1 Fit two M12 guide pins in the holes shown in the figure.	 xx0600003095 <ul style="list-style-type: none"> <li>A: Holes for M12 guide pins in gearbox axis 1 (2 pcs)</li> <li>B: Holes for attachment screws (16 pcs)</li> </ul>
2 Fit the lifting equipment on the complete arm system as described in section <a href="#">Replacement of complete arm system on page 234</a> .	

*Continues on next page*

## 4 Repair

### 4.7.1 Replacing gearbox axis 1

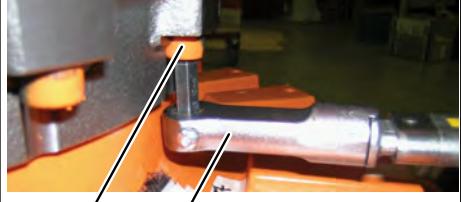
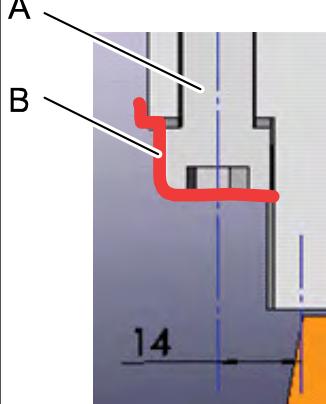
*Continued*

Action	Note
<p>3 Lower the arm system with the help from the guide pins fitted to the gearbox axis 1. Enter the guide pins in the corresponding holes in the frame.</p> <p><b>Note</b></p> <p>The refitting must be completely level. Make sure that the lifting device is adjusted prior to refitting of the arm system.</p>	  <p>xx0600003093</p> <ul style="list-style-type: none"> <li>A: Holes in the frame for guide pins, shown from above.</li> </ul>
<p>4 Fit the serrated lock washers on to the attachment screws. Check that the serrated lock washers are turned the right way as shown in the figure.</p> <p><b>Note</b></p> <p>Use new washers and attachment screws.</p>	 <p>xx0600003070</p> <ul style="list-style-type: none"> <li>A: Serrated lock washer</li> <li>B: Gearbox axis 1</li> <li>C: Attachment screws M12x80 quality 12.9 (16 pcs)</li> </ul>
5 Fit the 16 attachment screws, before the arm system is completely lowered.	Use new attachment screws.
6 Remove the guide pins and replace them with the remaining attachment screws.	
7 Lower the arm system into its place and secure the arm system to the base with its attachment screws.	

*Continues on next page*

## 4.7.1 Replacing gearbox axis 1

Continued

	Action	Note
8	<p>Tighten the screws with the correct tightening torque.</p> <p><b>Tip</b></p> <p>Use a torque wrench with a <i>holder for bits</i> as recommended in <a href="#">Replacing gearbox axis 1 on page 380</a>.</p> <p>The space is cramped.</p>	<p>Tightening torque: 105 Nm.</p>  <p>xx1000000362</p> <ul style="list-style-type: none"> <li>A: Attachment screw</li> <li>B: Holder for bits</li> </ul>
9	<p>Apply <i>Mercasol</i> on the attachment screws and washers.</p> <p><b>Note</b></p> <p><i>Mercasol</i> shall be applied <i>after</i> the attachment screws has been tightened!</p>	 <p>xx1000000363</p> <ul style="list-style-type: none"> <li>A: Attachment screw</li> <li>B: Mercasol</li> </ul>

Continues on next page

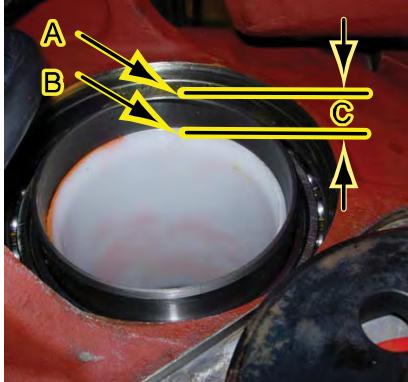
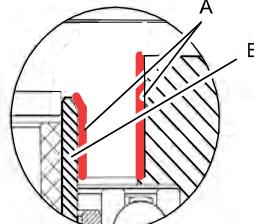
## 4 Repair

### 4.7.1 Replacing gearbox axis 1

*Continued*

#### Refitting protection pipe and cable guide - Foundry Prime

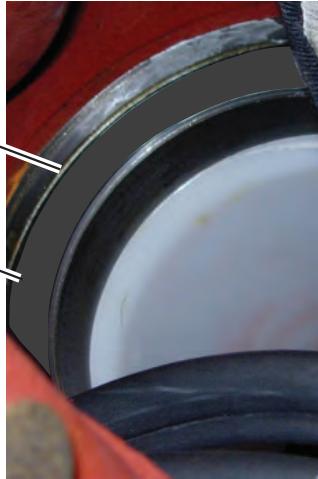
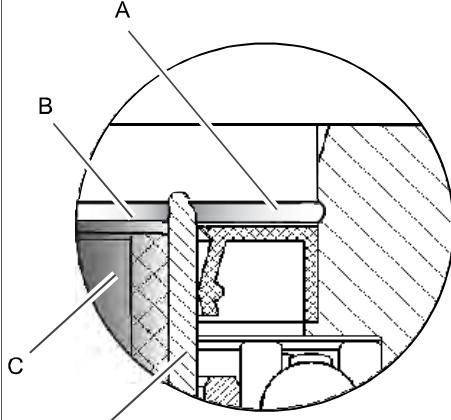
Use this procedure to install the protection pipe and cable guide on Foundry Prime robots.

Action	Note
1 Check that the <i>protection pipe</i> is temporarily installed as shown in the figure. This is important to be able to use the press tool when installing the sealing ring.	 xx1000000331 <ul style="list-style-type: none"> <li>A: Upper edge of center tube</li> <li>B: Upper edge of the protection pipe</li> <li>C: About 30 mm</li> </ul>
2 Lubricate the surfaces of the <i>center tube</i> with <i>grease</i> as shown in the figure.	 xx1000000365 <ul style="list-style-type: none"> <li>A: Surfaces to be lubricated with grease</li> <li>B: Center tube</li> </ul>
3 Install the <i>sealing ring</i> with the <i>press tool</i> . Use a <i>plastic mallet</i> .	For art. no. see: <ul style="list-style-type: none"> <li><a href="#">Required equipment on page 381</a></li> </ul>  xx1000000366 <ul style="list-style-type: none"> <li>A: Plastic mallet</li> <li>B: Press tool</li> </ul>

*Continues on next page*

## 4.7.1 Replacing gearbox axis 1

Continued

Action	Note
4 Check that the <i>sealing ring</i> is in the correct position. The <i>groove</i> for locking the cable guide shall be visible as shown in the figure.	 xx1000000367 <ul style="list-style-type: none"> <li>• A: Sealing ring</li> <li>• B: Groove</li> </ul>
5 Adjust the <i>protection pipe</i> to the <i>correct position</i> as shown in the figure by pushing it up inside the <i>center tube</i> .	<p> <b>Note</b></p> <p>The protection pipe is accessible from inside the base.</p>  xx1000000368 <ul style="list-style-type: none"> <li>• A: Groove</li> <li>• B: Correct position of protection pipe</li> <li>• C: Protection pipe</li> <li>• D: Center tube</li> </ul>

Continues on next page

## 4 Repair

### 4.7.1 Replacing gearbox axis 1

*Continued*

Action	Note
6 Replace the two screws temporarily used to secure the <i>protection pipe</i> , with two stainless attachment screws M6x16.	<p>View from below.</p> <p>xx1000000369</p> <ul style="list-style-type: none"> <li>A: Attachment screws (2 pcs)</li> <li>B: Protection pipe</li> </ul>
7 Apply <i>Mercasol</i> on surfaces as shown in the figure.	<p>xx1000000370</p> <ul style="list-style-type: none"> <li>A: Mercasol</li> <li>B: Protection pipe</li> <li>C: Sealing ring</li> </ul>
8 Install a new <i>cable guide</i> by pressing it down into position as shown in the figure.	<p><b>Note</b></p> <p>The cable guide shall be locked in position by the groove.</p> <p>xx1000000371</p> <ul style="list-style-type: none"> <li>A: Groove</li> <li>B: Cable guide</li> <li>C: Protection pipe</li> <li>D: Center tube</li> </ul>

*Continues on next page*

## 4.7.1 Replacing gearbox axis 1

Continued

Action	Note
9 Apply Sikaflex 521FC outside the <i>cable guide</i> as shown in the figure.	<p>xx1000000372</p> <ul style="list-style-type: none"> <li>A: Sikaflex 521FC</li> <li>B: Cable guide</li> </ul>

**Refitting the concluding parts - Foundry Prime**

Use this procedure to refit the concluding parts on Foundry Prime robots.

Action	Note
1 Refit the lower end of the <i>cable harness</i> .	See section <ul style="list-style-type: none"> <li><a href="#">Replacing cable harness, axes 1-6 on page 217</a></li> </ul>
2 Refit <i>motor axis 1</i> .	See section <ul style="list-style-type: none"> <li><a href="#">Replacing motor axis 1 on page 333</a></li> </ul>
3 Fill oil in gearbox axis 1.	See section <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-1 gearbox on page 166</a></li> </ul>
4 Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
5  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

## 4 Repair

### 4.7.2 Replacing gearbox axis 2

#### 4.7.2 Replacing gearbox axis 2

##### Introduction

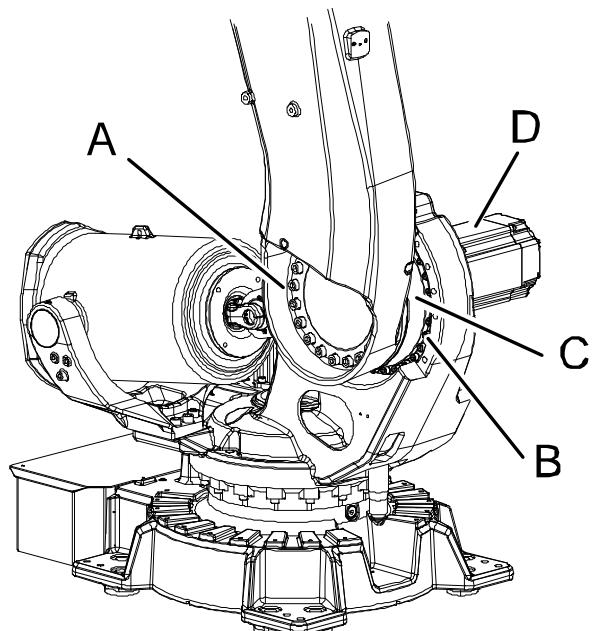
This section describes how to replace gearbox axis 2. It describes the procedures for both.

This section consist of the following parts:

- [Preparations before removing gearbox axis 2 on page 400](#)
- [Removing the armsystem on page 403](#)
- [Removing gearbox axis 2 on page 404](#)
- [Preparation of the frame before refitting of gearbox axis 2 on page 405](#)
- [Preparation of the lower arm before refitting of gearbox axis 2 on page 406](#)
- [Preparation of the spare part before refitting of gearbox axis 2 on page 407](#)
- [Refitting gearbox axis 2 to the frame on page 409](#)
- [Refitting the armsystem to gearbox axis 2 on page 410](#)
- [Refitting the cable harness on page 412](#)
- [Concluding refitting procedure on page 412](#)

##### Location of gearbox axis 2

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



xx0700000357

A	Attachment screws, M16x50 quality 12.9 Gleitmo (20 pcs)
B	Attachment screws, M12x60 quality 12.9 Gleitmo (32 pcs)
C	Gearbox axis 2
D	Motor axis 2

Continues on next page

**Required equipment**

Equipment	Art. no.	Note
Gearbox axis 2	For spare part number, see <a href="#">Spare parts on page 477</a> .	Includes: <ul style="list-style-type: none"><li>• Gearbox</li><li>• O-ring 3HAB3772-91</li></ul>
O-ring	3HAB3772-91	
Hex socket head cap screw	3HAB3409-84	M16x50 Quality 12.9 Gleitmo (20 pcs)
Washer	3HAA1001-186	17x25x3 (20 pcs)
Hex socket head cap screw	3HAB3409-71	M12x60 Quality 12.9 Gleitmo (32 pcs)
Washer	3HAA1001-134	13x19x1.5 (32 pcs)
Grease	3HAB3537-7	For lubricating o-rings
Lifting tool	3HAC025214-001	For lifting gearbox
Roundslings	-	
Shackle	-	Used for lifting the lower and upper arm without needing to use a hoisting block.
Lifting eye VLBG M12	3HAC16131-1	Used for lifting the lower and upper arm without needing to use a hoisting block.
Dismantling and mounting tool	3HAC028920-001	
Guide pins	3HAC13056-4	M12x250 Always use in pairs
Guide pins	3HAC13056-3	M12x200 Always use in pairs
Guide pins	3HAC022637-001	M16x130 Always use in pairs
Guide pins	3HAC13056-2	M16x150 Always use in pairs
Crank	3HAC020999-001	Used to turn the gear in the correct position
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</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

### 4.7.2 Replacing gearbox axis 2

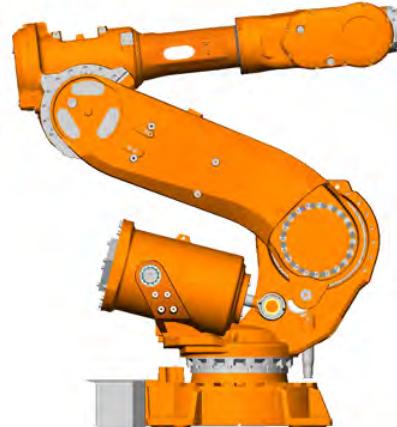
Continued

#### Additional equipment, Foundry Prime

Equipment	Art. no.	Note
Sikaflex 521FC	3HAC026579-001	Option Foundry Prime
Loctite 574	12340011-116	Option Foundry Prime
Rust preventive	3HAC034903-001	Option Foundry Prime Equivalent: <ul style="list-style-type: none"><li>• Mercasol</li></ul>
Brush	-	Option Foundry Prime

#### Preparations before removing gearbox axis 2

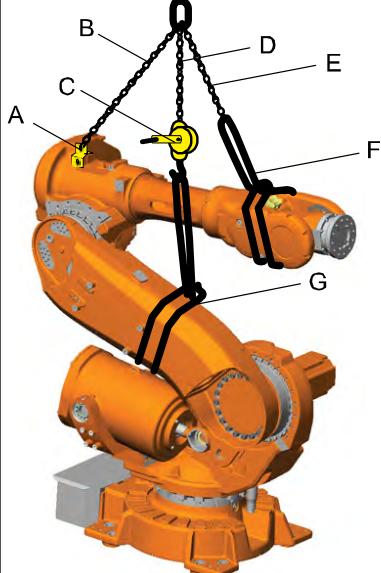
Use this procedure in order to make the necessary preparations for the removal of gearbox axis 2.

	Action	Information
1	Unload the balancing device.	Method 1 is described in section: <ul style="list-style-type: none"><li>• <a href="#">Unloading the balancing device using hydraulic press tool on page 327</a></li></ul> Method 2 is described in section: <ul style="list-style-type: none"><li>• <a href="#">Unloading the balancing device using distance tool on page 321</a></li></ul>
2	Remove the front shaft using the <i>dismantling and mounting tool</i> .	For art. no. see: <ul style="list-style-type: none"><li>• <a href="#">Required equipment on page 399</a></li></ul> How to use the tool is described in sections: <ul style="list-style-type: none"><li>• <a href="#">Replacing the balancing device (design 1) on page 297</a></li><li>• <a href="#">Replacing balancing device (design 2) on page 306</a></li></ul>
3	Jog the robot to the following position: <ul style="list-style-type: none"><li>• Axis 2 = -60°</li><li>• Axis 3 = +60°</li></ul>	 xx0700000351
4	 <b>CAUTION</b> The upper and lower arms (incl. gearboxes axes 2 and 3) weighs 455 kg. All lifting equipment used must be sized accordingly!	

Continues on next page

## 4.7.2 Replacing gearbox axis 2

Continued

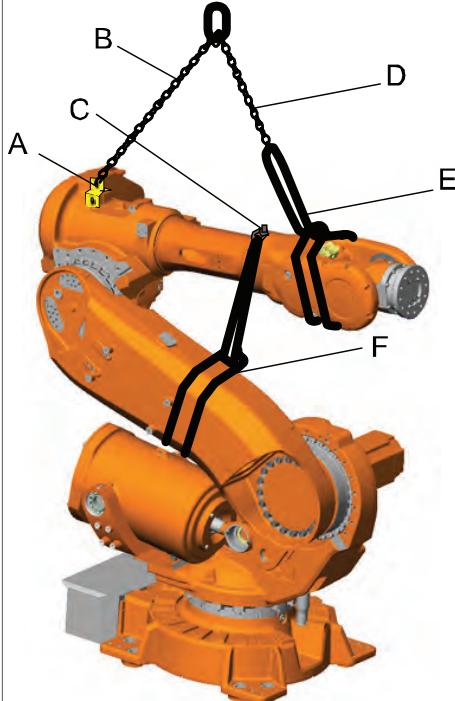
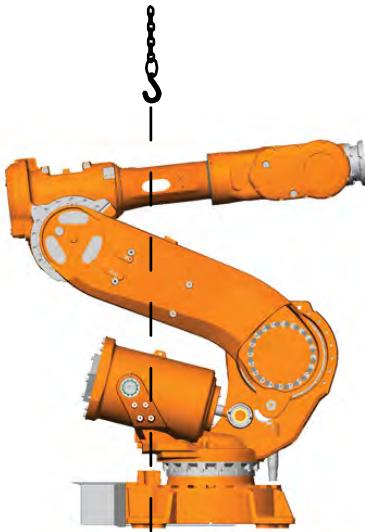
Action	Information
<p>5 Method 1 for lifting the upper and lower arms: Fit the <i>lifting tool</i> on the upper and lower arms as shown in the figure, and secure the robot in an overhead crane.</p>	 <p>xx0700000350</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Lifting eye (armhouse)</li> <li>• B: Lifting chain</li> <li>• C: Hoisting block</li> <li>• D: Lifting chain</li> <li>• E: Lifting chain</li> <li>• F: Roundsling (put in a loop around the wrist on the inside)</li> <li>• G: Roundsling (put in a loop around the lower arm)</li> </ul>

Continues on next page

## 4 Repair

### 4.7.2 Replacing gearbox axis 2

*Continued*

Action	Information
<p>6 Method 2 for lifting the upper and lower arms:</p> <ol style="list-style-type: none"> <li>1 Fit the <i>lifting accessories</i> on the upper and lower arms as shown in the figure, and secure the robot in an overhead crane.</li> <li>2 Jog axis 3 so that roundsling F is stretched.</li> </ol>	 <p>xx1200000675</p> <ul style="list-style-type: none"> <li>• A: Lifting eye (on arm house)</li> <li>• B: Lifting chain</li> <li>• C: Shackle and lifting eye VLBG M12</li> <li>• D: Lifting chain</li> <li>• E: Roundsling (put in a loop around the wrist on the inside)</li> <li>• F: Roundsling (1.5 m)</li> </ul>
<p>7 Raise the crane to reach lifting center and straighten the chains.</p>	 <p>xx0900000112</p>
<p>8 Release the brakes of axis 2 to let the weight of the arm system settle in the lifting accessories.</p>	

*Continues on next page*

	Action	Information
9	Drain the oil from gearbox axis 2.	See section <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-2 gearbox on page 169</a></li> </ul>

**Removing the armsystem**

	Action	Note
1	 <b>DANGER</b> <p>Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.  Also read the safety sections:</p> <ul style="list-style-type: none"> <li>• <a href="#">Safety risks related to pneumatic/hydraulic systems on page 27</a></li> <li>• <a href="#">Risks associated with live electric parts on page 29</a></li> <li>• <a href="#">Safety risks during installation and service work on robots on page 22</a></li> </ul>	
2	 <b>CAUTION</b> <p>Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot!  See <a href="#">Replacing parts on the robot on page 215</a></p>	
3	Remove the lower end of the cable harness.	See section <ul style="list-style-type: none"> <li>• <a href="#">Removing the cable harness - frame and base on page 221</a></li> </ul>
4	Loosen the cable attachment from the lower arm and pull up the cabling carefully. Let the removed part of the cable harness hang loose but be careful not to damage it during the continued removal process.	
5	Remove the attachment screws securing the lower arm to axis-2 gearbox.	M16x50 See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of gearbox axis 2 on page 398</a></li> </ul>
6	Lift away the upper and lower arms and put them down on the floor.	

*Continues on next page*

## 4 Repair

### 4.7.2 Replacing gearbox axis 2

Continued

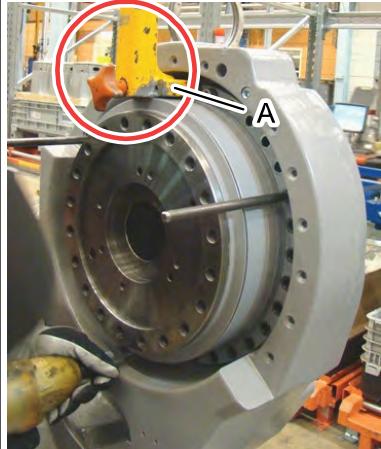
#### Removing gearbox axis 2

	Action	Note
1	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
2	Remove <i>motor axis 2</i> .	See section • <a href="#">Replacing motor axis 2 on page 340</a>
3	Remove two of the <i>attachment screws</i> ( <i>M12x60</i> ) parallel to each other, securing the gearbox to the frame. (The holes shall be used for the <i>guide pins</i> .)	 xx1000000376 Parts: • A: Guide pins (2 pcs)
4	Fit two <i>guide pins</i> in the holes as shown in the figure.	See the figure above.
5	 <b>CAUTION</b> The gearbox weighs 98 kg! All lifting equipment used must be sized accordingly!	
6	Remove the remaining <i>attachment screws</i> ( <i>M12x60</i> ).	See the figure in: • <a href="#">Location of gearbox axis 2 on page 398</a>

Continues on next page

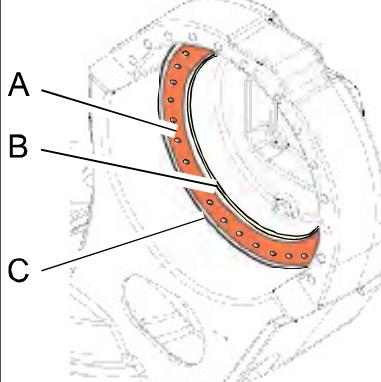
## 4.7.2 Replacing gearbox axis 2

Continued

Action	Note
7 Fit the <i>lifting tool</i> for lifting the gearbox and secure with a roundsling in an overhead crane or similar.	<p>For art. no. see: <a href="#">Required equipment on page 399</a></p>  <p>xx1000000378</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Lifting tool</li> </ul>
8 Remove the gearbox. Use two M12 screws to push out the gearbox, if necessary.	

**Preparation of the frame before refitting of gearbox axis 2**

Use this procedure to make the necessary preparations of the frame before refitting gearbox axis 2.

Action	Note
1 Clean the <i>machined surface</i> in the frame as shown in the figure, from paint, oil, corrosion coating or other kinds of contamination.	 <p>xx1000000379</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: Joint surface</li> <li>B: Surface for o-ring</li> <li>C: Machined surface</li> </ul>
2 Clean the <i>joint surface</i> carefully, by removing old corrosion coating and/or flange sealing from the surface.	See figure above.
3 Clean the <i>surface for the o-ring</i> .	See figure above

*Continues on next page*

## 4 Repair

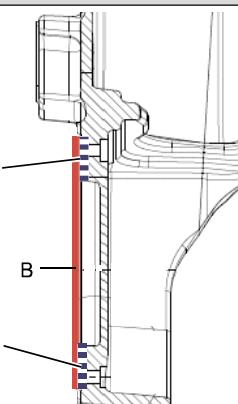
### 4.7.2 Replacing gearbox axis 2

Continued

	Action	Note
4	<p>Apply Mercasol on the <i>machined surface</i>.</p> <p><b>Note</b></p> <p>Make sure there is no Mercasol on the joint surface!</p>	See figure above

#### Preparation of the lower arm before refitting of gearbox axis 2

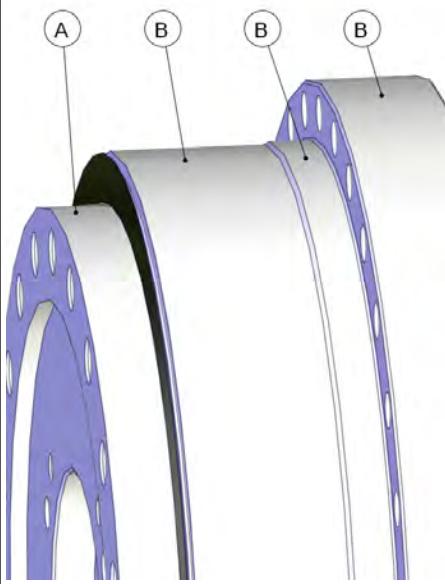
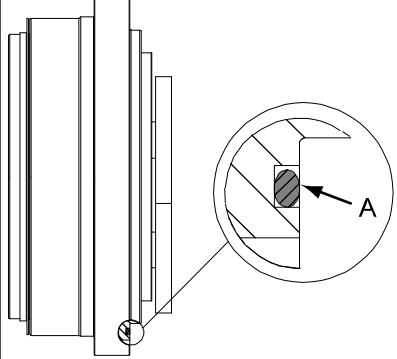
Use this procedure to make the necessary preparations of the lower arm before refitting gearbox axis 2.

	Action	Note
1	Clean the <i>joint surface</i> and <i>guidance edge</i> on the lower arm as shown in the figure.	 <p>xx1000000385</p> <p>Parts:</p> <ul style="list-style-type: none"><li>• A: Joint surface (dashed line)</li><li>• B: Guidance edge</li></ul>

Continues on next page

**Preparation of the spare part before refitting of gearbox axis 2**

Use this procedure to make the necessary preparations of the spare part before refitting gearbox axis 2.

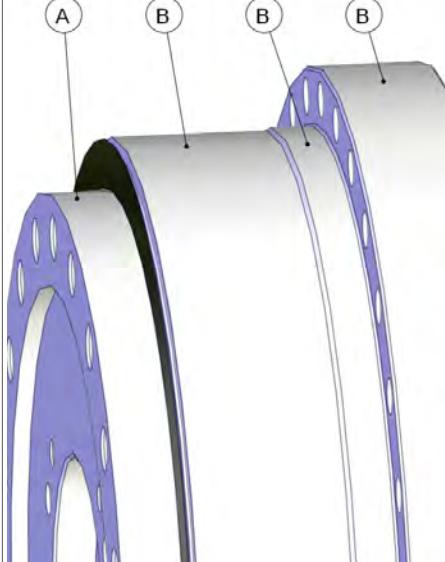
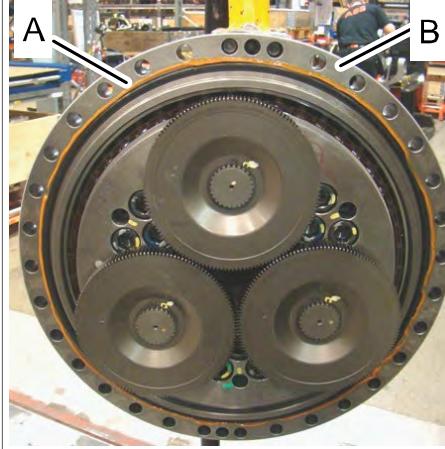
Action	Note
1 Check that the spare part is painted as shown in the figure.	 <p>xx1000000380</p> <ul style="list-style-type: none"> <li>A: Unpainted surfaces</li> <li>B: Painted surfaces</li> </ul>
2 Make sure that the <i>o-ring</i> (339.3x5.7) is fitted correctly on the new gear box unit.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li><i>Required equipment on page 399</i></li> </ul>  <p>xx0600003128</p>

*Continues on next page*

## 4 Repair

### 4.7.2 Replacing gearbox axis 2

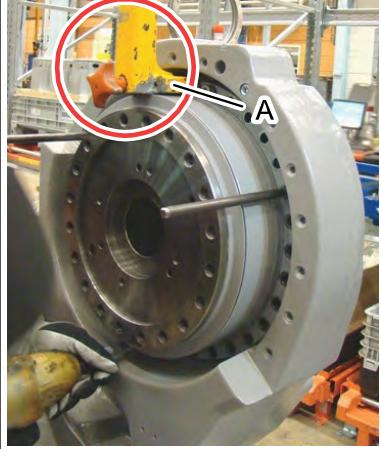
*Continued*

Action	Note
3 Apply a layer of <i>Mercasol</i> , with a thickness of minimum 0.5 mm, on the unpainted surface of the gearbox, as shown in the figure. Make sure the surface is covered properly, it should not be possible to see through the layer of Mercasol.	 xx1000000380 <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>A: Mercasol (on unpainted surface)</li> <li>B: Gearbox axis 2</li> </ul>
4 Clean the <i>joint surface</i> outside the o-ring.	 xx1000000383 <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>A: Flange sealing (Loctite 574)</li> <li>B: Joint surface</li> </ul>
5 Apply <i>flange sealing (Loctite 574)</i> on the joint surface outside the o-ring as shown in the figure.	See figure above.

*Continues on next page*

**Refitting gearbox axis 2 to the frame**

Use this procedure to refit gearbox axis 2.

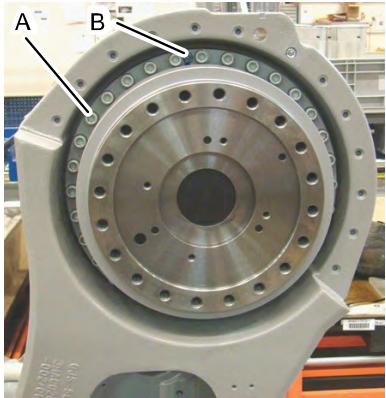
	Action	Note
1	 <b>CAUTION</b> The gearbox weighs 98 kg! All lifting equipment used must be sized accordingly!	
2	Fit the <i>lifting tool</i> , in the uppermost hole of the gearbox axis 2 and secure it with a roundsling in an overhead crane or similar.	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 399</a></li> </ul>  xx1000000378 Part: <ul style="list-style-type: none"> <li>• A: Lifting tool</li> </ul>
3	Fit two <i>guide pins</i> in two of the holes for the attachment screws, parallel to each other.	 xx1000000376 Part: <ul style="list-style-type: none"> <li>• A: Guide pins (2 pcs)</li> </ul>
4	Lift the gearbox on to the guide pins and push it to its mounting position.	
5	Secure the gearbox with its <i>attachment screws with washers</i> .	Tightening torque: 120 Nm For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 399</a></li> </ul> <p> <b>Note</b></p> Use new attachment screws and washers.

*Continues on next page*

## 4 Repair

### 4.7.2 Replacing gearbox axis 2

*Continued*

Action	Note
6 Install 2x M12x12 <i>set screws</i> in the threaded holes in the flange of the gearbox.	 xx1000000384 <b>Parts:</b> <ul style="list-style-type: none"><li>• A: Screw head</li><li>• B: Set screw (2 pcs opposite each other)</li></ul>
7 Apply <i>Mercasol</i> on all screw heads and set screws after tightening.	See figure above.

### Refitting the armsystem to gearbox axis 2

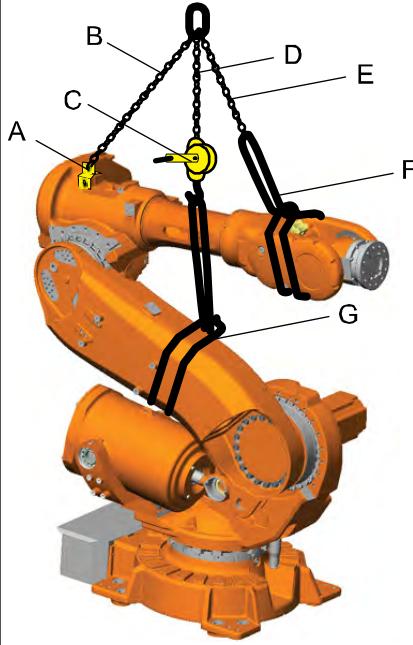
Use this procedure to refit the armsystem to gearbox axis 2.

Action	Note
1  <b>CAUTION</b> The upper and lower arms (incl. gearboxes axes 2 and 3) weighs 455 kg. All lifting equipment used must be sized accordingly!	

*Continues on next page*

## 4.7.2 Replacing gearbox axis 2

Continued

Action	Note
2 Fit the lifting tool on the upper and lower arms and secure the robot in an overhead crane.	 <p>xx0700000350</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>A: Lifting eye (armhouse)</li> <li>B: Lifting chain</li> <li>C: Hoisting block</li> <li>D: Lifting chain</li> <li>E: Lifting chain</li> <li>F: Roundsling (put in a loop around the wrist on the inside)</li> <li>G: Roundsling (put in a loop around the lower arm)</li> </ul>
3 Use a <i>crank</i> in the gearbox in order to find the holes for the attachment screws.	For art. no. see: <ul style="list-style-type: none"> <li><a href="#">Required equipment on page 399</a></li> </ul>
4 Secure the lower arm to gearbox axis 2 with its <i>attachment screws and washers</i> .	<p>Tightening torque: 300 Nm.      See the figure in:  <ul style="list-style-type: none"> <li><a href="#">Location of gearbox axis 2 on page 398</a></li> </ul> </p> <p>For art. no. see:  <ul style="list-style-type: none"> <li><a href="#">Required equipment on page 399</a></li> </ul> </p>
5 Apply Mercasol on all screw heads of the attachment screws after tightening them.	

Continues on next page

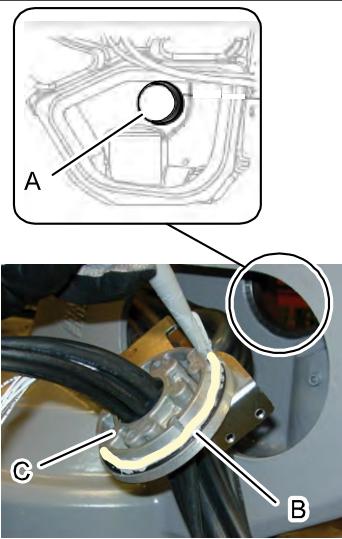
## 4 Repair

### 4.7.2 Replacing gearbox axis 2

*Continued*

#### Refitting the cable harness

Use this procedure to refit the cable harness.

Action	Note
1 Apply Sikaflex 521FC on the cover (at the SMB/BU units) mounted on the cable harness, before the harness is fitted in the hole in the frame.	 <p>xx1000000386</p> <p><b>Parts:</b></p> <ul style="list-style-type: none"> <li>• A: Hole (for cover)</li> <li>• B: Sikaflex 521FC</li> <li>• C: Cover</li> </ul>
2 Refit motor axis 2.	See section • <a href="#">Replacing motor axis 2 on page 340</a>
3 Refit the lower end of the cable harness.	See section • <a href="#">Replacing cable harness, axes 1-6 on page 217</a>

#### Concluding refitting procedure

Use this procedure for the concluding procedure of refitting.

Action	Note
1 Fill gearbox axis 2 with oil.	See section • <a href="#">Changing oil, axis-2 gearbox on page 169</a>
2 Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
3  <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

### 4.7.3 Replacing gearbox axis 3

---

#### Introduction

This section describes how to replace gearbox axis 3.

This section consist of the following parts:

- [\*Removal of gearbox axis 3 on page 416\*](#)
- [\*Preparations of lower arm before refitting of gearbox axis 3 on page 418\*](#)
- [\*Preparations of upper arm before refitting of gearbox axis 3 on page 419\*](#)
- [\*Preparations of spare part before the refitting on page 420\*](#)
- [\*Refitting gearbox axis 3 on the upper arm on page 421\*](#)
- [\*Refitting the upper arm on page 422\*](#)
- [\*Concluding refitting procedure on page 423\*](#)

*Continues on next page*

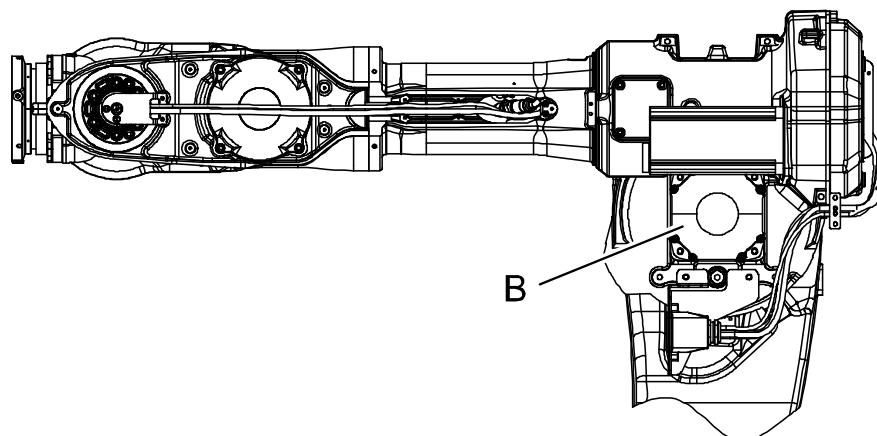
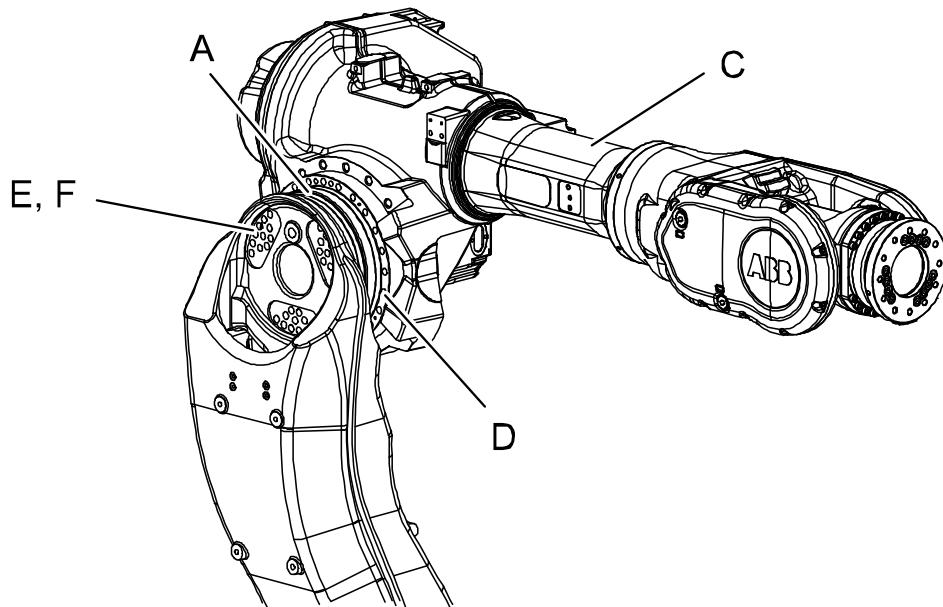
## 4 Repair

### 4.7.3 Replacing gearbox axis 3

*Continued*

#### Location of gearbox axis 3

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



xx0200000194

A	Gearbox, axis 3
B	Motor, axis 3
C	Upper arm
D	Attachment screws M12x60 quality 12.9 Gleitmo (24 pcs)
E	Attachment screws M12x50 quality 12.9 Gleitmo (33 pcs)
F	Washer (3 pcs)

#### Required equipment

Equipment	Spare part no.	Art no.	Note
Gearbox	See Spare parts chapter		<b>Includes:</b> <ul style="list-style-type: none"><li>• Gearbox</li><li>• O-ring 3HAB3772-68</li></ul>

*Continues on next page*

## 4.7.3 Replacing gearbox axis 3

*Continued*

Equipment	Spare part no.	Art no.	Note
Attachment screw	3HAB3409-71		M12x60 Quality 12.9 Gleitmo 24 pcs
Washer	3HAA1001-134		13x19x1.5 24 pcs
Attachment screw	3HAB7700-69		M12x50 Quality 12.9 Gleitmo 33 pcs
Washer	3HAC038648-001		3 pcs
Sealing, axis 2/3	3HAC17212-1		A new sealing must be used on each assembly.
O-ring	3HAB3772-68		Replace if damaged!
Grease		3HAB3537-1	For lubrication of o-rings
Mechanical stop axis 3		3HAC12708-1	Used to secure the upper arm. Use attachment screws 3HAB3409-86, M16x69
Washers		3HAA1001-186	For mechanical stop axis 3
Bolt		3HAB3409-86	M16x60 For mechanical stop axis 3
Lifting eye		3HAC025333-005	M12
Guide pins		3HAC13056-3	M12x200 For guiding gearbox Always use guide pins in pairs!
Guide pins		3HAC13056-4	M12x250 For guiding gearbox Always use guide pins in pairs!
Guide pins		3HAC14628-1	80 mm For guiding sealing ax 2/3 Always use guide pins in pairs!
Guide pins		3HAC14628-2	100 mm For guiding sealing ax 2/3 Always use guide pins in pairs!
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual
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

### 4.7.3 Replacing gearbox axis 3

Continued

#### Additional equipment, Foundry Prime

Equipment	Spare part no.	Art. no.	Note
Rust preventive		3HAC034903-001	Mercasol
Loctite 574		12340011-113	
Brush		-	

#### Removal of gearbox axis 3

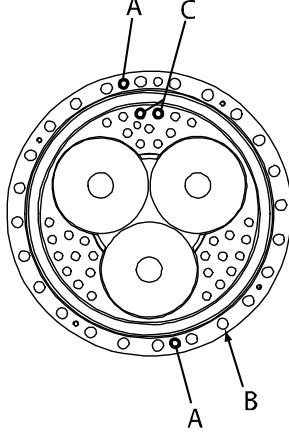
Use this procedure to remove gearbox axis 3.

	Action	Information
1	Remove all equipment fitted to turning disk.	
2	Move the upper arm to a horizontal position. Rotate axis 4 so that the <i>attachment hole for lifting eye</i> is faced upwards!	Shown in the figure <a href="#">Location of upper arm on page 269</a> .
3	Rotate axis 5 to position +90°.	
4	 <b>DANGER</b>  Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li></ul> to the robot, before entering the robot working area.	
5	 <b>CAUTION</b>  Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
6	Drain the axis-3 gearbox.	See section <ul style="list-style-type: none"><li>• <a href="#">Changing oil, axis-3 gearbox on page 172</a></li></ul>
7	Secure the upper arm in a horizontal position, using roundslings fitted in the lifting eye on the upper arm.	How to lift and remove the upper arm is described in section: <ul style="list-style-type: none"><li>• <a href="#">Removal, upper arm on page 272</a></li></ul>
8	Remove motor axis 3.	See section <ul style="list-style-type: none"><li>• <a href="#">Replacing motor axis 3 on page 348</a></li></ul>  <b>DANGER</b>  When removing motor axis 3, the brake on axis 3 is released. Make sure the upper arm is secured and disabled from moving.
9	Remove the upper arm.	See section <ul style="list-style-type: none"><li>• <a href="#">Removal, upper arm on page 272</a></li></ul>

Continues on next page

## 4.7.3 Replacing gearbox axis 3

Continued

Action	Information
10 Remove the <i>sealing</i> axis 2/3 between gearbox and lower arm.	<p> Note</p> <p>On reassembly a new sealing must be used! For art. no. see: <a href="#">Replacing gearbox axis 3 on page 413</a>.</p>
11 Place the removed upper arm safely on a workbench, in a fixture or similar.	
12 Remove the <i>attachment screws</i> that secure the axis-3 gearbox to the upper arm.	<p>See the figure in:</p> <ul style="list-style-type: none"> <li>• <a href="#">Location of gearbox axis 3 on page 414</a></li> </ul>
13 Fit two <i>guide pins</i> in 180° relation to each other in the holes for the attachment screws of the gearbox.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 414</a></li> </ul>
14 If required, use two M12 screws in the the holes shown in the figure, in order to press the gearbox free.	<p>For art. no. see:</p> <ul style="list-style-type: none"> <li>• <a href="#">Required equipment on page 414</a></li> </ul>  <p>xx0200000201</p> <ul style="list-style-type: none"> <li>• A: M12 holes for pressing the gearbox out</li> <li>• B: Holes for attachment screws, between gearbox and upper arm</li> <li>• C: Holes for attachment screws, between gearbox and lower arm</li> </ul>
15  CAUTION The gearbox weighs 60 kg! All lifting equipment used must be sized accordingly!	
16 Fit the lifting eye to the gearbox.	
17 Remove the gearbox with guidance from the guide pins. Use an overhead crane or similar.	

Continues on next page

## 4 Repair

### 4.7.3 Replacing gearbox axis 3

Continued

#### Preparations of lower arm before refitting of gearbox axis 3

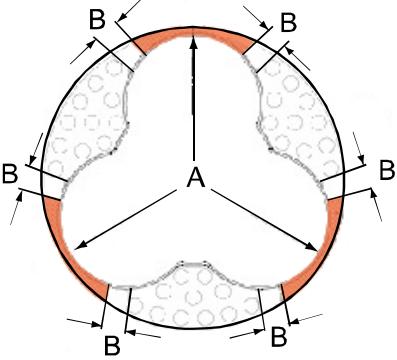
Use this procedure to make the necessary preparations of the lower arm before refitting gearbox axis 3.

Action	Note
1 Clean the machined surface on the lower arm where the gearbox axis is located.	
2 Careful cleaning of: <ul style="list-style-type: none"><li>• <i>guidance edges</i> for the gearbox in the lower arm</li><li>• <i>joint surface</i></li></ul>	 xx1000000432 <b>Parts:</b> <ul style="list-style-type: none"><li>• A: Joint surface (3x)</li><li>• B: Guidance edge (3x)</li><li>• C: Lower arm</li></ul>
3 Apply <i>Mercasol</i> on the guidance edges as well as between these.	 xx1000000433 <b>Parts:</b> <ul style="list-style-type: none"><li>• A: Mercasol on guidance edge</li><li>• B: Lower arm</li><li>• C: Joint surface (3x)</li></ul> <p> <b>Note</b></p> <p>Make sure that there is no Mercasol on the joint surfaces.</p>

Continues on next page

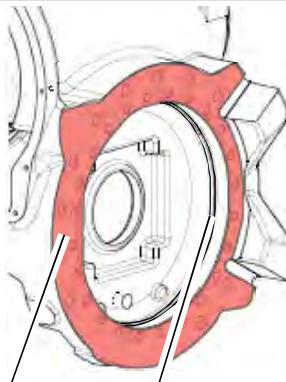
## 4.7.3 Replacing gearbox axis 3

Continued

Action	Note
<p>4 Apply <i>Loctite 574</i> on a new sealing ring on both sides.</p> <p><b>Note</b></p> <p>Do not apply the flange sealing closer than 20 mm from the edge of holes as shown in the figure.</p>	 <p>xx1000000434</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Surfaces with Loctite 574</li> <li>• B: Maximum 20 mm from edge holes</li> </ul>

**Preparations of upper arm before refitting of gearbox axis 3**

Use this procedure to make the necessary preparations of the upper arm before refitting gearbox axis 3.

Action	Note
<p>1 Clean the machined <i>joint surface</i> on the upper arm housing.</p> <p>Remove contaminations such as paint, oil, corrosion coating etc. from the surface.</p>	 <p>xx1000000435</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Joint surface</li> <li>• Surface for o-ring</li> </ul>
2 Clean the <i>surface for the o-ring</i> in the upper arm housing.	See figure above.

*Continues on next page*

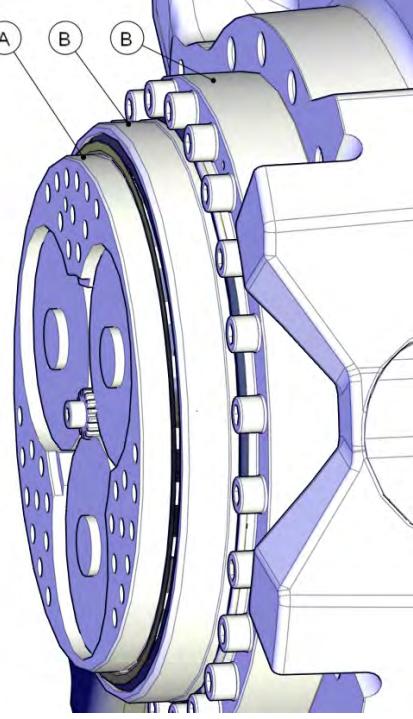
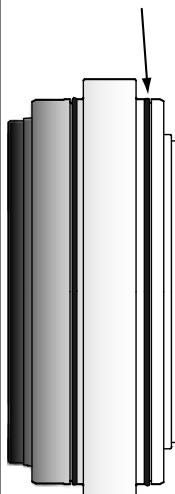
## 4 Repair

### 4.7.3 Replacing gearbox axis 3

*Continued*

#### Preparations of spare part before the refitting

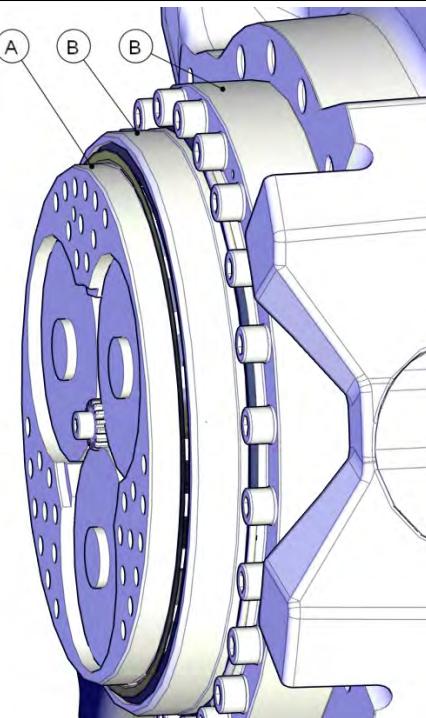
Use this procedure to make the necessary preparations of the spare part before the refitting.

Action	Note
1 Check that the spare part is painted as shown in the figure.	 xx1000000437 <b>Parts:</b> <ul style="list-style-type: none"><li>A: Unpainted surfaces</li><li>B: Painted surfaces</li></ul>
2 Make sure that the o-ring is fitted on the new gearbox unit.   <b>Tip</b>  Apply some grease on the o-ring in order to make it stay in the groove during assembly.	Dimension: 276x3.53  xx0200000173 <b>Part:</b> <ul style="list-style-type: none"><li>A: O-ring, gearbox axis 3</li></ul>

*Continues on next page*

## 4.7.3 Replacing gearbox axis 3

Continued

Action	Note
3 Apply <i>Mercasol</i> on the unpainted surface of the gearbox, as shown in the figure.	 xx1000000437 <p><b>Part:</b></p> <ul style="list-style-type: none"> <li>A: Mercasol</li> <li>B: Painted surfaces</li> </ul>
4 Apply <i>Loctite 574</i> on the flange outside the o-ring as shown in the figure.	 xx1000000438 <p><b>Part:</b></p> <ul style="list-style-type: none"> <li>A: Loctite 574</li> </ul>

**Refitting gearbox axis 3 on the upper arm**

Use this procedure to refit gearbox axis 3 on the upper arm.

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> </ul> to the robot, before entering the robot working area.	

*Continues on next page*

## 4 Repair

### 4.7.3 Replacing gearbox axis 3

*Continued*

Action	Note
2 Turn the upper arm in such a position that the gear mating surface faces upwards.	
3 Fit two <i>guide pins</i> in 180° relation to each other in the holes of the upper arm, used for the attachment screws of the gearbox	For art. no. see: • <a href="#">Required equipment on page 414</a>
4  <b>CAUTION</b>  The gearbox weighs 60 kg! All lifting equipment used must be sized accordingly!	
5 Lift the gearbox to its mounting position.	
6 Turn the gearbox to align the holes of the attachment screws of the gearbox with those in the upper arm.	
7 Place the gearbox on the guide pins and slide it carefully into position.	
8 Make sure that: • the <i>o-rings</i> are seated correctly • the gearbox is correctly oriented.	
9 Remove the lifting tool.	
10 Secure the gearbox with 22 of the 24 attachment screws. Tightening torque: 115 Nm	M12x60
 <b>Note</b>  Use new attachment screws and washers!	

### Refitting the upper arm

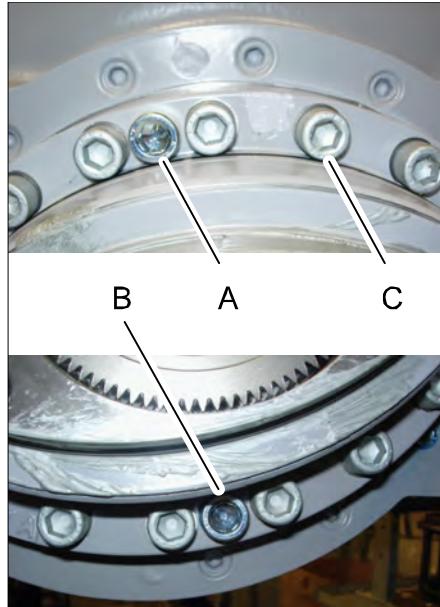
Use this procedure to refit the upper arm.

Action	Note
1 Fill the <i>hole for the slotted spring pin</i> with Sikaflex 521FC.	 xx1000000439 Part: • A: Hole for slotted spring pin

*Continues on next page*

## 4.7.3 Replacing gearbox axis 3

Continued

Action	Note
2 Fit M12x16 bolts in the two M12 disassembly holes.	<p> Note Max length 40 mm.</p>  <p>xx1000000440</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>A: M12 bolt for disassembly, upper</li> <li>B: M12 bolt for disassembly, lower</li> <li>C: Attachment screw M12x60 (24 pcs)</li> </ul>
3 Apply Mercasol on the heads of all M12 attachment screws after tightening.	See figure above.
4 Refit the upper arm.	<p> Note Use a new sealing axis 2/3.</p> <p>How to lift and refit the upper arm is described in section:</p> <ul style="list-style-type: none"> <li><a href="#">Replacement of upper arm on page 269</a></li> </ul> <p>For art. no. see:</p> <ul style="list-style-type: none"> <li><a href="#">Required equipment on page 414</a></li> </ul>

## Concluding refitting procedure

Use this procedure for the concluding procedure of refitting gearbox axis 3.

Action	Note
1 Refill gearbox axis 3 with oil.	<p>See section</p> <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-3 gearbox on page 172</a></li> </ul>
2 Refit motor axis 3.	<p>See section</p> <ul style="list-style-type: none"> <li><a href="#">Replacing motor axis 3 on page 348</a></li> </ul>
3 Recalibrate the robot.	<p>Calibration is detailed in a separate calibration manual enclosed with the calibration tools.</p> <p>General calibration information is included in section <a href="#">Calibration information on page 431</a>.</p>

Continues on next page

## 4 Repair

### 4.7.3 Replacing gearbox axis 3

*Continued*

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

## 4.7.4 Replacing gearbox axis 6

### Introduction

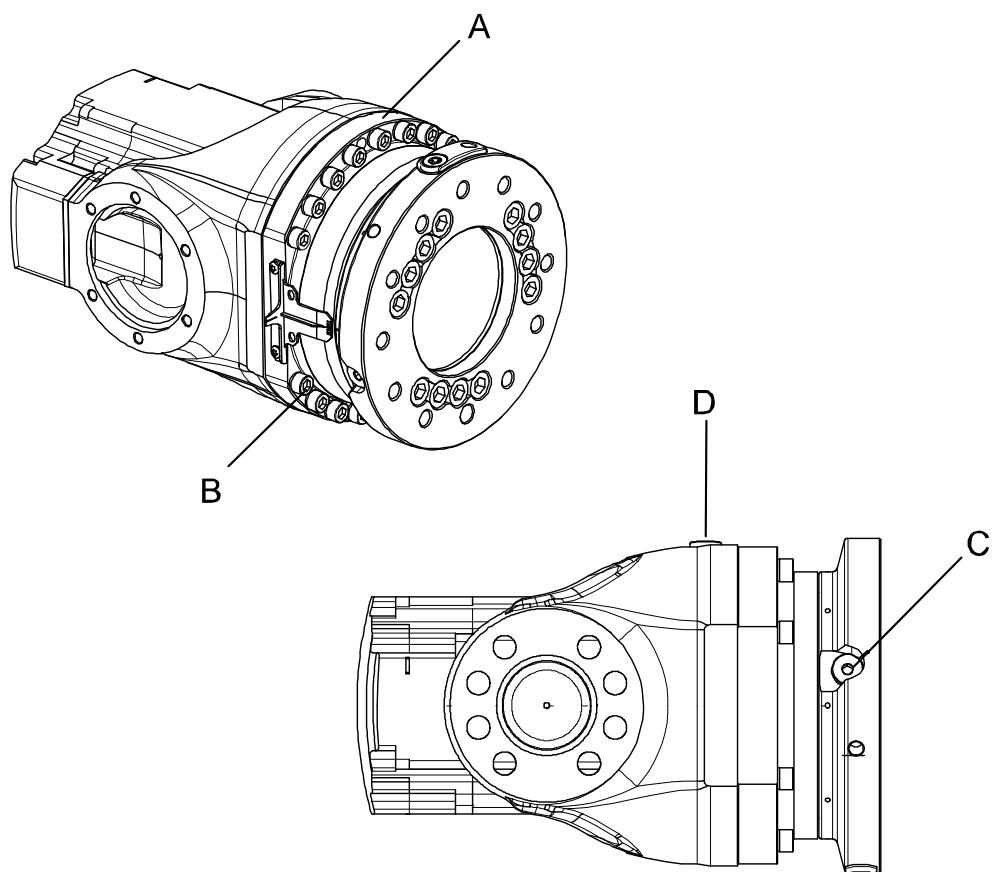
This section describes how to replace gearbox axis 6.

This section consists of the following parts:

- [Removing gearbox axis 6 on page 427](#)
- [Refitting gearbox axis 6 on page 428](#)
- [Concluding refitting procedure on page 429](#)

### Location of gearbox axis 6

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



xx0200000219

A	Gearbox, axis 6
B	Attachment screws, M8x40 with washers (18 pcs)
C	Oil plug, draining
D	Oil plug, filling
-	O-ring (not shown in the figure)

*Continues on next page*

## 4 Repair

### 4.7.4 Replacing gearbox axis 6

*Continued*

#### Required equipment

Equipment	Spare part no.	Art. no.	Note
Gearbox, type 1	See Spare parts		Includes: <ul style="list-style-type: none"><li>• Gearbox</li><li>• O-ring 3HAB3772-58</li></ul>
Gearbox, type 2	See Spare parts		Includes: <ul style="list-style-type: none"><li>• Gearbox</li><li>• O-ring 3HAB3772-57</li></ul>
Attachment screw	3HAB7700-55		M8x40 Quality 12.9 Gleitmo 18 pcs
Washer	3HAA1001-172		8.4x13x1.5 18 pcs
O-ring (type 1)	3HAB3772-58		152.0x3.53 Must be replaced when reassembling the gearbox.
O-ring (type 1)	3HAB3772-65		131.0x2.0 Must be replaced when reassembling the gearbox.
O-ring (type 1)	21520431-20		15.5x1.5 Must be replaced when reassembling the gearbox. 6 pcs
O-ring (type 2)	3HAB3772-57		164.7x3.53 Must be replaced when reassembling the gearbox.
O-ring (type 2)	3HAB3772-64		150.0x2.0 Must be replaced when reassembling the gearbox.
O-ring (type 2)	3HAB3772-61		13.1x1.6 Must be replaced when reassembling the gearbox. 12 pcs
Grease		3HAB3537-1	For lubricating o-ring
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit which also includes Operating manual.
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.

#### Required equipment - Foundry Prime

Equipment	Spare part no.	Art. no.	Note
Rust preventive		3HAC034903-001	Mercasol

*Continues on next page*

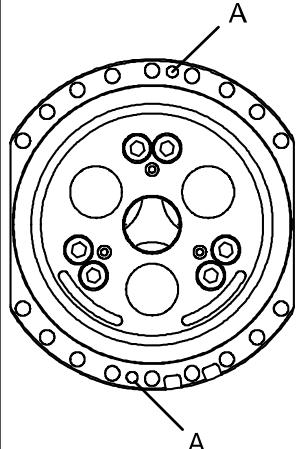
## 4.7.4 Replacing gearbox axis 6

Continued

Equipment	Spare part no.	Art. no.	Note
Loctite 574		12340011-116	
Brush		-	

**Removing gearbox axis 6**

Use this procedure to remove gearbox axis 6.

	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> </ul> to the robot, before entering the robot working area.	
2	 <b>CAUTION</b> Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <a href="#">Replacing parts on the robot on page 215</a>	
3	Drain the oil from gearbox axis 6.	See section <ul style="list-style-type: none"> <li>• <a href="#">Changing oil, axis-6 gearbox on page 181</a></li> </ul>
4	Remove the <i>turning disk</i> .	See section <ul style="list-style-type: none"> <li>• <a href="#">Replacing the turning disk on page 255</a></li> </ul>
5	Remove the gearbox by unscrewing its 18 attachment screws.	See section <ul style="list-style-type: none"> <li>• <a href="#">Location of gearbox axis 6 on page 425</a></li> </ul>
6	Only valid for type 2 of the wrist unit: If required, fit two M8 screws in the holes in order to press out the gearbox.	 xx0200000220 Part: <ul style="list-style-type: none"> <li>• A: M8 holes for pressing out the gearbox</li> </ul>

*Continues on next page*

## 4 Repair

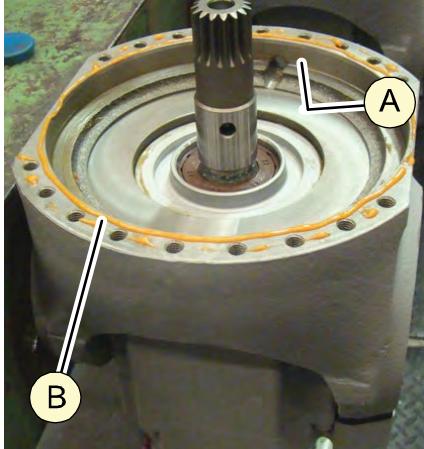
### 4.7.4 Replacing gearbox axis 6

*Continued*

Action	Information
7 Remove the gearbox by lifting it out carefully.	 <b>CAUTION</b> Do not damage the pinion of the motor!

#### Refitting gearbox axis 6

Use this procedure to refit gearbox axis 6.

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></ul> to the robot, before entering the robot working area.	
2 Make sure the <i>o-ring</i> is fitted to the rear of the gearbox.  Lubricate the <i>o-ring</i> with <i>grease</i> .	
3 Put grease on the surface of the <i>guiding edge</i> and on the <i>contact surface for the RV gearbox</i> in the tilthouse.	 xx1000000446 <b>Parts:</b> <ul style="list-style-type: none"> <li>• A: Surface of guiding edge and RV gearbox</li> <li>• B: Loctite 574</li> </ul>
4 Apply <i>Loctite 574</i> on the joint surface of the tilthouse.	See the figure above.
5 Release the <i>holding brake</i> of motor axis 6.	See section <ul style="list-style-type: none"> <li>• <a href="#">Manually releasing the brakes on page 85</a></li> </ul>
6 Place <i>gearbox axis 6</i> in the wrist unit.   <b>Note</b>  Make sure the gears of the gearbox mate with the gears of the motor!	For art. no. see: <ul style="list-style-type: none"> <li>• <a href="#">Spare parts</a></li> </ul> See the figure in: <ul style="list-style-type: none"> <li>• <a href="#">Location of gearbox axis 6 on page 425</a></li> </ul>

*Continues on next page*

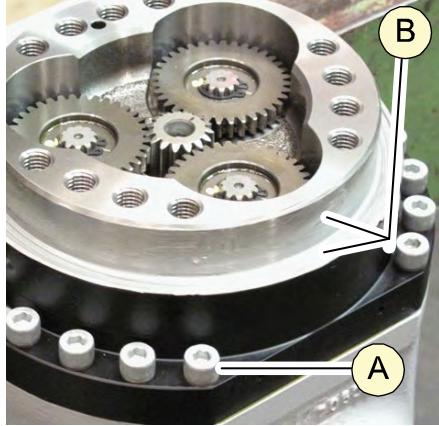
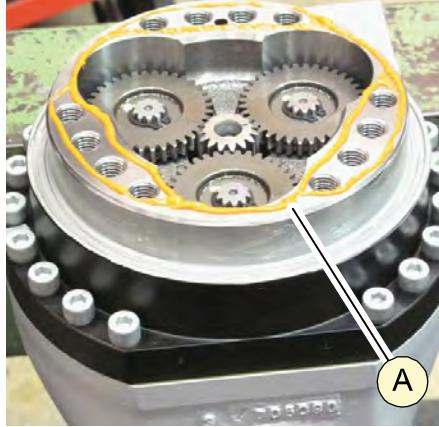
## 4.7.4 Replacing gearbox axis 6

Continued

	Action	Note
7	<p>Secure the gearbox with its <i>attachment screws and washers</i>. Tightening torque: 30 Nm.</p> <p> Note Use new attachment screws and washers!</p>	<p>See the figure in:</p> <ul style="list-style-type: none"> <li>• <a href="#">Location of gearbox axis 6 on page 425</a></li> </ul> <p>M8x40 quality 12.9 Gleitmo (18 pcs)</p>

**Concluding refitting procedure**

Use this procedure for the concluding procedure of refitting gearbox axis 6 on Foundry Prime robots.

	Action	Note
1	Apply rust protection <i>Mercasol</i> on the attachment screws after tightening.	 <p>xx1000000447</p> <p>Parts:</p> <ul style="list-style-type: none"> <li>• A: Attachment screws (18 pcs)</li> <li>• B: Surfaces with Mercasol</li> </ul>
2	Apply rust protection <i>Mercasol</i> on surfaces shown in the figure.	See the figure above!
3	Apply <i>Loctite 574</i> on surfaces of the gearbox as shown in the figure.	 <p>xx1000000448</p> <p>Part:</p> <ul style="list-style-type: none"> <li>• A: Loctite 574</li> </ul>

*Continues on next page*

## 4 Repair

### 4.7.4 Replacing gearbox axis 6

Continued

	Action	Note
4	Refit the <i>turning disk</i> .	See section <ul style="list-style-type: none"><li>• <a href="#">Replacing the turning disk on page 255</a></li></ul>
5	Perform a <i>leak-down test</i> .	See section <ul style="list-style-type: none"><li>• <a href="#">Performing a leak-down test on page 210</a></li></ul>
6	Refill gearbox axis 6 with <i>oil</i> .	See section <ul style="list-style-type: none"><li>• <a href="#">Changing oil, axis-6 gearbox on page 181</a></li></ul>
7	Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <a href="#">Calibration information on page 431</a> .
8	 <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="#">DANGER - First test run may cause injury or damage! on page 48</a> .	

# 5 Calibration information

## 5.1 When to calibrate

### When to calibrate

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

#### The resolver values are changed

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

If the robot has *absolute accuracy* calibration, it is also recommended, but not always necessary to calibrate for new absolute accuracy.

The resolver values will change when parts affecting the calibration position are replaced on the robot, for example motors or parts of the transmission.

#### The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See [Updating revolution counters on page 436](#). This will occur when:

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

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

#### The robot is rebuilt

If the robot is rebuilt, for example, after a crash or when the reach ability of a robot is changed, it needs to be recalibrated for new resolver values.

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

## 5 Calibration information

### 5.2 Calibration methods

#### 5.2 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	<p>The calibrated robot is positioned at calibration position.</p> <p>Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.</p> <p>For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.</p>	Calibration Pendulum
Absolute accuracy calibration (optional)	<p>Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for:</p> <ul style="list-style-type: none"><li>Mechanical tolerances in the robot structure</li><li>Deflection due to load</li></ul> <p>Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot.</p> <p>Absolute accuracy calibration data is found on the SMB (serial measurement board) in the robot.</p> <p>For robots with RobotWare 5.05 or older, the absolute accuracy calibration data is delivered in a file, absacc.cfg, supplied with the robot at delivery. The file replaces the calib.cfg file and identifies motor positions as well as absolute accuracy compensation parameters.</p> <p>A robot calibrated with absolute accuracy has a sticker next to the identification plate of the robot.</p> <p>To regain 100% absolute accuracy performance, the robot must be recalibrated for absolute accuracy!</p>  <p>ABSOLUTE ACCURACY</p> <p>xx0400001197</p> <p>3HAC 14257-1</p>	CalibWare

##### Brief description of calibration methods

###### Calibration Pendulum method

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

*Continues on next page*

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

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

#### CalibWare - Absolute Accuracy calibration

To achieve a good positioning in the Cartesian coordinate system, Absolute Accuracy calibration is used as a TCP calibration. The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field 5.0*.

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

---

#### References

Article numbers for the calibration tools are listed in the section [Special tools on page 456](#).

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

## 5 Calibration information

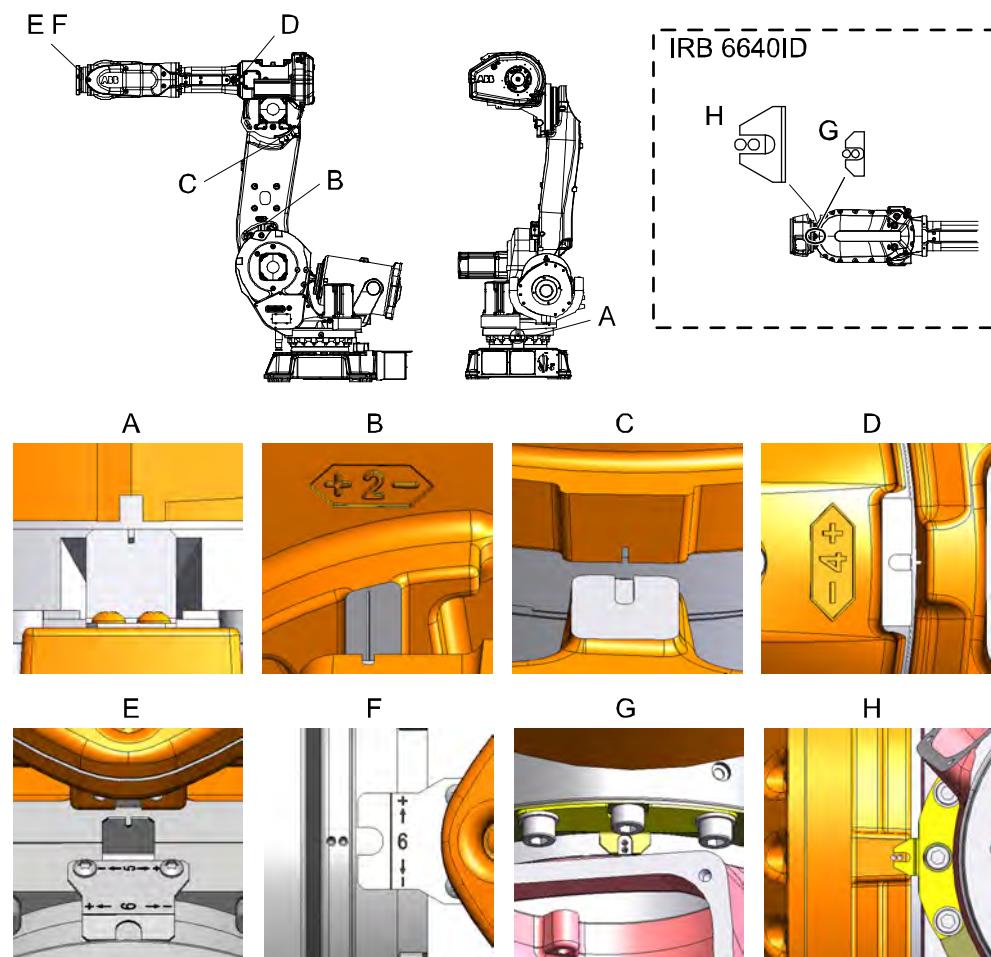
### 5.3 Synchronization marks and synchronization position for axes

#### Introduction

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

#### Synchronization marks, IRB 6640 and IRB 6640ID

The figure below shows the positions of the calibration marks on the robot.



xx0700000340

A	Calibration mark axis 1
B	Calibration mark axis 2
C	Calibration mark axis 3
D	Calibration mark axis 4
E	Calibration mark axis 5
F	Calibration mark axis 6
G	Calibration mark axis 5, IRB 6640ID
H	Calibration mark axis 6, IRB 6640ID

## 5.4 Calibration movement directions for all axes

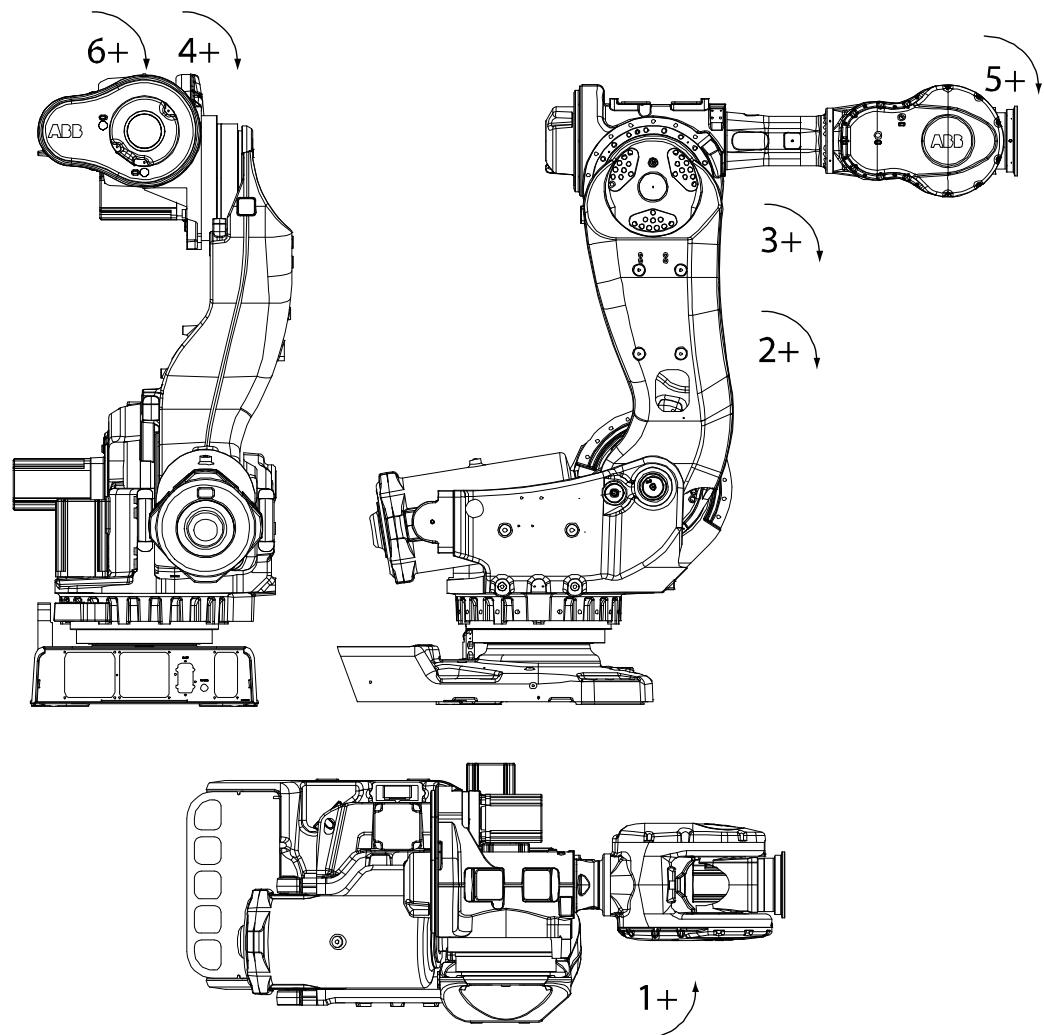
### Overview

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

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

### Manual movement directions, 6 axes

Note! The graphic shows an IRB 7600. The positive direction is the same for all 6-axis robots, except the positive direction of axis 3 for IRB 6400R, which is in the opposite direction!



xx0200000089

## 5 Calibration information

### 5.5 Updating revolution counters

#### 5.5 Updating revolution counters

##### Introduction

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

##### 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. IRB 140, 1400, 2400, 4400, 6600ID/6650ID, 6640ID: Axes 5 and 6 must be positioned together!	See <a href="#">Synchronization marks and synchronization position for axes on page 434</a> .
3 When all axes are positioned, update the revolution counter.	<a href="#">Step 2 - Updating the revolution counter with the FlexPendant on page 437</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:

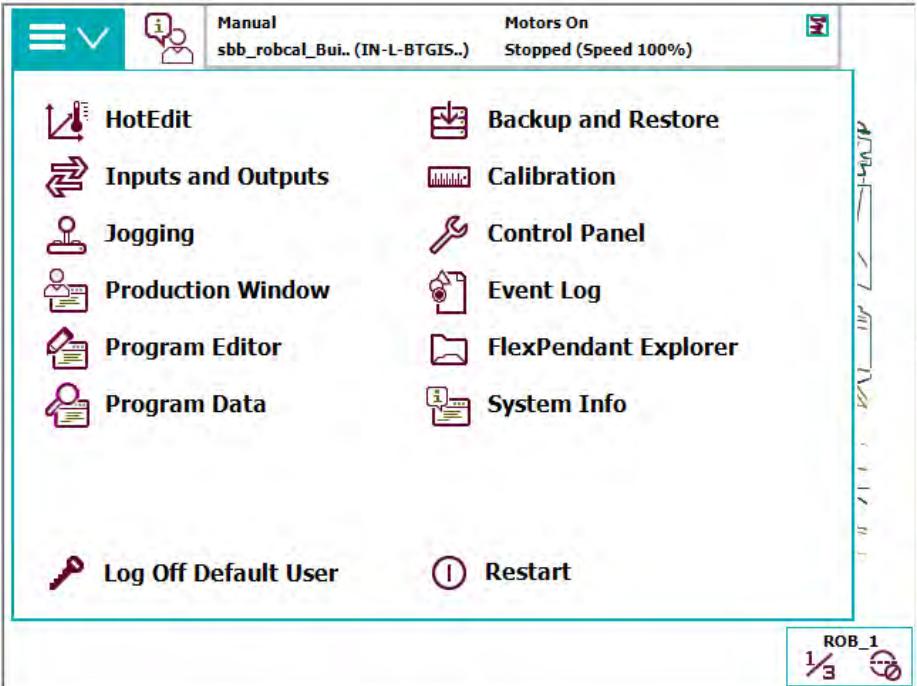
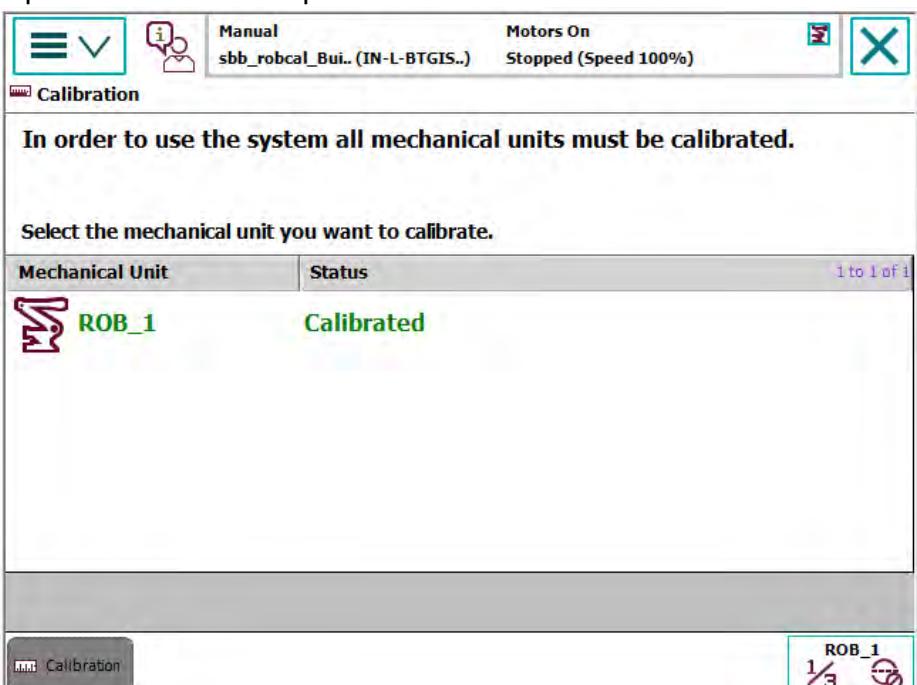
Manipulator variant	Axis 4	Axis 6
IRB 6640 -180/2.55	Yes	No
IRB 6640 - 235/2.55, 205/2.75, 185/2.8, 130/3.2	Yes	Yes
IRB 6640ID - 170/2.75, 200/2.55	Yes	No

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

Continues on next page

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

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

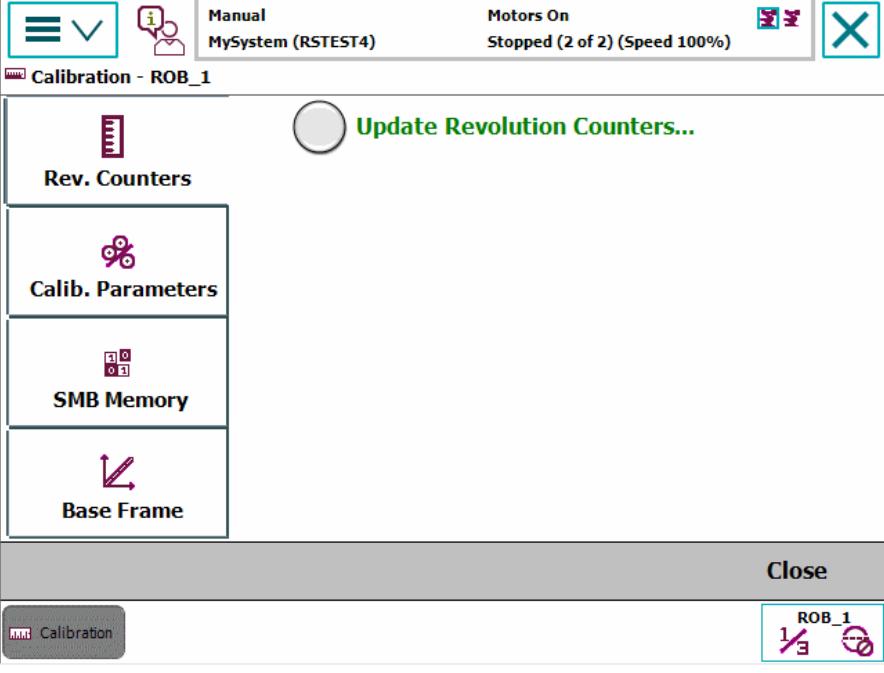
Action
<p>1 On the ABB menu, tap Calibration.</p>  <p>The screenshot shows the ABB menu interface. At the top, it says 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below the menu bar is a list of icons and their corresponding functions: HotEdit, Backup and Restore; Inputs and Outputs, Calibration; Jogging, Control Panel; Production Window, Event Log; Program Editor, FlexPendant Explorer; Program Data, System Info. At the bottom left is a 'Log Off Default User' button, and at the bottom right is a 'Restart' button. The 'Calibration' icon is highlighted with a red box.</p>
<p>2 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, it says 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below the title, it says 'In order to use the system all mechanical units must be calibrated.' A table titled 'Select the mechanical unit you want to calibrate.' shows one entry: 'Mechanical Unit' (ROB_1) and 'Status' (Calibrated). At the bottom left is a 'Calibration' button, and at the bottom right is a 'ROB_1' button with a red box around it.</p>

*Continues on next page*

## 5 Calibration information

### 5.5 Updating revolution counters

*Continued*

Action
<p>3 A screen is displayed, tap <b>Rev. Counters</b>.</p> 
<p>4 Tap <b>Update Revolution Counters....</b>. 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>
<p>5 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>
<p>6 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>
<p>7  <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 439</a>.</p>

## 5.6 Checking the synchronization position

### Introduction

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

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

### Using 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]] \NoEOoffs, 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 434</a> and <a href="#">Updating revolution counters on page 436</a> .

### Using the jogging window

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

	Action	Note
1	On the ABB menu, tap <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 434</a> and <a href="#">Updating revolution counters on page 436</a> .

**This page is intentionally left blank**

# 6 Decommissioning

## 6.1 Introduction

---

### 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.

---

### 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**

##### **Hazardous material**

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

Dispose components properly to prevent health or environmental hazards.

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

##### **Oil and grease**

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

Also note that:

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

#### 6.3 Scrapping of robot

##### Important when scrapping the robot



###### DANGER

When a robot is disassembled while being scrapped, it is very important to remember the following before disassembling starts, in order to prevent injuries:

- Always remove all batteries from the robot. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.

## 6 Decommissioning

### 6.4 Decommissioning of balancing device

#### General

There is much energy stored in the balancing device. Therefore a special procedure is required to dismantle it. The coil springs inside the balancing device exert a potentially lethal force unless dismantled properly.

The device must be dismantled by a decommissioning company.

#### Required equipment

Equipment	Art. no.	Note
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 455</a> .
Protective clothing that also covers face and hands	-	Must protect against spatter of sparks and flames.
Cutting torch with a long shaft	-	For opening housing and cutting coils. The long shaft is a safety requirement.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.



#### DANGER

*Do not under any circumstances, deal with the balancing device in any other way than that detailed in the product documentation! For example, attempting to open the balancing device is potentially lethal!*

#### Action on field, decommissioning

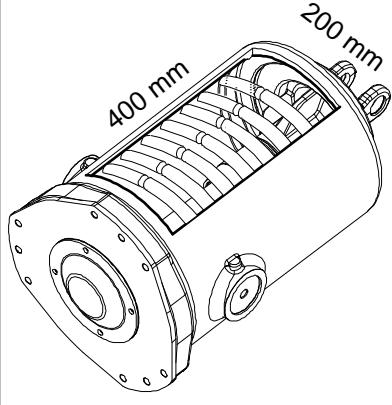
The procedure below details the actions to perform on field, when the balancing device is to be decommissioned.

	Action	Note
1	Remove the balancing device from the robot.	Detailed in section <a href="#">Decommissioning of balancing device on page 444</a> .
2	Send the device to a decommissioning company.	Make sure the decommissioning company is well informed about the stored energy built up by high tensioned compression springs and that the device contains some grease. The following procedure contains useful information about decommissioning.

*Continues on next page*

**Decommissioning at decommissioning company, balancing device**

The instruction below details how to decommission the balancing device. Contact ABB Robotics for further consultation.

Action	Note
1  <b>DANGER</b> There is stored energy built up by high tensioned compression springs inside the balancing device! When a coil is cut the released tension creates a spatter of sparks and flames. The working area must be free of flammable materials. Position the balancing device so that the spatter will be directed away from personnel.	
2 Clamp the device at the working location. Place the device at ground level so that the hole and spring coils are cut from a more safe distance.	
3  <b>DANGER</b> The hole must be cut as specified in the figure. Pieces can be ejected from the cylinder at high speed if the hole is cut larger than specified!	
4 Cut a hole in the housing as shown in the figure.	Use a cutting torch with a long shaft. The measurements shown below are maximum values! 

Continues on next page

## 6 Decommissioning

### 6.4 Decommissioning of balancing device

*Continued*

Action	Note
5  <b>DANGER</b> There is stored energy built up by high tensioned compression springs inside the balancing device! When a coil is cut the released tension creates a spatter of sparks and flames. The working area must be free of flammable materials. Position the balancing device so that the spatter will be directed away from personnel.	
6 Cut the coils of the springs inside the housing as specified below: <ul style="list-style-type: none"><li>• Outer spring: cut at least five coils!</li><li>• Middle spring: cut at least four coils!</li><li>• Inner spring: cut at least four coils!</li></ul>	Use a cutting torch with a long shaft.
7 Double-check the number of coils cut and make sure all the tension in the springs are removed.	

# 7 Reference information

## 7.1 Introduction

---

### General

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

## 7 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.

##### Standards, EN ISO

The product is designed in accordance with the requirements of:

Standard	Description
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Robots and robotic devices -- Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1 <sup>i</sup>	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 <sup>ii</sup>	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 <sup>ii</sup>	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

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

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

##### European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design

*Continues on next page*

---

#### Other standards

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-14	Industrial robots and robot Systems - General safety requirements

## **7 Reference information**

---

### **7.3 Unit conversion**

#### **7.3 Unit conversion**

---

##### **Converter table**

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

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

## 7.4 Screw joints

### General

This section describes how to tighten the various types of screw joints on the IRB 6640 Foundry Prime.

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

### UNBRAKO screws

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

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

### Gleitmo treated screws

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

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

### Screws lubricated in other ways

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

In such cases, proceed as follows:

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

Lubricant	Article number
Molykote 1000 (molybdenum disulphide grease)	11712016-618

### Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard** torques are specified in the following tables. Any **special** torques are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct* tightening torque for each type of screw joint.
- Only use *correctly calibrated* torque keys.

*Continues on next page*

## 7 Reference information

### 7.4 Screw joints

*Continued*

- Always *tighten the joint by hand*, and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not jerk*. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is 10%!

#### Oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with slotted or cross-recess head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

#### Oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670
M24	680	960	1150

#### Lubricated screws (*Molykote, Gleitmo or equivalent*) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molykote 1000, Gleitmo 603 or equivalent with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque (Nm) Class 10.9, lubricated <sup>i</sup>	Tightening torque (Nm) Class 12.9, lubricated <sup>i</sup>
M8	28	35
M10	55	70
M12	96	120
M16	235	280
M20	460	550
M24	790	950

<sup>i</sup> Lubricated with Molykote 1000, Gleitmo 603 or equivalent

*Continues on next page*

## Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one or both* connectors are made of *brass*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque Nm - Nominal	Tightening torque Nm - Min.	Tightening torque Nm - Max.
1/8	12	8	15
1/4	15	10	20
3/8	20	15	25
1/2	40	30	50
3/4	70	55	90

## 7 Reference information

---

### 7.5 Weight specifications

#### 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
	<p><b>CAUTION</b></p> <p>The robot weighs 1,340 kg (IRB6640), 1,405 kg (IRB6640ID). All lifting accessories used must be sized accordingly!</p>	

## 7.6 Standard tools

### General

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

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

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

### Contents, standard toolkit

Qty	Tool	Rem.
1	Ring-open-end spanner 8-19 mm	
1	Socket head cap 5-17 mm	
1	Torx socket no: 20-60	
1	Box spanner set	
1	Torque wrench 10-100 Nm	
1	Torque wrench 75-400 Nm	
1	Ratchet head for torque wrench 1/2	
2	Hexagon-headed screw M10x100	
1	Hex bit socket head cap no. 14 socket 40 mm L=100 mm	
1	Hex bit socket head cap no. 14 socket 40 mm L=20 mm	To be shortened to 12 mm
1	Hex bit socket head cap no. 6 socket 40 mm L=145 mm	
1	Hex bit socket head cap no. 6 socket 40mm bit L=220 mm	

## 7 Reference information

### 7.7 Special tools

#### 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 tools on page 455](#), and of special tools, listed directly in the instructions and also gathered in this section.

##### Basic tools

The following table specifies the tools that are used for the current robot model. This toolkit is necessary primary when removing and refitting the motors.

The tools are also listed directly in the instructions.

Description	Qty	Art. no.
Extension 300mm for bits 1/2"	1	3HAC12342-1
Guide pins M8 x 100	2	3HAC15520-1
Guide pins M8 x 150	2	3HAC15520-2
Guide pins M10 x 100	2	3HAC15521-1
Guide pins M10 x 150	2	3HAC15521-2
Lifting tool, wrist unit	1	3HAC13605-1
Lifting tool, motor ax 1, 4, 5	1	3HAC14459-1
Lifting tool, motor ax 2, 3, 4	1	3HAC026061-001
Removal tool, motor M10x	2	3HAC14972-1 Fits motors, axes 4, 5 and 6.
Removal tool, motor M12x	2	3HAC14973-1 Fits motors axes 1, 2 and 3.
Rotation tool	1	3HAC17105-1
Mechanical stop axis 3	2	3HAC12708-1
Bolts M16 x 60 (for mechanical stop axis 3)	2	3HAB3409-86
Washers (for mechanical stop axis 3)	2	3HAA1001-186
Standard toolkit (content described in section <a href="#">Standard tools on page 455</a> )	1	3HAC15571-1

##### Special tools

The following table specifies the special tools required during several of the service procedures. The tools may be ordered separately and are also specified directly in concerned instructions in the product manual.

Description	Qty	Art. no.
Distance tool	1	3HAC030662-001
Gearbox crank, axis 2	1	3HAC020999-001
Guide pins M12 x 130	1	3HAC022637-001
Guide pins M12 x 150	1	3HAC13056-2
Guide pins M12 x 200	1	3HAC13056-3

*Continues on next page*

Description	Qty	Art. no.
Guide pins M12 x 250	1	3HAC13056-4
Guide pins M16 x 250	1	3HAC13120-4
Guide pins M16 x 300	1	3HAC13120-5
Guide pins, sealing ax 2/3, 100mm	1	3HAC14628-2
Guide pins, sealing ax 2/3, 80mm	1	3HAC14628-1
Holder for bits (Stahlwille 736/40 S 5/16")	1	3HAC029090-001
Hydraulic cylinder	1	3HAC11731-1
Hydraulic pump, 80 MPa	1	3HAC13086-1
Lifting accessory, upper arm	1	3HAC15994-1
Lifting accessory, lower arm	1	3HAC027794-001
Lifting accessory, gearbox axis 3	1	3HAC032724-001
Lifting eye	2	3HAC025333-001
Lifting eye VLBG M12	1	3HAC16131-1
Lifting eye M16	2	3HAC14457-4
Lifting tool (chain)	1	3HAC15556-1
Lifting tool, gearbox axis 2	1	3HAC025214-001
Measuring tool	1	6896134-GN
Oil injector / max 500 MPa	1	3HAC021590-001
Press gear axis 1	1	3HAC026594-001
Press tool, balancing device	1	3HAC020902-001
Shackle, balancing device	1	3HAC020997-001
Support, base	1	3HAC15535-1
Tool set balancing device	1	3HAC028920-001

**Calibration equipment, Levelmeter (alternative method)**

The following table specifies the calibration equipment required when calibrating the robot with the alternative method, Levelmeter Calibration.

Description	Art. no.	Note
Angle bracket	68080011-LP	
Calibration bracket	3HAC13908-9	
Calibration tool ax1	3HAC13908-4	
Levelmeter 2000 kit	6369901-347	Includes one sensor.
Measuring pin	3HAC13908-5	
Sensor fixture	68080011-GM	
Sensor plate	3HAC0392-1	
Sync. adapter	3HAC13908-1	

*Continues on next page*

## 7 Reference information

### 7.7 Special tools

*Continued*

#### Calibration equipment, Calibration Pendulum

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

Description	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual.

#### Oil exchange equipment

The following table specifies the recommended equipment for oil exchange.

Description	Art. no.	Note
Oil exchange equipment	3HAC021745-001	<b>Includes:</b> <ul style="list-style-type: none"><li>• Vacuum pump with regulator, hose and coupling</li><li>• Couplings and adapters</li><li>• Pump (manual) with hose and coupling</li><li>• Graduated measuring glass</li><li>• Oil gun</li><li>• User instructions.</li></ul>

## 7.8 Dismounting and mounting tool 3HAC028920-001

---

### General

This section details how to configure the tool 3HAC028920-001 for dismounting and mounting the balancing device on the IRB 6640 Design 1 and Design 2. The difference in the design is described in [Design 1 and Design 2 of IRB 6640 on page 62](#).

The following setups for the tool are described:

- [Tool description on page 460](#)
- [Removal front shaft design 1 and 2 on page 461](#)
- [Removal front bearing Design 1 on page 465](#)
- [Refitting front bearing and sealing Design 1 on page 467](#)
- [Removal front bearing Design 2 on page 468](#)
- [Refitting front bearing with sealing Design 2 on page 470](#)
- [Removal rear shafts Design 1 and 2 on page 471](#)
- [Refitting rear shafts Design 1 on page 472](#)
- [Refitting rear shafts Design 2 on page 474](#)

*Continues on next page*

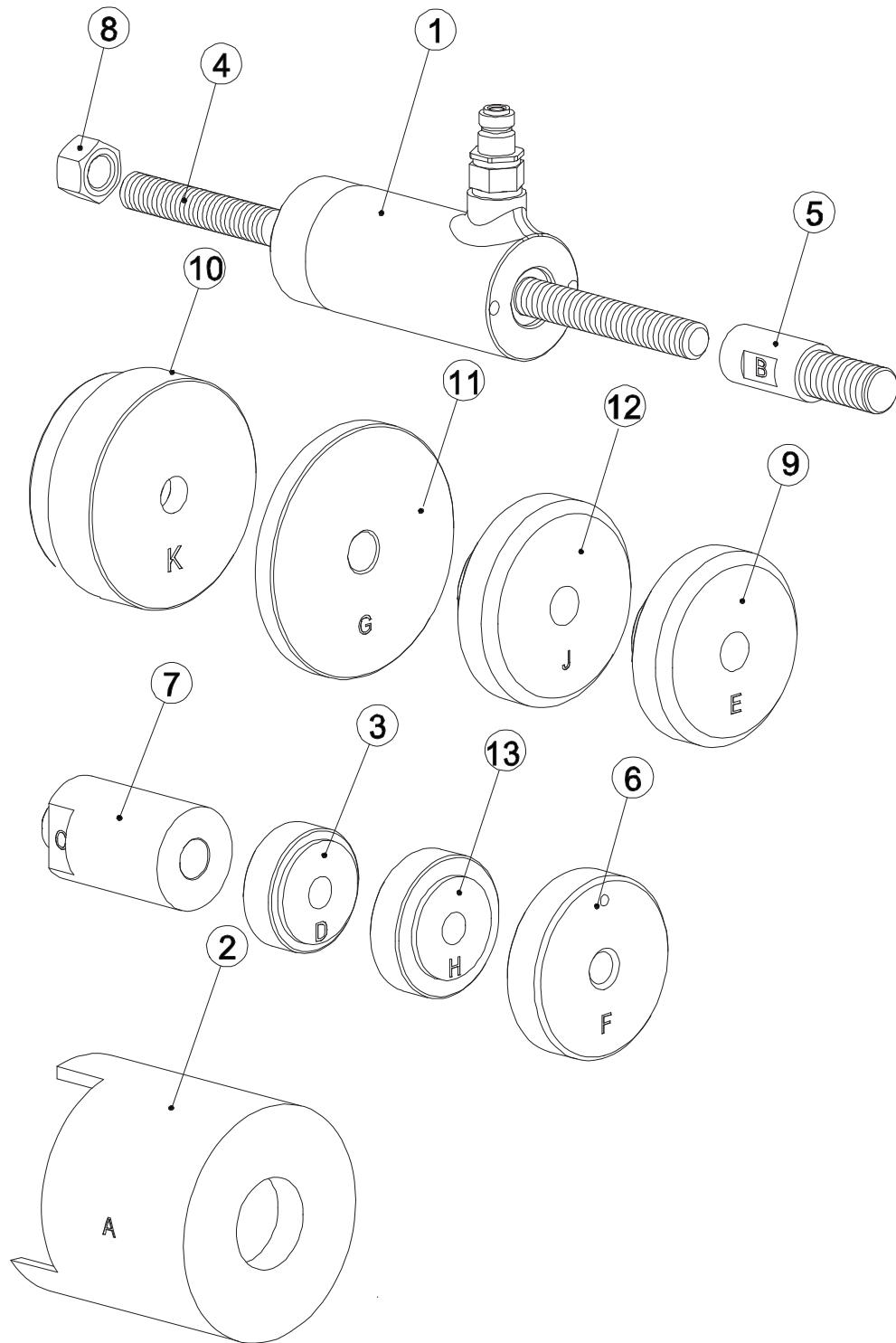
## 7 Reference information

### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

---

#### Tool description



xx0900000024

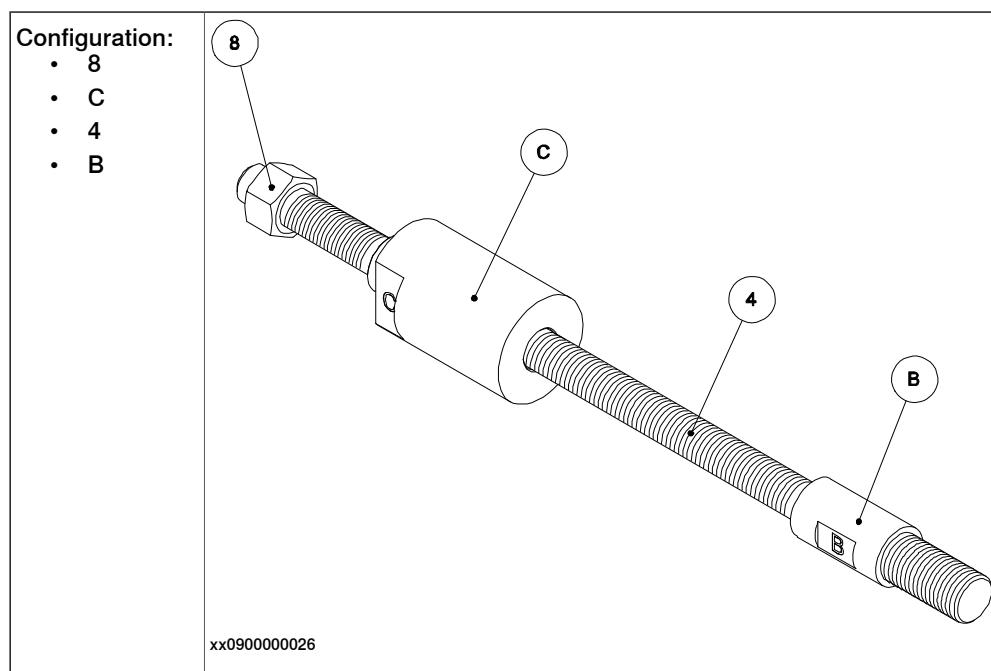
Item	Mark	Description
1		Hydraulic cylinder not included in tool 3HAC028920-001 (ordered separately).
2	A	Press tool D=103

*Continues on next page*

Item	Mark	Description
3	D	Press tool D=54
4		Threaded bar, M16
5	B	Adapter M16/M20
6	F	Knurled nut D=80
7	C	Slide hammer / Distance
8		Nut M16
9	E	Press tool D=85
10	K	Press tool D=100
11	G	Press tool D=110
12	J	Press tool D=90
13	H	Press tool D=62

**Removal front shaft design 1 and 2**

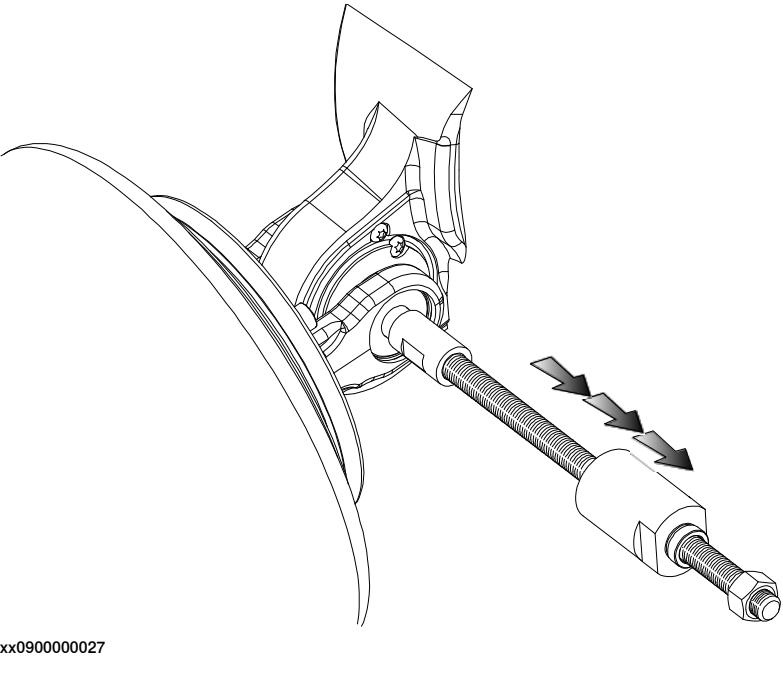
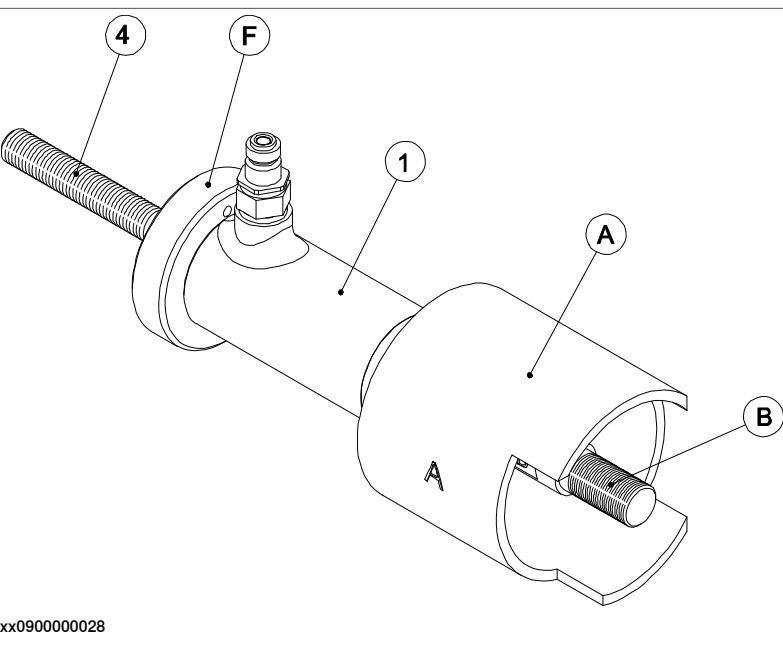
The following configuration is used for removal of the front shaft Design 1 and 2.  
In the figure only Design 1 is shown.

*Continues on next page*

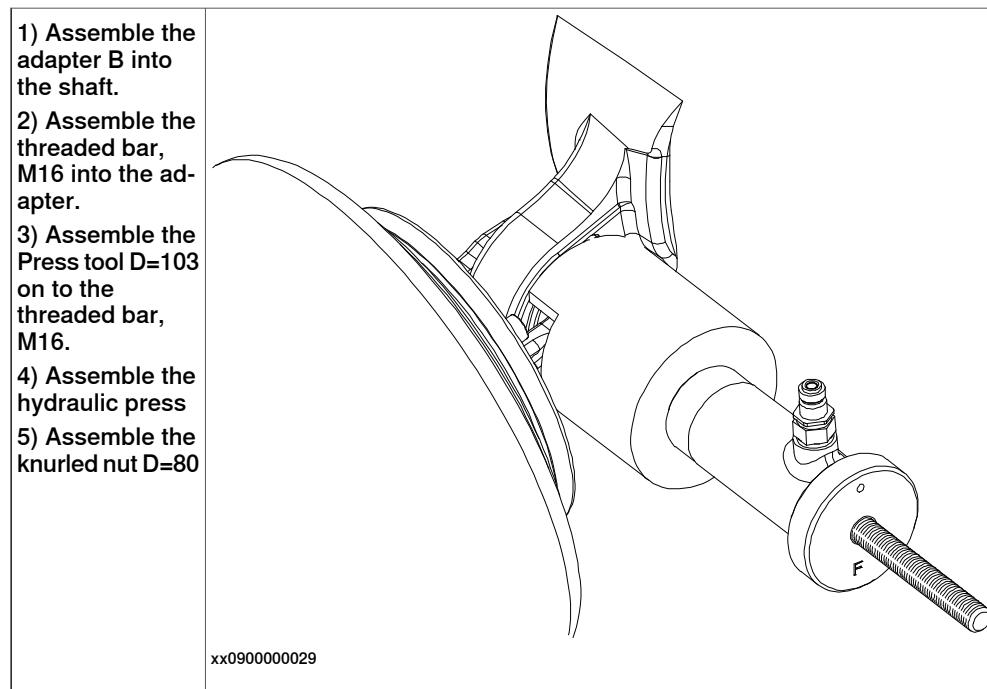
## 7 Reference information

### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

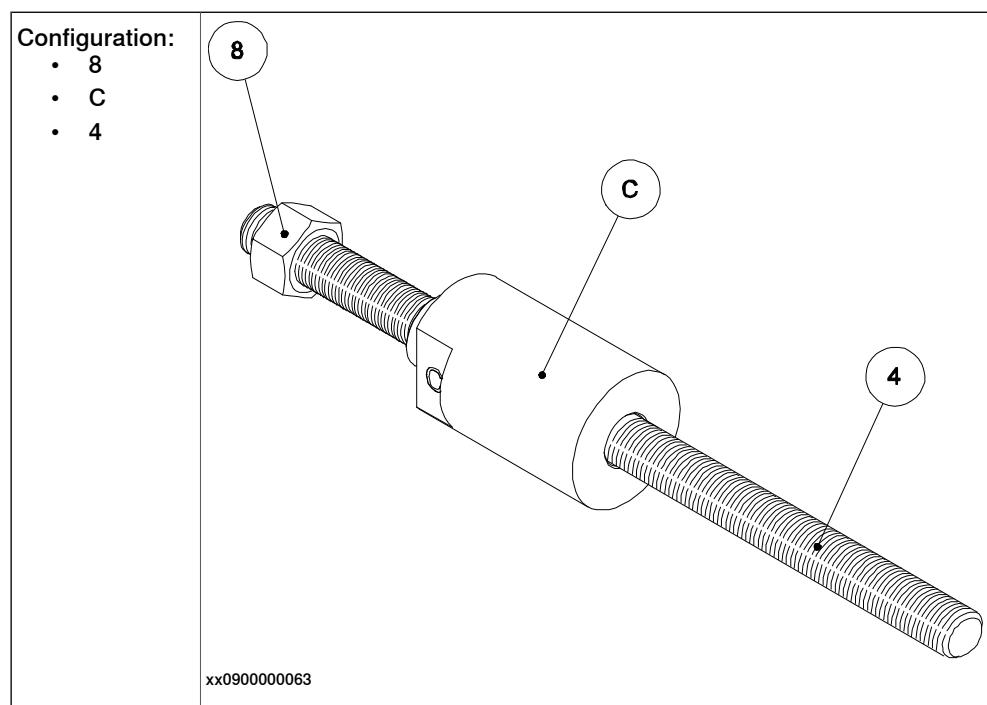
<p>1) Assemble the adapter B into the shaft. 2) Assemble the threaded bar, M16 into the adapter. 3) Assemble the Slide hammer / Distance on to the threaded bar, M16. 4) Assemble the nut M16.</p>	 <p>xx0900000027</p>
<p>Alternative configuration:</p> <ul style="list-style-type: none"><li>• 4</li><li>• F</li><li>• 1</li><li>• A</li><li>• B</li></ul>	 <p>xx0900000028</p>

*Continues on next page*



#### Refitting front shaft design 1 and 2

The following configuration is used for refitting of the front shaft Design 1 and 2.

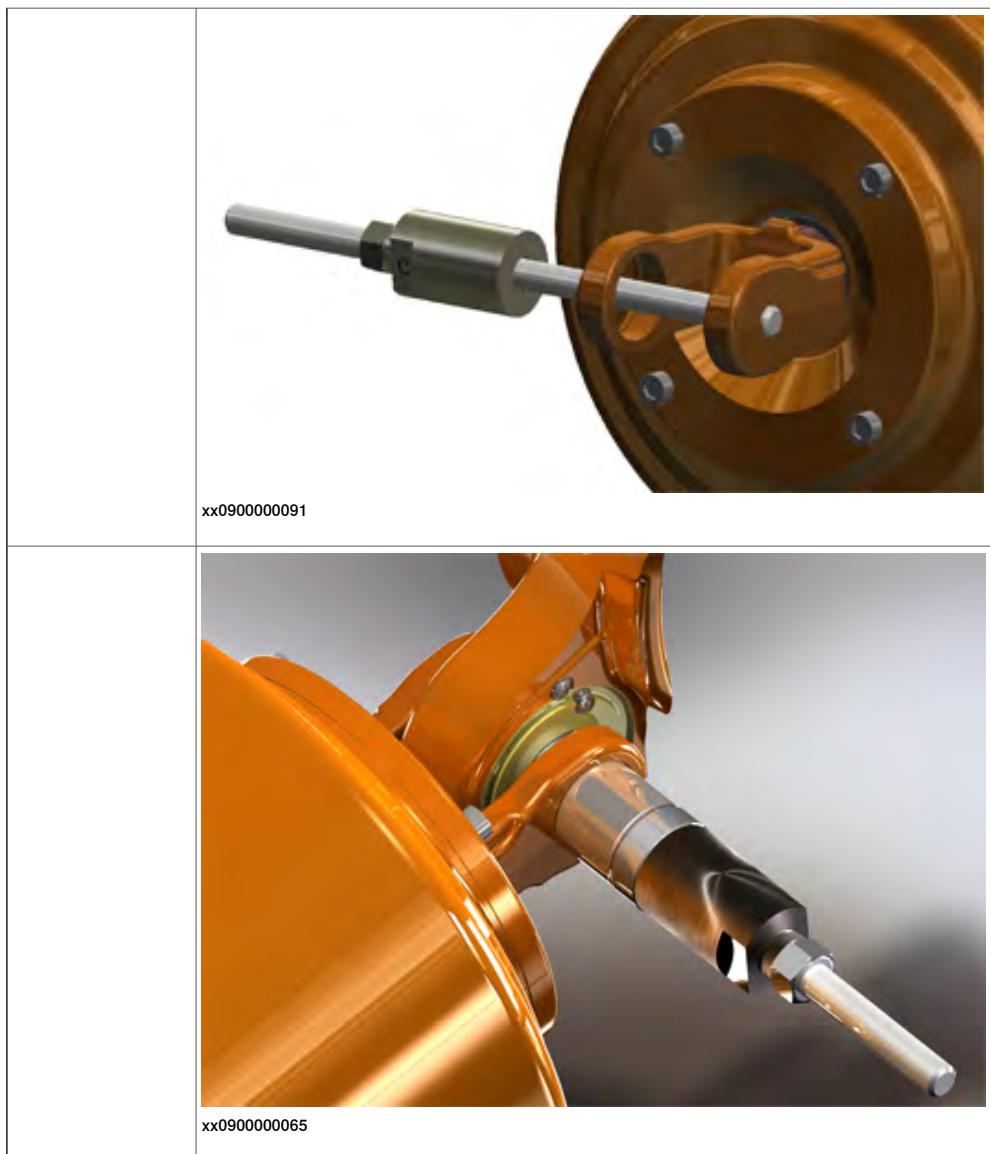


*Continues on next page*

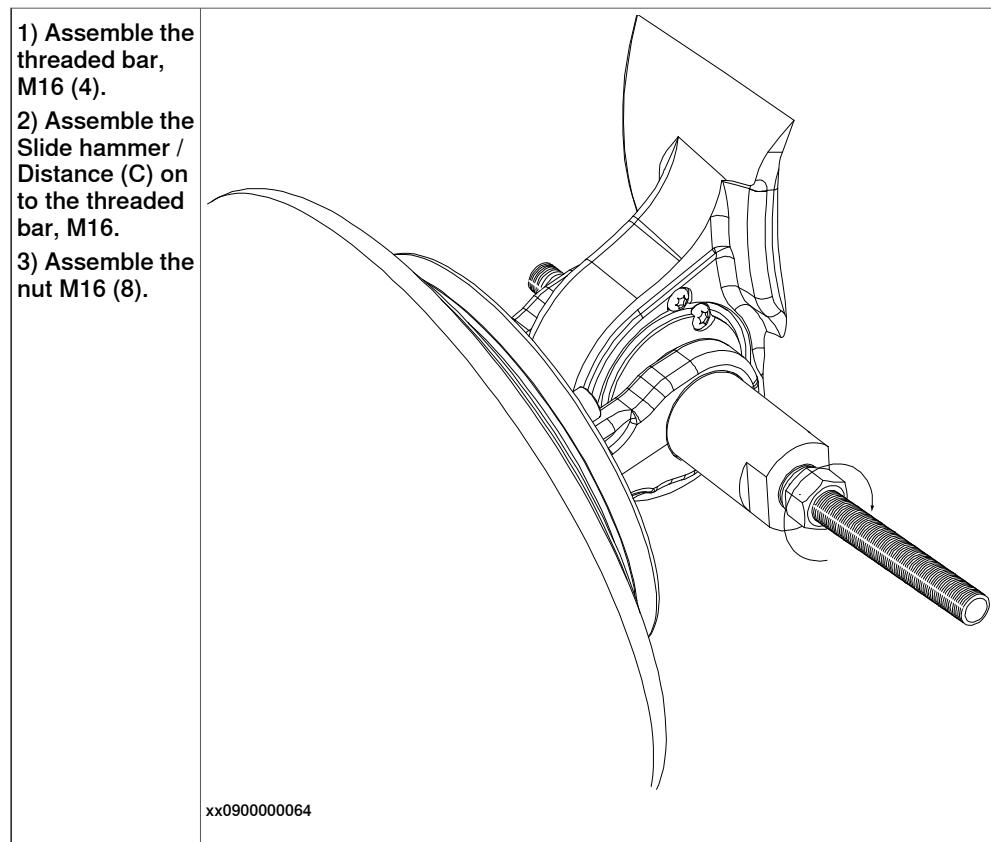
## **7 Reference information**

### **7.8 Dismounting and mounting tool 3HAC028920-001**

*Continued*

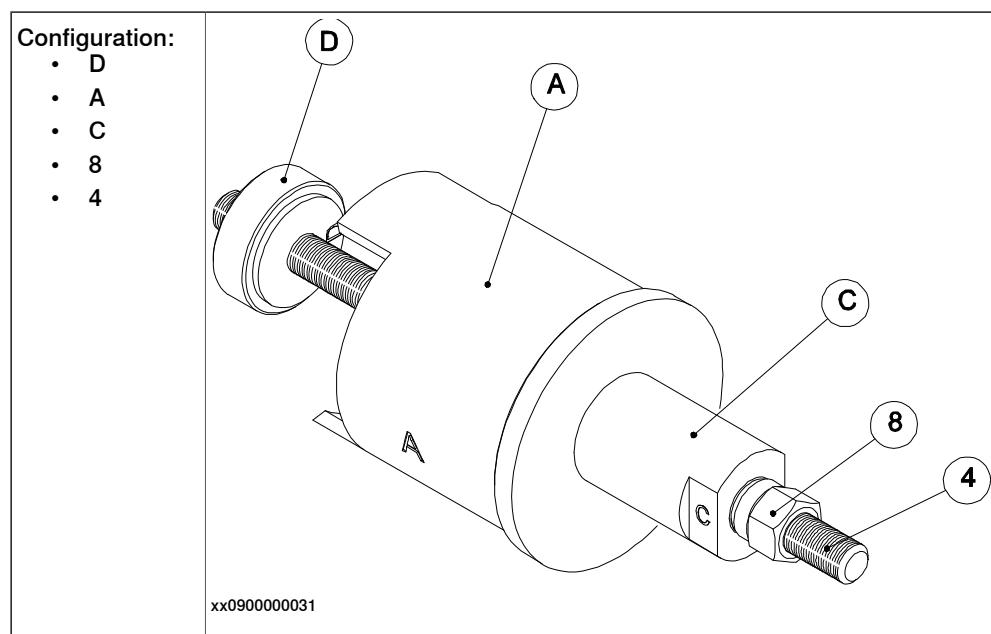


*Continues on next page*



### Removal front bearing Design 1

The following configuration is used for removal of the front bearing Design 1.

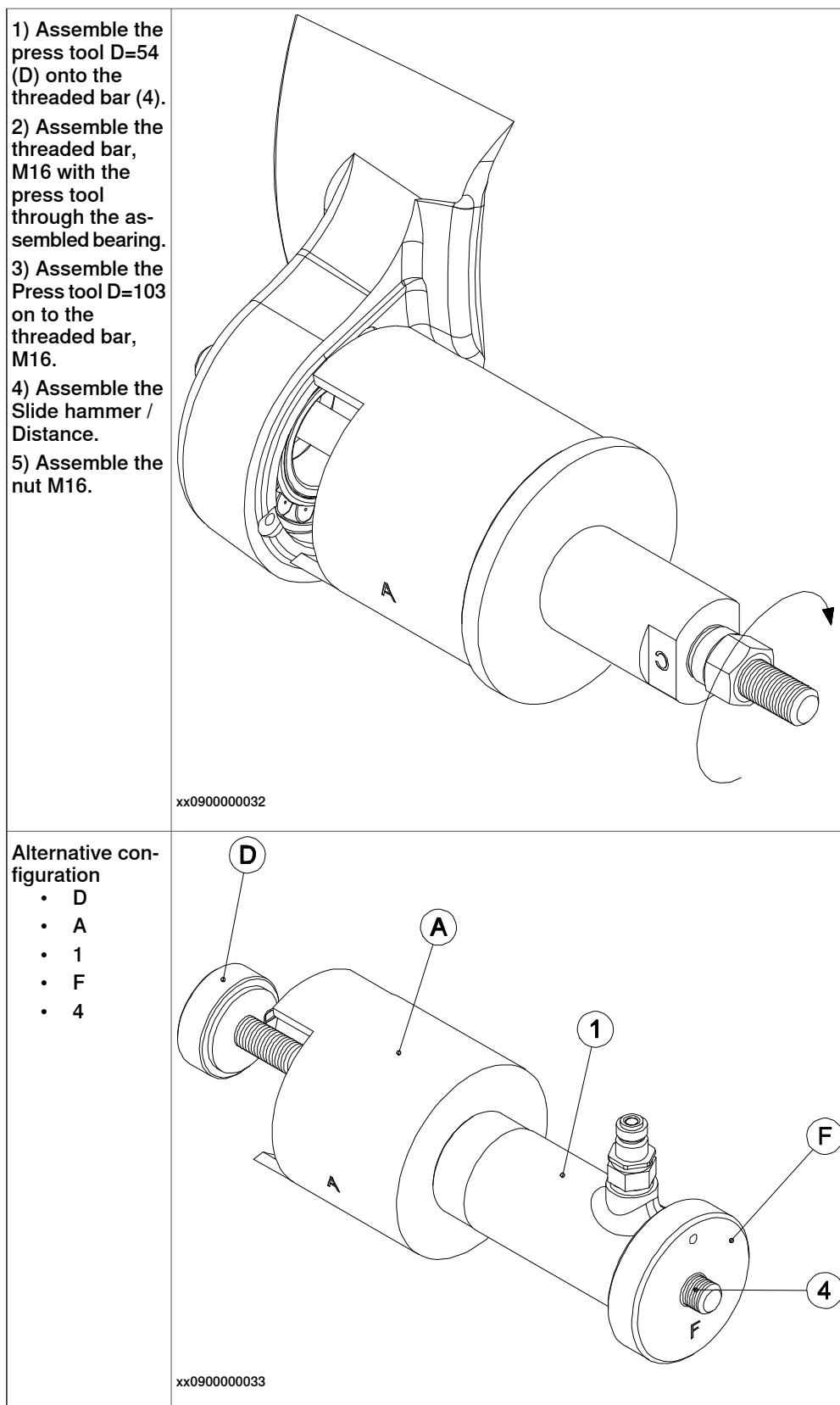


*Continues on next page*

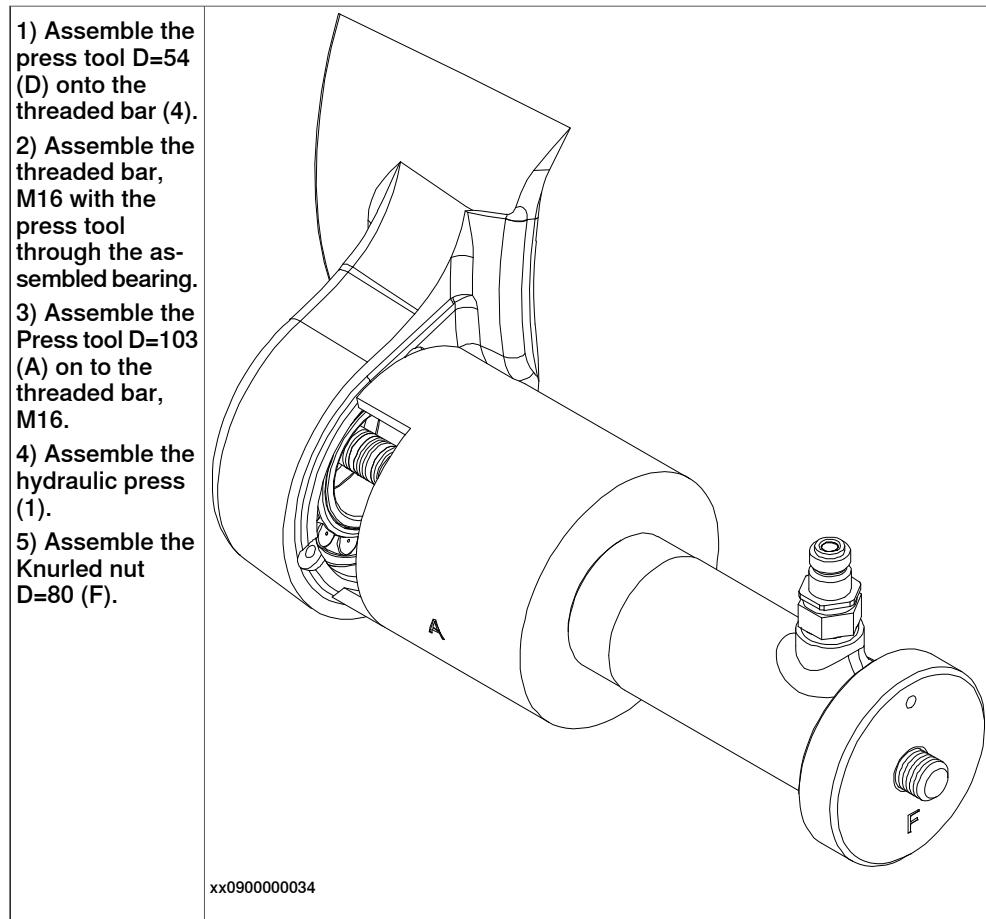
## 7 Reference information

### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

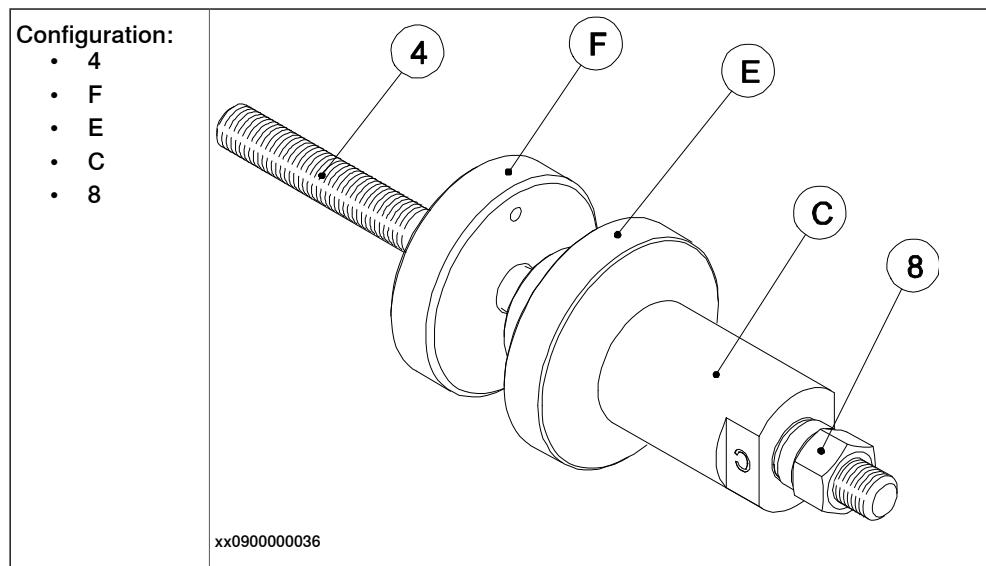


*Continues on next page*



### Refitting front bearing and sealing Design 1

The following configuration is used for refitting of the front bearing and sealing Design 1

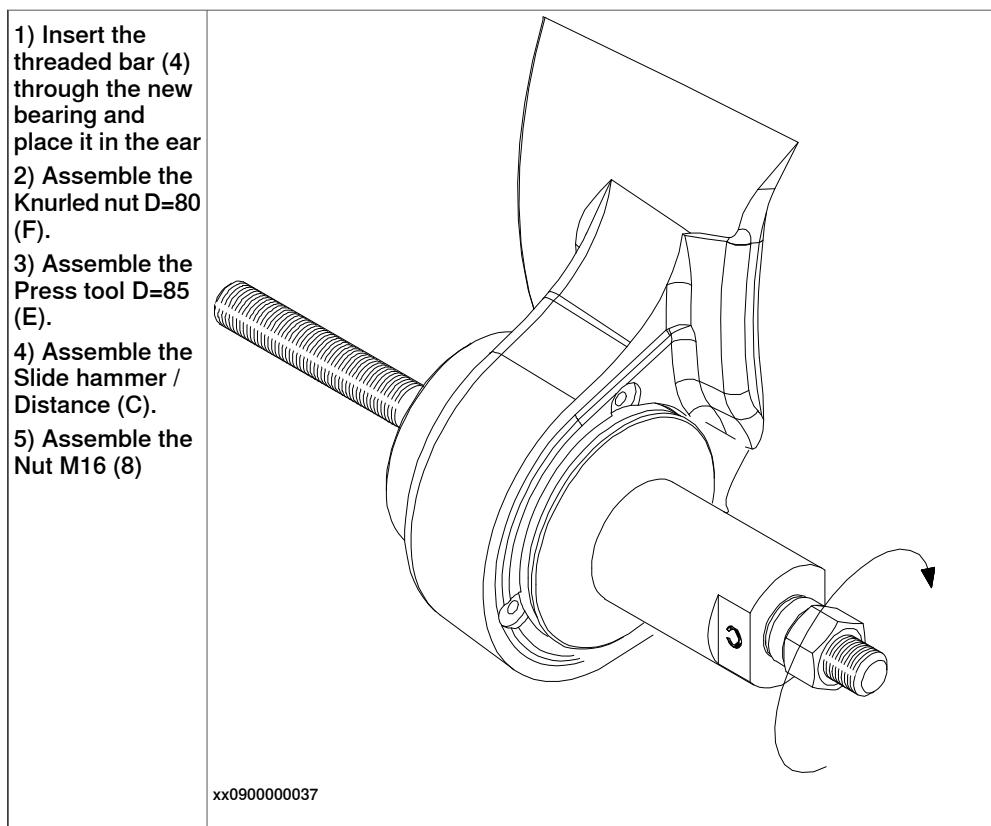


*Continues on next page*

## 7 Reference information

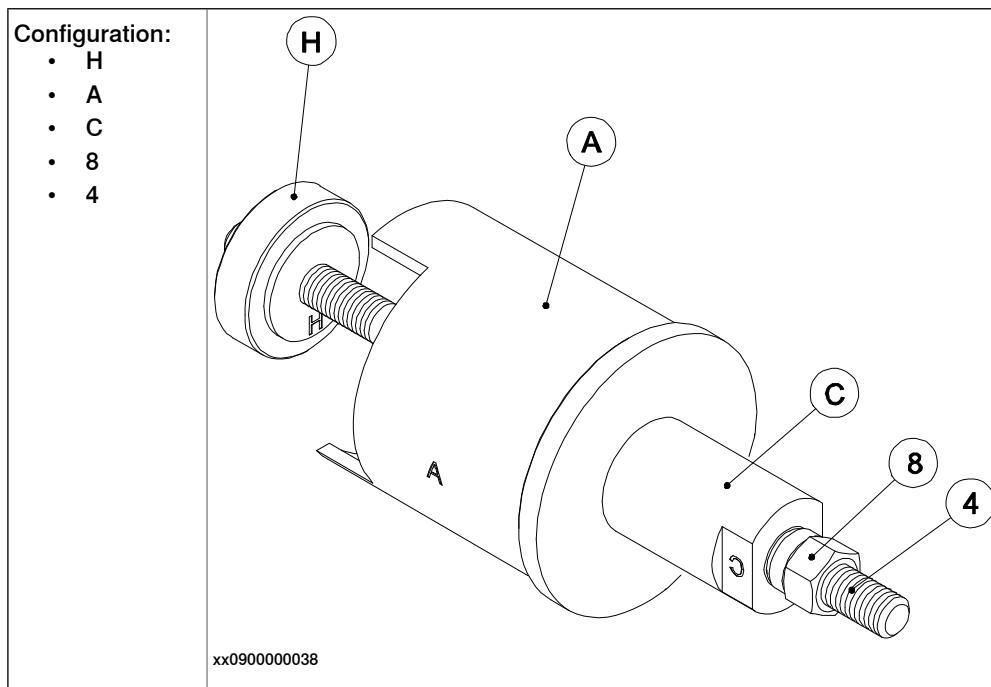
### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*



### Removal front bearing Design 2

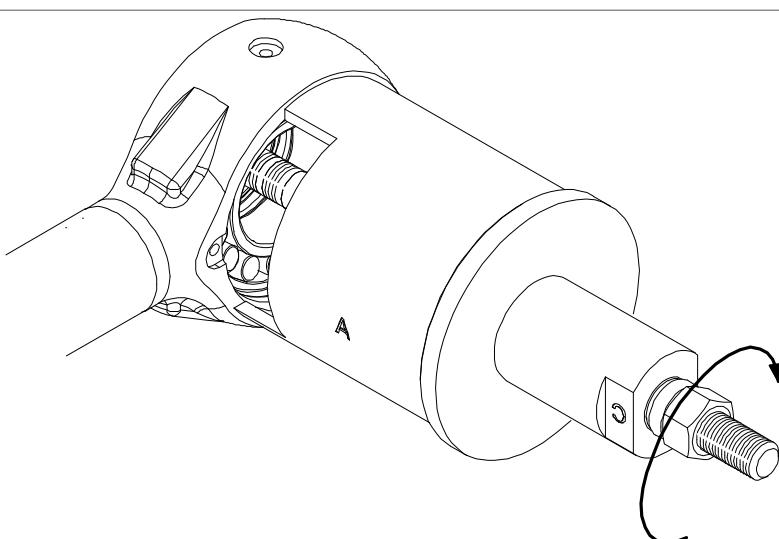
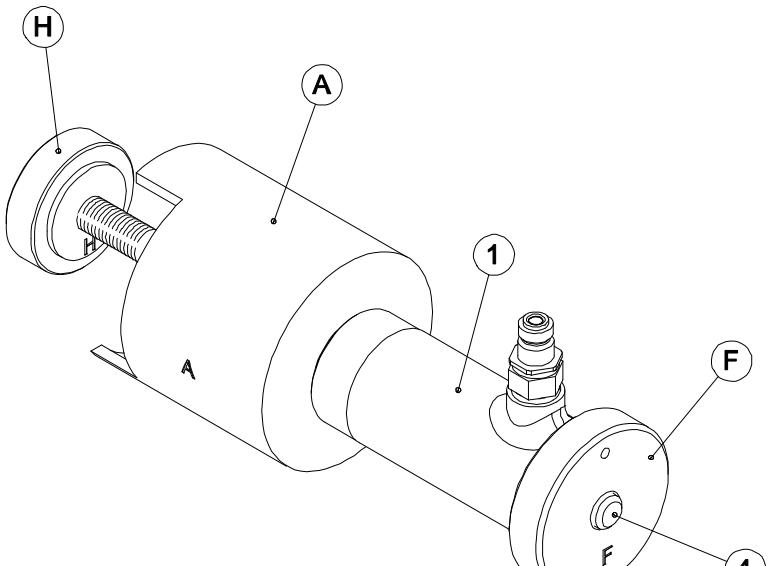
The following configuration is used for removal of the front bearing Design 2.



*Continues on next page*

## 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

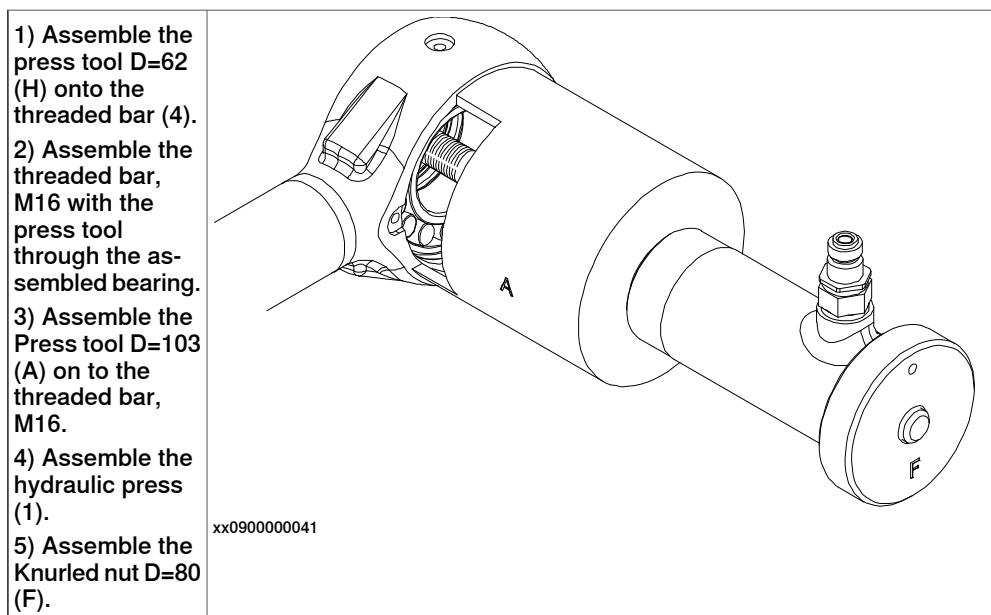
<p>1) Assemble the press tool D=62 (H) onto the threaded bar (4).      2) Assemble the threaded bar, M16 with the press tool through the assembled bearing.      3) Assemble the Press tool D=103 (A) on to the threaded bar, M16.      4) Assemble the Slide hammer / Distance (C).      5) Assemble the nut M16 (8).</p>	 <p>xx0900000039</p>
<p>Alternative configuration:</p> <ul style="list-style-type: none"> <li>• H</li> <li>• A</li> <li>• 1</li> <li>• F</li> <li>• 4</li> </ul>	 <p>xx0900000040</p>

*Continues on next page*

## 7 Reference information

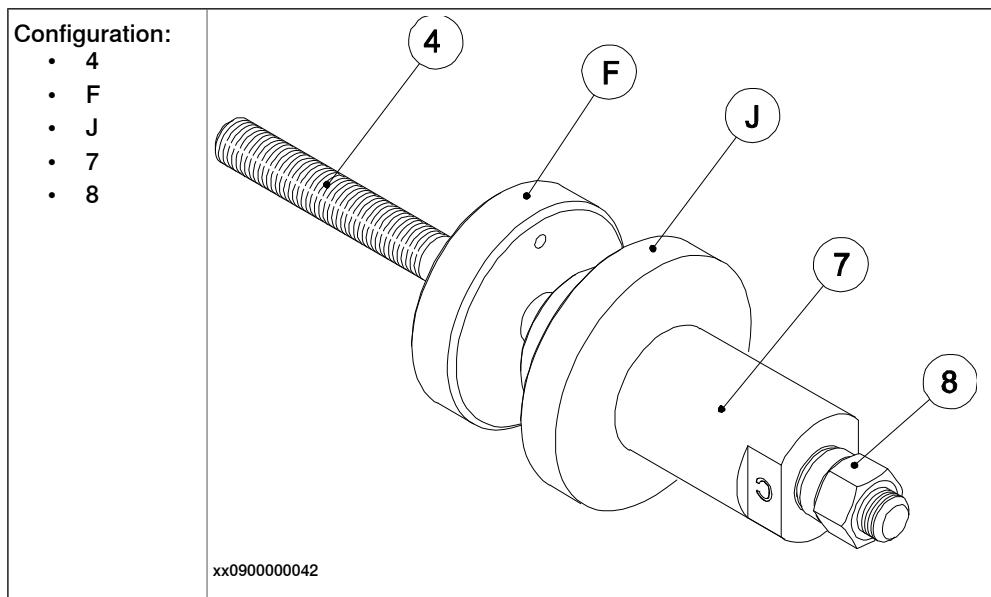
### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

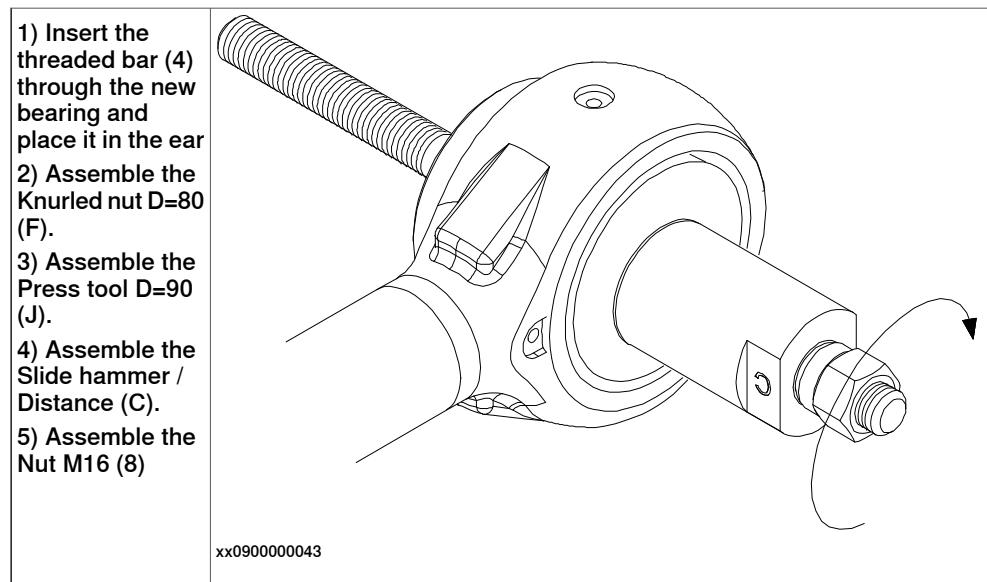


#### Refitting front bearing with sealing Design 2

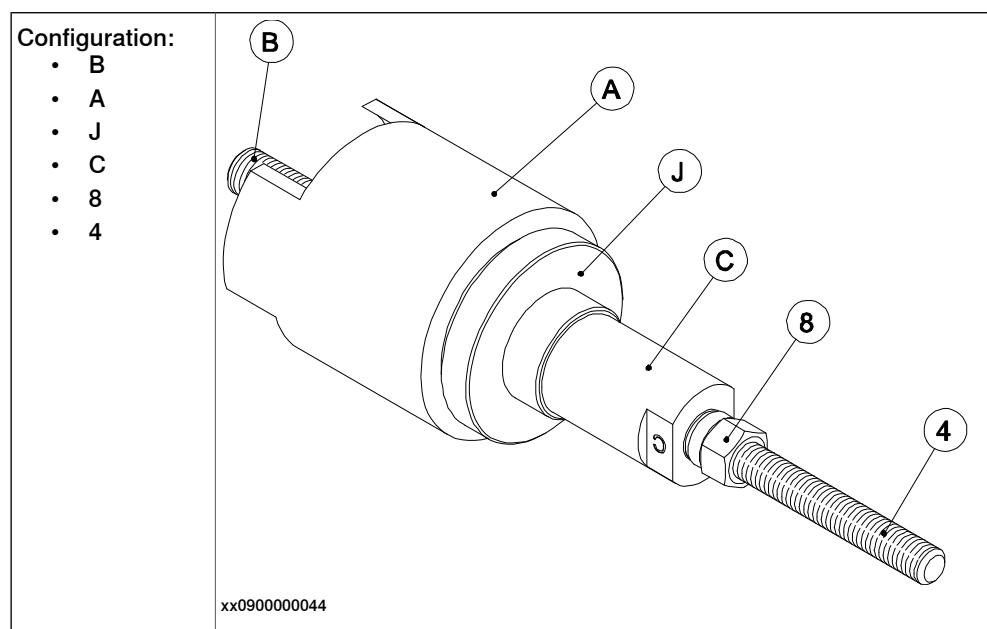
The following configuration is used for refitting of the front bearing with sealing Design 2.



*Continues on next page*

**Removal rear shafts Design 1 and 2**

The following configuration is used for removal of the rear shafts Design 1 and 2.

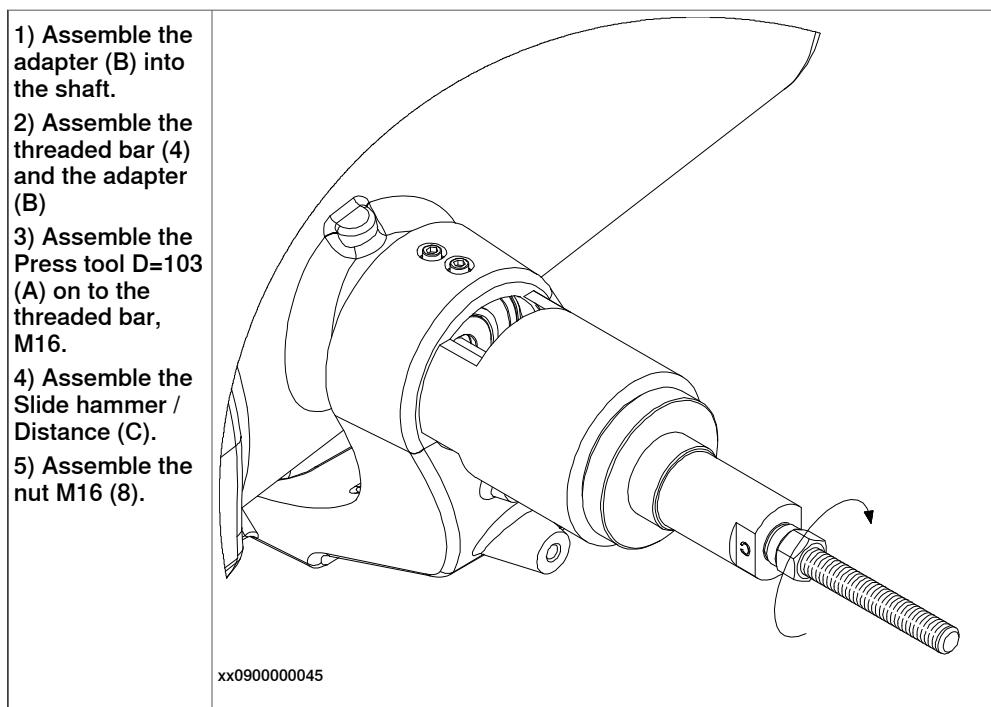


*Continues on next page*

## 7 Reference information

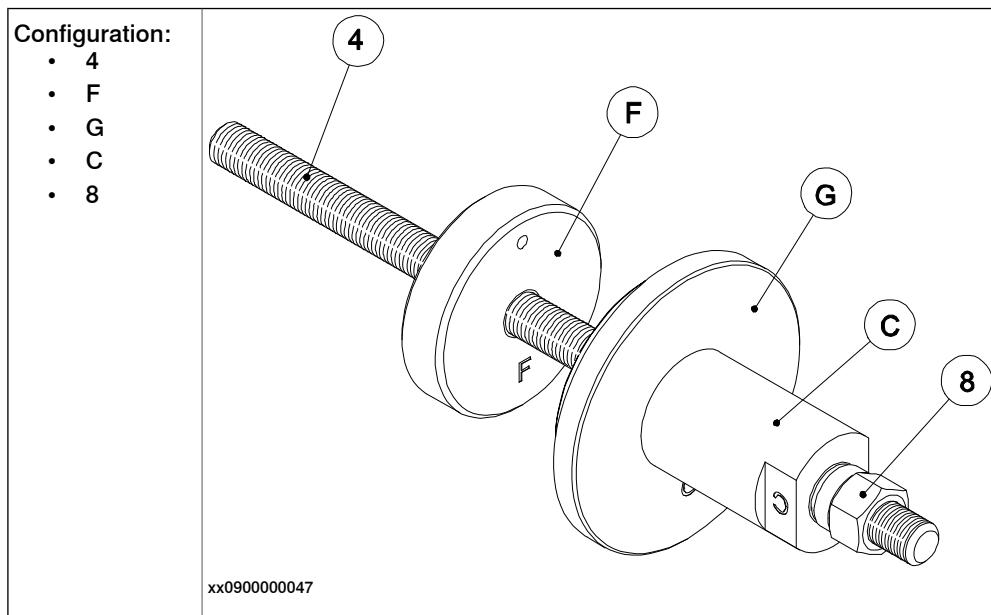
### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

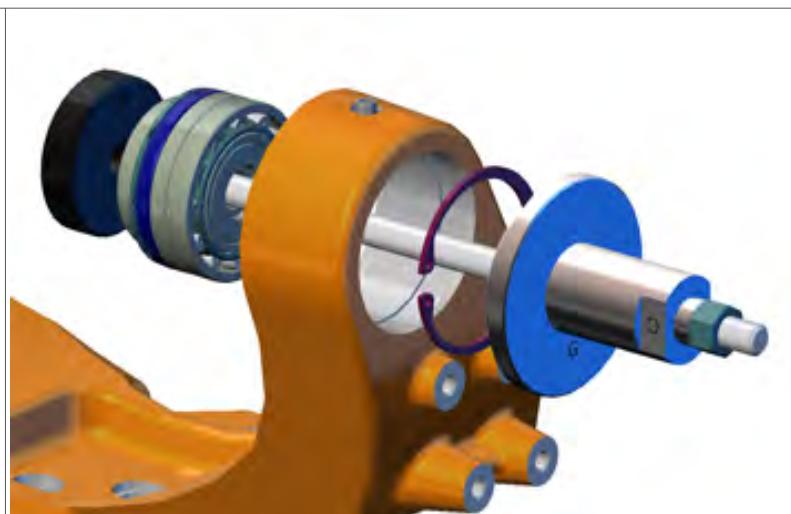
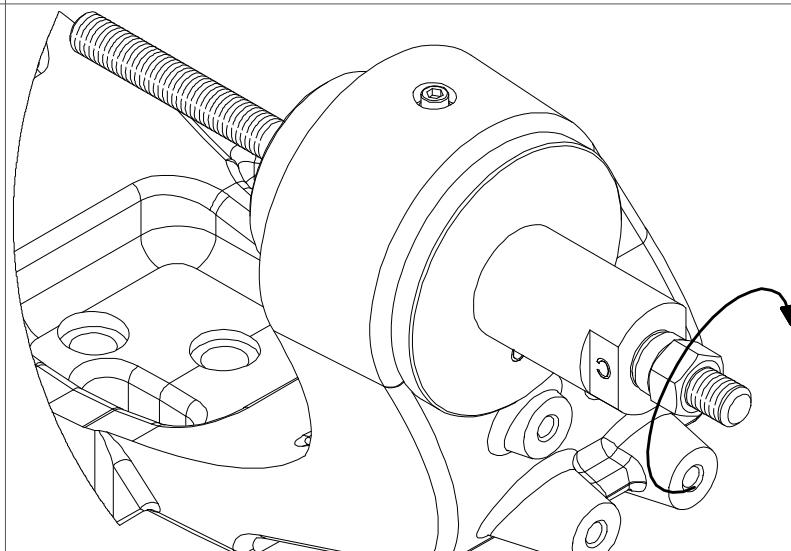


### Refitting rear shafts Design 1

The following configuration is used for refitting of the rear shafts Design 1.



*Continues on next page*

<p>1) Insert the threaded bar (4) through the new bearing. 2) Assemble the Knurled nut D=80 (F). 3) Assemble the Press tool D=110 (G). 4) Assemble the Slide hammer / Distance (C). 5) Assemble the Nut M16 (8).</p>	 <p>xx0900000060</p>
	 <p>xx0900000048</p>

*Continues on next page*

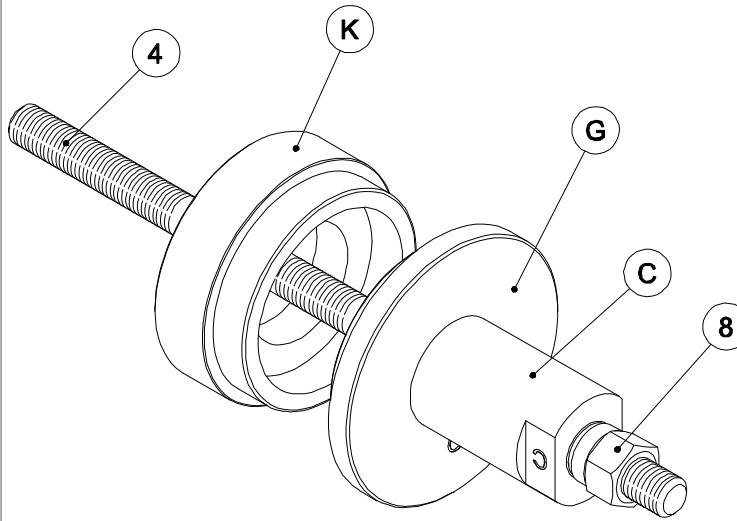
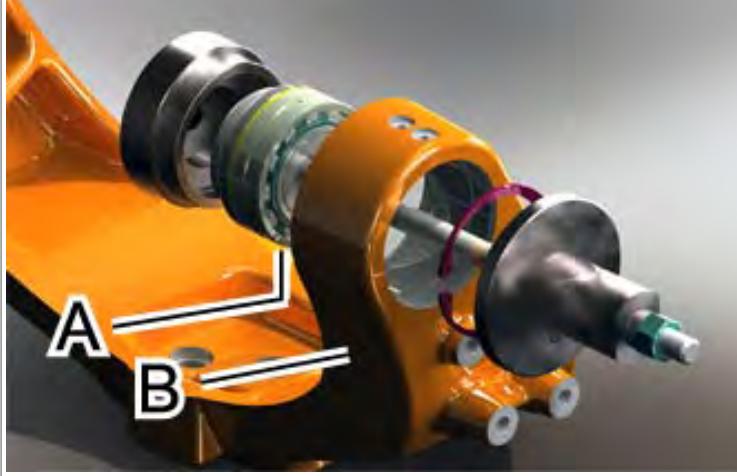
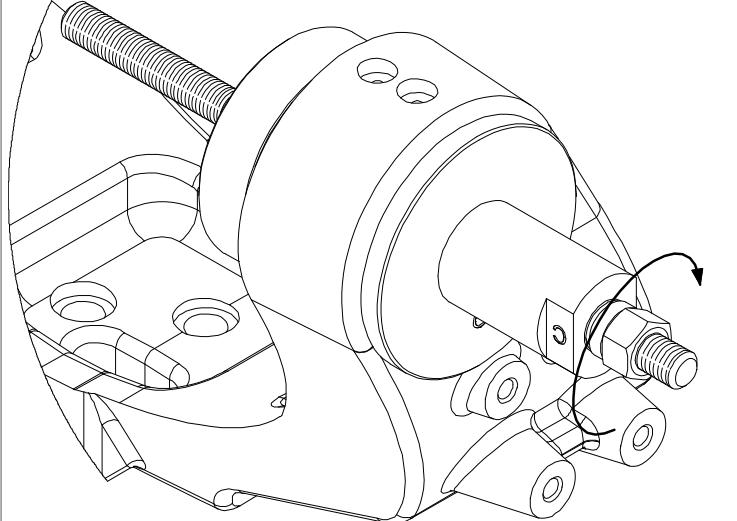
## 7 Reference information

### 7.8 Dismounting and mounting tool 3HAC028920-001

*Continued*

#### Refitting rear shafts Design 2

The following configuration is used for refitting of the rear shafts Design 2.

Configuration: <ul style="list-style-type: none"><li>• 4</li><li>• K</li><li>• G</li><li>• C</li><li>• 8</li></ul>	 <p>xx0900000049</p>
1) Insert the threaded bar (4) through the new bearing. 2) Assemble the Press tool D=100 (K). 3) Assemble the Press tool D=110 (G). 4) Assemble the Slide hammer / Distance (C). 5) Assemble the Nut M16 (8)	 <p>xx0900000061</p>
	 <p>xx0900000050</p>

## 7.9 Lifting accessories and lifting instructions

---

### General

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

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

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

**This page is intentionally left blank**

# **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 on the documentation DVD.

**This page is intentionally left blank**

# 9 Circuit diagrams

## 9.1 Circuit diagrams

### Overview

The circuit diagrams are not included in this manual, but delivered as separate documents on the documentation DVD. See the article numbers in the tables below.

### Controllers

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRC5</i>	<i>3HAC024480-011</i>
<i>Circuit diagram - IRC5 Compact</i>	<i>3HAC049406-003</i>
<i>Circuit diagram - IRC5 Panel Mounted Controller</i>	<i>3HAC026871-020</i>
<i>Circuit diagram - Euromap</i>	<i>3HAC024120-004</i>
<i>Circuit diagram - Spot welding cabinet</i>	<i>3HAC057185-001</i>

### Robots

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 120</i>	<i>3HAC031408-003</i>
<i>Circuit diagram - IRB 140 type C</i>	<i>3HAC6816-3</i>
<i>Circuit diagram - IRB 260</i>	<i>3HAC025611-001</i>
<i>Circuit diagram - IRB 360</i>	<i>3HAC028647-009</i>
<i>Circuit diagram - IRB 460</i>	<i>3HAC036446-005</i>
<i>Circuit diagram - IRB 660</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 760</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 1200</i>	<i>3HAC046307-003</i>
<i>Circuit diagram - IRB 1410</i>	<i>3HAC2800-3</i>
<i>Circuit diagram - IRB 1600/1660</i>	<i>3HAC021351-003</i>
<i>Circuit diagram - IRB 1520</i>	<i>3HAC039498-007</i>
<i>Circuit diagram - IRB 2400</i>	<i>3HAC6670-3</i>
<i>Circuit diagram - IRB 2600</i>	<i>3HAC029570-007</i>
<i>Circuit diagram - IRB 4400/4450S</i>	<i>3HAC9821-1</i>
<i>Circuit diagram - IRB 4600</i>	<i>3HAC029038-003</i>
<i>Circuit diagram - IRB 6400RF</i>	<i>3HAC8935-1</i>
<i>Circuit diagram - IRB 6600 type A</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6600 type B</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6620</i>	<i>3HAC025090-001</i>

*Continues on next page*

## 9 Circuit diagrams

---

### 9.1 Circuit diagrams

*Continued*

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6640</i>	<i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6650S</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6660</i>	<i>3HAC025744-001</i> <i>3HAC029940-001</i>
<i>Circuit diagram - IRB 6700</i>	<i>3HAC043446-005</i>
<i>Circuit diagram - IRB 7600</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 14000</i>	<i>3HAC050778-003</i>
<i>Circuit diagram - IRB 910SC</i>	<i>3HAC056159-002</i>

# Index

## A

Absolute Accuracy, calibration, 433  
 additional mechanical stop location, 157  
 air quality, 59  
 aluminum  
     disposal, 442  
 ambient humidity  
     operation, 72  
     storage, 72  
 ambient temperature  
     operation, 72  
     storage, 72  
 assembly instructions, 57

## B

balancing device  
     risk, 24  
 balancing device bearing, replacement, 292  
 base plate  
     guide pins, 88  
     securing, 88  
 batteries  
     disposal, 442  
     handling, 54  
 battery  
     replacing, 184, 283  
 battery pack  
     replacing, interval, 119  
 battery shutdown  
     service routine, 184, 283  
 brake release, 85  
 brake release board, replacement, 288  
 brakes  
     testing function, 34  
 buttons for brake release, 85

## C

cabinet lock, 22  
 cable harness axes 1-6, replacement, 217  
 cabling, robot, 113  
 cabling axis 5, replacement, 231  
 cabling between robot and controller, 113  
 calibrating  
     roughly, 436  
 calibration  
     Absolute Accuracy type, 432  
     rough, 436  
     standard type, 432  
     when to calibrate, 431  
 calibration, Absolute Accuracy, 433  
 calibration manuals, 433  
 calibration marks, 434  
 calibration position  
     jogging to, 439  
     scales, 434  
 calibration scales, 434  
 CalibWare, 432  
 carbon dioxide extinguisher, 32  
 cast iron  
     disposal, 442  
 changing oil  
     axis 1, 166  
 cleaners  
     approved, 207

    requirements, 207  
 cleaning, 205  
 climbing on robot, 23  
 complete arm system, replacement, 234  
 connecting the robot and controller, cabling, 113  
 connection  
     external safety devices, 19  
 copper  
     disposal, 442

## D

damage to additional mechanical stop, 157  
 damage to mechanical stop, 155  
 danger levels, 39  
 detergents  
     approved, 207  
     requirements, 207  
 dimensions  
     frame, 99  
     lower arm, 96  
     turning disk, 100  
     upper arm, 98  
 direction of axes, 435

## E

enabling device, 36  
 environmental information, 442  
 equipment on robot, 96  
 ESD  
     damage elimination, 52  
     sensitive equipment, 52  
     wrist strap connection point, 52  
 expected life, 121  
 extra equipment  
     fastener quality, 101  
     frame, 99  
     lower arm, 96  
     robot, 96  
     turning disk, 100  
     upper arm, 98

## F

fastener quality for extra equipment, 101  
 fence dimensions, 31  
 fire extinguishing, 32  
 fitting equipment on robot, 96  
 fitting fork lift, 77

## FlexPendant

*jogging to calibration position, 439  
 MoveAbsJ instruction, 439  
 updating revolution counters, 437*

## fork lift, 80

foundation  
     requirements, 72  
 frame  
     dimensions, 99

## G

gearbox  
     oil change axis 1, 166  
 gearboxes  
     location of, 165  
 grease  
     disposal, 442  
 guide pins, base plate, 88

## H

- hanging
  - installed hanging, 23
- hazardous material, 442
- height
  - installed at a height, 23
- hold-to-run, 36
- hot components
  - risk, 23
- humidity
  - operation, 72
  - storage, 72

## I

- information labels location, 153
- inspecting
  - additional mechanical stop, 157
  - information labels, 153
  - mechanical stop, 155
- inspecting oil levels
  - axis-6, 135
  - axis-5, 132
  - axis-4, 130
  - axis-3, 127
  - axis-2, 125
  - axis-1, 123
- installation
  - mechanical stop axis 1, 106
  - mechanical stop axis 2, 108
  - mechanical stop axis 3, 110
- installing equipment on robot, 96
- instructions for assembly, 57
- intervals for maintenance, 118

## L

- labels
  - robot, 41
- leak-down test, 210
- lifting accessory, 454
- lifting robot
  - with fork lift, 80
  - with roundslings, 83
- lifting upper arm
  - attachment points for lifting accessory, 269
- Lithium
  - disposal, 442
- loads on foundation, 71
- locking screw, 310
- lower arm
  - dimensions, 96
  - replacement, 277
- lubrication
  - amount in gearboxes, 164
  - type of lubrication, 164

## M

- main power
  - switching off, 50
- main switch
  - controller cabinet, 50
  - control module, 51
  - drive module, 51
- maintenance schedule, 118
- manually releasing brakes, 85
- mechanical stop
  - axis 1, 106
  - axis 2, 108

## axis 3, 110

- mechanical stop location, 155
- motion of axes, 74
- MoveAbsJ instruction, 439

## N

- negative directions, axes, 435
- neodymium
  - disposal, 442
- NiCad
  - disposal, 442
- nodular iron
  - disposal, 442

## O

- oil
  - amount in gearboxes, 164
  - disposal, 442
  - type of oil, 164
- oil change
  - axis 1, 166
  - safety risks, 55
- oil level
  - gearbox axis-6, 135
  - gearbox axis-5, 132
  - gearbox axis-4, 130
  - gearbox axis-3, 127
  - gearbox axis-2, 125
  - gearbox axis-1, 123
- operating conditions, 72

## P

- paint surface damages, 152
- pedestal
  - installed on pedestal, 23
- plastic
  - disposal, 442
- positive directions, axes, 435
- pressurized components
  - air quality, 59
  - Foundry Prime, 58
- product standards, 448
- protection classes, 72
- protection type, 72
- protective equipment, 22
- protective wear, 22

## R

- range of movement, 74
- repair
  - painted surface, 152
- replacement
  - bearing, balancing device, 292
  - brake release board, 288
  - cable harness axes 1-6, 217
  - cabling axis 5, 231
  - complete arm system, 234
  - lower arm, 277
  - turning disk, 255
  - upper arm, 269
  - wrist unit, 259
- replacing
  - xx, 201, 203
- requirements on foundation, 72
- responsibility and validity, 19
- restricting
  - working range axis 1, 106

- working range axis 2, 108
- working range axis 3, 110
- revolution counters**
  - storing on FlexPendant, 437
  - updating, 436
- risk of tipping, 76
- robot**
  - labels, 41
  - protection class, 72
  - protection types, 72
  - symbols, 41
- rubber**
  - disposal, 442
- S**
- safety**
  - brake testing, 34
  - ESD, 52
  - fence dimensions, 31
  - fire extinguishing, 32
  - introduction, 17
  - moving robots, 47
  - reduced speed function, 35
  - release robot arm, 33
  - robot, 19
  - service, 19
  - signal lamp, 38
  - signals, 39
  - signals in manual, 39
  - symbols, 39
  - symbols on robot, 41
  - test run, 48
  - working range, 37
  - wrist strap, 52
- safety equipment**
  - mechanical stop, 106
  - mechanical stop axis 2, 108
  - mechanical stop axis 3, 110
  - signal lamp, 162
- safety risk**
  - electric parts, 29
  - hot parts, 25
  - hydraulic system, 27
  - installation, 22
  - oil change, 55
  - operational disturbance, 28
  - pneumatic system, 27
  - service work, 22
  - tools, 26
  - voltage, 29
  - work pieces, 26
- safety signals**
  - in manual, 39
- safety standards**, 448
- safety zones**, 23
- scales on robot**, 434
- schedule for maintenance**, 118
- securing**
  - base plate, 88
- securing, robot**, 93
- securing the robot to foundation, attachment screws**, 93
- sensitive points**
  - Foundry Prime, 61
- signal lamp**, 38
- signals**
  - safety, 39
- SMB**
  - replacing, 283
- SMB battery**
  - extension of lifetime, 184, 283
  - replacing, 184, 283
- special tools**, 456
- stability**, 76
- standards**, 448
  - ANSI, 449
  - CAN, 449
  - EN, 448
  - EN IEC, 448
  - EN ISO, 448
- steel**
  - disposal, 442
- storage conditions**, 72
- symbols**
  - safety, 39
- synchronization position**, 436
- sync marks**, 434
- T**
- temperatures**
  - operation, 72
  - storage, 72
- testing**
  - brakes, 34
- three-position enabling device**, 36
- tightening torque**
  - mechanical stop axis 1, 107
  - mechanical stop axis 2, 109
- tools**
  - calibration equipment, Levelmeter, 457
  - Calibration Pendulum, 458
  - for service, 456
  - oil exchange equipment, 458
- torques on foundation**, 71
- transporting the robot**, 68
- transport support**, 68
- turning disk dimensions**, 100
- turning disk replacement**, 255
- type of motion**, 74
- U**
- updating revolution counters**, 436
- upper arm**
  - dimensions, 98
  - replacement, 269
- V**
- validity and responsibility**, 19
- W**
- weight**, 70
  - balancing device, 299, 301, 317
  - base plate, 87, 92
  - gearbox, 417, 422
  - lower arm, 279–280
  - motor, 336–337, 351, 353
  - robot, 82–83, 454
  - upper arm, 273, 275
  - wrist unit, 262–263
- working range**, 73
  - restricting axis 1, 106
  - restricting axis 2, 108
  - restricting axis 3, 110
- wrist unit, replacement**, 259

# **Index**

---

## **X**

**xx**

replacing, 201, 203

## **Z**

**zero position**

checking, 439



# Contact us

**ABB AB, Robotics**  
**Robotics and Motion**  
S-721 68 VÄSTERÅS, Sweden  
Telephone +46 (0) 21 344 400

**ABB AS, Robotics**  
**Robotics and Motion**  
Nordlysvegen 7, N-4340 BRYNE, Norway  
Box 265, N-4349 BRYNE, Norway  
Telephone: +47 22 87 2000

**ABB Engineering (Shanghai) Ltd.**  
Robotics and Motion  
No. 4528 Kangxin Highway  
PuDong District  
SHANGHAI 201319, China  
Telephone: +86 21 6105 6666

**ABB Inc.**  
**Robotics and Motion**  
1250 Brown Road  
Auburn Hills, MI 48326  
USA  
Telephone: +1 248 391 9000

[www.abb.com/robotics](http://www.abb.com/robotics)