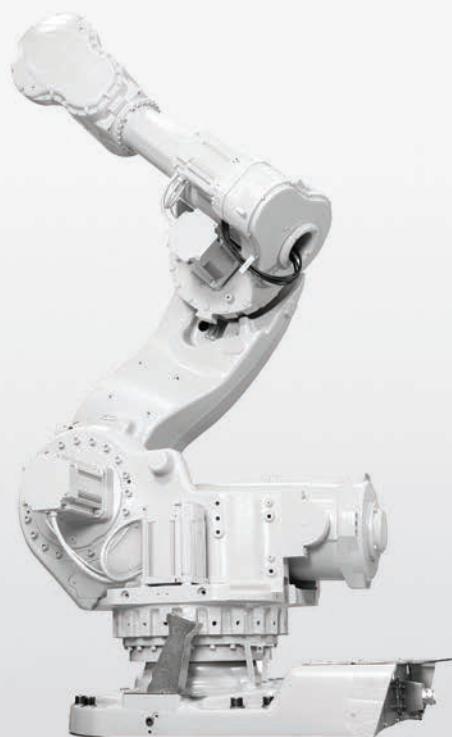


ROBOTICS

# Product manual

## IRB 7600



Trace back information:  
Workspace 23B version a11  
Checked in 2023-06-20  
Skribenta version 5.5.019

## **Product manual**

**IRB 7600 - 500/2.55**

**IRB 7600 - 500/2.3**

**IRB 7600 - 400/2.55**

**IRB 7600 - 340/2.8**

**IRB 7600 - 325/3.1**

**IRB 7600 - 150/3.5**

**M2000, M2000A, IRC5**

**Document ID: 3HAC022033-001**

**Revision: AG**

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, damage 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 2007 - 2023 ABB. All rights reserved.  
Specifications subject to change without notice.

# Table of contents

Overview of this manual .....	9
Product documentation, M2000/M2000A .....	18
Product documentation, IRC5 .....	19
How to read the product manual .....	21
<b>1 Safety</b> .....	<b>23</b>
1.1 Safety information .....	23
1.1.1 Limitation of liability .....	23
1.1.2 Requirements on personnel .....	24
1.2 Safety signals and symbols .....	25
1.2.1 Safety signals in the manual .....	25
1.2.2 Safety symbols on manipulator labels .....	27
1.3 Robot stopping functions .....	33
1.4 Safety during installation and commissioning .....	34
1.5 Safety during operation .....	37
1.6 Safety during maintenance and repair .....	38
1.6.1 Safety during maintenance and repair .....	38
1.6.2 Emergency release of the robot axes .....	41
1.6.3 Brake testing .....	42
1.7 Safety during troubleshooting .....	43
1.8 Safety during decommissioning .....	44
<b>2 Installation and commissioning</b> .....	<b>45</b>
2.1 Introduction to installation and commissioning .....	45
2.2 Robot transportation precautions .....	46
2.3 Securing the robot with a transport support .....	50
2.4 Unpacking .....	52
2.4.1 Pre-installation procedure .....	52
2.4.2 Technical data .....	53
2.4.3 Working range, IRB 7600 - 150/3.5 .....	57
2.4.4 Working range, IRB 7600 - 340/2.8 .....	58
2.4.5 Working range, IRB 7600 - 400/2.55, IRB 7600 - 500/2.55 .....	59
2.4.6 Working range, IRB 7600 - 500/2.3 .....	60
2.4.7 Risk of tipping/stability .....	61
2.4.8 The unit is sensitive to ESD .....	62
2.5 On-site installation .....	63
2.5.1 Lifting robot with fork lift .....	63
2.5.2 Lifting robot with lifting accessory (recommended lifting method) .....	69
2.5.3 Lifting robot with roundslings .....	71
2.5.4 Manually releasing the brakes .....	73
2.5.5 Lifting the base plate .....	75
2.5.6 Securing the base plate .....	76
2.5.7 Orienting and securing the robot .....	81
2.5.8 Fitting equipment on robot .....	84
2.5.9 Installation of base spacers (option) .....	89
2.5.10 Installation of cooling fan for motors (option) .....	91
2.5.11 Installation of Foundry Plus Cable guard (option) .....	98
2.5.12 Loads fitted to the robot, stopping time and braking distances .....	99
2.5.13 Safety lamp (option for IRC5) .....	100
2.5.14 Extended working range, axis 1 (option) .....	101
2.6 Restricting the working range .....	103
2.6.1 Axes with restricted working range .....	103
2.6.2 Mechanically restricting the working range of axis 1 .....	104
2.6.3 Mechanically restricting the working range of axis 2 .....	106
2.6.4 Mechanically restricting the working range of axis 3 .....	108

## Table of contents

---

2.7	Electrical connections .....	111
2.7.1	Robot cabling and connection points .....	111
2.8	Start of robot in cold environments .....	115
2.9	Test run after installation, maintenance, or repair .....	116
<b>3</b>	<b>Maintenance</b> .....	<b>117</b>
3.1	Introduction .....	117
3.2	Maintenance schedule and expected life .....	118
3.2.1	Specification of maintenance intervals .....	118
3.2.2	Maintenance schedule .....	119
3.2.3	Expected component life .....	123
3.3	Inspection activities .....	124
3.3.1	Inspecting the motor seal .....	124
3.3.2	Inspecting the oil level in axis-1 gearbox .....	126
3.3.3	Inspecting the oil level in axis-2 gearbox .....	129
3.3.4	Inspecting the oil level in axis-3 gearbox .....	132
3.3.5	Inspecting the oil level in axis-4 gearbox .....	135
3.3.6	Inspecting the oil level in axis-5 gearbox .....	138
3.3.7	Inspecting the oil level in axis-6 gearbox .....	141
3.3.8	Inspecting the balancing device .....	144
3.3.9	Inspecting the cable harness .....	150
3.3.10	Inspecting the axis-1 mechanical stop pin .....	153
3.3.11	Inspecting the mechanical stops on axes 1, 2, and 3 .....	155
3.3.12	Inspecting the damper on axes 2 to 5 .....	157
3.3.13	Inspecting the information labels .....	159
3.3.14	Inspecting the UL lamp .....	161
3.4	Changing/replacement activities .....	163
3.4.1	Type of lubrication in gearboxes .....	163
3.4.2	Changing oil, axis-1 gearbox .....	165
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 .....	182
3.4.8	Replacing the SMB battery .....	185
3.5	Lubrication activities .....	190
3.5.1	Lubrication of spherical roller bearing, balancing device .....	190
3.6	Cleaning activities .....	192
3.6.1	Flushing a contaminated gearbox .....	192
3.6.2	Cleaning the IRB 7600 .....	194
3.7	Service Information System, M2000 .....	197
3.7.1	Using the SIS system .....	197
3.7.2	Description of Service Information System (SIS) .....	198
3.7.3	SIS system parameters .....	201
3.7.4	Setting the SIS parameters .....	202
3.7.5	Reading the SIS output logs .....	203
3.7.6	Exporting the SIS data .....	204
<b>4</b>	<b>Repair</b> .....	<b>205</b>
4.1	Introduction .....	205
4.2	General procedures .....	206
4.2.1	Performing a leak-down test .....	206
4.2.2	Mounting instructions for bearings .....	207
4.2.3	Mounting instructions for sealings .....	209
4.2.4	Cut the paint or surface on the robot before replacing parts .....	212
4.2.5	The brake release buttons may be jammed after service work .....	213
4.3	Complete robot .....	214
4.3.1	Replacement of cable harness, axes 1-4 .....	214
4.3.2	Replacement of cable harness, axes 5-6 .....	224

4.3.3	Replacement of complete arm system .....	227
4.4	Upper and lower arm .....	232
4.4.1	Replacing turning disk .....	232
4.4.2	Replacement of complete wrist unit .....	236
4.4.3	Replacement of complete upper arm .....	241
4.4.4	Replacement of complete lower arm .....	246
4.4.5	Replacement of lower arm shaft .....	256
4.5	Frame and base .....	264
4.5.1	Replacing the SMB unit .....	264
4.5.2	Replacement of brake release board .....	268
4.5.3	Replacement of spherical roller bearing, balancing device .....	274
4.5.4	Replacing the balancing device .....	279
4.6	Motors .....	291
4.6.1	Replacement of motor, axis 1 .....	291
4.6.2	Replacement of motor axis 2 .....	296
4.6.3	Replacement of motor, axis 3 .....	302
4.6.4	Replacement of motor, axis 4 .....	309
4.6.5	Replacement of motor, axis 5 .....	316
4.6.6	Replacement of motor, axis 6 .....	321
4.7	Gearboxes .....	328
4.7.1	Replacing the axis 1 gearbox .....	328
4.7.2	Replacement of gearbox, axis 2 .....	340
4.7.3	Replacement of gearbox, axis 3 .....	349
4.7.4	Replacement of gearbox, axis 4 .....	356
4.7.5	Replacement of gearbox, axis 5 .....	361
4.7.6	Replacement of gearbox, axis 6 .....	368
<b>5</b>	<b>Calibration</b> .....	<b>373</b>
5.1	Introduction to calibration .....	373
5.1.1	Introduction and calibration terminology .....	373
5.1.2	Calibration methods .....	374
5.1.3	When to calibrate .....	377
5.2	Synchronization marks and axis movement directions .....	378
5.2.1	Synchronization marks and synchronization position for axes .....	378
5.2.2	Calibration movement directions for all axes .....	379
5.3	Updating revolution counters .....	380
5.3.1	Updating revolution counters on IRC5 robots .....	380
5.4	Calibrating with Axis Calibration method .....	385
5.4.1	Description of Axis Calibration .....	385
5.4.2	Calibration tools for Axis Calibration .....	388
5.4.3	Installation locations for the calibration tools .....	390
5.4.4	Axis Calibration - Running the calibration procedure .....	391
5.4.5	Reference calibration .....	395
5.5	Calibrating with Calibration Pendulum method .....	397
5.6	Calibrating with Wrist Optimization method .....	398
5.7	Verifying the calibration .....	400
5.8	Checking the synchronization position .....	401
<b>6</b>	<b>Decommissioning</b> .....	<b>403</b>
6.1	Introduction to decommissioning .....	403
6.2	Environmental information .....	404
6.3	Scrapping of robot .....	406
6.4	Decommissioning of balancing device .....	407
<b>7</b>	<b>Robot description</b> .....	<b>411</b>
7.1	Type A vs type B motors .....	411

## Table of contents

---

<b>8</b>	<b>Reference information</b>	<b>413</b>
8.1	Introduction .....	413
8.2	Applicable standards .....	414
8.3	Unit conversion .....	416
8.4	Screw joints .....	417
8.5	Weight specifications .....	420
8.6	Standard tools .....	421
8.7	Special tools .....	422
8.8	Lifting accessories and lifting instructions .....	426
<b>9</b>	<b>Spare part lists</b>	<b>427</b>
9.1	Spare part lists and illustrations .....	427
<b>10</b>	<b>Circuit diagram</b>	<b>429</b>
10.1	Circuit diagrams .....	429
10.2	Validity of circuit diagram 3HAC025744-1 .....	431
10.3	Validity of circuit diagram 3HAC13347-1 .....	432
<b>Index</b>		<b>433</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 manual also contains reference information for all procedures detailed in the manual.

The robot described in this manual has the protection type Standard and Foundry Plus.

---

## 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.
- 

## Who should read this manual?

This manual is intended for:

- installation personnel
  - maintenance personnel
  - repair personnel.
- 

## Prerequisites

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

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

## Product manual scope

The manual covers covers all variants and designs of the IRB 7600. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

---

## Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety	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.

*Continues on next page*

## Overview of this manual

Continued

Chapter	Contents
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, tools, etc.
Calibration	Calibration procedures and general information about calibration.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards etc.
Spare part list	Complete spare part list 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

Procedures in this product manual contain references to the following manuals:

Document name	Document ID	Note
<i>Product manual - IRB 7600 Foundry Prime</i>	3HAC044350-001	
<i>Product manual, spare parts - IRB 7600</i>	3HAC049113-001	
<i>Product specification - IRB 7600</i>	3HAC023934-001	
<i>Product specification - IRB 7600 M2000/M2000A</i>	3HAC13491-1	
<i>Circuit diagram - IRB 7600</i>	3HAC13347-1 3HAC025744-001	
<i>Safety manual for robot - Manipulator and IRC5 or OmniCore controller<sup>1</sup></i>	3HAC031045-001	M2004
<i>Product manual - IRC5</i> IRC5 with main computer DSQC 639.	3HAC021313-001	
<i>Product manual - IRC5</i> IRC5 with main computer DSQC1000.	3HAC047136-001	
<i>Product manual - S4Cplus M2000</i>	3HAC021333-001	
<i>Product manual - S4Cplus M2000A</i>	3HAC022419-001	
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001	
<i>User's guide - S4Cplus (BaseWare OS 4.0)</i>	3HAC7793-1	
<i>Operating manual - Calibration Pendulum</i>	3HAC16578-1	
<i>Operating manual - Service Information System</i>	3HAC050944-001	M2004
<i>Operating manual - Levelmeter Calibration</i>	3HAC022907-001	M2000/M2000A
<i>Technical reference manual - Lubrication in gear-boxes</i>	3HAC042927-001	
<i>Technical reference manual - System parameters</i>	3HAC050948-001	
<i>Application manual - Additional axes and standalone controller</i>	3HAC051016-001	M2004

Continues on next page

Document name	Document ID	Note
Application manual - External axes	3HAC9299-1	M2000

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

Additional document references

Document name	Document ID
Application manual - CalibWare Field	3HAC030421-001

Revisions

Revision	Description
-	<p>First edition.</p> <p>Replaces previous manuals:</p> <ul style="list-style-type: none"> <li>• Installation and Commissioning Manual</li> <li>• Maintenance Manual</li> <li>• Repair Manual, part 1</li> <li>• Repair Manual, part 2.</li> </ul> <p>Changes made in the material from the previous manuals:</p> <ul style="list-style-type: none"> <li>• Model M2004 implemented.</li> <li>• Various corrections due to technical revisions, changes in the toolkits etc.</li> </ul>
A	<p>Chapter <i>Calibration</i> replaced with chapter <i>Calibration information</i>.</p> <p>Following corrections are made:</p> <ul style="list-style-type: none"> <li>• In chapter 3: <i>Maintenance</i> in section <i>Exporting the SIS data</i>, the unit <b>seconds</b> for different SIS parameters is replaced by the unit <b>hours</b>. The change is only valid for RobotWare release 5.0.</li> </ul> <p>Following updates are made:</p> <ul style="list-style-type: none"> <li>• In chapter 4: <i>Repair</i>, the sections <i>Removal of complete lower arm</i> and <i>Refitting of complete lower arm</i> are completed with more detailed information about how to use the glycerin pump.</li> <li>• Section <i>Document references</i> is completed with article numbers for calibration manuals.</li> <li>• Section <i>Part list</i> is completed with the spare part number for a variant of the cable harness/brake release unit.</li> </ul>
B	<p>New lubricating oil in the gearboxes. Changes made in the chapter <a href="#">Maintenance on page 117</a> and <a href="#">Part list</a>.</p>
C	<ul style="list-style-type: none"> <li>• New variant of the robot (IRB 7600 - 500/2.55) implemented throughout the manual.</li> <li>• Wrist unit updated, new spare part number is specified in <a href="#">Replacement of complete wrist unit on page 236</a> and <a href="#">Spare part list</a>.</li> <li>• Insulated wrist unit implemented, new spare part number is specified in <a href="#">Replacement of complete wrist unit on page 236</a> and <a href="#">Spare part list</a>. Amount of oil differs from non-insulated wrist unit, changes made in sections <i>Type of oil in gearboxes</i> and <a href="#">Changing oil, axis-6 gearbox on page 182</a>.</li> <li>• New section that describes how to replace the bearing at the front eye of the balancing device, <a href="#">Replacement of spherical roller bearing, balancing device on page 274</a>.</li> <li>• Incorrect article numbers for position switches are corrected.</li> <li>• New section: <a href="#">Installation of cooling fan for motors (option) on page 91</a>.</li> <li>• New section: <a href="#">Installation of base spacers (option) on page 89</a></li> <li>• New section that specifies all the recommended spare parts: <a href="#">Spare part list</a>.</li> </ul>

Continues on next page

Revision	Description
	<ul style="list-style-type: none"> <li>Repair sections for removal/refitting are restructured into replacement sections.</li> <li>Various corrections made, due to technical revisions etc.</li> </ul>
D	Foundry Prime option included.
E	<ul style="list-style-type: none"> <li>New variant of the robot (IRB 7600 - 325/3.1) implemented throughout the manual.</li> <li>In chapter 3 <i>Maintenance</i> section <i>Oil in gearboxes</i> type of oil and art. no. in gearbox axes 1 has been added.</li> <li>New product name has been implemented throughout the manual: "Mobilgear 600 XP 320". Replaces "Mobil Gearlube X320".</li> <li>Interval for change of Shell Tivela S 150 has been changed in section <i>Maintenance schedule</i>.</li> <li>Section <i>Service Information System</i> has been removed from the manual. There is a specific manual for SIS. See <i>References</i>.</li> <li>Section <i>Chip and dust protection</i> has been removed from the manual. This option is no longer available.</li> <li>Standard tightening torque for M24 Allen head screws has been added in section <i>Screw joints</i>.</li> <li>Prerequisites in section Overview</li> </ul>
F	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>Section "<b>WARNING!</b> - <i>Mixed oils may cause severe damage to gearboxes</i>" in chapter Safety, has been integrated in section "<i>Type of oil in gearboxes</i>" in the Maintenance chapter.</li> <li>The oil Shell Tivela S150 in gearboxes 1, 2, 3 and 6 has been replaced by <i>Kyodo Yushi TMO 150</i>. Changes made in chapters <i>Maintenance</i> and <i>Spare Parts</i>.</li> <li>The section "<i>Type of oil in gearboxes</i>" in chapter Maintenance has been updated according to changes made in oil types and intervals for oil change.</li> <li>Sections "Robot transportation precaution" and "Securing the robot" are added to the Installation chapter.</li> <li>Modified maintenance intervals for oil change in gearboxes.</li> <li>Chapter Maintenance, section "Maintenance Schedule": interval for replacement of battery pack changed.</li> <li>Section "Type of oil" changed.</li> </ul>
G	<p>This revision include the following addition:</p> <ul style="list-style-type: none"> <li>New <b>WARNING!</b> added in <i>Safety chapter</i> section <i>Work inside the robot's working range</i>.</li> <li>New <b>WARNING!</b> added in <i>Safety chapter</i> section <b>WARNING!</b> - <i>Safety risks during work with gearbox oil</i>.</li> <li>The text in the introduction to chapters <i>Installation</i>, <i>Maintenance</i> and <i>Repair</i> has been updated concerning the robot being connected to earth when power connected.</li> <li>Section <i>Expected component life</i> in chapter <i>Maintenance</i>: The lifetime of certain parts has been updated.</li> <li>Section <i>Type of oil</i> in chapter <i>Maintenance</i> has been updated.</li> <li>Section <i>Foundry Plus, Cable guard</i> added to Installation chapter.</li> </ul>
H	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> <li>Circuit diagrams are not included in this document but delivered as separate files. See <a href="#">Circuit diagram on page 429</a>.</li> <li>List of standards updated, see <a href="#">Applicable standards on page 414</a>.</li> <li>Interval changed for <i>inspection</i> and <i>lubrication</i> of balancing device (Foundry Prime). See chapter Maintenance section <a href="#">Maintenance schedule on page 119</a>.</li> </ul>

Revision	Description
	<p>The chapter <i>Safety</i> updated with:</p> <ul style="list-style-type: none"> <li>Updated safety signal graphics for the levels <i>Danger</i> and <i>Warning</i>, see <a href="#">Safety signals in the manual on page 25</a>.</li> <li>New safety labels on the manipulators, see <a href="#">Safety symbols on manipulator labels on page 27</a>.</li> <li>Revised terminology: <i>robot</i> replaced with <i>manipulator</i>.</li> </ul>
J	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>Maximum deviation changed, see <a href="#">Securing the base plate on page 76</a>.</li> <li>Corrected part numbers, see <a href="#">Wrist, 3HAC16628-4</a>.</li> <li>Corrected exploded view, see <a href="#">Wrist complete</a>.</li> <li>Added inspection of oil level in gearboxes and inspection of surface treatment in maintenance schedule for Foundry Prime. See section <a href="#">Activities and intervals, Foundry Prime</a>.</li> <li>Text in maintenance schedules concerning lubrication of balancing device bearing changed into concerning all bearings of the balancing device, see <a href="#">Maintenance schedule on page 119</a>.</li> <li>Replacement of cable harness in Foundry Prime robots added to maintenance schedule, see <a href="#">Activities and intervals, Foundry Prime</a>.</li> </ul>
K	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>Removed incorrect article number for fork lift, see <a href="#">Lifting robot with fork lift on page 63</a>.</li> <li>Information about restricting and extending the working range of axis 1 is now separated, see <a href="#">Mechanically restricting the working range of axis 1 on page 104</a> and the new section <a href="#">Extended working range, axis 1 (option) on page 101</a>. Also added signal about option 561-1 in section <a href="#">Inspecting the axis-1 mechanical stop pin on page 153</a>.</li> </ul>
L	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>A new block, about general illustrations, added in section <a href="#">How to read the product manual on page 21</a>.</li> <li>Made minor corrections and improvements in the complete instruction for how to replace the axis 1 gearbox, see <a href="#">Replacing the axis 1 gearbox on page 328</a>.</li> <li>Robot designations are adjusted in sub-headings in section <a href="#">Robot transportation precautions on page 46</a>.</li> <li>Added new mechanical structure of the lower arm attachment point for robots with protection Foundry Plus and Foundry Prime, see <a href="#">Replacement of complete lower arm on page 246</a>, the new section <a href="#">Replacement of lower arm shaft on page 256</a> and the exploded view <a href="#">Frame-Lower arm 2 in Product manual, spare parts - IRB 7600</a>.</li> <li>Some general tightening torques have been changed/added, see updated values in <a href="#">Screw joints on page 417</a>.</li> <li>Added information about batteries.</li> <li>The maximum allowed deviation in levelness of the base plate is changed, see <a href="#">Securing the base plate on page 76</a>.</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 76</a>.</li> <li>Added attachment plate for axis-2 switch to equipment list for installation of position switch.</li> <li>Friction washer added to the instruction for replacing axis-2 gearbox and to the exploded view, see <a href="#">Replacement of gearbox, axis 2 on page 340</a> and <a href="#">Exploded view</a>.</li> <li>Moved all information about Foundry Prime to a separate Product manual, see <a href="#">References on page 10</a> for document number.</li> </ul>

Continues on next page

Revision	Description
	<ul style="list-style-type: none"> <li>Corrected article numbers for the o-rings and removed the removal tool from the equipment list and from the procedure, see <a href="#">Replacement of gearbox, axis 6 on page 368</a>.</li> <li>Corrected article number for axis-2-3 sealing, see <a href="#">Replacement of complete lower arm on page 246</a> and <a href="#">Replacement of complete upper arm on page 241</a>.</li> </ul>
M	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>A new SMB unit and battery is introduced, with longer battery lifetime.</li> </ul>
N	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>Instruction for inspection of oil level updated.</li> <li>Spare part number, motor axis 2 corrected.</li> <li>Added information about risks when scrapping a decommissioned robot, see <a href="#">Scrapping of robot on page 406</a>.</li> <li>Added information in draining instructions and in Safety chapter about draining oil from gearboxes.</li> <li>Information regarding fork lift set 3HAC0604-2 deleted from manual.</li> <li>Information regarding oil types added to maintenance schedule.</li> <li>New illustrations, and updated repair instructions regarding brake unit cover.</li> <li><i>Spare parts and exploded views</i> are not included in this document but delivered as a separate document. See <i>Product manual, spare parts - IRB 7600</i></li> </ul>
P	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>Information about maintenance kit (3HAC15834-1), and upgrade kit (3HAC14965-1), deleted from manual.</li> <li>The maximum allowed deviation in levelness of the base plate and foundation is changed, see <a href="#">Securing the base plate on page 76</a>.</li> <li>Added tightening torque for R1.SMB and 7th axis connector, see <a href="#">Replacement of cable harness, axes 1-4 on page 214</a>.</li> <li>Minor corrections.</li> </ul>
Q	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <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 124</a>.</li> <li>Illustrations of SMB battery RMU improved.</li> </ul>
R	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>Article number changed for Fork lift accessory (from 3HAC0604-1 to 3HAC0604-2)</li> <li>New standard calibration method introduced (Axis Calibration). See <a href="#">Calibration on page 373</a>.</li> <li>Tightening torque for securing screw in piston shaft front eye changed, see <a href="#">Replacing the balancing device on page 279</a>.</li> <li>External brake release unit section removed from the manual.</li> <li>Turning disk fixture is removed from special tools for Levelmeter calibration.</li> </ul>
S	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> <li>Oil types in maintenance schedule table removed and a reference to the Tech. manual added.</li> <li>Maintenance table splitted into several tables.</li> <li>Edited information regarding deciding calibration routine in each repair section.</li> <li>Added a warning that calibration pin must be inserted in the calibration bushing until it snaps, see <a href="#">Description of Axis Calibration on page 385</a>.</li> </ul>

Continues on next page

Revision	Description
	<ul style="list-style-type: none"> <li>• Added warning regarding risk of pinching, in <a href="#">Description of Axis Calibration on page 385</a>.</li> <li>• Added information about inspection of calibration tool prior to usage, see <a href="#">Examining the calibration tool on page 388</a>.</li> <li>• Added information about the calibration procedure, see <a href="#">Overview of the calibration procedure on the FlexPendant on page 391</a>, <a href="#">Restarting an interrupted calibration procedure on page 393</a>.</li> <li>• Added information about Axis Calibration when SafeMove is installed, see <a href="#">Axis Calibration with SafeMove option on page 393</a>.</li> </ul>
T	<p>Published in release R16.2. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>• Drawing of base plate is not available for purchase, faulty information removed in <a href="#">Securing the base plate on page 76</a>.</li> <li>• Corrections due to updates in terminology.</li> <li>• Drawing of tool flange for LeanID added.</li> </ul>
U	<p>Published in release R17.2. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>• Caution about removing metal residues added in sections about SMB boards.</li> <li>• Information about minimum resonance frequency added.</li> <li>• Bending radius for static floor cables added.</li> <li>• Note regarding VK cover on axis 3 (lower arm) due to removal of hole in new design of the lower arm.</li> <li>• Cooling fans (option) is available for axes 1 and 2.</li> <li>• Applicable standards updated</li> <li>• Added text regarding overhaul in section specification of maintenance intervals.</li> <li>• Section <a href="#">Start of robot in cold environments on page 115</a> added.</li> <li>• Updated information regarding replacement of brake release board.</li> <li>• Updated information regarding disconnecting and reconnecting battery cable to serial measurement board.</li> <li>• Updated information regarding lubrication of gearbox oil for all axis.</li> <li>• Definition of reference calibration clarified.</li> </ul>
V	<p>Published in release R18.1. The following updates are made in this revision:</p> <ul style="list-style-type: none"> <li>• Information added about fatigue to Axis Calibration tool, see <a href="#">Calibration tools for Axis Calibration on page 388</a>.</li> <li>• Updated information about locking liquid in replacement of cable harness, axes 1-4.</li> <li>• Added sections in <a href="#">General procedures on page 206</a>.</li> <li>• Safety restructured.</li> <li>• Updated spare part number brake release unit (was DSQC561, is DSQC1052).</li> <li>• Type B motors are introduced throughout the manual. <ul style="list-style-type: none"> <li>- New periodic maintenance activity regarding inspection of the type B motor oil seal.</li> <li>- New gasket at axis-6 motor cable inlet.</li> </ul> </li> <li>• Note added to calibration chapter to emphasize the requirement of equally dressed robot when using previously created reference calibration values.</li> <li>• Information about myABB Business Portal added.</li> <li>• Revised tightening torque for gearbox axis 2.</li> <li>• Added Nickel in Environmental information.</li> <li>• Changed direction of installed cooling fan on axis-2 motor and removed a faulty image showing the design of the cooling fan. Also added detailed images to installation procedure for the fan.</li> </ul>

Continues on next page

Revision	Description
W	Published in release 19B. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• New touch up color Graphite White available. See <a href="#">Cut the paint or surface on the robot before replacing parts on page 212</a>.</li> <li>• Levelmeter 2000 kit (6369901-347) no longer available.</li> <li>• Updated oil plug torque on axis 6 gearbox to 20 Nm.</li> </ul>
X	Published in release 19C. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• Added three velcro straps to the cable harness in the lower arm.</li> </ul>
Y	Published in release 19D. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• Added references to DressPack manual in <a href="#">Robot cabling and connection points on page 111</a>.</li> </ul>
Z	Published in release 20B. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• Clarified and added information in mounting instructions for rotating sealings, see <a href="#">Mounting instructions for sealings on page 209</a>.</li> <li>• Clarified text about position of robot and added table with dependencies between axes during Axis Calibration.</li> <li>• Added information about Wrist Optimization in calibration chapter.</li> <li>• Replaced article number and name of grease, previously 3HAB3537-1.</li> </ul>
AA	Published in release 20C. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• New press equipment for unloading balancing device introduced. New article number. User instructions for the equipment are enclosed with the tool and removed from this manual.</li> <li>• New press equipment for replacing the lower arm shaft introduced. New article numbers. User instructions for the equipment are enclosed with the tools and removed from this manual.</li> <li>• New press equipment introduced for following repair procedures. New article numbers added. User instructions for the equipment are enclosed with the tool and removed from this manual. <ul style="list-style-type: none"> <li>- unloading balancing device</li> <li>- replacing lower arm shaft</li> <li>- replacing balancing device shaft</li> </ul> </li> </ul>
AB	Published in release 20D. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• Recommended fastener quality is replaced with a general text, see <a href="#">Fitting equipment on robot on page 84</a>.</li> </ul>
AC	Published in release 21A. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• Changed lifting accessory for lifting axis-2 and axis-3 gearboxes.</li> <li>• Tool number for Press device, axis 2 shaft and axis 2 bearing changed, see <a href="#">Required equipment on page 257</a></li> <li>• New tool/adaptor added to required equipment, see <a href="#">Replacing the balancing device on page 279</a>.</li> </ul>
AD	Published in release 21B. The following updates are made in this revision: <ul style="list-style-type: none"> <li>• Oil name Optimol PD0 is changed to Tribol GR 100-0-PD in <i>Lubrication of spherical roller bearing, balancing device and Replacement of balancing device</i>.</li> <li>• Information regarding documentation of Installation of Foundry Plus Cable guard (option no. 908-1) is changed since DVDs are removed. See <a href="#">Installation of Foundry Plus Cable guard (option) on page 98</a>.</li> <li>• Text regarding fastener quality is updated, see <a href="#">Fastener quality on page 88</a>.</li> <li>• The information about extended working range for axis 1 is updated, see <a href="#">Extended working range, axis 1 (option) on page 101</a>.</li> </ul>
AE	Published in release 22A. The following updates are done in this revision: <ul style="list-style-type: none"> <li>• Updated information about Gleitmo treated screws, see <a href="#">Screw joints on page 417</a>.</li> </ul>



Revision	Description
	<ul style="list-style-type: none"> <li>• Removed information about position switches as they are no longer available.</li> </ul>
AF	<p>Published in release 22C. The following updates are made in this revision:</p> <ul style="list-style-type: none"> <li>• Corrected article numbers for axis-6 gearbox o-ring and turning disk o-ring.</li> </ul>
AG	<p>Published in release 23B. The following updates are done in this revision:</p> <ul style="list-style-type: none"> <li>• Added a step for overall inspection of cabling after cable harness has been replaced.</li> <li>• Corrected the section <a href="#">Lubrication of spherical roller bearing, balancing device on page 190</a>.</li> <li>• Added note about oscillations in section about reference calibration.</li> <li>• Updated the torque value for transparent plug.</li> </ul>

## Product documentation, M2000/M2000A

---

### General

The complete product documentation kit for the M2000 robot system, including controller, robot and any hardware option, consists of the manuals listed below:

---

### Product manuals

Manipulators, controllers, DressPack/SpotPack, and most other hardware will be 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).

---

### Software manuals

The software documentation consists of a wide range of manuals, ranging from manuals for basic understanding of the operating system to manuals for entering parameters during operation.

A complete listing of all available software manuals is available from ABB.

---

### Controller hardware option manual

Each hardware option for the controller is supplied with its own documentation.

Each document set contains the types of information specified below:

- Installation information
- Repair information
- Maintenance information

In addition, spare part information is supplied for the entire option.

# 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.



### Tip

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

---

## 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.
  - Troubleshooting.
  - Decommissioning.
  - Reference information (safety standards, unit conversions, screw joints, lists of tools).
  - Spare parts list with corresponding figures (or references to separate spare parts lists).
  - References to circuit diagrams.
- 

## Technical reference manuals

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

---

## Application manuals

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

An application manual generally contains information about:

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

*Continues on next page*

- Examples of how to use the application.

---

### **Operating manuals**

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

# How to read the product manual

## Reading the procedures

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

### References to figures

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

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

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

	Action	Note/Illustration
8.	Remove the <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 23](#).

## 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.

**This page is intentionally left blank**

---

# 1 Safety

## 1.1 Safety information

### 1.1.1 Limitation of liability

---

#### Limitation of liability

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

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

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

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

---

#### Spare parts and equipment

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

# 1 Safety

---

## 1.1.2 Requirements on personnel

### 1.1.2 Requirements on personnel

---

#### General

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

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

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

---

#### Personal protective equipment

Use personal protective equipment, as stated in the instructions.



## 1.2 Safety signals and symbols

### 1.2.1 Safety signals in the manual







#### Introduction to safety signals

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

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

#### Hazard levels

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

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


*Continues on next page*

# 1 Safety

---

## 1.2.1 Safety signals in the manual

*Continued*

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

## 1.2.2 Safety symbols on manipulator labels

### Introduction to symbols

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



#### Note

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




### Types of symbols

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

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 27](#).

The information labels can contain information in text.

### Symbols on safety labels

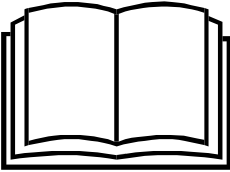
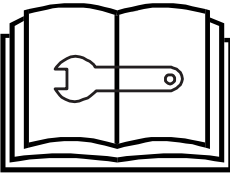
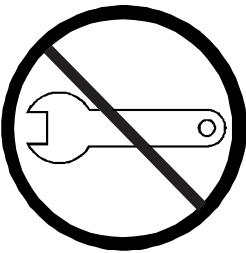
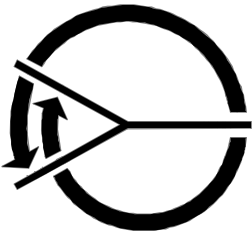

Symbol	Description
 xx0900000812	<b>Warning!</b> Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical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

*Continues on next page*

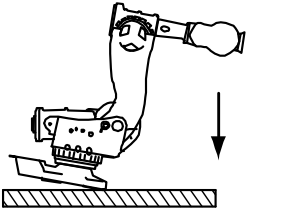

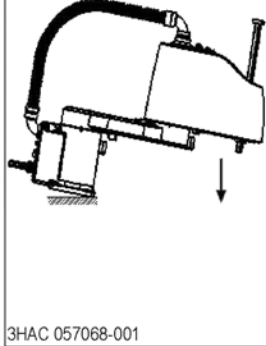


# 1 Safety

## 1.2.2 Safety symbols on manipulator labels

Continued

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



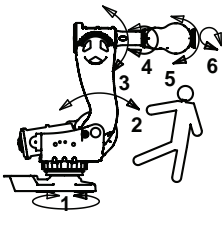
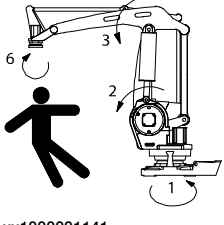
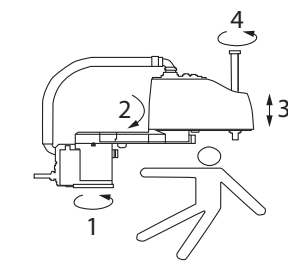
Continues on next page

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

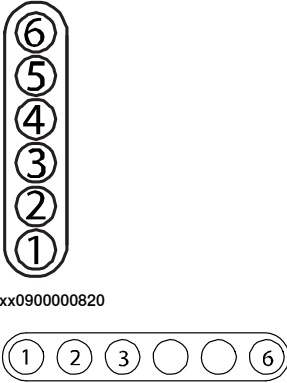

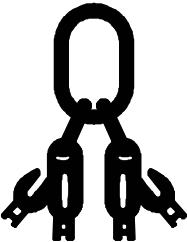



# 1 Safety

## 1.2.2 Safety symbols on manipulator labels

Continued

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

Continues on next page



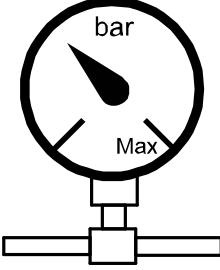
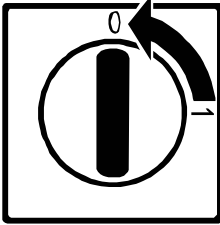

Symbol	Description
 <p>xx0900000820</p> <p>xx1000001140</p>	<p><b>Brake release buttons</b></p>
 <p>xx0900000821</p>	<p><b>Lifting bolt</b></p>
 <p>xx1000001242</p>	<p><b>Adjustable chain sling with shortener</b></p>
 <p>xx0900000822</p>	<p><b>Lifting of robot</b></p>
 <p>xx0900000823</p>	<p><b>Oil</b>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

Continues on next page

# 1 Safety

## 1.2.2 Safety symbols on manipulator labels

Continued

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



### 1.3 Robot stopping functions

---

#### Protective stop and emergency stop

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

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Panel Mounted Controller*

# 1 Safety

---

## 1.4 Safety during installation and commissioning

### 1.4 Safety during installation and commissioning

---

#### National or regional regulations

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

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

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

---

#### Layout

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

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

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

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

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

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

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

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

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

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

---

#### Allergenic material

See [Environmental information on page 404](#) for specification of allergenic materials in the product, if any.

---

#### Securing the robot to the foundation

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

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

---

*Continues on next page*

### Electrical safety

Incoming mains must be installed to fulfill national regulations.

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

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

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

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



#### Note

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

### Safety devices

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

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

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

### Other hazards

A robot may perform unexpected limited movement.



#### WARNING

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

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

- Water
- Compressed air
- Hydraulics

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

*Continues on next page*

# 1 Safety

---

## 1.4 Safety during installation and commissioning

*Continued*

---

### Pneumatic or hydraulic related hazards



#### Note

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

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

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

Dump valves should be used in case of emergency.

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

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

---

### Verify the safety functions

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

### 1.5 Safety during operation

#### Automatic operation

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

#### Unexpected movement of robot arm



#### WARNING

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

A robot may perform unexpected limited movement.



#### WARNING

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

# 1 Safety

## 1.6.1 Safety during maintenance and repair

## 1.6 Safety during maintenance and repair

### 1.6.1 Safety during maintenance and repair

#### General

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

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

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


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

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

#### Hot surfaces

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

#### Allergic reaction

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


#### Gearbox lubricants (oil or grease)

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










#### Note

Take special care when handling hot lubricants.

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

*Continues on next page*


Warning	Description	Elimination/Action
 <b>Allergic reaction</b>	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 <b>Possible pressure build-up in gearbox</b>	When opening the oil or grease plug, there may be pressure present in the gearbox, causing lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling.
 <b>Do not overfill</b>	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: <ul style="list-style-type: none"> <li>• damage seals and gaskets</li> <li>• completely press out seals and gaskets</li> <li>• prevent the robot from moving freely.</li> </ul>	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
 <b>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 for the product.
 <b>Oil residues</b>	Oil residues might be present in a drained gearbox and spilled when separating a motor and gearbox during repair.	Make sure that protective gear like goggles/protective visor, gloves and arm protection are always worn during this activity. Put oil absorbent cloth or paper at appropriate locations to catch any oil residues.
 <b>Heat up the oil</b>	Warm oil drains quicker than cold oil.	Run the robot before changing the gearbox oil, if possible.
 <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.

*Continues on next page*

# 1 Safety

## 1.6.1 Safety during maintenance and repair

Continued

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

### Hazards related to batteries

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

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

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

Operating temperatures are listed in [Operating conditions, robot on page 55](#).

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

### Unexpected movement of robot arm



#### WARNING

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

A robot may perform unexpected limited movement.



#### WARNING

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

### Related information

See also the safety information related to installation and operation.



### 1.6.2 Emergency release of the robot axes

#### Description

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

How to release the brakes is described in the section:

- [Manually releasing the brakes on page 73](#).

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

#### Increased injury

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



#### **DANGER**

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

Make sure no personnel is near or beneath the robot.

# 1 Safety

---

## 1.6.3 Brake testing

### 1.6.3 Brake testing

---

#### When to test

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

---

#### How to test

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

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

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



#### Note

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

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

### 1.7 Safety during troubleshooting

#### General

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

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



#### **DANGER**

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

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



#### **WARNING**

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

A robot may perform unexpected limited movement.



#### **WARNING**

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

#### Related information

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

# 1 Safety

---

## 1.8 Safety during decommissioning

### 1.8 Safety during decommissioning

---

#### General

See section [Decommissioning on page 403](#).

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

---

#### Unexpected movement of robot arm



#### WARNING

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

A robot may perform unexpected limited movement.



#### WARNING

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

## 2 Installation and commissioning

### 2.1 Introduction to installation and commissioning

#### General

This chapter contains assembly instructions and information for installing the IRB 7600 at the working site.

See also the product manual for the robot controller.

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

The technical data is detailed in section [Technical data on page 53](#).

#### Safety information

Before any installation work is commenced, all safety information must be observed. There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 23](#) before performing any installation work.



#### Note

Always connect the IRB 7600 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Panel Mounted Controller*

## 2 Installation and commissioning

---

### 2.2 Robot transportation precautions

### 2.2 Robot transportation precautions

---

#### General

This section describes ABB approved transportation precautions for ABB robots.



#### CAUTION

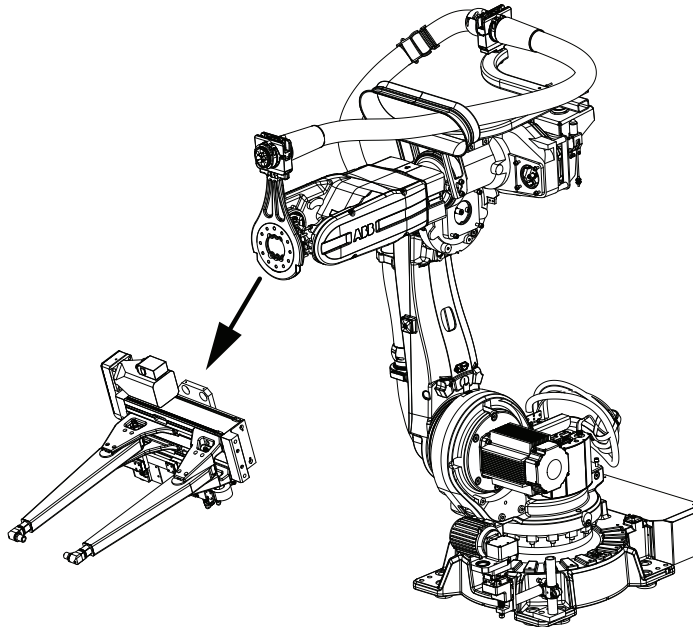
All transportation in or outside the plant, must be carried out according to the method described in this section.

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

---

#### Method 1 - recommended method

Transportation according to method 1 is strongly recommended by ABB.



xx080000030

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 61](#).
- Always read and follow the instructions in section [Pre-installation procedure on page 52](#)

---

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

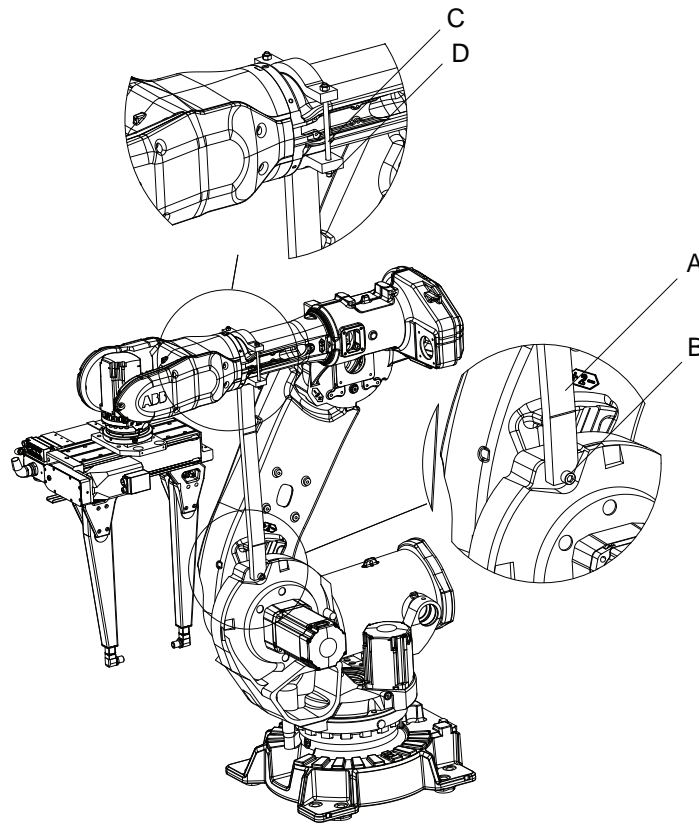
Transportation according to method 2 is approved by ABB, only if use of method 1 is not possible.

*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 50](#)
- 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 48](#).
- Always use the recommended transport support described in sub section [Recommended transport support on page 49](#).

IRB 7600



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

---

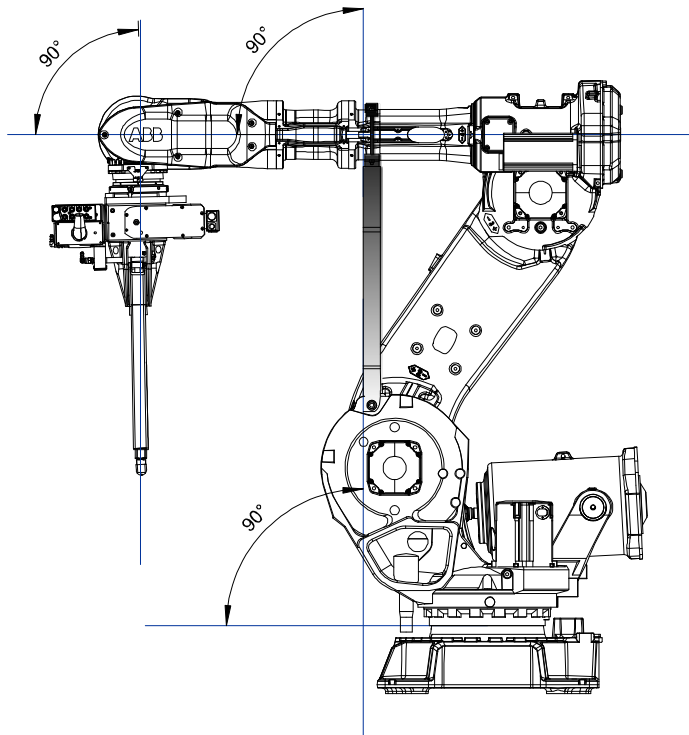
### 2.2 Robot transportation precautions

*Continued*

Transport position with a transport support

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

IRB 7600



xx0800000040

*Continues on next page*

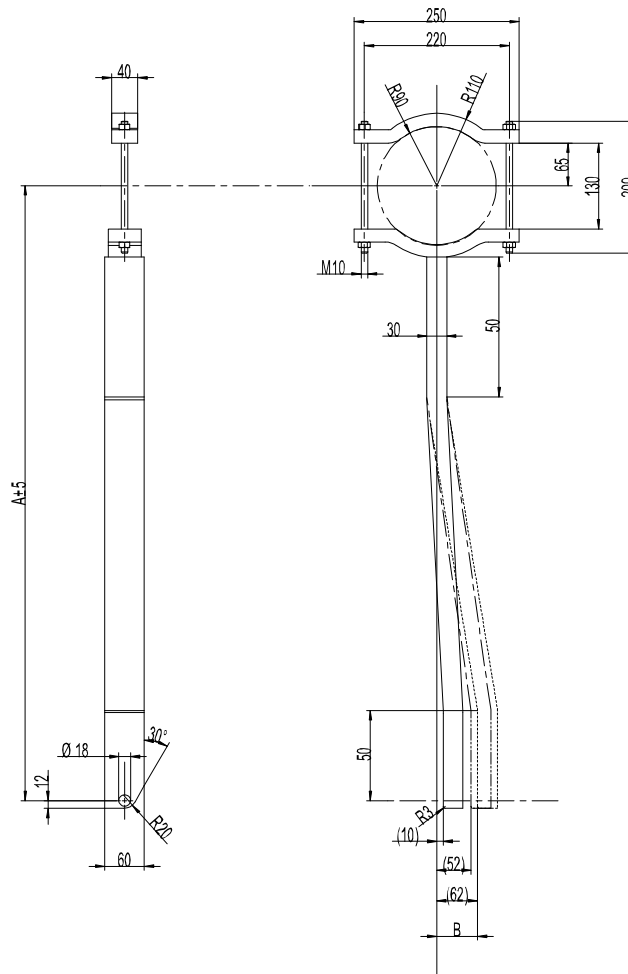


#### Recommended transport support

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

#### IRB 7600

		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



xx080000039

## 2 Installation and commissioning

### 2.3 Securing the robot with a transport support

### 2.3 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.

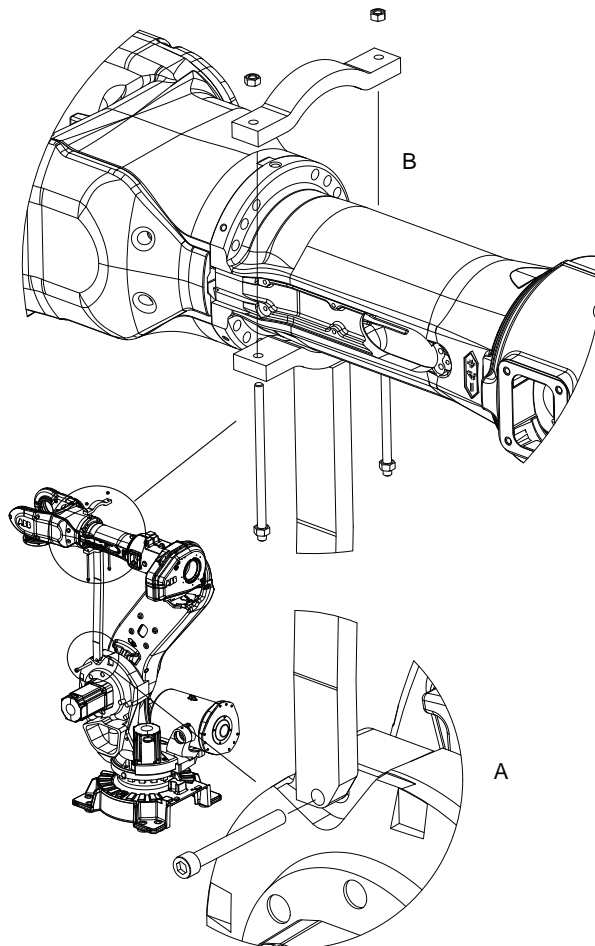


#### DANGER

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



xx080000062

*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 48</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 48</a> .	 <b>CAUTION</b> 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 73</a> .	See attachment point for the specific robot in the section <a href="#">Transport position with a transport support on page 48</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.	 <b>CAUTION</b> 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 73</a>	

## 2 Installation and commissioning

### 2.4.1 Pre-installation procedure

## 2.4 Unpacking

### 2.4.1 Pre-installation procedure

#### Introduction


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

#### Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

#### Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage.  <b>Note</b> Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: <a href="#">Weight, robot on page 53</a>
6	If the robot is not installed directly, it must be stored as described in: <a href="#">Storage conditions, robot on page 55</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 55</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 54</a></li><li>• <a href="#">Protection classes, robot on page 56</a></li><li>• <a href="#">Requirements, foundation on page 55</a></li></ul>
9	Before moving the robot, please observe the stability of the robot: <a href="#">Risk of tipping/stability on page 61</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 63</a>
11	Install required equipment, if any. <ul style="list-style-type: none"><li>• <a href="#">Safety lamp (option for IRC5) on page 100</a></li><li>• <a href="#">Installation of base spacers (option) on page 89</a></li></ul>

## 2.4.2 Technical data

### Weight, robot

The table shows the weight of the robot.

The weight does not include the weight of the DressPack.

Robot model	Weight
IRB 7600	2500 kg



#### Note

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

### Mounting positions

The table shows valid mounting options for the manipulator.

Mounting option	Installation angle	Note
Floor mounted	0° <sup>i</sup>	

<sup>i</sup> A tilt of up to 5° does not affect the payload or reach, but it can have a negative impact on performance and lifetime. The actual value must be set in the system parameters.



#### Note

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

*Continues on next page*

## 2 Installation and commissioning

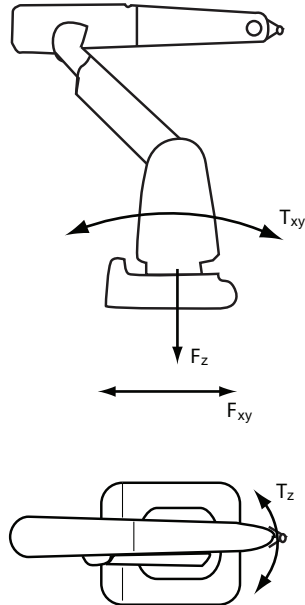
### 2.4.2 Technical data

Continued

#### Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

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



xx1100000521

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

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



#### Note

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



#### WARNING

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


#### Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$\pm 14$ kN	$\pm 31$ kN
Force z	$+32 \pm 10$ kN	$+39 \pm 16$ kN
Torque xy	$\pm 42$ kNm	$\pm 72$ kNm
Torque z	$\pm 11$ kNm	$\pm 19.5$ kNm

Continues on next page

#### Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Minimum resonance frequency	22 Hz  <b>Note</b> It may affect the manipulator life-time to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment. <sup>i</sup> For information about compensating for foundation flexibility, see the application manual of the controller software, section <i>Motion Process Mode</i> .

<sup>i</sup> The minimum resonance frequency given should be interpreted as the frequency of the robot mass/inertia, robot assumed stiff, when a foundation translational/torsional elasticity is added, i.e., the stiffness of the pedestal where the robot is mounted. The minimum resonance frequency should not be interpreted as the resonance frequency of the building, floor etc. For example, if the equivalent mass of the floor is very high, it will not affect robot movement, even if the frequency is well below the stated frequency. The robot should be mounted as rigid as possibly to the floor.  
Disturbances from other machinery will affect the robot and the tool accuracy. The robot has resonance frequencies in the region 10 – 20 Hz and disturbances in this region will be amplified, although somewhat damped by the servo control. This might be a problem, depending on the requirements from the applications. If this is a problem, the robot needs to be isolated from the environment.

#### Storage conditions, robot

The table shows the allowed storage conditions for the robot:

Parameter	Value
Minimum ambient temperature	-25° C
Maximum ambient temperature	+55° C
Maximum ambient temperature (less than 24 hrs)	+70° C
Maximum ambient humidity	95% at constant temperature (gaseous only)

#### Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5° C
Maximum ambient temperature	+50° C
Maximum ambient humidity	Max. 95% at constant temperature

*Continues on next page*

## 2 Installation and commissioning

---

### 2.4.2 Technical data

*Continued*

---

#### Protection classes, robot

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

Protection type	Protection class <sup>i</sup>
Manipulator, protection type Standard	IP 67
Manipulator, protection type Foundry Plus	IP 67

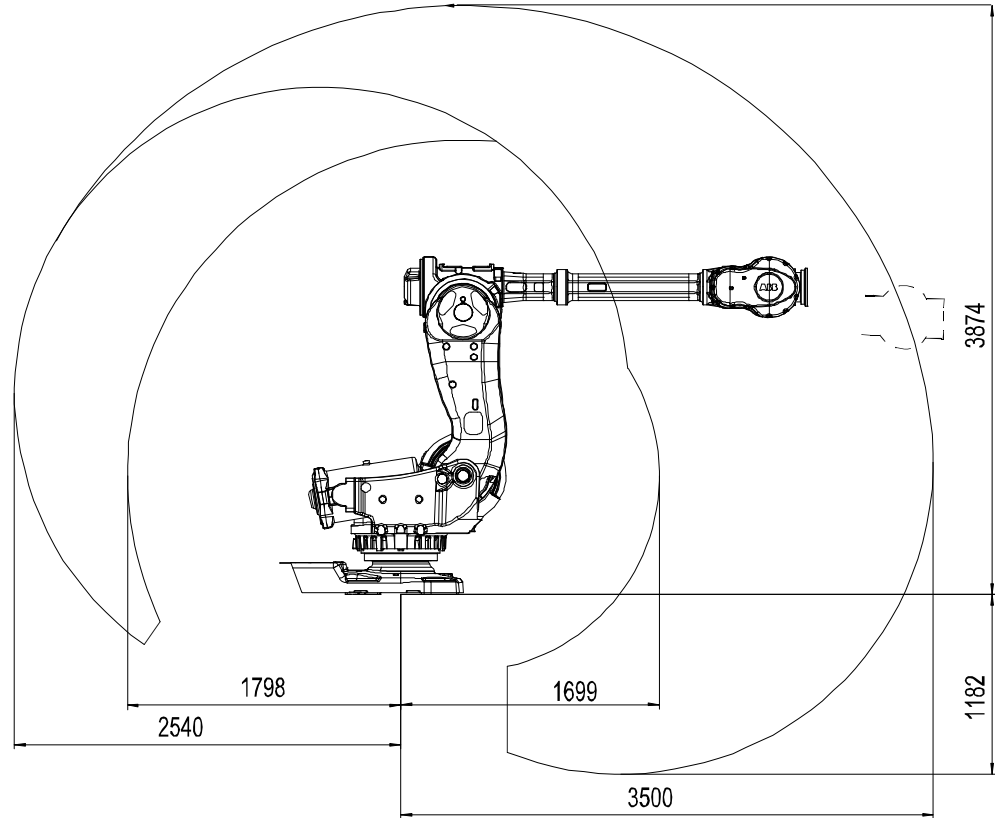
<sup>i</sup> According to IEC 60529.



### 2.4.3 Working range, IRB 7600 - 150/3.5

#### Illustration

The illustration below shows the unrestricted working range of IRB 7600 - 150/3.5:



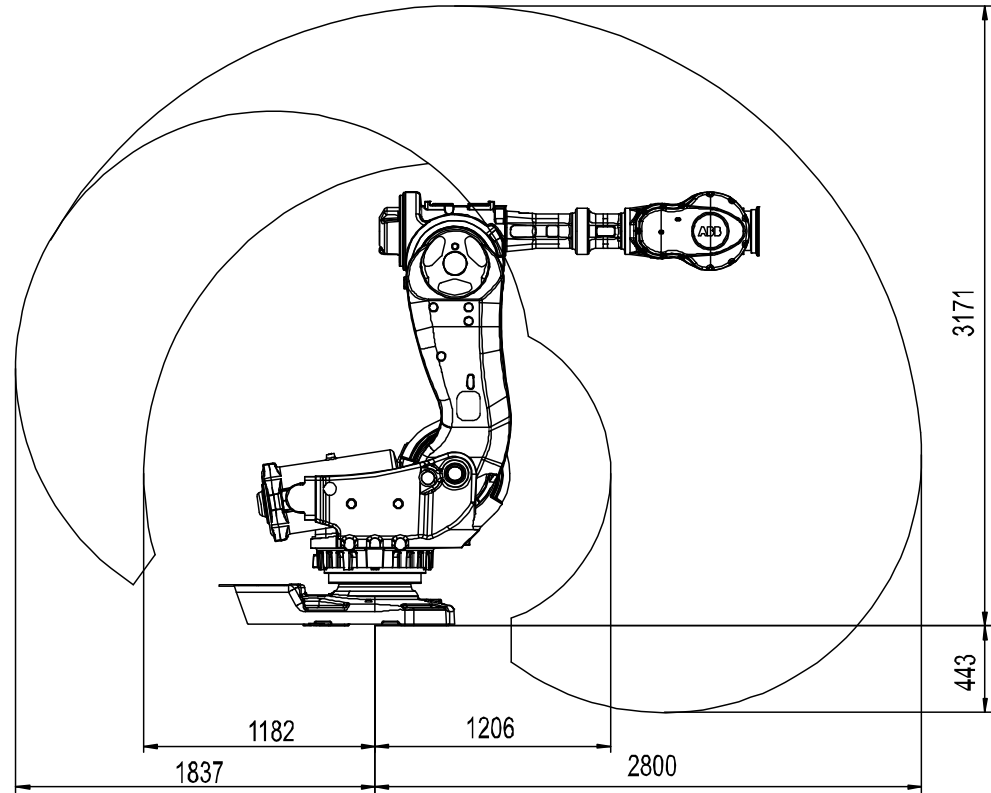
## 2 Installation and commissioning

### 2.4.4 Working range, IRB 7600 - 340/2.8

### 2.4.4 Working range, IRB 7600 - 340/2.8

#### Illustration

The illustration below shows the unrestricted working range of IRB 7600 - 340/2.8:

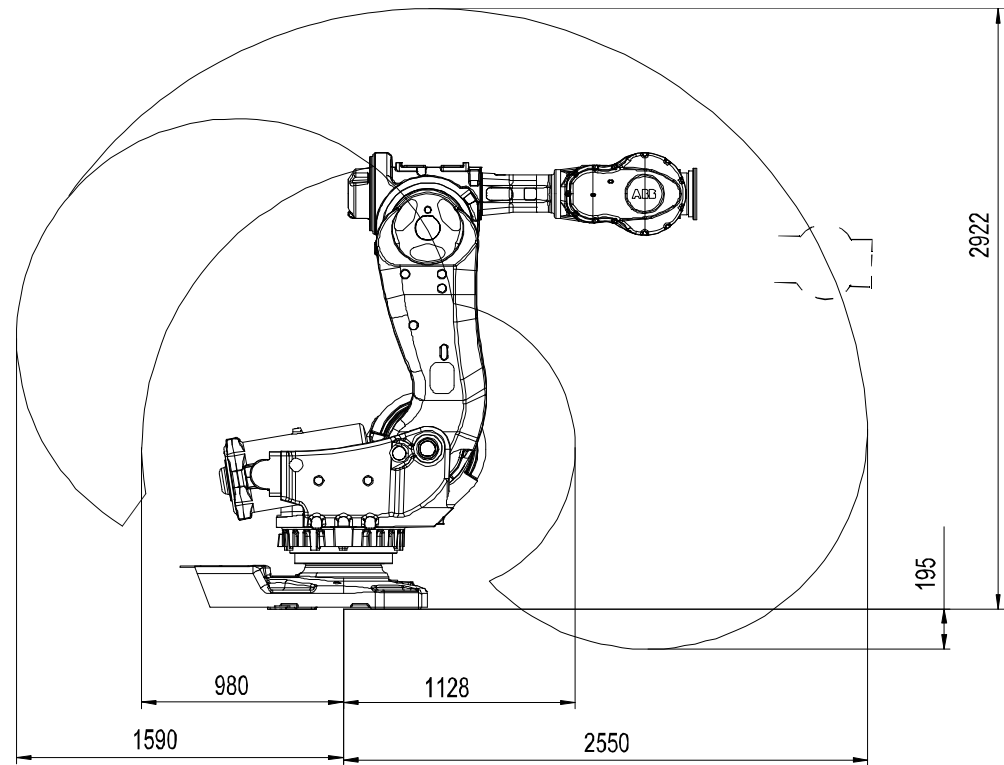


xx0300000296

#### 2.4.5 Working range, IRB 7600 - 400/2.55, IRB 7600 - 500/2.55

##### Illustration

The illustration below shows the unrestricted working range of IRB 7600 - 400/2.55 and IRB 7600 - 500/2.55:



xx0100000100

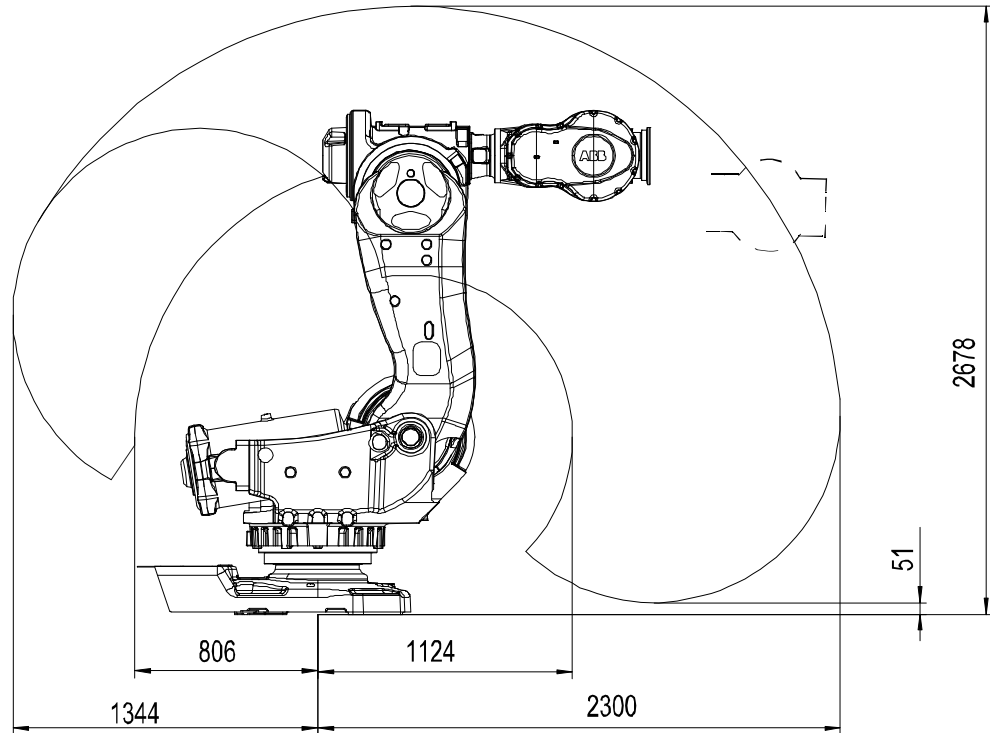
## 2 Installation and commissioning

### 2.4.6 Working range, IRB 7600 - 500/2.3

### 2.4.6 Working range, IRB 7600 - 500/2.3

#### Illustration

The illustration below shows the unrestricted working range of IRB 7600 - 500/2.3:



en010000099

#### 2.4.7 Risk of tipping/stability

##### Risk of tipping

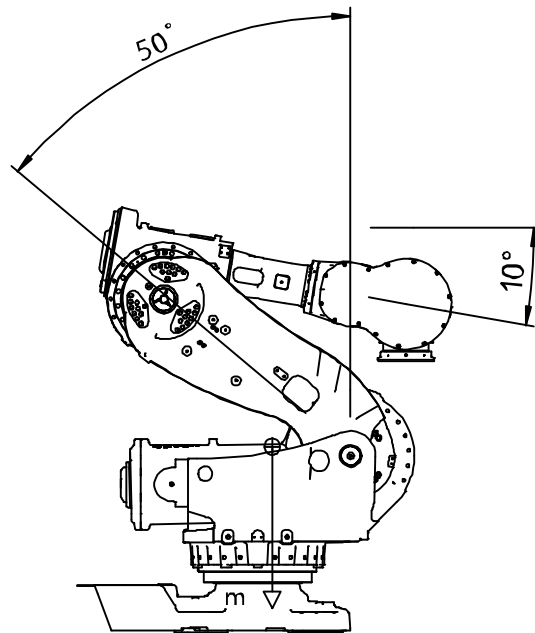
If the robot is not fastened to the foundation while moving the arm, the robot is not stable in the whole working area. Moving the arm will displace the center of gravity, which may cause the robot to tip over.

The transportation position is the most stable position.

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

##### Transportation position

This figure shows the robot in its transportation position.



xx0100000103



##### Note

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



##### WARNING

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

## 2 Installation and commissioning

---

### 2.4.8 The unit is sensitive to ESD

### 2.4.8 The unit is sensitive to ESD

---

#### Description

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

#### Safe handling

Use one of the following alternatives:

- Use a wrist strap.

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

- Use an ESD protective floor mat.

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

- Use a dissipative table mat.

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

2.5 On-site installation

2.5.1 Lifting robot with fork lift

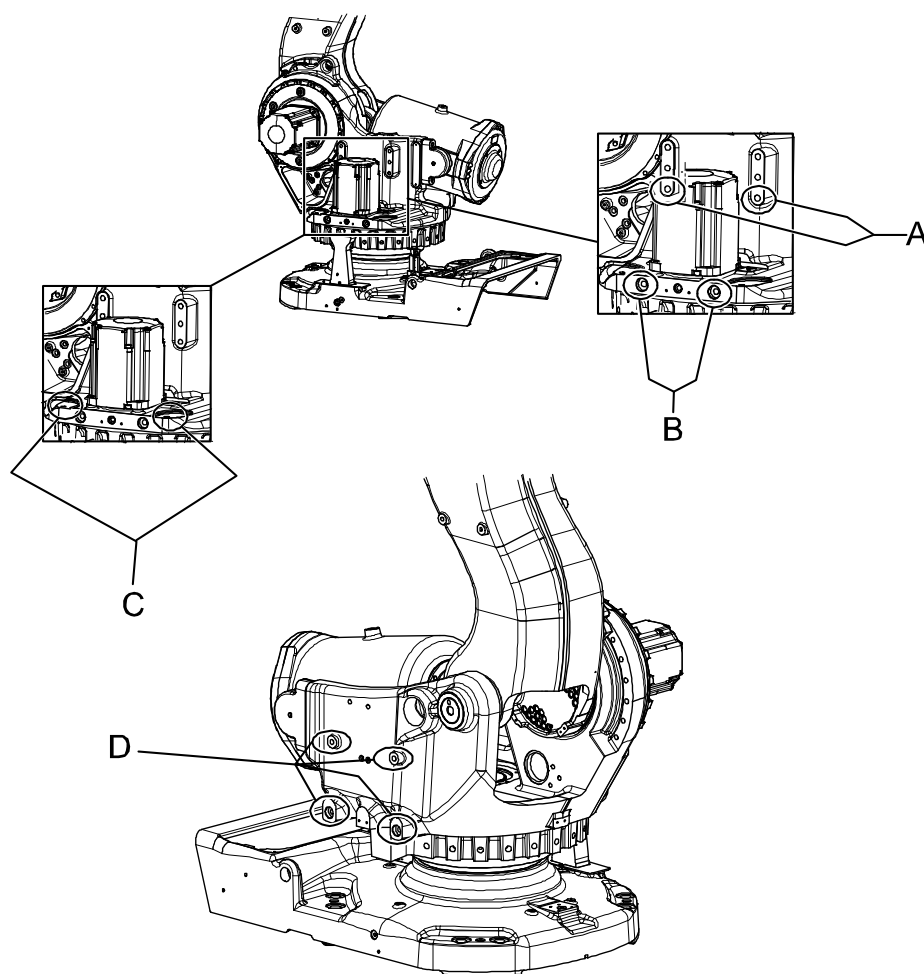
General

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

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

Attachment points on robot

The attachment points for the fork lift equipment are shown in this figure.



xx040000707

A	Attachment points, spacer and horizontal attachment screws
B	Attachment points, horizontal attachment screws
C	Attachment points, vertical attachment screws
D	Attachment points, horizontal attachment screws

*Continues on next page*

## 2 Installation and commissioning

### 2.5.1 Lifting robot with fork lift

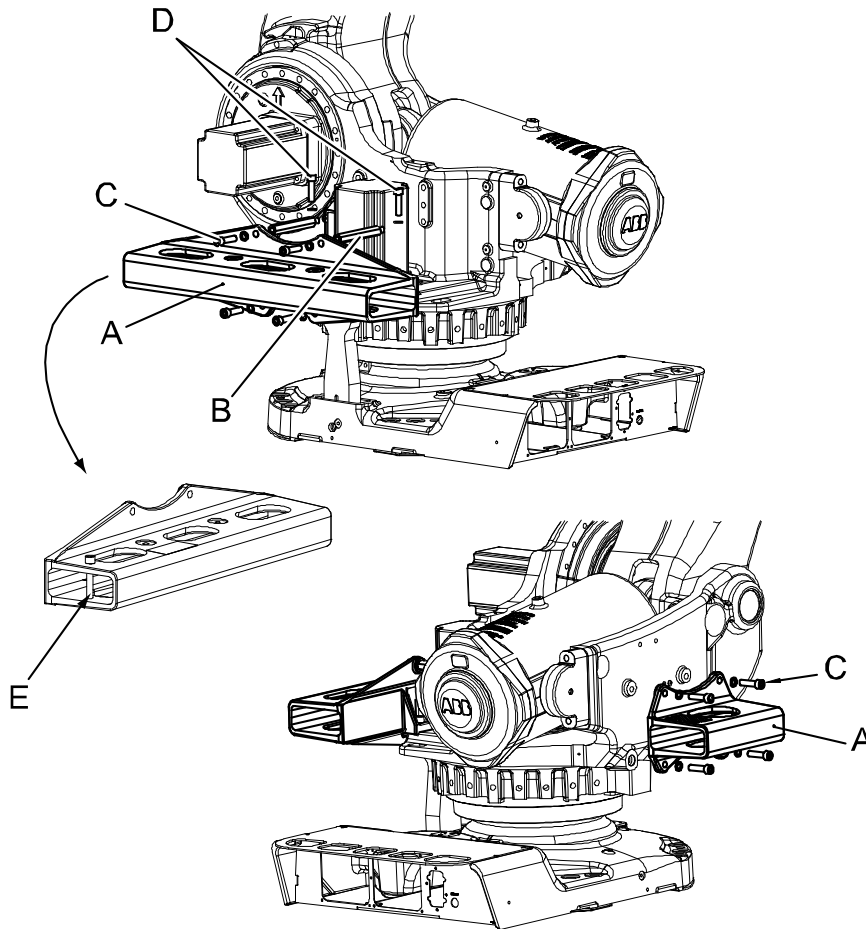
Continued

#### Required equipment

Equipment, etc.	Art. no.	Note
Fork lift accessory, incl. all required hardware	3HAC0604-2	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .

#### Fork lift accessory, 3HAC0604-2

The Fork lift accessory, 3HAC0604-2, is fitted to the robot as shown in the figure below.



xx0200000379


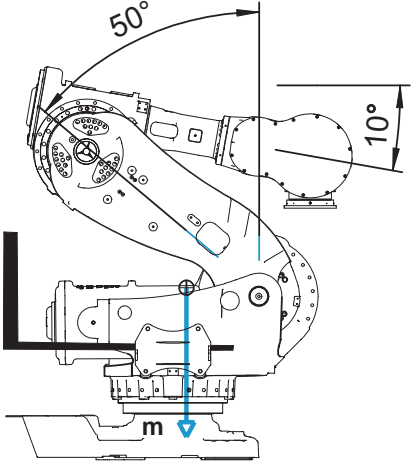
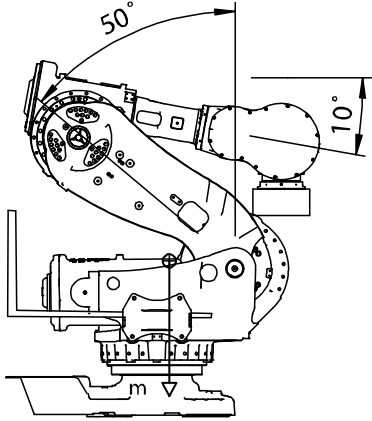

A	Fork lift pocket (2 pcs, 3HAC15766-1 , 3HAC11264-1)
B	Spacer (2 pcs)
C	Horizontal attachment screws (4 pcs/ fork lift pocket)
D	Vertical attachment screws (2 pcs)

Continues on next page



#### Lifting robot with fork lift

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


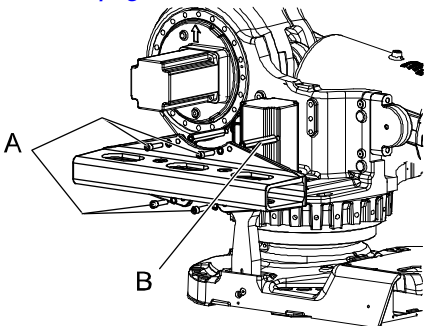
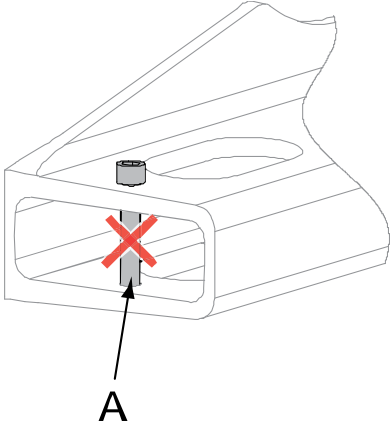
Action	Note
1	If a cooling fan for the axis 1 motor is used, it must be removed in order to use the fork lift device!
2	<p>Position the robot as shown in the figure to the right!</p> <p> <b>Note</b></p> <p>No load is permitted on the robot if the fork lift set 3HAC0604-2 is used!</p> <div style="text-align: right;">  <p>xx020000079</p> <p>When using fork lift set 3HAC0604-2, no load is permitted on the robot!</p>  <p>xx0200000387</p> </div>
3	Fit the two <i>spacers</i> to the robot and secure.
4	<p> <b>CAUTION</b></p> <p>The fork lift pocket weighs 60 kg!</p>

*Continues on next page*

## 2 Installation and commissioning

### 2.5.1 Lifting robot with fork lift

Continued


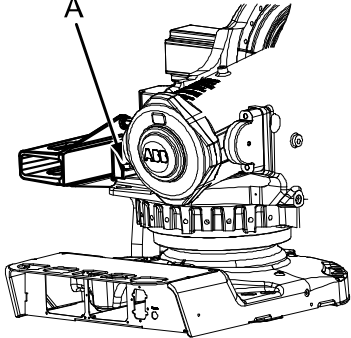

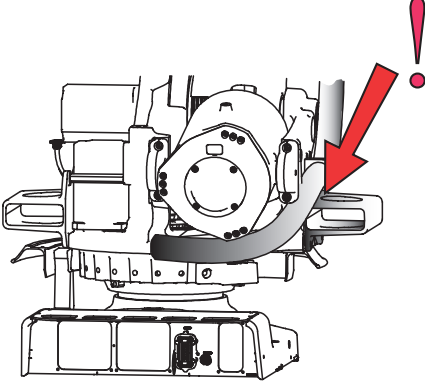
	Action	Note
5	<p>Secure the longer <i>fork lift pocket</i> to the spacers with four of the <i>horizontal attachment screws</i> and washers.</p> <p> <b>Note</b></p> <p>The screws, which are attached horizontally and vertically, are identical. However, they are tightened with different torque!</p>	<p>Always use original screws (or replacements of equivalent quality: M16, quality 12.9)!</p> <p>Attachment points on the robot are shown in figure <a href="#">Attachment points on robot on page 63</a>.</p>  <p>xx0400001068</p> <p><b>A</b> Horizontal attachment screws, 4 pcs, M16 x 60. Tightening torque: 60 Nm.</p> <p><b>B</b> Spacers, 2 pcs.</p>
6	<p>Make sure the securing screw is removed from the fork lift pocket! It is only used for robot model IRB 6650S.</p>	 <p>xx0700000655</p> <p><b>A</b> Securing screw</p>

Continues on next page

## 2 Installation and commissioning

### 2.5.1 Lifting robot with fork lift

*Continued*



	Action	Note
7	<p>Secure fork lift pocket to robot with two <i>vertical attachment screws</i> and washers. (only valid for the Fork lift accessory 3HAC0604-2)</p> <p> <b>Note</b></p> <p>Vertically and the horizontally attached screws are identical, but tightened with different torques!</p>	 <p>xx0300000464</p> <p><b>A</b> Vertical attachment screws, 2 pcs, M16x60. Tightening torque: 270 Nm.</p> <p>Always use original screws (or replacements of equivalent quality: M16, quality 12.9)!</p> <p>Attachment points on robot are shown in figure <a href="#">Attachment points on robot on page 63</a>.</p>
8	<p> <b>CAUTION</b></p> <p>The fork lift pocket weighs 22 kg!</p>	
9	<p>Secure the shorter fork lift pocket on the other side of the robot with the four remaining <i>horizontal attachment screws</i>.</p>	<p>4 pcs, M16x60. Tightening torque: 60 Nm.</p> <p>Always use original screws (or replacements of equivalent quality: M16, quality 12.9)!</p> <p>Attachment points on robot are shown in figure <a href="#">Attachment points on robot on page 63</a>.</p>
10	<p>Double-check that pockets are properly secured to the robot! Insert fork lift forks into the pockets.</p>	 <p>xx0200000380</p> <p>Reposition harness, if any, before using a fork lift!</p>

*Continues on next page*

## 2 Installation and commissioning

### 2.5.1 Lifting robot with fork lift

*Continued*

	Action	Note
11	 <b>CAUTION</b> The IRB 7600 robot weighs 2500 kg. All lifting accessories used must be sized accordingly!	
12	Carefully lift the robot and move it to its installation site.	
13	 <b>WARNING</b> Personnel must not, under any circumstances, be present under the suspended load!	
14	Refit the cooling fan to the motor, if any.	Detailed in section <i>Installation of cooling fan for motors (option)</i> on page 91.

#### 2.5.2 Lifting robot with lifting accessory (recommended lifting method)

##### General

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

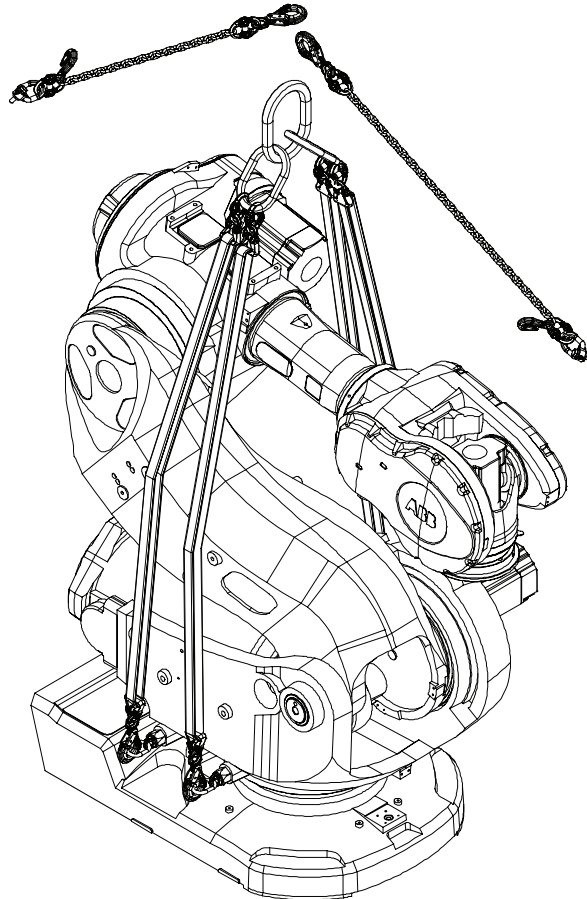
##### Illustration, lifting accessory

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



##### Note

The user manual may be out of date. The latest revision is available for download via myABB Business Portal, [www.abb.com/myABB](http://www.abb.com/myABB).



xx0200000153

##### Required equipment

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

*Continues on next page*

## 2 Installation and commissioning

### 2.5.2 Lifting robot with lifting accessory (recommended lifting method)

Continued




#### Slings attached directly onto robot

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



#### Note

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

	Action	Note
1	Run the overhead crane to a position above the robot.	
2	Position the robot as detailed in enclosed instruction!	Article number is specified in <a href="#">Required equipment on page 69</a> . Release the brakes, if required, as detailed in section <a href="#">Manually releasing the brakes on page 73</a> .
3	Fit the <i>lifting accessory</i> to the robot as described in the enclosed instruction! Go to the user instructions enclosed with the lifting accessory.   <b>DANGER</b>  Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Article number is specified in <a href="#">Required equipment on page 69</a> .
4	 <b>CAUTION</b>  The IRB 7600 robot weighs 2500 kg. All lifting accessories used must be sized accordingly!	
5	 <b>WARNING</b>  Personnel must not, under any circumstances, be present under the suspended load!	
6	Raise overhead crane to lift the robot.	Make sure all hooks and attachments maintain their correct positions while lifting the robot!  Always move the robot at very low speeds, making sure it does not tip.

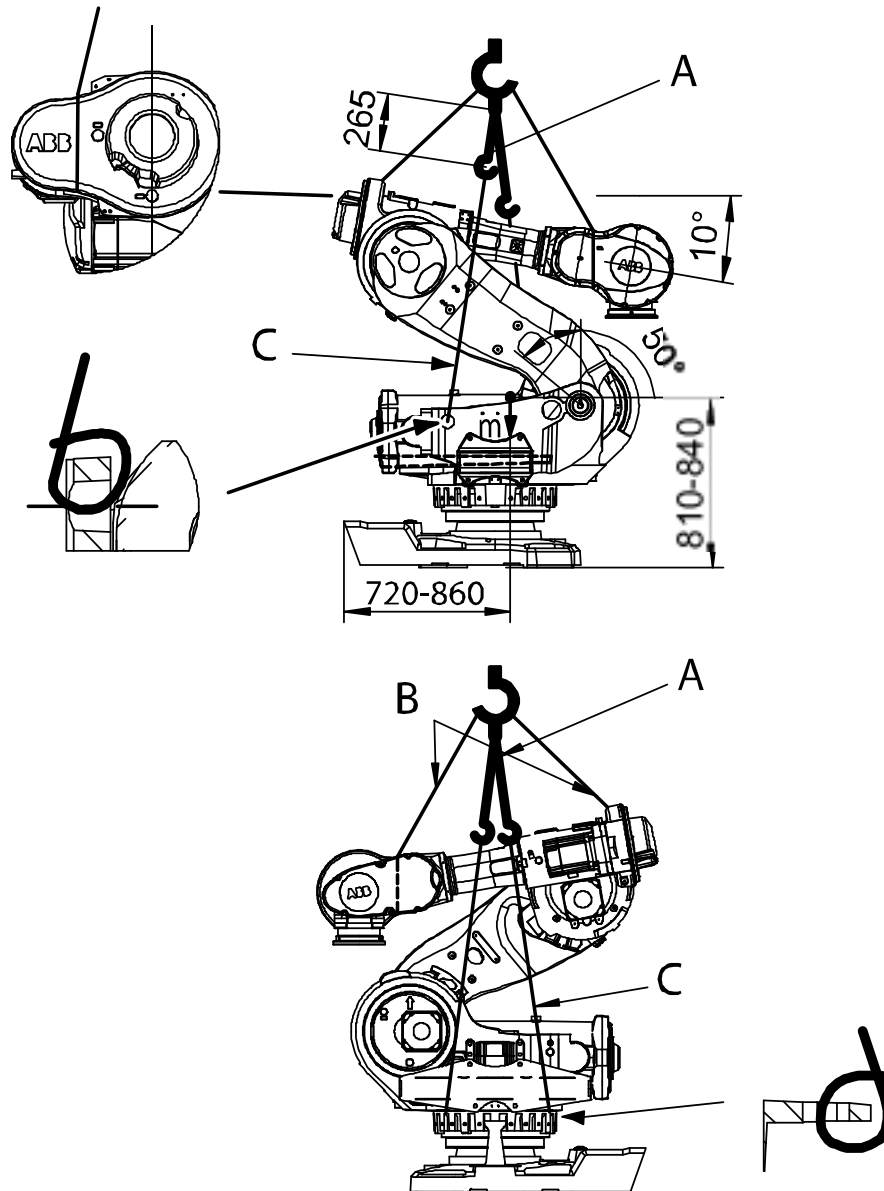
2.5.3 Lifting robot with roundslings

General

The figure below shows how to lift the complete robot with roundslings.

Notice the recommended robot position shown in the figure below!

Roundslings attached to the robot



xx0200000315

A	Chain sling with shortener, 4250 kg, 3 pcs (0.5 m, 0.5 m, 0.265 m)
B	Roundsling, 1000 kg, 2 pcs
C	Roundsling, 2000 kg, 3 pcs (4 m)

*Continues on next page*

## 2 Installation and commissioning

### 2.5.3 Lifting robot with roundslings



Continued

#### Required equipment

Equipment	Note
Chain sling with shortener, 4250 kg, 3 pcs	Lengths: 0.5 m (2 pcs), 0.265 m (1 pc).
Roundslings, 1000 kg, 2 pcs	
Roundslings, 2000 kg, 3 pcs	Lengths: 4 m (3 pcs).

#### Slings attached directly on to robot

The section below details how to attach roundslings to the robot in order to lift the complete robot.

	Action	Note
1	 <b>CAUTION</b> Attempting to lift the robot in any other position than that recommended may result in the robot tipping over and causing severe damage or injury!	Recommended robot position is described in section <a href="#">Risk of tipping/stability on page 61</a> .
2	 <b>CAUTION</b> The IRB 7600 robot weighs 2500 kg. All lifting accessories used must be sized accordingly!	
3	Run the overhead crane to a position above the robot.	
4	Attach the three <i>chain slings with shorteners</i> to the overhead crane hook.	Shown in the figure <a href="#">Roundslings attached to the robot on page 71</a> . Lengths are specified in <a href="#">Required equipment on page 72</a> .
5	Fit the three <i>roundslings, 2000 kg</i> to the robot. Attach the roundslings to the chain slings hanging from the overhead crane.	Shown in the figure <a href="#">Roundslings attached to the robot on page 71</a> . Lengths are specified in <a href="#">Required equipment on page 72</a> .
6	Attach the two <i>roundslings, 1000 kg</i> to the upper arm and the overhead crane hook!	Shown in the figure <a href="#">Roundslings attached to the robot on page 71</a> .
7	Raise the overhead crane to lift the robot.	Make sure all hooks and attachments maintain correct position while lifting the robot! Always move the robot at very low speeds, making sure it does not tip.



#### 2.5.4 Manually releasing the brakes

##### General

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

The brakes may be released by:

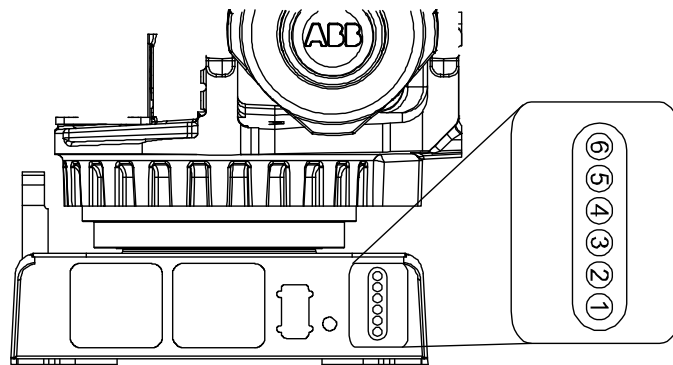
- Internal brake release unit: using push buttons on the robot. This requires either the controller to be connected or that power is supplied to the R1.MP connector, according to the section [Supplying power to connector R1.MP on page 74](#).

##### Location of brake release unit

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

##### Brake release at base

The figure below shows the unit located at the base.

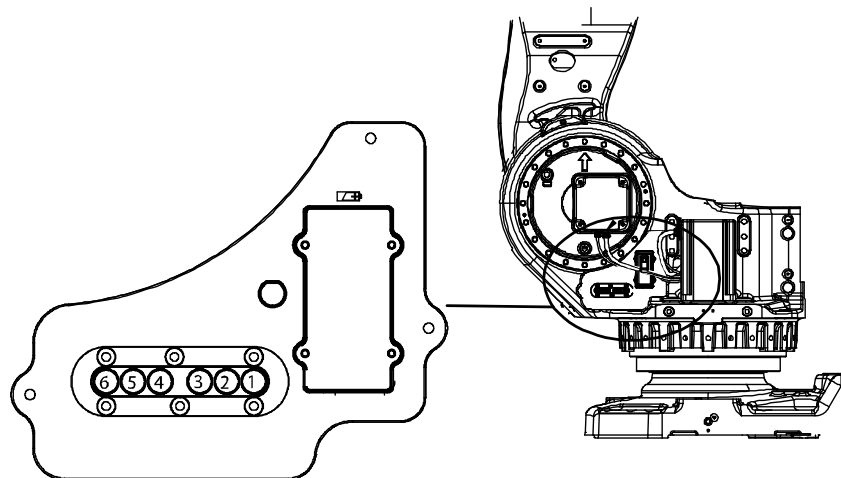


xx0200000375

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

##### Brake release at frame

The figure below shows the unit located at the frame.



xx0200000376

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

*Continues on next page*


## 2 Installation and commissioning

### 2.5.4 Manually releasing the brakes

Continued


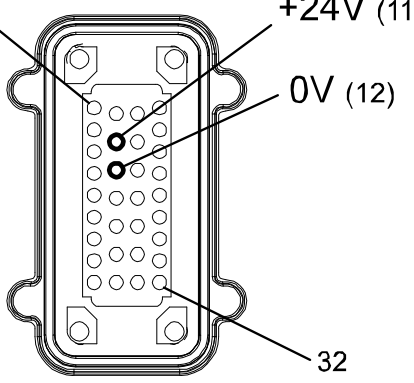
#### Releasing the brakes

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

	Action	Note
1	The internal brake release unit is equipped with buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes. If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section <a href="#">Supplying power to connector R1.MP on page 74</a> .	Buttons are shown in figure <a href="#">Location of brake release unit on page 73</a> .
2	 <b>DANGER</b> When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways! Make sure no personnel is near or beneath the robot arm!	
3	Release the holding brake on a particular robot axis by pressing the corresponding button on the internal brake release unit. The brake will function again as soon as the button is released.	

#### 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.

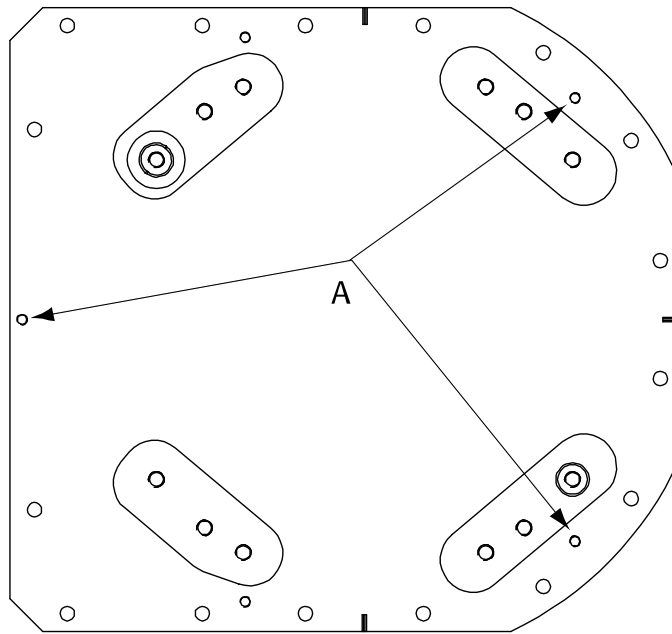
	Action	Note
1	 <b>DANGER</b> Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	
2	Supply 0V on pin 12 and 24V on pin 11.	 <p>xx0600002937</p>

2.5.5 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



xx020000096

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

Lifting, base plate

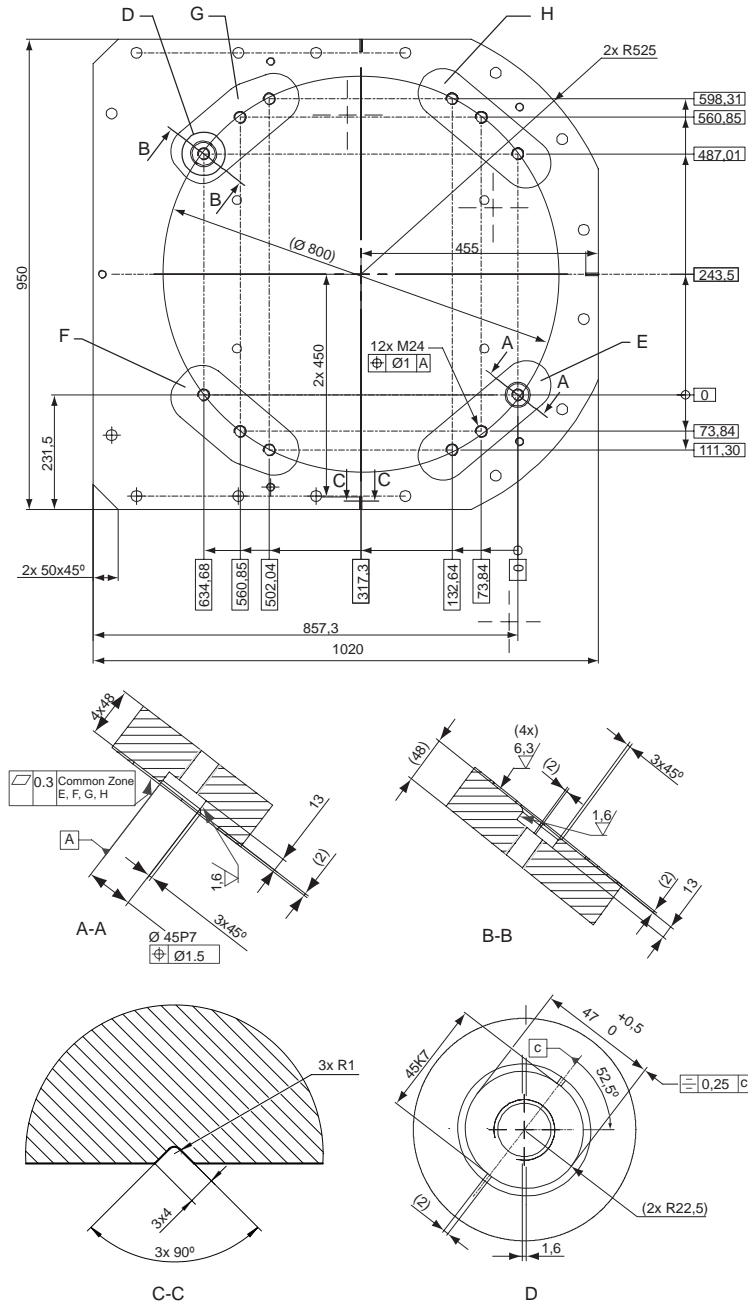
	Action	Note
1	 <b>CAUTION</b> The base plate weighs 353 kg. All lifting accessories used must be sized accordingly.	
2	Fit lifting eyes in specified holes.	Shown in figure <a href="#">Hole configuration on page 75</a> .
3	Fit lifting slings to the eyes and to the lifting accessory.  <b>CAUTION</b> Lift and move the base plate very slowly. If the base plate starts to swing it is a risk for injuries or damage.	

## 2 Installation and commissioning

### 2.5.6 Securing the base plate

### 2.5.6 Securing the base plate

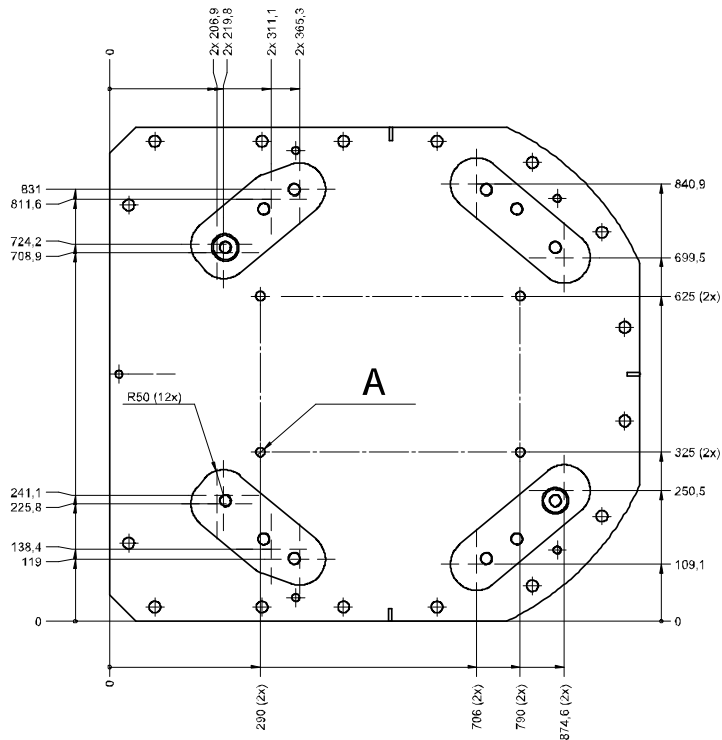
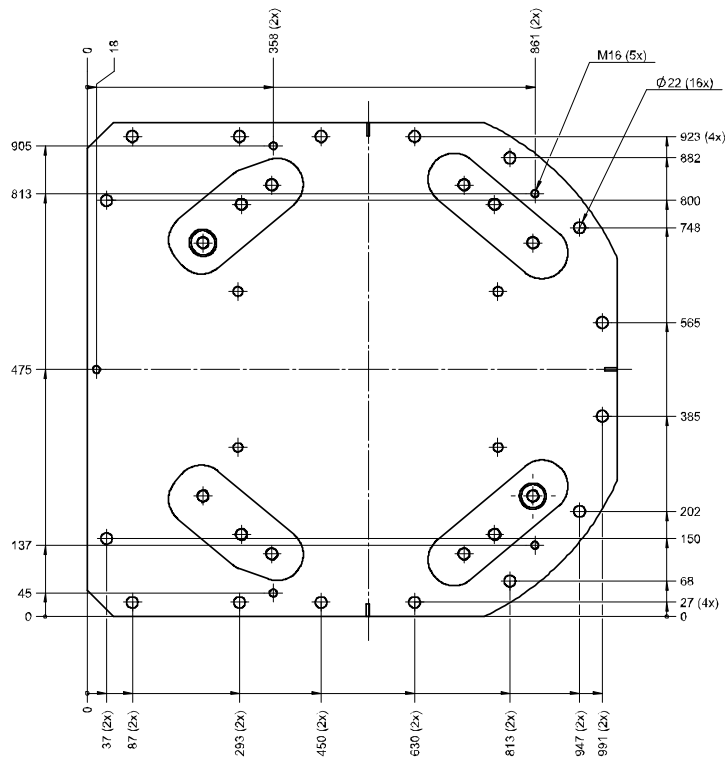
#### Base plate, dimensions



xx1000001053

E, F, G, H	Common tolerance zone (accuracy all over the base plate from one contact surface to the other)
------------	--

Continues on next page



xx0400000715

<b>A</b>	<b>Four holes for alternative clamping, 4x Ø18</b>
----------	--

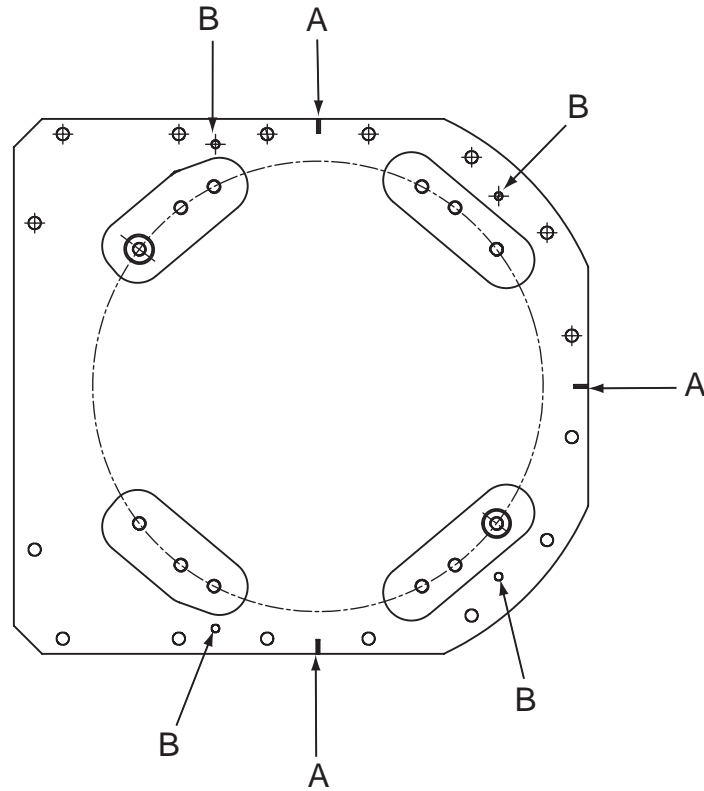
## 2 Installation and commissioning

### 2.5.6 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.



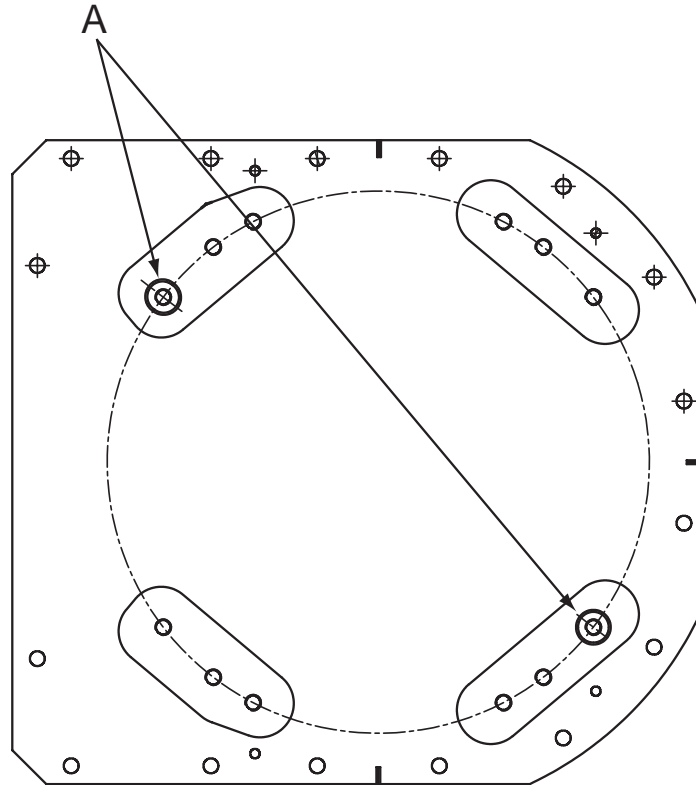
xx150000312

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	3HAC12937-7	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 421</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

### 2.5.6 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 78</a> .
4	Lift the base plate to its mounting position.	Detailed in section <a href="#">Lifting the base plate on page 75</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 78</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.



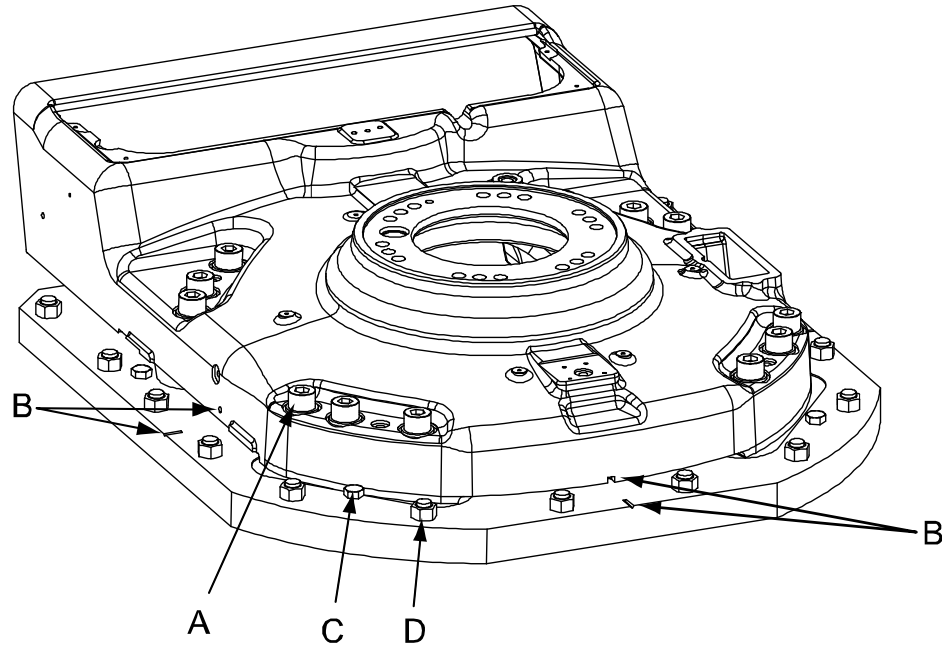
#### 2.5.7 Orienting and securing the robot

##### 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.



xx010000107

A	Robot attachment bolts and washers, 12 pcs (M24 x 140)
B	Orienting grooves in the robot base and in the base plate
C	Levelling screws
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 140
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

### 2.5.7 Orienting and securing the robot

*Continued*

#### Securing the robot

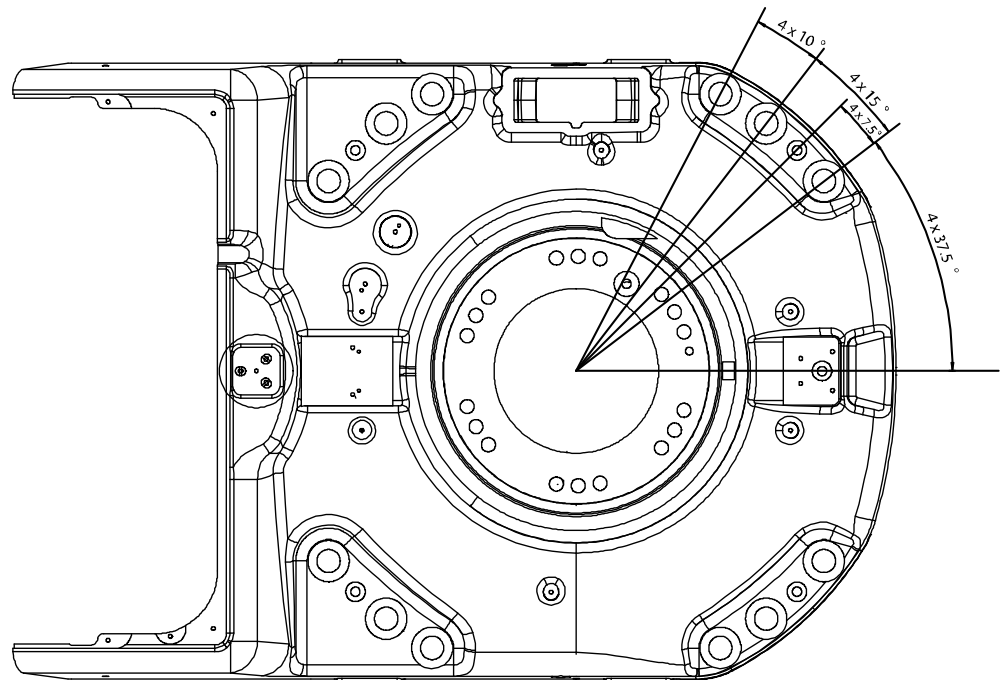
Use this procedure to secure robot to base plate after fitting plate to the foundation.

	Action	Note
1	Lift the robot.	See section <a href="#">Lifting robot with lifting accessory (recommended lifting method) on page 69</a> . See section <a href="#">Lifting robot with round-slings on page 71</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 79</a> .  <b>Note</b> 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 81</a> . Shown in figure <a href="#">Illustration, robot fitted to base plate on page 81</a> .  <b>Note</b> 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

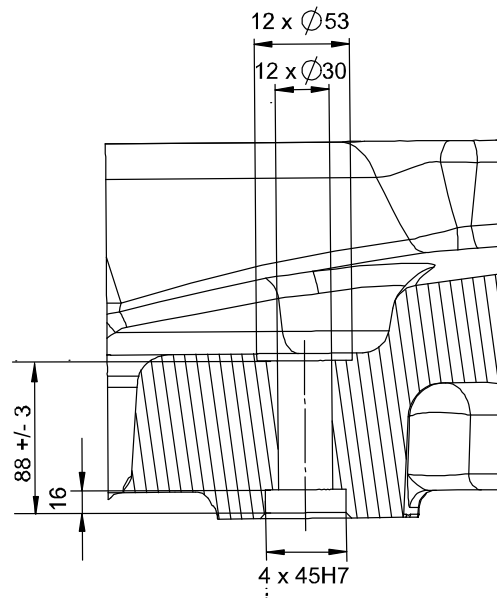
This illustration shows the hole configuration used when securing the robot.



xx0300000046

#### Cross section, guide sleeve hole

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



xx0100000109

## 2 Installation and commissioning

### 2.5.8 Fitting equipment on robot

### 2.5.8 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.



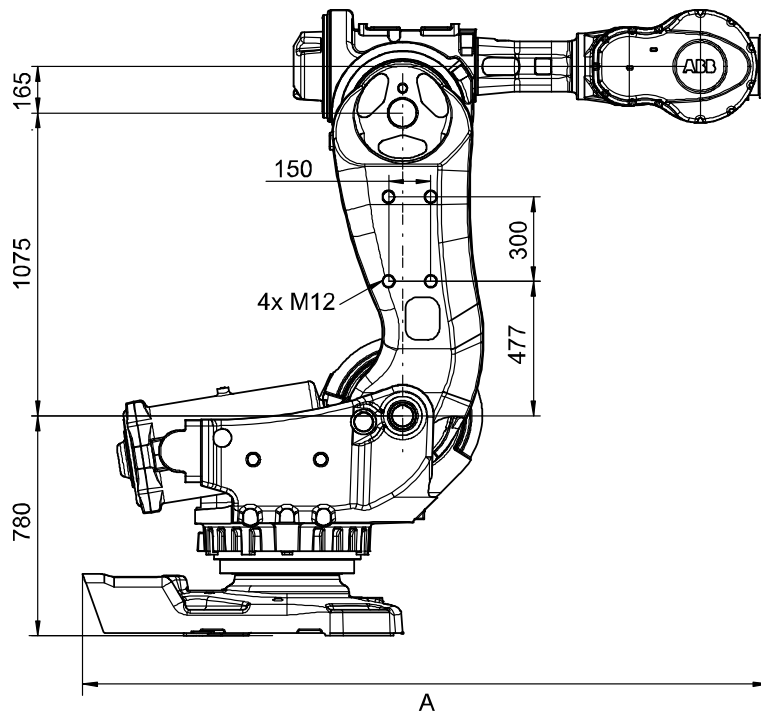
#### Note

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 illustration 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!



xx0700000722

Robot variant	A
IRB 7600 - 500/2.55	2442 mm
IRB 7600 - 500/2.3	2192 mm
IRB 7600 - 400/2.55	2442 mm
IRB 7600 - 340/2.8	2692 mm
IRB 7600 - 325/3.1	2942 mm

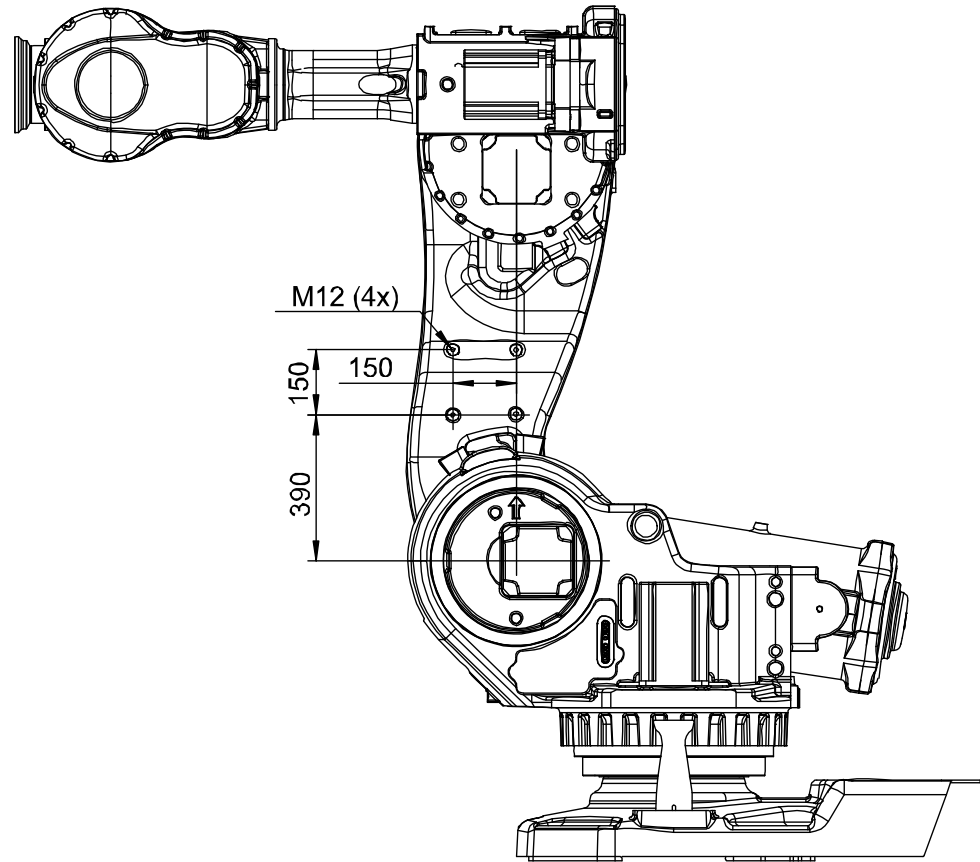
Continues on next page

## 2 Installation and commissioning

### 2.5.8 Fitting equipment on robot

*Continued*

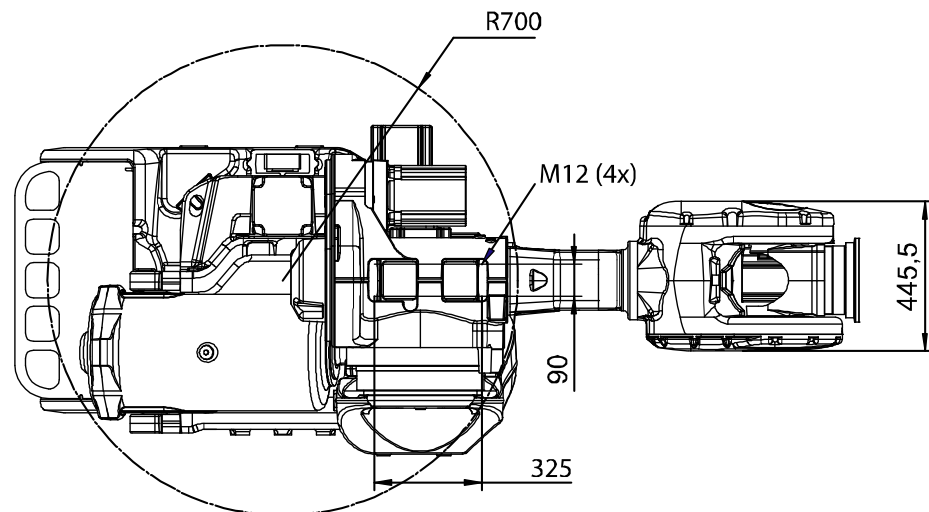
<b>Robot variant</b>	<b>A</b>
IRB 7600 - 130/3.5	3398 mm



xx0100000120

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

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



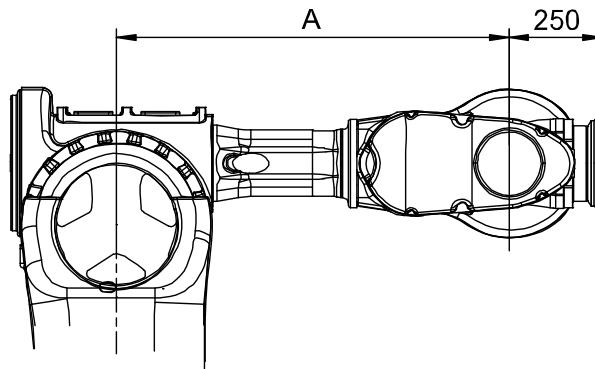
xx0100000116

*Continues on next page*

## 2 Installation and commissioning

### 2.5.8 Fitting equipment on robot

Continued

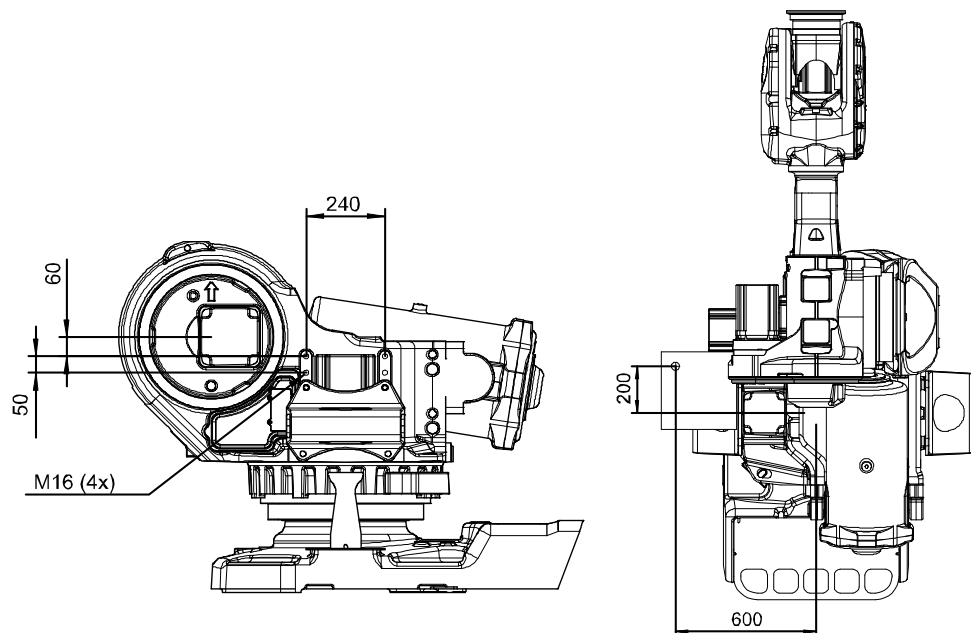


xx0300000299

Robot variant	A
IRB 7600 - 500/2.55	1056 mm
IRB 7600 - 500/2.3	806 mm
IRB 7600 - 400/2.55	1056 mm
IRB 7600 - 340/2.8	1306 mm
IRB 7600 - 325/3.1	1556 mm
IRB 7600 - 150/3.5	2012 mm

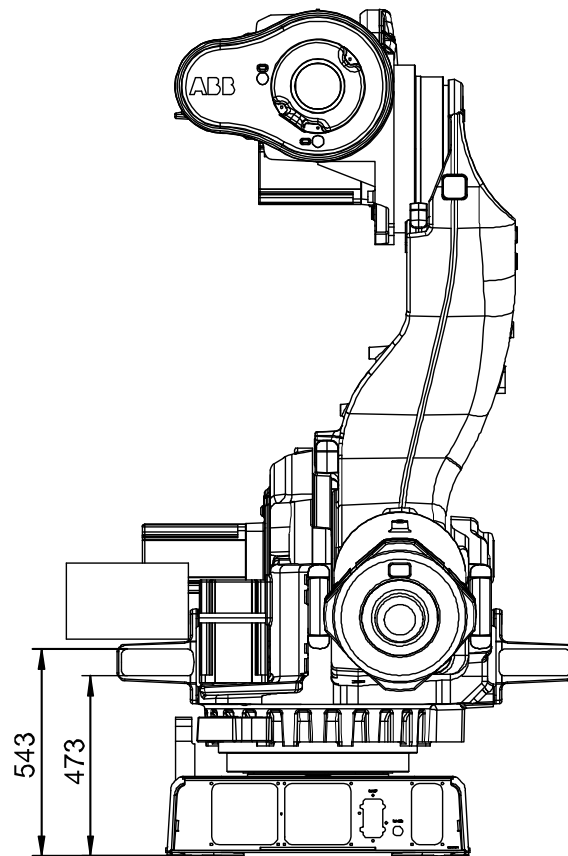
### Illustration, fitting of extra equipment on frame

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



xx0100000117

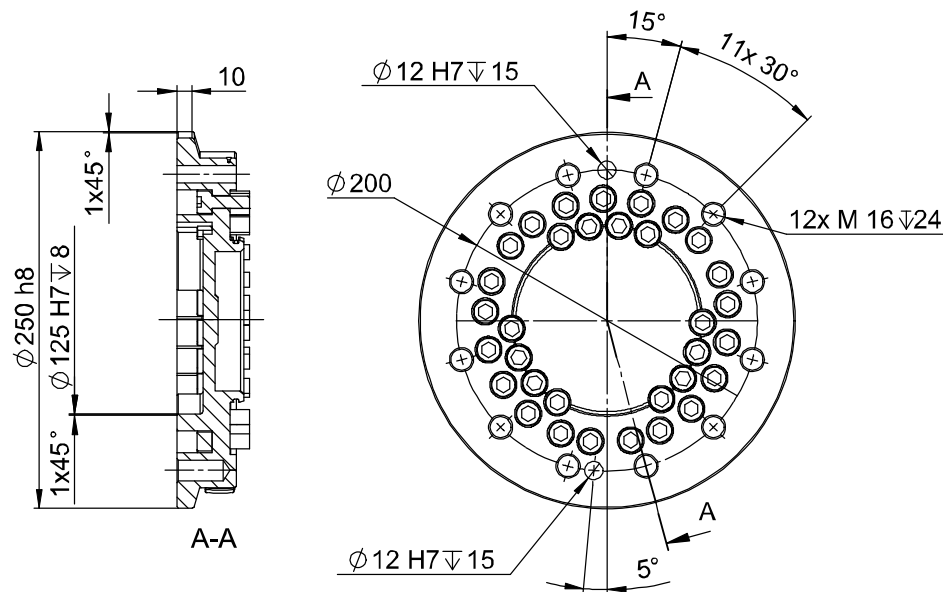
Continues on next page



xx0100000118

#### Tool flange, standard

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



xx0100000119

*Continues on next page*

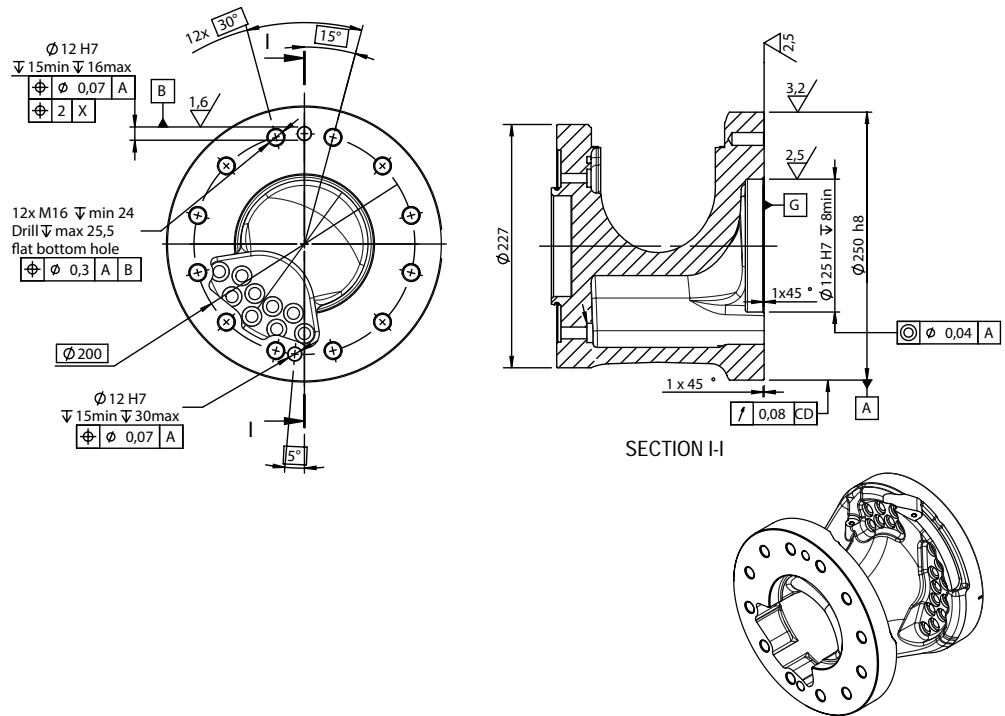
## 2 Installation and commissioning

### 2.5.8 Fitting equipment on robot

Continued

#### Tool flange, LID (LeanID)

The illustration below shows the tool flange for option LID (LeanID).



xx1600000980

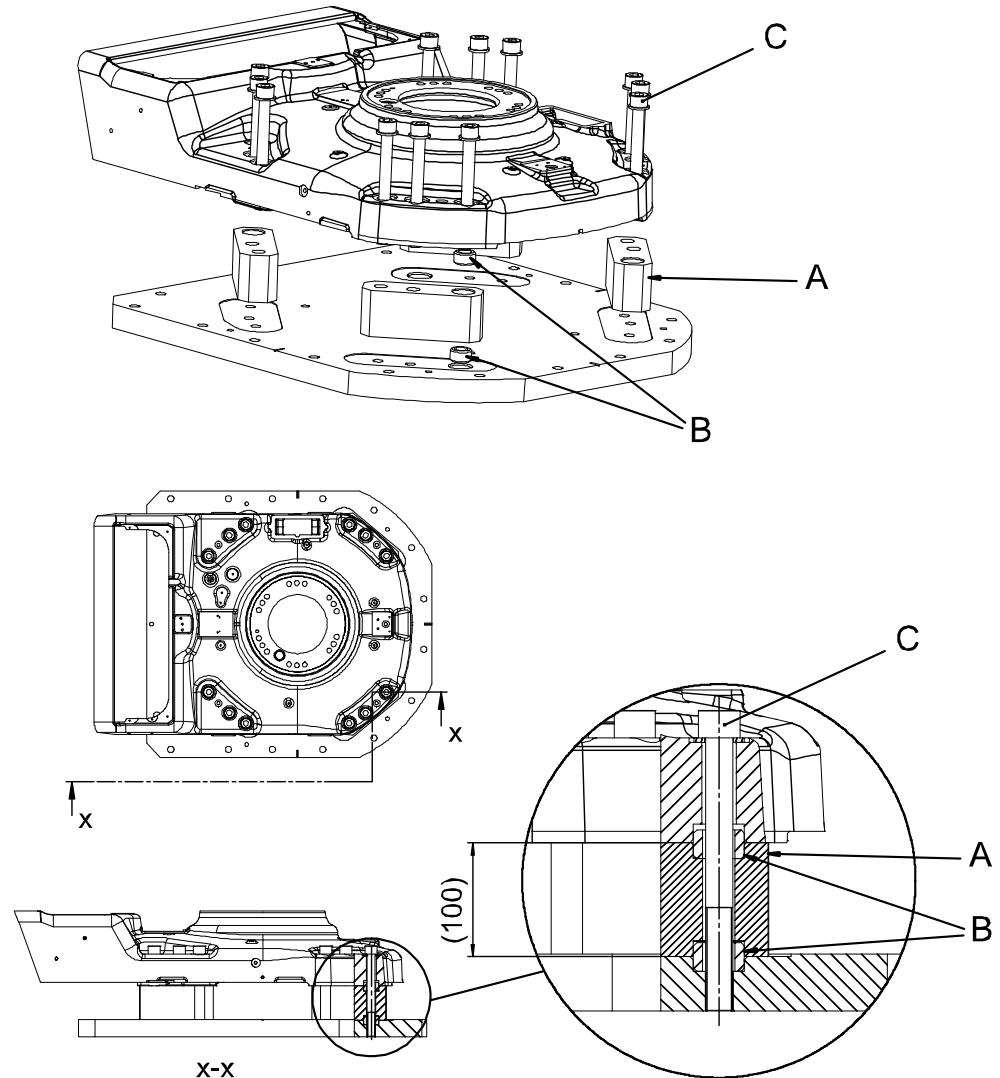
#### Fastener quality

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



#### 2.5.9 Installation of base spacers (option)

##### Illustration, installation of base spacers



xx0500001570

A	Base spacer (4 pcs)
B	Guide sleeve (4 pcs)
C	Attachment screws and washers (12 pcs)

##### Required equipment

Equipment	Art. no.	Note
Base spacers	3HAC021899-002	Includes mounting set with attachment screws and mounting instruction.
Base plate	3HAC12937-7	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .

*Continues on next page*

## 2 Installation and commissioning



### 2.5.9 Installation of base spacers (option)

Continued

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.

#### Installation, base spacers

The procedure below details how to fit the base spacers between the robot and the base plate.

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Unfasten the robot from the foundation, if fastened, and lift it away with lifting slings. Make sure the robot is positioned in the most stable position; the transport position!	Detailed in section <a href="#">Lifting robot with lifting accessory (recommended lifting method) on page 69</a> .
3	Install the base plate to the foundation, if not used previously.	Detailed in section <a href="#">Securing the base plate on page 76</a> .
4	Fit the four <i>base spacers</i> and <i>guiding sleeves</i> to the base plate.	Shown in the figure <a href="#">Illustration, installation of base spacers on page 89</a> .
5	Lift the robot with lifting slings and move it to the prepared base plate.	
6	Guide the robot with the guiding sleeves as lowering it towards the base plate and spacers.	
7	Fasten the robot base to the spacers with enclosed attachment screws and washers.	M24 x 240, tightening torque: 775 Nm.
8	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

#### 2.5.10 Installation of cooling fan for motors (option)

##### General

A cooling fan can be installed on the motors of axes 1 or 2.

Cooling fans for axes 1 and 2 can not be combined!

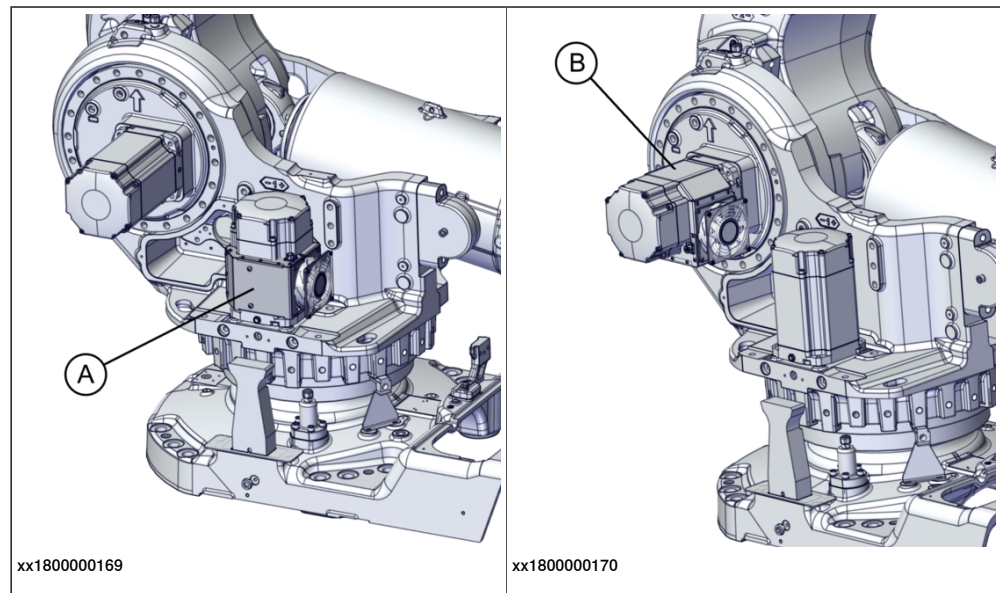
The cabling for the fans is available in different designs:

- complete cabling, including connections for cooling fans at axes 1 and 2.
- separate cabling for axis 1 or 2, including only connections for the cooling fans on axes 1 or 2. Installation of this cabling is detailed in section [Installation, separate fan cabling axis 1 or 2 on page 95](#).

If both cooling fans and position switches are installed on the robot, the complete cabling must be used! It can not be combined with the separate cabling.

##### Location of cooling fans

The fans are installed on the motors, axes 1 or 2, as shown in the figure below.



A	Cooling fan, axis 1
B	Cooling fan, axis 2

*Continues on next page*

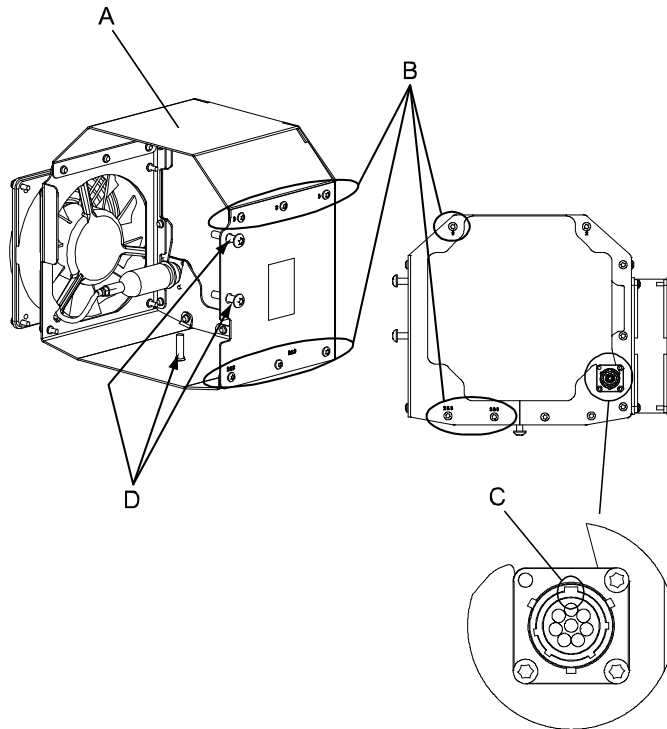
## 2 Installation and commissioning

### 2.5.10 Installation of cooling fan for motors (option)

Continued

#### Cooling fan

The details of the cooling fan are shown in the figure below.



xx0500002158

A	Fanbox
B	Attachment screws, fanbox plates (9 pcs)
C	Groove in the connector
D	Tightening screws, fanbox (3 pcs)

#### Required equipment

Equipment	Article number	Note
Cooling fan	3HAC15374-1	
Cabling cooling fan, axes 1 or 2.	3HAC023599-001	Choose this cabling if equipping the robot with cooling fans on axis 1 or 2.
Plate for customer connections	3HAC025778-001	An additional connection plate must be fitted to the robot base, if not already installed. The plate is shown in the figure <a href="#">Plate for customer connections, at base on page 93</a> .
Additional cabling to and inside the controller	-	Specified in section <a href="#">Robot cabling and connection points on page 111</a> .
Material set fan axes 1 and 2	3HAC023999-001	The set includes: <ul style="list-style-type: none"> <li>fan axes 1 &amp; 2 cable harness</li> <li>plate, customer</li> <li>attachment screws and nuts.</li> </ul>
Cable harness inside controller	3HAC025488-001	

Continues on next page

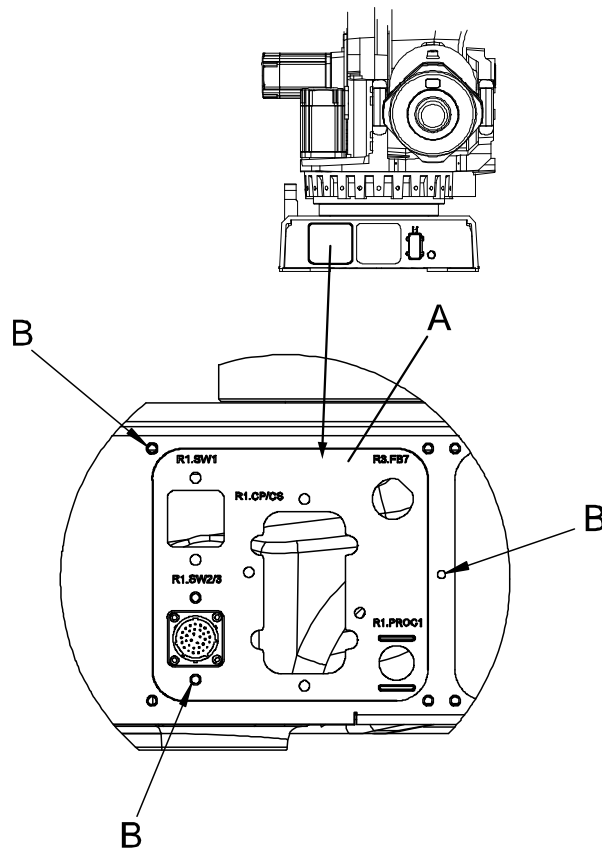
## 2 Installation and commissioning

### 2.5.10 Installation of cooling fan for motors (option)

*Continued*

Equipment	Article number	Note
Locking liquid	-	Loctite 243. Used for the three tightening screws.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Circuit diagram	-	See chapter <a href="#">Circuit diagram on page 429</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.

#### Plate for customer connections, at base



xx0500002301

A	Plate for customer connections
B	Attachment screws, 3 pcs, M6x16 quality 8.8-A2F

*Continues on next page*


## 2 Installation and commissioning

### 2.5.10 Installation of cooling fan for motors (option)

Continued

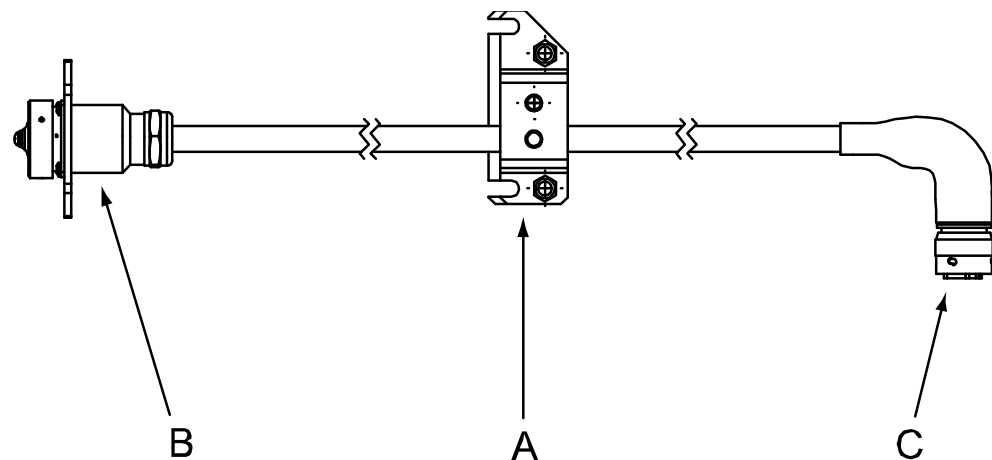
#### Installation, fan

The procedure below details how to install the cooling fan on any of the motors, axes 1-3 .

Action	Note
1  <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply to the robot</li><li>• hydraulic pressure supply to the robot</li><li>• air pressure supply to the robot</li></ul> Before entering the robot working area.	
2 Prepare the fanbox for installation: <ul style="list-style-type: none"><li>• disassemble the two parts of the box by removing the nine <i>attachment screws</i></li><li>• loosen the three <i>tightening screws</i>, to avoid damaging the surfaces of the motor when fitting the fanbox</li><li>• turn the connector to the correct position; axis 1 : groove pointing inwards, as shown in the figure <a href="#">Cooling fan on page 92</a>. Positions for axis 2 and 3 are shown in the figure <a href="#">Location of cooling fans on page 91</a>.</li></ul>	Shown in the figure <a href="#">Cooling fan on page 92</a> .
3 Temporarily lift the motor cabling out of the way of the current motor to make room for the fanbox.	
4 Fit the parts of the fanbox to the motor and reassemble with the nine <i>attachment screws</i> .	
5 Lift the box (axis 1) so that it does not rest directly on the robot and secure the box with the three tightening screws, using locking liquid. Tighten them properly so that the box is firmly attached to the motor.	
6 Install the cabling and make adjustments in RobotWare, as described in the following procedures.	

#### Separate cabling for axis 1 or 2

The figure below shows the cabling used only for the fan on axis 1 or 2.




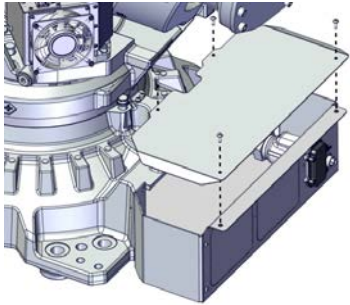
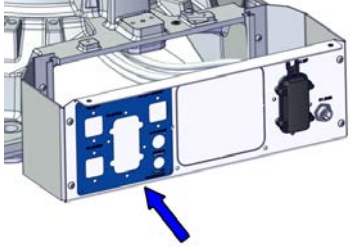
xx0500002173

Continues on next page

A	Cable bracket
B	Connector R1.SW2/3, connected to the robot base
C	Connector R3.FAN2, connected to the fan of axis 1 or 2

#### Installation, separate fan cabling axis 1 or 2

The procedure below details how to install the separate cabling for the cooling fan of axis 1 or 2.


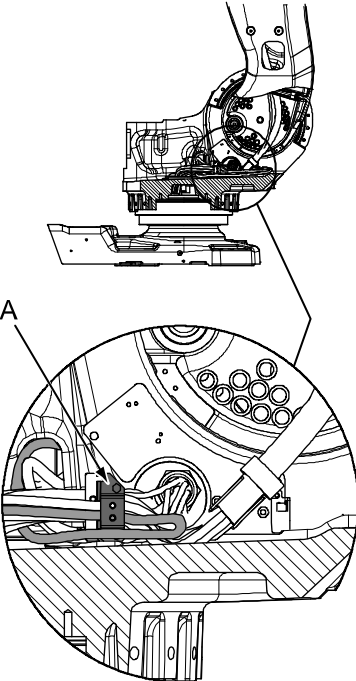

	Action	Note
1	Move the robot to its calibration position.	This is detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 378</a> .
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Remove the rear cover plate from the robot base.	 xx180000161
4	Remove the cable bracket (A)	Shown in the figure <a href="#">Separate cabling for axis 1 or 2 on page 94</a>
5	Fit the <i>plate for customer connections</i> , if not already fitted, to the connection plate of the robot base.	Art. no. is specified in <a href="#">Required equipment on page 92</a> .  xx180000162
6	Run the cabling up through the base and frame, beneath the balancing device.	

*Continues on next page*

## 2 Installation and commissioning

### 2.5.10 Installation of cooling fan for motors (option)

Continued

	Action	Note
7	<p>Secure the <i>cable bracket</i> to the bracket of the robot cabling inside the frame.</p> <p>Run the cable underneath the robot cabling and out through the side of the frame, at motor, axis 1 . The correct cable run is shown in the figure to the right!</p> <p> <b>Note</b></p> <p>There is a risk of the balancing device damaging the cable if it is not protected by the robot cabling!</p>	 <p>xx0500002174</p> <p>A Cable bracket. Also shown in the figure <a href="#">Separate cabling for axis 1 or 2 on page 94</a>.</p>
8	<p>Connect the connector R3.FAN2 to the fan of axis 1 or 2.</p>	<p> <b>Note</b></p> <p>Fans on both axis 1 and 2 can not be used at the same time!</p>
9	<p>Connect the connector R1.SW2/3 to the base of the robot. Make sure that the cabling, run through the frame and base, is not twisted and runs freely from the robot cabling.</p>	
10	<p>Refit the rear cover plate to the robot base.</p>	
11	<p>Install additional cabling to and inside the controller.</p> <p>Also make adjustments in RobotWare, as described in the following procedure.</p>	<p>Cabling is specified in section <a href="#">Robot cabling and connection points on page 111</a>.</p>

Continues on next page



## 2 Installation and commissioning

### 2.5.10 Installation of cooling fan for motors (option)

*Continued*

#### Adjustments in RobotWare

	Action	Note
1	Modify the settings in RobotWare to include the cooling fans.	<p>RobotWare 4.0: modify the settings in RobIn-stall. RobotWare 4.063 and older must be updated with a newer release.</p> <p>RobotWare 5: modify the option information in <b>System Builder</b> (RobotStudio). Read more about modifying the system in <i>Operating manual - RobotStudio</i>.</p> <p>RobotWare 6: modify the option information in <b>Installation Manager</b> (RobotStudio). Read more about modifying the system in <i>Operating manual - RobotStudio</i>.</p>

## 2 Installation and commissioning

---

### 2.5.11 Installation of Foundry Plus Cable guard (option)

#### 2.5.11 Installation of Foundry Plus Cable guard (option)

---

##### Introduction

How to install the Foundry Plus Cable guard is described in the instruction delivered with the cable guard.

Separate instructions for IRB 2600, 4600, 6620, 6640, 6650S, 6660 and 7600 are available in English, German, French, Spanish, and Italian and can be found for registered users on myABB Business Portal ([www.abb.com/myabb](http://www.abb.com/myabb)) and delivered with the Cable guard, article number 3HAC035933-001.

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

##### General

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



##### CAUTION

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

##### References

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

- *User's guide - S4Cplus (BaseWare OS 4.0)*
- *Operating manual - IRC5 with FlexPendant*

##### Stopping time and braking distances

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

## 2 Installation and commissioning

---

### 2.5.13 Safety lamp (option for IRC5)

#### 2.5.13 Safety lamp (option for IRC5)

---

##### Description

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

---

##### Installation

See the assembly instruction delivered with the signal lamp.

---

##### 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.

#### 2.5.14 Extended working range, axis 1 (option)

##### Overview

The working range of axis 1 can be extended on a floor-mounted robot, from the default range limited by mechanical stops. The working range can be extended to  $\pm 220^\circ$ .



#### CAUTION

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

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

For information about the option *SafeMove*, see *Application manual - Functional safety and SafeMove2*.

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

##### Extending the working range

	Action	Note/Illustration
1	Configure the safety setup and verify it by test.	
2	Hold the mechanical stop pin in a firm grip, and remove it by unscrewing the attachment screw.	<p>xx0400001034</p>
3	In RobotWare, redefine the working range limitations in the system parameters, topic <i>Motion</i> . The Arm parameters <i>Upper Joint Bound</i> and <i>Lower Joint Bound</i> can be changed to the values corresponding to the actual installation.	With the option <i>Extended working range</i> , the maximum value for the system parameters <i>Upper Joint Bound</i> and <i>Lower Joint Bound</i> is 3.84 respectively -3.84. The values are in radians, that is 3.84 radians = 220 degrees.

##### Related information

The system parameters are described in detail in the reference manual, see [References on page 10](#).

*Continues on next page*

## 2 Installation and commissioning

---

### 2.5.14 Extended working range, axis 1 (option)

*Continued*

For more information about SafeMove, see *Application manual - Functional safety and SafeMove2*.

How to define the range of movement in M2000/M2000A is detailed in *User's guide - S4Cplus (BaseWare OS 4.0)*, chapter *System Parameters - topic Manipulator*.

## 2.6 Restricting the working range

### 2.6.1 Axes with restricted working range

#### General

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

The working range of the following axes may be restricted:

- Axis 1, hardware (mechanical stop)
- Axis 2, hardware (mechanical stop)
- Axis 3, hardware (mechanical stop)

As standard configuration, axis 1 is allowed to move  $\pm 180^\circ$ . The working range may however be increased to  $\pm 220^\circ$  with option 561-1 *Extended working range axis 1*. Note that this option also requires installation of option 810-1 *Electronic position switch*.

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

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

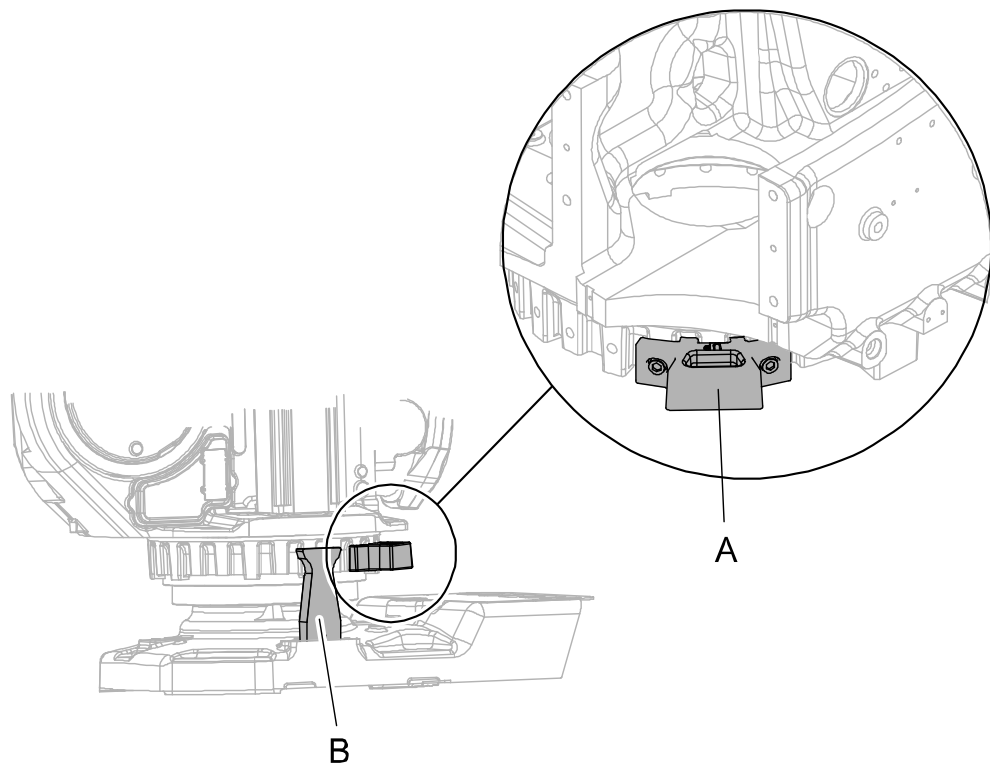
#### 2.6.2 Mechanically restricting the working range of axis 1

##### General

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

##### Mechanical stops, axis 1

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



xx030000049

A	Additional mechanical stop
B	Stop pin

##### Required equipment

Equipment, etc.	Article number	Note
Mechanical stop for axis 1, 7.5°	3HAC11076-1	Includes attachment screws and an assembly drawing.
Mechanical stop for axis 1, 15°	3HAC11076-2	Includes attachment screws and an assembly drawing.
Standard toolkit	-	



*Continues on next page*



Equipment, etc.	Article number	Note
<i>User's guide - S4Cplus (BaseWare OS 4.0) (BaseWare 4.0)</i> <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	 <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> <li>• air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	
2	Fit the additional mechanical stop to the frame according to the figure <a href="#">Mechanical stops, axis 1 on page 104</a> .	Tightening torque: 120 Nm.
3	Adjust the software working range limitations (system parameter configuration) to correspond to the mechanical limitations.	How to define the range of movement in RobotWare 4.0 is detailed in <i>User's guide - S4Cplus (BaseWare OS 4.0)</i> , chapter <i>System Parameters - topic Manipulator</i> .  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	 <p><b>WARNING</b></p> <p>If the mechanical stop pin is deformed after a hard collision, it must be replaced!</p> <p>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.</p>	

## 2 Installation and commissioning

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

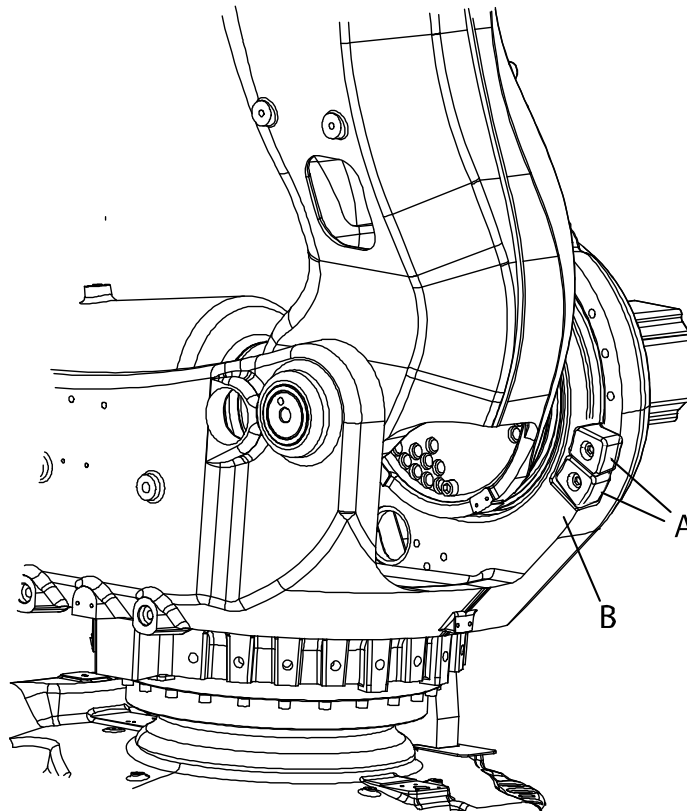
### 2.6.3 Mechanically restricting the working range of axis 2

#### 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.



xx0300000047

A	Additional mechanical stops
B	Fixed mechanical stop

#### Required equipment



Equipment, etc.	Art. no.	Note
Mechanical stop set, axis 2	3HAC11077-1	Includes six stops, 3HAC11407-1, each one restricting the working range by 15°. Includes attachment screws.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .

*Continues on next page*

Equipment, etc.	Art. no.	Note
<i>User's guide - S4Cplus (BaseWare OS 4.0) (RobotWare 4.0)</i> <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> <li>• air 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 2 on page 106</a> .
3	The software working range limitations must be redefined to correspond to the changes in the mechanical limitations of the working range.	How to define the range of movement in RobotWare 4.0 is detailed in <i>User's guide - S4Cplus (BaseWare OS 4.0), chapter System Parameters - topic Manipulator</i> .  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

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

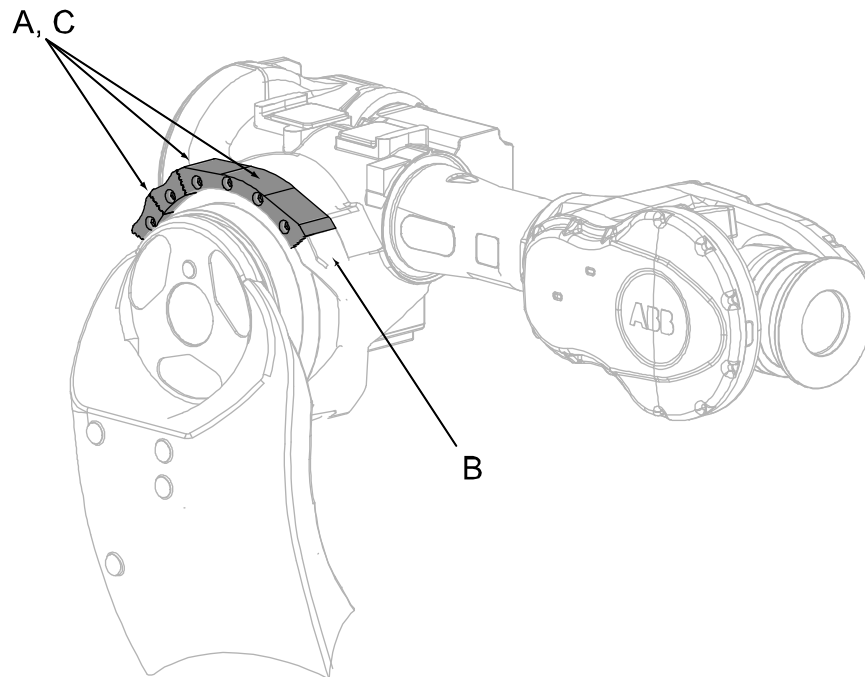
### 2.6.4 Mechanically restricting the working range of axis 3

#### 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.



xx030000048

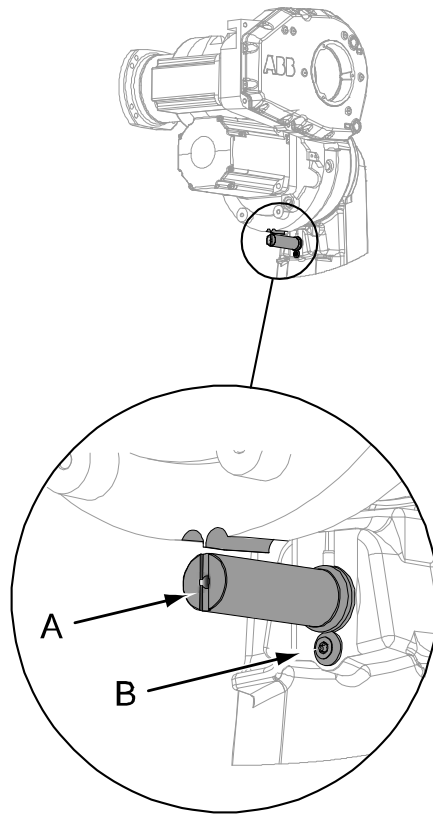
A	Additional mechanical stops
B	Fixed mechanical stop
C	Attachment screw M16x60 quality 12.9

*Continues on next page*

## 2 Installation and commissioning

### 2.6.4 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	3HAC13128-2	Includes six stops, one with 80° restriction, 3HAC12708-4 (use when limitation angle $\geq 80$ ), and five with 20°, 3HAC 12708-2. Includes attachment screws.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
<i>User's guide - S4Cplus (BaseWare OS 4.0) (RobotWare 4.0)</i> <i>Technical reference manual - System parameters</i>	-	Art. no. is specified in section <a href="#">References on page 10</a> .

*Continues on next page*




## 2 Installation and commissioning

### 2.6.4 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><li>• air 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 108</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.	How to define the range of movement in RobotWare 4.0 is detailed in <i>User's guide - S4Cplus (BaseWare OS 4.0)</i> , chapter <i>System Parameters - topic Manipulator</i> . 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.	

## 2.7 Electrical connections

### 2.7.1 Robot cabling and connection points

#### Introduction

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



#### CAUTION

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



#### CAUTION

Verify that the robot serial number is according to the number(s) in the *Declaration of Incorporation (DoI)*.

#### Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table <a href="#">Robot cables on page 112</a> .
Fan cables (option)	Handles supply to and feedback from any cooling fan on the robot. Specified in the table <a href="#">Fan cables (option) 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 <i>Application manual - Additional axes and standalone controller</i> , document number in <a href="#">References on page 10</a> .
DressPack cables (option)	Handles signals, process media and power feeding for customer use, regarding material handling or spot welding. See the <i>Product manual - DressPack/SpotPack IRB 6650S/7600</i> , see document number in <a href="#">References on page 10</a> .

*Continues on next page*

## 2 Installation and commissioning

### 2.7.1 Robot cabling and connection points

*Continued*

#### 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 (OmniCore controllers)	R1.MP
Robot cable, signals	Transfers resolver data from and power supply to the serial measurement board.	XS2 (OmniCore controllers)	R1.SMB

#### Robot cable, power

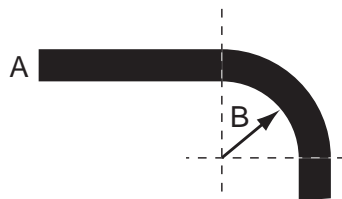
Cable	Art. no.
Robot cable, power: 7 m	3HAC026787-001
Robot cable, power: 15 m	3HAC026787-002
Robot cable, power: 22 m	3HAC026787-003
Robot cable, power: 30 m	3HAC026787-004

#### Robot cable, signals

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

#### Bending radius for static floor cables

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



xx1600002016

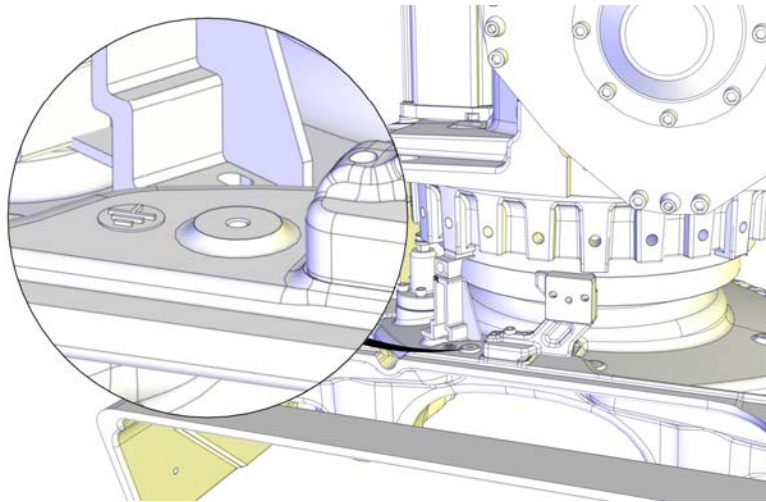
A	Diameter
B	Diameter x10

*Continues on next page*



#### 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.



xx1500001601



#### Note

How to ground DressPack/SpotPack cables is detailed in the *Product manual - DressPack/SpotPack IRB 6650S/7600*, see the document number in [References on page 10](#).

#### Fan cables (option)

These cables are *not* included in the standard delivery, but are included in the delivery if the fan option is ordered. The cables are completely pre-manufactured and ready to plug in.

Cabling to be installed on the robot is specified in section [Installation of cooling fan for motors \(option\) on page 91](#).

#### Cabling between robot base and control cabinet, cooling fans, M2004

The cables specified below are specific for the IRC5 controller and used when the robot is equipped with cooling fans. The cabling for the cooling fans runs all the way from the robot base to the inside of the cabinet. Fans can also be ordered without cables.

If equipping the robot with cooling fans, use the cabling specified below. The cables for cooling fans listed below are used together with a distributing cable, also specified below.

Cable	Art. no.	Connection point
Harness - cooling, 7 m	3HAC022723-001	Distributing cable: R1.FAN.SW2/3 Inside cabinet: A43.X10 and A43.X11
Harness - cooling, 15 m	3HAC022723-004	Distributing cable: R1.FAN.SW2/3 Inside cabinet: A43.X10 and A43.X11

*Continues on next page*

## 2 Installation and commissioning

---

### 2.7.1 Robot cabling and connection points

*Continued*

Cable	Art. no.	Connection point
Harness - cooling, 22 m	3HAC022723-005	Distributing cable: R1.FAN.SW2/3 Inside cabinet: A43.X10 and A43.X11
Harness - cooling, 30 m	3HAC022723-006	Distributing cable: R1.FAN.SW2/3 Inside cabinet: A43.X10 and A43.X11

## 2.8 Start of robot in cold environments

### Introduction

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

### Problems with starting the robot

#### Event message from Motion Supervision

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

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

#### Robot stopping with other event message

Use this procedure if the robot is not starting.

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

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

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

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

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

## 2 Installation and commissioning

---

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

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

---

#### Safe handling

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



#### **DANGER**

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

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

#### Collision risks



#### **CAUTION**

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

## 3 Maintenance

### 3.1 Introduction

---

#### Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 7600.

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

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

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

---

#### Safety information

Observe all safety information before conducting any service work.

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 23](#) before performing any service work.

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



#### Note

If the IRB 7600 is connected to power, always make sure that the IRB 7600 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Panel Mounted Controller*
- [Robot cabling and connection points on page 111](#).

## 3 Maintenance

---

### 3.2.1 Specification of maintenance intervals

## 3.2 Maintenance schedule and expected 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 7600:

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

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

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

---

#### Overhaul

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

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

Contact your local ABB Customer Service to get more information.

### 3.2.2 Maintenance schedule

#### General

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

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

The inspection intervals *do not* specify the life of each component. Values for these are specified in the section [Expected component life on page 123](#)

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

- [Inspection activities on page 124](#)
- [Changing/replacement activities on page 163](#)
- [Cleaning activities on page 192](#)

#### Activities and intervals, standard equipment

The following tables specifies the required maintenance activities and intervals.

#### Inspecting activities

Maintenance activity	Equipment	Interval	Detailed in section
Cleaning	Robot	-	<a href="#">Cleaning the IRB 7600 on page 194</a>
Inspection	Motor seal <sup>i</sup>	Every: <ul style="list-style-type: none"> <li>• 12 months</li> </ul>	<a href="#">Inspecting the motor seal on page 124</a>
Inspection	Balancing device	Every: <ul style="list-style-type: none"> <li>• 6 months</li> </ul>	<a href="#">Inspecting the balancing device on page 144</a>
Inspection	Robot harness	Every: <ul style="list-style-type: none"> <li>• 12 months <sup>ii</sup></li> </ul>	<a href="#">Inspecting the cable harness on page 150</a>
Inspection	Information labels	Every: <ul style="list-style-type: none"> <li>• 12 months</li> </ul>	<a href="#">Inspecting the information labels on page 159</a>
Inspection	Dampers	Every: <ul style="list-style-type: none"> <li>• 12 months</li> </ul>	<a href="#">Inspecting the damper on axes 2 to 5 on page 157</a>
Inspection	Mechanical stops	Every: <ul style="list-style-type: none"> <li>• 12 months</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Inspecting the axis-1 mechanical stop pin on page 153</a></li> <li>• <a href="#">Inspecting the mechanical stops on axes 1, 2, and 3 on page 155</a></li> </ul>

<sup>i</sup> Only valid for robots that are equipped with Type B motors. Type B motors include evacuation on the motor flange to indicate failure of primary sealing between the gearbox and the motor. Robots with protection type Foundry Plus have a sight glass installed in the evacuation holes.

See [Type A vs type B motors on page 411](#).

<sup>ii</sup> Replace when damage or cracks is detected or life limit is approaching that specified in section [Expected component life on page 123](#).

*Continues on next page*

### 3 Maintenance

#### 3.2.2 Maintenance schedule

Continued

#### Changing activities



#### Note

It is very important not to mix different types of oil. The oil change intervals are determined based on the generation of the robot. For more information, see *Technical reference manual - Lubrication in gearboxes*.

Maintenance activity	Equipment	Interval	Detailed in section
Changing	Oil in axis-1 gearbox, robot generation 1:	Every: <ul style="list-style-type: none"> <li>12,000 hours</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-1 gearbox on page 165</a></li> </ul>
Changing	Oil in axis-1 gearbox, robot generation 2 and 3:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-1 gearbox on page 165</a></li> </ul>
Changing	Oil in axis-2 gearbox, robot generation 1:	Every: <ul style="list-style-type: none"> <li>12,000 hours</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-2 gearbox on page 169</a></li> </ul>
Changing	Oil in axis-2 gearbox, robot generation 2 and 3:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-2 gearbox on page 169</a></li> </ul>
Changing	Oil in axis-3 gearbox, robot generation 1:	Every: <ul style="list-style-type: none"> <li>12,000 hours</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-3 gearbox on page 172</a></li> </ul>
Changing	Oil in axis-3 gearbox, robot generation 2 and 3:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-3 gearbox on page 172</a></li> </ul>
Changing	Oil in axis-4 primary gearbox, all generations:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-4 gearbox on page 175</a></li> </ul>

Continues on next page



Maintenance activity	Equipment	Interval	Detailed in section
Changing	Oil in axis-4 secondary gearbox, robot generation 1:	Every: <ul style="list-style-type: none"> <li>12,000 hours</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-4 gearbox on page 175</a></li> </ul>
Changing	Oil in axis-4 secondary gearbox, robot generation 2 and 3:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-4 gearbox on page 175</a></li> </ul>
Changing	Oil in axis-5 primary gearbox, all generations:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-5 gearbox on page 178</a></li> </ul>
Changing	Oil in axis-5 secondary gearbox, robot generation 1:	Every: <ul style="list-style-type: none"> <li>12,000 hours</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-5 gearbox on page 178</a></li> </ul>
Changing	Oil in axis-5 secondary gearbox, robot generation 2 and 3:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-5 gearbox on page 178</a></li> </ul>
Changing	Oil in axis-6 gearbox, all generations:	First change when DTC <sup>i</sup> reads: 6,000 hours Second change when DTC <sup>i</sup> reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none"> <li><a href="#">Changing oil, axis-6 gearbox on page 182</a></li> </ul>

<sup>i</sup> DTC = Duty Time Counter. Shows the operational time of the robot.

*Continues on next page*

## 3 Maintenance

### 3.2.2 Maintenance schedule

*Continued*

#### Miscellaneous activities

Maintenance activity	Equipment	Interval	Detailed in section
Cleaning	Robot	-	<a href="#">Cleaning the IRB 7600 on page 194</a>
Overhaul	Robot	Every: 40,000 hours	<a href="#">Expected component life on page 123</a>
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert <sup>i</sup>	<a href="#">Replacing the SMB battery on page 185</a>
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert <sup>ii</sup>	<a href="#">Replacing the SMB battery on page 185</a>
Lubrication	Balancing device bearings	Every: 12,000 hours <sup>iii</sup>	

<sup>i</sup> 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.

<sup>ii</sup> 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.

<sup>iii</sup> Always lubricate the front eye bearing after refitting the shaft of the balancing device.

#### Activities and intervals, optional equipment

The following table specifies the required maintenance activities and intervals for common optional equipment. The maintenance of other external equipment for the robot is detailed in separate documents.

Maintenance activity	Equipment	Interval	Note	Detailed in section
Inspection	Signal lamp	Every: 12 months		<a href="#">Inspecting the UL lamp on page 161</a>
Inspection	Mechanical stop axes 1-2-3	Every: 12 months	Mechanical stops in addition to the fixed stops	<a href="#">Inspecting the mechanical stops on axes 1, 2, and 3 on page 155</a>
Inspection	Motor fans, axes 1-2-3	Every 12 months	Inspect the fans for contamination that could hinder the air supply. Clean if necessary.	-

### 3.2.3 Expected component life

#### General

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

#### Expected component life - protection type Standard

Component	Expected life	Note
Cable harness Normal usage <sup>i</sup>	40,000 hours <sup>ii</sup>	Not including: <ul style="list-style-type: none"> <li>• Possible SpotPack harnesses</li> <li>• Optional upper arm harnesses</li> </ul>
Cable harness Extreme usage <sup>iii</sup>	20,000 hours <sup>ii</sup>	Not including: <ul style="list-style-type: none"> <li>• Possible SpotPack harnesses</li> <li>• Optional upper arm harnesses</li> </ul>
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*.

For an M2000 system, the SIS is described in section [Service Information System, M2000 on page 197](#).

## 3 Maintenance

---

### 3.3.1 Inspecting the motor seal

## 3.3 Inspection activities

### 3.3.1 Inspecting the motor seal

---

#### Purpose of evacuation holes

This section is only valid for robots that are equipped with Type B motors.

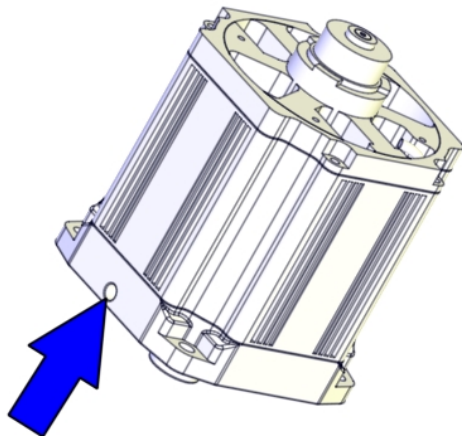
The motors include evacuation on the motor flange to indicate failure of primary sealing between the gearbox and the motor.

More information is found in [Type A vs type B motors on page 411](#).

---

#### Location of evacuation hole on motor

The evacuation hole is located on each motor flange. The figure shows axis-1 motor as an example.



xx1500001057

#### Plug in the evacuation hole




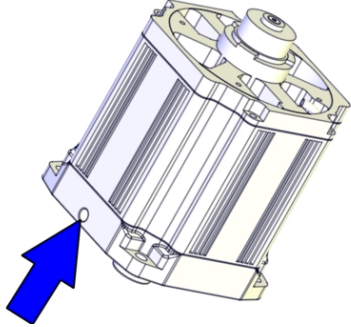
New motors have a transparent plug/sight glass installed in the evacuation hole. Remove the plug or drill a drainage hole with diameter 3 mm, if an open evacuation hole is required instead.



xx2200002188

*Continues on next page*

#### Inspecting the evacuation hole

	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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>	
2	 <p><b>WARNING</b></p> <p>Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a>.</p>	
3	<p>Do a leakage check of the sight glass/evacuation hole of each motor.</p> <p>If any oil is available on the sight glass or if any oil has been spilled out from the evacuation hole, replacement of the motor is recommended.</p> <p> <b>Note</b></p> <p>If oil is present in the evacuation it is an indication that the primary seal of the motor is leaking. A secondary seal after the evacuation is keeping the oil out from the motor, but it is still recommended to replace the motor at a suitable timing if oil is present in the evacuation.</p>	 <p>xx1500001057</p> <p>Replacing of motors is described in the repair chapter <a href="#">Motors on page 291</a>.</p>

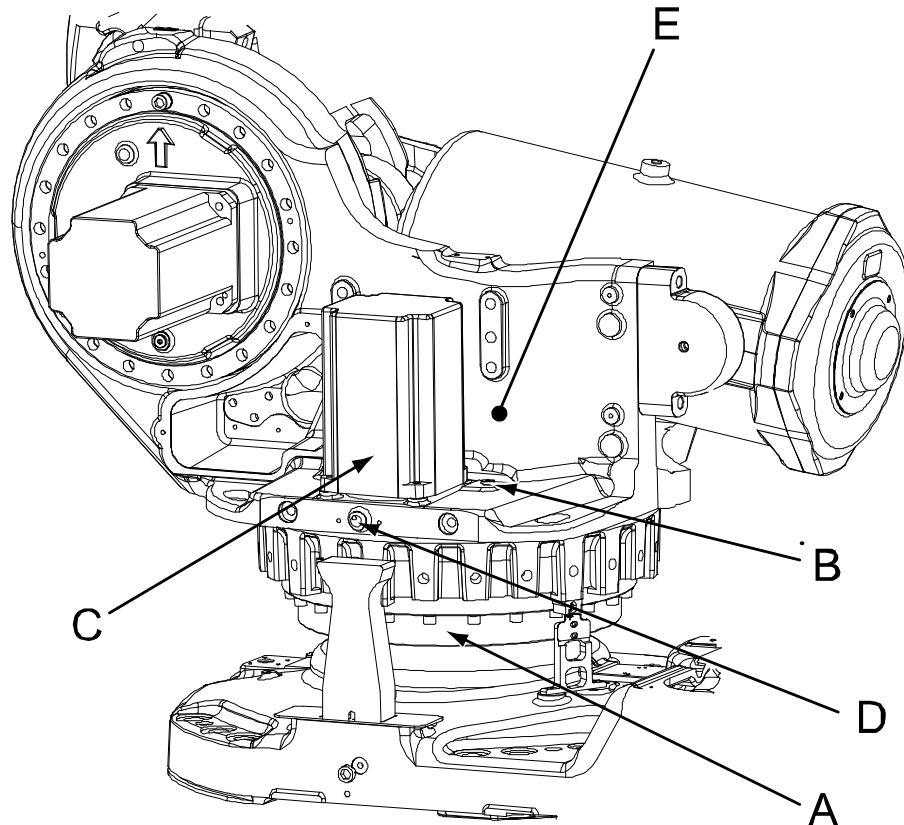
### 3 Maintenance

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

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

##### Location of gearbox

The axis-1 gearbox is located between the frame and base as shown in the following figure.



xx020000111

A	Gearbox axis 1
B	Oil plug, filling
C	Motor, axis 1
D	Oil plug, inspection (not available in all designs)
E	Label, specifies type of oil in the axis 1 gearbox

##### Required equipment




Equipment, etc.	Art. no.	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	
Standard toolkit	-	Content is defined in section <i>Standard tools on page 421.</i>

*Continues on next page*

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.

#### Inspection through the oil plug, filling

Use this procedure to inspect the oil level in the axis-1 gearbox, when the oil plug for inspection (shown in figure [Location of gearbox on page 126](#)) is not available.

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ .	This is a precaution to reduce the temperature dependency of the measurement.
4	Remove the motor, axis 1.	Detailed in section <a href="#">Removal, motor axis 1 on page 293</a> .
5	Measure the oil level through the motor hole. Required oil level: 35-45 mm to the motor hole.	
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 163</a> . Filling and draining detailed in <a href="#">Changing oil, axis-1 gearbox on page 165</a> .
7	Refit the motor, axis 1.	Detailed in section <a href="#">Refitting, motor axis 1 on page 294</a> .
8	 <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <a href="#">Technical reference manual - Lubrication in gearboxes</a> .	

*Continues on next page*



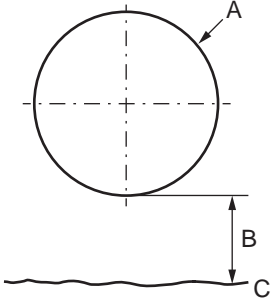

### 3 Maintenance

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

Continued

#### Inspection through the oil plug, inspection

Use this procedure to inspect the oil level in the axis-1 gearbox, when the oil plug for inspection (shown in figure [Location of gearbox on page 126](#)) is available.

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	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 the figure <a href="#">Location of gearbox on page 126</a> .
5	Measure the oil level. Required oil level: 0-10 mm	 <p>xx1400002785</p> <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 163</a> . Detailed in section <a href="#">Changing oil, axis-1 gearbox on page 165</a> .
7	Refit the oil plug, inspection.	Tightening torque: 24 Nm.
8	 <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <a href="#">Technical reference manual - Lubrication in gearboxes</a> .	



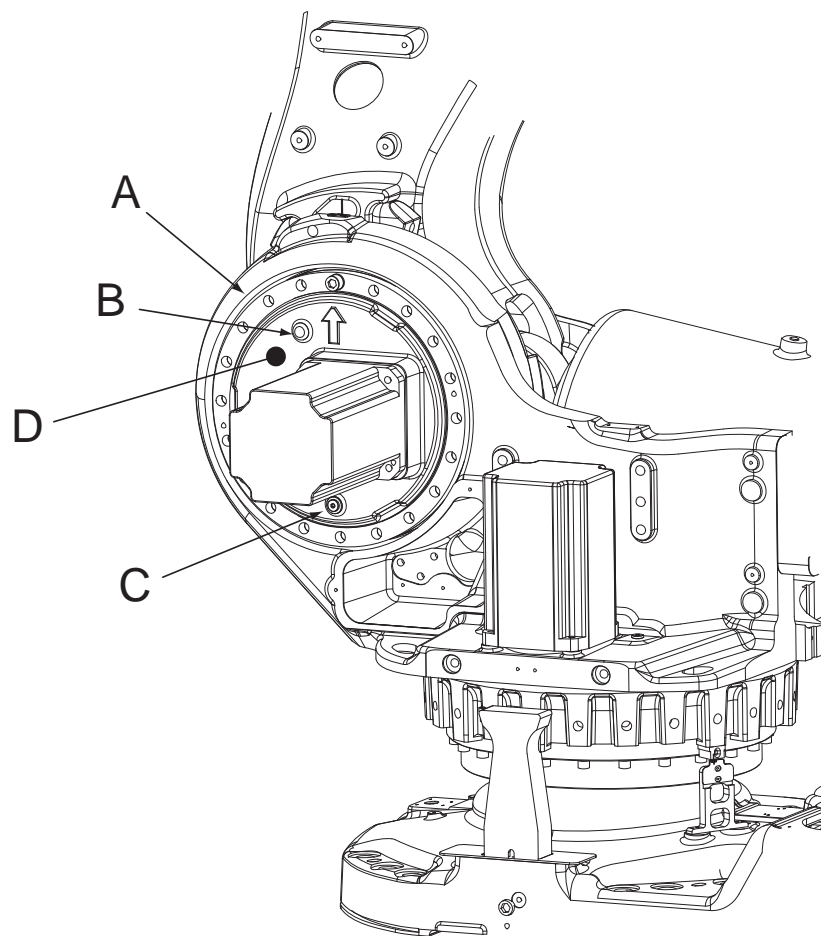
### 3.3.3 Inspecting the oil level in axis-2 gearbox

#### Different designs

The cover of the axis-2 gearbox is available in different designs, with different locations of the oil plug hole for filling. The oil plug hole of the later design is located 33 mm lower than on the earlier design. The measured distance to the oil level varies, depending on the design of the cover.

#### Oil plug, early design

The axis-2 gearbox is located in the lower arm rotational center. The following figure shows the early design of the gearbox cover.



xx030000068

A	Gearbox, axis 2 (behind the motor attachment, not shown in figure)
B	Oil plug, filling (early design)
C	Oil plug, draining
D	Label, specifies the type of oil in the axis-2 gearbox

*Continues on next page*

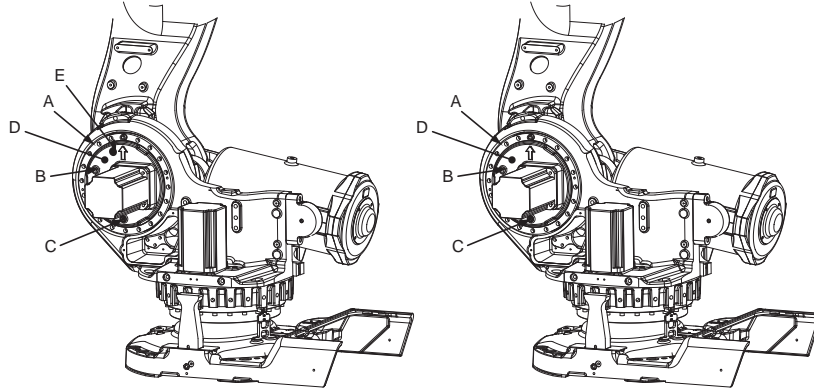
### 3 Maintenance

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

Continued

##### Oil plug, later design

The axis-2 gearbox is located in the lower arm rotational center. The following figure shows the later design of the gearbox cover.



xx020000112


A	Gearbox, axis 2 (behind the motor attachment, not shown in figure)
B	Oil plug, filling/inspection (later design)
C	Oil plug, draining
D	Label, specifies the type of oil in axis-2 gearbox
E	Oil plug, ventilation (later design)

##### Required equipment


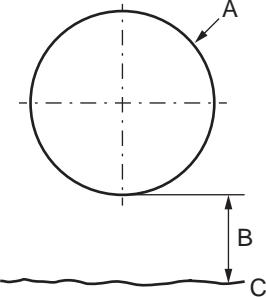

Equipment etc.	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 163</a> .	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Other tools and procedures may be required. See references to these procedures in the step-by-step 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
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	

Continues on next page

	Action	Note
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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>	
3	<p>Make sure that the oil temperature is <math>+25^{\circ}\text{C} \pm 10^{\circ}\text{C}</math>.</p>	<p>This is a precaution to reduce the temperature dependency of the measurement.</p>
4	<p>Open the <i>oil plug, filling/inspection</i> (two different designs).</p>	<p>Read more about the differences in <a href="#">Changing oil, axis-2 gearbox on page 169!</a></p>
5	<p>Measure the oil level.</p> <p>Required oil level, early design: 30-45 mm</p> <p>Required oil level, later design: 0-15 mm</p>	 <p>xx1400002785</p> <p>A Oil plug hole B Required oil level C Gearbox oil</p> <p>Shown in the figures <a href="#">Oil plug, early design on page 129</a> or <a href="#">Oil plug, later design on page 130!</a></p>
6	<p>Adjust the oil level, if required.</p>	<p>Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a>.</p> <p>Detailed in section <a href="#">Filling, oil on page 170</a>.</p>
7	<p>Refit the oil plug, filling.</p>	<p>Tightening torque: 24 Nm.</p>
8	 <p><b>WARNING</b></p> <p>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>	

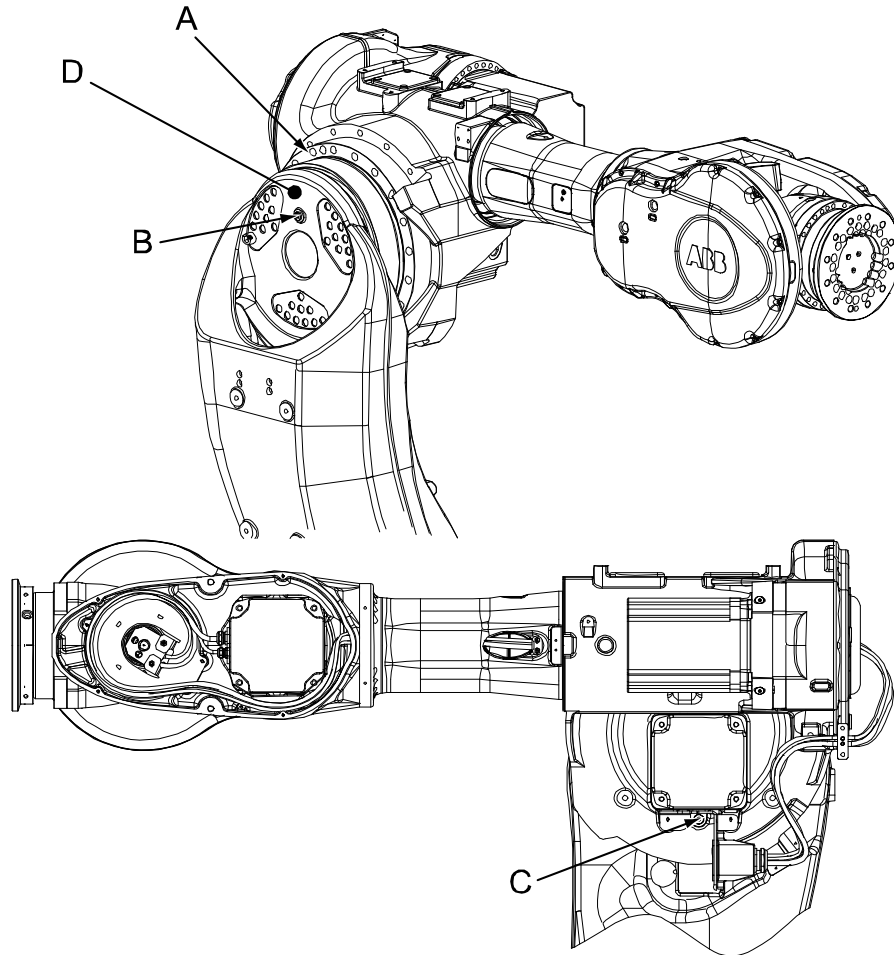
## 3 Maintenance

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

### 3.3.4 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 following figure.



xx0200000113

A	Gearbox, axis 3
B	Oil plug, filling/inspection
C	Oil plug, draining
D	Label, specifies the oil type of axis-3 gearbox

#### Required equipment



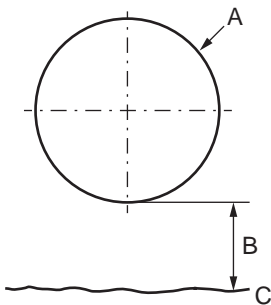
Equipment	Art. no.	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	
Standard toolkit	-	Content is defined in section <i>Standard tools on page 421.</i>

*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.

#### 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, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	Move the robot to the calibration position.	Detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 378</a> .
3	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
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/inspection</i> .	Shown in the figure <a href="#">Location of gearbox on page 132</a> !
6	Measure the oil level. Required oil level: 0-20 mm	 <p>xx1400002785</p> <p>A Oil plug hole                      B Required oil level                      C Gearbox oil</p>
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 163</a> . Detailed in section <a href="#">Changing oil, axis-3 gearbox on page 172</a> .


*Continues on next page*

### 3 Maintenance

---

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

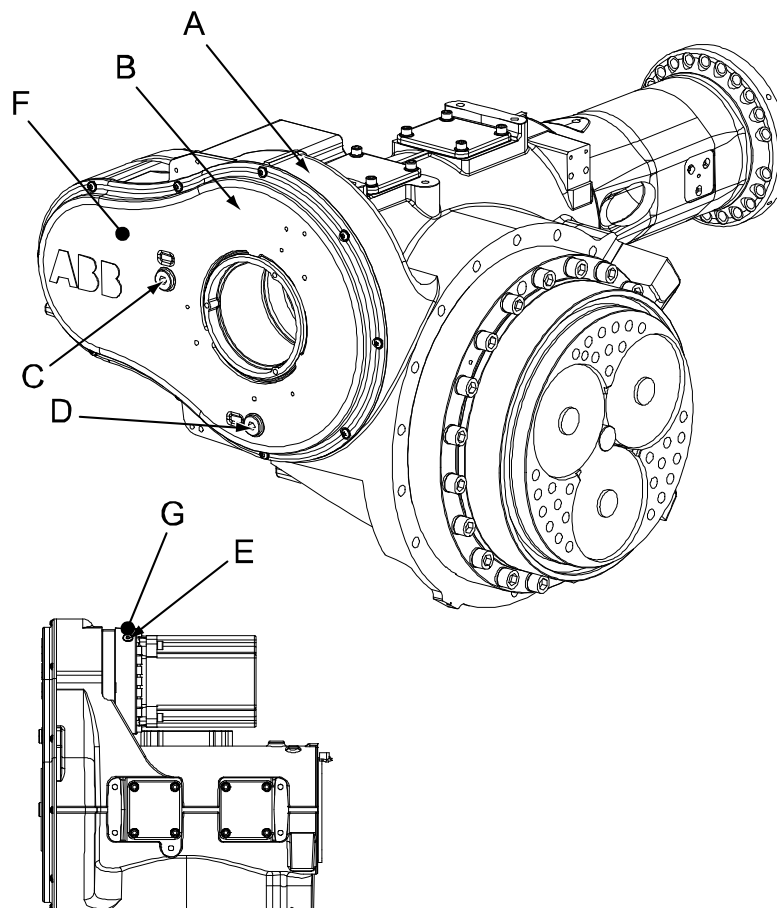
*Continued*

	Action	Note
8	Refit the oil plug.	Tightening torque: 24 Nm.
9	 <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> .	

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

#### Location of gearbox

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



xx020000107

A	Upper arm housing
B	Cover, axis-4 gearbox
C	Oil plug, filling/inspection, secondary gearbox
D	Oil plug, draining, secondary gearbox
E	Oil plug, filling/inspection, primary gearbox The oil plug for draining of the primary gearbox is not shown in the figure
F	Label, specifies the type of oil in the axis-4 secondary gearbox
G	Label, specifies the type of oil in the axis-4 primary gearbox

#### Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 163</a> .	

*Continues on next page*

### 3 Maintenance



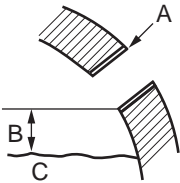
#### 3.3.5 Inspecting the oil level in axis-4 gearbox

Continued

Equipment, etc.	Art. no.	Note
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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.

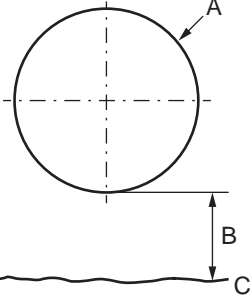

#### Inspecting the oil level in axis-4 gearbox

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, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	Move the robot to the calibration position.	This is detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 378</a> .
3	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
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 oil plug, filling/inspection, in the primary gearbox.	Shown in the figure <a href="#">Location of gearbox on page 135</a> !
6	Measure the oil level. Required oil level: 30-40 mm	 <p>xx1400002859</p> <ul style="list-style-type: none"> <li>A Oil plug hole</li> <li>B Required oil level</li> <li>C Gearbox oil</li> </ul>
7	Add oil 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 163</a> . Detailed in section <a href="#">Changing oil, axis-4 gearbox on page 175</a> .

Continues on next page



	Action	Note
8	Open the oil plug, filling/inspection, in the secondary gearbox.	Shown in the figure <a href="#">Location of gearbox on page 135!</a>
9	Measure the oil level. Required oil level: 0-10 mm	 <p>xx1400002785</p> <ul style="list-style-type: none"> <li>A Oil plug hole</li> <li>B Required oil level</li> <li>C Gearbox oil</li> </ul>
10	Add oil 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 163</a> . Detailed in section <a href="#">Changing oil, axis-4 gearbox on page 175</a> .
11	Refit the oil plugs.	Tightening torque: 24 Nm.
12	 <p><b>WARNING</b></p> <p>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>	

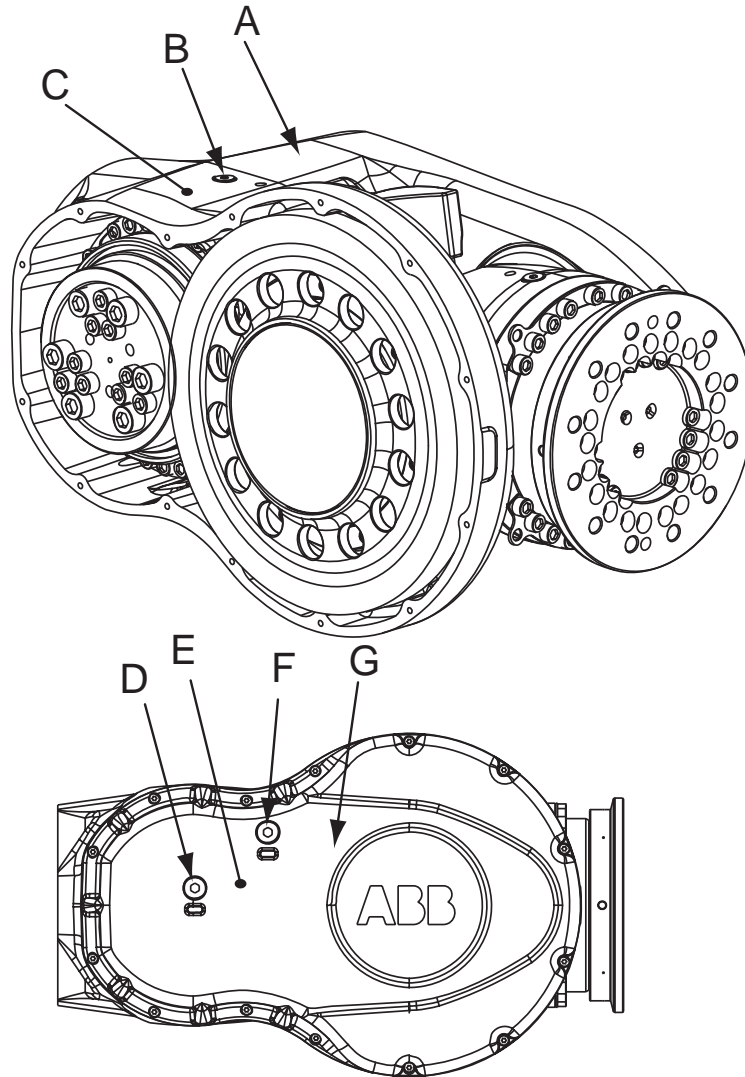
### 3 Maintenance

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

#### 3.3.6 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 following figure.



xx020000108

A	Wrist housing
B	Oil plug, filling/inspection, primary gearbox The oil plug for draining of the primary gearbox is on the opposite side of the wrist housing, not shown in the figure.
C	Label, specifies the type of oil in the axis-5 primary gearbox
D	Oil plug, draining/inspection, secondary gearbox
E	Label, specifies the type of oil in the axis-5 secondary gearbox
F	Oil plug, filling, secondary gearbox
G	Cover, axis-5 gearbox



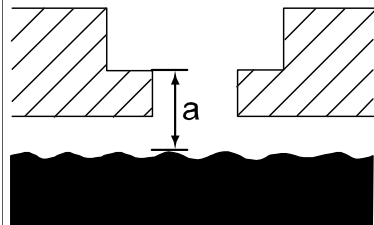
*Continues on next page*

#### Required equipment

Equipment etc.	Art. no.	Note
Lubricating oil	See <i>Type and amount of oil in gear-boxes on page 163</i> .	
Standard toolkit	-	Content is defined in section <i>Standard tools on page 421</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.

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

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

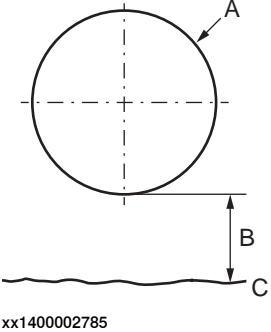

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <i>Gearbox lubricants (oil or grease) on page 38</i> .	
2	Run the robot to the calibration position.	This is detailed in section <i>Synchronization marks and synchronization position for axes on page 378</i> .
3	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
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/inspection</i> , in the <i>primary gearbox</i> .	Shown in the figure <i>Location of gearbox on page 138</i> .
6	Measure the oil level. Required oil level to the upper edge of the filling and inspection oil plug hole (a): 80-96 mm	 xx0500002222

*Continues on next page*

### 3 Maintenance

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

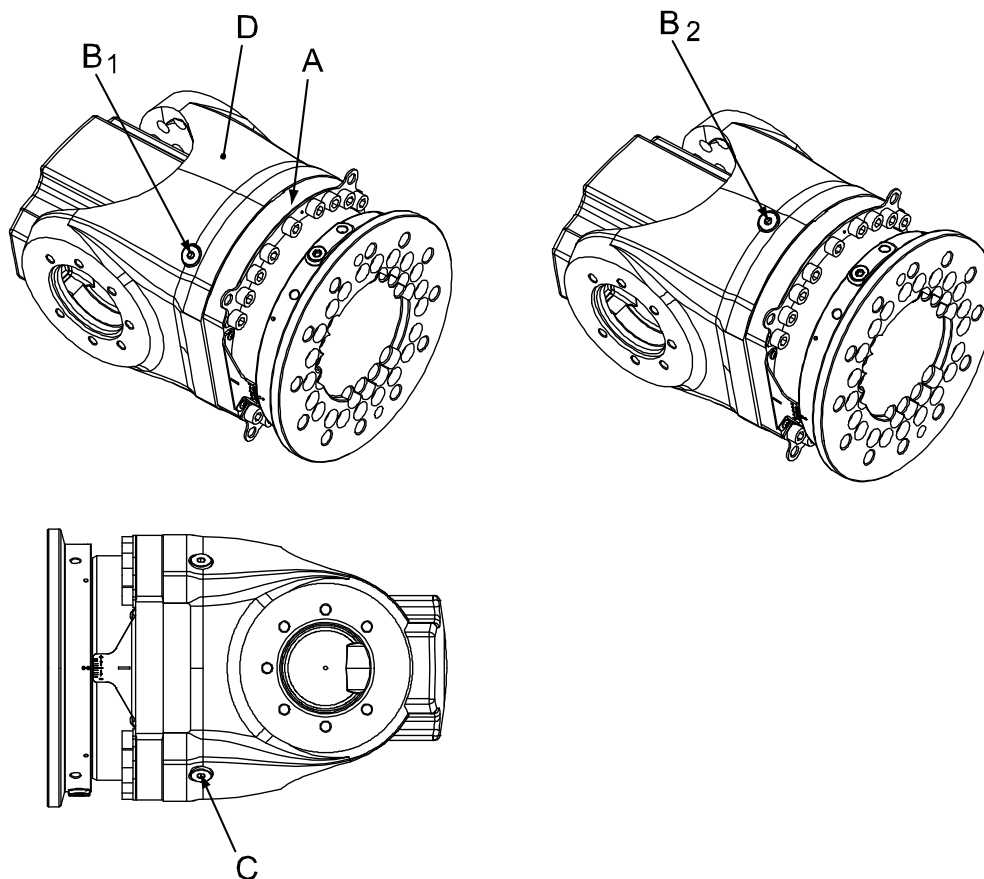
Continued

	Action	Note
7	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> . Detailed in section <a href="#">Changing oil, axis-5 gearbox on page 178</a> .
8	Open the <i>oil plug, draining/inspection</i> , in the <i>secondary gearbox</i> .	Shown in the figure <a href="#">Location of gearbox on page 138</a> .
9	Measure the oil level. Required oil level: 0-10 mm	 <p>xx1400002785</p> <p>A Oil plug hole B Required oil level C Gearbox oil</p>
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 163</a> . Detailed in section <a href="#">Changing oil, axis-5 gearbox on page 178</a> .
11	Refit the oil plugs.	Tightening torque: 24 Nm.
12	 <p><b>WARNING</b></p> <p>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>	

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

#### Location of gearbox

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



xx020000114

A	Gearbox, axis 6
B	Oil plug, filling/inspection (notice the different locations of the plug, shown as B <sub>1</sub> and B <sub>2</sub> )
C	Oil plug, draining (can be located on the turning disk instead)
D	Label, specifies the type of oil in gearbox axis 6

#### Required equipment

Equipment	Art. no.	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	
Standard toolkit	-	Content is defined in section <i>Standard tools on page 421.</i>

*Continues on next page*

### 3 Maintenance




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

Continued


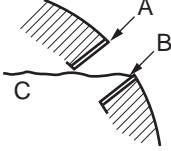

Equipment	Art. no.	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

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

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

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	Move axes 3 and 5 to a horizontal position, and make sure that the <i>oil plug, filling and inspection (B1 or B2)</i> is facing upwards.	Shown in the figure <a href="#">Location of gearbox on page 141</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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
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> .	
6	Open the <i>oil plug, draining</i> .	This is a precaution to avoid vacuum effects by allowing air to enter at the top of the gearbox.   <b>Note</b> 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.
7	Slowly turn axis 4, while adjusting axis 6 so that the oil plug, filling and inspection always faces upwards. Turn axis 4 until the axis-4 angle reads: <ul style="list-style-type: none"> <li>• <math>-36^{\circ}</math> to <math>-39^{\circ}</math> for oil plug position B1</li> <li>• <math>-80^{\circ}</math> to <math>-83^{\circ}</math> for oil plug position B2</li> </ul>	

Continues on next page

	Action	Note
8	<p>Inspect the oil level in the hole for the <i>oil plug, filling and inspection</i>.</p> <p>The oil should reach all the way up to the external edge of the thread for the <i>oil plug, filling and inspection</i>.</p> <p> <b>Note</b></p> <p>If the <i>oil plug, draining</i> is not opened, then use a clean, narrow object, for example an oil stick or a cable tie, to gently poke the oil surface. This will avoid surface tension from stopping air to enter into the gearbox.</p>	 <p>xx1400002786</p> <p>A Oil plug hole B Required oil level C Gearbox oil</p>
9	Adjust the oil level, if required.	<p>Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a>.</p> <p>Detailed in section <a href="#">Changing oil, axis-6 gearbox on page 182</a>.</p>
10	Refit the oil plugs.	Tightening torque: 20 Nm
11	<p> <b>WARNING</b></p> <p>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>	

## 3 Maintenance

---

### 3.3.8 Inspecting the balancing device

### 3.3.8 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.

---

#### Action at detected faults

If any faults are detected during the inspection, a maintenance may be performed according to specific maintenance kits.

If the balancing device is an older model, it must in some cases be upgraded instead! The instruction for the current inspection details if a fault requires a maintenance / upgrade and the table below specifies the different models and which of the two actions they require.

The article number of the balancing device is located on a label at the rear cover, shown in the figure [Inspection points, balancing device on page 145](#).

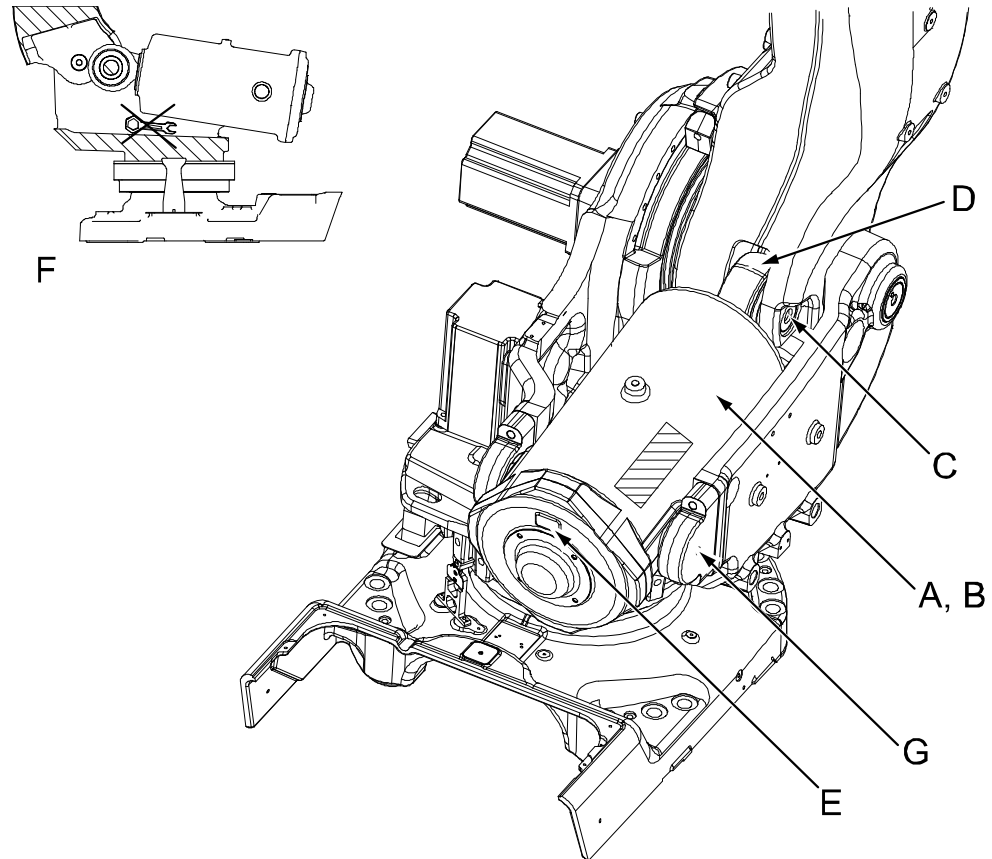
Balancing device, art. no.	Action at detected faults
3HAC10538-1	Upgrade
3HAC14675-1	Maintenance

*Continues on next page*



#### 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.



xx030000580

A	Balancing device
B	Piston rod (inside)
C	Shaft, including securing screw
D	Ear, bearing and o-rings
E	Label with article number
F	Inspect the surroundings
G	Bearing, balancing device attachments

#### Required equipment

The table below specifies the equipment used if damage is detected on the balancing device. See section [Action at detected faults on page 144](#) to determine whether to perform maintenance or upgrade!

Equipment, etc.	Spare part no.	Art. no.	Note
Maintenance kit, bearings and seals	3HAC14962-1		Includes: <ul style="list-style-type: none"> <li>kit with bearings, o-rings and seals only</li> <li>instructions for maintenance.</li> </ul>

*Continues on next page*

### 3 Maintenance

#### 3.3.8 Inspecting the balancing device

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
			Includes <ul style="list-style-type: none"> <li>kit with piston rod, support shaft etc.</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		3HAC15943-1	
Puller for separator		4552-2 (Bahco)	Used for removing the spherical roller bearings.
Separator		4551-C (Bahco)	Used for removing the spherical roller bearings.
Standard toolkit		3HAC15571-1	Content is defined in section <a href="#">Standard tools on page 421</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 145](#).

	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>	<p>... perform maintenance or upgrade according to given instructions in Maintenance kit, bearings and seals / Upgrade kit. The replacement of the bearing at the ear is also detailed in section <a href="#">Replacement of spherical roller bearing, balancing device on page 274</a>.</p> <p>Art. no. for the kit and the documentation are specified in section <a href="#">Required equipment on page 145</a>.</p> <p>To decide whether to perform maintenance or upgrade, see section <a href="#">Action at detected faults on page 144</a>.</p>
2	<ul style="list-style-type: none"> <li>balancing device (a tapping sound, caused by the springs inside the cylinder).</li> </ul>	<p>...replace the balancing device or consult ABB Robotics. How to replace the device is detailed in section <a href="#">Replacing the balancing device on page 279</a>. This section also specifies the spare part number!</p>
3	<ul style="list-style-type: none"> <li>piston rod (squeaking may indicate worn plain bearings, internal contamination or insufficient lubrication).</li> </ul>	<p>If dissonance is detected, wipe clean the piston rod.</p> <p>If dissonance continues after the piston rod is cleaned, perform maintenance according to given instructions in <i>Maintenance kit, complete</i>.</p> <p>Art. no. for the kit and the documentation are specified in section <a href="#">Required equipment on page 145</a>.</p> <p>To decide whether to perform maintenance or upgrade, see section <a href="#">Action at detected faults on page 144</a>.</p>

Continues on next page

#### Check for damage

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

The check points are shown in the figure [Inspection points, balancing device on page 145](#).

	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>	<p>... perform maintenance or upgrade according to given instructions in Maintenance kit, complete / Upgrade kit.</p> <p>Art. no. for the kit and the documentation are specified in section <a href="#">Required equipment on page 145</a>.</p> <p>To decide whether to perform maintenance or upgrade, see section <a href="#">Action at detected faults on page 144</a>.</p>
2	<ul style="list-style-type: none"> <li>the securing screw in the front ear shaft.</li> </ul> <p>Also check the tightening torque (50 Nm).</p>	<p>...replace.</p> <p>Dimension is specified in section <a href="#">Required equipment on page 145</a>.</p>

#### Check for leakage

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!

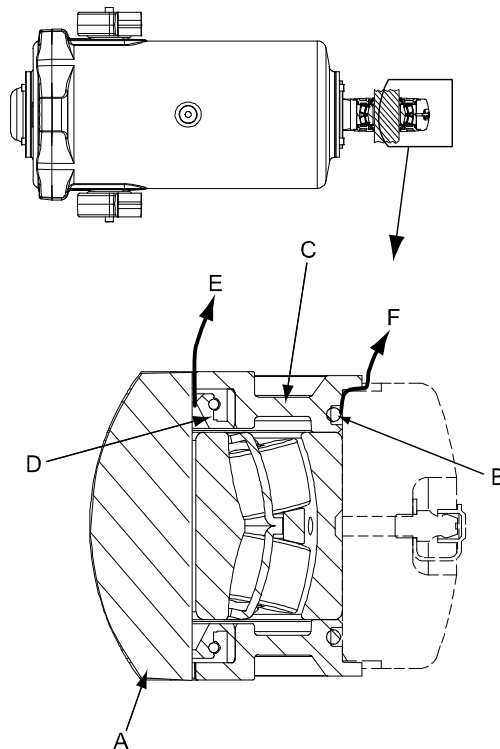
*Continues on next page*

### 3 Maintenance

#### 3.3.8 Inspecting the balancing device

Continued

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




xx0300000284

A	Shaft
B	O-ring
C	Sealing spacer
D	Sealing ring in sealing spacer
E	Correct way out for excessive grease from inside the front ear
F	Incorrect leakage from the front ear

	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!	<p>The o-rings are included in the <i>Maintenance kit, bearings and seals</i>, already assembled with sealing spacers and sealing rings.</p> <p>Art. no. for the kit is specified in <a href="#">Required equipment on page 145</a>.</p> <p>The replacement of the complete bearing is also detailed in section <a href="#">Replacement of spherical roller bearing, balancing device on page 274</a>.</p> <p>Incorrect leakage is shown in the previous figure.</p>

Continues on next page

Check for contamination / lack of free space

Action	
1	 <p><b>DANGER</b></p> <p>Turn off all:</p> <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the safeguarded space.</p>
2	<p>Check that there are no obstacles inside the frame, that could prevent the balancing device from moving freely. See the figure <a href="#">Inspection points, balancing device on page 145</a>.</p> <p>Keep the areas around the balancing device clean and free from objects, such as service tools.</p>

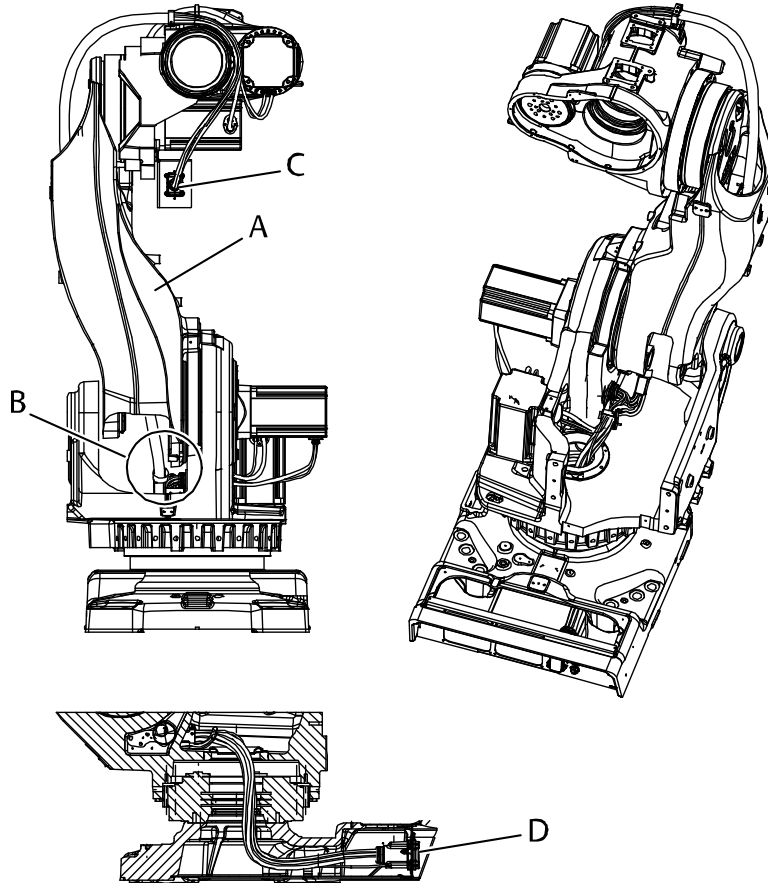
## 3 Maintenance

### 3.3.9 Inspecting the cable harness

#### 3.3.9 Inspecting the cable harness

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

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



xx020000097

A	Lower arm
B	Cables attached with velcro straps and mounting plate
C	Connectors at cable harness division point, R2.M5/6
D	Connectors at base


##### Required equipment

Equipment, etc.	Art. no.	Note
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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 diagram on page 429</a> .

*Continues on next page*

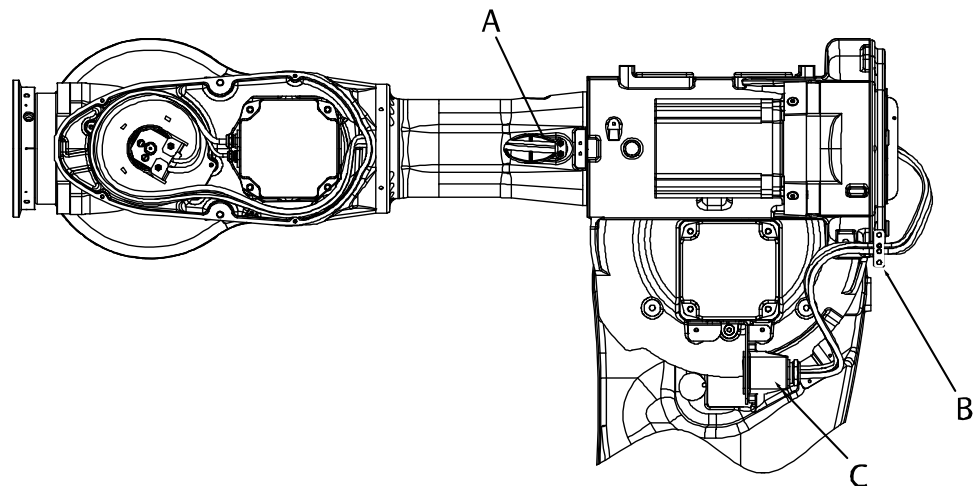
Inspection, cable harness 1-4

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 to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Make an overall visual inspection of the cable harness, in order to detect wear and damage.	
3	Check the <i>connectors at the division point and at the base.</i>	Shown in the figure <a href="#">Location of cable harness, axes 1-4 on page 150.</a>
4	Check that <i>velcro straps and the mounting plate</i> are properly attached to the frame. Also check the cabling, leading into the lower arm. Make sure it is attached by the straps and not damaged.	Location is shown in the figure <a href="#">Location of cable harness, axes 1-4 on page 150.</a> A certain wear of the hose at the entrance to the lower arm is natural.
5	Replace the cable harness if wear, cracks or damage is detected.	Described in <a href="#">Replacement of cable harness, axes 1-4 on page 214.</a>

Location of cabling axes 5-6

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



xx0200000155

A	Cable attachment, upper arm tube
B	Cable attachment, rear of upper arm
C	Connectors at cable harness division point, R2.M5/6

Continues on next page


## 3 Maintenance

### 3.3.9 Inspecting the cable harness

*Continued*

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

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

	Action	Note
1	 <b>DANGER</b>  Turn off all: <ul style="list-style-type: none"><li>• electric power supply to the robot</li><li>• hydraulic pressure supply to the robot</li><li>• air pressure supply to the robot</li></ul> Before entering the robot working area.	
2	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> . Check the <i>connectors at the cable harness division</i> . Make sure the attachment plate is not bent or in any other way damaged.	Shown in the figure <a href="#">Location of cabling axes 5-6 on page 151</a> .
4	Replace the cable harness if wear, cracks or damage is detected.	Described in section <a href="#">Replacement of cable harness, axes 5-6 on page 224</a>



3.3.10 Inspecting the axis-1 mechanical stop pin

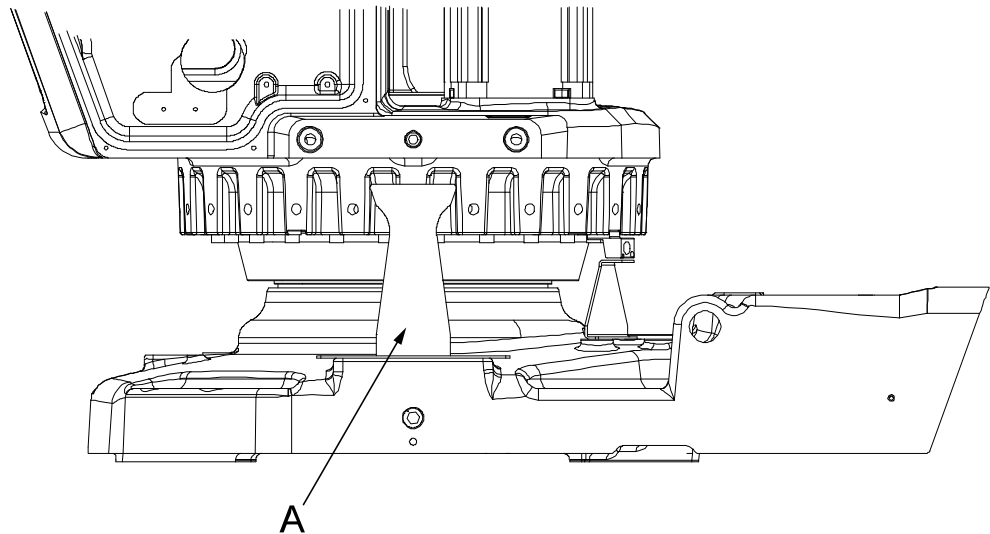


**WARNING**

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

**Location of mechanical stop pin**

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



xx020000151

A	Mechanical stop pin
---	---------------------

**Required equipment**

Visual inspection, no tools are required.

**Inspecting, mechanical stop pin**

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

	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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the safeguarded space.</p>	


*Continues on next page*

### 3 Maintenance

---

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

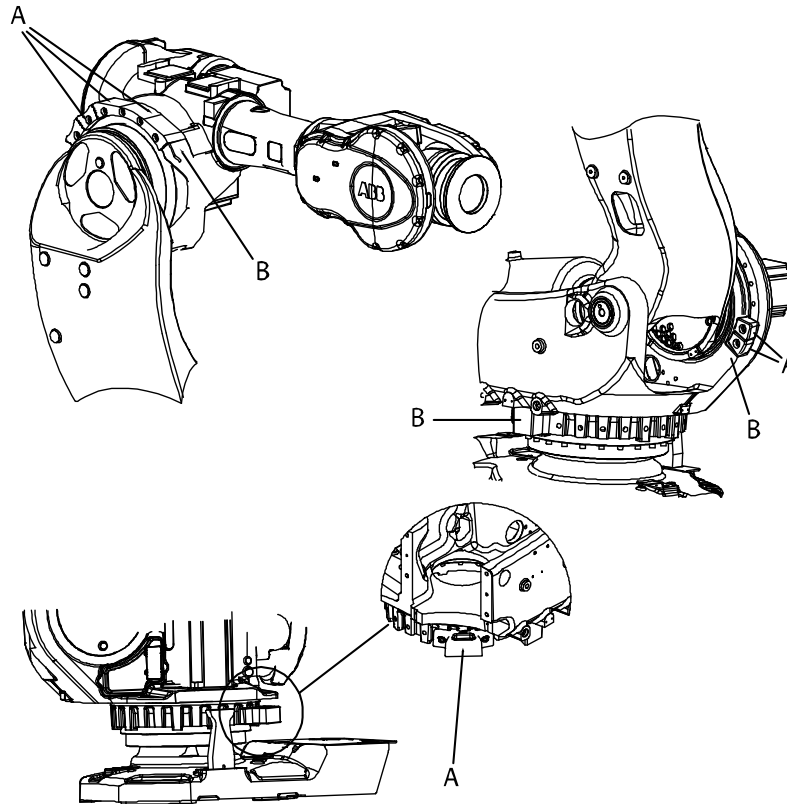
*Continued*

	Action	Note
2	<p>Inspect the axis-1 mechanical stop pin. If the mechanical stop pin is bent or damaged, it must be replaced.</p> <p> <b>Note</b></p> <p>The expected life of gearboxes can be reduced after collision with the mechanical stop.</p>	
3	<p>Make sure the mechanical stop pin can move in both directions.</p>	

3.3.11 Inspecting the mechanical stops on axes 1, 2, and 3

Location of the mechanical stops

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



xx0200000150

A	Additional stop
B	Fixed stop

Required equipment

Equipment etc.	Art. no.	Note
Mechanical stop ax 1	3HAC11076-1	Limits the robot working range to 7.5°.
Mechanical stop ax 1	3HAC11076-2	Limits the robot working range to 15°.
Mechanical stop ax 2	3HAC11077-1	
Mechanical stop ax 3	3HAC13128-2	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .

Continues on next page


## 3 Maintenance

### 3.3.11 Inspecting the mechanical stops on axes 1, 2, and 3

*Continued*

#### Inspection, mechanical stops

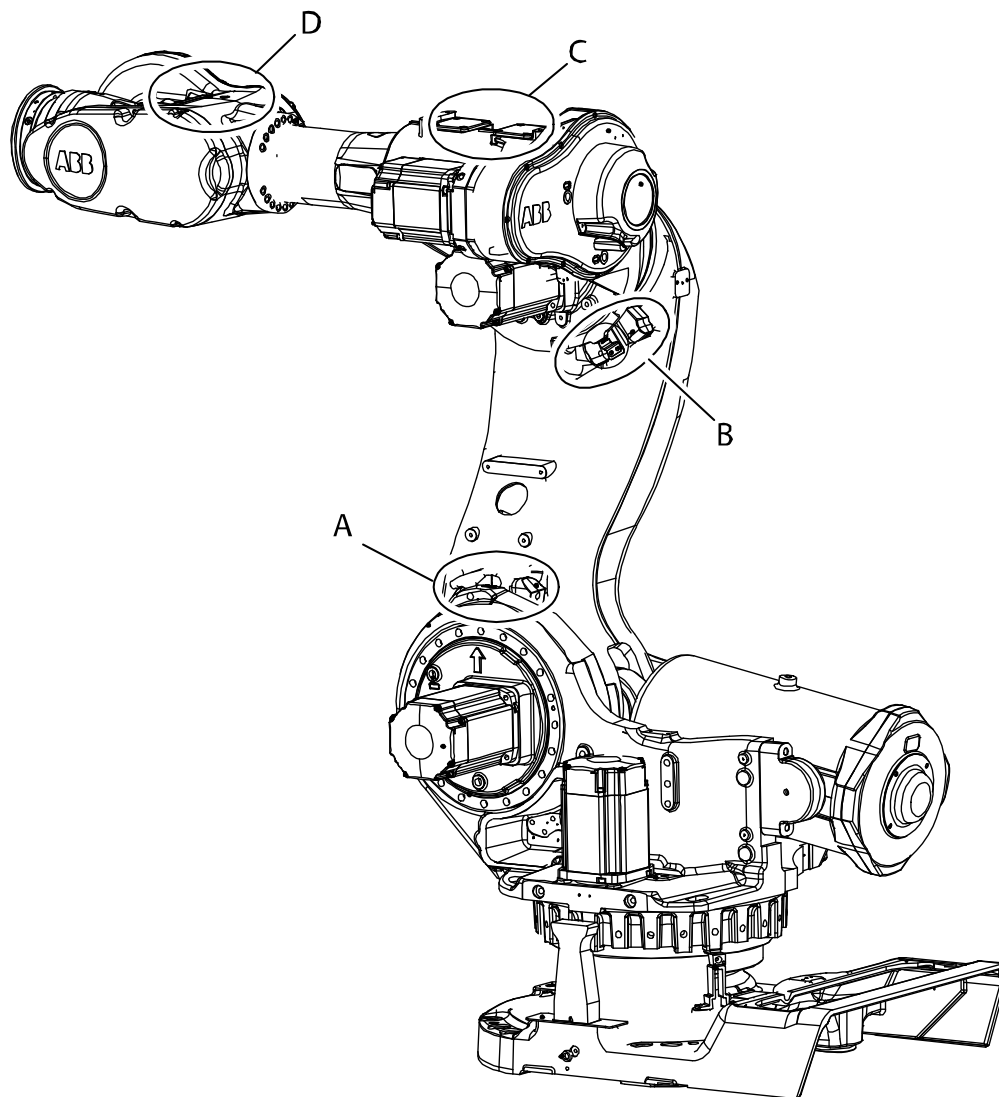
The procedure below details how to inspect the additional mechanical stops on axes 1, 2 and 3.

	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><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
2	Check the <i>additional stops</i> on axes 1, 2 and 3 for damage.	Shown in the figure <a href="#">Location of the mechanical stops on page 155</a> .
3	Make sure the stops are properly attached. Correct tightening torque: 115 Nm.	
4	If any damage is detected, the <i>mechanical stops</i> must be replaced! Correct attachment screws: <ul style="list-style-type: none"><li>• Axis 1: M16 x 35</li><li>• Axis 2: M16 x 50</li><li>• Axis 3: M16 x 80</li></ul>	Art. no. is specified in <a href="#">Required equipment on page 155</a> !

## 3.3.12 Inspecting the damper on axes 2 to 5

## Location of dampers

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



xx020000099

A	Damper, axis 2 (2 pcs)
B	Damper, axis 3 (2 pcs)
C	Damper, axis 4 (2 pcs)
D	Damper, axis 5 (2 pcs)

## Required equipment

Equipment	Art. no.	Note
Damper axis 2	3HAC12990-1	Replace if damaged!
Damper axis 3	3HAC11750-1	Replace if damaged!

*Continues on next page*

### 3 Maintenance


#### 3.3.12 Inspecting the damper on axes 2 to 5

*Continued*

Equipment	Art. no.	Note
Damper axis 4	3HAC13564-1	Replace if damaged!
Damper axis 5	3HAC10503-8	Replace if damaged!
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .

#### Inspection, damper axis 2-5

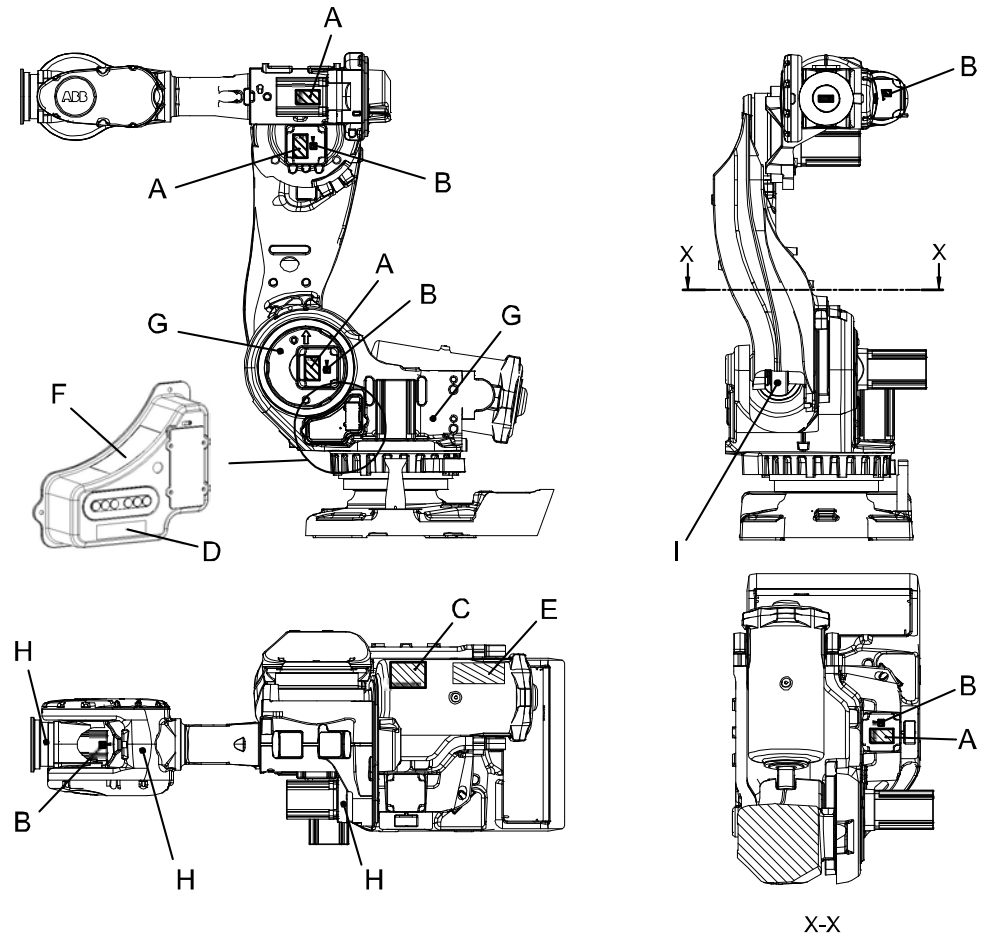
The procedure below details how to inspect the dampers, axis 2-5.

	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><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
2	Check all <i>dampers</i> for damage, such as cracks or existing impressions larger than 1 mm. In order to inspect dampers, axis 4, the two covers on top of the upper arm must be removed!	Shown in the figure <a href="#">Location of dampers on page 157</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 157</a> .

3.3.13 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 manipulator labels on page 27](#).



xx0200000100

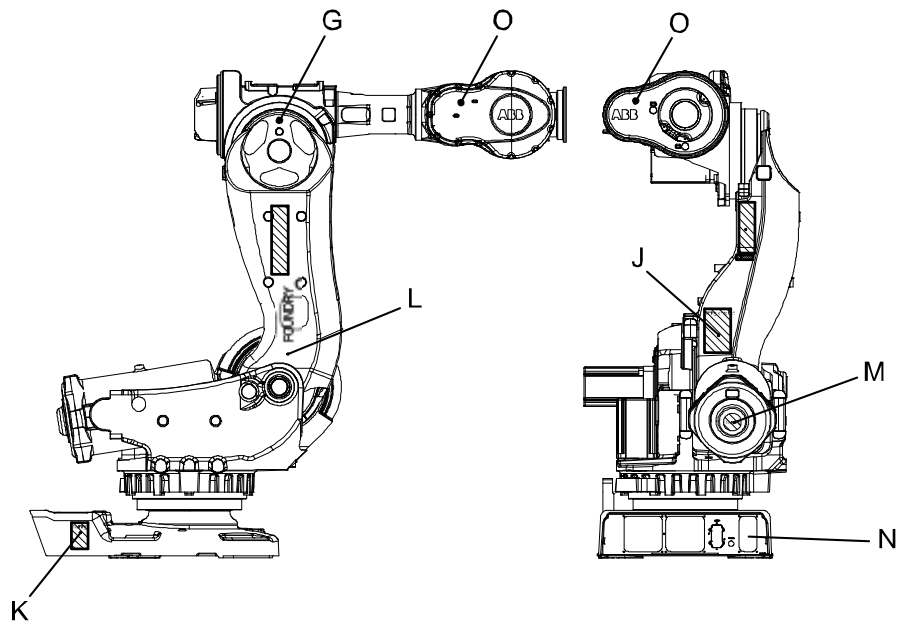
A	Warning label concerning high temperature
B	Warning sign, symbol of a lightning flash (located on motor cover)
C	Instruction label
D	Warning label concerning brake release
E	Warning label, tools are not allowed around the balancing device during operation
F	Warning label concerning shutting off power
G	Label, type of oil in gearbox
H	Label, type of oil in gearbox
I	Label, type of grease in ear
-	Information labels at gearboxes and at robot base, specifying which oil is used in gearboxes

Continues on next page

## 3 Maintenance

### 3.3.13 Inspecting the information labels

Continued




xx0200000101

J	Instruction label concerning lifting the robot
K	Warning label concerning risk of tipping
L	Foundry logotype
M	Warning label concerning stored energy
N	Information label, specifying with type of oil is used in gearboxes of each axis
O	Label, type of oil in gearbox

#### Required tools and equipment

Visual inspection, no tools are required.

#### Inspecting, labels

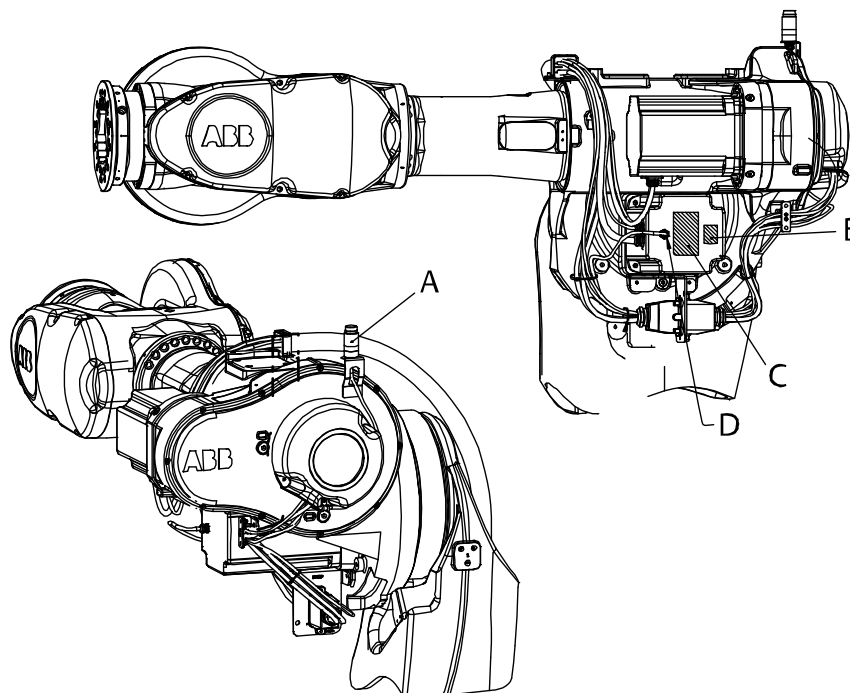
	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the safeguarded space.	
2	Inspect the labels, located as shown in the figures.	
3	Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in <a href="#">Spare part lists on page 427</a> .



### 3.3.14 Inspecting the UL lamp

#### Location of UL-lamp

The UL-lamp is located as shown in figure below. Notice that the location can vary depending on how the customer harness for axes 4-6 is mounted.



xx020000117

A	UL signal lamp
B	Warning sign
C	Warning label
D	Position for cable gland

#### Required equipment

Equipment, etc.	Spare part no.	Note
Signal lamp	3HAC10830-1	To be replaced in case of detected damage. Includes UL signal lamp, 3HAC 13097-1, Warning label, 3HAC 4431-1, Warning sign, 3HAC 1589-1
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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

---

#### 3.3.14 Inspecting the UL lamp

*Continued*

---

#### Inspection, UL-lamp

The procedure below details how to inspect the function of the UL-lamp.

	Action	Note
1	Check that the UL-lamp is lit, when the motors are in operation ("motors ON").	
2	If the lamp is not lit, trace the fault! <ul style="list-style-type: none"><li>• Check whether the <i>UL-lamp</i> is broken. If so, replace it.</li><li>• Check the cable connections.</li><li>• Measure the voltage in connectors motor axis 3 (=24V).</li><li>• Check the cabling. Replace cabling if a fault is detected.</li></ul>	Part no. is specified in <a href="#">Required equipment on page 161!</a>

## 3.4 Changing/replacement activities

### 3.4.1 Type of lubrication in gearboxes

#### Introduction

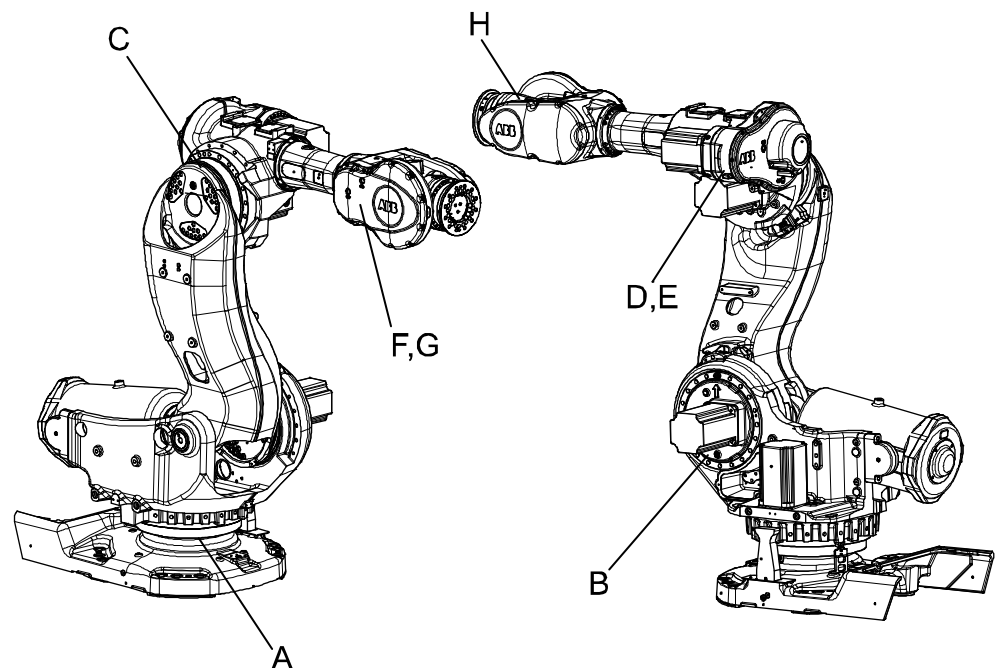
This section describes where to find information about the type of lubrication, article number and the amount of lubrication in the specific gearbox. It also describes the equipment needed when working with lubrication.

#### Type and amount of oil in gearboxes

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

#### Location of gearboxes

The figure shows the location of the gearboxes.



xx0400000798

A	Axis 1 gearbox
B	Axis 2 gearbox
C	Axis 3 gearbox
D	Axis 4 primary gearbox
E	Axis 4 secondary gearbox
F	Axis 5 primary gearbox
G	Axis 5 secondary gearbox
H	Axis 6 gearbox

*Continues on next page*

### 3 Maintenance

---

#### 3.4.1 Type of lubrication in gearboxes

*Continued*

---

#### Equipment

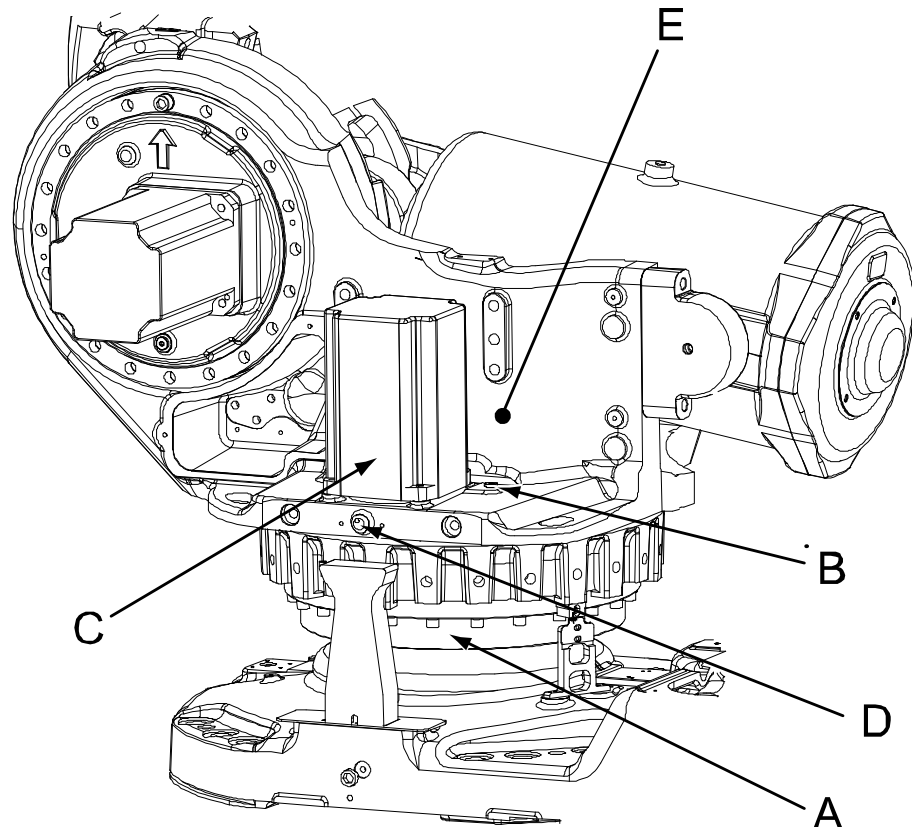
Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: <ul style="list-style-type: none"><li>• Orion OriCan article number 22590 (pneumatic)</li></ul>
Nipple for quick connect fitting, with o-ring	

### 3.4.2 Changing oil, axis-1 gearbox

#### Location of gearbox

The axis 1 gearbox is located between the frame and base as shown in the figure below.

The oil is drained with a hose that may be reached behind the rear cover of the robot base.



xx020000111

A	Gearbox, axis 1
B	Oil plug, filling
C	Motor, axis 1
D	Oil plug, inspection (not in all designs)
E	Label, specifies the type of oil in the gearbox

*Continues on next page*

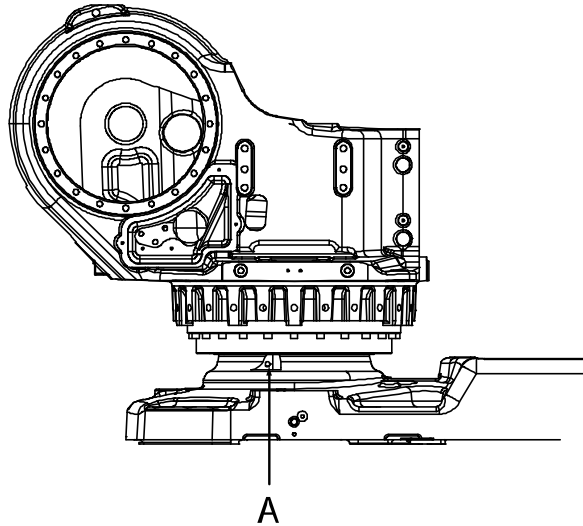
### 3 Maintenance

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

*Continued*

#### Oil plug in the base

In some early versions of the robot, the oil plug for draining may be located in the base, as shown in the figure below.



xx030000065

A	Oil plug in the base
---	----------------------

#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	See <i>Type and amount of oil in gearboxes on page 163.</i>	
Oil collecting vessel			Capacity: 8,000 ml.
Oil exchange equipment	3HAC17313-1		Content is defined in section <i>Special tools on page 422.</i>
Standard toolkit	-		Content is defined in section <i>Standard tools on page 421.</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.



#### Note





The specified amount of oil is based on the total volume of the gearbox. When changing the oil, the amount of refilled oil may differ from the specified amount, depending on how much oil has previously been drained from the gearbox.

*Continues on next page*

#### Draining, oil, gearbox axis 1

The procedure below details how to drain the oil from the gearbox axis 1.

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 166](#).

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	Remove the rear cover on the base by unscrewing its attachment screws.	
4	Pull the oil hose out of the rear of the base. Some early versions of the robot has the oil draining plug in the base as shown in the figure <a href="#">Oil plug in the base on page 166</a> instead of the hose.	
5	Place an oil vessel close to the hose end.	Vessel capacity specified in <a href="#">Required equipment on page 166</a> .
6	Remove the oil plug, filling, in order to drain the oil quicker!	
7	Open the hose end and drain the oil into the vessel.  <b>CAUTION</b> Drain as much oil as possible.	 <b>Note</b> The draining is time-consuming. Elapsed time depends on the temperature of the oil.
8	Close the oil drain hose, and put it back inside the base.	
9	Close the rear cover by securing it with its attachment screws.	

Continues on next page

## 3 Maintenance




### 3.4.2 Changing oil, axis-1 gearbox

Continued

#### Filling, oil, gearbox axis 1

The procedure below details how to fill oil in gearbox, axis 1.

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 166](#).

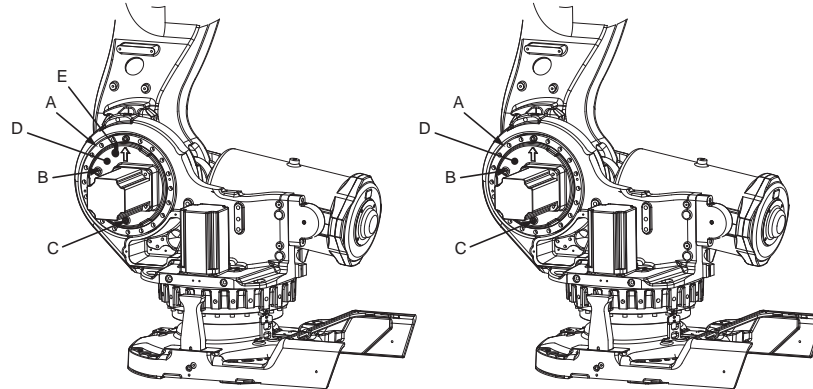
	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
3	Open the <i>oil plug, filling</i> .	Shown in the figure <a href="#">Location of gearbox on page 165</a> .
4	Refill the gearbox with <i>lubricating oil</i> . The amount of oil to be refilled depends on the amount previously being drained. The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-1 gearbox on page 126</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> .
5	 <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <a href="#">Technical reference manual - Lubrication in gearboxes</a> .	
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.



xx020000112

A	Gearbox, axis 2
B	Oil plug, filling/inspection (later design)
C	Oil plug, draining
D	Label, specifies the type of oil in the gearbox
E	Oil plug, ventilation (later design)

The early design of the gearbox cover is shown in [Oil plug, early design on page 129](#).

#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 163</a> .	See <a href="#">Type and amount of oil in gearboxes on page 163</a> .	<b>Note!</b> Do not mix with other oil types!
Oil collecting vessel	-		Capacity: 5,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 422</a> .
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 421</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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
3	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.	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.
4	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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	

Continues on next page

	Action	Note
3	Remove the <i>oil plug for filling</i> and the plug from the <i>vent hole</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 129</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> .
5	 <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> .	
6	Refit the oil plug.	Tightening torque: 24 Nm.

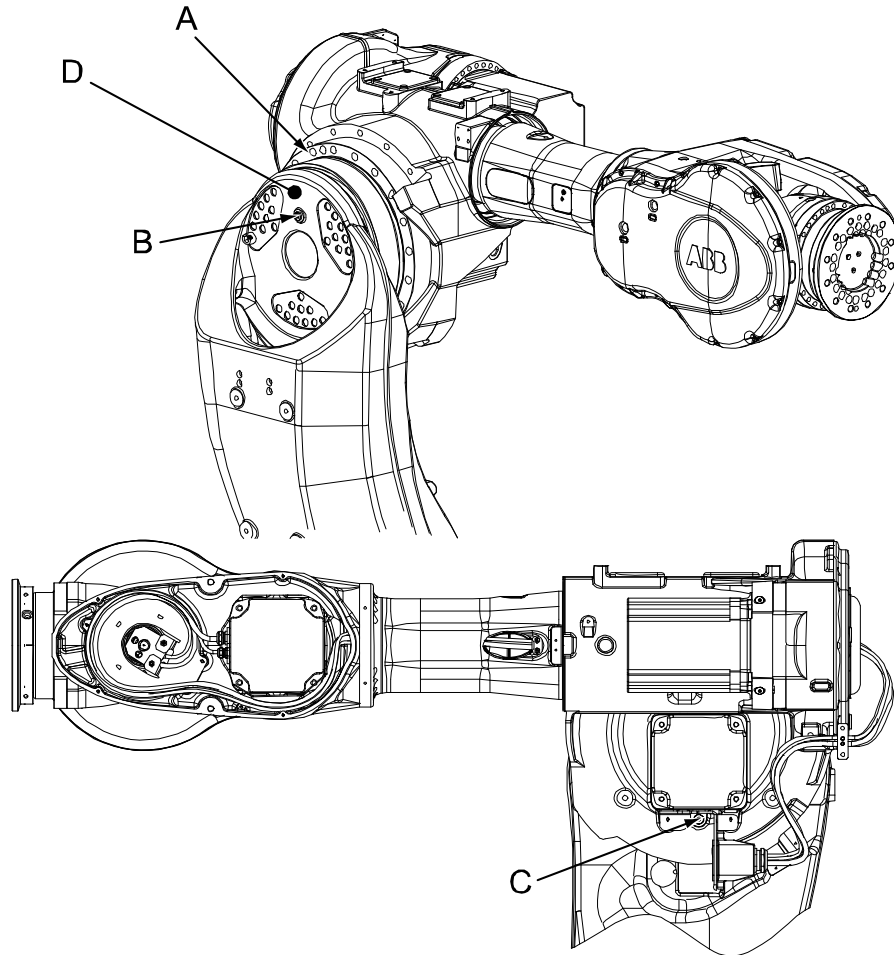
## 3 Maintenance

### 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.



xx0200000113

A	Gearbox, axis 3
B	Oil plug, filling
C	Oil plug, draining
D	Label, specifies the type of oil in gearbox

#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	See <i>Type and amount of oil in gearboxes on page 163.</i>	<b>Note!</b> Do not mix with other oil types!





*Continues on next page*

Equipment, etc.	Art. no.	Amount	Note
Oil exchange equipment	3HAC021745-001		Content is defined in section <a href="#">Special tools on page 422</a> .
Oil collecting vessel	-		Capacity: 5,000 ml.
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 421</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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</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.	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><li>• air pressure supply to the robot</li></ul> Before entering the robot working area.	
2	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</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 132</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> .
5	 <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> .	
6	 <b>Note</b> Do not mix Kyodo Yushi TMO 150 with other oil types!	
7	Refit the oil plug.	Tightening torque: 24 Nm.

### 3.4.5 Changing oil, axis-4 gearbox

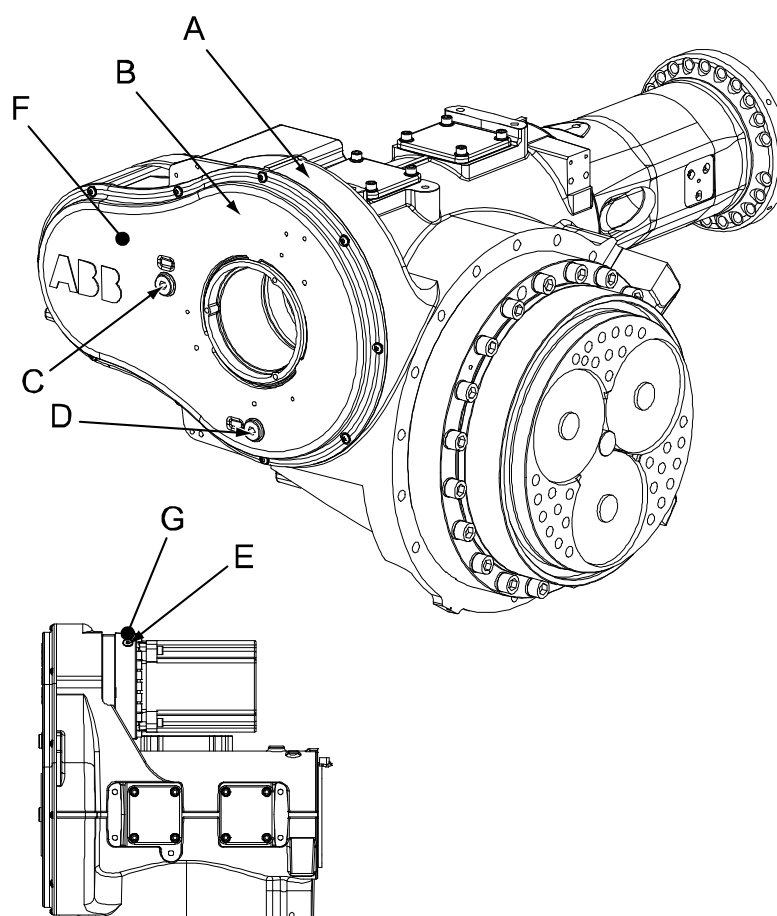
#### Different types of oil

The primary and secondary gear may require different types of oil, that must never be mixed!

If they are mixed, the gear must be rinsed according to section [Flushing a contaminated gearbox on page 192](#).

#### Location of gearbox

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



xx020000107

A	Upper arm housing
B	Cover, axis 4 gearbox
C	Oil plug, filling, secondary gear
D	Oil plug, draining, secondary gear
E	Oil plug, filling, primary gearbox (draining not shown in figure, located further down on the motor flange)
F	Label, specifies the type of oil in the secondary gear
G	Label, specifies the type of oil in the primary gear

*Continues on next page*

### 3 Maintenance

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

Continued




#### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	See <i>Type and amount of oil in gearboxes on page 163.</i>	
Oil collecting vessel, primary gearbox			Capacity: 1,000 ml.
Oil collecting vessel, secondary gearbox			Capacity: 4,000 ml.
Oil exchange equipment	3HAC17313-1		Content is defined in section <i>Special tools on page 422.</i>
Standard toolkit	-		Content is defined in section <i>Standard tools on page 421.</i>

#### Draining, oil, gearbox axis 4

The procedure below details how to drain the oil from 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 176.*

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <i>Gearbox lubricants (oil or grease) on page 38.</i>	
2	Open the <i>oil plug, draining, secondary gear.</i>	Shown in the figure <i>Location of gearbox on page 175.</i>
3	Drain the oil from the secondary gearbox by running the upper arm -45° from calibration position.	Vessel capacity specified in <i>Required equipment on page 176.</i>
4	Run the robot back to its calibration position.	Detailed in section <i>Synchronization marks and synchronization position for axes on page 378.</i>
5	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
6	Drain the primary gear by opening the oil plug, draining, primary gearbox.   <b>CAUTION</b> Drain as much oil as possible.	Vessel capacity specified in <i>Required equipment on page 176.</i>

Continues on next page






	Action	Note
7	Refit the both oil plugs, draining.	Tightening torque: 24 Nm.

#### Filling, oil, gearbox axis 4

The procedure below details how to fill oil in 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 176](#).

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	Refill the secondary gear with <i>lubricating oil</i> through the <i>oil plug, filling, secondary gear</i> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> . Shown in the figure <a href="#">Location of gearbox on page 175</a> .
4	Refill the primary gearbox with oil through the <i>oil plug, filling, primary gear</i> . Make sure the air is ventilated through the oil plug during filling, to avoid overpressure in the gearbox. The amount of oil to be refilled depends on the amount previously being drained. The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-4 gearbox on page 135</a> .	Kyodo Yushi TMO 150 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 163</a> .
5	 <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> .	
6	Refit the both oil plugs, filling.	Shown in the figure <a href="#">Location of gearbox on page 175</a> . Tightening torque: 24 Nm.

### 3 Maintenance

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

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

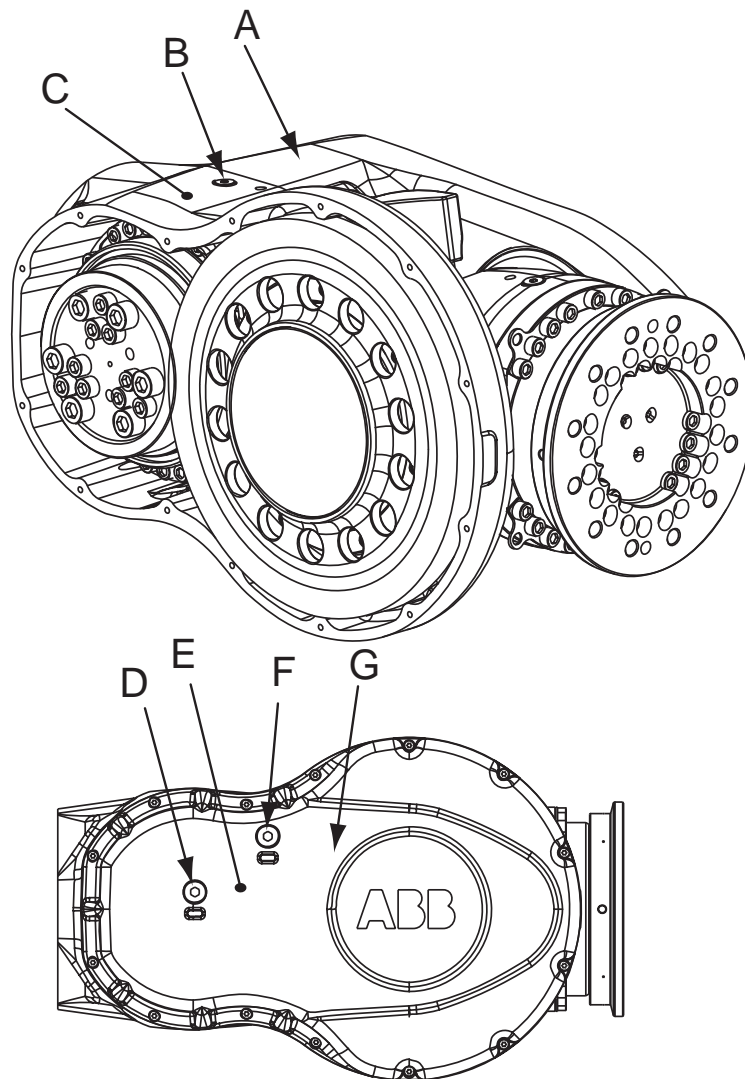
##### Different types of oil

The primary and secondary gear may require different types of oil, that must never be mixed!

If they are mixed, the gear must be rinsed according to section [Flushing a contaminated gearbox on page 192](#).

##### Location of gearbox

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



xx020000108

A	Wrist housing
B	Oil plug, filling/inspection, primary gearbox The oil plug for draining of the primary gearbox is on the opposite side of the wrist housing, not shown in the figure.
C	Label, specifies the type of oil in the axis-5 primary gearbox

*Continues on next page*

D	Oil plug, draining/inspection, secondary gearbox
E	Label, specifies the type of oil in the axis-5 secondary gearbox
F	Oil plug, filling, secondary gearbox
G	Cover, axis-5 gearbox

#### Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See <a href="#">Type and amount of oil in gearboxes on page 163</a> .	
Oil collecting vessel		Capacity: 1 liter
Oil collecting vessel		Capacity: 4 liters
Oil exchange equipment	3HAC17313-1	Content is defined in section <a href="#">Special tools on page 422</a> .
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .



#### Note

The specified amount of oil is based on the total volume of the gearbox. When changing the oil, the amount of refilled oil may differ from the specified amount, depending on how much oil has previously been drained from the gearbox.

#### Draining oil, axis-5 gearbox

The procedure below details how to drain the oil from the 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 179](#).


	Action	Note
1	<b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	<b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	Open the <i>oil plug, draining, primary gearbox</i> .	
4	Drain the oil from the primary gearbox.	Vessel capacity: 1 liter
5	Run axis 4 to a position +90° from the calibration position.	

*Continues on next page*

### 3 Maintenance

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




Continued

	Action	Note
6	Open the <i>oil plug, draining/inspection, secondary gearbox</i> .	Shown in the figure <a href="#">Location of gearbox on page 178</a> .
7	Drain the oil from the secondary gear.  <b>CAUTION</b> Drain as much oil as possible.	Vessel capacity: 4 liters
8	Refit the oil plugs.	Shown in the figure <a href="#">Location of gearbox on page 178</a> . Tightening torque: 24 Nm.

#### Filling oil, axis-5 gearbox

The procedure below details how to fill 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 179](#).

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	Refill the primary gearbox with <i>lubricating oil</i> through the <i>oil plug, filling</i> . Make sure the air is ventilated through the oil plug during filling, to avoid overpressure in the gearbox. The amount of oil to be refilled depends on the amount previously being drained. The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-5 gearbox on page 138</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> . Shown in the figure <a href="#">Location of gearbox on page 178</a> .
4	Refill the secondary gearbox with <i>lubricating oil</i> through the <i>oil plug, filling</i> . The amount of oil to be refilled depends on the amount previously being drained. The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-5 gearbox on page 138</a> .	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> . Shown in the figure <a href="#">Location of gearbox on page 178</a> .
5	 <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <a href="#">Technical reference manual - Lubrication in gearboxes</a> .	

Continues on next page

	Action	Note
6	Refit the oil plugs.	Shown in the figure <a href="#">Location of gearbox on page 178</a> . Tightening torque: 24 Nm.

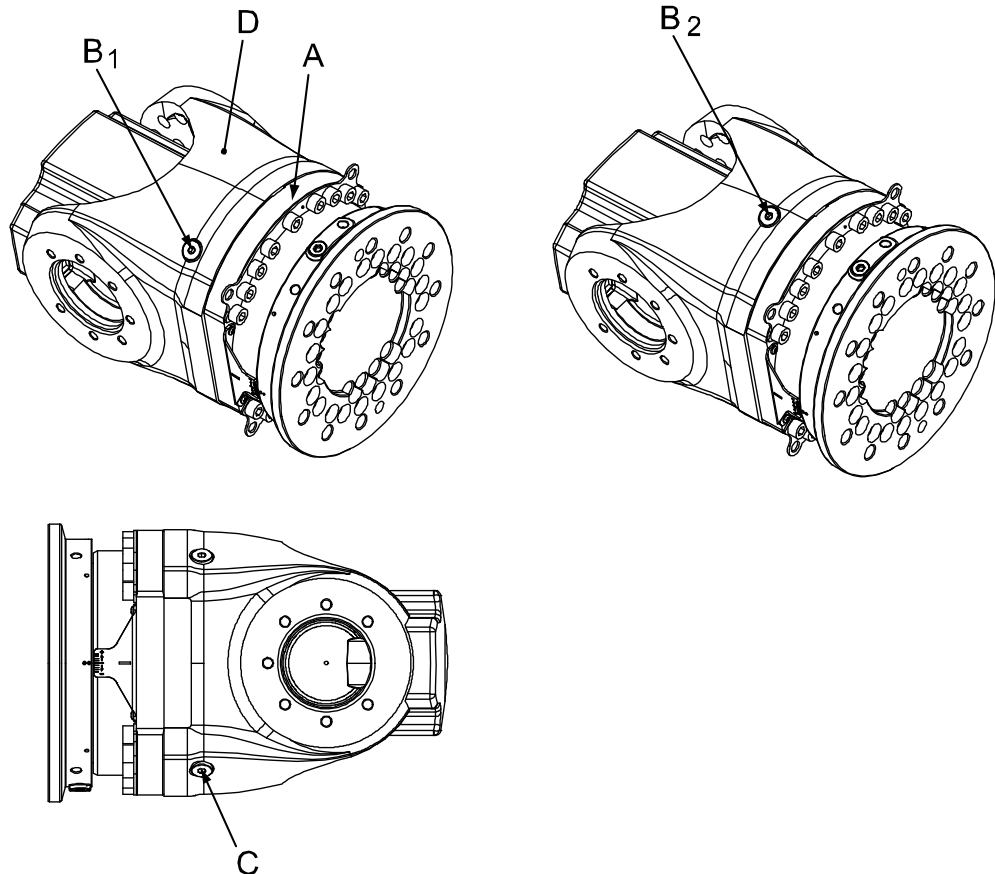
### 3 Maintenance

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

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

##### Location of gearbox

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



xx020000114

A	Gearbox, axis 6
B	Oil plug, filling/inspection (notice the different locations of the plug, shown as B <sub>1</sub> and B <sub>2</sub> )
C	Oil plug, draining (can be located on the turning disk instead)
D	Label, specifies the type of oil in gearbox axis 6

##### Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See <i>Type and amount of oil in gearboxes on page 163.</i>	See <i>Type and amount of oil in gearboxes on page 163.</i>	
Oil collecting vessel			Vessel capacity: 1,000 ml.
Oil exchange equipment	3HAC17313-1		Content is defined in section <i>Special tools on page 422.</i>

*Continues on next page*

Equipment, etc.	Art. no.	Amount	Note
Standard toolkit	-		Content is defined in section <a href="#">Standard tools on page 421</a> .



#### Note

The specified amount of oil is based on the total volume of the gearbox. When changing the oil, the amount of refilled oil may differ from the specified amount, depending on how much oil has previously been drained from the gearbox.

#### Draining oil, gearbox axis 6

The procedure below details how to drain the oil in 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 182](#).

	Action	Note
1	<p><b>WARNING</b></p> <p>Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a>.</p>	
2	<p>Move the wrist so that the <i>oil plug, draining</i> of axis 6 gearbox faces downwards.</p> <p>If the <i>oil plug, draining</i> is located on the turning disc, rotate the disc so that the plug faces downwards.</p>	Shown in the figure <a href="#">Location of gearbox on page 182</a> !
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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>	
4	<p>Drain the oil from gearbox 6 by removing the oil plug. Collect the oil with a suitable vessel.</p> <p><b>CAUTION</b></p> <p>Drain as much oil as possible.</p>	Vessel capacity: 1000 ml.
	Measure the amount of oil drained.	The amount of oil to be refilled depends on the amount previously being drained. The correct oil level is detailed in section <a href="#">Inspecting the oil level in axis-6 gearbox on page 141</a> .

*Continues on next page*

### 3 Maintenance




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

Continued

#### Filling oil, gearbox axis 6

The procedure below details how to fill oil in 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 182](#).

	Action	Note
1	 <b>WARNING</b> Handling gearbox oil involves several safety risks, see <a href="#">Gearbox lubricants (oil or grease) on page 38</a> .	
2	Run the robot to a position where the <i>oil plug, filling (B1 or B2)</i> of axis 6 gearbox, is facing upwards. If the oil plug for draining is located on the turning disk, rotate the disk so that the oil plug faces upwards.	
3	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
4	Remove the <i>oil plug, filling</i> .	Shown in the figure <a href="#">Location of gearbox on page 182</a> .
5	Refill the wrist with <i>lubricating oil</i> . Make sure the air is ventilated through the oil plug during filling, to avoid overpressure in the gearbox. If the plug hole for draining is located on the turning disk, the air is ventilated through the open plug hole.	Where to find type of oil and total amount is detailed in <a href="#">Type and amount of oil in gearboxes on page 163</a> .
6	 <b>WARNING</b> Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <a href="#">Technical reference manual - Lubrication in gearboxes</a> .	
7	Refit both oil plugs.	Tightening torque: 20 Nm.



#### 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 the operating manual for the robot controller for instructions.



#### WARNING

See [Hazards related to batteries on page 40](#).

*Continues on next page*

### 3 Maintenance

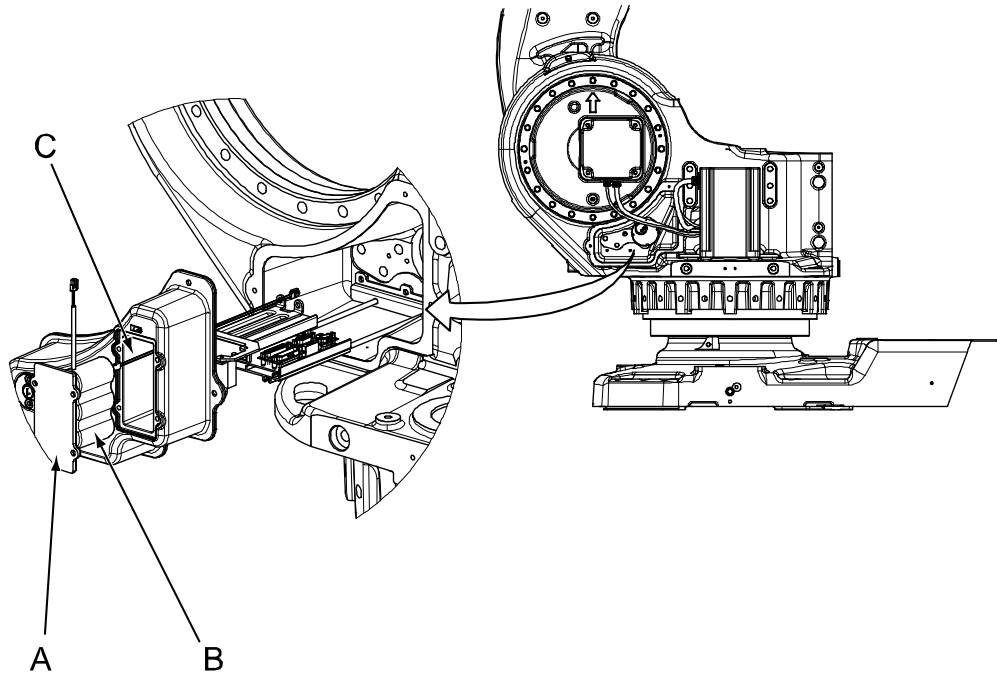
#### 3.4.8 Replacing the SMB battery

*Continued*

##### 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)

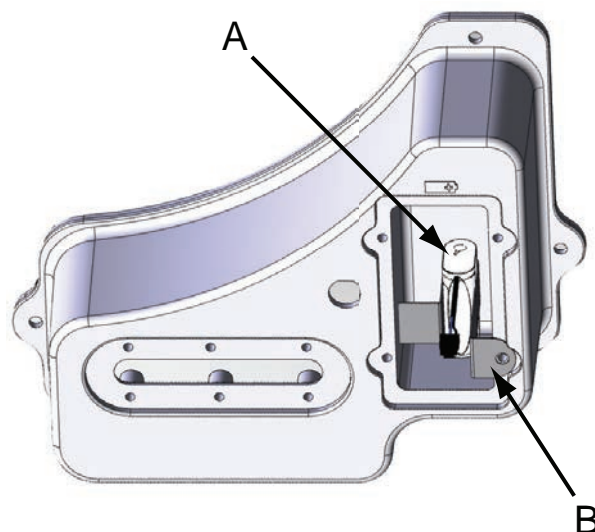


xx0200000238

A	SMB battery cover
B	SMB battery pack with 2-pole battery contact.
C	Battery cable

*Continues on next page*

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



xx130000308

- A Battery pack RMU
- B Battery holder

#### 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: <ul style="list-style-type: none"> <li>• <a href="#">Spare part lists on page 427</a></li> </ul>	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 421</a> .
Circuit diagram	-	See chapter <a href="#">Circuit diagram on page 429</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.

Continues on next page

## 3 Maintenance



### 3.4.8 Replacing the SMB battery

Continued


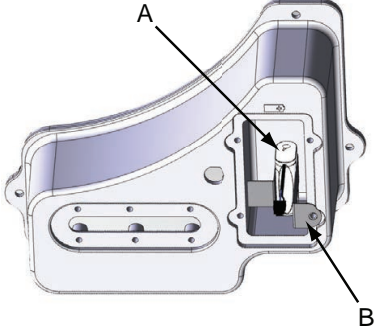

	Action	Note
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the safeguarded space.	
3	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit please read the safety information in the section <a href="#">The unit is sensitive to ESD on page 62</a>	
4	Remove the <i>SMB battery cover</i> by unscrewing the attachment screws.  <b>CAUTION</b> Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	Shown in figure <a href="#">Location of SMB battery on page 186</a> .
5	Pull out the battery and disconnect the <i>battery cable</i> .	Shown in figure <a href="#">Location of SMB battery on page 186</a> .
6	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 186</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> <li>• air pressure supply</li> </ul> to the robot, before entering the safeguarded space.	
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="#">The unit is sensitive to ESD on page 62</a>	

Continues on next page

	Action	Note
3	<p>Reconnect the <i>battery cable</i> and install the battery pack into the SMB/battery recess.</p> <p> <b>Note</b></p> <p>RMU batteries are installed together with a battery holder to be properly secured inside the recess. See figure.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 187</a>. Shown in figure <a href="#">Location of SMB battery on page 186</a>.</p>  <p>xx1300000308</p> <p>A Battery pack RMU B Battery holder</p>
4	Secure the <i>SMB battery cover</i> with its attachment screws.	Shown in figure <a href="#">Location of SMB battery on page 186</a> .
5	Update the revolution counters.	Detailed in chapter Calibration - section <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .
6	<p> <b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

### 3 Maintenance

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

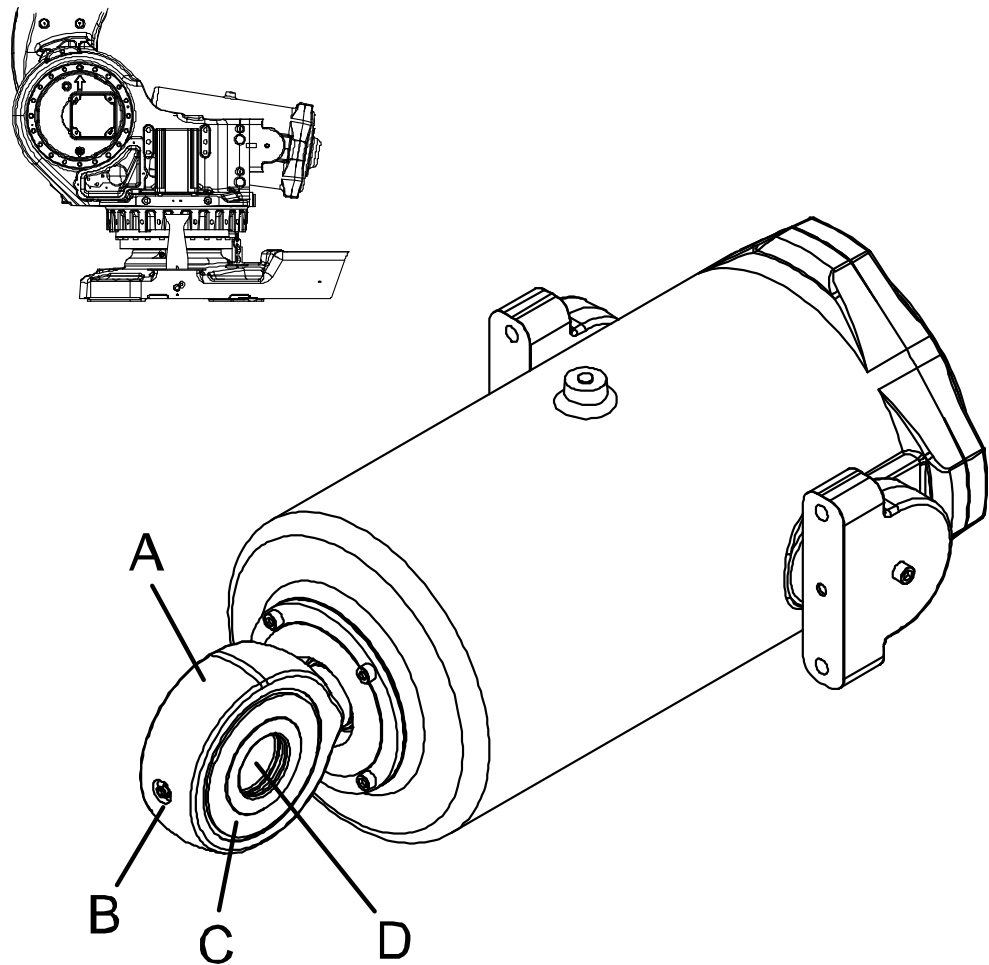
### 3.5 Lubrication activities

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

##### Location of bearing

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!



xx020000109

A	Ear (spherical roller bearing located inside)
B	Securing screw
C	Sealing spacer
D	Hole through which the shaft is pressed

##### Required equipment


Equipment, etc.	Art. no.	Note
Grease	3HAC042534-001	Tribol GR 100-0-PD, 150 ml

*Continues on next page*

Equipment, etc.	Art. no.	Note
Lubrication nipple		M6.
Grease pump	-	

#### Lubrication, balancing device bearing

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

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the safeguarded space.	
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> , approximately 5 grams.	Art. no. and amount is specified in <a href="#">Required equipment on page 190!</a> Shown in the figure <a href="#">Location of bearing on page 190!</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.	M6x10, 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 on page 147.</a>

## 3 Maintenance

---

### 3.6.1 Flushing a contaminated gearbox

## 3.6 Cleaning activities

### 3.6.1 Flushing a contaminated gearbox

---

#### Different types of oil

As the Shell Tivela S 150 is not compatible with mineral oil, contamination with other types of oils used in the gearboxes is not accepted. Equipment used in handling of Tivela S 150 must be carefully cleaned.

This section details how to flush the primary gears of axis 4 and 5, and the gearbox of axis 6 in case of contamination with other type of oil.

---

#### Required equipment

Equipment	Art. no.	Note
Lubricating oil	3HAC032140-001	Kyodo Yushi TMO 150 Amount: 700 ml for each gearbox and flush. Three flushes required.
Oil collecting vessel	-	
Syringe + plastic hose	-	D <sub>inside</sub> =4 mm, L= 400 mm.
Standard toolkit	3HAC15571-1	Content is defined in section <a href="#">Standard tools on page 421</a> .

---

#### Service program

Create a program with motions on axis 3, 4, 5 and 6. There is no need to remove the tool and equipment installed on the robot if the Service program can be created and is possible to run.

##### Recommended motion

- axis 3:  $\pm 15$  degrees
  - axis 4-6: maximum working range with regard to the installation (limitation: axis 4 and 5:  $\pm 90$  degrees, axis 6:  $\pm 180$  degrees).
- 

#### Draining the gearbox properly

The contaminated gearbox must be drained properly before and during the flushing procedure:

- Axis 4 gearbox: open both oil plugs (filling and draining) and run axis 3 in different directions. Draw out the last volume (approx. 40 –60 ml) by using a syringe with a prepared hose end.
  - Axis 5 gearbox: open both oil plugs (filling and draining) and run axis 4 back and forward until the oil draining has stopped.
  - Axis 6 gearbox: open both oil plugs (filling and draining) and run axis 5 and 6 in different directions until the oil draining has stopped.
- 

*Continues on next page*



#### Flushing

The procedure below details how to flush a contaminated gearbox. The procedure is the same for all gearboxes.

	Action	Note
1	Run the Service program until the castings of the gearboxes axis 4, 5 and 6 have reached a temperature of about 30-35° C. Use the finger tips to measure the temperature.	Recommended service program described in section <a href="#">Service program on page 192</a> .
2	Drain the gearbox properly.	Described in section above: <a href="#">Draining the gearbox properly on page 192</a> .
3	Fill the gearbox with 700 ml of <i>lubricating oil</i> .	Kyodo Yushi TMO 150 Art. no . is specified in <a href="#">Required equipment on page 192</a> .
4	Refit the oil plug.	Tightening torque: 24 Nm.
5	Run the Service program at low speed (25%) during 10 minutes.	
6	Drain the gearbox properly.	
7	Repeat the steps above until the gearbox is flushed three times.	

## 3 Maintenance

---

### 3.6.2 Cleaning the IRB 7600

### 3.6.2 Cleaning the IRB 7600



#### DANGER

Turn off all:

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

to the robot, before entering the safeguarded space.

---

#### General

To secure high uptime it is important that the IRB 7600 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works. Different cleaning methods are allowed depending on the type of protection of the IRB 7600.



#### 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 124](#).
- 2 Write down the oil level.
- 3 Inspect the oil level again after, for example, 6 months.
- 4 If the oil level is decreased then replace the gearbox.

---

#### Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

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

*Continues on next page*

**Cleaning methods**

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

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

<sup>i</sup> Perform according to section [Cleaning with water and steam on page 195](#).

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

**Cables**

Movable cables need to be able to move freely:

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

<sup>1</sup> See [Cleaning methods on page 195](#) for exceptions.

<sup>2</sup> See [Cleaning methods on page 195](#) for exceptions.

Continues on next page

### 3 Maintenance

---

#### 3.6.2 Cleaning the IRB 7600

*Continued*

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

---

#### Cooling fans

Inspect the air supply inlet of the the motor cooling fans. Clean to remove any contamination that could hinder the air supply.

## 3.7 Service Information System, M2000

### 3.7.1 Using the SIS system

#### General

This is a brief description of how to use the Service Information System, SIS for M2000 robot systems. Details may be found in:

- Service Information System, SIS
- Defining the SIS input parameters
- Setting the SIS parameters
- Importing/exporting SIS data
- Reading the SIS output logs

The section is only valid for M2000 systems. For information regarding M2004 robot systems, see additional documentation, *Operating manual - Service Information System*. Article number is specified in section [References on page 10](#).

#### Basic procedure

	Action	Reference
1	Determine which of the system functions you require.	These are described in <a href="#">Description of Service Information System (SIS) on page 198</a> .
2	Define what values are adequate and suitable for your application in your production environment.	Recommendations on how to define these are given in <a href="#">SIS system parameters on page 201</a> .
3	Enter these parameters in the system.	How to do this is detailed in <a href="#">Setting the SIS parameters on page 202</a> .
4	Run the robot in normal operation.	
5	Reset the counter if a repair is made, or if a counter for any other reason is restarted.	The TPU displays for resetting any SIS value are shown in <a href="#">Description of Service Information System (SIS) on page 198</a> .
6	When a time limit, set in the parameters, is exceeded, a message may be read on the Tech Pendant Unit (TPU).	How to access this is detailed in <a href="#">Reading the SIS output logs on page 203</a> .
7	If the log containing the message is to be available from an external PC, or if the SIS parameters are to be entered from an external PC, a set of software tools are available to build such an application.	These are described in <a href="#">Exporting the SIS data on page 204</a> .

## 3 Maintenance

---

### 3.7.2 Description of Service Information System (SIS)

### 3.7.2 Description of Service Information System (SIS)

---

#### General

Service Information System (SIS) is a software function within the robot controller, which simplifies maintenance of the robot system. It supervises the operating time and mode of the robot, and alerts the operator when a maintenance activity is scheduled.

Maintenance is scheduled by setting the system parameters of the type SIS Parameters, see section [Setting the SIS parameters on page 202](#). All system parameters are described in *User's Guide - System Parameters*.

---

#### Supervised functions

The following counters are available:

- Calendar time counter, a general alarm based on calendar time
- Operation time counter, a general alarm based on operational time
- Gearbox 1 operation time counter, based on percentage of the axis 1 gearbox service interval
- Gearbox 2 operation time counter, based on percentage of the axis 2 gearbox service interval
- Gearbox 3 operation time counter, based on percentage of the axis 3 gearbox service interval
- Gearbox 6 operation time counter, based on percentage of the axis 6 gearbox service interval

Counters are reset when maintenance has been performed.

The counter status is displayed after running the service routine for maintenance. Status "OK" indicates that no service interval limit has been exceeded by that counter.

---

#### Calendar time

This is a clock within the control system that keeps track of the service interval, based on calendar time.

When the calendar time limit for maintenance is reached, a message is displayed on the TPU. How to access this is detailed in section [Reading the SIS output logs on page 203](#).

The following information is available about the calendar time in the service routine.

Prev service	Date when the counter was reset last time, i.e. after the last service.
Elapsed time	Elapsed time since the counter was reset the last time.
Next service	Date when next scheduled service is planned. This date is calculated using system parameters, as detailed in section <a href="#">Setting the SIS parameters on page 202</a> .
Remaining time	Remaining time to next scheduled service date.

*Continues on next page*

**Operation time**

This is a function within the control system that keeps track of the amount of time the "MOTORS ON" signal is active, i.e. the amount of time the robot is in the operating mode.

When the operation time limit for maintenance is reached, a message is displayed on the TPU. How to access this is detailed in section [Reading the SIS output logs on page 203](#).

The following information is available about the operation time in the service routine.

Service interval	The specified service interval until another service will be required. This parameter was entered manually as detailed in section <a href="#">Setting the SIS parameters on page 202</a> .
Elapsed time	Operation time since the service interval was set the last time.
Remaining time	Remaining operation time until the time set in service interval has expired.

**Gearbox**

Based on measurements, torque and RPM, for example, the system calculates an expected service interval for each gearbox. When service is due, a message will be shown on the TPU. How to access this is detailed in section [Reading the SIS output logs on page 203](#).

The following information is available about the joint service status in the service routine.

Joint x OK	Service status for axis x, i.e. the automatically calculated time parameter has not been exceeded.
Joint x NOK	The service interval for the axis in question has been reached.
Joint x N/A	No service time parameter calculation available. Applies to axes 4 and 5 (IRB 6600 and IRB 7600).

The following information is available for the axis service status in the service routine.

Consumed time	The consumed time as a percentage of the total amount of time.
Elapsed time	Operation time for axis x since calculation began.
Remaining time	Remaining operation time for axis x until the service time parameter value has been reached.

**Reset values**

Counters may be reset at any time by running the service routine.

When resetting, the counter variables are reset. The variables are described in section [Exporting the SIS data on page 204](#)!

**Service interval exceeded**

When the service time has been exceeded for the selection made, an error message (Service interval exceeded!) is displayed.

*Continues on next page*

### 3 Maintenance

---

#### 3.7.2 Description of Service Information System (SIS)

*Continued*

---

#### **No data available**

When no data is available for the selection made, a message (No data available!) is displayed when trying to display the data.



### 3.7.3 SIS system parameters

---

#### General

This section details the system parameters that may be set with estimated values. The values can be defined by the operating organization as knowledge of the robot's working conditions are accumulated.

Since the counters are to be used for purposes defined by the user, ABB cannot give any recommendations regarding their definitions.

---

#### Operation time limit (service level)

The number of operation hours selected as service interval.

E.g. by setting the value "20,000", the SIS will save this as the nominal time for activating the alarm, not counting the percentage described below.

---

#### Operation time warning

A percentage of the "Operation time limit" specified above.

E.g. by setting the value "90", the SIS will alert the operator 18,000 hours after an operation time "Reset" was made the last time.

---

#### Calendar time limit (service level)

The number of calendar years selected as service interval.

E.g. by setting the value "2", the SIS will save this as the nominal time for activating the alarm, not counting the percentage described below.

---

#### Calendar time warning

A percentage of the "Calendar time limit" specified above.

E.g. by setting the value "90", the SIS will alert the operator after 90% of two years, i.e. 657 days after a calendar time "Reset" was made the last time.

---

#### Gearbox warning

A percentage of the gearbox service interval as calculated by the system. E.g. by setting the value "90", the SIS will alert the operator after 90% of the expected service interval of *each* gearbox.

The robot system automatically detects and stores all required variables to calculate the expected service interval (estimated remaining lifetime) of each gearbox. This is done by extrapolating data from earlier operation into a function of time, using a formula including:

- input and output torque
- gearbox spindle speed
- other variables

## 3 Maintenance

---

### 3.7.4 Setting the SIS parameters

#### 3.7.4 Setting the SIS parameters

---

##### General

If the SIS system is to function properly, a number of parameters must be set. This is detailed below.

---

##### Procedure M2000

This is an instruction of how to enter SIS parameters to the M2000 robot system.

	Action	Note
1	Open "System parameters" using the TPU.	Detailed in the User's Guide.
2	Go to "System parameters/Manipulator/types 2".	
3	Select "0 SIS parameters" and press "Enter".	
4	Select the required system The parameter list is displayed.	
5	Select the required parameters by stepping up and down through the parameter list.	Available parameters are described in section <a href="#">SIS system parameters on page 201</a> .

### 3.7.5 Reading the SIS output logs

#### General

Whenever a set condition has expired (e.g. max allowed operation time before service), a message to this effect will be shown in the Operational log.

#### Access to logs

How to open a log and show its contents is detailed in the User's Guide, chapter *Service*.

#### Available messages

The following messages may be shown:

Available in:	SIS message in the log:	Meaning:
Calendar time	Service Message Service is due! X calendar days since last service.	The manually set calendar time limit has expired. How to set the limit is detailed in section <a href="#">Setting the SIS parameters on page 202</a> . Proceed with the required service as detailed in chapter <a href="#">Repair on page 205</a> or chapter <a href="#">Maintenance on page 117</a> depending on which type of service.
Calendar time	Service Message X calendar days to next service.	X number of calendar days remain until the manually set calendar time limit expires. How to set the value determining when the message is to be shown, is detailed in section <a href="#">Setting the SIS parameters on page 202</a> .
Operation time	Service Message Service is due! X production hours since last service.	The manually set operation time limit has expired. How to set the limit is detailed in section <a href="#">Setting the SIS parameters on page 202</a> . Proceed with the required service as detailed in chapter <a href="#">Repair on page 205</a> or chapter <a href="#">Maintenance on page 117</a> depending on which type of service.
Operation time	Service Message X production hours to next service.	X number of operation hours remain until the manually set operation time limit expires. How to set the value determining when the message is to be shown, is detailed in section <a href="#">Setting the SIS parameters on page 202</a> .
Gearbox time	Service Message Gearbox x requires service!	The automatically calculated gearbox time limit has expired. Proceed with the required service as detailed in chapter <a href="#">Repair on page 205</a> or chapter <a href="#">Maintenance on page 117</a> depending on which type of service.
Gearbox time	Service Message X% of the service interval has expired for gearbox x!	X percent of gearbox hours remain until the automatically calculated gearbox time limit expires. How to set the value determining when the message is to be shown, is detailed in section <a href="#">Setting the SIS parameters on page 202</a> .

## 3 Maintenance

### 3.7.6 Exporting the SIS data

### 3.7.6 Exporting the SIS data

#### General

This section describes the available variables for entering SIS parameters as well as showing any values of exceeded time limits as detected by the SIS counters.

In a M2000 robot system, the values can be read on a PC using "Webware SDK". How to access these variables and how to perform the actual programming sequences are detailed in the robot system User's Guide.

#### Definitions

The table below defines the names and functions of all software variables available for communication between the SIS and an external computer.

Signal	Unit	Counter type	Function
sisRestartDate	seconds	Calendar time	The date on which the supervision was started/reset last time.
sisCalendarT	seconds	Calendar time	The number of hours since start/last reset.
sisTotRunT	seconds	Operation time	Total number of operation hours since the system was started. Corresponds to the operating time counter on the control cabinet.
sisRunT	seconds	Operation time	The number of operation hours since start/last reset of the operation time counter. Corresponds to the operating time counter on the control cabinet.
sisL10h_1	hours	Gearbox time	Estimated life of gearbox axis 1
sisL10h_Time_1	seconds	Gearbox time	Operation time of gearbox axis 1
sisL10h_2	hours	Gearbox time	Estimated life of gearbox axis 2
sisL10h_Time_2	seconds	Gearbox time	Operation time of gearbox axis 2
sisL10h_3	hours	Gearbox time	Estimated life of gearbox axis 3
sisL10h_Time_3	seconds	Gearbox time	Operation time of gearbox axis 3
sisL10h_6	hours	Gearbox time	Estimated life of gearbox axis 6
sisL10h_Time_6	hours	Gearbox time	Operation time of gearbox axis 6

# 4 Repair

## 4.1 Introduction

### Structure of this chapter

This chapter describes repair activities for the IRB 7600. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.



#### WARNING

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

### Report replaced units



#### Note

When replacing a part on the IRB 7600, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

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

### Safety information

Make sure to read through the chapter [Safety on page 23](#) before commencing any service work.



#### Note

If the IRB 7600 is connected to power, always make sure that the IRB 7600 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Panel Mounted Controller*

## 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.

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

#### Required equipment

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

#### Performing a leak-down test

	Action	Note
1	Finish the refitting procedure of the motor or gear in question, but <b>do not</b> refill the gearbox with oil before performing the leak-down test.	
2	Remove the upper oil plug on the gear and replace it with the leak-down tester. Regulators, which are included in the leak-down test, may be required.	
3	Use caution, apply compressed air and raise the pressure with the knob until the correct value is shown on the manometer.  <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	3HAC042536-001	Shell Gadus S2 Used to grease the bearings, if not specified otherwise.

### Assembly of all bearings


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

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

### Assembly of tapered bearings

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

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

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

### Greasing of bearings



#### Note

This instruction is not valid for solid oil bearings.

*Continues on next page*

## 4 Repair

---

### 4.2.2 Mounting instructions for bearings

*Continued*

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

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

Grease the different types of bearings as following description:

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



## 4.2.3 Mounting instructions for sealings

### General

This section describes how to mount different types of sealings.

### Equipment

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

### Rotating sealings

The following procedures describe how to fit rotating sealings.



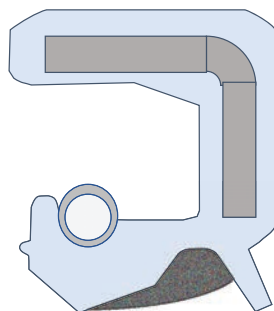
#### CAUTION

Please observe the following before commencing any assembly of sealings:

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

### Radial sealings

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



xx2300000433

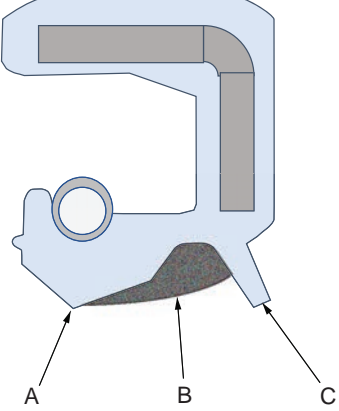
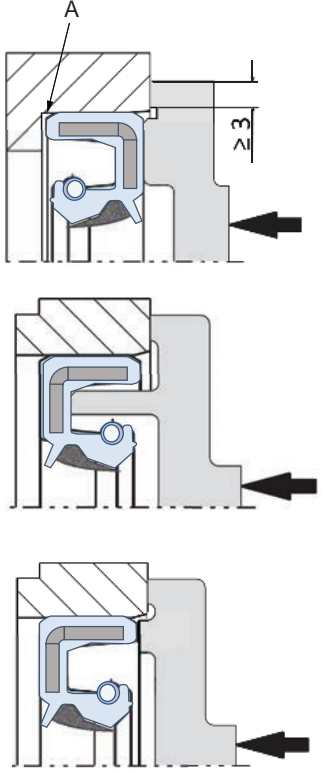
	Action	Note
1	Check the sealing to ensure that: <ul style="list-style-type: none"> <li>• The sealing is of the correct type.</li> <li>• There is no damage on the main lip.</li> </ul>	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may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

*Continues on next page*

## 4 Repair

### 4.2.3 Mounting instructions for sealings

Continued

	Action	Note
3	<p>Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.)</p> <p>Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.</p>	<p>Article number is specified in <a href="#">Equipment on page 209</a>.</p>  <p>xx200000071</p> <p>A Main lip B Grease C Dust lip</p>
4	<p>Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.</p>	 <p>xx200000072</p> <p>A Gap</p>

Continues on next page

**Flange sealings and static sealings**

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

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

**O-rings**

The following procedure describes how to fit o-rings.

	Action	Note
1	Ensure that the correct o-ring size is used.	
2	Check the o-ring for surface defects, burrs, shape accuracy, or deformation.	Defective o-rings, including damaged or deformed o-rings, may not be used.
3	Check the o-ring grooves and mating surfaces. They should be free of pores, contamination and obvious scratches/damage.	
4	Lubricate the o-ring with grease.	
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	

## 4 Repair

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

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

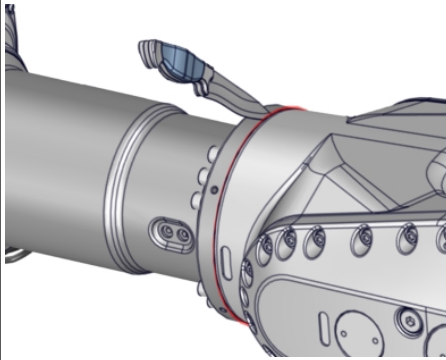
#### General

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

#### Required equipment

Equipment	Spare parts	Note
Cleaning agent		Ethanol
Knife		
Lint free cloth		
Touch up paint Standard/Foundry Plus	3HAC067974-001	Graphite White
Touch up paint Standard/Foundry Plus	3HAC037052-001	ABB Orange

#### Removing

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

## 4.2.5 The brake release buttons may be jammed after service work

## 4.2.5 The brake release buttons may be jammed after service work

## Description

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

**DANGER**

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

## Elimination

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

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

## 4 Repair

### 4.3.1 Replacement of cable harness, axes 1-4

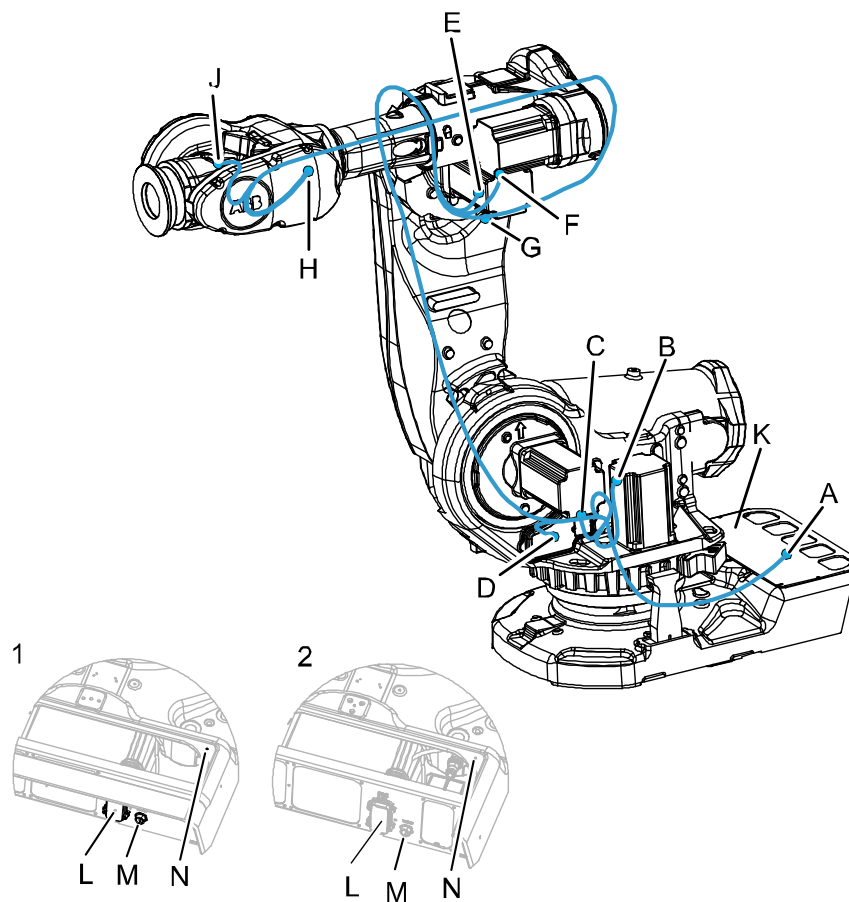
## 4.3 Complete robot

### 4.3.1 Replacement of cable harness, axes 1-4

#### Location of cable harness

The cable harness for axes 1-4 is run throughout the base, frame and lower arm as shown in the figure below.

The brake release unit can be located at two alternative places, either at the rear of the base or at the side of the frame. Depending on the location, the two types of harnesses are distinguished some from each other! Any differences are pointed out in the procedures!



xx0100000140

1	Alternative with brake release at frame
2	Alternative with brake release at base
A	Connector at robot base, R1.MP and R1.SMB
B	Connectors at motor 1; R2.FB1 and R2.MP1
C	Connectors at motor 2; R2.FB2 and R2.MP2
D	Connectors at serial measurement board; R1.SMB1-3, R1.SMB4-6, R1.SMB1.7, R2.FB7 and R2.SMB. Battery connector X3 R1.G and R2.G. If brake release located at the frame: also connectors X8, X9 and X10!

*Continues on next page*

E	Connectors at motor 3; R2.FB3 and R2.MP3 and for signal lamp R2.H1 and R2.H2
F	Connectors at motor 4; R2.FB4 and R2.MP4
G	Connectors at cable harness separation; R2.M5/6
H	Connectors at motor 5; R3.FB5 and R3.MP5
J	Connectors at motor 6; R3.FB6 and R3.MP6
K	Rear cover plate
L	Connector R1.MP
M	Connector R1.SMB
N	Connection of earth cable

### Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Cable harness, axes 1-4	3HAC12782-1		Brake release located at base.
Cable harness, axes 1-4	3HAC14940-1		Brake release located in frame.
Locking liquid			Loctite 243 Used to secure the attachment screws for the attachment plate inside the frame.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</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 diagram on page 429</a> .

### Removal, cable harness, axes 1-4

The procedure below details how to remove the cable harness, axes 1-4.


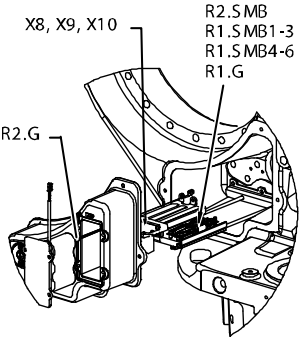
	Action	Note
1	In order to facilitate refitting of cable harness, run the robot to the specified position: <ul style="list-style-type: none"> <li>• Axis 1: 0 °</li> <li>• Axis 2: 0 °</li> <li>• Axis 3: 0 °</li> <li>• Axis 4: 0 °</li> <li>• Axis 5: +90 °</li> <li>• Axis 6: no significance</li> </ul>	Axes 2 and 3 may be tilted slightly to improve access.

Continues on next page

## 4 Repair


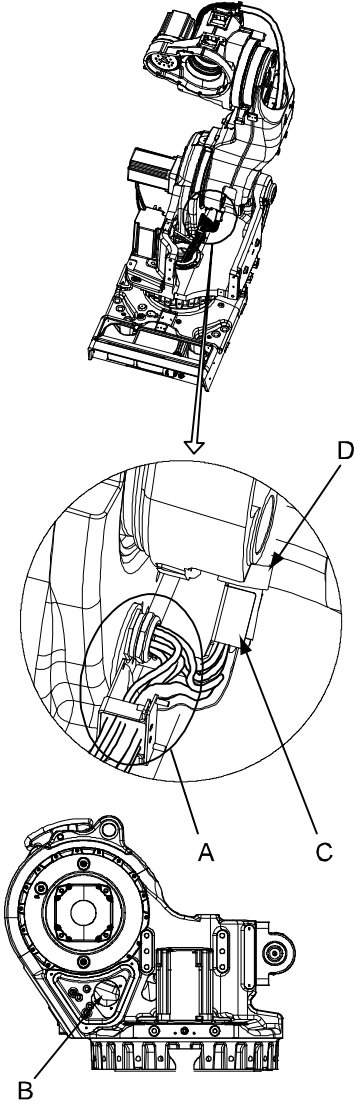
### 4.3.1 Replacement of cable harness, axes 1-4

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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	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 214</a> .
4	Disconnect the <i>earth cable</i> .	Attachment point is shown in the figure <a href="#">Location of cable harness on page 214</a> !
5	Disconnect connectors <i>R1.MP and R1.SMB</i> .	Attachment points are shown in the figure <a href="#">Location of cable harness on page 214</a> .
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.	Specified and shown in the figure <a href="#">Location of cable harness on page 214</a> !
8	Open the SMB cover carefully. The cable between the battery and the SMB-unit may 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! In order to remove the cover completely, the connector R1.G must be disconnected! This causes a necessary updating of the revolution counter!	
9	Disconnect connectors R2.SMB, R1.SMB1-3, R1.SMB4-6 from the SMB unit. Disconnect X8, X9 and X10 if the brake release board is located in frame.	 <p>xx0200000118</p>

Continues on next page



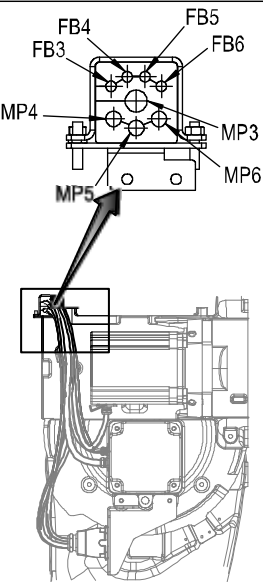
	Action	Note
10	<p>Remove</p> <ul style="list-style-type: none"> <li>the <i>cable gland</i> (A), by removing the four attachment screws from inside the SMB recess (B)</li> <li>the <i>attachment plate</i> (C), by removing the attachment screws and the velcro strap (D).</li> </ul> <p> <b>Note</b></p> <p>Different robot versions are fitted with different versions of the attachment plate. When replacing the cable harness, make sure the correct one is used to avoid cable failure.</p>	 <p>xx0300000560</p> <ul style="list-style-type: none"> <li>A: Cable gland</li> <li>B: Attachment screws, cable gland</li> <li>C: Attachment plate</li> <li>D: Velcro strap</li> </ul>
11	<p>Remove the cable gland securing the cables inside the lower arm.</p>	

Continues on next page

## 4 Repair


### 4.3.1 Replacement of cable harness, axes 1-4

Continued

	Action	Note
12	Remove the cable gland securing the cables to the arm house.	 <p>xx0100000143</p>
13	Remove the <i>velcro strap</i> from the harness at the cable fixing bracket at the arm house.	Shown in the figure <a href="#">Location of cable harness on page 214</a> .
14	Disconnect <i>connector R2.M5/6</i> at the cable division point.	Shown in the figure <a href="#">Location of cable harness on page 214</a> !
15	Disconnect all connectors at motor 3 and motor 4.	Specified and shown in the figure <a href="#">Location of cable harness on page 214</a> !
16	Gently pull the cable harness out.	

### Refitting, cable harness, axes 1-4

The procedure below details how to refit the cable harness, axes 1-4.

	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> <li>• air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	
2	<p>In order to facilitate refitting of cable harness, move the robot to the specified position:</p> <ul style="list-style-type: none"> <li>• Axis 1: 0 degrees</li> <li>• Axis 2: 0 degrees</li> <li>• Axis 3: 0 degrees</li> <li>• Axis 4: 0 degrees</li> <li>• Axis 5: +90 degrees</li> <li>• Axis 6: no significance</li> </ul>	Axes 2 and 3 may be tilted slightly to improve access.

Continues on next page

## 4.3.1 Replacement of cable harness, axes 1-4

*Continued*


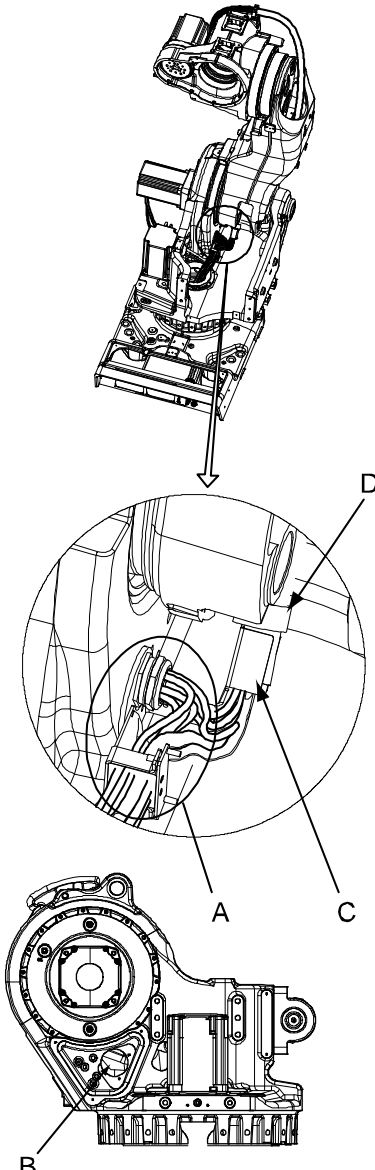
	Action	Note
3	Pull the cable and connectors down through the cable guide in the center of the frame.	Make sure the cables are not twisted with each other or with eventual customer harnesses! Make a note of the correct positions of the connectors!
4	Reconnect connectors <i>R1.MP</i> and <i>R1.SMB</i> at the rear cover plate.	Tightening torque for R1.SMB: 10 Nm. Make a note of the correct positions of the connectors! Attachment point is shown in the figure <a href="#">Location of cable harness on page 214</a> .
5	Reconnect the earth cable.	Attachment point is shown in the figure <a href="#">Location of cable harness on page 214</a> !
6	Refit the <i>rear cover plate</i> to the robot with its attachment screws.	Shown in the figure <a href="#">Location of cable harness on page 214</a> .
7	Reconnect all connectors at motors 1 and 2.	Specified and shown in the figure <a href="#">Location of cable harness on page 214</a> !

*Continues on next page*

## 4 Repair

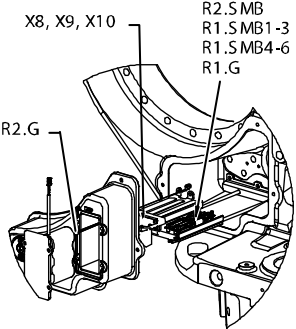

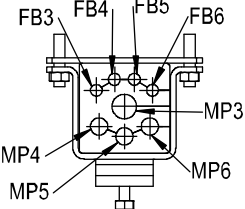
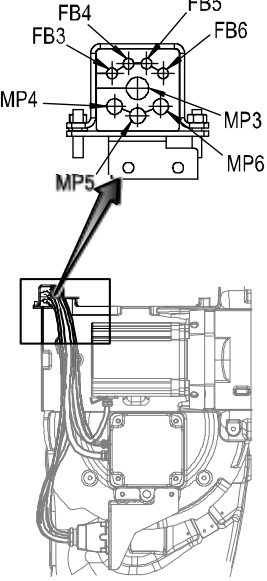
### 4.3.1 Replacement of cable harness, axes 1-4

Continued

	Action	Note
8	<p>Secure the cable gland (A) with four attachment screws (B) from inside the SMB recess.</p> <p>Secure the correct attachment plate (C) to the cable gland with its two attachment screws, using locking liquid.</p> <p>Refit the velcro strap (D).</p> <p> <b>Note</b></p> <p>Different robot versions are fitted with different versions of the attachment plate. Make sure the correct one is used to avoid cable failure.</p>	<p>Locking liquid is specified in <a href="#">Required equipment on page 215</a>.</p>  <p>xx0300000560</p> <ul style="list-style-type: none"><li>• A: Cable gland</li><li>• B: Attachment screws, cable gland</li><li>• C: Attachment plate</li><li>• D: Velcro strap</li></ul>

Continues on next page

4.3.1 Replacement of cable harness, axes 1-4  
Continued

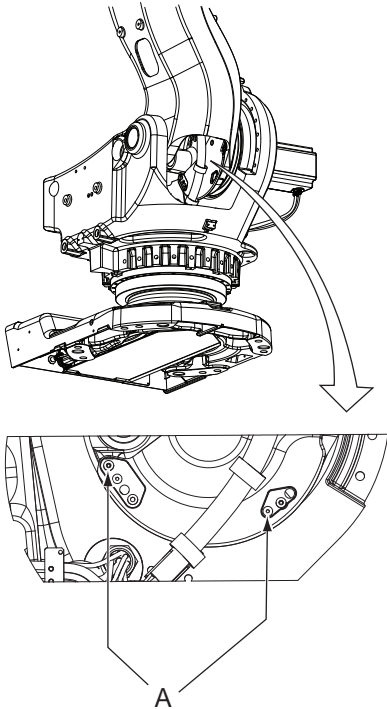
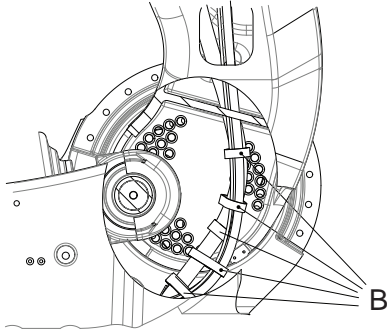
	Action	Note
9	<p>Reconnect connectors R2.SMB, R1.SMB1-3, R1.SMB4-6 to the SMB unit.</p> <p>Reconnect X8, X9 and X10 if the brake release board is located in frame.</p> <p>Reconnect R1.G if it has been disconnected.</p>	 <p>xx0200000118</p>
10	<p>Secure the SMB cover with its attachment screws.</p> <p>If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.</p>	
11	 <p><b>WARNING</b></p> <p>Before continuing any service work, please observe the safety information in section <i>The brake release buttons may be jammed after service work on page 213!</i></p>	
12	<p>Pull the cable harness through the lower arm.</p>	
13	<p>Refit the cable gland securing the cables inside the lower arm.</p>	 <p>xx0100000142</p>
14	<p>Refit the cable gland securing the cables to the arm house.</p> <p>Make sure not to twist the harness!</p>	 <p>xx0100000143</p>

Continues on next page


## 4 Repair

### 4.3.1 Replacement of cable harness, axes 1-4

Continued

	Action	Note
15	Reconnect all connectors at motor 3 and motor 4.	Specified and shown in the figure <a href="#">Location of cable harness on page 214!</a>
16	Reconnect the <i>connector R2.M5/6</i> gently at the cable division point. Be careful not to bend the attachment plate when fastening the screws!	Shown in the figure <a href="#">Location of cable harness on page 214!</a> M6, 2 pcs.
17	Secure the cable harness to the upper arm house by refitting the <i>velcro strap</i> to the cable bracket at the upper arm house.	Shown in the figure <a href="#">Location of cable harness on page 214!</a>
18	Fit a cable protection to the lower arm, if not already mounted, with two securing screws (A), M6x16.	 <p data-bbox="1018 1361 1129 1384">xx0500002320</p>
19	Secure the cable harness with five velcro straps (B), according to the figure. Fix the strap by wrapping it two turns around the largest cable before wrapping around the complete harness.	 <p data-bbox="1018 1749 1129 1771">xx1900001419</p>
20	Refit the cable harness to the <i>guide plate axis 2</i> .	Shown in the figure <a href="#">Location of cable harness on page 214.</a>
21	Refit the <i>velcro strap</i> at the guide plate axis 2.	Shown in the figure <a href="#">Location of cable harness on page 214.</a>
22	Make an overall inspection of the installed cable harness.	See <a href="#">Inspecting the cable harness on page 150.</a>

Continues on next page

	Action	Note
23	If the connection between the SMB battery and the SMB unit has been broken, the revolution counters must now be updated!	Detailed in the Calibration chapter - section <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .
24	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

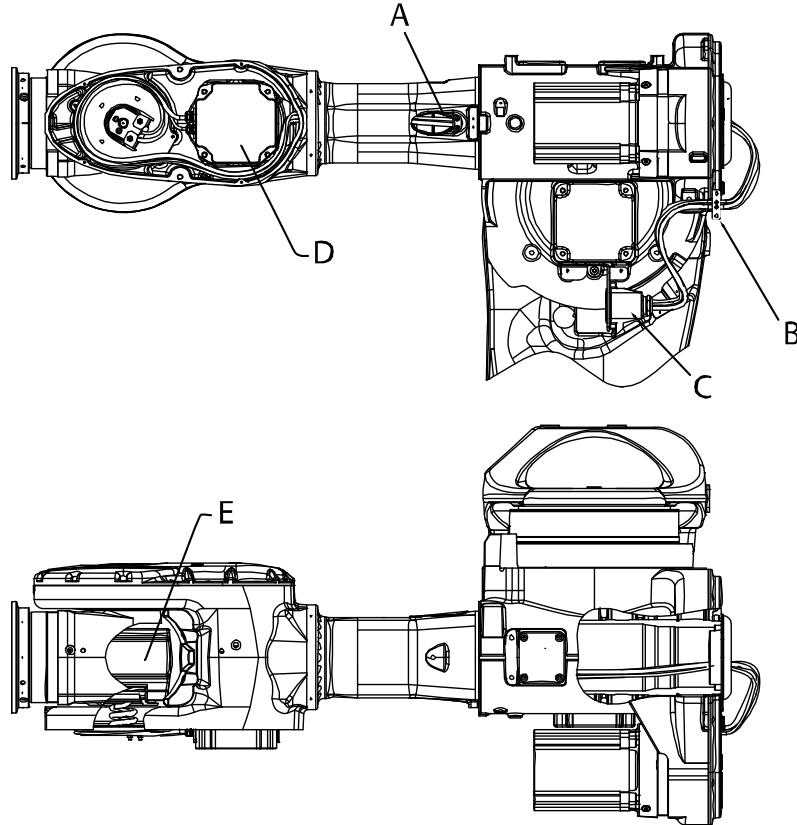
## 4 Repair

### 4.3.2 Replacement of cable harness, axes 5-6

### 4.3.2 Replacement of cable harness, axes 5-6

#### Location of cable harness ax 5-6

The location of the cable harness, axes 5-6, is shown in the figure below.



xx010000145

A	Cable attachment, upper arm
B	Cable attachment, rear
C	Connector at cable harness division; R2.M5/6
D	Connectors at motor 5; R3.FB5 and R3.MP5
E	Connectors at motor 6; R3.FB6 and R3.MP6

#### Required equipment

Equipment, etc.	Spare part no.	Note
Cable harness ax.5-6	3HAC11440-1	
Gasket	3HAC033489-001	Recommended to be changed for Foundry Plus robots.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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*



Equipment, etc.	Spare part no.	Note
Circuit diagram		See chapter <a href="#">Circuit diagram on page 429</a> .

### Removal, cable harness, axes 5-6

The procedure below details how to remove the upper arm cable harness.

	Action	Note
1	Position the upper arm as follows: <ul style="list-style-type: none"> <li>• Axis 4: 0 degrees</li> <li>• Axis 5: +90 degrees</li> <li>• Axis 6: no significance</li> </ul>	
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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Remove the left hand side wrist cover by unscrewing its attachment screws.	
4	 <b>Note</b> Axis 5 must be oriented in the correct position (+90°) to allow the motor 6 cover to open!	
5	Disconnect all connectors at motor 5 and motor 6.	Specified in the figure <a href="#">Location of cable harness ax 5-6 on page 224</a> .
6	Remove the plastic cover on the rear of the upper arm, by removing the attachment screws.	
7	Remove the spiral plate by unscrewing the screw at the bottom of the spiral cup.	
8	Remove eventual cable straps from the harness.	
9	Disconnect connector R2.M5/6 at the <i>cable harness division</i> .	Shown in the figure <a href="#">Location of cable harness ax 5-6 on page 224</a> .
10	Remove the cable attachment inside the upper arm.	
11	Gently pull the cable harness out.	

### Refitting, cable harness, axes 5-6

The procedure below details how to refit the upper cable harness.

	Action	Note
1	Position the upper arm as follows: <ul style="list-style-type: none"> <li>• Axis 4: 0 degrees</li> <li>• Axis 5: +90 degrees</li> <li>• Axis 6: no significance</li> </ul>	

Continues on next page

## 4 Repair

### 4.3.2 Replacement of cable harness, axes 5-6

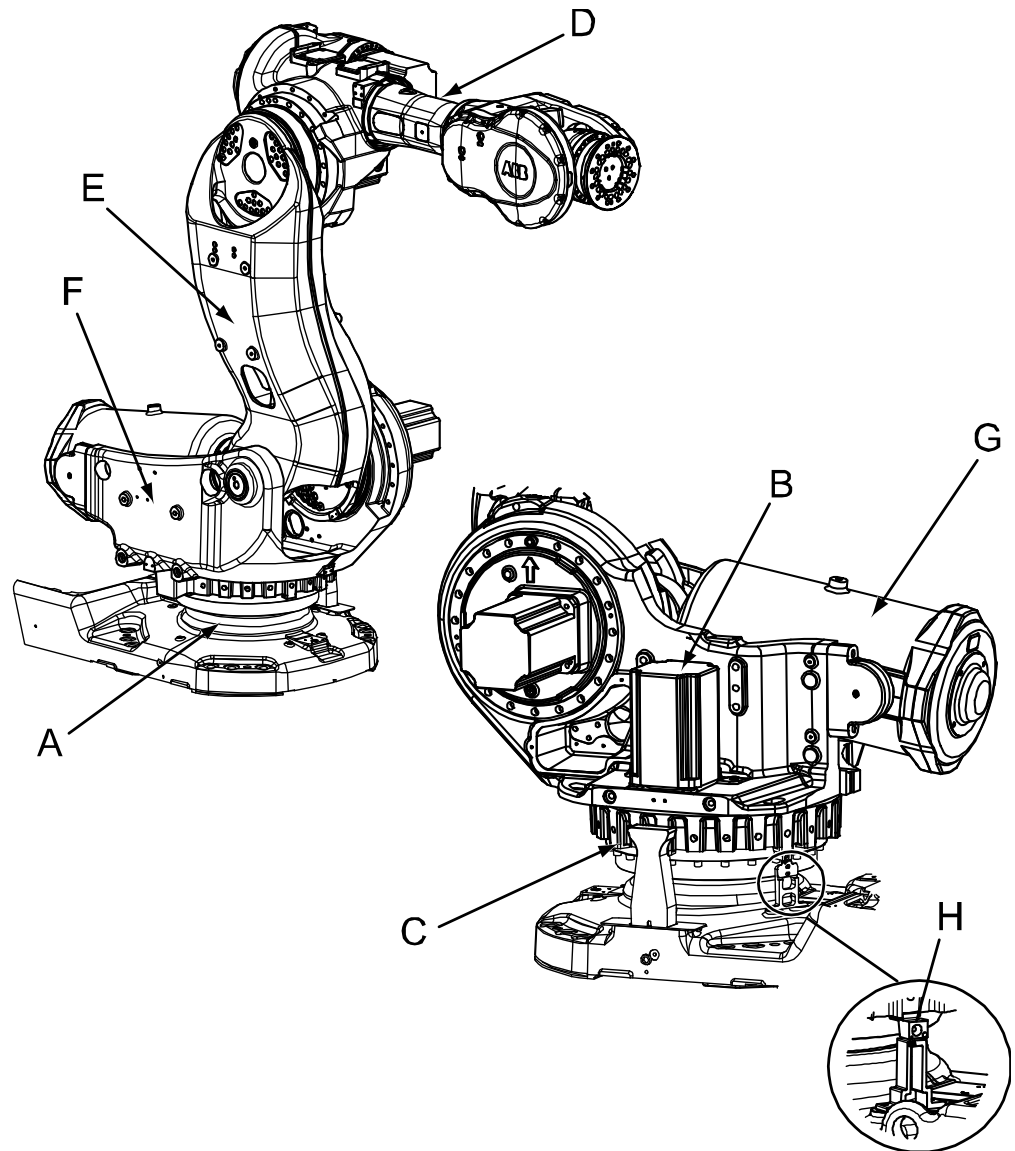
Continued

	Action	Note
2	Gently insert the cable harness from the rear into the upper arm.	
3	Pull the small spiral plate past motor 5.	
4	Route the cables outside the heat protection plate.	
5	Secure the small plate to the large plate. Secure the spiral cup with its attachment screw in the bottom of the cup.	
6	Secure any excess cable length tightly to the large plate in the wrist housing, using cable straps. Use the attachment holes in the large plate intended for the cable straps!	Excess cable length may be present if upper arm length is not the maximum.
7	Reconnect all connectors at motor 5 and motor 6.	Specified in the figure <a href="#">Location of cable harness ax 5-6 on page 224</a> .
8	Secure the cable with the cable attachment inside the upper arm.	
9	Refit the left hand side wrist cover with its attachment screws.	Tightening torque: 14 Nm. Add Loctite to screw before fastening. Screw 3HAB3409-25, Washer 3HAC062379-001
10	Reconnect connector R2.M5/6 gently at the <i>cable harness division</i> with two screws, M6. Be careful not to bend the attachment plate when fastening the screws!	Shown in the figure <a href="#">Location of cable harness ax 5-6 on page 224</a> . M6, 2 pcs.
11	Refit the plastic cover on the rear of the upper arm.	
12	Make an overall inspection of the installed cable harness.	See <a href="#">Inspecting the cable harness on page 150</a> .
13	Update the revolution counters.	Detailed in section <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .

### 4.3.3 Replacement of complete arm system

#### Location of complete arm system

The complete arm system is defined as the complete robot except for the base and gearbox axis 1, that is the upper and lower arms, balancing device and frame. This is shown in the figure below.



xx0100000150

A	Gearbox, axis 1
B	Motor, axis 1
C	Base attachment screws
D	Upper arm
E	Lower arm
F	Frame

*Continues on next page*

## 4 Repair

### 4.3.3 Replacement of complete arm system

Continued

G	Balancing device
H	Block for calibration

#### Required equipment

Equipment, etc.	Art. no.	Note
Lifting device, robot	3HAC15607-1	Instruction 3HAC15971-2 enclosed!
Guide pins, M12 x 130	-	Used to guide the complete arm system when refitting.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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.

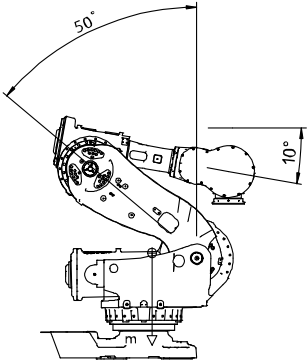


	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> <li>Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.</li> <li>Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.</li> </ul>	
	<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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a> .
	<b>If the robot is to be calibrated with fine calibration:</b> Remove all external cable packages (DressPack) and tools from the robot.	

#### Removal, complete arm system

The procedure below details how 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.	

Continues on next page

	Action	Note
2	Position the robot in its most stable position, as shown in the figure to the right.	<p>If the brakes need to be released, see section <a href="#">Manually releasing the brakes on page 73</a>.</p>  <p>xx0100000103</p>
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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>	
4	Drain the oil from the gearbox, axis 1.	Detailed in section <a href="#">Changing oil, axis-1 gearbox on page 165</a> .
5	Disconnect the cabling in the rear of the robot base and remove the cable support plate inside of the base.	
6	Pull the disconnected cabling up through the center of the axis-1 gearbox.	
7	Remove the motor, axis 1.	Detailed in section <a href="#">Removal, motor axis 1 on page 293</a> .
8	Run the overhead crane to a position above the robot.	
9	<p> <b>CAUTION</b></p> <p>The complete arm system weighs 2000 kg! All lifting equipment used must be sized accordingly!</p>	
10	Fit the <i>lifting device</i> and adjust it as detailed in enclosed instruction.	<p>Art. no. is specified in <a href="#">Required equipment on page 228</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 device! <b>Read the instructions before lifting!</b></p>
11	Remove the <i>block for calibration</i> from the bottom of the frame.	Shown in the figure <a href="#">Location of complete arm system on page 227</a> !

Continues on next page

## 4 Repair



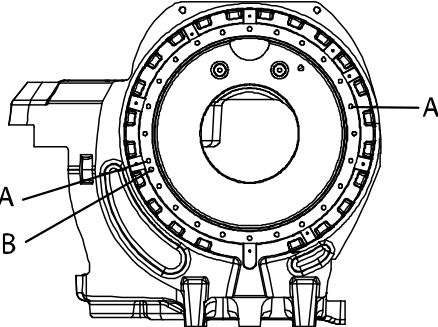
### 4.3.3 Replacement of complete arm system

Continued


	Action	Note
12	Remove the arm system from the base by unscrewing the 24 base attachment screws.	Shown in the figure <a href="#">Location of complete arm system on page 227!</a>
13	Lift the arm system and secure it in a safe area.	Make sure all hooks and attachments maintain in correct position while lifting the robot!  Always move the robot at very low speeds, making sure it does not tip.

### Refitting, complete arm system

The procedure below details how to refit the complete arm system to the robot.

	Action	Note
1	 <b>DANGER</b>  Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
2	 <b>CAUTION</b>  The complete arm system weighs 2000 kg! All lifting equipment used must be sized accordingly!	
3	Fit and adjust the <i>lifting device</i> as detailed in enclosed instruction.	Art. no. is specified in <a href="#">Required equipment on page 228</a> .
4	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!	Make sure all the hooks and attachments maintain in correct position while lifting the robot!
5	Fit two guide pins, M12 x 130, in the frame attachment holes as shown in the figure to the right.  Fit one guide pin next to the guiding hole (for the spring pin in the gearbox) and the other guide pin straight across the frame.	 <p>xx030000070</p> <p>The figure above shows a view from below of the frame.</p> <p>A Attachment holes for the guide pins, M12.</p> <p>B Guiding hole for the spring pin located in the gearbox, axis 1.</p>

Continues on next page

	Action	Note
6	<p>Look through the empty mounting hole of motor axis 1, to assist in aligning the assembly during refitting of the arm system. The guiding pin in the gearbox must be fitted to the guiding hole of the frame (B). Lower the arm system with guidance from the guide pins previously fitted to the frame.</p>	<p>This is a complex task to be performed with utmost care in order to avoid injury or damage!</p>
7	<p>Refit 22 of the 24 attachment screws before the arm system is completely lowered.</p>	
8	<p>Remove the guide pins and secure the arm system to the base with the 24 <i>base attachment screws</i> and washers.</p>	<p>Shown in the figure <a href="#">Location of complete arm system on page 227</a>. 24 pcs, M12 x 110; 12.9 quality UN-BRAKO, tightening torque: 110 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.</p>
9	<p>Refit the <i>block for calibration</i> at the bottom of the frame.</p>	<p>Shown in the figure <a href="#">Location of complete arm system on page 227</a>.</p>
10	<p>Refit the motor, axis 1.</p>	<p>Detailed in section <a href="#">Refitting, motor axis 1 on page 294</a>.</p>
11	<p>Perform a leak-down test.</p>	<p>Detailed in section <a href="#">Performing a leak-down test on page 206</a>.</p>
12	<p>Refill the gearbox axis 1 with lubricating oil.</p>	<p>Detailed in section <a href="#">Filling, oil, gearbox axis 1 on page 168</a>.</p>
13	<p>Recalibrate the robot.</p>	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>. General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>
14	<p> <b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

## 4 Repair

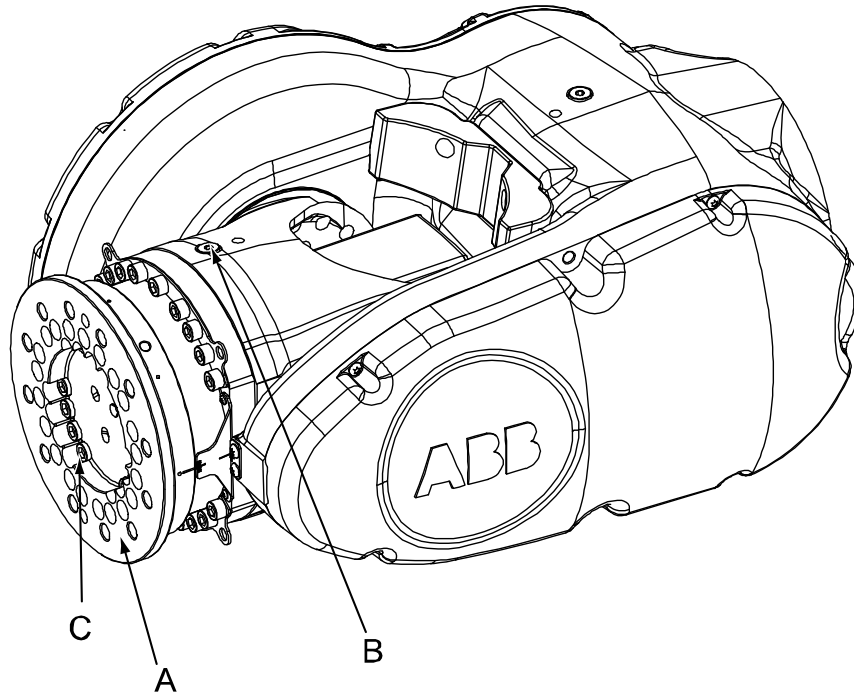
### 4.4.1 Replacing turning disk

## 4.4 Upper and lower arm

### 4.4.1 Replacing turning disk

#### Location of turning disk

The turning disk is located in the center of the wrist unit as shown in the figure below.



xx0100000129

A	Turning disk
B	Oil plug, filling (oil plug for draining is located on the opposite side of the tilt-house)
C	Turning disk attachment screws, 33 pcs

#### Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Turning disk, dia. 250	3HAC13193-1		Does not include o-ring!
Turning disk, insulated	3HAC023124-002		
O-ring		3HAB3772-83	Must be replaced when replacing the turning disk!
Grease		3HAC042536-001	Used to lubricate the o-ring.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .


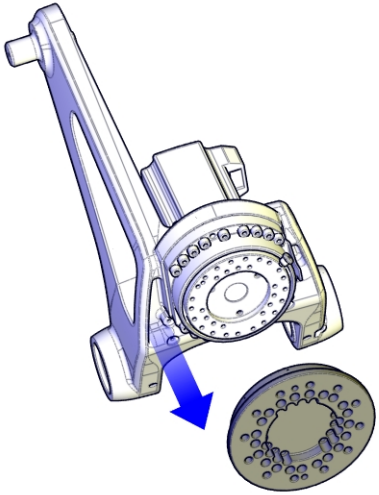
*Continues on next page*



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

Removing turning disk

Use the procedure to remove the turning disk.

Action	Information
<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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2 Drain the oil from gearbox 6.	Detailed in section <a href="#">Changing oil, axis-6 gearbox on page 182</a> .
3 Remove the <i>attachment screws</i> (33 pcs) securing the turning disk.	Shown in the figure <a href="#">Location of turning disk on page 232</a> .
4 Remove the <i>turning disk</i> .	 <p>xx1000001135</p>

Continues on next page


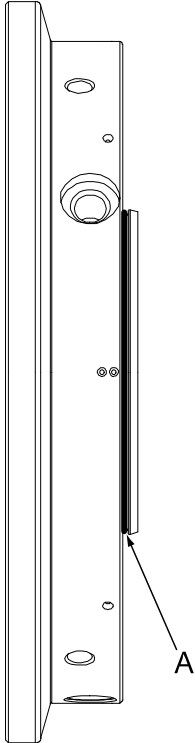
## 4 Repair

### 4.4.1 Replacing turning disk


Continued

#### Refitting turning disk

Use this procedure to refit the turning disk.

	Action	Information
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Lubricate the o-ring with <i>grease</i> and fit it to the rear of the turning disk.	Art. no. is specified in <a href="#">Required equipment on page 232</a> .  <small>xx0100000130</small> O-ring, turning disk
3	Secure the <i>turning disk</i> with its <i>attachment screws</i> .	Attachment screws: <ul style="list-style-type: none"> <li>• M10 x 25, 12.9 quality UNBRAKO</li> <li>• Tightening torque: 50 Nm.</li> </ul> Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
4	Refill the gearbox, axis 6, with oil.	

Continues on next page

	Action	Information
5	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

## 4 Repair

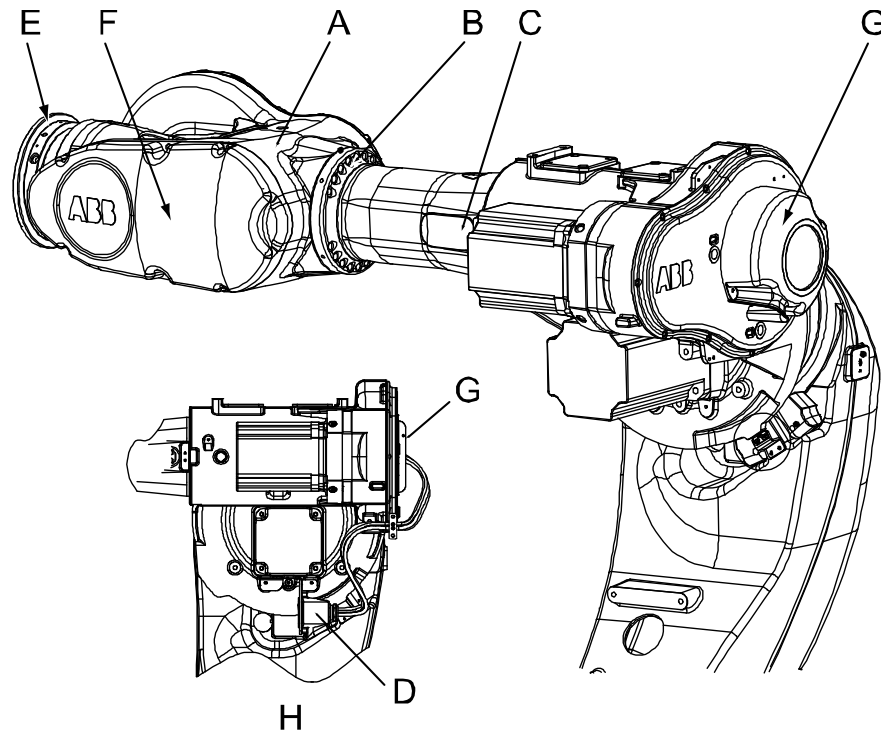
### 4.4.2 Replacement of complete wrist unit

#### 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 *Exploded views* in *Product manual, spare parts - IRB 7600*.



xx0100000147

A	Wrist unit
B	Wrist unit attachment screws and washers
C	Attachment, cable harness axis 5-6
D	Connectors at cable harness division; R2.M5/6
E	Turning disk
F	Cover, axis 5
G	Rear cover
H	View with cable harness mounted on robot

##### Required equipment

Equipment, etc.	Art. no.	Note
Wrist	For spare part number, see <a href="#">Spare part lists on page 427</a> .	

*Continues on next page*

Equipment, etc.	Art. no.	Note
Friction washer	3HAC11755-1	A new friction washer must always be used when refitting the wrist unit.
Lifting tool, wrist unit	3HAC12734-1	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	-	See chapter <a href="#">Circuit diagram on page 429</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	<p>Decide which calibration routine to use for calibrating the robot.</p> <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>	
	<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
	<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

Continues on next page



## 4 Repair

### 4.4.2 Replacement of complete wrist unit

Continued

#### 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	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply to the robot</li><li>• hydraulic pressure supply to the robot</li><li>• air pressure supply to the robot</li></ul> Before entering the robot working area.	
3	Remove all equipment fitted to the turning disk.	
4	Turn axis 4 to a position where the <i>cover, axis 5</i> faces upwards.	Shown in the figure <a href="#">Location of wrist unit on page 236</a> .
5	Remove the cover, axis 5, by unscrewing its attachment screws.	
6	 <b>CAUTION</b> The complete wrist unit weighs 200 kg! All lifting equipment used must be sized accordingly!	
7	Fit the <i>lifting tool, wrist unit</i> to the two holes on the sealing surface against the cover, axis 5.	Art. no. is specified in <a href="#">Required equipment on page 236</a> . If required, cut any cable ties securing the cables in order to fit the tool.
8	Remove the <i>rear cover</i> by unscrewing its attachments.	Shown in the figure <a href="#">Location of wrist unit on page 236</a> .
9	Disconnect <i>connector R2.M5/6 at the rear cable division point</i> .	Shown in the figure <a href="#">Location of wrist unit on page 236</a> .
10	Remove all cable attachment inside the upper arm and at the rear of the robot.	Do not remove the attachments from the cabling!
11	Slightly raise the wrist unit to unload the screw joint, facilitating removal of the attachment screws.	
12	Remove the <i>wrist unit attachment screws and washers</i> .	
13	Pull the cabling forwards through the upper arm tube.	Make sure the attachments do not get stuck inside the tube!
14	Remove the friction washer between the wrist unit and the upper arm tube.	A new washer must always be used on reassembly.
15	Lift the wrist unit down and place it on a secure surface.	

Continues on next page

## 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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	 <b>CAUTION</b> The complete wrist unit weighs 200 kg! All lifting equipment used must be sized accordingly!	
3	Remove the cover, axis 5 from the wrist unit to be fitted. Fit the <i>lifting tool, wrist unit</i> to the wrist unit.	Art. no. is specified in <a href="#">Required equipment on page 236</a> .
4	Lift the wrist unit and move it to its mounting position.	
5	Fit a new <i>friction washer</i> between the upper arm tube and the wrist unit.	Art. no. is specified in <a href="#">Required equipment on page 236</a> .
6	Gently pull the wrist unit cable harness through the upper arm and out the rear.	
7	Secure the wrist unit with its attachment screws and washers.	Screws: M12 x 50, UNBRAKO quality 12.9, tightening torque: 115 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
8	Secure the cable harness with the cable attachment inside the upper arm as well as at the rear of the upper arm.	Make sure the cabling is not twisted!
9	Remove the lifting tool and refit the <i>cover, axis 5</i> with its attachment screws.	Shown in the figure <a href="#">Location of wrist unit on page 236</a> .
10	Refit any cable ties that were previously cut during disassembly.	
11	Reconnect <i>connector R2.M5/6</i> at the rear cable division point.	Shown in the figure <a href="#">Location of wrist unit on page 236</a> .
12	Refit the <i>rear cover</i> with its attachment screws.	Shown in the figure <a href="#">Location of wrist unit on page 236</a> .
13	Check the oil levels at gearboxes axis 5 and 6.	Detailed in sections: <ul style="list-style-type: none"> <li>• <a href="#">Inspecting the oil level in axis-5 gearbox on page 138</a></li> <li>• <a href="#">Inspecting the oil level in axis-6 gearbox on page 141</a></li> </ul>

Continues on next page

## 4 Repair

### 4.4.2 Replacement of complete wrist unit

*Continued*

	Action	Note
14	Re-calibrate the robot.	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>
15	Refit any equipment previously removed from the turning disk.	
16	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

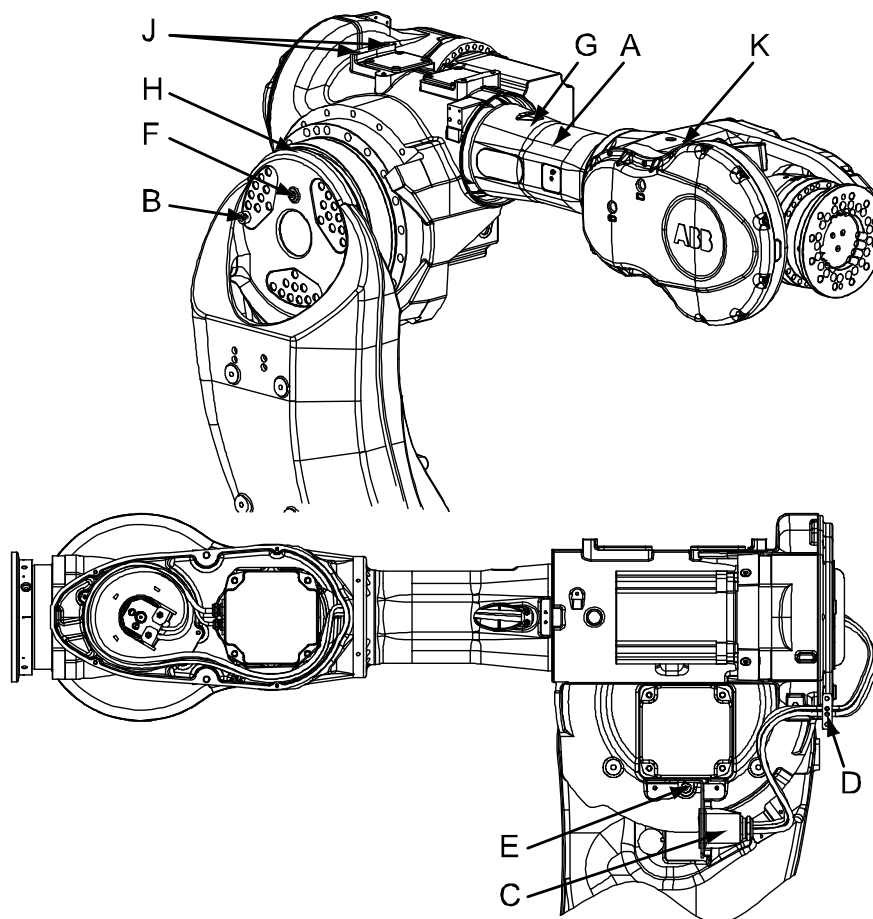


### 4.4.3 Replacement of complete upper arm

#### Location of upper arm

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

A more detailed view of the component and its position may be found in chapter *Exploded views in Product manual, spare parts - IRB 7600*.



xx0100000148

A	Upper arm
B	Attachment screws, upper arm
C	Connectors at cable harness division; R2.M5/6
D	Rear cable attachment
E	Oil plug, draining
F	Oil plug, filling
G	Attachment hole, M12
H	Sealing between lower arm and gearbox 3
J	Attachment holes for lifting device, upper arm
K	Attachment holes for lifting eye

*Continues on next page*

## 4 Repair

### 4.4.3 Replacement of complete upper arm

*Continued*

#### Required equipment

Equipment, etc.	Art. no.	Note
Sealing, axis 2/3	3HAC17213-1	Always use a new sealing when reassembling!
Washer	3HAC11828-1	Replace if damaged!
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Lifting eye, M12	3HAC14457-3	
Lifting device, upper arm	3HAC15536-1	
Lifting tool (chain)	3HAC15556-1	
Hoisting block	-	Standard hoisting block, capacity 200 kg.
Guide pins, sealing axis 2/3	3HAC14627-2	80 mm. For guiding "Sealing, axis 2/3".
Guide pins, sealing axis 2/3	3HAC14627-3	100 mm For guiding "Sealing, axis 2/3".
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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a> .
	<b>If the robot is to be calibrated with fine calibration:</b> Remove all external cable packages (DressPack) and tools from the robot.	

*Continues on next page*

## Removal, upper arm

The procedure below details how to remove the complete upper arm.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Run the upper arm to a horizontal position.	
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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
4	 <b>CAUTION</b> The complete upper arm weighs 450 kg without any additional equipment fitted! Use a suitable lifting device to avoid injury to personnel!	
5	Fit the lifting eye to the <i>attachment hole</i> in the wrist unit.	Shown in the figure <a href="#">Location of upper arm on page 241</a> . Art. no. is specified in <a href="#">Required equipment on page 242</a> .
6	Fit one of the pieces included in the <i>lifting device, upper arm</i> to the <i>attachment holes for lifting device, upper arm</i> using the included attachment screws.	Shown in the figure <a href="#">Location of upper arm on page 241</a> . Art. no. is specified in <a href="#">Required equipment on page 242</a> .
7	Run the <i>lifting chain</i> from the rear lifting point through the overhead crane hook, through the hoisting block to the lifting eye in the front.	Art. no. is specified in <a href="#">Required equipment on page 242</a> .
8	Use the hoisting block to adjust the tension in the chain in order to lift the upper arm completely level.	
9	Drain the oil from gearbox 3.	Detailed in section <a href="#">Changing oil, axis-3 gearbox on page 172</a> .
10	Disconnect connector R2.M5/6 at the rear cable division point as well as all remaining connections to the upper arm.	
11	Disconnect all connectors inside motors 3 and 4.	
12	Remove all brackets securing cabling to the upper arm by unscrewing their attachment screws respectively.	
13	Raise the lifting equipment to take the weight of the upper arm.	
14	Carefully remove the <i>upper arm attachment screws</i> . Make sure that the upper arm is lifted in a completely level position in all planes in order not to damage the upper arm!	Shown in the figure <a href="#">Location of upper arm on page 241</a> . 30 pcs.
15	Lift the upper arm and place it on a secure surface.	

Continues on next page

## 4 Repair


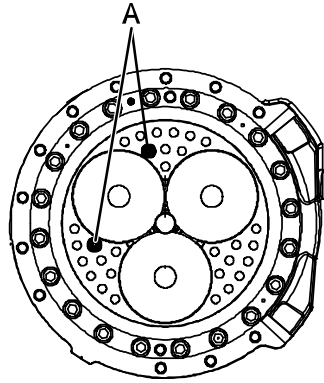

### 4.4.3 Replacement of complete upper arm

Continued

	Action	Note
16	Remove the sealing from the lower arm.	


#### Refitting, upper arm

The procedure below details how to refit the upper arm to the robot.

	Action	Note/Illustration
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	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 242</a> .  <small>xx0200000125</small> Holes for guide pins in the gearbox.
3	 <b>CAUTION</b> The complete upper arm weighs 450 kg without any additional equipment fitted! Use a suitable lifting device to avoid injury to personnel!	
4	Fit the <i>lifting eye</i> to the <i>attachment hole</i> in the wrist unit.	Shown in the figure <a href="#">Location of upper arm on page 241</a> . Art. no. is specified in <a href="#">Required equipment on page 242</a> .
5	Fit one of the pieces included in the <i>lifting device, upper arm</i> to the <i>attachment holes for lifting device, upper arm</i> using the included attachment screws.	Shown in the figure <a href="#">Location of upper arm on page 241</a> . Art. no. is specified in <a href="#">Required equipment on page 242</a> .
6	Run the <i>lifting chain</i> from the rear lifting point through the overhead crane hook, through the hoisting block to the lifting eye in the front.	Art. no. is specified in <a href="#">Required equipment on page 242</a> .

Continues on next page

4.4.3 Replacement of complete upper arm  
*Continued*

	Action	Note/Illustration
7	Use the hoisting block to adjust the tension in the chain in order to lift the upper arm completely level.	
8	Lift the upper arm and move it to its mounting position.	
9	Fit the three <i>washers</i> to be placed beneath the attachment screws.	Make sure the washers are not scarred or pitted in the surface facing the screw heads. If both washer sides are damaged, replace the washer. Art. no. is specified in <a href="#">Required equipment on page 242</a> .
10	Insert the attachment screws. Do not remove the guide pins until the attachment screws are tightened as detailed below!	In some cases, 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 <i>upper arm attachment screws</i> .	30 pcs: M16 x 50. Tightening torque: 300 Nm. Shown in the figure <a href="#">Location of upper arm on page 241</a> .
12	Remove the guide pins and fit the two remaining attachment screws. Tighten them as detailed above!	
13	Refit any cabling removed during the removal process.	
14	Reconnect all connectors inside motors 3 and 4.	
15	Reconnect connector R2.M5/6 gently at the rear cable division point. Be careful not to bend the attachment plate when fastening the screws!	
16	Refill the gearbox with oil.	Detailed in section <a href="#">Filling, oil on page 174</a> .
17	Re-calibrate the robot.	Pendulum Calibration is described in <a href="#">Operating manual - Calibration Pendulum</a> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .
18	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

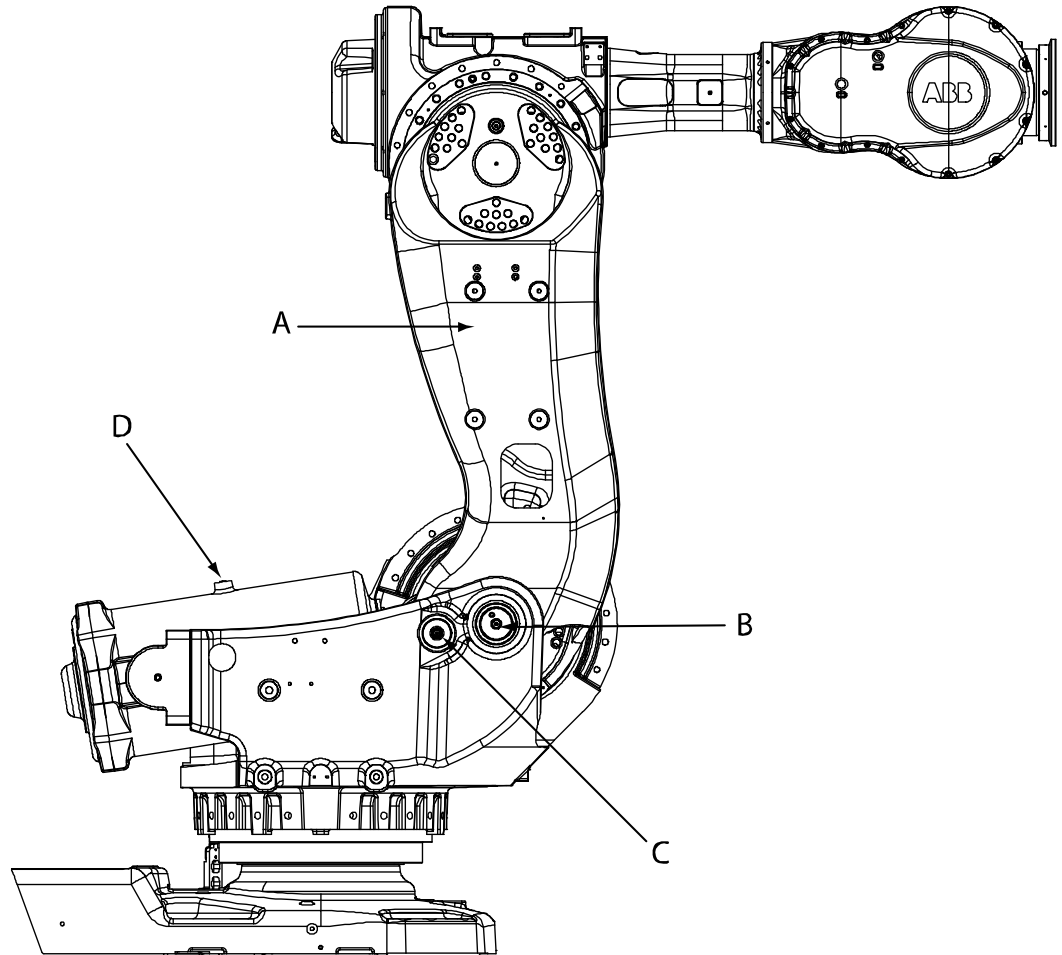
## 4 Repair

### 4.4.4 Replacement of complete lower arm

### 4.4.4 Replacement of complete lower arm

#### Location of lower arm

The lower arm is located as shown in the figure below.



xx0100000149

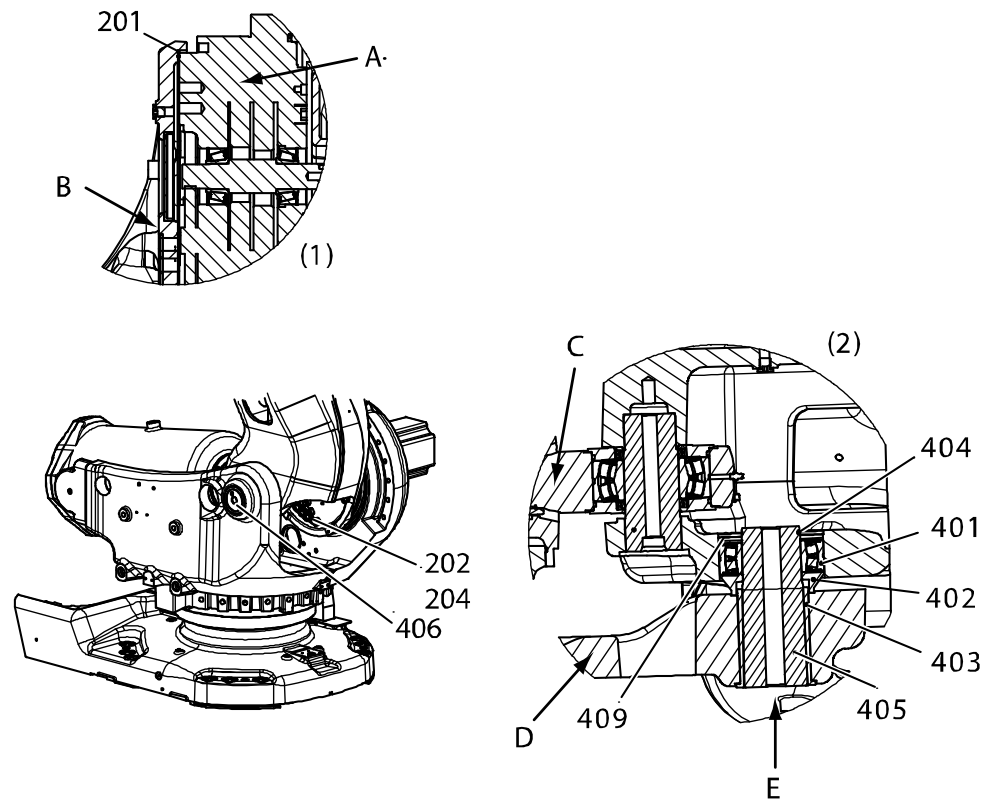
A	Lower arm
B	Pivot point, axis 2
C	Front shaft, balancing device, including securing screw
D	Attachment for lifting eye, M12, balancing device

#### Attachment points, lower arm

The lower arm attachment points are located as shown in the figure below:

- The figure (1) shows gearbox 3, but the location of sealing axis 2/3 in relation to the gearbox is identical for axis 3.
- The figure (2) shows a cut view through the lower arm pivot point in axis 2 (item B in the figure above!), valid for robots with protection Standard.

*Continues on next page*



xx020000031

A	Gearbox
B	Lower arm
C	Balancing device piston rod ear
D	Frame
E	Shaft hole
201	Sealing, axis 2/3
202	Attachment screw
204	Washer
401	Bearing
402	Thrust washer
403	Bushing
404	Retaining ring
405	Shaft
406	Protection plug
409	Protection washer

Continues on next page

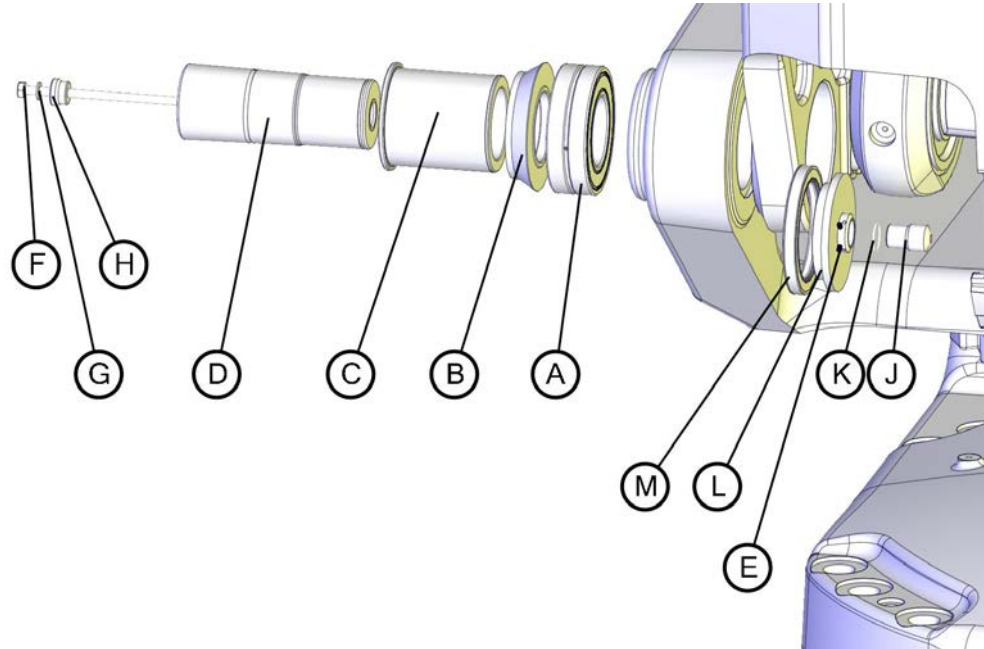
## 4 Repair

### 4.4.4 Replacement of complete lower arm

*Continued*

#### Components, lower arm shaft for robots with protection Foundry Plus and Foundry Prime

The figure shows components fitted to the lower arm shaft when the robot has protection Foundry Plus and Foundry Prime.



xx110000954

A	Bearing
B	Thrust washer
C	Bushing
D	Shaft for the lower arm
E	Set screw with cup point, M4x6 (2 pcs)
F	Hexagon bolt M8x190
G	Conical spring washer 8.4x16x1.6
H	Shaft tap
J	Shaft for the sealing cover
K	O-ring
L	Sealing cover
M	Radial sealing with dust lip

#### Required equipment

Equipment, etc.	Article number	Note
Bearing	3HAC4310-1	Always use a new bearing.
Sealing, axis 2/3	3HAC17213-1	Always use a new sealing.
VK cover	3HAA2166-23	Replace if damaged. Only used on lower arms with a hole in the upper end (axis 3).

*Continues on next page*



Equipment, etc.	Article number	Note
Lifting tool, lower arm	3HAC14691-1	Tool that may be rented from ABB. Includes <ul style="list-style-type: none"> <li>• Guidances, 3HAC14445-1</li> </ul> The guidings are used for guiding the sealing, axis 2/3.
Rotation tool	3HAC17105-1	
Lifting eye M12	3HAC14457-3	Used to lift the balancing device.
Press equipment, balancing device shaft	3HAC076202-001	For replacing the balancing device shaft. User instructions are enclosed with the tool.
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with the press and puller tools. See technical specifications in the user instructions for the press equipment.
Hydraulic pump, 150 MPa (Glycerin)	3HAC021563-012	To be used with the press and puller tools. See technical specifications in the user instructions for the press equipment.
Press device, axis 2 shaft	3HAC076203-001	Hydraulic pressing accessory. User instructions are enclosed with the tool.
Press tool, axis 2 bearing	3HAC13453-1	
Power supply	-	24 VDC, 1.5 A. For releasing the brakes.
Retaining ring pliers	-	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Continues on next page

## 4 Repair

### 4.4.4 Replacement of complete lower arm

*Continued*


#### Deciding calibration routine

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


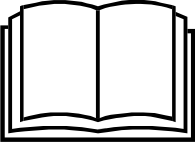

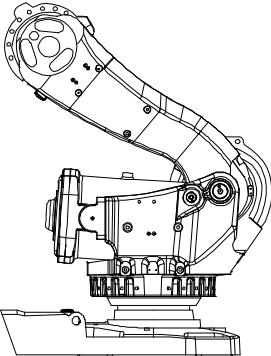

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> <li>Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.</li> <li>Fine calibration. All external cable packages (DressPack) and tools must 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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a> .
	<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> <li>air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Remove the upper arm.	Detailed in section <a href="#">Replacement of complete upper arm on page 241</a> .
4	Disconnect and remove the cables from inside the lower arm. Release any cable attachments.	Detailed in section <a href="#">Replacement of cable harness, axes 1-4 on page 214</a> .
5	Apply the <i>lifting eye</i> to the balancing device and raise to unload the device.	Art. no. is specified in <a href="#">Required equipment on page 248</a> . Attachment is shown in the figure <a href="#">Location of lower arm on page 246</a> .

*Continues on next page*


	Action	Note
6	<p>Unload the balancing device in order to make the piston rod and front ear adjustable when pulling the front shaft out.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Detailed in section <a href="#">Unloading the balancing device on page 283</a>.</p>
7	<p>Remove the securing screw from the balancing device <i>front shaft</i>.</p>	<p>Shown in the figure <a href="#">Location of lower arm on page 246</a>.</p>
8	<p>Pull the shaft out using the <i>press equipment, balancing device shaft</i>, according to user instructions enclosed with the equipment.</p> <p></p> <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 248</a>. User instructions are enclosed with the tool.</p>
9	<p>Lower the balancing device until it rests safely against the bottom of the frame, out of reach from the lower arm.</p>	
10	<p>Move the lower arm backwards to the lowest position possible.</p>	<p></p> <p>xx0300000015</p>
11	<p> <b>CAUTION</b></p> <p>The lower arm weighs 225 kg! All lifting equipment used must be sized accordingly!</p>	
12	<p>Apply the <i>lifting tool</i> to the lower arm.</p>	<p>Article number is specified in <a href="#">Required equipment on page 248</a>!</p>

Continues on next page

## 4 Repair


### 4.4.4 Replacement of complete lower arm

Continued

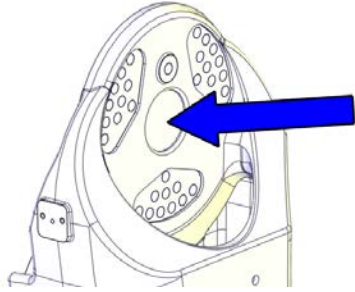
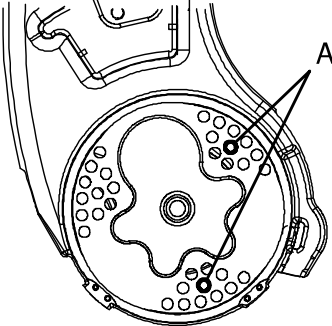

	Action	Note
13	Drain the oil from gearbox 2.	Detailed in section <a href="#">Changing oil, axis-2 gearbox on page 169</a> .
14	Raise the tool to unload the lower arm.	
15	Remove the lower arm shaft and all additional components, as detailed in section <a href="#">Replacement of lower arm shaft on page 256</a> .   <b>DANGER</b> Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	
16	Remove the lower arm <i>attachment screws and washers</i> that attaches the lower arm to the gearbox 2.	Shown in the figure <a href="#">Attachment points, lower arm on page 246</a> .
17	Lift the lower arm down and place it on a secure surface.	
18	Remove the <i>bearing and thrust washer</i> from the shaft hole in the lower arm.	Shown in the figure <a href="#">Attachment points, lower arm on page 246</a> . On reassembly a new bearing must be used!
19	Remove the <i>sealing</i> from the lower arm.	Shown in the figure <a href="#">Attachment points, lower arm on page 246</a> . On reassembly a new sealing must be used!

### Refitting, lower arm

The procedure below details how to refit the lower arm to the robot.

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

Continues on next page

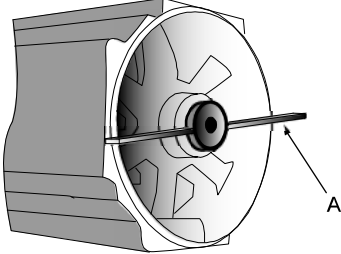

	Action	Note
2	If the lower arm is designed with a hole, fit a new VK-cover on a new lower arm or replace existing if damaged.	Spare part number is specified in <a href="#">Required equipment on page 248</a> .  xx1700000917
3	Fit the two <i>guidings</i> in the attachment holes of the lower arm.	Included in the lifting tool, lower arm, article number is specified in <a href="#">Required equipment on page 248</a> .  xx0200000262 <b>A</b> Attachment holes for the two guidings.
4	Fit the new <i>sealing</i> , axis 2/3 on the guidings.	Always use a new sealing when reassembling! Article number is specified in <a href="#">Required equipment on page 248</a> .
5	 <b>CAUTION</b> The lower arm weighs 225 kg! All lifting equipment used must be sized accordingly!	
6	Apply the <i>lifting tool</i> to the lower arm.	Article number is specified in <a href="#">Required equipment on page 248</a> .
7	Lift the lower arm and move it to its mounting position.	

Continues on next page

## 4 Repair


### 4.4.4 Replacement of complete lower arm

Continued

	Action	Note
8	In case the holes of the lower arm and the ones of the gearbox axis 2 doesn't match, use power supply to release the motor axis 2 brakes and rotate the pinion and gear with the <i>rotation tool</i> .	Connect power supply to connector R2.MP2: <ul style="list-style-type: none"> <li>• + : pin 2</li> <li>• -: pin 5</li> </ul>  <p>xx0200000165</p> <p>The rotation tool (A) is used beneath the motor cover, directly on the motor shaft as shown in the figure above! Article number is specified in <a href="#">Required equipment on page 248</a>.</p>
9	Secure the lower arm with 28 of the 30 <i>attachment screws</i> and washers in gearbox 2.	30 pcs: M16 x 50; tightening torque: 300 Nm. Shown in the figure <a href="#">Attachment points, lower arm on page 246</a> .
10	Remove the guidings and secure the two remaining attachment screws as detailed above!	
11	Refit the lower arm shaft and all additional components, as detailed in section <a href="#">Replacement of lower arm shaft on page 256</a> .   <b>DANGER</b> Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	
12	Refit and restore the balancing device.	Detailed in section <a href="#">Refitting, balancing device on page 286</a> .
13	Refit the upper arm.	Detailed in section <a href="#">Refitting, upper arm on page 244</a> .
14	Perform a leak-down test.	Detailed in section <a href="#">Performing a leak-down test on page 206</a> .
15	Refill the axis 2 gearbox with oil.	Detailed in section <a href="#">Filling, oil on page 170</a> .
16	Refit and reconnect all cables inside the lower arm. Refit removed cable attachments.	Detailed in section <a href="#">Refitting, cable harness, axes 1-4 on page 218</a> .

Continues on next page

4.4.4 Replacement of complete lower arm  
Continued

	Action	Note
17	Recalibrate the robot.	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>
18	 <p><b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

## 4 Repair

### 4.4.5 Replacement of lower arm shaft

### 4.4.5 Replacement of lower arm shaft

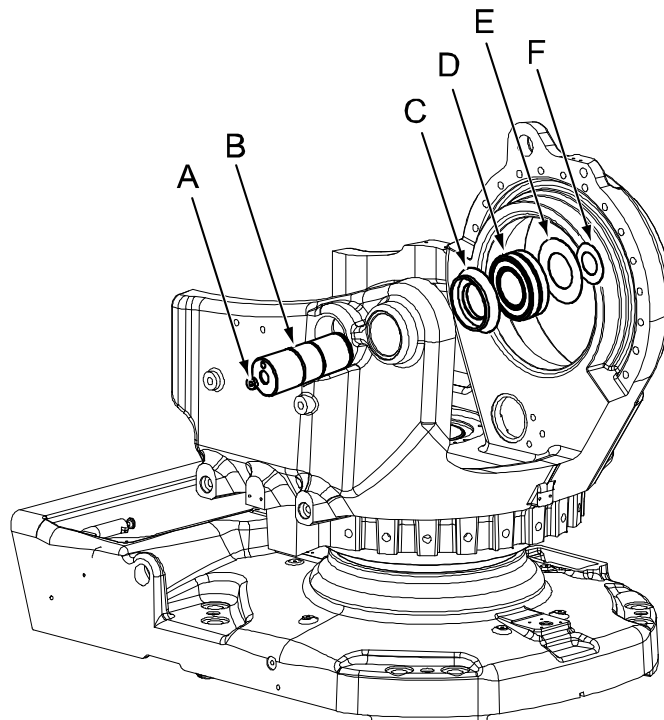
#### Prerequisites

This section details how to remove and refit the lower arm shaft as a step in the procedure of removing/refitting the complete lower arm. To perform the procedure described in this section, it is required that the preceding instructions in section [Replacement of complete lower arm on page 246](#) are followed! These include:

- removing the upper arm
- removing the cabling in the lower arm
- unloading the balancing device and removing the front eye shaft
- draining the oil in gearbox axis 2
- unloading the lower arm with specific lifting equipment.

#### Components, lower arm shaft for robots with protection Standard

The figure shows components fitted to the lower arm shaft when the robot has protection Standard.



xx0300000487

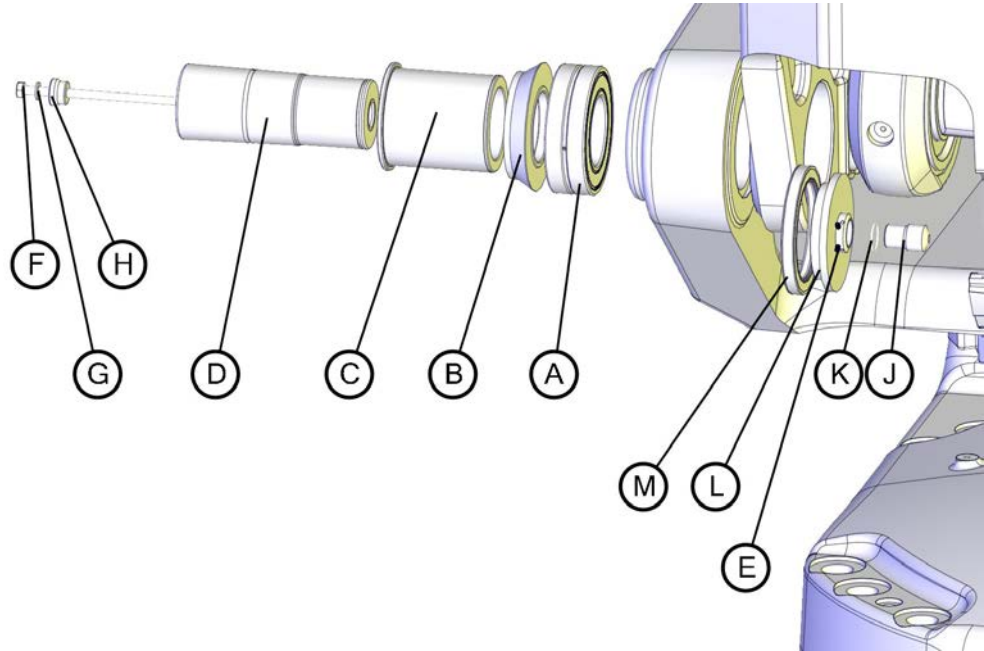
A	Protection plug
B	Lower arm shaft (axis 2 shaft)
C	Thrust washer
D	Bearing
E	Protection washer
F	Retaining ring

*Continues on next page*



**Components, lower arm shaft for robots with protection Foundry Plus**

The figure shows components fitted to the lower arm shaft when the robot has protection Foundry Plus.



xx110000954

A	Bearing
B	Thrust washer
C	Bushing
D	Shaft for the lower arm
E	Set screw with cup point, M4x6 (2 pcs)
F	Hexagon bolt M8x190
G	Conical spring washer 8.4x16x1.6
H	Shaft tap
J	Shaft for the sealing cover
K	O-ring
L	Sealing cover
M	Radial sealing with dust lip

**Required equipment**

Equipment	Article number	Note
Bearing	For spare part number see: <ul style="list-style-type: none"> <li><a href="#">Spare part lists on page 427.</a></li> </ul>	Always use a new bearing when reassembling!
Puller device, axis 2 shaft	3HAC075427-001	Hydraulic pressing accessory. User instructions are enclosed with the tool.

*Continues on next page*

## 4 Repair

### 4.4.5 Replacement of lower arm shaft


Continued

Equipment	Article number	Note
Press device, axis 2 shaft and bearing	3HAC076203-001	Hydraulic pressing accessory. User instructions are enclosed with the tool.
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with the press and puller tools. See technical specifications in the user instructions for the press equipment.
Hydraulic pump, 150 MPa (Glycerin)	3HAC021563-012	
Retaining ring plier	-	
Isopropanol	11771012-208	For cleaning the shaft.
Grease	3HAB3537-1	For lubrication of the bearing. For lubrication of the shaft.
Rust preventive	3HAC026621-001	Equivalent: <ul style="list-style-type: none"> <li>• Mercasol 3106</li> </ul>
Locking liquid (only for robots with protection Foundry Plus and Foundry Prime)	3HAB7116-1	Loctite 243

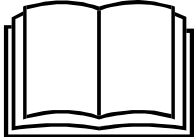

### Removal, lower arm shaft from robot with protection Standard

Use this procedure to remove the lower arm shaft if the robot has protection Standard.

If encountering any problems when removing the shaft, contact ABB Robotics!

	Action	Note/Illustration
1	 <b>WARNING</b> This procedure is a step in the complete procedure of removing the lower arm! Make sure all the preceding steps specified in <a href="#">Replacement of lower arm shaft on page 256</a> are made before removing the lower arm shaft!	
2	Remove the <i>protection plug</i> .	Shown in the figure <a href="#">Components, lower arm shaft for robots with protection Standard on page 256</a> !
3	Remove the <i>protection washer</i> and the <i>retaining ring</i> .	Shown in the figure <a href="#">Components, lower arm shaft for robots with protection Standard on page 256</a> ! Use a plier for the retaining ring.


Continues on next page

	Action	Note/Illustration
4	<p>Pull out the axis-2 shaft with the <i>puller device</i> according to user instructions enclosed with the equipment.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury.</p> <p>Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 257!</a></p> <p>User instructions are enclosed with the tool.</p>
5	<p>Remove the <i>bearing</i> and <i>thrust washer</i> from the shaft hole in the lower arm, recommendable after removing the complete lower arm as detailed in section <a href="#">Replacement of complete lower arm on page 246.</a></p>	

### Removal, lower arm shaft on robot with protection Foundry Plus

Use this procedure to remove the lower arm shaft if the robot has protection Foundry Plus.

If encountering any problems when removing the shaft, contact ABB Robotics!

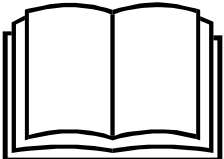

	Action	Note
1	<p> <b>WARNING</b></p> <p>This procedure is a step in the complete procedure of removing the lower arm! Make sure all the preceding steps specified in <a href="#">Replacement of lower arm shaft on page 256</a> are made before removing the lower arm shaft!</p>	
2	<p>Remove the two <i>set screws</i>.</p>	<p>Shown in the figure <a href="#">Components, lower arm shaft for robots with protection Foundry Plus on page 257.</a></p>
3	<p>Remove the <i>shaft sealing cover</i>.</p>	
4	<p>Remove the <i>sealing cover</i>.</p>	
5	<p>Remove the <i>radial sealing</i>, if the lower arm is to be replaced with a new one.</p> <p>If the same lower arm is refitted, the radial sealing can be left in the lower arm.</p>	
6	<p>Remove the <i>hexagon bolt</i> with the <i>washer</i> and <i>shaft tap</i>.</p>	

Continues on next page

## 4 Repair

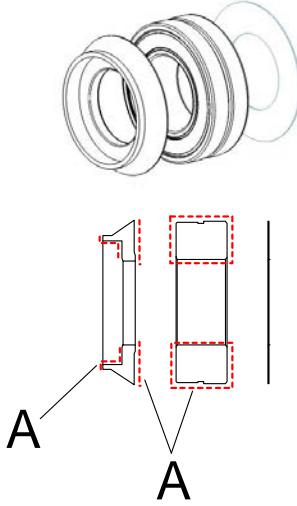
### 4.4.5 Replacement of lower arm shaft

Continued

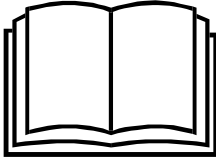

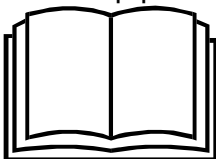


	Action	Note
7	<p>Pull out the axis-2 shaft with the <i>puller device</i> according to user instructions enclosed with the equipment.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 257!</a></p> <p>User instructions are enclosed with the tool.</p>
8	<p>Remove the <i>bearing</i> and <i>thrust washer</i> from the shaft hole in the lower arm, recommendable after removing the complete lower arm as detailed in section <a href="#">Replacement of complete lower arm on page 246.</a></p>	

### Refitting, lower arm shaft on robot with protection Standard

Use this procedure to refit the lower arm shaft if the robot has protection Standard.

	Action	Note/Illustration
1	<p>Clean the shaft with <i>isopropanol</i> and lubricate it with <i>grease</i>.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 257!</a></p>
2	<p>If the robot is going to work in a water jet application cell:</p> <p>Apply Mercasol 3106 on the Support shaft axis 2.</p> <ul style="list-style-type: none"> <li>Apply Mercasol 3106 on both sides of the thrust washer, all around the bearing and on surface on the shaft.</li> </ul>	 <p>Apply mercas</p> <ul style="list-style-type: none"> <li>A: Mercasol on marked areas.</li> </ul>
3	<p>Push the shaft in by hand.</p>	

Continues on next page

	Action	Note/Illustration
4	Refit the <i>thrust washer</i> to the shaft.	Also shown in the figure <a href="#">Components, lower arm shaft for robots with protection Standard on page 256!</a>
5	<p>Fit the axis-2 shaft with the <i>press device, axis 2 shaft</i> according to user instructions enclosed with the equipment.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 257!</a> User instructions are enclosed with the tool.</p>
6	Remove the press device, axis 2 shaft.	
7	Apply <i>grease</i> to the location of the shaft where the bearing is to be mounted.	Art. no. is specified in <a href="#">Required equipment on page 257</a>
8	<p>Press in the new <i>bearing</i> with the <i>press tool, axis 2 bearing</i> according to user instructions enclosed with the equipment..</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p> <b>Note</b></p> <p>Always use a new bearing when reassembling!</p> <p>Art. no. is specified in <a href="#">Required equipment on page 257</a>. User instructions are enclosed with the tool.</p>
9	Refit the <i>protection washer</i> and the <i>retaining ring</i> .	Shown in the figure <a href="#">Components, lower arm shaft for robots with protection Standard on page 256</a> .
10	Refit the <i>protection plug</i> .	
11	Proceed with the refitting procedure of the lower arm, detailed in section <a href="#">Replacement of complete lower arm on page 246</a> .	

Continues on next page

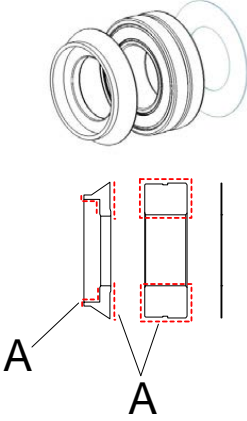
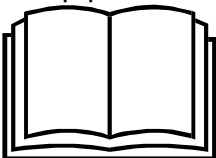

## 4 Repair

### 4.4.5 Replacement of lower arm shaft

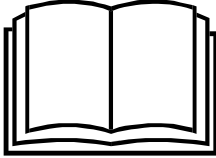


Continued

#### Refitting, lower arm shaft on robot with protection Foundry Plus

Use this procedure to refit the lower arm shaft if the robot has protection Foundry Plus.

	Action	Note/Illustration
1	Clean the shaft with <i>isopropanol</i> and lubricate it with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 257</a> !
2	If the robot is going to work in a water jet application cell: Apply Mercasol 3106 on the support shaft axis 2. <ul style="list-style-type: none"> <li>Apply Mercasol 3106 on both sides of the thrust washer, all around the bearing and on surface on the shaft.</li> </ul>	 <p>Apply mercasol</p> <p>A Mercasol on marked areas.</p>
3	Push the shaft in by hand.	
4	Refit the <i>thrust washer</i> to the shaft.	Also shown in the figure <a href="#">Components, lower arm shaft for robots with protection Foundry Plus on page 257</a> !
5	Fit the axis-2 shaft with the <i>press device, axis 2 shaft</i> according to user instructions enclosed with the equipment.  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	Art. no. is specified in <a href="#">Required equipment on page 257</a> ! User instructions are enclosed with the tool.
6	Remove the press device, axis 2 shaft.	
7	Apply <i>grease</i> to the location of the shaft where the bearing is to be mounted.	Art. no. is specified in <a href="#">Required equipment on page 257</a>

Continues on next page

	Action	Note/Illustration
8	<p>Press in the new <i>bearing</i> with the <i>press tool</i>, <i>axis 2 bearing</i> according to user instructions enclosed with the equipment.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury.</p> <p>Read and follow enclosed user instructions for the tool.</p>	<p> <b>Note</b></p> <p>Always use a new bearing when reassembling!</p> <p>Art. no. is specified in <a href="#">Required equipment on page 257</a>.</p> <p>User instructions are enclosed with the tool.</p>
9	Fit a <i>radial sealing</i> to the lower arm, if there is none left during removal of the arm.	<p>Shown in the figure <a href="#">Components, lower arm shaft for robots with protection Foundry Plus on page 257</a>.</p>
10	Refit the <i>hexagon bolt</i> with a <i>spring washer</i> and a <i>shaft tap</i> through the hole in the lower arm shaft.	
11	Fit the <i>shaft for the sealing cover</i> onto the hexagon bolt and tighten the bolt with torque: 24 Nm.	
12	Check the <i>o-ring</i> in the sealing cover. Replace if damaged.	
13	Refit the <i>sealing cover</i> onto the shaft. Press it tightly against the radial sealing while tightening the set screws. Use locking liquid.	
14	Proceed with the refitting procedure of the lower arm, detailed in section <a href="#">Replacement of complete lower arm on page 246</a> .	

## 4 Repair

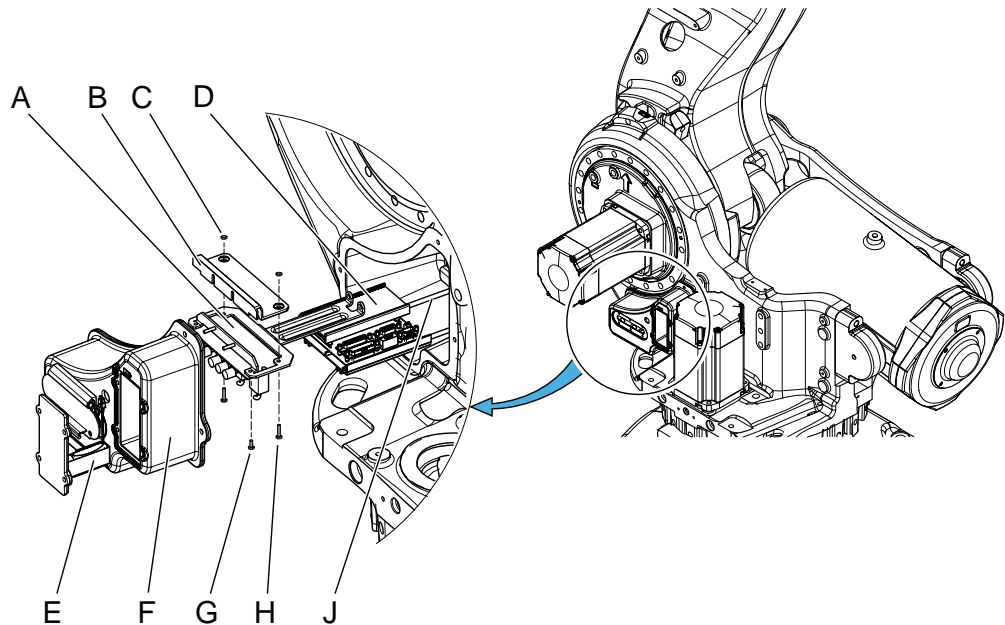
### 4.5.1 Replacing the SMB unit

## 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.



xx020000203

A	Brake release unit
B	Brake unit cover
C	Hexagon nut
D	Pins
E	Battery unit
F	SMB cover
G	Attachment screw, (2 pcs)
H	Attachment screw, brake unit cover (2 pcs)
J	Pins

#### 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.	Article number	Note
SMB unit	For spare part number, see: <a href="#">Spare part lists on page 427</a> .	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Circuit diagram	-	See chapter <a href="#">Circuit diagram on page 429</a> .

### Removing, SMB unit

Use this procedure to remove the SMB unit.

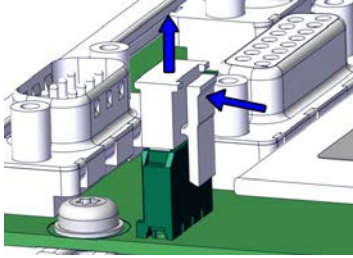
	Action	Note
1	Move the robot to the calibration position.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
3	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">The unit is sensitive to ESD on page 62</a> .	
4	Remove the SMB cover by unscrewing its attachment screws.   <b>CAUTION</b> Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	Shown in the figure <a href="#">Location of SMB unit on page 264</a> .
5	Use caution and remove the connectors X8, X9 and X10 from the brake release board, if need of more space.	
6	Remove the nuts and washers from the guide pins that secure the board.	Shown in the figure <a href="#">Location of SMB unit on page 264</a> .
7	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

Continues on next page

## 4 Repair



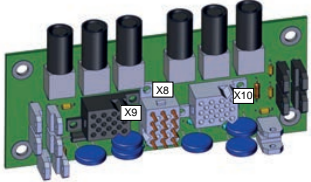
### 4.5.1 Replacing the SMB unit

Continued


	Action	Note
8	Disconnect the battery cable by pressing down the upper lip of the R2.G connector to release the lock while pulling the connector upwards.	 <p>xx1700000993</p>

### Refitting, SMB unit

Use this procedure to refit the SMB unit.

	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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>	
2	 <p><b>ELECTROSTATIC DISCHARGE (ESD)</b></p> <p>The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">The unit is sensitive to ESD on page 62</a>.</p>	
3	Connect the <i>battery cable</i> to the SMB unit. Make sure the lock on the battery cable connector R2.G snaps into place during refitting.	Shown in the figure <a href="#">Location of SMB unit on page 264</a> .
4	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 264</a> . Shown in the figure <a href="#">Location of SMB unit on page 264</a> .
5	Fit the <i>SMB unit</i> onto the <i>guide pins</i> .	
6	Secure the SMB unit to the pins with the nuts and washers.	
7	If disconnected, reconnect the connectors X8, X9 and X10 to the brake release board. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 <p>xx1700000978</p>

Continues on next page

	Action	Note
8	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 264</a> .
9	Update the revolution counters.	See <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .
10	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

## 4 Repair

### 4.5.2 Replacement of brake release board

#### 4.5.2 Replacement of brake release board

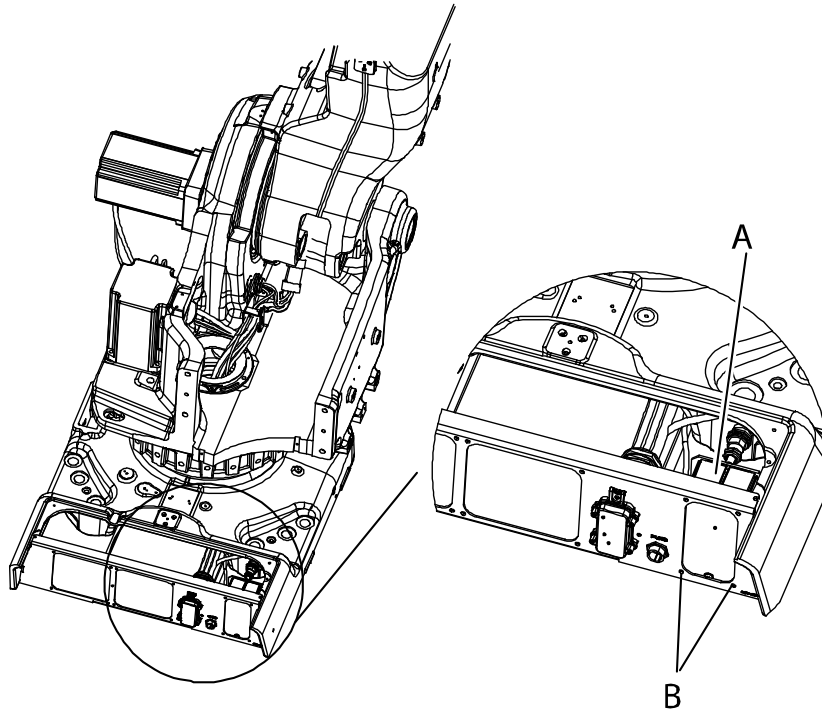
##### Different designs

Depending on the robot version, the brake release board may be located either at the base or at the frame. The following two figures show the different locations.

The early design includes a brake release board with or without push buttons, located at the base. The later design instead includes a brake release board with push buttons, placed together with the SMB unit on the left hand side of the frame. The different designs are not compatible.

##### Location of brake release board, base

The early design includes a brake release board with or without push buttons, located at the base as shown in the figure below.



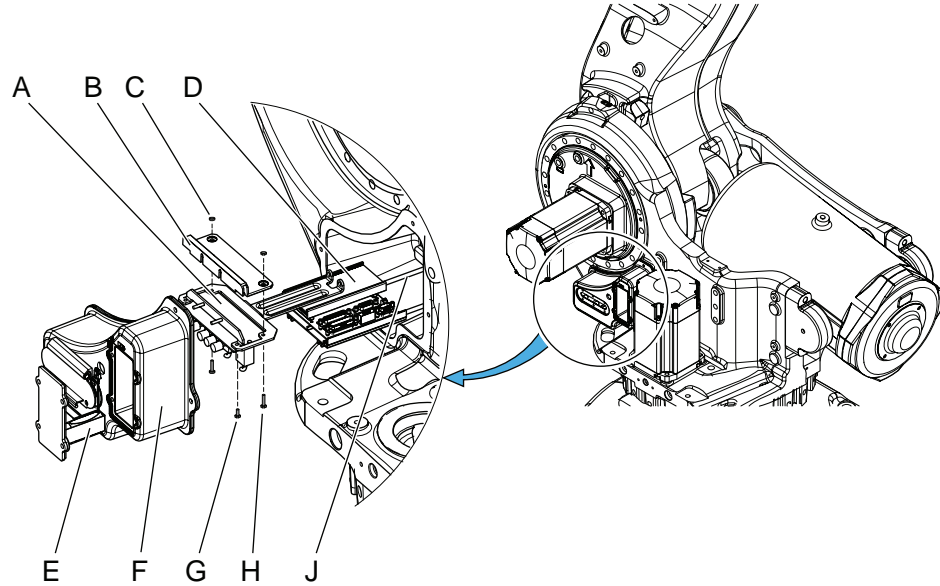
xx0200000127

A	Brake release circuit (brake release unit inside)
B	Attachment screws, brake release circuit, 4 pcs

*Continues on next page*

**Location of brake release board, frame**

The later design includes a brake release board with push buttons, placed together with the SMB unit on the left hand side of the frame as shown in the figure below.



xx0200000203

A	Break release unit
B	Break unit cover
C	Hexagon nut
D	Pins
E	Battery unit
F	SMB cover
G	Attachment screw, (2 pcs)
H	Attachment screw, brake unit cover (2 pcs)
J	Pins

**Required equipment**

Equipment, etc.	Spare part number	Note
Brake release circuit without buttons, at base	3HAC14219-1	Brake release at the base, according to figure <a href="#">Location of brake release board, base on page 268</a> . Includes brake release unit 3HAC14228-1.
Brake release circuit with buttons, at base	3HAC12989-1	Brake release at the base, according to figure <a href="#">Location of brake release board, base on page 268</a> . Includes brake release board 3HAC16036-1.
Brake release unit with harness, at frame	3HAC065021-001	Brake release unit at the frame, according to figure <a href="#">Location of brake release board, frame on page 269</a> . DSQC1052

Continues on next page

## 4 Repair



### 4.5.2 Replacement of brake release board

*Continued*

Equipment, etc.	Spare part number	Note
Push button guard	3HAC2744-1	
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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 of brake release circuit, located at base



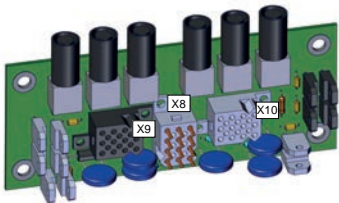
The procedure below details how to remove the brake release board, located at the rear of the base. See the figure [Location of brake release board, base on page 268](#).

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"><li>• electric power supply</li><li>• hydraulic pressure supply</li><li>• air pressure supply</li></ul> to the robot, before entering the robot working area.	
2	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">The unit is sensitive to ESD on page 62</a> .	
3	Remove the cover at the rear of the base.	
4	Unscrew the four <i>attachment screws, brake release circuit</i> on the outside of the base.	Shown in the figure <a href="#">Location of brake release board, base on page 268</a> .
5	Disconnect the cable from the brake release circuit and remove the circuit from the base.	

*Continues on next page*

**Removal of brake release board, located on frame**

The procedure below details how to remove the brake release board, located on the side of the frame. See the figure [Location of brake release board, frame on page 269](#).

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply</li> <li>• hydraulic pressure supply</li> <li>• air pressure supply</li> </ul> to the robot, before entering the robot working area.	
2	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">The unit is sensitive to ESD on page 62</a> .	
3	Remove the <i>push button guard</i> from the SMB cover.	Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> . The guard must be removed to ensure a correct refitting of the brake release unit.
4	Remove the <i>SMB cover</i> by unscrewing the attachment screws. 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, frame on page 269</a> .
5	Take a picture or make notes of how the robot cabling is positioned in regard to the brake release board.	
6	Disconnect the connectors X8, X9 and X10 from the brake release board.	 xx170000978
7	Unscrew the two <i>attachment screws, brake release unit</i> .	Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> !
8	Unscrew the two <i>attachment screws and nuts, brake unit cover</i> , and remove the <i>brake unit cover</i> .	Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> !
9	Remove the brake release board from the plate.	Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> !

Continues on next page


## 4 Repair

### 4.5.2 Replacement of brake release board

Continued


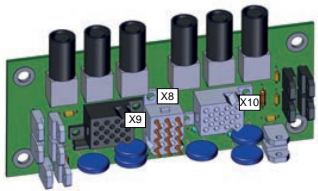
#### Refitting of brake release circuit, located at base

The procedure below details how to refit the brake release circuit, located at the rear of the base. See the figure [Location of brake release board, base on page 268](#).

	Action	Note
1	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">The unit is sensitive to ESD on page 62</a> .	
2	Place the <i>brake release unit</i> in the base of the robot.	Spare part no. is specified in <a href="#">Required equipment on page 269</a> . Shown in the figure <a href="#">Location of brake release board, base on page 268</a> .
3	Reconnect the cable to the brake release unit.	
4	Secure the <i>SMB cover</i> with its attachment screws.	Shown in the figure <a href="#">Location of brake release board, base on page 268</a> .
5	Refit the cover of the rear of the base.	





#### Refitting of brake release board, located on frame

The procedure below details how to refit the brake release board, located on the side of the frame. See the figure [Location of brake release board, frame on page 269](#).

	Action	Note
1	 <b>ELECTROSTATIC DISCHARGE (ESD)</b> The unit is sensitive to ESD. Before handling the unit read the safety information in section <a href="#">The unit is sensitive to ESD on page 62</a> .	
2	Fit the <i>brake release board</i> on the plate with the attachment screws. Make sure the board is positioned as straight as possible on the plate! The push buttons can otherwise get jammed when the SMB-cover is refitted.	Maximum tightening torque: 5 Nm. Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> . Spare part no. is specified in <a href="#">Required equipment on page 269</a> .
3	Place the <i>brake unit cover</i> on the <i>brake release unit</i> .	
4	Secure the <i>brake unit cover</i> with the two attachment screws and nuts, <i>brake unit cover</i> .	
5	Connect the connectors X8, X9 and X10 to the brake release board. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 xx170000978

Continues on next page



	Action	Note
6	<p>Verify that the robot cabling is positioned correctly, according to previously taken picture/notes.</p> <p> <b>WARNING</b></p> <p>Screened cables must not get in contact with the brake release board after installation. Eliminate all risks of contact between screened cables and the brake release board.</p>	<p>Make sure that the white cables run like shown in the figure.</p>  <p>xx1700001155</p>
7	Refit the <i>SMB cover</i> with its attachment screws.	Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> .
8	<p> <b>WARNING</b></p> <p>Before continuing any service work, follow the safety procedure in section <a href="#">The brake release buttons may be jammed after service work on page 213!</a></p>	
9	Refit the <i>push button guard</i> on the <i>SMB cover</i> .	Shown in the figure <a href="#">Location of brake release board, frame on page 269</a> .
10	Press the push buttons 1 to 6, one at a time, to make sure that the buttons are moving freely and do not stay in any locked position.	
11	If the battery has been disconnected the revolution counters must be updated.	Detailed in section <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .
12	<p> <b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

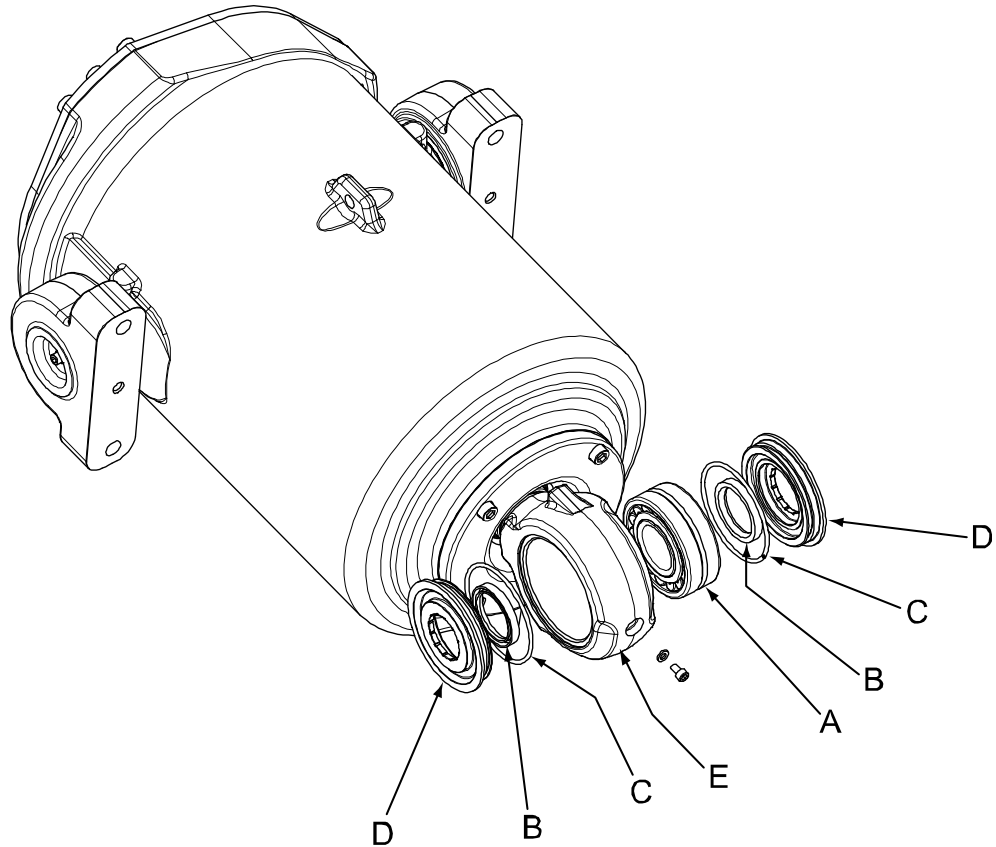
## 4 Repair

### 4.5.3 Replacement of spherical roller bearing, balancing device

### 4.5.3 Replacement of spherical roller bearing, balancing device

#### Location of bearing

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



xx0500002249

A	Spherical roller bearing
B	Sealing ring
C	O-ring
D	Sealing spacer
E	Front ear of balancing device

#### Required equipment

Equipment	Spare part no.	Art. no.	Note
Spherical roller bearing	3HAA2167-17		
Sealing spacer	3HAC12988-1		2 pcs required.
O-ring	3HAB3772-76		2 pcs required.
Sealing ring	3HAC11581-6		2 pcs required.
Grease		3HAC042536-001	For lubrication of the components.

*Continues on next page*

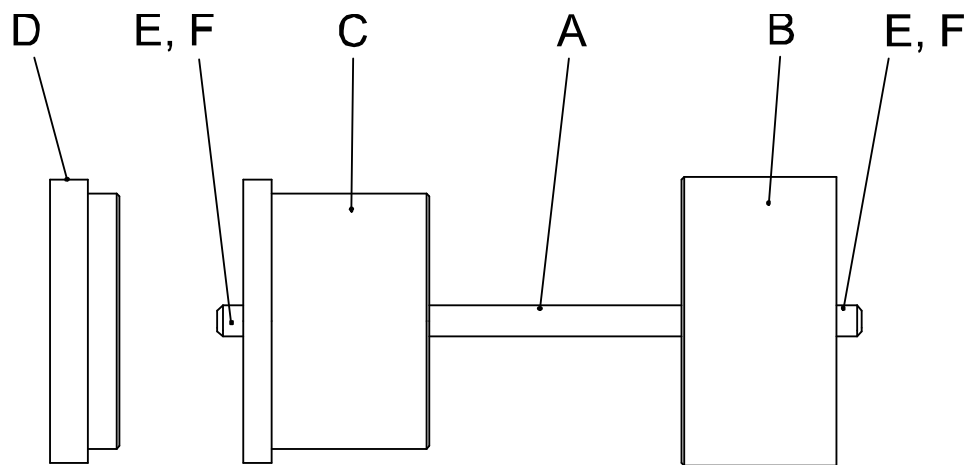
4.5.3 Replacement of spherical roller bearing, balancing device

Continued

Equipment	Spare part no.	Art. no.	Note
Toolkit		3HAC15943-1	The tools in the set are shown in the section Tool set.
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

The parts of the tool set for replacing the spherical roller bearing are shown in the figure.




xx0500002259

A	Threaded bar
B	Dolly
C	Press tool for removal of bearing
D	Press tool for refitting of bearing
E	Hexagon nut M12 (2pcs)
F	Plain washer 13x24x2,5 (2pcs)

Removal, spherical roller bearing

Use this procedure to remove the spherical roller bearing from the balancing device front ear.

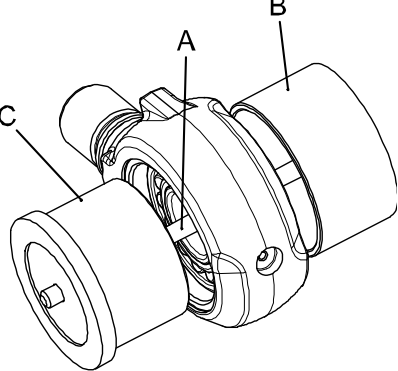
Action	Note
<p>1</p>  <p><b>DANGER</b></p> <p>Turn off all:</p> <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	

Continues on next page

## 4 Repair


### 4.5.3 Replacement of spherical roller bearing, balancing device

*Continued*

	Action	Note
2	Remove the balancing device from the robot.	Detailed in section <a href="#">Replacing the balancing device on page 279</a> .
3	Remove the both <i>sealing spacers</i> with a screwdriver or any equal tool.	Shown in the figure <a href="#">Location of bearing on page 274</a> .
4	Insert the threaded bar through the bearing.	
5	Fit the press tool and dolly to the threaded bar. Secure with the nut and washer at each end.	 <p data-bbox="963 887 1062 909">xx0500002255</p> <p data-bbox="991 920 1337 1021"> <b>A</b> Threaded bar 3HAC15945-1  <b>B</b> Dolly 3HAC15948-1  <b>C</b> Press tool 3HAC15941-1         </p>
6	Press out the bearing from the front ear.	

### Refitting, spherical roller bearing

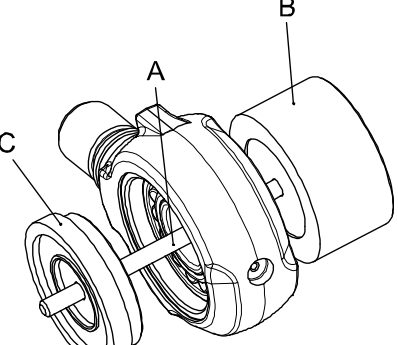

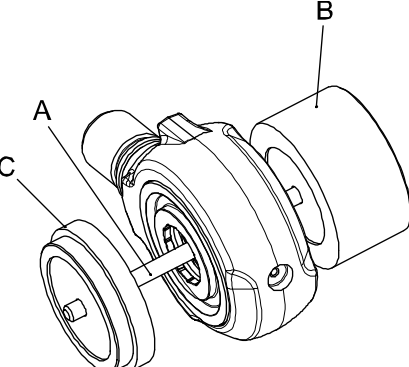

Use this procedure to refit the spherical roller bearing to the balancing device front ear.

	Action	Note
1	 <p data-bbox="564 1312 671 1335"><b>DANGER</b></p> <p data-bbox="469 1368 600 1391">Turn off all:</p> <ul data-bbox="504 1402 938 1536" style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> <p data-bbox="469 1536 906 1559">Before entering the robot working area.</p>	
2	Grease the inside walls of the front ear.	

*Continues on next page*

## 4.5.3 Replacement of spherical roller bearing, balancing device

Continued

	Action	Note
3	<p>Insert the threaded bar through the new <i>bearing</i> and place it at the front ear. Fit also the press tool and the dolly to the bar as shown in the figure to the right.</p> <p>Secure with the nut and washer at each end.</p>	<p>Spare part no. is specified in <a href="#">Required equipment on page 274</a>.</p>  <p>xx0500002257</p> <p>A Threaded bar 3HAC15945-1 B Dolly 3HAC15948-1 C Press tool 3HAC15846-1</p>
4	Press in the bearing properly inside the ear.	
5	Apply grease to the new <i>sealing rings</i> and <i>o-rings</i> and fit one of each to the new <i>sealing spacers</i> . Also, grease the sealing spacers.	Spare part no:s are specified in <a href="#">Required equipment on page 274</a> .
6	<p>Press in the sealing spacers with the press tools, as shown in the figure to the right.</p> <p>Secure the press tool and dolly with nuts and washers.</p> <p> <b>Note</b></p> <p>Fit the sealing spacers one at a time!</p>	 <p>xx0500002258</p> <p>A Threaded bar 3HAC15945-1 B Dolly 3HAC15948-1 C Press tool 3HAC15846-1</p>
7	Refit the balancing device to the robot.	Detailed in section <a href="#">Refitting, balancing device on page 286</a> .
8	<p>Lubricate the spherical roller bearing in the ear.</p> <p> <b>Note</b></p> <p>The balancing device must be mounted on the robot when lubrication is performed!</p>	Detailed in section <a href="#">Lubrication of spherical roller bearing, balancing device on page 190</a>
9	Make sure no incorrect leakage occurs. It could indicate damaged o-rings.	This is detailed in section <a href="#">Check for leakage on page 147</a> .


Continues on next page

## 4 Repair

---

### 4.5.3 Replacement of spherical roller bearing, balancing device

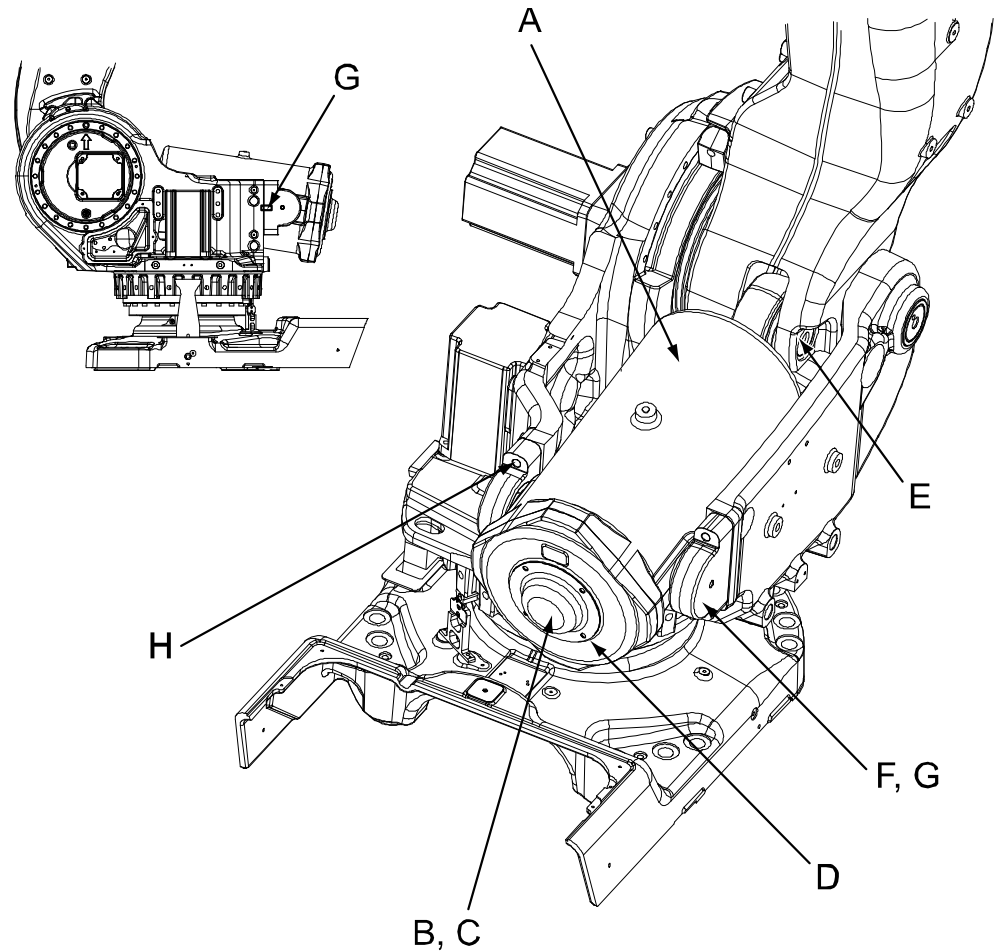
*Continued*

	Action	Note
10	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

### 4.5.4 Replacing the balancing device

#### Location of balancing device

The balancing device is located on rear top of the frame as shown in the figure below.



xx0100000139

A	Balancing device
B	Rear cover
C	Support shaft inside (included in balancing device 3HAC14675-1)
D	Attachment screws, rear cover
E	Balancing device shaft, including screw and washer
F	Bearing attachment
G	Parallel pin (inside bearing attachment)
H	Attachment screws, bearing attachment

*Continues on next page*

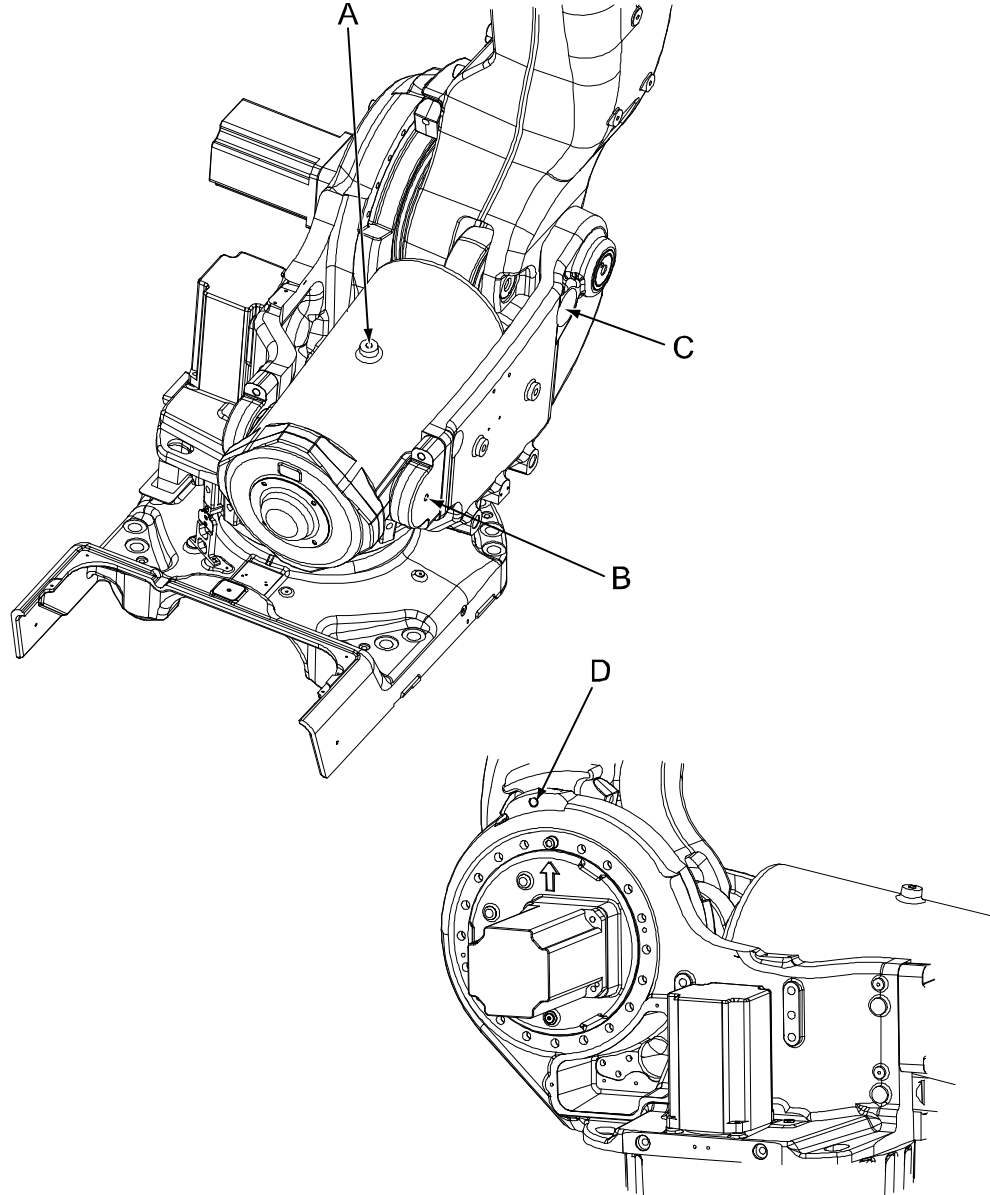
## 4 Repair

### 4.5.4 Replacing the balancing device

*Continued*

#### Attachment points, balancing device

The attachment points for the lifting tools etc. are located as shown in the figure below.



xx0600002653

A	Attachment hole for lifting eye, M12
B	Attachment hole for securing screw that secures the bearing attachment to the balancing device (protection plug fitted normally)
C	Hole in frame to access the balancing device front eye shaft with the puller/press tool
D	Attachment hole for locking screw that secures the lower arm to the frame

*Continues on next page*



## Required equipment

Equipment	Spare part no.	Art. no.	Note
Balancing device	See <i>Spare part lists on page 427.</i>		Includes: <ul style="list-style-type: none"> <li>balancing device 3HAC14675-1 or 3HAC023018-001</li> <li>o-ring 3HAB3772-44 (2 pcs)</li> </ul>
O-ring		3HAB3772-44	2 pcs , to be replaced if damaged! (included with the new balancing device)
Locking screw		3HAB3409-90	M16 x 90 For securing the lower arm.
Securing screw		9ADA183-66	M12 x 35, 2 pcs required For securing the bearing attachments to the balancing device when lifting.
Bearing grease		3HAC042536-001	For lubricating the o-rings and the shaft.
Grease		3HAA1001-294	150 ml, Tribol GR 100-0-PD For lubrication of spherical roller bearing in ear, in case of new balancing device.
Locking liquid		-	Loctite 243 To apply to the securing screw in the shaft.
Locking liquid		-	Loctite 577 Used to secure the attachment screws of the rear cover at the end of the balancing device.
Grease pump		-	To lubricate spherical roller bearing.
Guide pins M16 x 300		3HAC13120-5	Always use guide pins in pairs!
Lifting eye M12		3HAC14457-3	
Lifting tool (chain)		3HAC15556-1	
Press equipment, balancing device		3HAC074411-001	For unloading the balancing device. User instructions are enclosed with the tool.
Adapter for Press equipment, balancing device		3HAC078221-001	To be used with 3HAC074411-001 for balancing devices from 2002 and older.
Press equipment, balancing device shaft		3HAC076202-001	For replacing the balancing device shaft. User instructions are enclosed with the tool.

Continues on next page

## 4 Repair

### 4.5.4 Replacing the balancing device



Continued

Equipment	Spare part no.	Art. no.	Note
Hydraulic cylinder		3HAC11731-1	To be used with the press and puller tools. See technical specifications in the user instructions for the press equipment.
Hydraulic pump 80 MPa		3HAC13086-1	To be used with the hydraulic cylinder. See technical specifications in the user instructions for the press equipment.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</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, balancing device


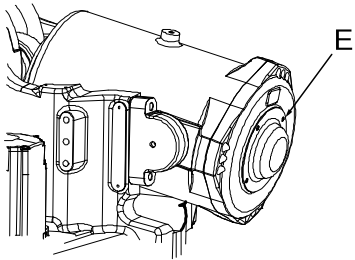
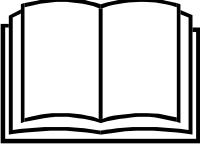

The procedures below detail how to remove the balancing device.

#### Preparations before removing the balancing device

	Action	Note
1	Move the lower arm to a position close to the calibration position.	
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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Secure the lower arm to the frame by inserting the <i>locking screw</i> into the attachment hole in the frame.	Attachment hole for the locking screw is shown in the figure <a href="#">Attachment points, balancing device on page 280</a> . Art. no. is specified in <a href="#">Required equipment on page 281</a> !
4	 <b>CAUTION</b> The balancing device weighs 300 kg! All lifting equipment used must be sized accordingly!	
5	Fit the <i>lifting eye, M12</i> to the balancing device and raise to unload the weight.	Art. no. is specified in <a href="#">Required equipment on page 281</a> ! Attachments are shown in the figure <a href="#">Attachment points, balancing device on page 280</a> .

Continues on next page

Unloading the balancing device

	Action	Note
1	<p>Remove the <i>rear cover</i> of the balancing device, by unscrewing the <i>attachment screws</i>.</p>  <p><b>DANGER</b></p> <p>DO NOT! remove any other screws than the rear cover attachment screws.</p>	 <p>xx0200000175</p> <ul style="list-style-type: none"> <li>E: Rear cover attachment screws, 4 pcs</li> </ul>
2	<p>Remove the o-ring from the balancing device end.</p>	
3	<p>Remove the support shaft.</p>	
4	<p>Unload the balancing device with the <i>press equipment</i> in order to make the piston rod and front ear adjustable when pulling the shaft out.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p>  <p><b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury.</p> <p>Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 281</a>!</p> <p>User instructions are enclosed with the tool.</p>

Removing the balancing device shaft

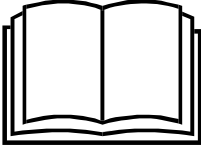

	Action	Note
1	<p>Remove the securing screw and washer from the <i>balancing device shaft</i>.</p>	<p>Shown in the figure <a href="#">Location of balancing device on page 279</a>!</p>

Continues on next page

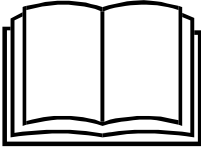

## 4 Repair

### 4.5.4 Replacing the balancing device

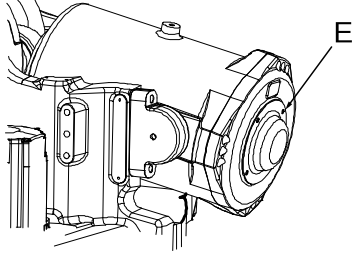

Continued

	Action	Note
2	<p>Pull the shaft out using the <i>press equipment, balancing device shaft</i>, according to user instructions enclosed with the equipment.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 281</a>!</p> <p>User instructions are enclosed with the tool.</p>


### Restoring the balancing device

	Action	Note
1	<p>Restore the balancing device according to instructions for the <i>press equipment</i>.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 281</a>!</p> <p>User instructions are enclosed with the tool.</p>
2	<p>Lubricate and refit the o-ring at the end of the balancing device.</p>	<p>Make sure the o-ring is seated properly! Replace if damaged.</p>
3	<p>Refit the support shaft to the balancing device.</p>	
4	<p>Lubricate and refit the o-ring on the support shaft.</p>	<p>Make sure the o-ring is seated properly! Replace if damaged.</p>

Continues on next page

	Action	Note
5	<p>Refit the rear cover to the balancing device with its attachment screws, using locking liquid. Apply sikaflex 521FX on the cover.</p>	 <p>xx0200000175</p> <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 281</a>.</p>
6	 <p><b>DANGER</b></p> <p>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!</p>	

#### Removing the balancing device

	Action	Note
1	<p>Secure the two <i>bearing attachments</i> to the balancing device by replacing the protection plug on the outside of each attachment, with <i>securing screws</i>. The protection plugs must be refitted after refitting the balancing device, do not loose them!</p>	<p>Shown in the figure <a href="#">Attachment points, balancing device on page 280</a>!</p> <p>Dimensions for the securing screws are specified in <a href="#">Required equipment on page 281</a>.</p>
2	<p>Remove the two <i>bearing attachments</i> from the frame by unscrewing their four <i>attachment screws</i>.</p>	<p>Shown in the figure <a href="#">Location of balancing device on page 279</a>!</p> <p>Make sure the parallel pins inside are not lost!</p>
3	<p>Fit two <i>guide pins</i> through the upper holes of the bearing attachments, to the frame.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 281</a>!</p>
4	<p>Lift the balancing device gently backwards to a secure area, allowing the bearing attachments to slide on the guide pins.</p>	 <p><b>Note</b></p> <p>Make sure not to burden the guide pins with the weight of the balancing device!</p>

*Continues on next page*

## 4 Repair




### 4.5.4 Replacing the balancing device

Continued

#### Refitting, balancing device

The procedures below detail how to refit the balancing device.


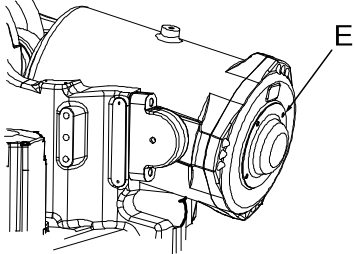
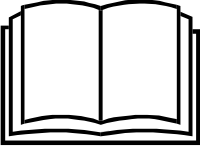

#### Refitting the balancing device

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Secure the lower arm to the frame by inserting the <i>locking screw</i> into the attachment hole in the frame.	Art. no. is specified in <a href="#">Required equipment on page 281!</a> Attachment hole is shown in the figure <a href="#">Attachment points, balancing device on page 280</a> .
3	Secure the <i>bearing attachments</i> to the balancing device with <i>securing screws</i> .	Shown in the figure <a href="#">Attachment points, balancing device on page 280!</a> Dimension of the securing screws is specified in <a href="#">Required equipment on page 281</a> .
4	Refit the two <i>parallel pins</i> in the frame.	Shown in the figure <a href="#">Location of balancing device on page 279!</a>
5	Fit two <i>guide pins</i> to the upper holes in the frame, where the bearing attachments are to be attached.	
6	Fit the <i>lifting eye</i> to the balancing device.	Art. no. is specified in <a href="#">Required equipment on page 281!</a> Attachments are shown in the figure <a href="#">Attachment points, balancing device on page 280</a> .
7	 <b>CAUTION</b> The balancing device weighs 300 kg! All lifting equipment used must be sized accordingly!	
8	Lift the balancing device and bring it forward, gliding the bearing attachments on to the guide pins.	 <b>Note</b> Make sure not to burden the guide pins with the weight of the balancing device!
9	Remove the guide pins.	

Continues on next page

	Action	Note
10	Secure the rear of the balancing device by fastening the two bearing attachments to the frame with their four <i>attachment screws</i> .	Shown in the figure <a href="#">Location of balancing device on page 279!</a> 4 pcs, M16x90, 12.9 quality UN-BRAKO, tightening torque: 300 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
11	Remove the screws from outside of the bearing attachments and refit the protection plugs.	
12	Raise the balancing device to a position where the balancing device shaft may be inserted through the piston shaft front eye.	

#### Unloading the balancing device

	Action	Note
1	<p>Remove the <i>rear cover</i> of the balancing device, by unscrewing the <i>attachment screws</i>.</p>  <p><b>DANGER</b></p> <p>DO NOT! remove any other screws than the rear cover attachment screws.</p>	 <p>xx0200000175</p> <ul style="list-style-type: none"> <li>E: Rear cover attachment screws, 4 pcs</li> </ul>
2	Remove the o-ring from the balancing device end.	
3	Remove the support shaft.	
4	<p>Unload the balancing device with the <i>press equipment</i> in order to make the piston rod and front ear adjustable when pulling the shaft out.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p>  <p><b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 281!</a> User instructions are enclosed with the tool.</p>

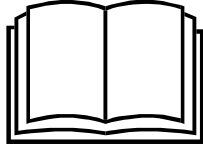


*Continues on next page*

## 4 Repair

### 4.5.4 Replacing the balancing device

Continued

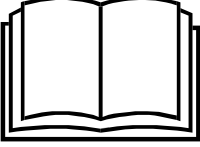

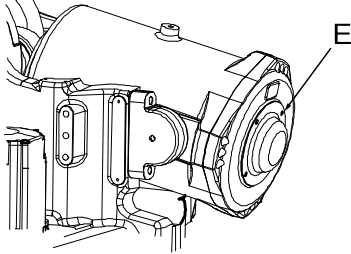

#### Refitting the balancing device shaft

	Action	Note
1	Lubricate the shaft with grease.	Art. no. is specified in <a href="#">Required equipment on page 281!</a>
2	<p>Fit the shaft to the piston shaft front eye through the hole in the frame, using the <i>press equipment, balancing device shaft</i>, according to user instructions enclosed with the equipment.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p>  <p><b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 281!</a> User instructions are enclosed with the tool.</p>  <p><b>Note</b></p> <p>Make sure the shaft is pressed all the way to the bottom.</p>
3	Refit the securing screw and washer into the shaft using <i>locking liquid</i> .	M16 x 180, tightening torque: 120 Nm. Locking liquid is specified in <a href="#">Required equipment on page 281!</a>
4	Lubricate the spherical roller bearing through the lubrication nipple in the ear with <i>grease</i> , approximately 5 grams.	Art. no. and amount are specified in <a href="#">Required equipment on page 281!</a> Lubrication is further detailed in section <a href="#">Lubrication of spherical roller bearing, balancing device on page 190</a> .
5	Clean the area from any excessive grease.	

Continues on next page



Restoring the balancing device

	Action	Note
1	<p>Restore the balancing device according to instructions for the <i>press equipment</i>.</p>  <p>xx0900000813</p> <p>Go to the user instructions enclosed with the press tool.</p> <p> <b>DANGER</b></p> <p>Handling the tool incorrectly will cause serious injury.</p> <p>Read and follow enclosed user instructions for the tool.</p>	<p>Art. no. is specified in <i>Required equipment on page 281!</i></p> <p>User instructions are enclosed with the tool.</p>
2	<p>Lubricate and refit the o-ring at the end of the balancing device.</p>	<p>Make sure the o-ring is seated properly! Replace if damaged.</p>
3	<p>Refit the support shaft to the balancing device.</p>	
4	<p>Lubricate and refit the o-ring on the support shaft.</p>	<p>Make sure the o-ring is seated properly! Replace if damaged.</p>
5	<p>Refit the rear cover to the balancing device with its attachment screws, using locking liquid. Apply sikaflex 521FX on the cover.</p>	 <p>xx0200000175</p> <ul style="list-style-type: none"> <li>E: 4 pcs: M10x30, tightening torque: 50 Nm.</li> </ul> <p>Locking liquid is specified in <i>Required equipment on page 281</i>.</p>
6	<p> <b>DANGER</b></p> <p>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!</p>	

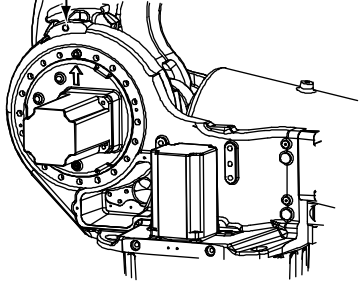

Continues on next page

## 4 Repair

### 4.5.4 Replacing the balancing device

*Continued*

#### Concluding procedure

	Action	Note
1	Remove the locking screw that secures the lower arm to the frame.	<p>1</p>  <p>xx0200000454</p> <p>1 Attachment hole for the securing screw.</p>
2	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

## 4.6 Motors

### 4.6.1 Replacement of motor, axis 1



#### Note

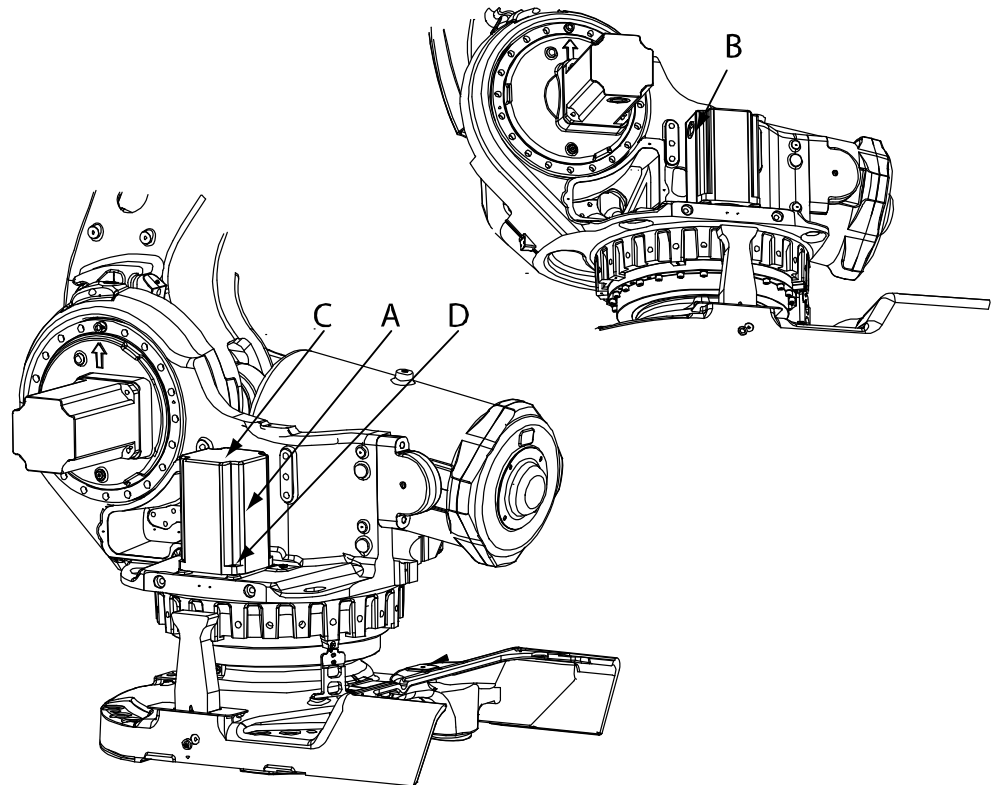
This procedure requires calibration of the robot.

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

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

#### Location of motor

The motor axis 1 is located on the left hand side of the robot as shown in the figure below.



xx010000123

A	Motor, axis 1
B	Cable gland cover, motor axis
C	Cover for connector access
D	Motor attachment screws

*Continues on next page*

## 4 Repair

### 4.6.1 Replacement of motor, axis 1

*Continued*

#### Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion	See <a href="#">Spare part lists on page 427</a> .		Includes <ul style="list-style-type: none"><li>• motor</li><li>• pinion</li><li>• o-ring 21522012-430.</li></ul>
O-ring	21522012-430		Must be replaced when reassembling the motor.
Mobilux EP 2	-	-	Used to lubricate the motor clutch.
Grease		3HAC042536-001	Used to lubricate the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!
Lifting tool, motor ax 1, 4, 5		3HAC14459-1	
Extension 300mm 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 421</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter <a href="#">Circuit diagram on page 429</a> .

*Continues on next page*


**Deciding calibration routine**

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a> .
	<b>If the robot is to be calibrated with fine calibration:</b> Remove all external cable packages (DressPack) and tools from the robot.	

**Removal, motor axis 1**

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


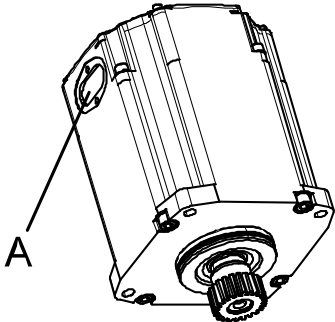

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>electric power supply to the robot</li> <li>hydraulic pressure supply to the robot</li> <li>air pressure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

Continues on next page

## 4 Repair


### 4.6.1 Replacement of motor, axis 1

Continued



	Action	Note
4	Remove the cable gland cover at the cable exit by unscrewing its two attachment screws.   <b>Note</b>  Make sure the gasket is not damaged!	  xx0200000199 <ul style="list-style-type: none"> <li>• A: Cable gland cover</li> </ul>
5	Disconnect all connectors beneath the motor cover.	
6	Apply <i>lifting tool, motor axis 1, 4, 5</i> to the motor.	Art. no. is specified in <a href="#">Required equipment on page 292</a> .
7	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>
8	Remove the motor by unscrewing its four <i>attachment screws</i> and plain washers. If required, use the <i>extension 300mm for bits 1/2"</i> .	Shown in the figure <a href="#">Location of motor on page 291</a> . Art. no. is specified in <a href="#">Required equipment on page 292</a> .
9	 <b>CAUTION</b>  The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
10	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
11	Remove the motor by gently lifting it straight up.	

### Refitting, motor axis 1

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

	Action	Note
1	 <b>DANGER</b>  Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 292</a> .

Continues on next page

	Action	Note
3	 <b>CAUTION</b> The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
4	Apply the <i>lifting tool, motor axis 1, 4, 5</i> to the motor.	Art no. is specified in <a href="#">Required equipment on page 292</a> .
5	In order to release the brake, 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>
6	Fit the motor, making sure the motor pinion is properly mated to gearbox of axis 1.	Make sure the motor is turned the correct way, that is connection of motorcable forwards. . Make sure the motor pinion does not get damaged!
7	Fit the clutch on the pinion on the motor.	
8	Secure the motor with its four attachment screws and plain washers.	M10 x 40, tightening torque: 50 Nm.
9	Disconnect the brake release voltage.	
10	Reconnect all connectors beneath the motor cover.	
11	Refit the cable gland cover at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed!
12	Refit the motor cover with its four attachment screws.	Make sure the cover is tightly sealed!
13	Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .
14	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

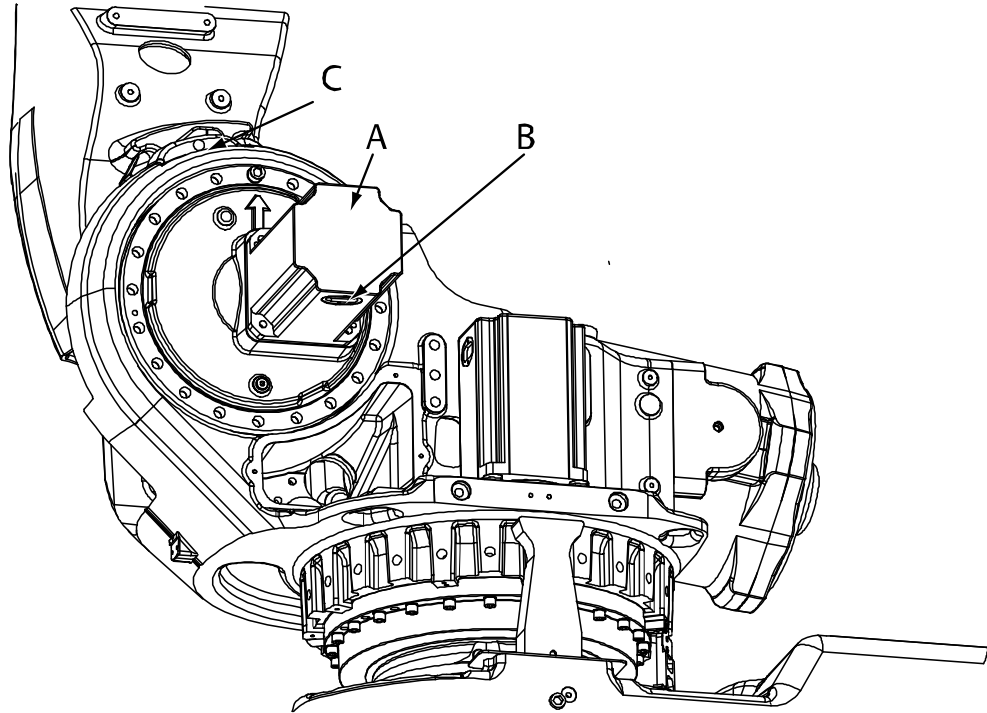
## 4 Repair

### 4.6.2 Replacement of motor axis 2

### 4.6.2 Replacement of motor axis 2

#### Location of motor

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



xx010000124

A	Motor, axis 2
B	Cable gland cover, motor axis 2
C	Hole for lock screw

#### Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor axis 2	See <a href="#">Spare part lists on page 427</a> .		Includes: <ul style="list-style-type: none"><li>• motor</li><li>• pinion</li><li>• o-ring 2152 2012-430</li></ul>
O-ring	21522012-430		Must be replaced when re-assembling motor!
Grease		3HAC042536-001	For lubricating the o-ring.
Locking screw		3HAA1001-266	M16 x 60 For securing the lower arm.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!
Guide pins M10 x 100		3HAC15521-1	For guiding the motor. Guides are to be used in pairs!

Continues on next page



Equipment, etc.	Spare part no.	Art. no.	Note
Guide pins M10 x 150		3HAC15521-2	For guiding the motor. Guides are to be used in pairs!
Lifting tool, motor ax 2, 3, 4		3HAC15534-1	
Extension 300mm for bits 1/2"		3HAC12342-1	
Extension bar, 300 mm for bits 1/2"		3HAC12342-1	
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Rotation tool		3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24VDC power supply.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter <a href="#">Circuit diagram on page 429</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 Repair


### 4.6.2 Replacement of motor axis 2

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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</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, motor

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


Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Move the robot to a position close enough to its calibration position, to allow the lock screw to be inserted into the <i>hole for lock screw</i> .	Shown in the figure <a href="#">Location of motor on page 296</a> .
<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> <li>• air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	
4 Lock the lower arm by inserting the <i>lock screw</i> into the hole.	Art. no. and dimension is specified in <a href="#">Required equipment on page 296</a> .
5 Drain the oil from gearbox, axis 2.	Detailed in the section <a href="#">Changing oil, axis-2 gearbox on page 169</a> .
6 Remove the cover on top of the motor by unscrewing its four attachment screws.	
7 Remove the <i>cable gland cover</i> at the cable exit by unscrewing its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 296</a> . Make sure the gasket is not damaged!
8 Disconnect all connectors beneath the motor cover.	

Continues on next page

	Action	Note
9	 <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 detailed above!
10	In order to release the brake, 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>
11	Remove the motor by unscrewing its four attachment screws and plain washers.	
12	Fit the two <i>guide pins</i> in two of the <i>motor attachment holes</i> .	Art. no. is specified in <a href="#">Required equipment on page 296</a> . Shown in the figure <a href="#">Location of motor on page 296</a> .
13	If required, press the motor out of position by fitting the <i>removal tool, motor</i> to the remaining <i>motor attachment holes</i> .	Art. no. is specified in <a href="#">Required equipment on page 296</a> . Shown in the figure <a href="#">Location of motor on page 296</a> . Always use the removal tools in pairs!
14	Remove the removal tools and fit the <i>lifting tool, motor axis 2, 3, 4</i> to the motor.	Art. no. is specified in <a href="#">Required equipment on page 296</a> .
15	 <b>CAUTION</b> The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
16	Lift the motor to get the pinion away from the gear.	Make sure the motor pinion does not get damaged!
17	Remove the motor by gently lifting it straight out and place it on a secure surface. Disconnect the brake release voltage.	

### Refitting, motor

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



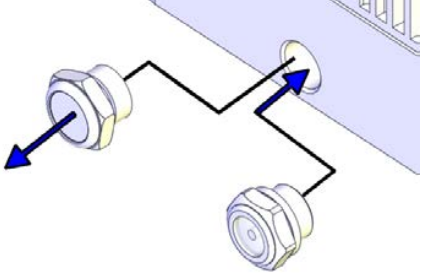

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	

Continues on next page

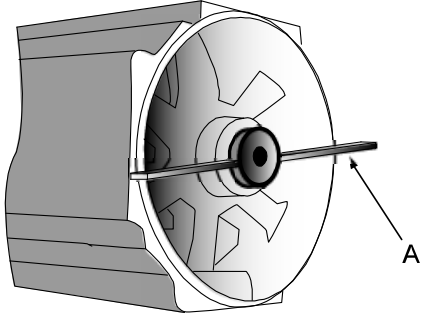

## 4 Repair

### 4.6.2 Replacement of motor axis 2

Continued

	Action	Note
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 296</a> .
3	<p><b>Foundry Plus:</b> If the motor is a new spare part, the evacuation hole protection filter must be replaced with a transparent plug/sight glass (enclosed with the spare part delivery). Remove the protection filter and install the transparent plug/sight glass.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>xx1800000101 Protection filter (Standard).</p> </div> <div style="text-align: center;">  <p>xx1800000102 Transparent plug (Foundry Plus).</p> </div> </div>	<p>Tightening torque, transparent plug: 20 Nm <math>\pm</math>10%. Tightening torque, protection filter: 10 Nm <math>\pm</math>10%.</p>  <p>xx1600000576</p>
4	In order to release the brake, remove the cover on top of the motor and connect the 24 VDC power supply.	<p>Connect to connector R2.MP2</p> <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>
5	Fit the <i>lifting tool</i> , <i>motor axis 2, 3, 4</i> to the motor.	Art. no. is specified in <a href="#">Required equipment on page 296</a> .
6	Fit the two <i>guide pins</i> in the two lower <i>motor attachment holes</i> .	<p>Art. no. is specified in <a href="#">Required equipment on page 296</a>. Shown in the figure <a href="#">Location of motor on page 296</a>.</p>
7	<p> <b>CAUTION</b></p> <p>The motor weighs 32 kg! All lifting equipment used must be sized accordingly!</p>	
8	<p>Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear.</p> <p>Make sure that the motor is turned the right direction, that is the cables facing downwards.</p>	
9	Remove the lifting tool and allow the motor to rest on the guide pins.	

Continues on next page

	Action	Note
10	Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear (see the figure to the right). Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox axis 2 and that it does not get damaged.	<p>Art. no. is specified in <a href="#">Required equipment on page 296</a>.</p>  <p>xx0200000165</p> <p>The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in the figure above.</p> <ul style="list-style-type: none"> <li>A: Rotation tool</li> </ul>
11	Remove the guide pins.	
12	Secure the motor with four attachment screws and plain washers. If required, use the <i>extension 300mm for bits 1/2"</i> .	M10 x 40, tightening torque: 50 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
13	Disconnect the brake release voltage.	
14	Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
15	Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 296</a> .
16	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
17	Remove the lock screw from the <i>hole for lock screw</i> .	Shown in the figure <a href="#">Location of motor on page 296</a> .
18	Perform a leak down test.	Detailed in <a href="#">Performing a leak-down test on page 206</a> .
19	Refill the gearbox with oil.	Detailed in the section <a href="#">Changing oil, axis-2 gearbox on page 169</a> .
20	Recalibrate the robot.	<p>Pendulum Calibration is described in <a href="#">Operating manual - Calibration Pendulum</a>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>
21	 <p><b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

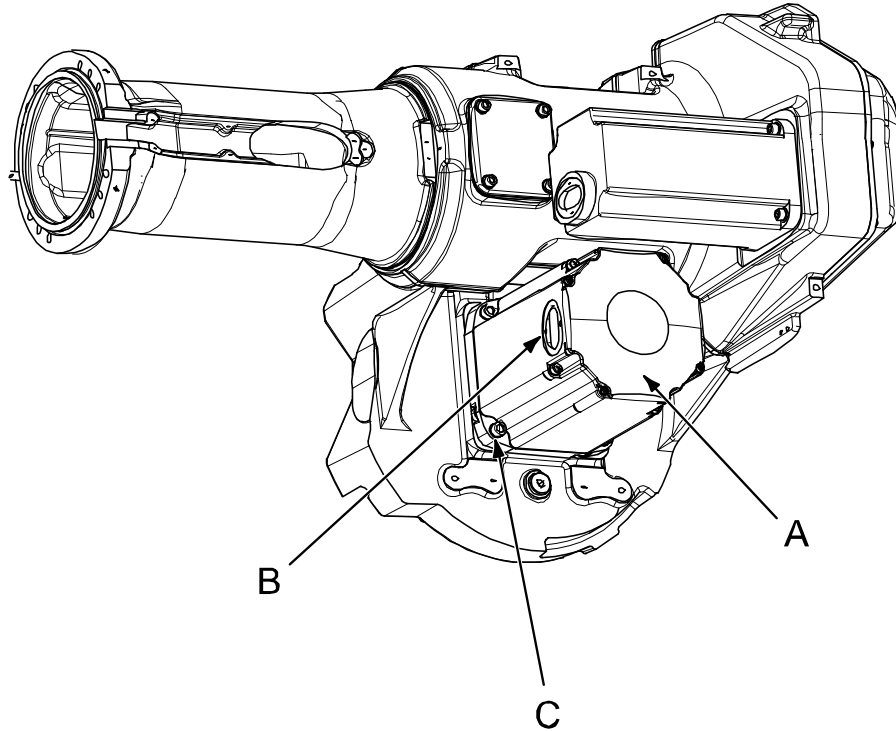
## 4 Repair

### 4.6.3 Replacement of motor, axis 3

### 4.6.3 Replacement of motor, axis 3

#### Location of motor

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



xx020000186

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

#### Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor, axis 3	See <a href="#">Spare part lists on page 427</a> .		Includes: <ul style="list-style-type: none"><li>• motor</li><li>• pinion</li><li>• o-ring 21522012-430.</li></ul>
O-ring	21522012-430		Must be replaced when reassembling motor!
Mechanical stop axis 3		3HAC12708-2	May be used to fix axis 3. Use attachment screws 3HAB 3409-86 (M16 x 60).
Grease		3HAC042536-001	For lubricating the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!

*Continues on next page*

Equipment, etc.	Spare part no.	Art. no.	Note
Lifting tool, motor ax 2, 3, 4		3HAC15534-1	
Bolts M16x60 (for mechanical stop axis 3)		3HAB3409-86	
Washers (for mechanical stop axis 3)		3HAA1001-186	
Guide pins M10 x 100		3HAC15521-1	For guiding the motor.
Guide pins M10 x 150		3HAC15521-2	For guiding the motor.
Extension 300mm for bits 1/2"		3HAC12342-1	
Rotation tool		3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24 VDC power supply.
Power supply		-	24 VDC, max. 1.5 A For releasing the brakes.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter <a href="#">Circuit diagram on page 429</a> .

Continues on next page

## 4 Repair

### 4.6.3 Replacement of motor, axis 3

Continued

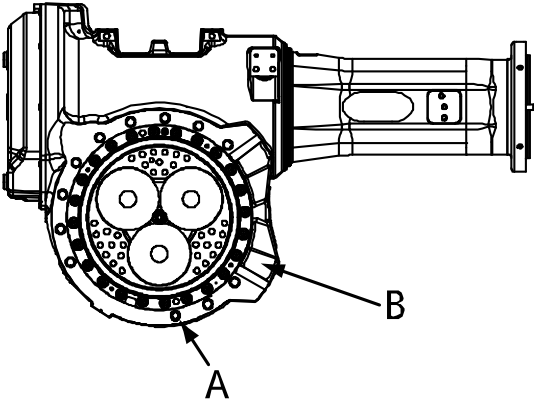
#### Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <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>	
	<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
	<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	



#### Removal, motor

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

	Action	Note
1	<p>Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.</p>	
2	<p>Unload the upper arm of the robot by either:</p> <ul style="list-style-type: none"> <li>Move the robot to a position where the turning disk rests against the foundation (recommended).</li> <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 mechanical stop in the attachment hole (A) with tightening torque: 115 Nm.</li> </ul>	 <p>xx030000051</p> <p>Fit the mechanical stop to the third and final attachment hole (A), below the fixed stop (B) in the upper arm. See the figure above!</p>

Continues on next page



	Action	Note
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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
4	Drain the oil from gearbox axis 3.	Detailed in section <a href="#">Changing oil, axis-3 gearbox on page 172.</a>
5	Remove any equipment hindering access to motor axis 3.	
6	Remove the cover on top of the motor by unscrewing its four attachment screws.	
7	Remove the <i>cable gland cover</i> at the cable exit by unscrewing its two securing screws.	Shown in the figure <a href="#">Location of motor on page 302.</a> Make sure the gasket is not damaged!
8	Disconnect all connectors beneath the motor cover.	
9	Unscrew the motors four <i>attachment screws and plain washers</i> .	Shown in the figure <a href="#">Location of motor on page 302.</a>
10	Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 302.</a>
11	Press the motor out of position by fitting <i>removal tool, motor</i> to the remaining motor attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 302.</a> Always use the removal tools in pairs!
12	Apply the <i>lifting tool, motor axis 2 ,3, 4</i> to the motor.	Art. no. is specified in <a href="#">Required equipment on page 302.</a>
13	 <b>CAUTION</b> The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
14	Lift the motor to get the pinion away from the gear.	
15	Remove the motor by gently lifting it straight out and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!

Continues on next page




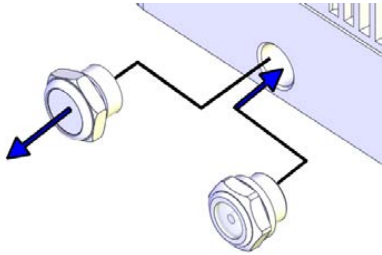

## 4 Repair

### 4.6.3 Replacement of motor, axis 3

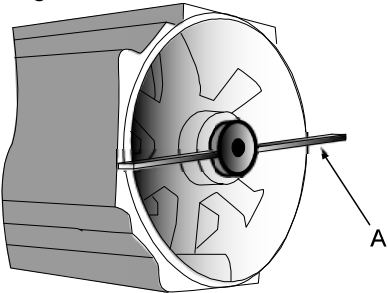
Continued

#### Refitting, motor

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

	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate it with <i>grease</i> .	Art no. is specified in <a href="#">Required equipment on page 302</a> .
3	<b>Foundry Plus:</b> If the motor is a new spare part, the evacuation hole protection filter must be replaced with a transparent plug/sight glass (enclosed with the spare part delivery). Remove the protection filter and install the transparent plug/sight glass. <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">  <p>xx1800000101</p> <p>Protection filter (Standard).</p> </div> <div style="text-align: center;">  <p>xx1800000102</p> <p>Transparent plug (Foundry Plus).</p> </div> </div>	Tightening torque, transparent plug: 20 Nm $\pm$ 10%. Tightening torque, protection filter: 10 Nm $\pm$ 10%. <div style="text-align: right; margin-top: 10px;">  <p>xx1600000576</p> </div>
4	Fit the <i>lifting tool, motor axis 2, 3, 4</i> to the motor.	Art no. is specified in <a href="#">Required equipment on page 302</a> .
5	Fit the two <i>guide pins</i> in the two lower <i>motor attachment holes</i> .	Art no. is specified in <a href="#">Required equipment on page 302</a> . Shown in the figure <a href="#">Location of motor on page 302</a>
6	 <b>CAUTION</b> The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
7	Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear.	
8	Remove the lifting tool and allow the motor to stay on the guide pins.	
9	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP3 <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>

Continues on next page

	Action	Note
10	<p>Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear!</p> <p>Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox, axis 3.</p>	<p>Art no. is specified in <a href="#">Required equipment on page 302</a>.</p> <p>Make sure the motor pinion does not get damaged!</p> <p>Make sure the motor is turned the right direction, that is the cables facing forwards.</p>  <p>xx0200000165</p> <p>The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above.</p> <ul style="list-style-type: none"> <li>A: Rotation tool.</li> </ul>
11	Remove the guide pins.	
12	<p>Secure the motor with four attachment screws and plain washers.</p> <p>If required, use the <i>extension 300mm for bits 1/2"</i>.</p>	<p>4 pcs: M10 x 40, tightening torque: 50 Nm.</p> <p>Art. no. is specified in <a href="#">Required equipment on page 302</a>.</p>
13	Disconnect the brake release voltage.	
14	Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
15	Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	<p>Make sure the cover is tightly sealed!</p> <p>Shown in the figure <a href="#">Location of motor on page 302</a>.</p>
16	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
17	Remove the equipment used to unload the upper arm.	
18	Perform a leak-down test.	Detailed in the section <a href="#">Performing a leak-down test on page 206</a> .
19	Refill the gearbox with oil.	Detailed in the section <a href="#">Changing oil, axis-3 gearbox on page 172</a> .
20	Recalibrate the robot!	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>


Continues on next page

## 4 Repair

---

### 4.6.3 Replacement of motor, axis 3

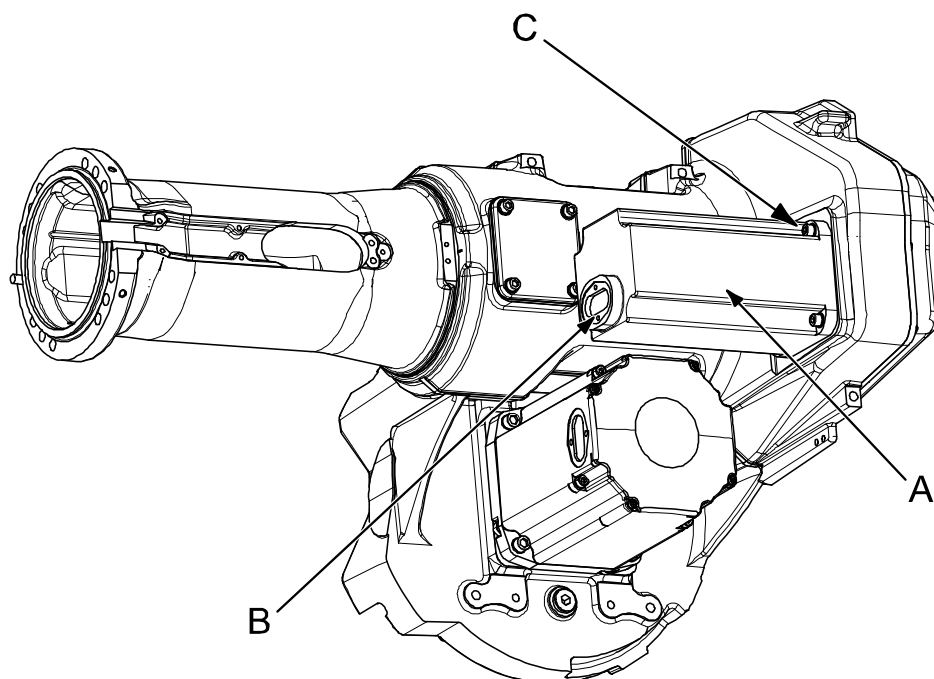
*Continued*

	Action	Note
21	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

### 4.6.4 Replacement of motor, axis 4

#### Location of motor

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



xx0200000202

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

#### Required equipment

Equipment, etc.	Art. no.	Note
Motor including pinion	See spare part number in <a href="#">Spare part lists on page 427</a> .	Includes: <ul style="list-style-type: none"> <li>• motor</li> <li>• pinion</li> <li>• o-ring 21522012-430</li> </ul>
O-ring	21522012-430	Must be replaced when reassembling motor!
Lifting tool, motor ax 1, 4, 5	3HAC14459-1	
Lifting tool, motor ax 2, 3, 4	3HAC15534-1	
Grease	3HAC042536-001	Used to lubricate the o-ring.
Loctite 574, Flange sealant	12340011-116	Option Foundry Plus
Lifting tool, motor ax 1, 4, 5	3HAC14459-1	To be used if the upper arm is positioned vertically.
Lifting tool, motor ax 2, 3, 4	3HAC15534-1	To be used if the upper arm is positioned horizontally.

*Continues on next page*

## 4 Repair

### 4.6.4 Replacement of motor, axis 4

Continued

Equipment, etc.	Art. no.	Note
Removal tool, motor M12x	3HAC14973-1	Always use the removal tools in pairs!
Guide pins M10 x 100	3HAC15521-1	For guiding the motor.
Guide pins M10 x 150	3HAC15521-2	For guiding the motor.
Extension 300mm for bits 1/2"	3HAC12342-1	
Rotation tool	3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24 VDC power supply.
Power supply	-	24 VDC, max. 1,5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram		See chapter <a href="#">Circuit diagram on page 429</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

Action	Note
<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

### Removal, motor axis 4

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


Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.
2	<p>Move the upper arm to one of the basic positions:</p> <ul style="list-style-type: none"> <li>upper arm is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.</li> <li>upper arm is close to horizontal. This position is recommended if the gearbox is also to be replaced, i.e. when the gearbox oil has to be drained anyway.</li> </ul>
3	<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> <li>air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>
4	<p>In horizontal position: unload the upper arm to avoid movement of the axis, with one of the given methods:</p> <ul style="list-style-type: none"> <li>move the upper arm to a position where the turning disk rests against the foundation (recommended)</li> <li>use a fork lift or an overhead crane and lifting slings to rest the weight of the upper arm.</li> </ul>
5	In horizontal position: drain the gearbox, axis 4. Detailed in section <a href="#">Draining, oil, gearbox axis 4 on page 176</a> .

Continues on next page

## 4 Repair


### 4.6.4 Replacement of motor, axis 4

Continued

	Action	Note
6	Remove the <i>cable gland cover</i> at the cable exit of the motor by unscrewing its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 309</a> . Make sure the gasket is not damaged!
7	Remove the cover on top of the motor by unscrewing its four attachment screws.	
8	Disconnect all connectors beneath the motor cover.	
9	In order 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>
10	 <b>CAUTION</b> The motor weighs 22 kg! All lifting equipment used must be sized accordingly!	
11	Unscrew the motor's four <i>attachment screws and plain washers</i> .	Shown in the figure <a href="#">Location of motor on page 309</a> .
12	Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	
13	If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 309</a> . Always use the removal tools in pairs!
14	Fit the <i>lifting tool</i> to the motor.	Choose the correct lifting tool: <ul style="list-style-type: none"> <li>• lifting tool, motor axis 1, 4 and 5, if the upper arm is positioned vertically.</li> <li>• lifting tool, motor axis 2, 3 and 4, if the upper arm is positioned horizontally.</li> </ul> Art. no. is specified in <a href="#">Required equipment on page 309</a> .
15	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
16	Remove the motor by gently lifting it straight out.	Make sure the motor pinion is not damaged!



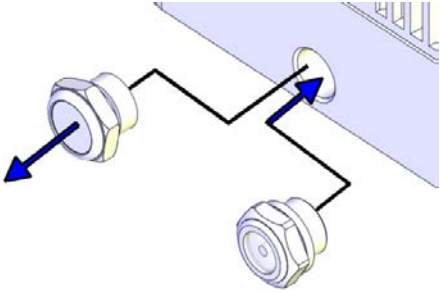

### Refitting, motor axis 4

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

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

Continues on next page



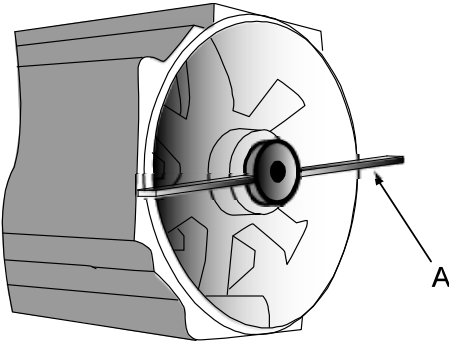
	Action	Note
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 309</a> .
3	<p><b>Foundry Plus:</b> If the motor is a new spare part, the evacuation hole protection filter must be replaced with a transparent plug/sight glass (enclosed with the spare part delivery). Remove the protection filter and install the transparent plug/sight glass.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="504 611 724 898">  <p>xx1800000101 Protection filter (Standard).</p> </div> <div data-bbox="732 611 975 898">  <p>xx1800000102 Transparent plug (Foundry Plus).</p> </div> </div>	<p>Tightening torque, transparent plug: 20 Nm <math>\pm</math>10%. Tightening torque, protection filter: 10 Nm <math>\pm</math>10%.</p>  <p>xx1600000576</p>
4	<p> <b>CAUTION</b></p> <p>The motor weighs 22 kg! All lifting equipment used must be sized accordingly!</p>	
5	Fit the <i>lifting tool</i> to the motor.	<p>Choose the correct lifting tool:</p> <ul style="list-style-type: none"> <li>lifting tool, motor axis 1, 4 and 5, if the upper arm is positioned vertically</li> <li>lifting tool, motor axis 2, 3 and 4, if the upper arm is positioned horizontally.</li> </ul> <p>Art. no. is specified in <a href="#">Required equipment on page 309</a>.</p>
6	In order to release the brakes, connect the 24 VDC power supply.	<p>Connect to connector R2.MP4:</p> <ul style="list-style-type: none"> <li>+: pin 2</li> <li>-: pin 5</li> </ul>
7	Fit the two <i>guide pins</i> in two of the <i>motor attachment holes</i> .	<p>Art. no. is specified in <a href="#">Required equipment on page 309</a>.</p> <p>Shown in the figure <a href="#">Location of motor on page 309</a>.</p>
8	Fit the motor with guidance of the pins, making sure the motor pinion is properly mated to the gear of gearbox 4.	Make sure the motor pinion does not get damaged!

*Continues on next page*


## 4 Repair

### 4.6.4 Replacement of motor, axis 4

Continued

	Action	Note
9	<p>Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear, axis 4.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 309</a>. Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.</p>  <p>xx020000165</p> <p>The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above.</p> <ul style="list-style-type: none"> <li>A: Rotation tool.</li> </ul>
10	Remove the guide pins.	
11	<p>Secure the motor with four attachment screws and plain washers. If required, use the <i>extension 300mm for bits 1/2"</i>.</p>	<p>4 pcs: M10 x 80, tightening torque: 50 Nm. Art. no. is specified in <a href="#">Required equipment on page 309</a>.</p>
12	Disconnect the brake release voltage.	
13	Reconnect all connectors beneath the motor cover.	
14	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
15	Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 309</a> .
16	Perform a leak-down test if the gearbox has been drained.	Detailed in the section <a href="#">Performing a leak-down test on page 206</a> .
17	Refill the gearbox with oil if drained.	Detailed in the section <a href="#">Filling, oil, gearbox axis 4 on page 177</a> .
18	Recalibrate the robot!	<p>Pendulum Calibration is described in <a href="#">Operating manual - Calibration Pendulum</a>, enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>. General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>

Continues on next page

	Action	Note
19	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

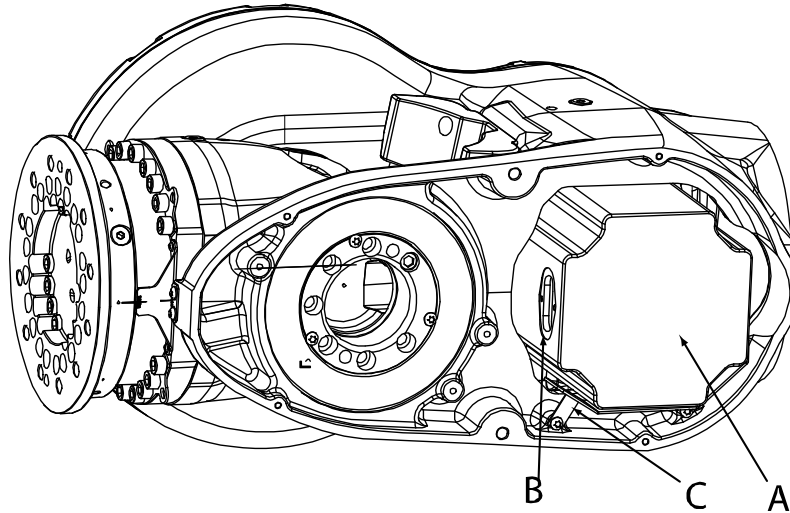
## 4 Repair

### 4.6.5 Replacement of motor, axis 5

### 4.6.5 Replacement of motor, axis 5

#### Location of motor

The motor axis 5 is located in the rear of the wrist unit as shown in the figure below. Notice that the left hand side cover already is removed in the figure!



xx0100000127

A	Motor, axis 5
B	Cable gland cover, motor axis 5
C	Heat protection plate

#### Required equipment

Equipment, etc.	Art. no.	Note
Motor, axis 5	See <a href="#">Spare part lists on page 427</a> .	Includes: <ul style="list-style-type: none"><li>• motor</li><li>• pinion</li><li>• o-ring 21522012-430</li></ul>
O-ring	21522012-430	Must be replaced when replacing motor!
Grease	3HAC042536-001	For lubricating the o-ring.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Guide pins M10 x 100	3HAC15521-1	For guiding the motor.
Guide pins M10 x 150	3HAC15521-2	For guiding the motor.
Lifting tool, motor ax 1, 4, 5	3HAC14459-1	For lifting the motor in a vertical position
Power supply		24 VDC, 1.5 A. For releasing the brakes.
Extension 300mm for bits 1/2"	3HAC12342-1	
Removal tool, motor M12x	3HAC14973-1	Always use the removal tools in pairs!

*Continues on next page*

Equipment, etc.	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram		See chapter <a href="#">Circuit diagram on page 429</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>	
	<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
	<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

### Removal, motor axis 5

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



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

Continues on next page

## 4 Repair

### 4.6.5 Replacement of motor, axis 5



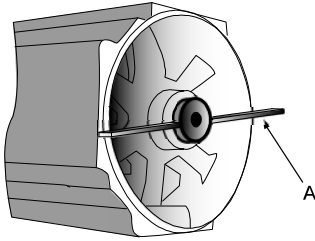
Continued

	Action	Note
2	Move the robot to a position where the motor in axis 5 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.	
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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
4	Remove the left hand side cover of the wrist unit by unscrewing its six attachment screws.	The motor is accessible behind the rear part of the cover.
5	Remove the <i>heat protection plate</i> by unscrewing its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 316</a> .
6	Remove the cover on top of the motor by unscrewing its four attachment screws.	
7	Remove the <i>cable gland cover</i> at the cable exit by unscrewing its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 316</a> .
8	Disconnect all connectors beneath the motor cover.	
9	In order to release the brake, connect the <i>24 VDC power supply</i> .	Connect to connector R3.MP5 <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>
10	 <b>CAUTION</b> The motor weighs 22 kg! All lifting equipment used must be sized accordingly!	
11	Remove the motor by unscrewing its four attachment screws and plain washers. If required, use the <i>extension 300 mm for bits 1/2</i> .	Art. no. is specified in <a href="#">Required equipment on page 316</a> .
12	Fit the <i>lifting tool, motor axis 1, 4, 5</i> to the motor.	Art. no. is specified in <a href="#">Required equipment on page 316</a> .
13	Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 316</a> .
14	If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 316</a> . Always use the removal tools in pairs and diagonally!
15	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
16	Remove the motor by gently lifting it straight out.	Make sure the motor pinion is not damaged!

Continues on next page

## Refitting, motor axis 5

The procedure below details how to refit the motor, 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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 316</a> .
3	 <b>CAUTION</b> The motor weighs 22 kg! All lifting equipment used must be sized accordingly!	
4	Fit the <i>lifting tool, motor axis 1, 4, 5</i> to the motor.	
5	In order to release the brakes, connect the 24 VDC power supply to the motor.	Connect to connector R3.MP5 <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>
6	Fit the two <i>guide pins</i> in two of the motor attachment holes.	Art. no. is specified in <a href="#">Required equipment on page 316</a> .
7	Fit the motor, with guidance from the pins, making sure the motor pinion is properly mated to the gear of gearbox, axis 5.	Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forward.
8	If necessary, use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear!	Art. no. is specified in <a href="#">Required equipment on page 316</a> .  <small>xx0200000165</small> The rotation tool (A) is used beneath the motor cover, directly on the motor shaft as shown in figure above.
9	Secure the motor with four attachment screws and plain washers. If required, use the <i>extension 300 mm for bits 1/2"</i> .	M10 x 40, 12.9 quality. Tightening torque: 50 Nm. Art. no. is specified in <a href="#">Required equipment on page 316</a> .
10	Disconnect the brake release voltage.	
11	Reconnect all connectors beneath the motor cover.	

Continues on next page

## 4 Repair

### 4.6.5 Replacement of motor, axis 5

Continued

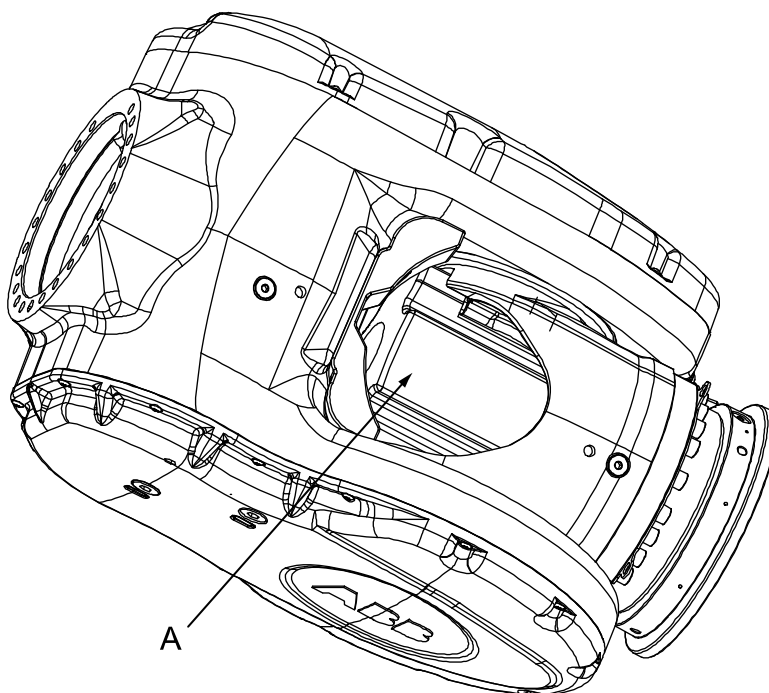
	Action	Note
12	Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 316</a> .
13	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
14	Refit the <i>heat protection plate</i> with its two attachment screws.	Shown in the figure <a href="#">Location of motor on page 316</a> .
15	If cables are loose, place them correctly and tie them up with cable ties.	
16	Refit the left hand side cover of the wrist unit with its six attachment screws.	
17	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .
18	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	



## 4.6.6 Replacement of motor, axis 6

## Location of motor

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



xx010000128

A	Motor, axis 6
---	---------------

## Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor, axis 6	See spare part number in <a href="#">Spare part lists on page 427</a> .		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	3HAC048560-001 i 3HAC063071-001 ii		Must be replaced when replacing motor
Gasket, cover	3HAC033489-001		Must be replaced when opening cover.
Removal tool, motor M10x		3HAC14972-1	Always use the removal tools in pairs!
Extension 300mm for bits 1/2"		3HAC12342-1	

Continues on next page

## 4 Repair

### 4.6.6 Replacement of motor, axis 6

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Grease		3HAC042536-001	For lubricating the o-ring.
Loctite 574, Flange sealant		12340011-116	Option Foundry Plus
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram		-	See chapter <a href="#">Circuit diagram on page 429</a> .

- i Only fits type A motor.  
See [Type A vs type B motors on page 411](#).
- ii Only fits type B motor.  
See [Type A vs type B motors on page 411](#).

#### 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

Action	Note
<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	


### Removal, motor

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



#### Note

Robots with protection type Foundry Plus or Foundry Prime require special repair routines to maintain the tightness level, in addition to the procedure below, described in [Replacement of the motor axis 6 \(Foundry Plus\) on page 325](#).

Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.
2	<p>Move the robot to one of the recommended positions:</p> <ul style="list-style-type: none"> <li>to a position where the motor in axis 6 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.</li> <li>to a position where the motor in axis 6 is close to horizontal. This position may be selected when the gearbox is to be replaced, i.e. when the gearbox oil has to be drained anyway.</li> </ul>
3	<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> <li>air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>
4	In horizontal position: drain the oil from the axis 6 gearbox. <a href="#">Detailed in section Draining oil, gearbox axis 6 on page 183.</a>
5	Remove the rear motor cover by unscrewing the five attachment screws.
6	Disconnect all connectors beneath the cover.

Continues on next page

## 4 Repair

### 4.6.6 Replacement of motor, axis 6

Continued

	Action	Note
7	Connect the 24 VDC power supply to release the brakes.	Connect to connector R3.MP6 <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>
8	Remove the motor by unscrewing its four attachment screws and plain washers. If required, use the extension 300mm for bits 1/2".	Art. no. is specified in <a href="#">Required equipment on page 321</a> .
9	If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 321</a> . Always use the removal tools in pairs!
10	Lift the motor carefully to get the pinion away from the gear and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!
11	Remove the motor by gently lifting it straight out.	

### Refitting, motor

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




#### Note

Robots with protection type Foundry Plus or Foundry Prime require special repair routines to maintain the tightness level, in addition to the procedure below, described in [Replacement of the motor axis 6 \(Foundry Plus\) on page 325](#).

	Action	Note
1	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 321</a> .
2	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R3.MP6 <ul style="list-style-type: none"> <li>• +: pin 2</li> <li>• -: pin 5</li> </ul>
3	Fit the two <i>guide pins</i> in two of the motor attachment holes.	Art. no. is specified in <a href="#">Required equipment on page 321</a> .
4	Fit the motor, with guidance from the pins, making sure the motor pinion is properly mated to the gear of gearbox, axis 6.	Make sure the pinion on the motor shaft is not damaged!
5	Remove the guide pins.	
6	Secure the motor with its four attachment screws and plain washers. If required, use <i>extension 300mm for bits 1/2"</i> .	4 pcs: M8 x 25, tightening torque: 24 Nm. Art. no. is specified in <a href="#">Required equipment on page 321</a> .
7	Disconnect the brake release voltage.	
8	Reconnect all connectors beneath the motor cover.	
9	Refit the cover on top of the motor with its five attachment screws.	Make sure the cover is tightly sealed!
10	Perform a leak-down test (if the gearbox has been drained).	Detailed in section <a href="#">Performing a leak-down test on page 206</a> .


Continues on next page

	Action	Note
11	Refill the gearbox with oil, if it has been drained.	Detailed in section <a href="#">Filling oil, gearbox axis 6 on page 184</a> .
12	Re-calibrate the robot.	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>
13	 <p><b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

#### Replacement of the motor axis 6 (Foundry Plus)

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

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

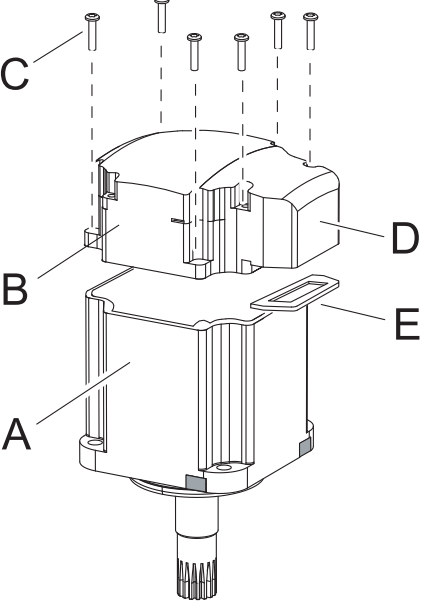

	Action	Note
1	<p>Move the robot to one of the recommended positions:</p> <ul style="list-style-type: none"> <li>to a position where the motor in axis 6 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.</li> <li>to a position where the motor in axis 6 is close to horizontal. This position may be selected when the gearbox is to be replaced, that is when the gearbox oil has to be drained anyway.</li> </ul>	
2	 <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> <li>air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	
3	In horizontal position: drain the oil from the axis 6 gearbox.	Detailed in section: <a href="#">Draining oil, gearbox axis 6 on page 183</a> .

*Continues on next page*

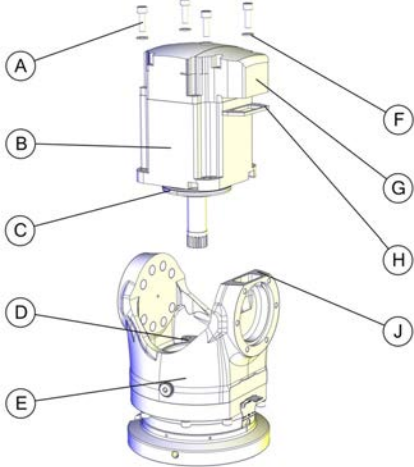
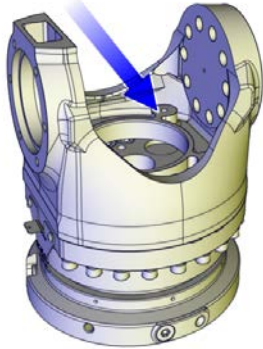
## 4 Repair

### 4.6.6 Replacement of motor, axis 6

Continued

	Action	Note
4	Remove the rear motor cover by unscrewing the five attachment screws.	 <p>xx1500002524</p> <ul style="list-style-type: none"><li>• A: Motor unit</li><li>• B: Connection box</li><li>• C: Attachment screw (5 pcs)</li><li>• D: Rear motor cover</li><li>• E: Gasket</li></ul>
5	Continue to remove the motor unit, according to step 6 and forwards in <a href="#">Removal, motor on page 323</a> .	
6	 <b>Note</b> Keep the old <i>rear motor cover</i> with the air nipple.	

Continues on next page

	Action	Note
7	Remove the protection strip on the <i>gasket</i> and mount it on the <i>motor</i> .	 <p>xx1500002425</p> <ul style="list-style-type: none"> <li>• A: Attachment screw (4pcs) Mercasol 3106</li> <li>• B: Motor unit</li> <li>• C: O-ring</li> <li>• D: Sikaflex in screw recesses</li> <li>• E: Tilt house</li> <li>• F: Washer</li> <li>• G: Rear motor cover</li> <li>• H: Sealing</li> <li>• J: Loctite 574</li> </ul>
8	Apply Mercasol 3106 on the <i>motor end cover</i> .	
9	Apply Loctite 574 flange sealant on the contact surface.	 <p>xx1400000992</p>
10	Apply grease on the <i>o-ring</i> on the <i>motor</i> .	
11	Continue to refit the new motor according to section, <a href="#">Refitting, motor on page 324</a> .	

## 4 Repair

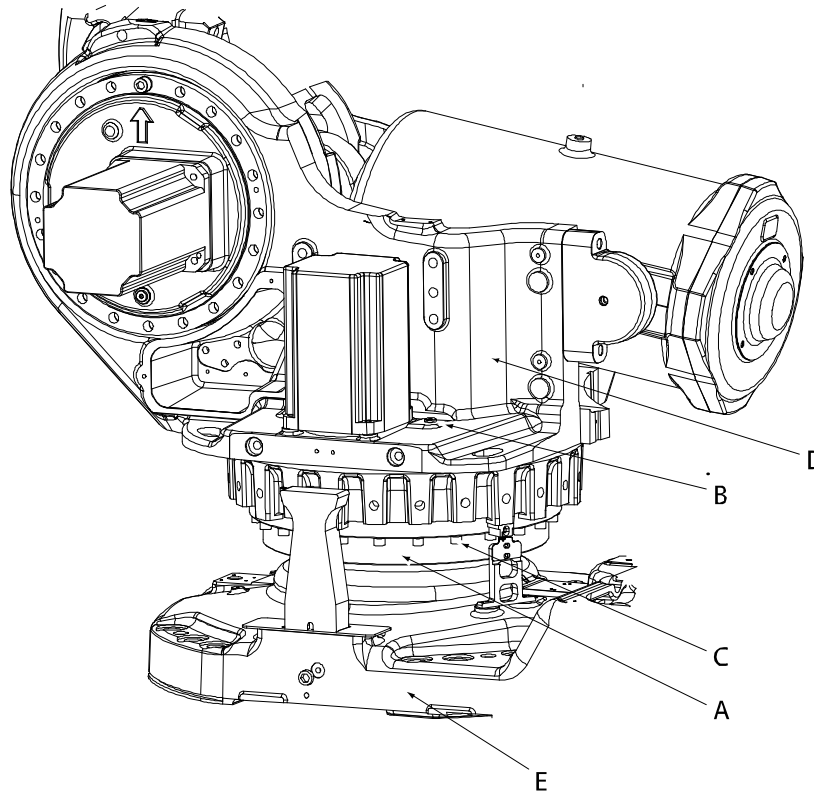
### 4.7.1 Replacing the axis 1 gearbox

## 4.7 Gearboxes

### 4.7.1 Replacing the axis 1 gearbox

#### Location of gearbox

The axis 1 gearbox is located between the frame and base as shown in the figure.



xx0100000133

A	Gearbox, axis 1
B	Oil plug, filling
C	Attachment screws, gearbox to frame
D	Frame
E	Base
-	Attachment screws, base to gearbox (not shown in figure)

#### Required equipment

Equipment, etc.	Art. no.	Note
Gearbox	For spare part no. see: • <a href="#">Spare part lists on page 427.</a>	Includes: • gearbox • all o-rings and sealing rings
O-ring	3HAB3772-54	Replace if damaged!
O-ring	3HAB3772-55	Replace if damaged!
Sealing ring	3HAC11581-4	Replace if damaged!

*Continues on next page*



Equipment, etc.	Art. no.	Note
Grease	3HAC042536-001	Shell Gadus S2 For lubricating the o-ring.
Support, base and gear 1	3HAC15535-1	
Lifting accessory, base	3HAC15560-1	
Lifting accessory (chain)	3HAC15556-1	
Guide pins		2 pcs, M16x150. Used for guiding the gearbox into place in the base. Always use guide pins in pairs!
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</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>	
	<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>

Continues on next page

## 4 Repair

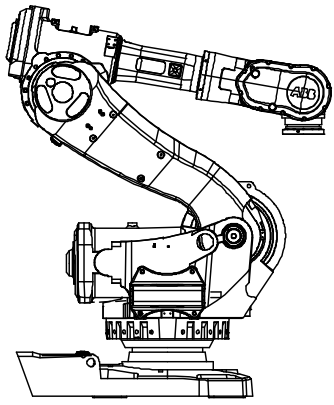

### 4.7.1 Replacing the axis 1 gearbox

Continued

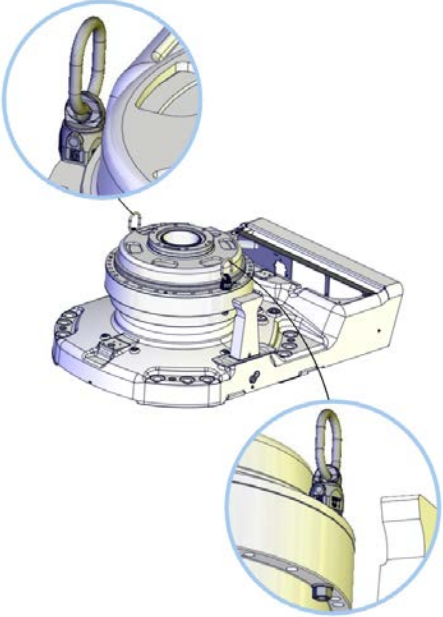

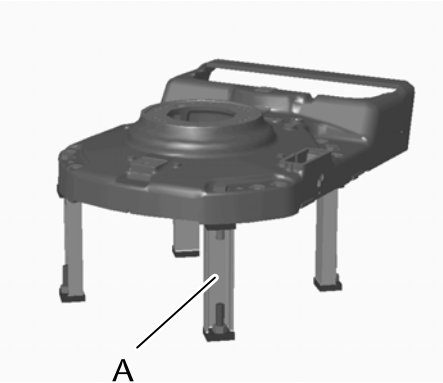
Action	Note
<p><b>If the robot is to be calibrated with fine calibration:</b> Remove all external cable packages (DressPack) and tools from the robot.</p>	

#### Removal, gearbox axis 1

Use this procedure to remove gearbox, axis 1.

Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.
2	<p>Move the robot to its most stable position, shown in the figure to the right.</p>  <p>xx0300000022</p>
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> <li>• air pressure supply</li> </ul> <p>to the robot, before entering the robot working area.</p>
4	Drain the axis 1 gearbox. <i>See <a href="#">Changing oil, axis-1 gearbox on page 165</a>.</i>
5	Remove the complete arm system. <i>Detailed in section <a href="#">Replacement of complete arm system on page 227</a>.</i>
6	Unfasten the robot base from the foundation by removing the base attachment screws.

Continues on next page

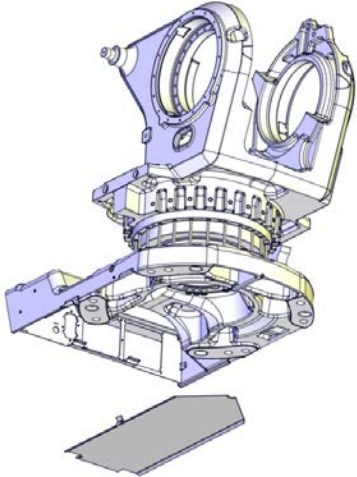
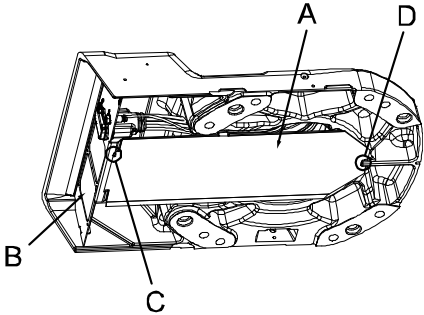
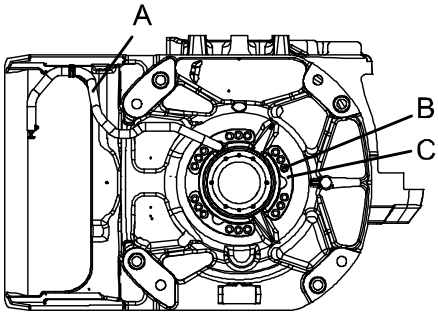
	Action	Note
7	<p>Attach the <i>lifting accessory, base and gear 1</i> and the <i>lifting tool (chain)</i> to the gearbox and base.</p>	 <p>xx1000001395</p> <p>Specified in <a href="#">Required equipment on page 328</a>.</p>
8	<p> <b>CAUTION</b></p> <p>The base and axis 1 gearbox weighs 310 kg + 200 Kg. All lifting accessories used must be sized accordingly!</p>	
9	<p>Lift the robot base including the axis 1 gearbox to allow the <i>base and gear 1 support</i> be fitted on each sides of the base.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 328</a>.</p>
10	<p>Secure the support to the base and to the foundation. Make sure the base remains in a stable position before performing any work underneath the base!</p>	 <p>xx1000000364</p> <p>A Support base (4 pcs)</p>

Continues on next page

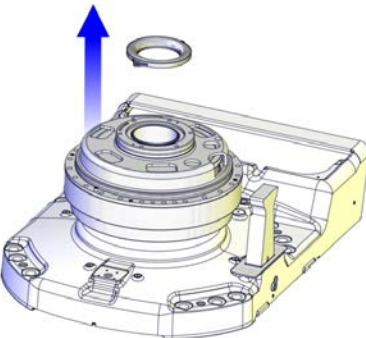



## 4 Repair

### 4.7.1 Replacing the axis 1 gearbox

Continued

	Action	Note
11	<p>Remove the bottom plate from underneath the base in order to get access to the attachment screws.</p> <p>It may be necessary to also remove the rear connector plate.</p>	 <p>xx1000001385</p>  <p>xx0300000612</p> <ul style="list-style-type: none"> <li>A Bottom plate</li> <li>B Rear connector plate</li> <li>C Attachment screw</li> <li>D Groove</li> </ul>
12	<p>Unscrew the attachment screws and remove the washers.</p>	 <p>xx0200000227</p> <p>A view from below:</p> <ul style="list-style-type: none"> <li>• A: Oil drain hose</li> <li>• B: Attachment screws, gearbox axis 1, 18 pcs</li> <li>• C: Washers, 3 pcs</li> </ul>

Continues on next page

	Action	Note
13	Remove the cable guide in the center of gearbox 1 by unscrewing its attachment screws.	 <p>xx1000001387</p>
14	 <b>CAUTION</b> The gearbox weighs 200 Kg. All lifting accessories used must be sized accordingly!	
15	Lift the gearbox away with the already mounted lifting tools.	
16	Turn the gearbox, and remove the protection pipe by unscrewing two attachment screws.   <b>Note</b> Move the protective pipe over to the new gearbox.	 <p>xx1400000786</p>

Continues on next page

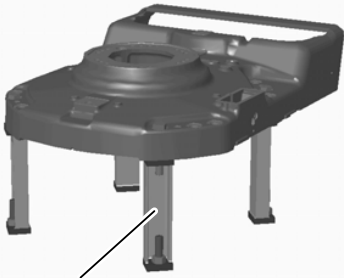
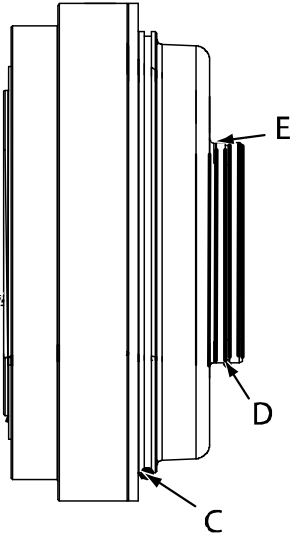
## 4 Repair

### 4.7.1 Replacing the axis 1 gearbox

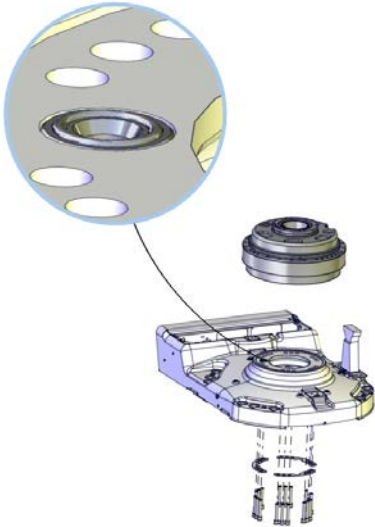
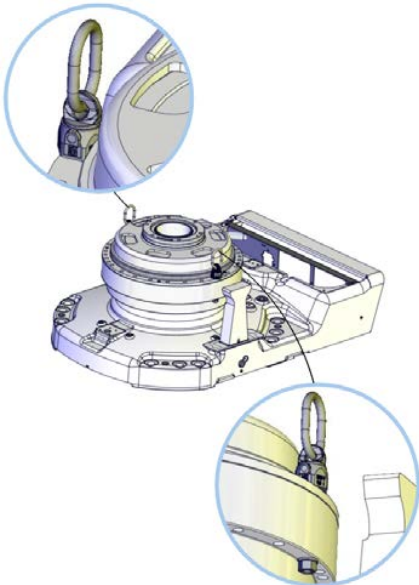

Continued

#### Refitting, gearbox axis 1

Use this procedure to refit gearbox, axis 1.

	Action	Note
1	Fit the <i>support, base and gear 1</i> to the base.	<p>Mounting of the support, base and gear 1 is detailed in section <a href="#">Removal, gearbox axis 1 on page 330</a>.</p>  <p>xx1000000364</p> <p>A Support base (4 pcs)</p>
2	Make sure the two <i>o-rings</i> on the circumference of the gearbox are seated properly in their respective groove. Lubricate them with <i>grease</i> .	<p>Art no. is specified in <a href="#">Required equipment on page 328</a>.</p>  <p>xx0200000055</p> <ul style="list-style-type: none"><li>• A: Guide pin</li><li>• C: O-ring 3HAB 3772-54</li><li>• D: O-ring 3HAB 3772-55</li><li>• E: Sealing ring 3HAC 11581-4</li></ul>

Continues on next page

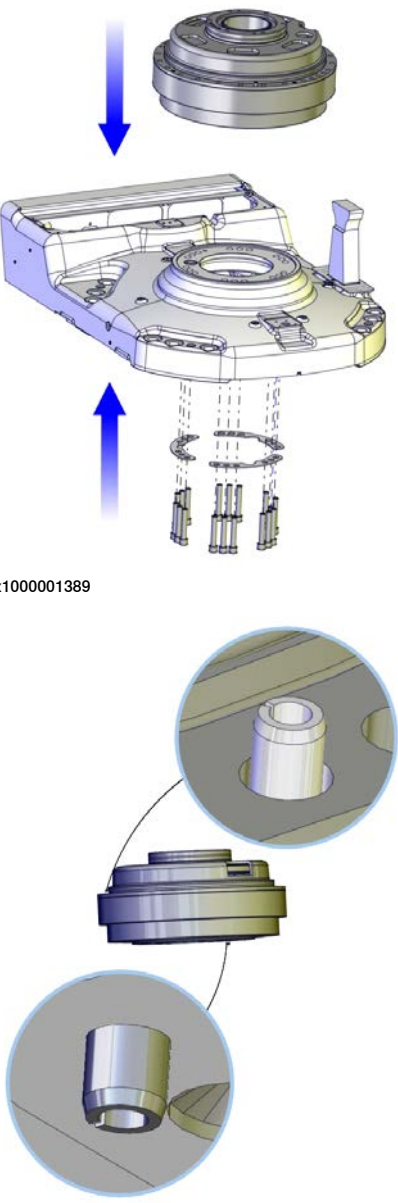
	Action	Note
3	<p>Make sure the small o-ring around the oil hole is fitted properly!</p>	 <p>xx1000001392</p>
4	<p>Attach the <i>lifting accessory, base and gear 1</i> and the <i>lifting tool (chain)</i> to the gearbox.</p>	<p>Specified in <a href="#">Required equipment on page 328</a>.</p>  <p>xx1000001395</p>
5	<p>Fit two <i>guide pins</i> in two of the attachment holes in the gearbox, parallel to each other.</p>	<p>Specified in <a href="#">Required equipment on page 328</a>.</p>
6	<p> <b>CAUTION</b></p> <p>The gearbox weighs 200 Kg. All lifting accessories used must be sized accordingly!</p>	

*Continues on next page*

## 4 Repair

### 4.7.1 Replacing the axis 1 gearbox

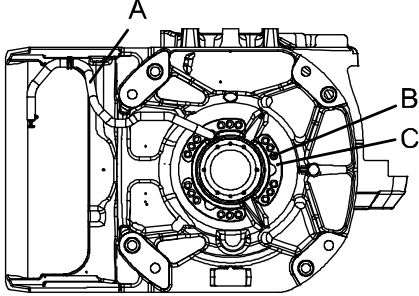
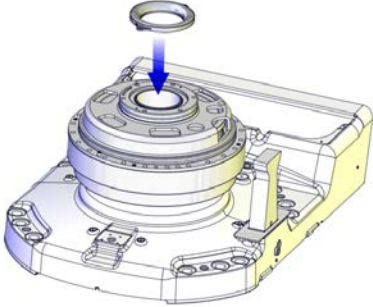
*Continued*

	Action	Note
7	<p>Lift the gearbox.</p> <p>Make sure the guide pin in the bottom face of the gearbox is properly aligned with the base.</p>	 <p>xx1000001389</p> <p>xx1000001391</p>
8	<p>Lift gearbox axis 1 onto the guide pins and lower it carefully to its mounting position.</p>	<p>Always use guide pins in pairs!</p>

*Continues on next page*



4.7.1 Replacing the axis 1 gearbox  
Continued


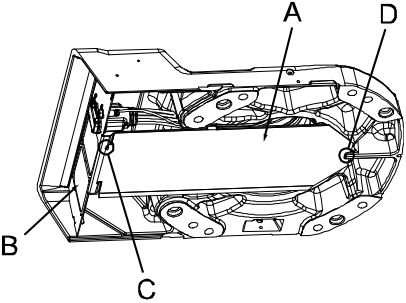


	Action	Note
9	Secure the gearbox with its <i>attachment screws</i> and washers.	<p>18 pcs, M16 x 90, 12.9 quality UN-BRAKO.</p> <p>Tightening torque: 300 Nm</p> <p>Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.</p>  <p>xx0200000227</p> <p>A view from below:</p> <ul style="list-style-type: none"> <li>• A: Oil drain hose</li> <li>• B: Attachment screws, gearbox axis 1, 18 pcs</li> <li>• C: Washers, 3 pcs</li> </ul>
10	Refit the cable guide in the center of gearbox 1 with its attachment screws.	 <p>xx1000001393</p>

Continues on next page


## 4 Repair

### 4.7.1 Replacing the axis 1 gearbox

Continued

	Action	Note
11	<p>Refit the bottom plate underneath the robot base by pushing it into the groove and fitting the attachment screw.</p> <p>If removed, also refit the rear connector plate.</p> <p> <b>Note</b></p> <p>Direct the bends on the bottom plate downwards!</p>	<p>1 screw: M6 x 8.</p>  <p>xx0300000612</p> <ul style="list-style-type: none"> <li>• A: Bottom plate</li> <li>• B: Rear connector plate</li> <li>• C: Attachment screw</li> <li>• D: Groove</li> </ul>
12	<p> <b>CAUTION</b></p> <p>The base and axis 1 gearbox weighs 310 kg + 200 Kg.</p> <p>All lifting accessories used must be sized accordingly!</p>	
13	Lift the robot base and gearbox 1 and remove the base and gear support.	
14	Secure the base to the mounting site.	See <a href="#">Orienting and securing the robot on page 81</a> .
15	<p>Refit the complete arm system.</p> <p> <b>CAUTION</b></p> <p>This is a complex task to be performed with utmost care in order to avoid injury or damage!</p>	Detailed in section <a href="#">Replacing the axis 1 gearbox on page 328</a> .
16	Perform a leak-down test.	See section <a href="#">Performing a leak-down test on page 206</a> .
17	Refill the gearbox with oil.	See <a href="#">Changing oil, axis-1 gearbox on page 165</a> .
18	Recalibrate the robot.	<p>Pendulum Calibration is described in <a href="#">Operating manual - Calibration Pendulum</a>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>

Continues on next page

	Action	Note
19	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

## 4 Repair

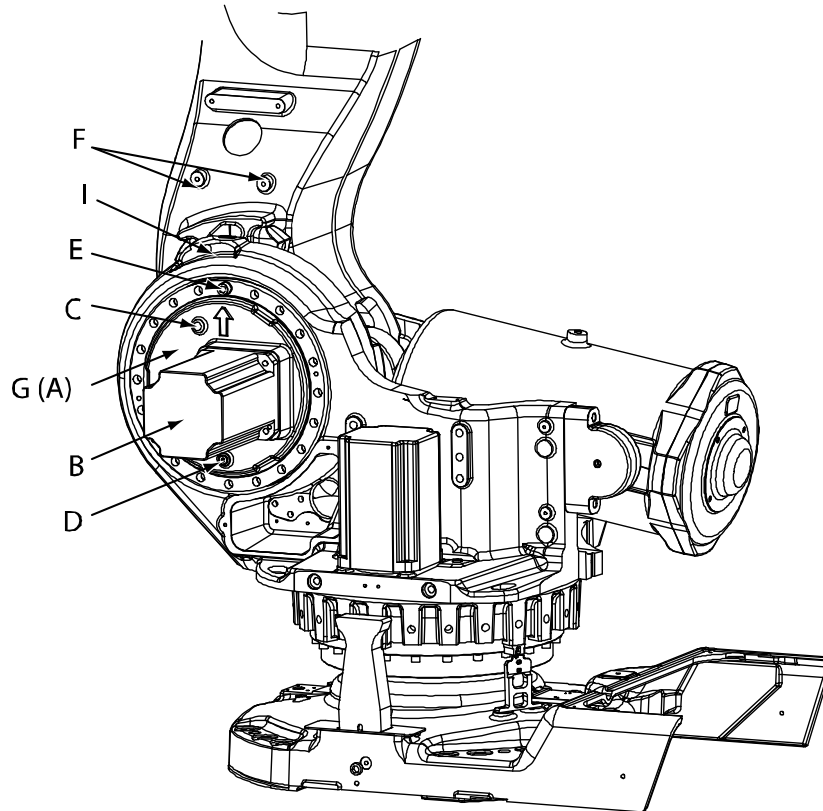
### 4.7.2 Replacement of gearbox, axis 2

#### 4.7.2 Replacement of gearbox, axis 2

##### Location of gearbox

The axis 2 gearbox is located in the lower arm rotational center as shown in the figure below.

A more detailed view of the component and its position may be found in chapter *Exploded views in Product manual, spare parts - IRB 7600*.



xx0100000135

A	Gearbox, axis 2 (behind motor attachment <i>not shown in figure</i> )
B	Motor, axis 2
C	Oil plug, filling
D	Oil plug, draining
E	Front gearbox attachment screws
F	Attachment holes, fixture lower arm
G	Motor attachment
I	Hole for locking screw, lower arm, M16 x 60
-	Sealing (between gearbox and motor attachment, <i>not shown in figure</i> )
-	Friction washer (between the gearbox and lower arm, <i>not shown in figure</i> )

*Continues on next page*

## Required equipment

Equipment, etc.	Spare part number	Article number	Note
Gearbox, axis 2	3HAC12641-1		Includes gearbox and o-ring
O-ring		3HAB3772-51	
Sealing, axis 2/3		3HAC17213-1	A new sealing must be used on each assembly!
Grease		3HAC042536-001	For lubricating the o-ring.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Lifting accessory, axis-2 and axis-3 gear		3HAC032723-001	
Fixture lower arm		3HAC13660-1	
Locking screw, lower arm			M16 x 60 8.8. Included in the fixture, lower arm.
Guide pins M16 x 150		3HAC13120-2	To be used in pairs!
Guide pins M16 x 200		3HAC13120-3	To be used in pairs!
Guide pins M16 x 300		3HAC13120-5	For guiding the gearbox. Always use the guide pins in pairs.
Guide pins, sealing ax 2/3, 80mm		3HAC14627-2	For guiding the sealing axis 2/3. Guides are to be used in pairs!
Guide pins, sealing ax 2/3, 100mm		3HAC14627-3	For guiding the sealing axis 2/3. Guides are to be used in pairs!
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Continues on next page

## 4 Repair

### 4.7.2 Replacement of gearbox, axis 2

Continued

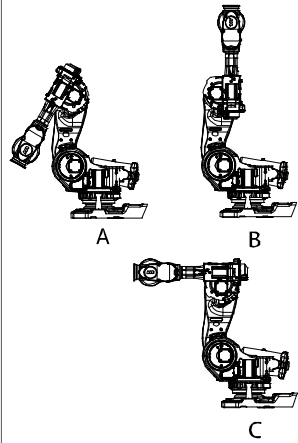
#### Deciding calibration routine

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


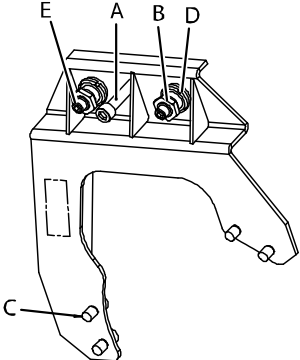

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> <li>Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.</li> <li>Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.</li> </ul>	
	<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
	<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

#### Removal, gearbox

The procedure below details how to remove gearbox, axis 2.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Remove any equipment fitted to the turning disk.	
3	<p>Run the robot to the calibration position. The upper arm may be directed in three different ways, shown in figure to the right.</p> <p>The lowered position, as in figure A, is recommended as it gives the least load on the tool.</p>	 <p>xx0200000260</p>

Continues on next page

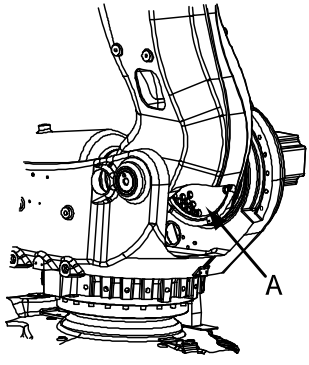

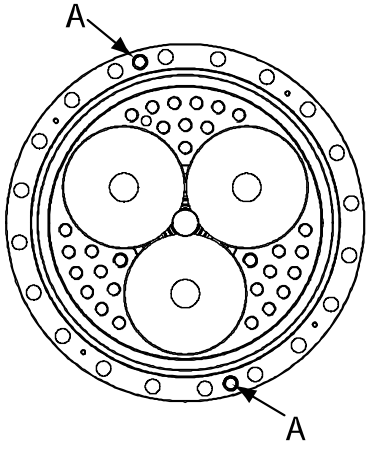
	Action	Note
4	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
5	If the robot is fitted with moveable mechanical stops on axis 2 (not stock equipment), these must be removed at this point. The attachment holes of the mechanical stops are used to attach the fixture, lower arm.	
6	Secure the lower arm to the frame by inserting the <i>locking screw</i> into the hole.	Art. no. is specified in <a href="#">Required equipment on page 341!</a> Shown in the figure <a href="#">Location of gearbox on page 340!</a>
7	Fit the <i>fixture, lower arm</i> to prevent the lower arm from falling. <ul style="list-style-type: none"> <li>• Make sure that both adjusters (B) on the fixture are screwed back.</li> <li>• Align the fixture with the frame and lower arm.</li> <li>• Tighten the four M16 bolts (C) on the <i>inside of the frame, in attachment holes</i>, with tightening torque: 220 Nm.</li> <li>• Screw in the two adjusters (B) until they rest against the flats on the lower arm. Tighten by hand.</li> <li>• Lock, using the two ring nuts (D).</li> <li>• Tighten the two M12 bolts (E) in the <i>attachment holes, fixture lower arm</i> with tightening torque: 91 Nm.</li> </ul>	Art. no. is specified in <a href="#">Required equipment on page 341!</a> Attachment holes for the fixture are shown in the figure <a href="#">Location of gearbox on page 340!</a> Make sure the fixture is pressed tightly against the lower arm before securing with screws!  xx0200000261 <ul style="list-style-type: none"> <li>• A: Locking screw, lower arm</li> </ul>
8	Unload the balancing device shaft by using a specific press tool.  <b>DANGER</b> Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Detailed in section <a href="#">Unloading the balancing device on page 283.</a>
9	Drain the gearbox, axis 2.	Detailed in section <a href="#">Draining, oil on page 170.</a>
10	Remove the motor, axis 2.	Detailed in section <a href="#">Removal, motor on page 298.</a>

Continues on next page

## 4 Repair

### 4.7.2 Replacement of gearbox, axis 2

Continued

	Action	Note
11	Remove the 30 rear gearbox attachment screws (A) from inside the lower section of the lower arm.	 <p>xx030000064</p>
12	Remove the <i>motor attachment</i> by unscrewing the front gearbox attachment screws.	Shown in the figure <a href="#">Location of gearbox on page 340!</a>
13	Fit the <i>lifting tool, gearbox axis 2</i> , to the motor attachment and secure it with the hook on the tool. Remove the motor attachment.	Art. no. is specified in <a href="#">Required equipment on page 341.</a>
14	 <b>CAUTION</b> The gearbox weighs 125 kg! All lifting equipment used must be sized accordingly!	
15	Fit the <i>lifting tool, gearbox axis 2</i> , to the gearbox.	Art. no. is specified in <a href="#">Required equipment on page 341.</a>
16	Fit two guide pins in 180° relation to each other instead of the removed front attachment screws.	Art. no. is specified in <a href="#">Required equipment on page 341.</a>
17	If required, apply an <i>M16 screw</i> to the hole shown in the figure to press it free.	 <p>xx020000033</p> <ul style="list-style-type: none"> <li>A: M16 holes for pressing the gearbox out</li> </ul>
18	Remove the gearbox using an overhead crane or similar.	
19	Remove the friction washer and clean it.	


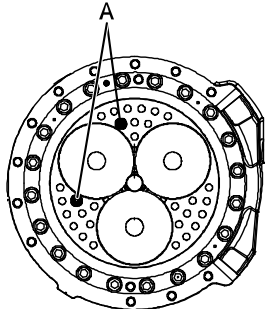
Continues on next page



	Action	Note
20	Remove the <i>sealing</i> from the lower arm.	On reassembly a new sealing must be used! Art. no. is specified in the refitting instructions <a href="#">Required equipment on page 341</a> !

## Refitting, gearbox axis 2

The procedure below details how to refit the gearbox, axis 2.

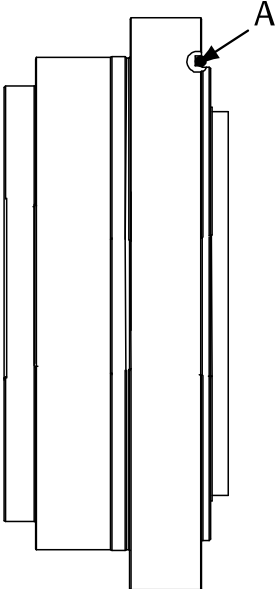
	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Fit the <i>guide pins, sealing axis 2/3</i> on gearbox, axis 2. Only the holes showed in figure beside are allowed to be used to the guide pins!	 <p>xx0200000125</p> <p>Holes for guide pins, sealing axis 2/3 on gearbox 2.            Always use a new sealing when re-assembling!            Article number is specified in <a href="#">Required equipment on page 341</a>.</p>
3	Fit the new <i>sealing, axis 2/3</i> on gearbox, axis 2, with guidance from the guide pins.	
4	Fit two <i>guide pins, M16 180°</i> in relation to each other in the attachment holes in the frame.	Article number is specified in <a href="#">Required equipment on page 341</a> .
5	Fit the cleaned friction washer onto the guide pins.	
6	Fit the <i>lifting tool, gearbox axis 2</i> , to the gearbox.	Article number is specified in <a href="#">Required equipment on page 341</a> .

Continues on next page

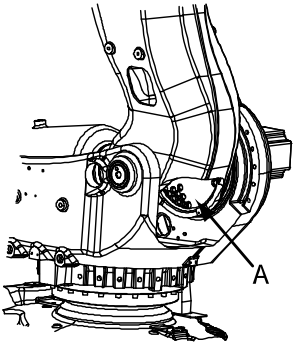

## 4 Repair

### 4.7.2 Replacement of gearbox, axis 2

Continued

	Action	Note
7	Make sure the <i>o-ring</i> is fitted to the rear of the gearbox. Lightly <i>grease</i> the o-ring.	<p>Article number is specified in <a href="#">Required equipment on page 341</a>.</p>  <p>xx0100000136</p> <p>A O-ring, gearbox, axis 2</p>
8	Lift the gearbox to its mounting position.	
9	Fit the gearbox onto the guide pins and slide it into position.	Make sure the gearbox is seated properly.
10	Remove the lifting tool.	
11	In a similar way, fit the lifting tool to the motor flange. Lock the tool with the hook. Lift it and slide it onto the guide pins. Remove the lifting tool.	
12	Insert and secure 18 of the 20 attachment screws on the front of the motor attachment. Remove the guide pins and tighten the remaining two screws.	Tightening torque: 280±15 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
13	Remove the guide pins and tighten the remaining two screws as above.	

Continues on next page

	Action	Note
14	Insert and secure 28 of the 30 attachment screws on the inside of the lower arm.	 <p data-bbox="1054 663 1158 678">xx0300000064</p> <p data-bbox="1054 696 1439 846">Tightening torque: 300 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.</p>
15	Remove the <i>guide pins, sealing axis 2/3</i> and tighten the remaining two screws as above.	
16	Refit the motor.	Detailed in section <a href="#">Refitting, motor on page 299</a> .
17	Perform a leak-down test.	Detailed in section <a href="#">Performing a leak-down test on page 206</a> .
18	Refill the gearbox with oil.	Detailed in section <a href="#">Filling, oil on page 170</a> .
19	Restore the balancing device.  <b>DANGER</b> Handling the tool incorrectly will cause serious injury. Read and follow enclosed user instructions for the tool.	Detailed in section <a href="#">Restoring the balancing device on page 284</a> .
20	Remove the fixture, lower arm.	
21	Remove the locking screw, lower arm.	
22	Refit any mechanical stops if such were removed during disassembly.	
23	Refit any equipment to the turning disc if such was removed during assembly.	
24	Re-calibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .


Continues on next page

## 4 Repair

---

### 4.7.2 Replacement of gearbox, axis 2

*Continued*

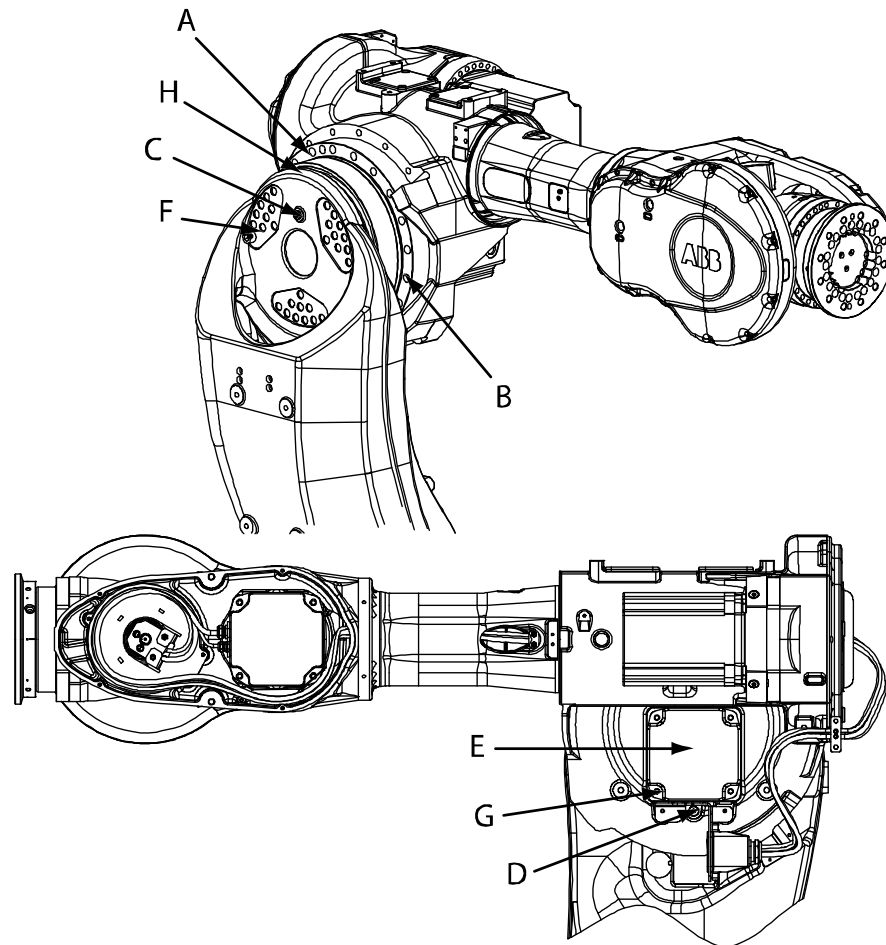
	Action	Note
25	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

### 4.7.3 Replacement of gearbox, axis 3

#### Location of gearbox

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

A more detailed view of the component and its position may be found in chapter *Exploded views* in *Product manual, spare parts - IRB 7600*.



xx010000137

A	Gearbox, axis 3
B	Attachment screws, gearbox
C	Oil plug, filling
D	Oil plug, draining
E	Motor, axis 3
F	Attachment screws, upper arm
G	Attachment screws, motor
H	Sealing, axis 2/3 (between lower arm and gearbox 3)

*Continues on next page*

## 4 Repair

### 4.7.3 Replacement of gearbox, axis 3

*Continued*

#### Required equipment

Equipment, etc.	Art. no.	Note
Gearbox	For spare part number, see <a href="#">Spare part lists on page 427</a> .	Includes <ul style="list-style-type: none"><li>• gearbox</li><li>• o-ring.</li></ul> Does not include the sealing, axis 2/3!
O-ring	3HAB3772-51	1 pc on the gearbox. Replace if damaged.
Grease	3HAC042536-001	For lubricating the o-rings.
Sealing, axis 3	3HAC17213-1	A new sealing must be used on each assembly!
Mechanical stop axis 3	3HAC12708-2	Used to secure the upper arm. Use attachment screws 3HAB3409-86 (M16 x 60).
Washers (for mechanical stop axis 3)	3HAA1001-186	
Bolt, M16x60 (for mechanical stop axis 3)	3HAB3409-86	
Lifting accessory, axis-2 and axis-3 gear	3HAC032723-001	
Guide pins M16 x 250	3HAC13120-4	For guiding the gearbox. Use guides in pairs!
Guide pins M16 x 300	3HAC13120-5	For guiding the gearbox. Use guides in pairs!
Guide pins, sealing ax 2/3, 80mm	3HAC14627-2	For guiding the axis-3 sealing. Use guides in pairs!
Guide pins, sealing ax 2/3, 100mm	3HAC14627-3	For guiding the axis-3 sealing. Use guides in pairs!
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

*Continues on next page*


**Deciding calibration routine**

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a> .
	<b>If the robot is to be calibrated with fine calibration:</b> Remove all external cable packages (DressPack) and tools from the robot.	

**Removal, gearbox axis 3**

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


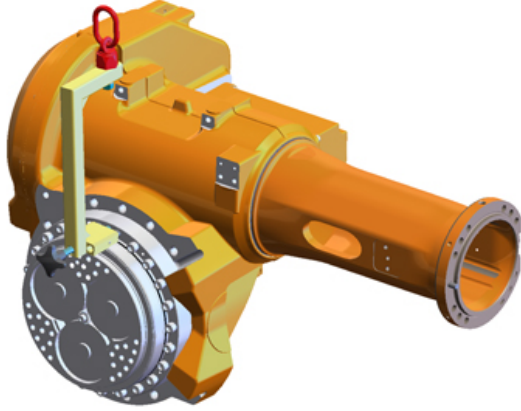
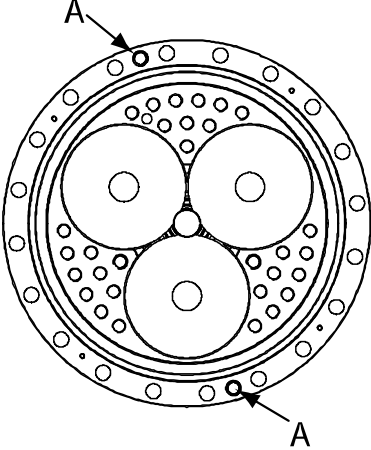
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>electric power supply to the robot</li> <li>hydraulic pressure supply to the robot</li> <li>air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Secure the upper arm in a horizontal position using round slings.	Art. no. is specified in <a href="#">Required equipment on page 350</a> .

Continues on next page

## 4 Repair


### 4.7.3 Replacement of gearbox, axis 3

Continued

	Action	Note
4	Remove the <i>motor, axis 3</i> .	Detailed in section <a href="#">Removal, motor on page 304</a> .   <b>Note</b> When removing the motor axis 3, the brake on axis 3 is released. Make sure the upper arm is secured and disabled to move!
5	Remove the <i>upper arm</i> .	Detailed in section <a href="#">Removal, upper arm on page 243</a> .
6	Remove the <i>sealing, axis 2/3</i> between the gearbox and lower arm.	On reassembly a new sealing must be used! Art. no. is specified in <a href="#">Required equipment on page 350</a> .
7	Place the upper arm safely on a workbench, in a fixture or similar.	
8	Remove the <i>attachment screws, gearbox</i> .	Shown in the figure <a href="#">Location of gearbox on page 349</a> .
9	Fit the two <i>guide pins</i> in 180° relation to each other in the gearbox attachment screw holes.	Art. no. is specified in <a href="#">Required equipment on page 350</a> .
10	Fit the Lifting accessory RV2 according to figure.	 xx0900000113
11	If required, use screws in the holes (A) shown in the figure to the right to press the gearbox free.	 xx0200000033 <ul style="list-style-type: none"> <li>A: M16 holed for pressing the gearbox out</li> </ul>



Continues on next page



	Action	Note
12	 <b>CAUTION</b> The gearbox weighs 125 kg! All lifting accessories used must be sized accordingly!	
13	Remove the gearbox, with guidance from the guide pins, using an overhead crane or similar.	

## Refitting, gearbox axis 3

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

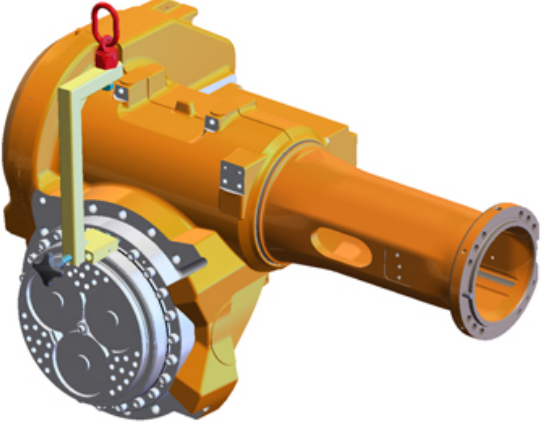
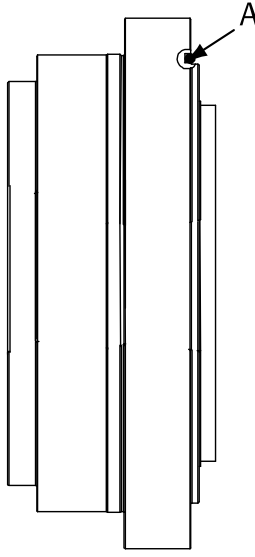
	Action	Note
1	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Turn the upper arm in such a position that the gear mating surface faces upwards.	
3	Fit two <i>guide pins</i> in 180° relation to each other in the holes in the upper arm, used for the gearbox attachment screws.	Art. no. is specified in <a href="#">Required equipment on page 350</a> .
4	 <b>CAUTION</b> The gearbox weighs 125 kg! All lifting accessories used must be sized accordingly!	

Continues on next page


## 4 Repair

### 4.7.3 Replacement of gearbox, axis 3

Continued

	Action	Note
5	Fit the lifting accessory RV2 according to figure.	 <p data-bbox="831 763 938 779">xx0900000113</p>
6	<p data-bbox="472 819 818 958">Make sure the o-ring is fitted to the rear of the gearbox. Apply grease to it to make sure it sticks in its groove during assembly! Replace if damaged!</p>	<p data-bbox="831 819 1342 875">Art. no. is specified in <a href="#">Required equipment on page 350</a>.</p>  <p data-bbox="831 1435 938 1451">xx0100000136</p> <ul data-bbox="863 1473 1182 1503" style="list-style-type: none"> <li>• A: O-ring, gearbox axis 3</li> </ul>
7	Lift the gearbox to its mounting position.	
8	Turn the gearbox to align the attachment screw holes with those in the upper arm.	
9	Fit the gearbox onto the guide pins and slide it into position.	Make sure the o-rings are seated properly and the gearbox correctly oriented!
10	Remove the lifting tool.	
11	<p data-bbox="472 1809 807 1883">Secure the gearbox with 18 of the 20 gearbox attachment screws.</p> <p data-bbox="472 1895 775 1968">Remove the guide pins and tighten the remaining two screws.</p>	<p data-bbox="831 1809 1407 1861">20 pcs: M16 x 90; 12.9 quality UNBRAKO, tightening torque: 300 Nm.</p> <p data-bbox="831 1872 1366 1946">Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.</p>

Continues on next page

	Action	Note
12	Refit the upper arm with a new sealing, axis 2/3 .	Art. no. is specified in <a href="#">Required equipment on page 350</a> . Detailed in section <a href="#">Refitting, upper arm on page 244</a> .
13	Refit the motor.	Detailed in section <a href="#">Refitting, motor on page 306</a> .
14	Recalibrate the robot!	Pendulum Calibration is described in <a href="#">Operating manual - Calibration Pendulum</a> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .
15	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

## 4 Repair

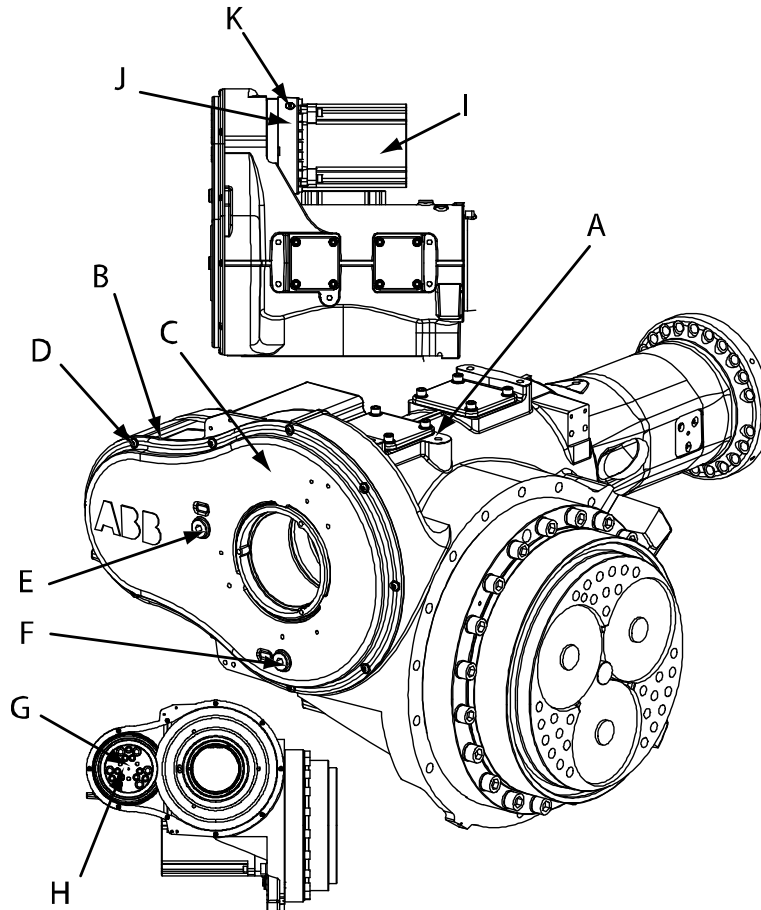
### 4.7.4 Replacement of gearbox, axis 4

#### 4.7.4 Replacement of gearbox, axis 4

##### Location of gearbox

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

A more detailed view of the component and its position may be found in chapter *Exploded views in Product manual, spare parts - IRB 7600*.



xx0100000144

A	Upper arm housing
B	Gearbox, axis 4
C	Cover, axis 4 gearbox
D	Attachment screws, cover axis 4
E	Oil plug, filling, secondary gearbox
F	Oil plug, draining, secondary gearbox
G	Gear, Z3
H	Gear attachment screws
I	Motor, axis 4
J	Motor flange
K	Oil plug, filling, primary gearbox (draining not shown in figure)

*Continues on next page*

## Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Gear axis 4	3HAC17810-1		Includes all o-rings!
O-ring		3HAB3772-49	Replace if damaged!
O-ring		3HAB3772-50	Replace if damaged!
Friction washer	3HAC10122-27		2 pcs. Must be replaced at assembly!
Gasket, cover axis 4		3HAC11423-3	
Grease		3HAC042536-001	For lubrication of gearbox, motor and motor attachment mating surfaces.
Guide pins M10 x 100		3HAC15521-1	Always use the guide pins in pairs!
Guide pins M10 x 150		3HAC15521-2	Always use the guide pins in pairs!
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

## Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> <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


### 4.7.4 Replacement of gearbox, axis 4

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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</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, gearbox axis 4

The procedure below details how to remove gearbox, axis 4.


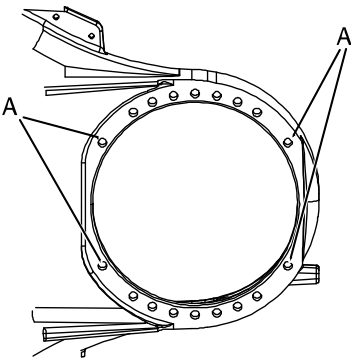

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Drain the oil from the primary gearbox through the oil plug, draining.	Detailed further in section <a href="#">Changing oil, axis-4 gearbox on page 175</a> .
4	Drain the oil from the secondary gearbox through the <i>oil plug, draining</i> .	Shown in the figure <a href="#">Location of gearbox on page 356</a> . Draining is further detailed in section <a href="#">Changing oil, axis-4 gearbox on page 175</a> .
5	Remove the plastic housing from the cover, axis 4 gearbox.	
6	Remove the <i>cover, axis 4 gearbox</i> by unscrewing its <i>attachment screws</i> .	Shown in the figure <a href="#">Location of gearbox on page 356</a> .
7	Loosen the <i>gear attachment screws</i> but do not remove the gear Z3.	Shown in the figure <a href="#">Location of gearbox on page 356</a> .
8	Remove the motor, axis 4.	Detailed in section <a href="#">Removal, motor axis 4 on page 311</a> .
9	Remove <i>gear Z3</i> from the gearbox by unscrewing the <i>15 gear attachment screws</i> . If required, insert screws into three holes in gear Z3 to press it out.	Shown in the figure <a href="#">Location of gearbox on page 356</a> .

Continues on next page

	Action	Note
10	Remove the <i>motor flange attachment screws</i> and plain washers.	Shown in the figure <a href="#">Location of gearbox on page 356</a> .
11	Pull the motor flange and gearbox, axis 4 out along with the friction washers. If required, insert screws into two holes in the gearbox to press it out.	M10.

#### Refitting, gearbox axis 4

The procedure below details how to refit the gearbox of axis 4.



	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> <li>• air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	
2	Make sure the two <i>o-rings</i> on the circumference of the gearbox are seated properly in their grooves respectively. Lightly lubricate the <i>o-rings</i> with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 357</a> .
3	Lubricate the gearbox, motor and motor attachment mating surfaces with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 357</a> .
4	Fit four <i>guide pins</i> symmetrically in the attachment holes in the upper arm housing.	 <p style="text-align: center; font-size: small;">xx0200000067</p> <p style="text-align: center;">A Attachment holes for guide pins, M10</p> <p>Art. no. is specified in <a href="#">Required equipment on page 357</a>.</p>
5	Fit two new <i>friction washers</i> onto the guide pins.	<p>Spare part no. is specified in <a href="#">Required equipment on page 357</a>.</p> <p> <b>Note</b></p> <p>Make sure the surface beneath the friction washers is clean and dry!</p>

*Continues on next page*

## 4 Repair

### 4.7.4 Replacement of gearbox, axis 4

Continued

	Action	Note
6	<p>Push in the <i>gearbox, axis 4, and the motor flange</i>.</p> <p>If necessary, use screws in the attachment holes to press in the motor flange.</p>	<p>Shown in the figure <a href="#">Location of gearbox on page 356</a>.</p> <p> <b>Note</b></p> <p>Make sure the motor flange is oriented correctly by observing the oil plugs as shown in the figure <a href="#">Replacement of gearbox, axis 4 on page 356</a>.</p>
7	<p>Secure the motor flange to the upper arm housing with 16 of the 18 washers and attachment screws.</p> <p>Secure with locking liquid.</p>	<p>18 pcs: M10 x 40; tightening torque: 65 Nm.</p>
8	<p>Remove the guide pins and secure the remaining two attachment screws as specified in previous step.</p>	
9	<p>Refit the motor, axis 4.</p>	<p>Detailed in section <a href="#">Refitting, motor axis 4 on page 312</a>.</p>
10	<p>Refit gear Z3 to the gearbox with its <i>gear attachment screws</i>.</p>	<p>Shown in the figure <a href="#">Location of gearbox on page 356</a>.</p> <p>9 pcs: M12 x 50; tightening torque: 115 Nm.</p> <p>6 pcs: M16 x 60; tightening torque: 300 Nm.</p>
11	<p>Replace the <i>gasket, cover axis 4</i>.</p>	<p>Art. no. is specified in <a href="#">Required equipment on page 357</a>.</p>
12	<p>Refit the <i>cover, axis 4 gearbox</i> with its <i>attachment screws</i> and secure with locking liquid.</p>	<p>Tightening torque: 10 Nm.</p> <p>Shown in the figure <a href="#">Location of gearbox on page 356</a>.</p>
13	<p>Perform a leak-down test.</p>	<p>Detailed in section <a href="#">Performing a leak-down test on page 206</a>.</p>
14	<p>Refill the primary gearbox with oil.</p>	<p>This is detailed in section <a href="#">Filling, oil, gearbox axis 4 on page 177</a>.</p>
15	<p>Refill the secondary gearbox with oil.</p>	<p>This is detailed in section <a href="#">Filling, oil, gearbox axis 4 on page 177</a>.</p>
16	<p>Recalibrate the robot.</p>	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a>.</p> <p>General calibration information is included in section <a href="#">Calibration on page 373</a>.</p>
17	<p> <b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

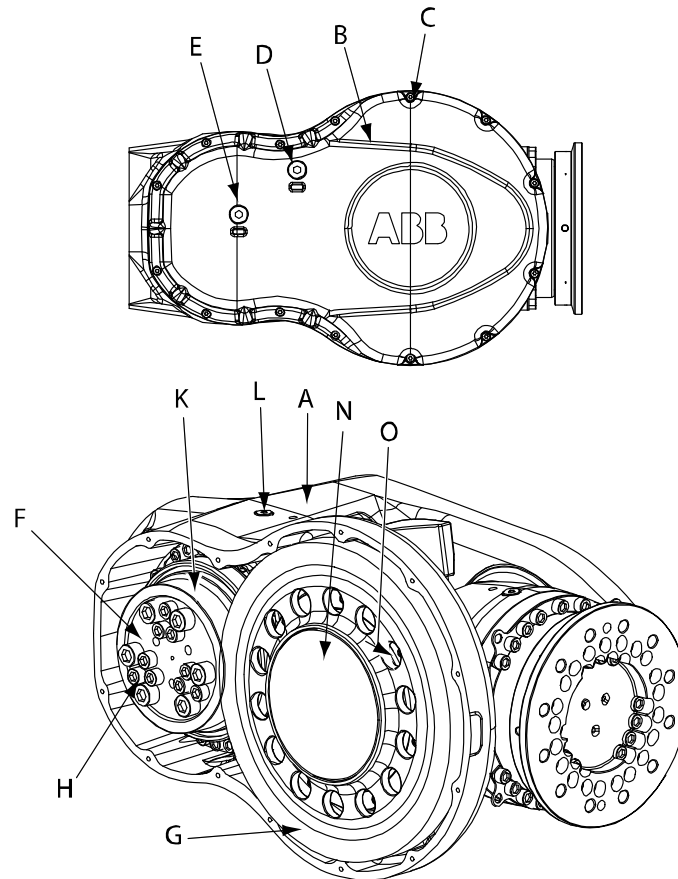


### 4.7.5 Replacement of gearbox, axis 5

#### Location of gearbox

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

A more detailed view of the component and its position may be found in chapter *Exploded views in Product manual, spare parts - IRB 7600*.



xx0100000146

A	Wrist housing
B	Cover, axis 5 gearbox
C	Attachment screws, cover axis 5
D	Oil plug, secondary, filling
E	Oil plug, secondary, draining
F	Gear, Z3
G	Wheel unit
H	Attachment screws, gear Z3
K	Gearbox, axis 5
L	Oil plug, primary, filling (draining plug on the opposite side of the wrist housing, not shown in figure)
N	VK-cover

*Continues on next page*

## 4 Repair

### 4.7.5 Replacement of gearbox, axis 5

Continued

O	Attachment screws, bearing washer, M6 x 16
---	--

#### Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Gear axis 5	3HAC17810-1		Includes all o-rings!
O-ring		3HAB3772-49	Replace if damaged!
O-ring		3HAB3772-50	Replace if damaged!
Friction washer	3HAC10122-27		2 pcs. Must be replaced at assembly!
VK-cover		3HAA2166-24	Must be replaced!
Gasket, cover		3HAC 11409-5	
Grease		3HAC042536-001	For lubricating the o-rings and the packing box.
Locking liquid		3HAB7116-1	Loctite 243
Isopropanol		11771012-208	To clean surface beneath VK-cover.
Standard toolkit		-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Lifting eye M12		3HAC14457-3	2 pcs required! For lifting the gearbox.
Removal tool, wheel unit		3HAC15814-1	For removing and lifting the wheel unit.
Guide pins M10 x 100		3HAC15521-1	Always use guide pins in pairs!
Guide pins M10 x 150		3HAC15521-2	Always use guide pins in pairs!
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Continues on next page


**Deciding calibration routine**

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <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>	
	<p><b>If the robot is to be calibrated with reference calibration:</b></p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in <a href="#">Reference calibration routine on page 386</a>.</p>
	<p><b>If the robot is to be calibrated with fine calibration:</b></p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

**Removal, gearbox**

The procedure below details how to remove the gearbox, axis 5.

	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> <li>air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Drain the oil from the primary gearbox.	Detailed in section <a href="#">Changing oil, axis-5 gearbox on page 178</a> .
4	Drain the oil from the secondary gearbox.	Detailed in section <a href="#">Changing oil, axis-5 gearbox on page 178</a> .
5	Remove the motor, axis 5.	Detailed in section <a href="#">Replacement of motor, axis 5 on page 316</a> .
6	Remove the cover, axis 5 gearbox by unscrewing its attachment screws.	Shown in the figure <a href="#">Location of gearbox on page 361</a> !

Continues on next page

## 4 Repair


### 4.7.5 Replacement of gearbox, axis 5

Continued

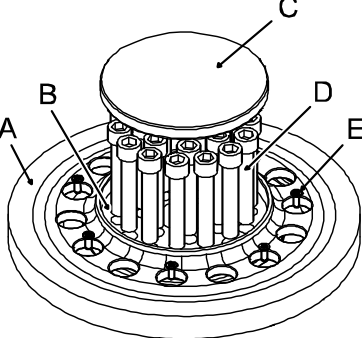
	Action	Note
7	Remove gear Z3 from the gearbox by unscrewing its attachment screws (let axis 6 turn to the stop). If necessary, insert screws into the three holes in gear Z3 to remove it.	Shown in the figure <a href="#">Location of gearbox on page 361!</a> 6 pcs: M16 x 60. 9 pcs: M12 x 50.
8	Remove the wheel unit.	Detailed in following section ( <a href="#">Removal, wheel unit on page 364</a> ).
9	Remove the gearbox, axis 5 by unscrewing its attachment screws and removing the washers.	Shown in the figure <a href="#">Location of gearbox on page 361!</a> 18 pcs: M10 x 40.
10	Apply two lifting eyes to the gearbox, axis 5, in opposite positions.	Art. no. is specified in <a href="#">Required equipment on page 362!</a>
11	Remove the gearbox by gently lifting it straight out.	
12	Remove the friction washers, located beneath the gearbox, from the wrist housing.	

#### Removal, wheel unit


The procedure below details how to remove the wheel unit.

	Action	Note
1	Drain the oil from the secondary gearbox.	Detailed in section <a href="#">Changing oil, axis-5 gearbox on page 178</a> .
2	Remove the cover, axis 5 gearbox by unscrewing its attachment screws.	Shown in the figure <a href="#">Location of gearbox on page 361!</a>
3	Make a short cut in the center of the VK-cover and remove it from the wheel unit by bending it off.	Shown in the figure <a href="#">Location of gearbox on page 361!</a>  <b>Note</b> Avoid damaging screws or surfaces beneath, when removing the cover!
4	Unscrew the attachment screws, bearing washer located beneath gear Z4. Turn the gear Z4 in order to reach all the screws.	Shown in the figure <a href="#">Location of gearbox on page 361</a> and in the figure below! 7 pcs: M6 x 16.

Continues on next page

	Action	Note
5	Remove the <i>attachment screws, gear Z4</i> .	 <p>xx0200000068</p> <p>A Gear Z4            B Surface beneath VK-cover            C VK-cover            D Attachment screws, gear Z4, 21 pcs: M16            E Attachment screws, bearing washer, 7 pcs: M6</p>
6	Apply the <i>removal tool</i> to the center hole of gear Z4 to press the wheel unit free.	Art. no. is specified in <a href="#">Required equipment on page 362!</a>
7	Remove the wheel unit by gently lifting it straight out.	

Refitting, gearbox 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> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
2	Make sure the two <i>o-rings</i> on the circumference of the gearbox are seated properly in their grooves respectively. Lightly lubricate the o-rings with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
3	Fit two <i>guide pins</i> in the housing.	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
4	Refit the two new <i>friction washers (2 pcs)</i> in the wrist housing.	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
5	Apply two <i>lifting eyes</i> to the gearbox, axis 5 , in opposite positions.	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
6	Refit the <i>gearbox, axis 5</i> to the wrist housing, by gently lowering it straight down, using the guide pins.	Shown in the figure <a href="#">Location of gearbox on page 361</a> .

Continues on next page

## 4 Repair

### 4.7.5 Replacement of gearbox, axis 5


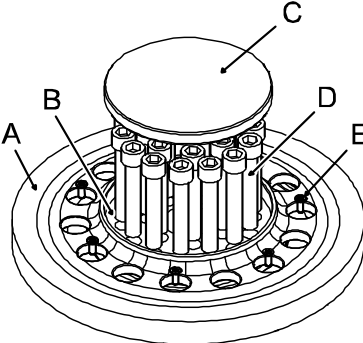
Continued

	Action	Note
7	Secure the gearbox with 16 of the 18 <i>attachment screws</i> and washers.	18 pcs: M10 x 40: tightening torque: 65 Nm. Shown in the figure <a href="#">Location of gearbox on page 361</a> .
8	Remove the guide pins and fit the remaining two attachment screws as specified in the previous step.	
9	Refit the <i>gear Z3</i> to the <i>gearbox, axis 5</i> with its <i>attachment screws</i> .	9 pcs: M12 x 50; 12.9 quality UN-BRAKO, tightening torque: 115 Nm. 6 pcs: M16 x 60: tightening torque: 300 Nm. Shown in the figure <a href="#">Location of gearbox on page 361</a> . Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
10	Refit the wheel unit.	Detailed in the following procedures ( <a href="#">Refitting, wheel unit on page 367</a> ).
11	Replace the <i>gasket</i> .	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
12	Refit the <i>cover, axis 5 gearbox</i> with its <i>attachment screws</i> and secure with locking liquid.	14 pcs, tightening torque: 10 Nm. Shown in the figure <a href="#">Location of gearbox on page 361</a> .
13	Refit the motor, axis 5.	Detailed in section <a href="#">Refitting, motor axis 5 on page 319</a> .
14	Perform a leak-down test.	Detailed in section <a href="#">Performing a leak-down test on page 206</a> .
15	Refill the primary gearbox with oil.	Detailed further in section <a href="#">Filling oil, axis-5 gearbox on page 180</a> .
16	Refill the secondary gearbox with oil.	Detailed further in section <a href="#">Filling oil, axis-5 gearbox on page 180</a> .
17	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .
18	 <p><b>DANGER</b></p> <p>Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a>.</p>	

Continues on next page

Refitting, wheel unit

The procedure below details how to refit the wheel unit.

	Action	Note
1	Clean the wheel unit and the tube mating surfaces.	
2	Lubricate packing box with <i>grease</i> .	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
3	Apply <i>removal tool</i> to the center hole of the gear Z4.	Art. no. is specified in <a href="#">Required equipment on page 362</a> .
4	Refit wheel unit by gently lowering it straight down.	
5	Gently knock on the wheel unit with a plastic mallet, to press it all the way down.	 <b>Note</b> Make sure the bearing reaches the bottom, before continuing the mounting!
6	Fasten the bearing washer with its <i>attachment screws</i> and secure with <i>locking liquid</i> . Turn the gear Z4 in order to reach all the screws.	 <p>xx0200000068</p> <ul style="list-style-type: none"> <li>A Gear Z4</li> <li>B Surface beneath VK-cover</li> <li>C VK-cover</li> <li>D Attachment screws, gear Z4, 21 pcs: M16</li> <li>E Attachment screws, bearing washer, 7 pcs: M6</li> </ul>
7	Clean the surface beneath the VK-cover with isopropanol.	
8	Secure the wheel unit with attachment screws, gear Z4.	21 pcs: M16 x 90; 12.9 quality UNBRAKO, tightening torque: 300 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
9	Refit the VK-cover.	Art. no. is specified in <a href="#">Required equipment on page 362</a> . Shown in the figure <a href="#">Location of gearbox on page 361</a> .
10	Proceed with step 11 in the refitting detailed in the previous procedure (procedure <a href="#">Refitting, gearbox axis 5 on page 365</a> ).	

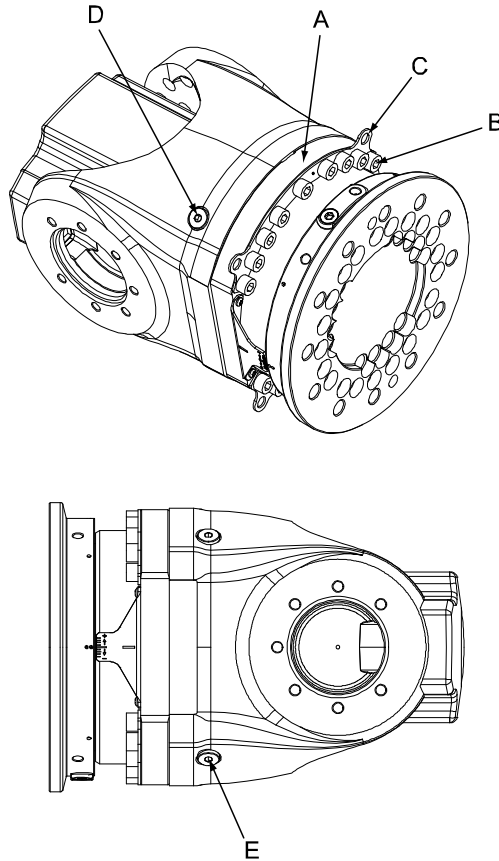
## 4 Repair

### 4.7.6 Replacement of gearbox, axis 6

### 4.7.6 Replacement of gearbox, axis 6

#### Location of gearbox

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



xx0100000131

A	Gearbox, axis 6
B	Attachment screws, gearbox
C	Washers
D	Oil plug, filling
E	Oil plug, draining (can be located on the turning disk instead)
-	O-ring (not shown in the figure)

#### Required equipment

Equipment, etc.	Article number	Note
Gearbox	For spare part number, see <a href="#">Spare part lists on page 427</a> .	Includes o-ring 3HAB3772-49
Washers	3HAC10122-13	Not included in the gearbox. Replace if damaged.

*Continues on next page*



Equipment, etc.	Article number	Note
O-ring	3HAB3772-83	Located between the gearbox and the turning disk. Must be replaced when reassembling gearbox.
Grease	3HAC042536-001	For lubricating the o-ring.
Flange sealant	12340011-116	Loctite 574
Standard toolkit	-	Content is defined in section <a href="#">Standard tools on page 421</a> .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

### Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> <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 Axis Calibration in <a href="#">Reference calibration routine on page 386</a> .
	<b>If the robot is to be calibrated with fine calibration:</b> Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page


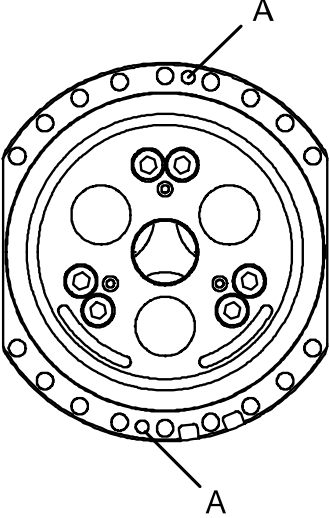
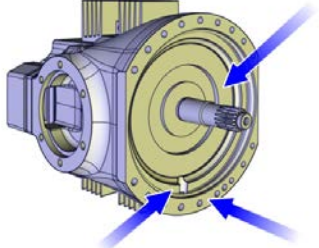
## 4 Repair

### 4.7.6 Replacement of gearbox, axis 6

Continued

#### Removal, gearbox

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


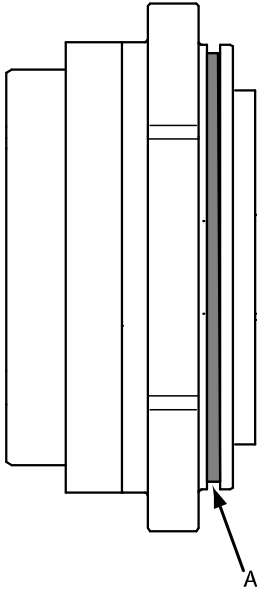
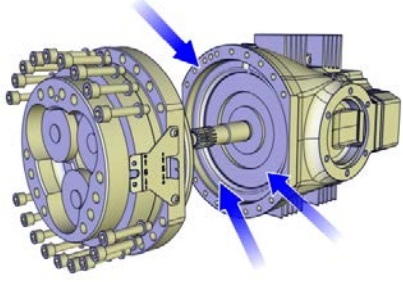
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 <b>DANGER</b> Turn off all: <ul style="list-style-type: none"> <li>• electric power supply to the robot</li> <li>• hydraulic pressure supply to the robot</li> <li>• air pressure supply to the robot</li> </ul> Before entering the robot working area.	
3	Drain the oil from gearbox, axis 6.	Detailed in the section <a href="#">Draining oil, gearbox axis 6 on page 183</a> .
4	Remove the <i>turning disc</i> .	Detailed in the section <a href="#">Removing turning disk on page 233</a> .
5	Remove the gearbox by unscrewing its <i>attachment screws</i> .	Shown in the figure <a href="#">Location of gearbox on page 368</a> .
6	If required, apply M10 screws to the holes shown in the figure to the right, to press the gearbox out.	 <p>xx0200000220</p> <ul style="list-style-type: none"> <li>• A: M10 holes for pressing out the gearbox</li> </ul>
	<b>Foundry Plus:</b> Remove old Loctite 574 flange sealant residues and other contamination from the contact surfaces.	 <p>xx1400001123</p>

Continues on next page

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

Refitting, gearbox

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


	Action	Note
1	 <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> <li>• air pressure supply to the robot</li> </ul> <p>Before entering the robot working area.</p>	
2	<p>Make sure the <i>o-ring</i> is fitted to the rear of the gearbox. Lubricate the o-ring with <i>grease</i>.</p>	<p>Article number is specified in <a href="#">Required equipment on page 368</a>.</p>  <p>xx0200000221</p> <ul style="list-style-type: none"> <li>• A: O-ring, gearbox axis 6</li> </ul>
3	<p>Release the holding brake of motor axis 6.</p>	<p>Detailed in the section <a href="#">Manually releasing the brakes on page 73</a>.</p>
4	<p><i>Foundry Plus:</i></p> <p>Apply Loctite 574 flange sealant on the contact surface.</p>	 <p>xx1400001122</p>

Continues on next page

## 4 Repair

### 4.7.6 Replacement of gearbox, axis 6

Continued

	Action	Note
5	Insert the <i>gearbox, axis 6</i> into the wrist unit.	Article number is specified in <a href="#">Required equipment on page 368</a> . Shown in the figure <a href="#">Location of gearbox on page 368</a> . Make sure the gears of the gearbox mate with the gears of the motor!
6	Fit the both <i>washers</i> and secure the gearbox with the <i>attachment screws</i> .	Shown in the figure <a href="#">Location of gearbox on page 368</a> . 18 pcs: M10 x 50; 12.9 quality Gleitmo, Tightening torque: 65 Nm. Reused screws may be used, providing they are lubricated as detailed in section <a href="#">Screw joints on page 417</a> before fitting.
7	Refit the <i>turning disc</i> .	Detailed in the section <a href="#">Refitting turning disk on page 234</a> .
8	Perform a <i>leak-down test</i> .	Detailed in the section <a href="#">Performing a leak-down test on page 206</a> .
9	Refill the gearbox with oil.	Detailed in the section <a href="#">Filling oil, gearbox axis 6 on page 184</a> .
10	Re-calibrate the robot.	Pendulum Calibration is described in <a href="#">Operating manual - Calibration Pendulum</a> , enclosed with the calibration tools. Axis Calibration is described in <a href="#">Calibrating with Axis Calibration method on page 385</a> . General calibration information is included in section <a href="#">Calibration on page 373</a> .
11	 <b>DANGER</b> Make sure all safety requirements are met when performing the first test run. See <a href="#">Test run after installation, maintenance, or repair on page 116</a> .	

## 5 Calibration

### 5.1 Introduction to calibration

#### 5.1.1 Introduction and calibration terminology

##### Calibration information

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

Detailed instructions of how to perform Axis Calibration are given on the FlexPendant during the calibration procedure. To prepare calibration with Axis Calibration method, see [Calibrating with Axis Calibration method on page 385](#).

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

##### Calibration terminology

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

## 5 Calibration


### 5.1.2 Calibration methods

### 5.1.2 Calibration methods

#### Overview

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

#### Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	<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. For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, <code>calib.cfg</code>, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.</p>	<p>Axis Calibration or Calibration Pendulum<sup>i</sup></p> <p>Levelmeter calibration (alternative method)</p>
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 serial measurement board (SMB) or other robot memory.</p> <p>For robots with RobotWare 5.05 or older, the absolute accuracy calibration data is delivered in a file, <code>absacc.cfg</code>, supplied with the robot at delivery. The file replaces the <code>calib.cfg</code> 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 (IRC5).</p> <p>To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;">  <div style="display: inline-block; vertical-align: middle; margin-left: 10px;"> <p><b>ABSOLUTE ACCURACY</b></p> <p style="font-size: small; margin: 0;">3HAC 14257-1</p> </div> </div> <p>xx0400001197</p>	<p>CalibWare</p>

*Continues on next page*

Type of calibration	Description	Calibration method
Optimization	<p>Optimization of TCP reorientation performance. The purpose is to improve reorientation accuracy for continuous processes like welding and gluing.</p> <p>Wrist optimization will update standard calibration data for axes 4 and 5.</p>	Wrist Optimization

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

### Brief description of calibration methods

#### Calibration Pendulum method

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

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

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

#### Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 7600. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

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

An introduction to the calibration method is given in this manual, see [Calibrating with Axis Calibration method on page 385](#).

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

#### Wrist Optimization method

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

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

Continues on next page

## 5 Calibration

---

### 5.1.2 Calibration methods

*Continued*

#### Levelmeter calibration - alternative method

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

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

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

#### CalibWare - Absolute Accuracy calibration

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

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

---

#### References

Article numbers for the calibration tools are listed in the section [Special tools on page 422](#).

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.



### 5.1.3 When to calibrate

---

#### When to calibrate

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

#### The resolver values are changed

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

If the robot has *absolute accuracy* calibration, it is also recommended, but not always necessary to calibrate for new absolute accuracy.

The resolver values will change when parts affecting the calibration position are replaced on the robot, for example motors or parts of the transmission.

#### The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See [Updating revolution counters on page 380](#). This will occur when:

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

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

#### The robot is rebuilt

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

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

## 5 Calibration

### 5.2.1 Synchronization marks and synchronization position for axes

## 5.2 Synchronization marks and axis movement directions

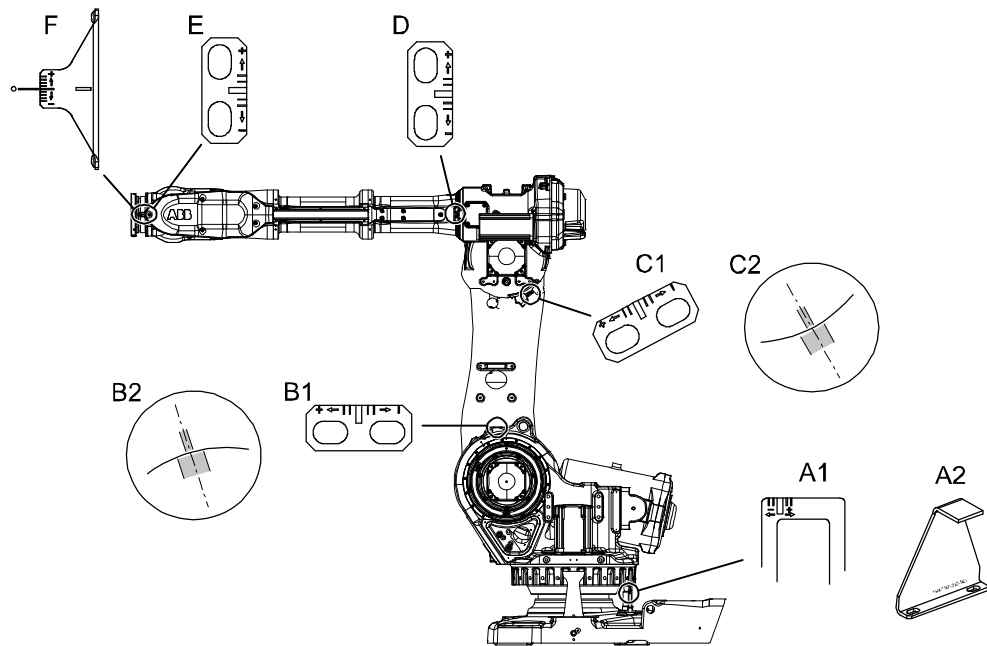
### 5.2.1 Synchronization marks and synchronization position for axes

#### Introduction

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

#### Synchronization marks, IRB 7600

The figure shows IRB 6600, but the scales and their positions are the same.



xx020000176

A1	Synchronization mark, axis 1 (early design)
A2	Synchronization mark, axis 1 (later design)
B1	Synchronization mark, axis 2 (early design)
B2	Synchronization mark, axis 2 (later design)
C1	Synchronization mark, axis 3 (early design)
C2	Synchronization mark, axis 3 (later design)
D	Synchronization mark, axis 4
E	Synchronization mark, axis 5
F	Synchronization mark, axis 6

#### Synchronization marks at axes 2 and 3

The synchronization marks at axes 2, 3 and 6, shown in the figure above, consist of two single marks that should be positioned opposite to one another when the robot is standing in its synchronization position. One of the marks is more narrow than the other and should be positioned within the limits of the wider mark.

## 5.2.2 Calibration movement directions for all axes

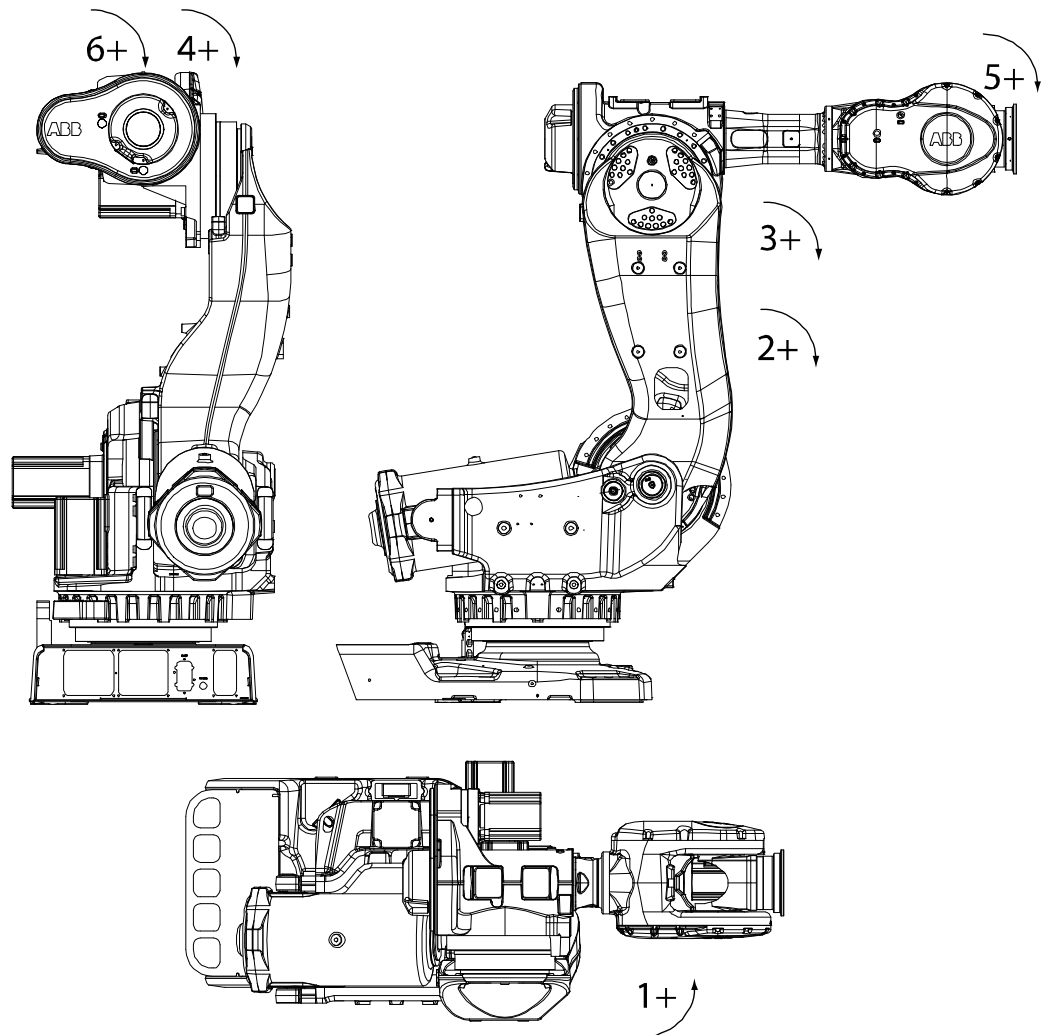
### Overview

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

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

### Manual movement directions, 6 axes

**Note!** The graphic shows an IRB 7600. The positive direction is the same for all 6-axis robots, except the positive direction of axis 3 for IRB 6400R, which is in the opposite direction!



xx020000089

## 5 Calibration

### 5.3.1 Updating revolution counters on IRC5 robots

## 5.3 Updating revolution counters

### 5.3.1 Updating revolution counters on IRC5 robots

#### Introduction

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

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

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

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See <a href="#">Synchronization marks and synchronization position for axes on page 378</a> .
3	When all axes are positioned, update the revolution counter.	<a href="#">Step 2 - Updating the revolution counter with the TPU on page 381</a> (BaseWare 4.0). <a href="#">Step 2 - Updating the revolution counter with the FlexPendant on page 382</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:


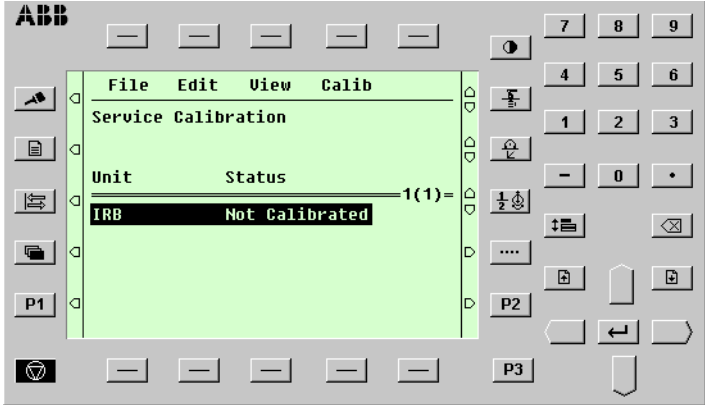
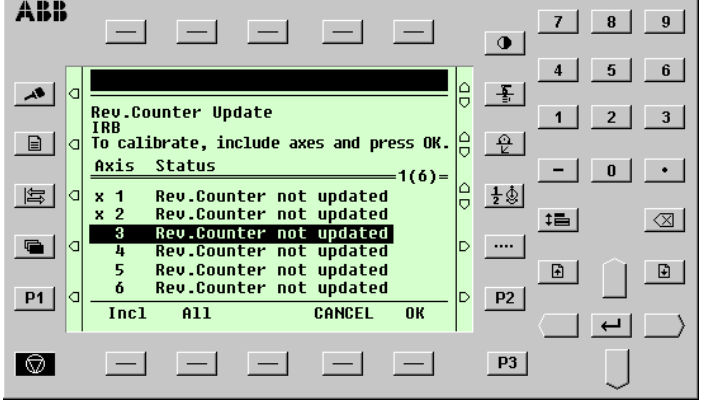
Manipulator variant	Axis 4	Axis 6
IRB 7600	Yes	Yes

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

*Continues on next page*

**Step 2 - Updating the revolution counter with the TPU**

Use this procedure to update the revolution counter with the TPU (BaseWare 4.0).


Action	Note
1	<p>Press the button <b>Miscellaneous</b> then <b>ENTER</b> to select the service window.</p>  <p>xx0100000194</p>
2	<p>Select <b>Calibration</b> from the <b>View</b> menu. The <b>Calibration</b> window appears.</p> <p>If there is more than one unit connected to the manipulator, they will be listed in the window.</p>  <p>xx0100000201</p>
3	<p>Select the desired unit and choose <b>Rev Counter Update</b> from the <b>Calib</b> menu. The <b>Revolution Counter Update</b> window appears.</p>  <p>xx0100000202</p>
4	<p>Select the desired axis and press <b>Incl</b> to include it (it will be marked with an <b>x</b>) or press <b>All</b> to select all axes.</p>
5	<p>Press <b>OK</b> when all axes that are to be updated are marked with an <b>x</b>. <b>CANCEL</b> returns to the <b>Calibration</b> window.</p>
6	<p>Press <b>OK</b> again to confirm and start the update. <b>CANCEL</b> returns to the <b>Revolution Counter Update</b> window.</p>

Continues on next page

## 5 Calibration

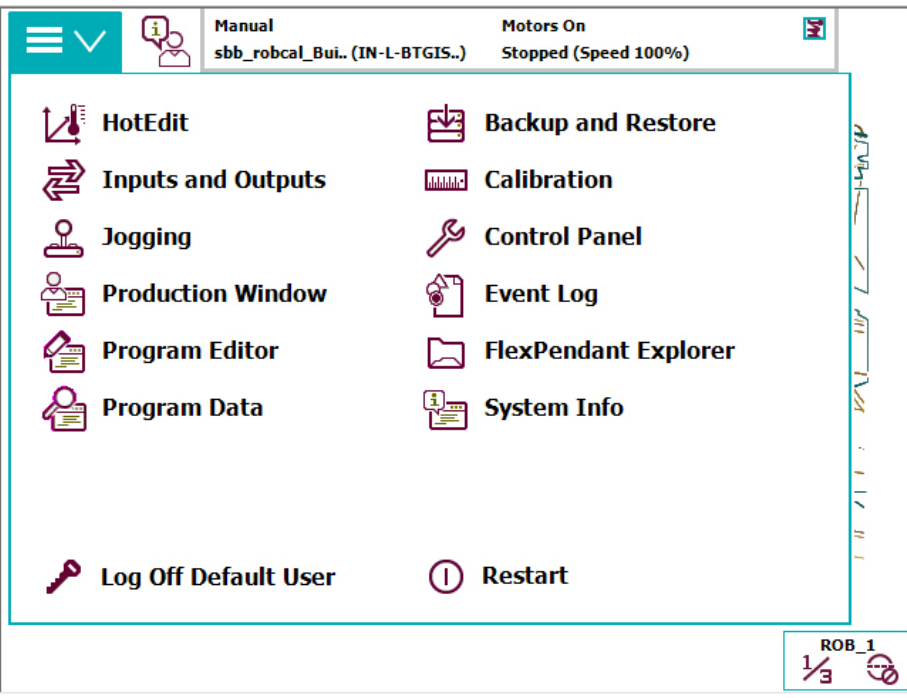
### 5.3.1 Updating revolution counters on IRC5 robots

Continued

	Action	Note
7	At this point, it is <i>recommended</i> that the revolution counter values are saved to a diskette.	Not required.
8	 <b>CAUTION</b> If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. How to perform the check is detailed in section <a href="#">Checking the synchronization position on page 401</a> .	

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

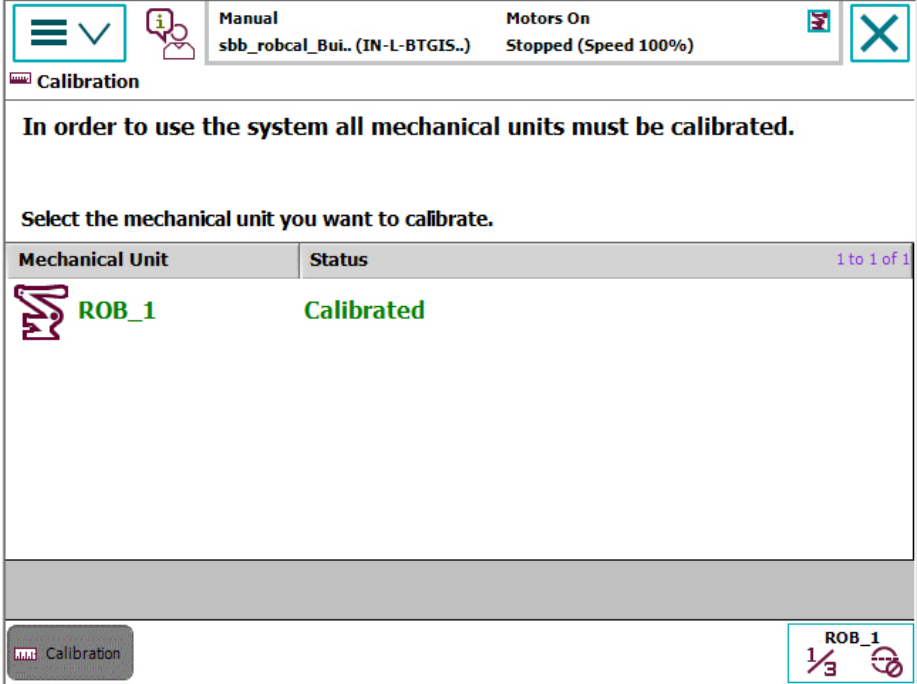
Use this procedure to update the revolution counter with the FlexPendant (IRC5).

	Action
1	<p>On the <b>ABB</b> menu, tap <b>Calibration</b>.</p>  <p>xx1500000942</p>

Continues on next page

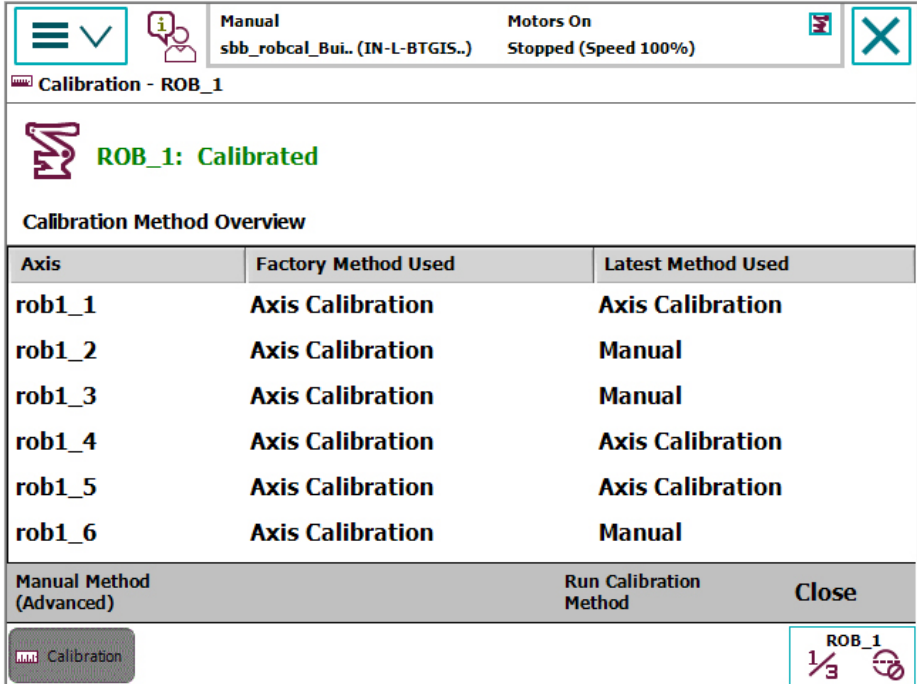
**Action**

2 All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.



xx1500000943

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



xx1500000944

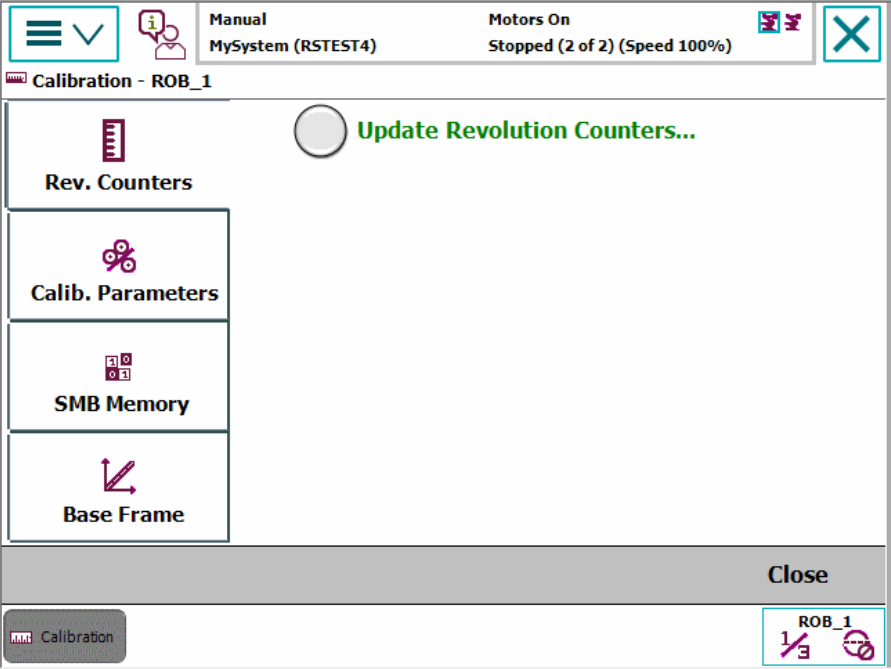

Axis	Factory Method Used	Latest Method Used
rob1_1	Axis Calibration	Axis Calibration
rob1_2	Axis Calibration	Manual
rob1_3	Axis Calibration	Manual
rob1_4	Axis Calibration	Axis Calibration
rob1_5	Axis Calibration	Axis Calibration
rob1_6	Axis Calibration	Manual

Continues on next page

## 5 Calibration

### 5.3.1 Updating revolution counters on IRC5 robots

Continued

Action	
4	<p>A screen is displayed, tap <b>Rev. Counters</b>.</p>  <p>en040000771</p>
5	<p>Tap <b>Update Revolution Counters...</b></p> <p>A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions:</p> <ul style="list-style-type: none"><li>• Tap <b>Yes</b> to update the revolution counters.</li><li>• Tap <b>No</b> to cancel updating the revolution counters.</li></ul> <p>Tapping <b>Yes</b> displays the axis selection window.</p>
6	<p>Select the axis to have its revolution counter updated by:</p> <ul style="list-style-type: none"><li>• Ticking in the box to the left</li><li>• Tapping <b>Select all</b> to update all axes.</li></ul> <p>Then tap <b>Update</b>.</p>
7	<p>A dialog box is displayed, warning that the updating operation cannot be undone:</p> <ul style="list-style-type: none"><li>• Tap <b>Update</b> to proceed with updating the revolution counters.</li><li>• Tap <b>Cancel</b> to cancel updating the revolution counters.</li></ul> <p>Tapping <b>Update</b> updates the selected revolution counters and removes the tick from the list of axes.</p>
8	<p> <b>CAUTION</b></p> <p>If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury!</p> <p>Check the synchronization position very carefully after each update. See <a href="#">Checking the synchronization position on page 401</a>.</p>



## 5.4 Calibrating with Axis Calibration method

### 5.4.1 Description of Axis Calibration

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

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

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

#### Overview of the Axis Calibration procedure

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

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

The Axis Calibration procedure described roughly:

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



#### WARNING

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



#### WARNING

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

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



#### WARNING

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

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

*Continues on next page*

## 5 Calibration

---

### 5.4.1 Description of Axis Calibration

*Continued*

---

#### Routines in the calibration procedure

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

##### Fine calibration routine

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

##### Reference calibration routine

Choose this routine to create reference values and to calibrate the robot when the robot is dressed with tools, process cabling or other equipment.



#### Note

When calibrating the robot with the reference calibration routine, the robot must be dressed with the same tools, process cabling and any other equipment as when the reference values were created.



#### Note

When using reference calibration with some tools, typically large or flexible tools, oscillations in the robot can cause issues leading to failure of the calibration.

If calibrating the robot with reference calibration there must be reference values created before repair is made to the robot, if values are not already available. Creating new values requires possibility to move the robot. The reference values contain positions of all axes, torque of axes and technical data about the tool installed. A benefit with reference calibration is that the current state of the robot is stored and not the state when the robot left the ABB factory. The reference value will be named according to tool name, date etc.

Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.

When reference calibration is performed, the robot is restored to the status given by the reference values.

##### Update revolution counters

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

##### Validation

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

---

#### Position of robot axes

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

It is possible to position some of the other axes in positions different from 0 degrees. Information about which axes are allowed to be jogged is given on the FlexPendant.

*Continues on next page*

These axes are marked with **Unrestricted** in the FlexPendant window. Also the following table shows the dependencies between the axes.

Requirements for axis positioning during calibration

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

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

#### System containing SafeMove

SafeMove will lose its synchronization to the controller if a new calibration is done. New calibration values have to be downloaded to SafeMove, and a new SafeMove calibration has to be done. Make sure that the user rights admit to change the safety settings and to synchronize SafeMove.

For robots with EPS, the same applies as for SafeMove.

## 5 Calibration

### 5.4.2 Calibration tools for Axis Calibration

#### 5.4.2 Calibration tools for Axis Calibration

##### Calibration tool set

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.

The calibration tool will eventually break from fatigue after longer period of use and then needs to be replaced. There is no risk for bad calibrations as long as the calibration tool is in one piece.



##### WARNING

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

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

##### Examining the calibration tool

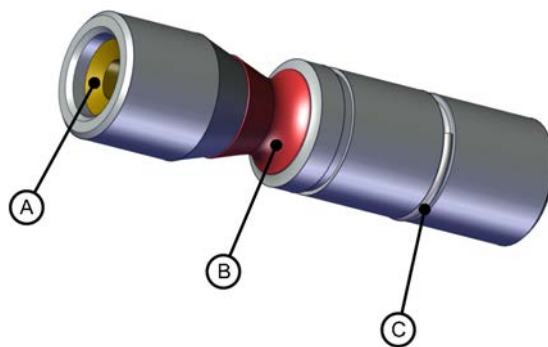
##### Check prior to usage

Before using the calibration tool, make sure that the tube insert, the plastic protection and the steel spring ring are present.



##### WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

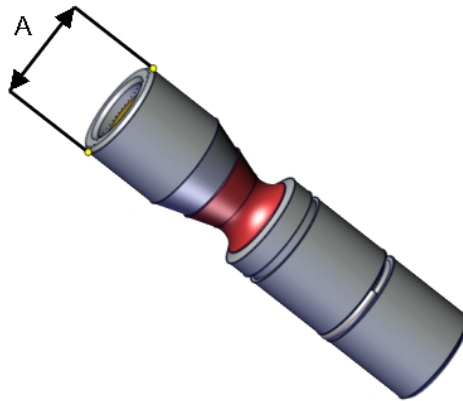
A	Tube insert
B	Plastic protection
C	Steel spring ring

*Continues on next page*

Periodic check of the calibration tool

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within  $\varnothing 12g4$  mm,  $\varnothing 8g4$  mm or  $\varnothing 6g5$  mm (depending on calibration tool size).
- Straightness within 0.005 mm.



xx150000951

A	Outer diameter
---	----------------

Identifying the calibrating tools

It is possible to make the calibration tool identifiable with, for example, an RFID chip. The procedure of how to install an RFID chip is described below.



**Note**

The tool identifier is NOT delivered from ABB, it is a customized solution.

	Action	Note
1	<p>It is possible to use any RFID solution, with the correct dimensions. ABB has verified function on some suppliers fulfilling the requirements of NFC compatible devices (13.56 Mhz) according to ISO 14443 or ISO 15693.</p> <div style="margin-top: 10px;"> <p><b>Note</b></p> <p>The maximum dimensions on the RFID chip must not exceed <math>\varnothing 7.9</math> mm x 8.0 mm, <math>\varnothing 5.9</math> mm x 8.0 mm or <math>\varnothing 3.9</math> mm x 8.0 mm (depending on calibration tool size).</p> </div>	
2	<p>There is a cavity on one end of the calibration tool in which the RFID chip can be installed.</p> <p>Install the RFID chip according to supplier instructions.</p> <p>Install the chip in flush with the tool end.</p>	

## 5 Calibration

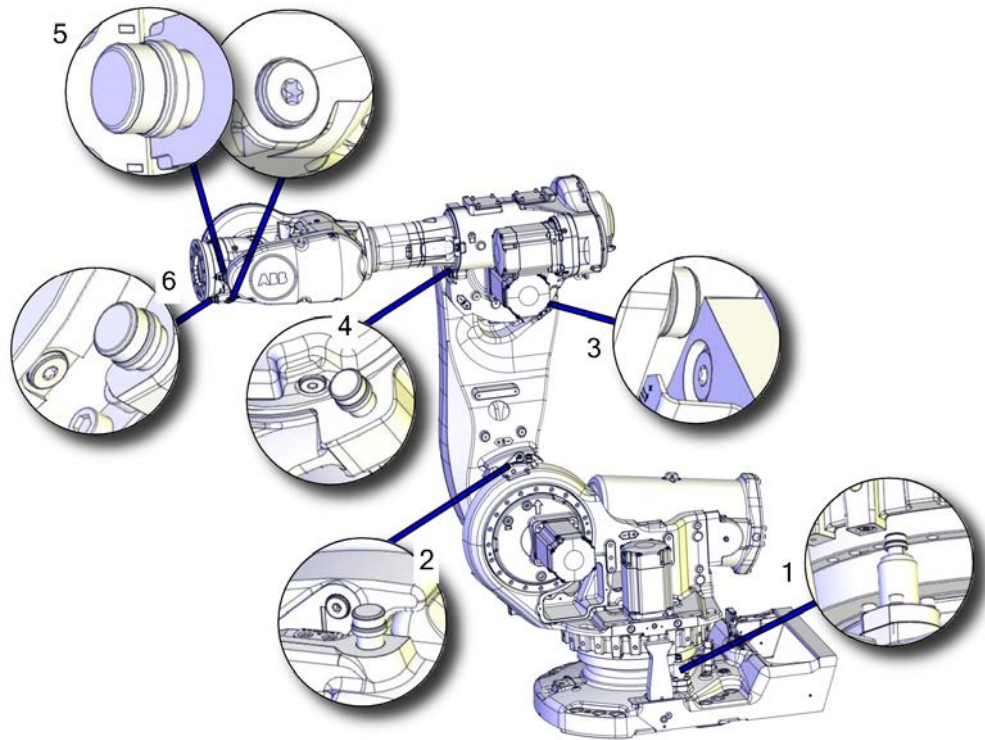
### 5.4.3 Installation locations for the calibration tools

### 5.4.3 Installation locations for the calibration tools

#### Location of fixed calibration items

This section shows how the robot is equipped with items for installation of calibration tools for Axis Calibration (fixed calibration pins and/or bushings). Installed calibration tools are not shown.

A fixed calibration pin and a bushing for the movable calibration tool are located on each axis as follows.



xx150000894

The fixed calibration pin for axis 1 is installed on a removable tower. The tower will need to be removed if electronic position switches are fitted to the robot. Keep the tower in a safe location for future recalibration needs and mark it with robot serial number to ensure that the correct one is refitted.

#### Spare parts

When calibration is not being performed, a protective cover and an o-ring should always be installed on the fixed calibration pin as well as a protective plug, included a sealing, in the bushing. Replace damaged parts with new.

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

### 5.4.4 Axis Calibration - Running the calibration procedure

#### Required tools

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.



#### WARNING

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

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

#### Required consumables

Consumable	Article number	Note
Clean cloth	-	

#### Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

#### Overview of the calibration procedure on the FlexPendant

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

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

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

- 1 Choose calibration routine. The routines are described in [Routines in the calibration procedure on page 386](#).
- 2 Choose which axis/axes to calibrate.
- 3 The robot moves to synchronization position.
- 4 Validate the synchronization marks.
- 5 The robot moves to preparation position.
- 6 Remove the protective cover from the fixed pin and the protection plug from the bushing, if any, and install the calibration tool.

*Continues on next page*

## 5 Calibration

### 5.4.4 Axis Calibration - Running the calibration procedure



*Continued*

- 7 The robot performs a measurement sequence by rotating the axis back and forth.
- 8 Remove the calibration tool and reinstall the protective cover on the fixed pin and the protection plug in the bushing, if any.
- 9 The robot moves to verify that the calibration tool is removed.
- 10 Choose whether to save the calibration data or not.

Calibration of the robot is not finished until the calibration data is saved, as last step of the calibration procedure.

#### Preparation prior to calibration

The calibration procedure is described in the FlexPendant while conducting it.

	Action	Note
1	 <b>DANGER</b> While conducting the calibration, the robot needs to be connected to power. Make sure that the robot's working area is empty, as the robot can make unpredictable movements.	
2	Wipe the calibration tool clean.  <b>Note</b> The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.
3	Check if the standard calibration data for axes 4 or 5 are updated with wrist optimization. This is shown in the calibration overview/summary window on the FlexPendant.	If the data is optimized, the calibration routine <b>Wrist Optimization</b> must be re-run after standard calibration. See <a href="#">Calibrating with Wrist Optimization method on page 398</a> .

#### Starting the calibration procedure

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

	Action	Note
1	Tap the calibration icon and enter the calibration main page.	
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.	
3	The calibration method used at ABB factory for each axis is shown, as well as calibration method used for the robot during last field calibration.	The FlexPendant will give all information needed to proceed with Axis Calibration.
4	<b>Valid for RobotWare 6</b> Tap <b>Call Calibration Method</b> . The software will automatically call for the procedure for the valid calibration method. If not, tap <b>Call Routine</b> and then tap <b>Axis calibration</b> .	

*Continues on next page*



### 5.4.4 Axis Calibration - Running the calibration procedure

*Continued*

	Action	Note
5	Follow the instructions given on the FlexPendant.	A brief overview of the sequence that will be run on the FlexPendant is given in <a href="#">Overview of the calibration procedure on the FlexPendant on page 391</a> .

#### Restarting an interrupted calibration procedure

If the Axis Calibration procedure is interrupted before the calibration is finished, the RobotWare program needs to be started again. Use this procedure to take required action.

Situation	Action
The three-position enabling device on the FlexPendant has been released during robot movement.	Press and hold the three-position enabling device and press <b>Play</b> .
The RobotWare program is terminated with <b>PP to Main</b> .	Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See <i>Starting the calibration procedure</i> . If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in <a href="#">Calibration movement directions for all axes on page 379</a>

#### Axis Calibration with SafeMove option

To be able to run Axis Calibration, SafeMove needs to be unsynchronized. The Axis Calibration routine recognizes if the robot is equipped with SafeMove and will force SafeMove to unsynchronize automatically.

However, SafeMove may generate other warning messages anytime during the Axis Calibration routine. When a warning message is displayed, tap **Acknowledge** to confirm the unsynchronized state and continue Axis Calibration procedure.



#### CAUTION

SafeMove must be synchronized after the calibration is completed.

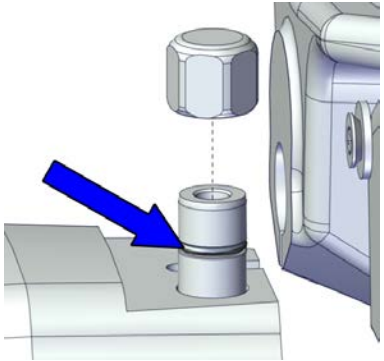
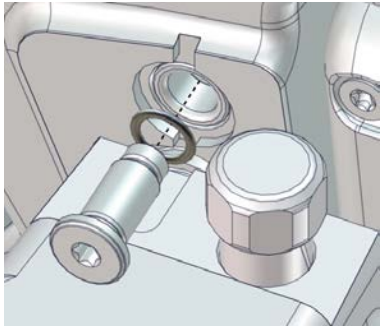
*Continues on next page*

## 5 Calibration

### 5.4.4 Axis Calibration - Running the calibration procedure

*Continued*

#### After calibration

	Action	Note
1	Check the o-ring on the fixed calibration pin. Replace if damaged or missing.	 <p>xx1600002102</p> <p>Protection cover and plug set: 3HAC056806-001.</p>
2	Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	
3	Reinstall the protective plug and sealing in the bushing on each axis, directly after the axis has been calibrated. Ensure that the sealing is not damaged. Replace the plug and the sealing with new spare part, if missing or damaged.	 <p>xx1500000952</p> <p>Protection cover and plug set: 3HAC056806-001.</p>
4	If the standard calibration data for axes 4, 5 or 6 should be updated with wrist optimization, run the calibration routine <b>Wrist Optimization</b> .	See <a href="#">Calibrating with Wrist Optimization method on page 398</a> .

---

## 5.4.5 Reference calibration

---

### Brief introduction to Reference Calibration

Reference calibration is a faster method compared to Fine calibration, as it refers to a previously made calibration.

- 1 Create a backup of the current robot system.
- 2 Check that the active calibration offset values corresponds to the values on the silver label (on the lower arm or the base).
- 3 Jog the manipulator so that all axes are in zero position (ex use `MoveAbsJ` instruction). Check that all axis scales are aligned with calibration marks.
- 4 If the scales differ from calibration marks it might depend on wrong turns of the revolution counters. Make a marker line on the corresponding axis to be able to validate the result of the calibration. If more than one motor revolutions are wrong, the calibration will fail.
- 5 Use a verification position. This is especially recommended if all axes were not aligned with the synchronization marks (step 3). Reuse an existing position that is suitable and accurate so it can be used to validate the repair. Use a position where a deviation in axis calibration gives a big deviation in positioning. Note! Check the position after each repair in one axis.
- 6 Use Reference calibration to save reference values for all axes that is to be replaced. Make sure that the values are saved in RobotStudio or FTP program. The files are located in "Active system folder name/HOME/RefCalibFiles".
- 7 Perform the repair.
- 8 Make sure that the tooling and process equipment are the same as when creating the reference. Use Reference calibration to update the system with new calibration offset value for the repaired axis.
- 9 Check the position against the verification position (step 5).
- 10 Proceed with the repair of the next axis, if necessary, and repeat (step 8-9) for every axis.
- 11 (For system containing SafeMove or EPS) Download new calibration values to SafeMove. Use Visual SafeMove in RobotStudio.
- 12 (For system containing SafeMove or EPS) Synchronize SafeMove to activate SafeMove.
- 13 Perform test run.
- 14 Update the label for resolver values with new calibration values.

### Manual tuning of calibration offset

Manual tuning of calibration offset is normally not needed, but can be useful in some situations. The requirement to do manual tuning is that there is a known accurate position, that worked accurately before the repair (step 5, see [Brief introduction to Reference Calibration on page 395](#)).

Example "Adjust axis 4":

- 1 Create a backup.

*Continues on next page*

## 5 Calibration

---

### 5.4.5 Reference calibration

*Continued*

- 2 Run the manipulator to the verification position. (The manipulator position is now deviating from the verification position.)
- 3 Read and note current axis 4 value in degrees (example: 96.3 degrees).
- 4 Manually jog, only axis 4, so that the manipulator is correctly positioned to the verification position.
- 5 Read and note current axis 4 value in degrees (example: 94.2 degrees).
- 6 Move the manipulator to its calibration position.
- 7 Calculate the angle difference (ie  $96.3 - 94.2 = 2.1$  degrees).
- 8 Manually jog axis 4 the calculated angle difference (-2.1). NOTE! The direction +/- shall be the same direction as the direction used when axis 4 was manually jogged to coincide with the verification process. In the example -2.1 degrees.
- 9 Make a new manual fine calibration of axis 4 with axis in -2.1 degrees position.
- 10 Check again against the verification position.
- 11 Repeat the manual tuning if needed.
- 12 Create a new reference if the intention is to use the reference in the future.

### 5.5 Calibrating with Calibration Pendulum method

---

#### Where to find information for Calibration Pendulum

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

## 5 Calibration

### 5.6 Calibrating with Wrist Optimization method

### 5.6 Calibrating with Wrist Optimization method

#### When to run Wrist Optimization

Wrist Optimization routine is run to improve TCP reorientation performance.

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

#### Overview of the calibration procedure on the FlexPendant

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

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

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

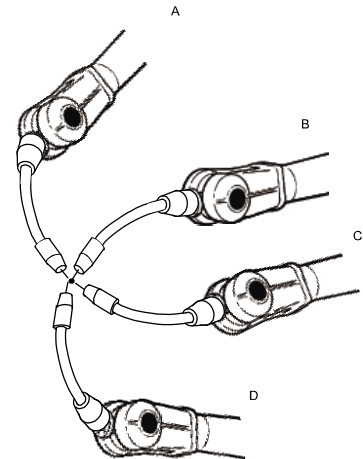
- 1 Choose calibration routine Wrist Optimization.
- 2 Modify targets for 4-point tool frame definition, in Wrist Optimization routine.



#### Tip

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

- a Jog the robot to an appropriate position, A, for the first approach point.  
Use small increments to accurately position the tool tip as close to the reference point as possible.
- b Tap **Modify Position** to define the point.
- c Repeat for each approach point to be defined, positions B, C, and D.  
Jog away from the fixed world point to achieve the best result. Just changing the tool orientation will not give as good a result.



en0400000906

- 3 Improved calibration data to the wrist axes is identified and presented.
- 4 Optimized positions for the wrist axes are presented.

*Continues on next page*

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



**WARNING**

Robot moves automatically when pressing **Calibrate**.

- 6 Wrist optimization is finished.
- 7 Redefine / verify TCP for all tools.

## 5 Calibration

---

### 5.7 Verifying the calibration

### 5.7 Verifying the calibration

---

#### Introduction

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

---

#### Verifying the calibration

Use this procedure to verify the calibration result.

	Action	Note
1	Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See <a href="#">Checking the synchronization position on page 401</a> .
2	Adjust the <i>synchronization marks</i> when the calibration is done, if necessary.	This is detailed in section <a href="#">Synchronization marks and synchronization position for axes on page 378</a> .
3	Write down the values on a new label and stick it on top of the calibration label. The label is located on the lower arm.	



## 5.8 Checking the synchronization position

### Introduction

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

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

### Using a `MoveAbsJ` instruction on the TPU, S4Cplus

Use this procedure to create a program that runs all the robot axes to their synchronization position.

	Action	Note
1	Create the following program: <pre>MoveAbsJ [[0,0,0,0,0,0], [9E9, 9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, z50, Tool0</pre>	
2	Run the program in manual mode.	
3	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 378</a> and <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .

### Using a `MoveAbsJ` instruction

Use this procedure to create a program that runs all the robot axes to their synchronization position.

	Action	Note
1	On ABB menu tap <b>Program editor</b> .	
2	Create a new program.	
3	Use <b>MoveAbsJ</b> in the <b>Motion&amp;Proc</b> menu.	
4	Create the following program: <pre>MoveAbsJ [[0,0,0,0,0,0], [9E9,9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, fine, tool0</pre>	
5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See <a href="#">Synchronization marks and synchronization position for axes on page 378</a> and <a href="#">Updating revolution counters on page 380</a> .

*Continues on next page*


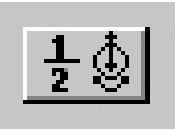
## 5 Calibration

### 5.8 Checking the synchronization position

*Continued*

#### Using the jogging window on the TPU, S4Cplus

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

	Action	Illustration/Note
1	Open the <b>Jogging</b> window.	 xx0100000195
2	Select running axes-by-axes.	 xx0100000196
3	Manually run the robot axes to a position where the axis position value read on the TPU, is equal to zero.	
4	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 378</a> and <a href="#">Updating revolution counters on IRC5 robots on page 380</a> .

#### Using the jogging window

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

	Action	Note
1	On the <b>ABB</b> menu, tap <b>Jogging</b> .	
2	Tap <b>Motion mode</b> to select group of axes to jog.	
3	Tap to select the axis to jog, axis 1, 2, or 3.	
4	Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to zero.	
5	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See <a href="#">Synchronization marks and synchronization position for axes on page 378</a> and <a href="#">Updating revolution counters on page 380</a> .

# 6 Decommissioning

## 6.1 Introduction to decommissioning

### Introduction

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

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



#### Note

The decommissioning process shall be preceded by a risk assessment.

### Disposal of materials used in the robot

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

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

See also [Environmental information on page 404](#).

### Transportation

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

## 6 Decommissioning

### 6.2 Environmental information

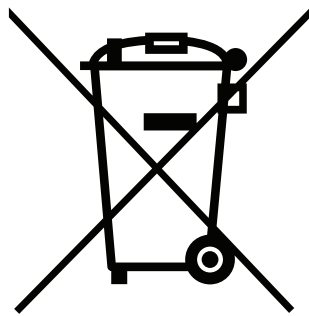
## 6.2 Environmental information

### Introduction

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

### Symbol

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



xx180000058

### Materials used in the product

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

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

Material	Example application
Aluminium	Covers, synchronization brackets
Batteries, Lithium	Serial measurement board
Cast iron/nodular iron	Base, lower arm, upper arm
Copper	Cables, motors
Neodymium	Brakes, motors
Nickel	Turning disc (foundry)
Oil, grease	Gearboxes
Plastic/rubber	Cables, connectors, drive belts, and so on.
Steel	Gears, screws, base frame, and so on.

*Continues on next page*

#### Oil and grease

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

Also note that:

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

## 6 Decommissioning

---

### 6.3 Scrapping of robot

### 6.3 Scrapping of robot



#### Note

The decommissioning process shall be preceded by a risk assessment.

---

#### Important when scrapping the robot



#### DANGER

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

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

## 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 421</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="#">Replacing the balancing device on page 279</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*



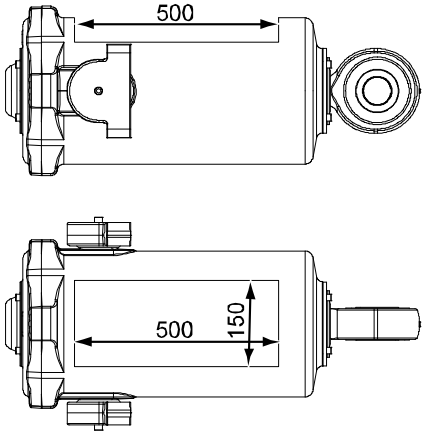
## 6 Decommissioning

### 6.4 Decommissioning of balancing device

*Continued*


#### Decommissioning at decommissioning company, balancing device

The instruction below details how to decommission the balancing device. Contact ABB Robotics for further consultation.

	Action	Note
1	 <p><b>DANGER</b></p> <p>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.</p> <p>The working area must be free of flammable materials. Position the balancing device so that the spatter will be directed away from personnel.</p>	
2	<p>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.</p>	
3	 <p><b>DANGER</b></p> <p>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!</p>	
4	<p>Cut a hole in the housing as shown in the figure.</p>	<p>Use a cutting torch with a long shaft. The measurements shown below are maximum values!</p>  <p>xx020000082</p>

*Continues on next page*



	Action	Note
5	 <p><b>DANGER</b></p> <p>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.</p> <p>The working area must be free of flammable materials. Position the balancing device so that the spatter will be directed away from personnel.</p>	
6	<p>Cut the coils of the springs inside the housing as specified below:</p> <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	<p>Double-check the number of coils cut and make sure all the tension in the springs are removed.</p>	

**This page is intentionally left blank**

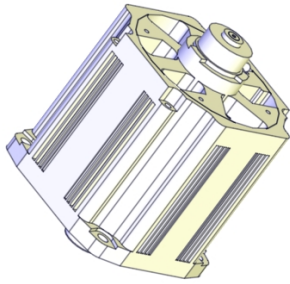
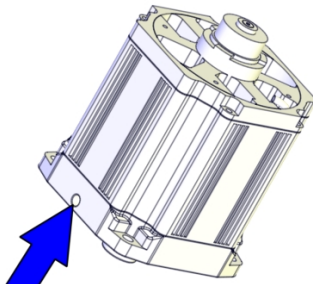
## 7 Robot description

### 7.1 Type A vs type B motors

#### Identifying the motor visually

Type B motors include evacuation on the motor flange to indicate failure of primary sealing between the gearbox and the motor. Robots with protection type Foundry Plus have a sight glass installed in the evacuation holes.

Use the images to identify which type of motor is installed on each robot axis.

Type A motor	Type B motor
 <p>xx1500001058</p>	 <p>xx1500001057</p>
No evacuation on type A motors.	The type B motor include evacuation on the motor flange.

#### Identifying the motor by article number

Use the table to identify which type of motor is installed on each robot axis by article number. The article numbers specified are found in WebConfig.

Contact ABB Service for further assistance regarding which motor type is installed on the robot, if needed.

The columns for reach refer to the robot variant designation.



#### Note

The article numbers in the table can not be used for ordering spare parts. The numbers are only used for identification of installed motors.

See *Product manual, spare parts - IRB 7600* for spare part numbers.

Robot axis	Article number Type A motor	Article number Type B motor	500 2.55	500 2.3	400 2.55	340 2.80	325 /3.10	150 3.50
1	3HAC057539-001	3HAC062338-001	X	X	X	X	X	X
	3HAC060565-001 (Foundry Prime)	N/A			X			
2	3HAC057540-001	3HAC062339-001		X	X	X		X
	3HAC057541-001	3HAC062340-001	X				X	
	3HAC060566-001 (Foundry Prime)	N/A			X			

Continues on next page

## 7 Robot description

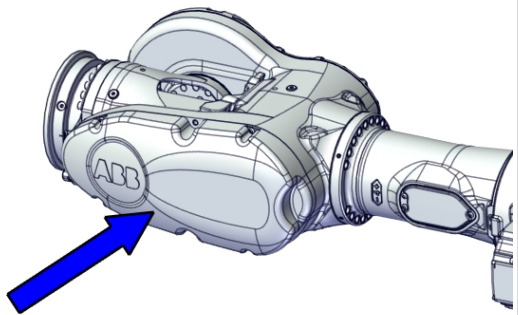
### 7.1 Type A vs type B motors

Continued

Robot axis	Article number Type A motor	Article number Type B motor	500 2.55	500 2.3	400 2.55	340 2.80	325 /3.10	150 3.50
3	3HAC057540-001	3HAC062339-001	X	X	X	X	X	X
	3HAC060566-001 (Foundry Prime)	N/A			X			
4	3HAC057543-001	3HAC062341-001	X	X	X	X	X	X
	3HAC036644-002 (Foundry Prime)	N/A			X			
5	3HAC057543-001	3HAC062341-001	X	X	X	X	X	X
	3HAC060567-001 (Foundry Prime)	N/A			X			
6	3HAC057544-001	3HAC062342-001	X	X	X	X	X	X
	3HAC060568-001 (Foundry Prime)	N/A			X			

### Interchangeable parts

Use the table to see if type A and type B motors are interchangeable on each robot axis.

Robot axis	Motor replacement from type A to type B	Requirements/notes for replacing type A motor with type B motor
1	Fully interchangeable.	
2	Fully interchangeable.	
3	Fully interchangeable.	
4	Fully interchangeable.	
5	Partly interchangeable.	Replacement to type B requires replacement of the left hand side wrist cover. Spare part number for the cover that fits the type B motor: 3HAC062450-005 (ABB Orange) / 3HAC062450-004 (Graphite White).  xx1800000129
6	Not interchangeable.	The complete wrist unit must be replaced.

## **8 Reference information**

### **8.1 Introduction**

---

#### **General**

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

## 8 Reference information

### 8.2 Applicable standards

### 8.2 Applicable standards



#### Note

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

#### General

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

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

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

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

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

#### Region specific standards and regulations

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 434-03	Industrial robots and robot Systems - General safety requirements

#### Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments

*Continues on next page*

## 8 Reference information

### 8.2 Applicable standards

*Continued*

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

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

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

## 8 Reference information

---

### 8.3 Unit conversion

### 8.3 Unit conversion

---

#### Converter table

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

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



## 8.4 Screw joints

### General

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

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

### UNBRAKO screws

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

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

### Gleitmo treated screws

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

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

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

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

### Screws lubricated in other ways

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

In such cases, proceed as follows:

- 1 Apply lubricant to the screw thread.
- 2 Apply lubricant between the plain washer and screw head.
- 3 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.

*Continues on next page*

## 8 Reference information

### 8.4 Screw joints

Continued

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

#### Tightening torque

Before tightening any screw, note the following:

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

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

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



#### Note

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

#### Tightening torque for oil-lubricated screws with allen head screws

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



#### Note

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

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

Continues on next page

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

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

**Note**

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

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

<sup>i</sup> Lubricated with Molycote 1000, Gleitmo 603 or equivalent

**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*.

**Note**

A 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

## 8 Reference information

---

### 8.5 Weight specifications

### 8.5 Weight specifications

---

#### Definition


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

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

---

#### Example

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

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

## 8.6 Standard tools

### General

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

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

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

### Contents, standard toolkit

Qty	Tool	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	

## 8 Reference information

### 8.7 Special tools

### 8.7 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 421](#), and of special tools, listed directly in the instructions and also gathered in this section.

#### Basic tools

The following table specifies the tools in the basic toolkit (3HAC15571-3) 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	3HAC12734-1
Lifting tool, motor ax 1, 4, 5	1	3HAC14459-1
Lifting tool, motor ax 2, 3, 4	1	3HAC15534-1
Removal tool, motor M10x	2	3HAC14972-1
Removal tool, motor M12x	1	3HAC14973-1 Fits motors, axes 1, 2, 3, 4 and 5.
Rotation tool	1	3HAC17105-1
Mechanical stop axis 3	2	3HAC12708-2
Bolts M16 x 80 (for mechanical stop axis 3)	2	3HAB3409-89
Washers (for mechanical stop axis 3)	2	3HAA1001-186
Standard toolkit (content described in section <a href="#">Standard tools on page 421</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.
Fixture lower arm	1	3HAC13660-1
Guide pins M12 x 130	2	3HAC022637-001
Guide pins M16 x 150	2	3HAC13120-2
Guide pins M16 x 200	2	3HAC13120-3
Guide pins M16 x 250	1	3HAC13120-4

*Continues on next page*

Description	Qty	Art. no.
Guide pins M16 x 300	2	3HAC13120-5
Guide pins, sealing ax 2/3, 100mm	1	3HAC14627-3
Guide pins, sealing ax 2/3, 80mm	1	3HAC14627-2
Holder for bits (Stahlwille 736/40 S 5/16")	1	3HAC029090-001
Hydraulic cylinder	1	3HAC11731-1
Hydraulic pump, 80 MPa	1	3HAC13086-1
Hydraulic pump, 150 MPa (Glycerin)	1	3HAC021563-012
Lifting accessory, base	1	3HAC15560-1
Lifting accessory, robot	1	3HAC15607-1
Lifting accessory, upper arm	1	3HAC15536-1
Lifting eye VLBG M12	1	3HAC16131-1
Lifting eye M12	2	3HAC14457-3
Lifting eye M16	2	3HAC14457-4
Lifting tool (chain)	1	3HAC15556-1
Lifting tool, gearbox axis 2 and axis 3	1	3HAC032723-001
Measuring tool	1	6896134-GN
Oil injector / max 500 MPa	1	3HAC021590-001
Press tool, axis 2 bearing	1	3HAC076203-001
Puller device, axis 2 shaft	1	3HAC075427-001
Press device, axis 2 shaft	1	3HAC076203-001
Press equipment, balancing device	1	3HAC074411-001
Adapter Used together with press equipment for balancing devices from 2002 and older.	1	3HAC078221-001
Press equipment, balancing device shaft	1	3HAC076202-001
Removal tool, wheel unit	1	3HAC15814-1
Support, base	1	3HAC15535-1
Tool set balancing device	1	3HAC15943-1

### Tools that may be rented

The following table specifies the tools that may be rented from ABB in order to perform certain service procedures as described in the Product manual.

The special tools are also listed directly in the instructions.

Description	Art. no.	Note
Lifting tool, lower arm	3HAC14691-1	Includes <ul style="list-style-type: none"> <li>Guidances, 3HAC14445-1</li> </ul>

Continues on next page

## 8 Reference information

---

### 8.7 Special tools

*Continued*

---

#### 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	
Measuring pin	3HAC13908-5	
Sensor fixture	68080011-GM	
Sensor plate	3HAC0392-1	
Sync. adapter	3HAC13908-1	

---

#### Calibration equipment, Calibration Pendulum

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

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

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

If no data is found related to standard calibration, Calibration Pendulum is used as default.

Description	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual.

---

#### Calibration equipment, Axis Calibration

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

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

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

If no data is found related to standard calibration, Calibration Pendulum is used as default.

Description	Art. no.	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

*Continues on next page*



---

**Oil exchange equipment**

The following table specifies the recommended equipment for oil exchange.

Description	Art. no.	Note
Oil exchange equipment	3HAC021745-001	Includes: <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>

## 8 Reference information

---

### 8.8 Lifting accessories and lifting instructions

### 8.8 Lifting accessories and lifting instructions

---

#### General

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

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

The instructions delivered with the lifting accessories should be stored for later reference.

## 9 Spare part lists

### 9.1 Spare part lists and illustrations

#### Location

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



#### Tip

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

**This page is intentionally left blank**

# 10 Circuit diagram

## 10.1 Circuit diagrams

### Overview

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

See the article numbers in the tables below.

### Controllers

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRC5</i>	<i>3HAC024480-011</i>
<i>Circuit diagram - IRC5 Panel Mounted Controller</i>	<i>3HAC026871-020</i>

### Manipulators

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 120</i>	<i>3HAC031408-003</i>
<i>Circuit diagram - IRB 140 type C</i>	<i>3HAC6816-3</i>
<i>Circuit diagram - IRB 260</i>	<i>3HAC025611-001</i>
<i>Circuit diagram - IRB 360</i>	<i>3HAC028647-009</i>
<i>Circuit diagram - IRB 390</i>	<i>3HAC060545-009</i>
<i>Circuit diagram - IRB 460</i>	<i>3HAC036446-005</i>
<i>Circuit diagram - IRB 660</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 760</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 1200</i>	<i>3HAC046307-003</i>
<i>Circuit diagram - IRB 1410</i>	<i>3HAC2800-3</i>
<i>Circuit diagram - IRB 1600/1660</i>	<i>3HAC021351-003</i>
<i>Circuit diagram - IRB 1520</i>	<i>3HAC039498-007</i>
<i>Circuit diagram - IRB 2400</i>	<i>3HAC6670-3</i>
<i>Circuit diagram - IRB 2600</i>	<i>3HAC029570-007</i>
<i>Circuit diagram - IRB 4400/4450S</i>	<i>3HAC9821-1</i>
<i>Circuit diagram - IRB 4600</i>	<i>3HAC029038-003</i>
<i>Circuit diagram - IRB 6620</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6640</i>	<i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6650S</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6660</i>	<i>3HAC025744-001</i> <i>3HAC029940-001</i>

*Continues on next page*

## 10 Circuit diagram

---

### 10.1 Circuit diagrams

*Continued*

<b>Product</b>	<b>Article numbers for circuit diagrams</b>
<i>Circuit diagram - IRB 6700 / IRB 6790</i>	<i>3HAC043446-005</i>
<i>Circuit diagram - IRB 7600</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 14000</i>	<i>3HAC050778-003</i>
<i>Circuit diagram - IRB 910SC</i>	<i>3HAC056159-002</i>

#### 10.2 Validity of circuit diagram 3HAC025744-1

##### Is this circuit diagram valid for your robot?

The validity of the circuit diagram depends on which cable harness is fitted to the robot.

Check the article number of the cable harness fitted to the robot and see page 3 of the circuit diagram in order to determine if the diagram is valid for the harness or not.

Where to find the article number	Action
Label on the cable harness	The label is located at the connectors in the base. Remove the rear cover plate to see the label.
WebConfig	

## 10 Circuit diagram

---

### 10.3 Validity of circuit diagram 3HAC13347-1

### 10.3 Validity of circuit diagram 3HAC13347-1

---

#### Is this circuit diagram valid for your robot?

The validity of the circuit diagram depends on which cable harness is fitted to the robot.

Check the article number of the cable harness fitted to the robot.

Where to find the article number	Action
Label on the cable harness	The label is located at the connectors in the base. Remove the rear cover plate to see the label.
WebConfig	-

This circuit diagram is valid for the following cable harness assemblies:

Robot	Cable harness	Revision
IRB 6600	3HAC 14940-1	all
IRB 6650, IRB 6650S	3HAC 16331-1	all
IRB 7600	3HAC 14940-1	revision 0-2

For remaining cable harness assemblies, see section [Validity of circuit diagram 3HAC025744-1 on page 431](#).



# Index

## A

Absolute Accuracy, calibration, 376  
 allergenic material, 34  
 aluminum  
   disposal, 404  
 ambient humidity  
   operation, 55  
   storage, 55  
 ambient temperature  
   operation, 55  
   storage, 55  
 assembly instructions, 45  
 assessment of hazards and risks, 34  
 Axis Calibration, 385  
   calibration tool  
     article number, 388, 391  
     examining, 388  
     installation position, 390  
   overview of method, 385  
   procedure on FlexPendant, 391, 398  
   protective cover and protection plug, 390–391

## B

balancing device, replacement, 279  
 balancing device bearing, replacement, 274  
 base plate  
   guide pins, 76  
   securing, 76  
 batteries  
   disposal, 404  
 battery  
   replacing, 185, 264  
 battery pack  
   replacing, interval, 122  
 battery shutdown  
   service routine, 185, 264  
 brakes  
   testing function, 42

## C

cabinet lock, 35  
 cable harness axes 1-4, replacement, 214  
 cabling, robot, 112  
 cabling, robot axes 1-4, 215  
 cabling, robot axes 5-6, 224  
 cabling between robot and controller, 111  
 calibrating  
   robot, 385  
   roughly, 380  
 calibrating robot, 385, 397–398  
 calibration  
   Absolute Accuracy type, 374  
   alternative method, 376  
   Levelmeter calibration, 376  
   rough, 380  
   standard type, 374  
   verification, 400  
   when to calibrate, 377  
 calibration, Absolute Accuracy, 376  
 calibration manuals, 376  
 calibration marks, 378  
 Calibration Pendulum  
   overview of method, 397  
 calibration position

  jogging to, 402  
   jogging to, TPU, 402  
   scales, 378  
 calibration scales, 378  
 CalibWare, 374  
 carbon dioxide extinguisher, 35  
 cast iron  
   disposal, 404  
 cleaning, 194  
 climbing on robot, 38  
 Cold environments, 115  
 connecting the robot and controller, cabling, 111  
 copper  
   disposal, 404

## D

damage to mechanical stop, 153  
 dimensions  
   frame, 86  
   lower arm, 84  
   upper arm, 85  
 direction of axes, 379

## E

environmental information, 404  
 EPS, 101  
 equipment on robot, 84  
 ESD  
   damage elimination, 62  
   sensitive equipment, 62  
 expected life, 123  
 extended working range, 101  
 extended working range, axis 1, 101  
 extra equipment  
   frame, 86  
   lower arm, 84  
   robot, 84  
   upper arm, 85

## F

fire extinguishing, 35  
 fitting equipment on robot, 84  
 FlexPendant  
   jogging to calibration position, 402  
   MoveAbsJ instruction, 401  
   updating revolution counters, 382  
 fork lift, 63  
 foundation  
   requirements, 55  
 frame  
   dimensions, 86

## G

gearbox axis 1, replacement, 328  
 gearbox axis 3, replacement, 349  
 gearbox axis 6, replacement, 368  
 gearboxes  
   location of, 163  
 grease, 38  
   disposal, 404  
 guide pins, base plate, 76

## H

hanging  
   installed hanging, 34  
 hazard levels, 25  
 hazardous material, 404

height  
  installed at a height, 34  
hot surfaces, 38  
HRA, 34  
humidity  
  operation, 55  
  storage, 55

**I**  
information labels location, 159  
inspecting  
  information labels, 159  
  mechanical stop, 153  
  motor seal, 124  
inspecting oil levels  
  axis-6, 141  
  axis-5, 138  
  axis-4, 135  
  axis-3, 132  
  axis-2, 129  
  axis-1, 126  
installation  
  mechanical stop axis 1, 104  
  mechanical stop axis 2, 106  
  mechanical stop axis 3, 108  
installing equipment on robot, 84  
instructions for assembly, 45  
integrator responsibility, 34  
intervals for maintenance, 119

**L**  
labels  
  robot, 27  
leak-down test, 206  
Levelmeter calibration, 376  
lifting accessory, 420  
lifting accessory, robot, 69  
lifting robot  
  with fork lift, 63  
  with lifting accessory, 69  
  with roundslings, 71  
limitation of liability, 23  
Lithium  
  disposal, 404  
loads on foundation, 54  
lock and tag, 35  
lower arm  
  dimensions, 84  
lower arm shaft, replacement, 256  
lubricants, 38  
lubrication  
  amount in gearboxes, 163  
  type of lubrication, 163

**M**  
magnesium  
  disposal, 404  
maintenance schedule, 119  
mechanical stop  
  axis 1, 104  
  axis 2, 106  
  axis 3, 108  
mechanical stop location, 153  
motor axis 1, replacement, 291  
motor axis 2, replacement, 296  
motor axis 3, replacement, 302  
motor axis 4, replacement, 309

motor axis 6, replacement, 321  
motor brakes  
  releasing, 73  
motor seal  
  inspecting, 124  
MoveAbsJ instruction, 401  
  TPU, 401

**N**  
national regulations, 34  
negative directions, axes, 379  
neodymium  
  disposal, 404  
nodular iron  
  disposal, 404

**O**  
oil, 38  
  amount in gearboxes, 163  
  disposal, 404  
  type of oil, 163  
oil level  
  gearbox axis-6, 141  
  gearbox axis-5, 138  
  gearbox axis-4, 135  
  gearbox axis-3, 132  
  gearbox axis-2, 129  
  gearbox axis-1, 126  
operating conditions, 55  
option  
  Extended working range, 101  
original spare parts, 23

**P**  
pedestal  
  installed on pedestal, 34  
personnel  
  requirements, 24  
plastic  
  disposal, 404  
positive directions, axes, 379  
PPE, 24  
product standards, 414  
protection classes, 56  
protection type, 56  
protective equipment, 24  
protective wear, 24

**R**  
recycling, 404  
regional regulations, 34  
release brakes, 41  
releasing motor brakes, 73  
replacement  
  balancing device, 279  
  bearing, balancing device, 274  
  cable harness axes 1-4, 214  
  gearbox axis 1, 328  
  gearbox axis 3, 349  
  gearbox axis 6, 368  
  lower arm shaft, 256  
  motor axis 1, 291  
  motor axis 2, 296  
  motor axis 3, 302  
  motor axis 4, 309  
  motor axis 6, 321  
replacements, report, 205

- report replacements, 205
- requirements on foundation, 55
- responsibility and validity, 23
- restricting
  - working range axis 1, 101, 104
  - working range axis 2, 106
  - working range axis 3, 108
- revolution counters
  - storing on FlexPendant, 382
  - storing on TPU, 381
  - updating, 380
- risk of burns, 38
- risk of tipping, 61
- robot
  - labels, 27
  - protection class, 56
  - protection types, 56
  - symbols, 27
- roundslings attached to robot, 71
- rubber
  - disposal, 404
- S**
- safety
  - brake testing, 42
  - ESD, 62
  - fire extinguishing, 35
  - release robot axes, 41
  - signal lamp, 100
  - signals, 25
  - signals in manual, 25
  - symbols, 25
  - symbols on robot, 27
  - test run, 116
- safety devices, 35
- safety equipment
  - mechanical stop, 104
  - mechanical stop axis 2, 106
  - mechanical stop axis 3, 108
- safety hazard
  - hydraulic system, 36
  - pneumatic system, 36
- safety signals
  - in manual, 25
- safety standards, 414
- scales on robot, 378
- schedule for maintenance, 119
- screw joints, 417
- securing
  - base plate, 76
- securing, robot, 81
- securing, upper arm, 304
- securing the robot to foundation, attachment screws, 81
- shipping, 403
- signal lamp, 100
- signals
  - safety, 25
- SMB
  - replacing, 264
- SMB battery
  - extension of lifetime, 185, 264
  - replacing, 185, 264
- special tools, 422
- speed
  - adjusting, 115
- stability, 61
- standards, 414
- ANSI, 414
- CAN, 414
- EN IEC, 414
- EN ISO, 414
- start of robot in cold environments, 115
- steel
  - disposal, 404
- storage conditions, 55
- symbols
  - safety, 25
- synchronization position, 380
- sync marks, 378
- system integrator requirements, 34
- T**
- temperatures
  - operation, 55
  - storage, 55
- testing
  - brakes, 42
- tightening torque
  - mechanical stop axis 2, 107
- tools
  - Axis Calibration, 424
  - calibration equipment, Levelmeter, 424
  - Calibration Pendulum, 424
  - for service, 422
  - oil exchange equipment, 425
- torques on foundation, 54
- TPU
  - jogging to calibration position, 402
  - MoveAbsJ instruction, 401
  - updating revolution counters, 381
- transportation, 403
- transporting the robot, 50
- transport support, 50
- troubleshooting
  - oil spills, 194
  - safety, 43
- type A motors, 411
- type B motors, 411
- U**
- upcycling, 404
- updating revolution counters, 380
- upper arm
  - dimensions, 85
- users
  - requirements, 24
- V**
- validity and responsibility, 23
- velocity
  - adjusting, 115
- verifying calibration, 400
- W**
- weight, 53
  - balancing device, 282, 286
  - base plate, 75, 80
  - complete arm system, 229–230
  - gearbox, 344, 353
  - lower arm, 251, 253
  - motor, 312–313, 318–319
  - robot, 68, 70, 72, 331, 333, 335, 338
  - upper arm, 243–244
  - wrist unit, 238–239

## working range

- IRB 7600 - 150/3.5, 57
- IRB 7600 - 340/2.8, 58
- IRB 7600 - 400/2.55, 59
- IRB 7600 - 500/2.3, 60
- IRB 7600 - 500/2.55, 59
- restricting axis 1, 104

- restricting axis 2, 106

- restricting axis 3, 108

## Wrist Optimization

- overview of method, 398

## Z

- zero position

- checking, 401





**ABB AB**

**Robotics & Discrete Automation**

S-721 68 VÄSTERÅS, Sweden

Telephone +46 10-732 50 00

**ABB AS**

**Robotics & Discrete Automation**

Nordlysvegen 7, N-4340 BRYNE, Norway

Box 265, N-4349 BRYNE, Norway

Telephone: +47 22 87 2000

**ABB Engineering (Shanghai) Ltd.**

Robotics & Discrete Automation

No. 4528 Kangxin Highway

PuDong New District

SHANGHAI 201319, China

Telephone: +86 21 6105 6666

**ABB Inc.**

**Robotics & Discrete Automation**

1250 Brown Road

Auburn Hills, MI 48326

USA

Telephone: +1 248 391 9000

**[abb.com/robotics](http://abb.com/robotics)**