

Product manual

IRB 7600

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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

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Table of contents

Overview of this manual	9
Product documentation, M2000/M2000A	16
Product documentation, IRC5	17
How to read the product manual	19
1 Safety	21
1.1 Introduction to safety information	21
1.2 General safety information	22
1.2.1 Introduction to general safety information	22
1.2.2 Safety in the robot system	23
1.2.3 Safety risks	25
1.2.3.1 Safety risks during installation and service work on robots	25
1.2.3.2 CAUTION - Hot parts may cause burns!	28
1.2.3.3 Safety risks related to tools/work pieces	29
1.2.3.4 Safety risks related to pneumatic/hydraulic systems	30
1.2.3.5 Safety risks during operational disturbances	31
1.2.3.6 Risks associated with live electric parts	32
1.2.4.1 Safety fence dimensions	34
1.2.4.2 Fire extinguishing	35
1.2.4.3 Emergency release of the robot arm	36
1.2.4.4 Brake testing	37
1.2.4.5 Risk of disabling function "Reduced speed 250 mm/s"	38
1.2.4.6 Safe use of the jogging device	39
1.2.4.7 Work inside the working range of the robot	40
1.2.4.8 Signal lamp (optional)	41
1.2.5 Safety stops	42
1.2.5.1 What is an emergency stop?	42
1.2.5.2 What is a safety stop or protective stop?	44
1.3 Safety signals and symbols	46
1.3.1 Safety signals in the manual	46
1.3.2 Safety symbols on product labels	48
1.4 Safety related instructions	54
1.4.1 DANGER - Moving robots are potentially lethal!	54
1.4.2 DANGER - First test run may cause injury or damage!	55
1.4.3 WARNING - The brake release buttons may be jammed after service work	56
1.4.4 DANGER - Make sure that the main power has been switched off!	57
1.4.5 WARNING - The unit is sensitive to ESD!	58
1.4.6 WARNING - Safety risks during handling of batteries	59
1.4.7 WARNING - Safety risks during work with gearbox lubricants (oil or grease)	60
2 Installation and commissioning	63
2.1 Introduction	63
2.2 Robot transportation precautions	64
2.3 Securing the robot with a transport support	68
2.4 Unpacking	70
2.4.1 Pre-installation procedure	70
2.4.2 Working range, IRB 7600 - 150/3.5	74
2.4.3 Working range, IRB 7600 - 340/2.8	75
2.4.4 Working range, IRB 7600 - 400/2.55, IRB 7600 - 500/2.55	76
2.4.5 Working range, IRB 7600 - 500/2.3	77
2.4.6 Risk of tipping/stability	78
2.5 On-site installation	79
2.5.1 Lifting robot with fork lift	79
2.5.2 Lifting robot with lifting slings	85
2.5.3 Lifting robot with roundslings	87

Table of contents

2.5.4	Manually releasing the brakes	89
2.5.5	Lifting the base plate	91
2.5.6	Securing the base plate	92
2.5.7	Orienting and securing the robot	97
2.5.8	Fitting equipment on robot	100
2.5.9	Installation of base spacers (option)	105
2.5.10	Extended working range, axis 1 (option 561-1)	107
2.5.11	Installation of cooling fan for motors (option)	108
2.5.12	Installation of Foundry Plus Cable guard (option no. 908-1)	116
2.5.13	Loads fitted to the robot, stopping time and braking distances	117
2.5.14	Installation of signal lamp (option)	118
2.6	Restricting the working range	119
2.6.1	Axes with restricted working range	119
2.6.2	Mechanically restricting the working range of axis 1	120
2.6.3	Mechanically restricting the working range of axis 2	122
2.6.4	Mechanically restricting the working range of axis 3	124
2.6.5	Installation of position switches (option)	127
2.7	Electrical connections	139
2.7.1	Robot cabling and connection points	139
3	Maintenance	143
3.1	Introduction	143
3.2	Maintenance schedule and expected life	144
3.2.1	Specification of maintenance intervals	144
3.2.2	Maintenance schedule	145
3.2.3	Expected component life	149
3.3	Inspection activities	150
3.3.1	Inspecting the oil level in axis-1 gearbox	150
3.3.2	Inspecting the oil level in axis-2 gearbox	154
3.3.3	Inspecting the oil level in axis-3 gearbox	157
3.3.4	Inspecting the oil level in axis-4 gearbox	160
3.3.5	Inspecting the oil level in axis-5 gearbox	163
3.3.6	Inspecting the oil level in axis-6 gearbox	166
3.3.7	Inspecting the balancing device	169
3.3.8	Inspecting the cable harness	175
3.3.9	Inspecting the axis-1 mechanical stop pin	178
3.3.10	Inspecting the mechanical stops on axes 1, 2, and 3	180
3.3.11	Inspecting the damper on axes 2 to 5	182
3.3.12	Inspecting the position switch on axes 1, 2, and 3	184
3.3.13	Inspecting the information labels	188
3.3.14	Inspecting the UL lamp	190
3.4	Changing/replacement activities	192
3.4.1	Type of lubrication in gearboxes	192
3.4.2	Changing oil, axis-1 gearbox	194
3.4.3	Changing oil, axis-2 gearbox	198
3.4.4	Changing oil, axis-3 gearbox	201
3.4.5	Changing oil, axis-4 gearbox	204
3.4.6	Changing oil, axis-5 gearbox	208
3.4.7	Changing oil, axis-6 gearbox	212
3.4.8	Replacing the SMB battery	215
3.5	Lubrication activities	220
3.5.1	Lubrication of spherical roller bearing, balancing device	220
3.6	Cleaning activities	223
3.6.1	Flushing a contaminated gearbox	223
3.6.2	Cleaning the IRB 7600	225
3.7	Service Information System, M2000	228
3.7.1	Using the SIS system	228
3.7.2	Description of Service Information System (SIS)	229
3.7.3	SIS system parameters	232

3.7.4	Setting the SIS parameters	233
3.7.5	Reading the SIS output logs	234
3.7.6	Exporting the SIS data	235
4	Repair	237
4.1	Introduction	237
4.2	General procedures	238
4.2.1	Performing a leak-down test	238
4.2.2	Mounting instructions for bearings	239
4.2.3	Mounting instructions for seals	241
4.3	Complete robot	243
4.3.1	Replacement of cable harness, axes 1-4	243
4.3.2	Replacement of cable harness, axes 5-6	252
4.3.3	Replacement of complete arm system	255
4.4	Upper and lower arm	260
4.4.1	Replacing turning disk	260
4.4.2	Replacement of complete wrist unit	264
4.4.3	Replacement of complete upper arm	269
4.4.4	Replacement of complete lower arm	274
4.4.5	Replacement of lower arm shaft	283
4.5	Frame and base	293
4.5.1	Replacing the SMB unit	293
4.5.2	Replacement of brake release board	296
4.5.3	Replacement of spherical roller bearing, balancing device	302
4.5.4	Replacement of balancing device	307
4.5.4.1	Replacing the balancing device	307
4.5.4.2	Unloading the balancing device using hydraulic press tool	315
4.5.4.3	Restoring the balancing device using a hydraulic press tool	319
4.6	Motors	322
4.6.1	Replacement of motor, axis 1	322
4.6.2	Replacement of motor axis 2	327
4.6.3	Replacement of motor, axis 3	333
4.6.4	Replacement of motor, axis 4	340
4.6.5	Replacement of motor, axis 5	346
4.6.6	Replacement of motor, axis 6	351
4.7	Gearboxes	358
4.7.1	Replacing the axis 1 gearbox	358
4.7.2	Replacement of gearbox, axis 2	370
4.7.3	Replacement of gearbox, axis 3	378
4.7.4	Replacement of gearbox, axis 4	385
4.7.5	Replacement of gearbox, axis 5	390
4.7.6	Replacement of gearbox, axis 6	397
5	Calibration	403
5.1	Introduction to calibration	403
5.1.1	Introduction and calibration terminology	403
5.1.2	Calibration methods	404
5.1.3	When to calibrate	407
5.2	Synchronization marks and axis movement directions	408
5.2.1	Synchronization marks and synchronization position for axes	408
5.2.2	Calibration movement directions for all axes	410
5.3	Updating revolution counters	411
5.4	Calibrating with Axis Calibration method	416
5.4.1	Description of Axis Calibration	416
5.4.2	Calibration tools for Axis Calibration	418
5.4.3	Location of calibration items	420
5.4.4	Axis Calibration - Running the calibration procedure	421
5.5	Calibrating with Calibration Pendulum method	427
5.6	Verifying the calibration	428

Table of contents

5.7	Checking the synchronization position	429
6	Decommissioning	431
6.1	Environmental information	431
6.2	Scraping of robot	432
6.3	Decommissioning of balancing device	433
7	Reference information	437
7.1	Introduction	437
7.2	Applicable safety standards	438
7.3	Unit conversion	440
7.4	Screw joints	441
7.5	Weight specifications	444
7.6	Standard tools	445
7.7	Special tools	446
7.8	Lifting accessories and lifting instructions	450
8	Spare part lists	451
8.1	Spare part lists and illustrations	451
9	Circuit diagram	453
9.1	Circuit diagrams	453
9.2	Validity of circuit diagram 3HAC025744-1	455
9.3	Validity of circuit diagram 3HAC13347-1	456
Index		457

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.

Organization of chapters

The manual is organized in the following chapters:

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

Continues on next page

Overview of this manual

Continued

Chapter	Contents
Calibration information	Procedures that do not require specific calibration equipment. General information about calibration.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards etc.
Spare part 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>Operating manual - General safety information</i> 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 stand alone controller</i>	3HAC051016-001	M2004
<i>Application manual - External axes</i>	3HAC9299-1	M2000

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

Continues on next page

Additional document references

Document name	Document ID
Application manual - CalibWare Field 5.0	3HAC030421-001

Revisions

Revision	Description
-	<p>First edition.</p> <p>Replaces previous manuals:</p> <ul style="list-style-type: none"> • Installation and Commissioning Manual • Maintenance Manual • Repair Manual, part 1 • Repair Manual, part 2. <p>Changes made in the material from the previous manuals:</p> <ul style="list-style-type: none"> • Model M2004 implemented. • Various corrections due to technical revisions, changes in the toolkits etc.
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"> • In chapter 3: <i>Maintenance</i> in section <i>Exporting the SIS data</i>, the unit seconds for different SIS parameters is replaced by the unit hours. The change is only valid for RobotWare release 5.0. <p>Following updates are made:</p> <ul style="list-style-type: none"> • 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. • Section <i>Document references</i> is completed with article numbers for calibration manuals. • Section <i>Part list</i> is completed with the spare part number for a variant of the cable harness/brake release unit.
B	New lubricating oil in the gearboxes. Changes made in the chapter Maintenance on page 143 and <i>Part list</i> .
C	<ul style="list-style-type: none"> • New variant of the robot (IRB 7600 - 500/2.55) implemented throughout the manual. • Wrist unit updated, new spare part number is specified in Replacement of complete wrist unit on page 264 and <i>Spare part list</i>. • Insulated wrist unit implemented, new spare part number is specified in Replacement of complete wrist unit on page 264 and <i>Spare part list</i>. Amount of oil differs from non-insulated wrist unit, changes made in sections <i>Type of oil in gearboxes</i> and Changing oil, axis-6 gearbox on page 212. • New section that describes how to replace the bearing at the front eye of the balancing device, Replacement of spherical roller bearing, balancing device on page 302. • Incorrect article numbers for position switches are corrected, section Installation of position switches (option) on page 127. • New section: Installation of cooling fan for motors (option) on page 108. • New section: Installation of base spacers (option) on page 105 • New section that specifies all the recommended spare parts: <i>Spare part list</i>. • Repair sections for removal/refitting are restructured into replacement sections. • Various corrections made, due to technical revisions etc.
D	Foundry Prime option included.

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Overview of this manual

Continued

Revision	Description
E	<ul style="list-style-type: none">• New variant of the robot (IRB 7600 - 325/3.1) implemented throughout the manual.• 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.• New product name has been implemented throughout the manual: "Mobilgear 600 XP 320". Replaces "Mobil Gearlube X320".• Interval for change of Shell Tivela S 150 has been changed in section <i>Maintenance schedule</i>.• Section <i>Service Information System</i> has been removed from the manual. There is a specific manual for SIS. See <i>References</i>.• Section <i>Chip and dust protection</i> has been removed from the manual. This option is no longer available.• Standard tightening torque for M24 Allen head screws has been added in section <i>Screw joints</i>.• Prerequisites in section <i>Overview</i>
F	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none">• Section "<i>WARNING! - Mixed oils may cause severe damage to gearboxes</i>" in chapter <i>Safety</i>, has been integrated in section "<i>Type of oil in gearboxes</i>" in the <i>Maintenance</i> chapter.• 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>.• The section "<i>Type of oil in gearboxes</i>" in chapter <i>Maintenance</i> has been updated according to changes made in oil types and intervals for oil change.• Sections "<i>Robot transportation precaution</i>" and "<i>Securing the robot</i>" are added to the <i>Installation</i> chapter.• Modified maintenance intervals for oil change in gearboxes.• Chapter <i>Maintenance</i>, section "<i>Mainenence Schedule</i>": interval for replacement of battery pack changed.• Section "<i>Type of oil</i>" changed.
G	<p>This revision include the following addition:</p> <ul style="list-style-type: none">• New <i>WARNING!</i> added in <i>Safety chapter</i> section <i>Work inside the robot's working range</i>.• New <i>WARNING!</i> added in <i>Safety chapter</i> section <i>WARNING! - Safety risks during work with gearbox oil</i>.• 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.• Section <i>Expected component life</i> in chapter <i>Maintenance</i>: The lifetime of certain parts has been updated.• Section <i>Type of oil</i> in chapter <i>Maintenance</i> has been updated.• Section <i>Foundry Plus,Cable guard</i> added to <i>Installation</i> chapter.
H	<p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none">• Circuit diagrams are not included in this document but delivered as separate files. See Circuit diagram on page 453.• List of standards updated, see Applicable safety standards on page 438.• Interval changed for <i>inspection</i> and <i>lubrication</i> of balancing device (Foundry Prime). See chapter <i>Maintenance</i> section Maintenance schedule on page 145. <p>The chapter <i>Safety</i> updated with:</p> <ul style="list-style-type: none">• Updated safety signal graphics for the levels <i>Danger</i> and <i>Warning</i>, see Safety signals in the manual on page 46.• New safety labels on the manipulators, see Safety symbols on product labels on page 48.• Revised terminology: <i>robot</i> replaced with <i>manipulator</i>.

Continues on next page

Revision	Description
J	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • Maximum deviation changed, see Securing the base plate on page 92. • Corrected part numbers, see Wrist, 3HAC16628-4. • Corrected exploded view, see Wrist complete. • Added inspection of oil level in gearboxes and inspection of surface treatment in maintenance schedule for Foundry Prime. See section Activities and intervals, Foundry Prime. • Text in maintenance schedules concerning lubrication of balancing device bearing changed into concerning all bearings of the balancing device, see Maintenance schedule on page 145. • Replacement of cable harness in Foundry Prime robots added to maintenance schedule, see Activities and intervals, Foundry Prime.
K	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • Removed incorrect article number for fork lift, see Lifting robot with fork lift on page 79. • Information about restricting and extending the working range of axis 1 is now separated, see Mechanically restricting the working range of axis 1 on page 120 and the new section Extended working range, axis 1 (option 561-1) on page 107. Also added signal about option 561-1 in section Inspecting the axis-1 mechanical stop pin on page 178.
L	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • A new block, about general illustrations, added in section How to read the product manual on page 19. • Made minor corrections and improvements in the complete instruction for how to replace the axis 1 gearbox, see Replacing the axis 1 gearbox on page 358. • Robot designations are adjusted in sub-headings in section Robot transportation precautions on page 64. • Added new mechanical structure of the lower arm attachment point for robots with protection Foundry Plus and Foundry Prime, see Replacement of complete lower arm on page 274, the new section Replacement of lower arm shaft on page 283 and the exploded view Frame-Lower arm 2 in Product manual, spare parts - IRB 7600. • Some general tightening torques have been changed/added, see updated values in Screw joints on page 441. • Added WARNING - Safety risks during handling of batteries on page 59. • The maximum allowed deviation in levelity of the base plate is changed, see Securing the base plate on page 92. • 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 Securing the base plate on page 92. • Added attachment plate for axis-2 switch to equipment list, see Installation of position switches (option) on page 127. • Friction washer added to the instruction for replacing axis-2 gearbox and to the exploded view, see Replacement of gearbox, axis 2 on page 370 and Exploded view. • Moved all information about Foundry Prime to a separate Product manual, see References on page 10 for document number. • Corrected article numbers for the o-rings and removed the removal tool from the equipment list and from the procedure, see Replacement of gearbox, axis 6 on page 397. • Corrected article number for axis-2-3 sealing, see Replacement of complete lower arm on page 274 and Replacement of complete upper arm on page 269.

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Overview of this manual

Continued

Revision	Description
M	This revision includes the following updates: <ul style="list-style-type: none">A new SMB unit and battery is introduced, with longer battery lifetime.
N	This revision includes the following updates: <ul style="list-style-type: none">Instruction for inspection of oil level updated.Spare part number, motor axis 2 corrected.Added information about risks when scrapping a decommissioned robot, see Scraping of robot on page 432.Added information in draining instructions and in Safety chapter about draining oil from gear boxes, see WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60.Information regarding fork lift set 3HAC0604-2 deleted from manual.Information regarding oil types added to maintenance schedule.New illustrations, and updated repair instructions regarding brake unit cover.<i>Spare parts and exploded views</i> are not included in this document but delivered as a separate document. See Product manual, spare parts - IRB 7600
P	This revision includes the following updates: <ul style="list-style-type: none">Information about maintenance kit (3HAC15834-1), and upgrade kit (3HAC14965-1), deleted from manual.The maximum allowed deviation in levelness of the base plate and foundation is changed, see Securing the base plate on page 92.Added tightening torque for R1.SMB and 7th axis connector, see Replacement of cable harness, axes 1-4 on page 243.Minor corrections.
Q	This revision includes the following updates: <ul style="list-style-type: none">The inspection of oil level in gearboxes is removed from the maintenance schedule and moved to the cleaning section.The instructions for inspection of oil level in gearboxes are updated, see Inspection activities on page 150.Illustrations of SMB batteru RMU improved.
R	This revision includes the following updates: <ul style="list-style-type: none">Article number changed for Fork lift accessory (from 3HAC0604-1 to 3HAC0604-2)New standard calibration method introduced (Axis Calibration). See Calibration on page 403.Tightening torque for securing screw in piston shaft front eye changed, see Replacing the balancing device on page 307.External brake release unit section removed from the manual.Turning disk fixture is removed from special tools for Levelmeter calibration.
S	This revision includes the following updates: <ul style="list-style-type: none">Oil types in maintenance schedule table removed and a reference to the Tech. manual added.Maintenance table splitted into several tables.Edited information regarding deciding calibration routine in each repair section.Added a warning that calibration pin must be inserted in the calibration bushing until it snaps, see Description of Axis Calibration on page 416.Added warning regarding risk of pinching, in Description of Axis Calibration on page 416.Added information about inspection of calibration tool prior to usage, see Examining the calibration tool on page 418.

Continues on next page

Revision	Description
	<ul style="list-style-type: none">Added information about the calibration procedure, see Overview of the calibration procedure on the FlexPendant on page 421, Restarting an interrupted calibration procedure on page 423.Added information about Axis Calibration when SafeMove is installed, see Axis Calibration with SafeMove option on page 424.
T	Published in release R16.2. The following updates are done in this revision: <ul style="list-style-type: none">Drawing of base plate is not available for purchase, faulty information removed in Securing the base plate on page 92.Corrections due to updates in SAP terminology.Drawing of tool flange for LeanID added.

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.

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

Product manuals

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

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

Technical reference manuals

The technical reference manuals describe reference information for robotics products.

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

Continues on next page

Application manuals

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

An application manual generally contains information about:

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

Operating manuals

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

The group of manuals includes (among others):

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

How to read the product manual

Reading the procedures

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

References to figures

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

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

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

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

References to required equipment

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

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

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

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

Safety information

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

Read more in the chapter [Safety on page 21](#).

Illustrations

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

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

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1 Safety

1.1 Introduction to safety information

Overview

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

- General safety aspects, important to attend to before performing any service work on the robot. These are applicable for all service work and are found in [General safety information on page 22](#).
- Safety signals and symbols shown in the manual and on the robot, warning for different types of dangers, are found in [Safety signals and symbols on page 46](#).
- Specific safety information, pointed out in the procedures. How to avoid and eliminate the danger is either described directly in the procedure, or in specific instructions in the section [Safety related instructions on page 54](#).

1 Safety

1.2.1 Introduction to general safety information

1.2 General safety information

1.2.1 Introduction to general safety information

Definitions

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

Sections

The general safety information is divided into the following sections.

Contents	Examples of content
General information	<ul style="list-style-type: none">• safety, service• limitation of liability• related information
Safety risks lists dangers relevant when working with the product. The dangers are split into different categories.	<ul style="list-style-type: none">• safety risks during installation or service• risks associated with live electrical parts
Safety actions describes actions which may be taken to remedy or avoid dangers.	<ul style="list-style-type: none">• fire extinguishing• safe use of the teach pendant or jogging device
Safety stops describes different types of stops.	<ul style="list-style-type: none">• stopping functions• description of emergency stop• description of safety stop

1.2.2 Safety in the robot system

Validity and responsibility

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

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

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

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

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

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

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

Connection of external safety devices

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

Limitation of liability

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

Related information

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

Continues on next page

1 Safety

1.2.2 Safety in the robot system

Continued

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

1.2.3.1 Safety risks during installation and service work on robots

1.2.3 Safety risks

1.2.3.1 Safety risks during installation and service work on robots

Overview

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

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

General risks during installation and service

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

Spare parts and special equipment

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

Personal protective equipment

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

Nation/region specific regulations

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

Non-voltage related risks

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

Continues on next page

1 Safety

1.2.3.1 Safety risks during installation and service work on robots

Continued

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

To be observed by the supplier of the complete system

When integrating the robot with external devices and machines:

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

Complete robot

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

Continues on next page

1.2.3.1 Safety risks during installation and service work on robots

Continued

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

Cabling

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

Gearboxes and motors

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

Balancing device

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

1 Safety

1.2.3.2 CAUTION - Hot parts may cause burns!

Description

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

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

Elimination

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

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

1.2.3.3 Safety risks related to tools/work pieces

Safe handling

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

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

Safe design

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

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



CAUTION

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

1 Safety

1.2.3.4 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.



Note

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

Residual energy

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

Safe design

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

1.2.3.5 Safety risks during operational disturbances

General

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

Qualified personnel

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

Extraordinary risks

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

1 Safety

1.2.3.6 Risks associated with live electric parts

1.2.3.6 Risks associated with live electric parts

Voltage related risks, general

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

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

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

All work must be performed:

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

Voltage related risks, IRC5 controller

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

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

Continues on next page

Voltage related risks, robot

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

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

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

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

1 Safety

1.2.4.1 Safety fence dimensions

1.2.4 Safety actions

1.2.4.1 Safety fence dimensions

General

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

Dimensioning

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

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

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

1.2.4.2 Fire extinguishing



Note

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

1 Safety

1.2.4.3 Emergency release of the robot arm

1.2.4.3 Emergency release of the robot arm

Description

In an emergency situation, the brakes on the robot axes can be released manually by pushing the brake release buttons.

How to release the brakes is detailed in the section:

- [*Manually releasing the brakes on page 89.*](#)

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

Increased injury

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

1.2.4.4 Brake testing

When to test

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

How to test

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

- 1 Run each robot axis to a position where the combined weight of the robot arm and any load is maximized (maximum static load).
- 2 Switch the motor to the MOTORS OFF.
- 3 Inspect and verify that the axis maintains its position.
If the robot does not change position as the motors are switched off, then the brake function is adequate.

1 Safety

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



Note

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

1.2.4.6 Safe use of the jogging device

Three-position enabling device

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

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



Note

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

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

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

Hold-to-run function

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

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

1 Safety

1.2.4.7 Work inside the working range of the robot



WARNING

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

- The operating mode selector on the controller must be in the manual mode position to render the three-position enabling device operational and to block operation from a computer link or remote control panel.
- The maximum speed of the robot is limited to 250 mm/s when the operating mode selector is in the position *Manual mode with reduced speed*. This should be the normal position when entering the working space.
The position *Manual mode with full speed (100%)* may only be used by trained personnel who are aware of the risks that this entails. *Manual mode with full speed (100%)* is not available in USA or Canada.
- Pay attention to the rotating axes of the robot. Keep away from axes to not get entangled with hair or clothing. Also, be aware of any danger that may be caused by rotating tools or other devices mounted on the robot or inside the cell.
- Test the motor brake on each axis, according to the section [Brake testing on page 37](#).
- To prevent anyone else from taking control of the robot, always put a safety lock on the cell door and bring the three-position enabling device with you when entering the working space.



WARNING

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

1.2.4.8 Signal lamp (optional)

Description

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

Function

The lamp is active in MOTORS ON mode.

Further information

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

1 Safety

1.2.5.1 What is an emergency stop?

1.2.5 Safety stops

1.2.5.1 What is an emergency stop?

Definition of emergency stop

An emergency stop is a state that takes precedence over all other robot controls, causes all controlled hazards to stop, removes drive power from the robot actuators, remains active until it is reset, and can only be reset by manual action.

An emergency stop state means that all power is disconnected from the robot except for the manual brake release circuits. You must perform a recovery procedure, that is, resetting the emergency stop button and pressing the Motors On button, to return to normal operation.

The robot system can be configured so that the emergency stop results in either:

- A category 0 stop, immediately stopping the robot actions by disconnecting power from the motors.
- A category 1 stop, stopping the robot actions with power available to the motors so that the robot path can be maintained. When completed, power is disconnected from the motors.

The default setting is a category 0 stop. However, category 1 stops are preferred since they minimize unnecessary wear on the robot and the actions needed to return the system back to production. Consult your plant or cell documentation to see how your robot system is configured.



Note

The emergency stop function may only be used for the purpose and under the conditions for which it is intended.



Note

The emergency stop function is intended for immediately stopping equipment in the event of an emergency.



Note

Emergency stop should not be used for normal program stops as this causes extra, unnecessary wear on the robot.

For how to perform normal program stops, see section *Stopping programs* in *Operating manual - IRC5 with FlexPendant*.

Classification of stops

The safety standards that regulate automation and robot equipment define categories in which each type of stop applies:

If the stop is...	... then it is classified as...
category 0 (zero)	uncontrolled

Continues on next page

If the stop is...	... then it is classified as...
category 1	controlled

Emergency stop buttons

In a robot system there are several emergency stop buttons that can be operated in order to achieve an emergency stop. There are emergency stop buttons available on the FlexPendant and on the controller cabinet. There can also be other types of emergency stops on your robot. Consult your plant or cell documentation to see how your robot system is configured.

1 Safety

1.2.5.2 What is a safety stop or protective stop?

1.2.5.2 What is a safety stop or protective stop?

Definition of safety stops

A safety stop is a state that stops all robot motion and removes power to the robot drive actuators. There is no recovery procedure. You need only to restore motor power to recover from a safety stop. Safety stop is also called protective stop.

The robot system can be configured so that the safety stop results in either:

- A category 0 stop, immediately stopping the manipulator actions by disconnecting power from the motors.
- A category 1 stop, stopping the manipulator actions with power available to the motors so that the manipulator path can be maintained. When completed, power is disconnected from the motors.

The default setting is a category 1 stop.

Category 1 stops are preferred since they minimize unnecessary wear on the manipulator and the actions needed to return the system back to production. Consult your plant or cell documentation to see how your robot system is configured.



Note

The safety stop function may only be used for the purpose and under the conditions for which it is intended.



Note

Safety stop should not be used for normal program stops as this causes extra, unnecessary wear on the manipulator.

For how to perform normal program stops, see section *Stopping programs* in *Operating manual - IRC5 with FlexPendant*.

Classification of stops

The safety standards that regulate automation and robot equipment define categories in which each type of stop applies:

If the stop is...	... then it is classified as...
category 0 (zero)	uncontrolled
category 1	controlled

Continues on next page

1.2.5.2 What is a safety stop or protective stop?

Continued

Type of safety stops

Safety stops are activated through special signal inputs to the controller, see *Product manual - IRC5*.

The inputs are intended for safety devices such as cell doors, light curtains, or light beams.

Safety stop:	Description:
Automatic mode stop (AS)	Disconnects drive power in automatic mode. In manual mode this input is inactive.
General stop (GS)	Disconnects drive power in all operating modes.
Superior stop (SS)	Disconnects drive power in all operating modes. Intended for external equipment.



Note

Use normal program stop for all other types of stop.

1 Safety

1.3.1 Safety signals in the manual

1.3 Safety signals and symbols

1.3.1 Safety signals in the manual

Introduction to safety signals

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

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

Danger levels

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

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

Continues on next page

1.3.1 Safety signals in the manual

Continued

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

1 Safety

1.3.2 Safety symbols on product labels

1.3.2 Safety symbols on product labels

Introduction to labels

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

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



Note

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

Types of labels

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

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 48](#).

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

The labels are identified and located on the product as shown in the section:

- [on page ?](#)

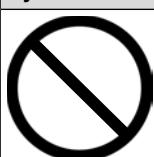
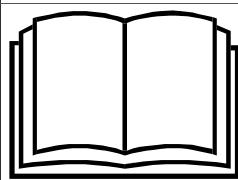
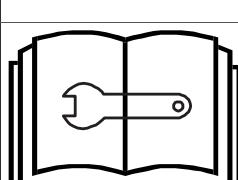
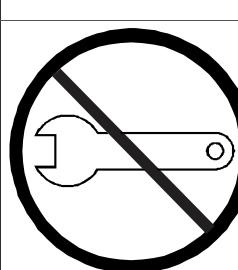
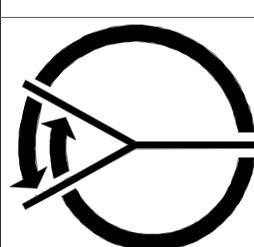
Symbols on safety labels

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

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1.3.2 Safety symbols on product labels

Continued

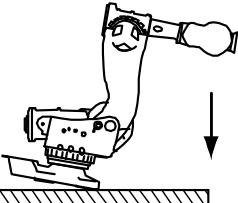
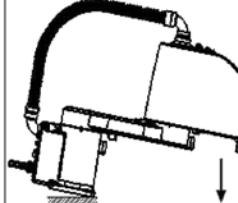
Symbol	Description
 xx0900000839	Prohibition Used in combinations with other symbols.
 xx0900000813	See user documentation Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none"> • No text: <i>Product manual</i>. • EPS: <i>Application manual - Electronic Position Switches</i>.
 xx0900000816	Before disassemble, see product manual
 xx0900000815	Do not disassemble Disassembling this part can cause injury.
 xx0900000814	Extended rotation This axis has extended rotation (working area) compared to standard.
 xx0900000808	Brake release Pressing this button will release the brakes. This means that the robot arm can fall down.

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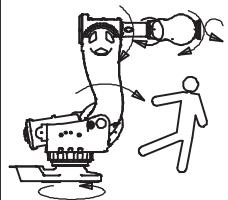
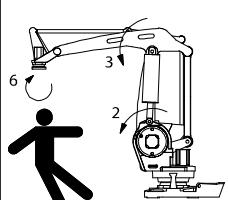
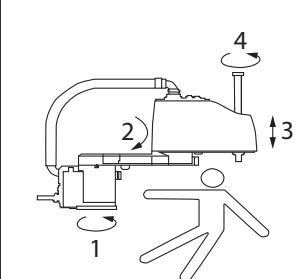
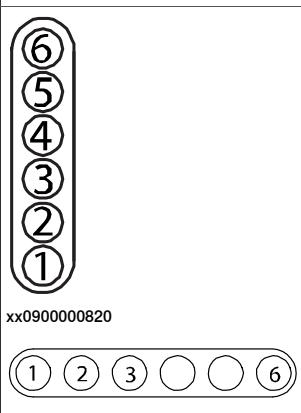
1 Safety

1.3.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000810	Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened.
  3HAC 057068-001 xx1500002402	
 xx0900000817	Crush Risk of crush injuries.
	Heat Risk of heat that can cause burns.

Continues on next page

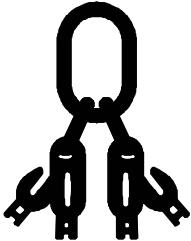
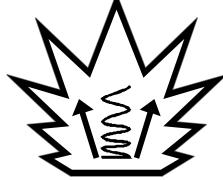
Symbol	Description
 xx0900000819	Moving robot The robot can move unexpectedly.
 xx1000001141	
 xx1500002616	
 xx0900000820	Brake release buttons
 xx0900000821	Lifting bolt

Continues on next page

1 Safety

1.3.2 Safety symbols on product labels

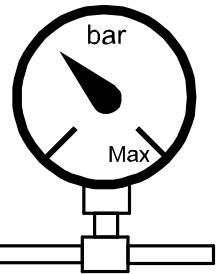
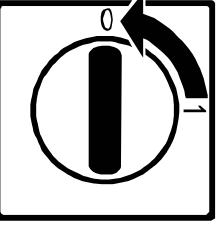
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Symbol	Description
 xx1000001242	Chain sling with shortener
 xx0900000822	Lifting of robot
 xx0900000823	Oil Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	Mechanical stop
 xx1000001144	No mechanical stop
 xx0900000825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

Continues on next page

1.3.2 Safety symbols on product labels

Continued

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

1 Safety

1.4.1 DANGER - Moving robots are potentially lethal!

1.4 Safety related instructions

1.4.1 DANGER - Moving robots are potentially lethal!

Description

Any moving robot is a potentially lethal machine.

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

Elimination

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

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

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

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

Elimination

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

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

Collision risks**CAUTION**

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

1 Safety

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

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

Description

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



DANGER

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

Elimination

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

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

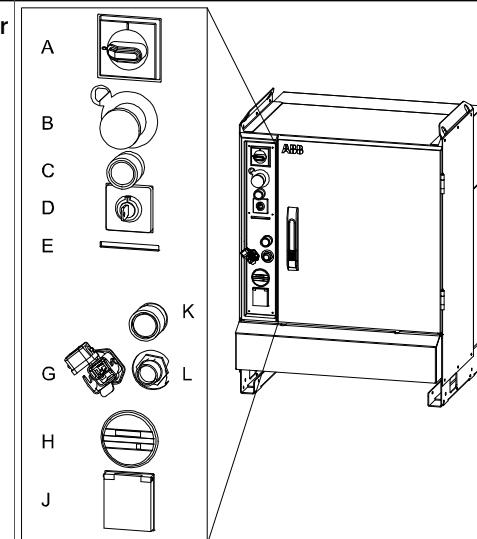
1.4.4 DANGER - Make sure that the main power has been switched off!

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

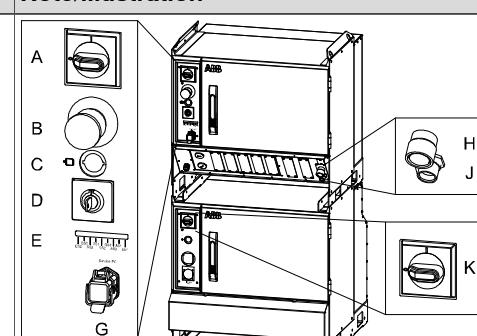
Description

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

Elimination, Single Cabinet Controller

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

Elimination, Dual Cabinet Controller

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

1 Safety

1.4.5 WARNING - The unit is sensitive to ESD!

Description

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

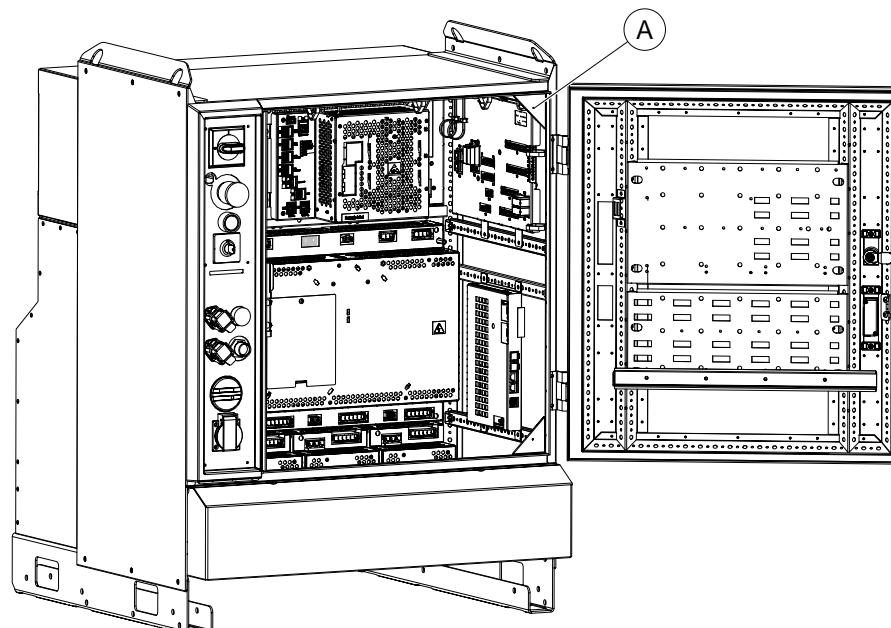
Elimination

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

Location of wrist strap button

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

IRC5



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

1.4.6 WARNING - Safety risks during handling of batteries

Description

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

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



Note

Appropriate disposal regulations must be observed.

Elimination

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

1 Safety

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

Description

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



Note

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



Note

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



Note

Appropriate disposal regulations must be observed.



Note

Take special care when handling hot lubricants.

Warnings and elimination

Warning	Description	Elimination/Action
 xx0100000002 Hot oil or grease	Changing and draining gearbox oil or grease may require handling hot lubricant heated up to 90 °C.	Make sure that protective gear like goggles and gloves are always worn during this activity.
 xx0100000002 Allergic reaction	When working with gearbox lubricant there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
 xx0100000002 Possible pressure build-up in gearbox	When opening the oil or grease plug, there may be pressure present in the gearbox, causing lubricant to spray from the opening.	Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling.

Continues on next page

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

Continued

Warning	Description	Elimination/Action
 xx0100000002 Do not overfill	<p>Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may:</p> <ul style="list-style-type: none"> • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely. 	<p>Make sure not to overfill the gearbox when filling it with oil or grease!</p> <p>After filling, verify that the level is correct.</p>
 xx0100000002 Do not mix types of oil	<p>Mixing types of oil may cause severe damage to the gearbox.</p>	<p>When filling gearbox oil, do not mix different types of oil unless specified in the instructions. Always use the type of oil specified by the manufacturer!</p>
 xx0100000098 Heat up the oil	<p>Warm oil drains quicker than cold oil.</p>	<p>When changing gearbox oil, first run the robot for a time to heat up the oil.</p>
 xx0100000004 Specified amount depends on drained volume	<p>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.</p>	<p>After filling, verify that the level is correct.</p>
 xx0100000003 Contaminated oil in gear boxes	<p>When draining the oil make sure that as much oil as possible is drained from the gearbox. The reason for this is to drain as much oil sludge and metal chips as possible from the gearbox. The magnetic oil plugs will take care of any remaining metal chips.</p>	

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2 Installation and commissioning

2.1 Introduction

General

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

More detailed technical data can be found in the *Product specification* for the IRB 7600, such as:

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

Safety information

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

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 21](#) before performing any installation work.



Note

If the IRB 7600 is connected to power, always make sure that the robot is connected to *protective earth* before starting any installation work!

For more information see:

- *Product manual - IRC5*

2 Installation and commissioning

2.2 Robot transportation precautions

2.2 Robot transportation precautions

General

This section describes ABB approved transportation precautions for ABB robots.



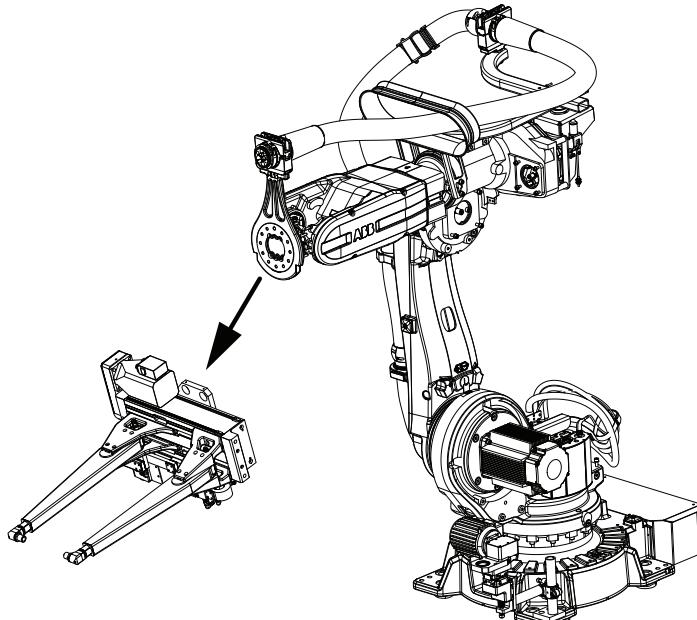
CAUTION

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

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

Method 1 - recommended method

Transportation according to method 1 is strongly recommended by ABB.



xx0800000030

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

- Always remove the tool before transportation of the robot.
- Always place the robot in the ABB recommended transport position, described in section [Risk of tipping/stability on page 78](#).
- Always read and follow the instructions in section [Pre-installation procedure on page 70](#)

Method 2 - transportation with a tool mounted to the robot

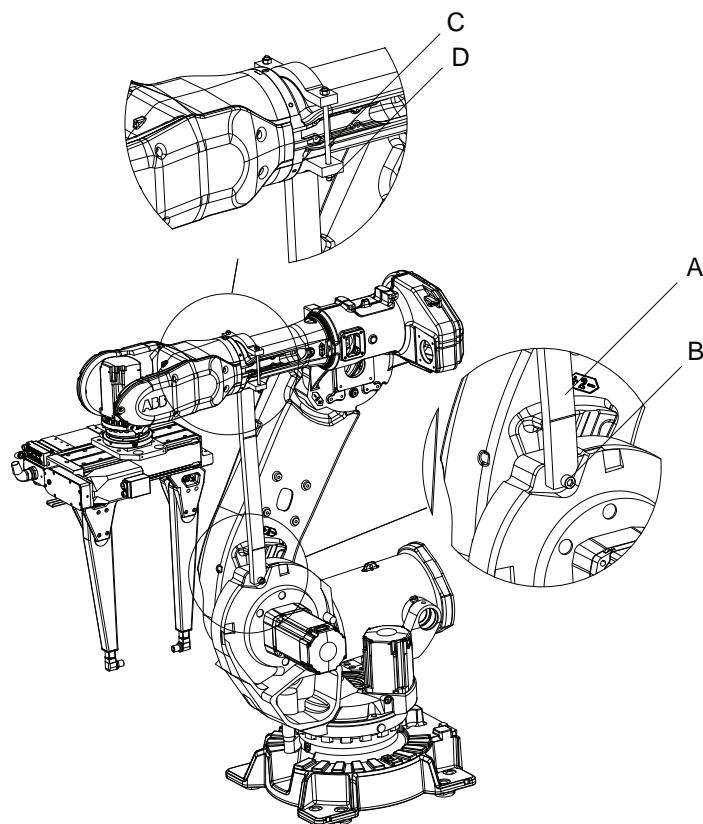
Transportation according to method 2 is approved by ABB, only if use of method 1 is not possible.

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

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

IRB 7600



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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

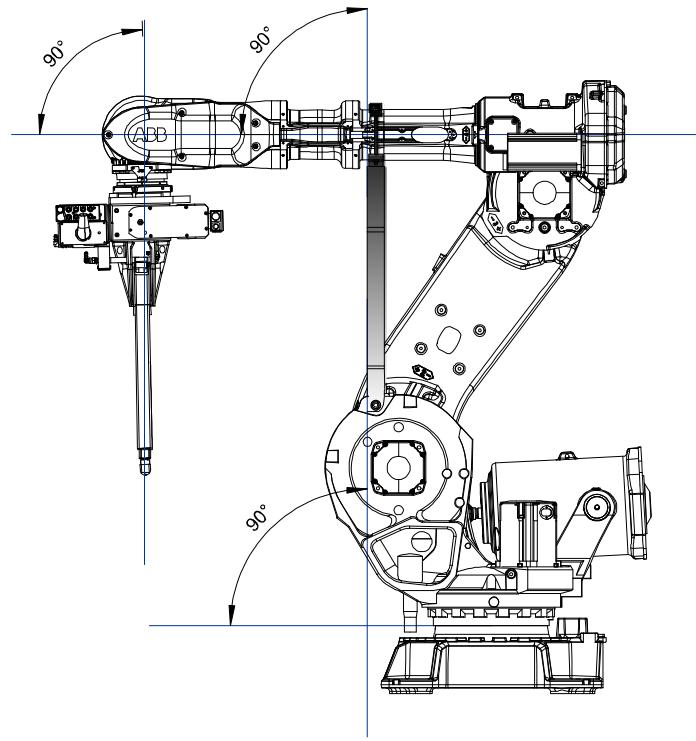
2.2 Robot transportation precautions

Continued

Transport position with a transport support

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

IRB 7600



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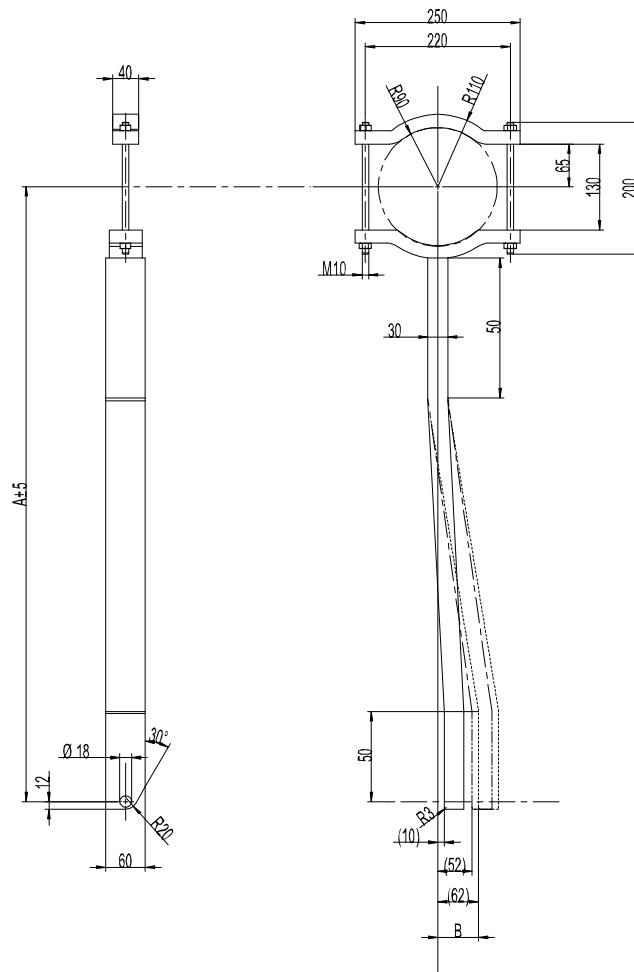
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Recommended transport support

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



xx0800000039

2 Installation and commissioning

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.

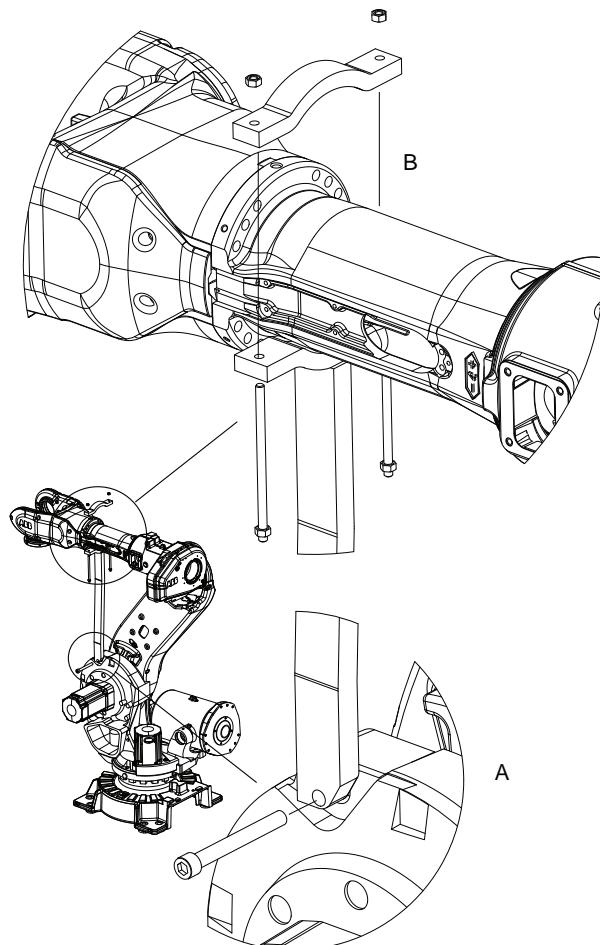


DANGER

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



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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 Transport position with a transport support on page 66 .
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 Transport position with a transport support on page 66 .	 CAUTION Do not try to jog the robot to the exact position (max distance 1mm).
3	Use the brake release for axis 3 to reach the final resting position on the transport support, see the section Manually releasing the brakes on page 89 .	See attachment point for the specific robot in the section Transport position with a transport support on page 66
4	Tighten all the attachment screws, (A) and (B), in the figure with the brake release for axis 3 still activated starting with the lower attachment screw.	 CAUTION Do not attempt to tighten any attachment screws without first releasing the brakes. This can seriously damage the robot.
5	Use the brake release for axis 5 and 6 to reach the final resting position for the tool, see the section Manually releasing the brakes on page 89	

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.

Checking the pre-requisites for installation

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

Installation personnel working with an ABB robot 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.

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage.  Note Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used is suitable to handle the weight of the robot as specified in: Weight, robot on page 71
6	If the robot is not installed directly, it must be stored as described in: Storage conditions, robot on page 72
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: Operating conditions, robot on page 72
8	Before taking the robot to its installation site, make sure that the site conforms to: <ul style="list-style-type: none">• Loads on foundation, robot on page 71• Protection classes, robot on page 73• Requirements, foundation on page 72
9	Before moving the robot, please observe the stability of the robot: Risk of tipping/stability on page 78
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: On-site installation on page 79
11	Install required equipment, if any. <ul style="list-style-type: none">• Installation of signal lamp (option) on page 118

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Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 7600	2500 kg

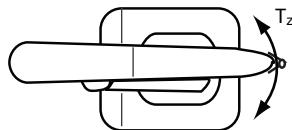
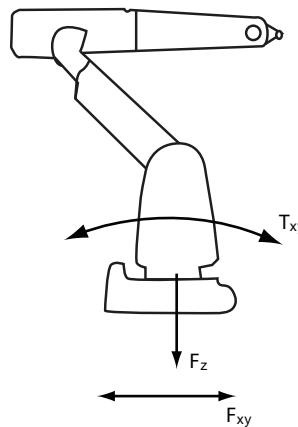
**Note**

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

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

The directions are valid for all floor mounted and suspended 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!

Continues on next page

2 Installation and commissioning

2.4.1 Pre-installation procedure

Continued

Floor mounted

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

Requirements, foundation

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

Requirement	Value	Note
Maximum deviation from levelness	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Maximum tilt	5°	The limit for the maximum payload on the robot is reduced if the robot is tilted from 0°. Contact ABB for further information about acceptable loads.
Minimum resonance frequency	22 Hz	

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

Parameter	Value
Minimum ambient temperature	-25° C
Maximum ambient temperature	+55° C
Maximum ambient temperature (less than 24 hrs)	+70° C
Maximum ambient humidity	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

Protection classes, robot

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

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

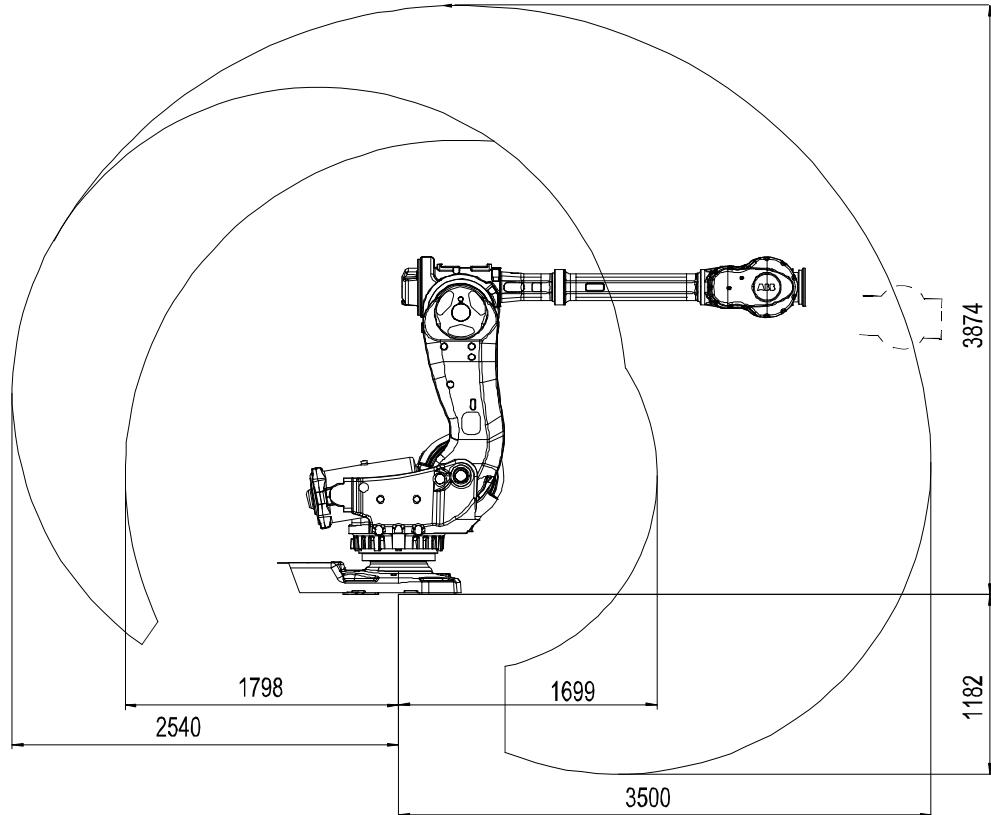
2 Installation and commissioning

2.4.2 Working range, IRB 7600 - 150/3.5

2.4.2 Working range, IRB 7600 - 150/3.5

Illustration

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

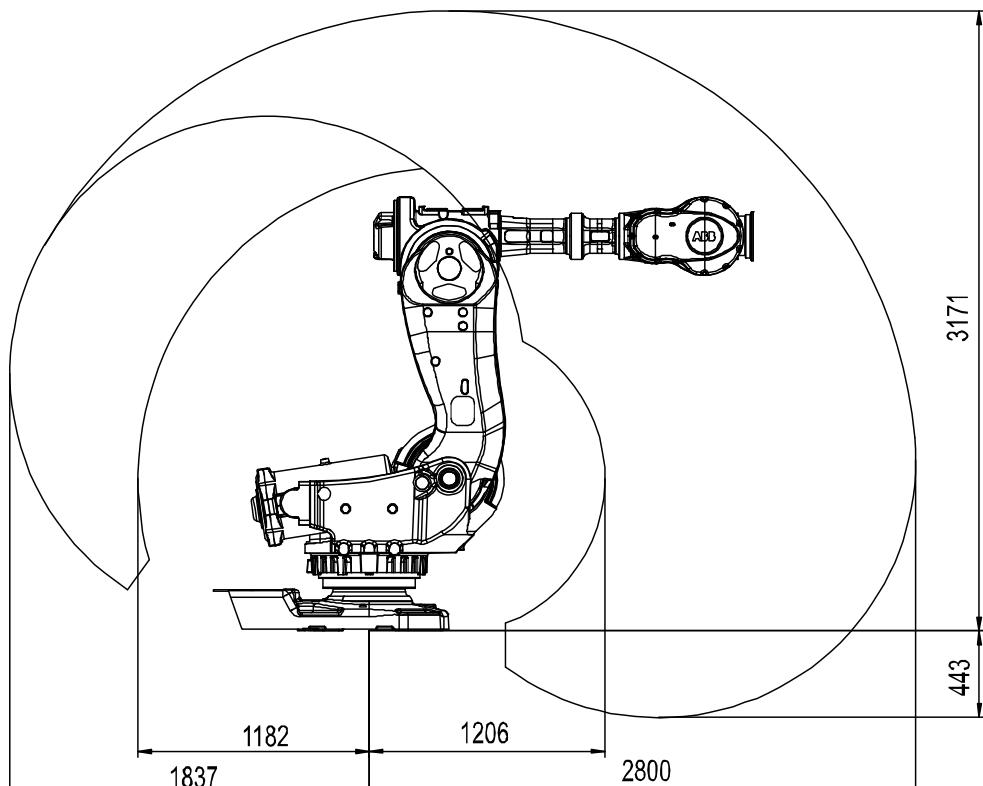


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2.4.3 Working range, IRB 7600 - 340/2.8

Illustration

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



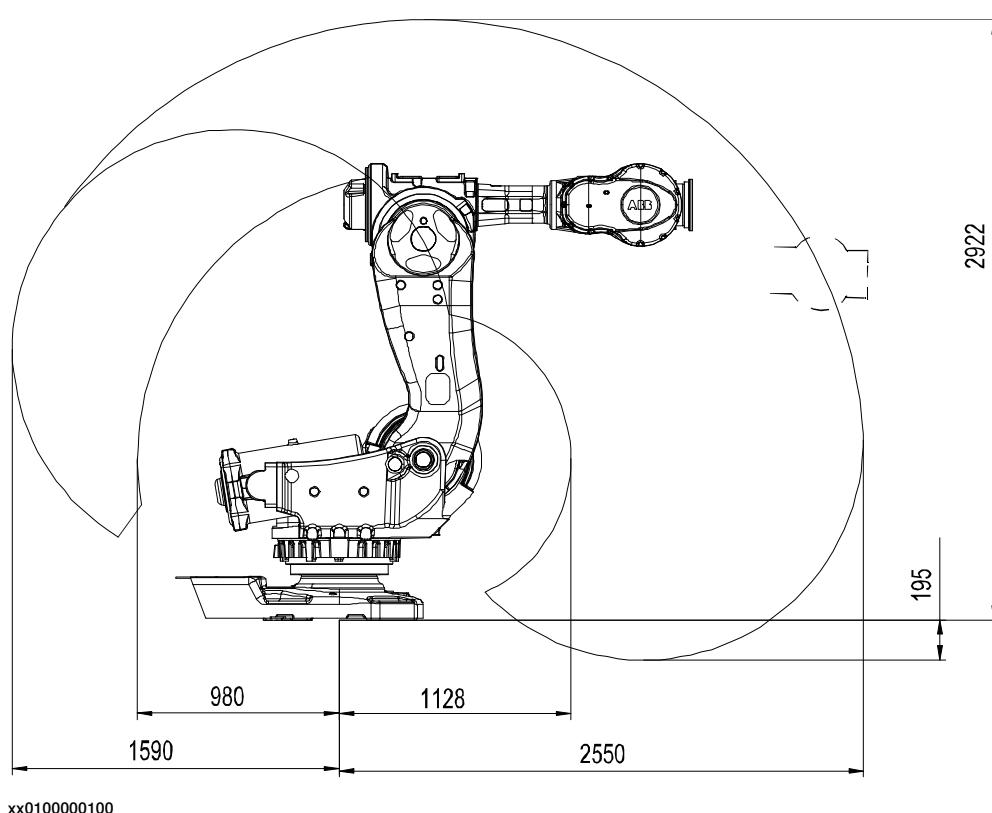
xx0300000296

2 Installation and commissioning

2.4.4 Working range, IRB 7600 - 400/2.55, IRB 7600 - 500/2.55

Illustration

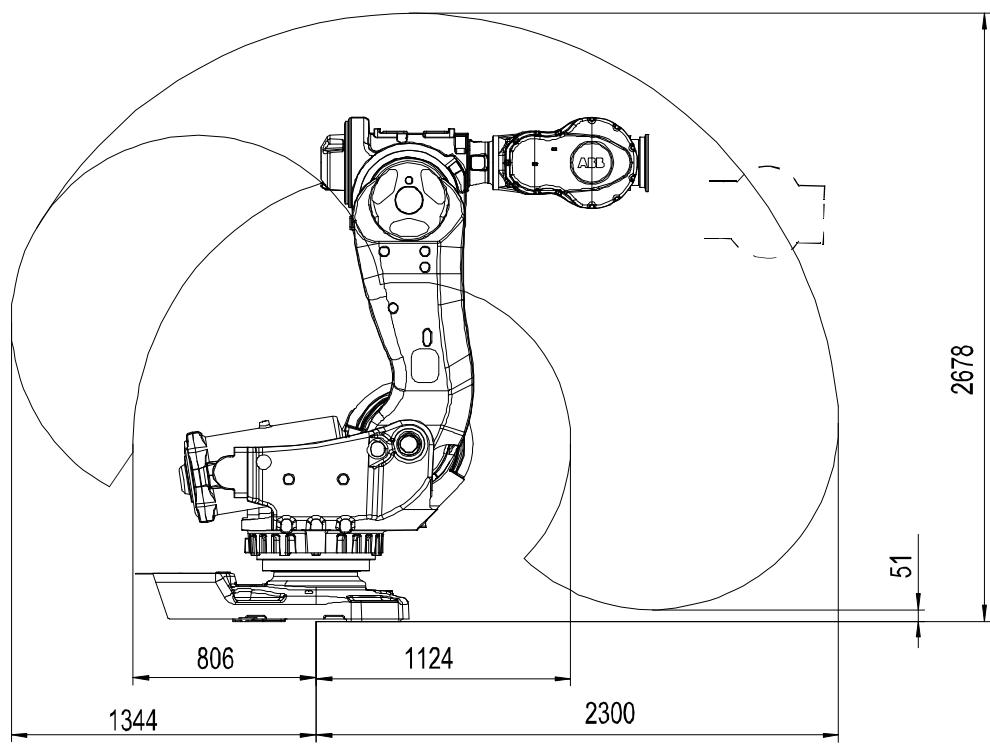
The illustration below shows the unrestricted working range of IRB 7600 - 400/2.55 and IRB 7600 - 500/2.55:



2.4.5 Working range, IRB 7600 - 500/2.3

Illustration

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



en0100000099

2 Installation and commissioning

2.4.6 Risk of tipping/stability

2.4.6 Risk of tipping/stability

Risk of tipping

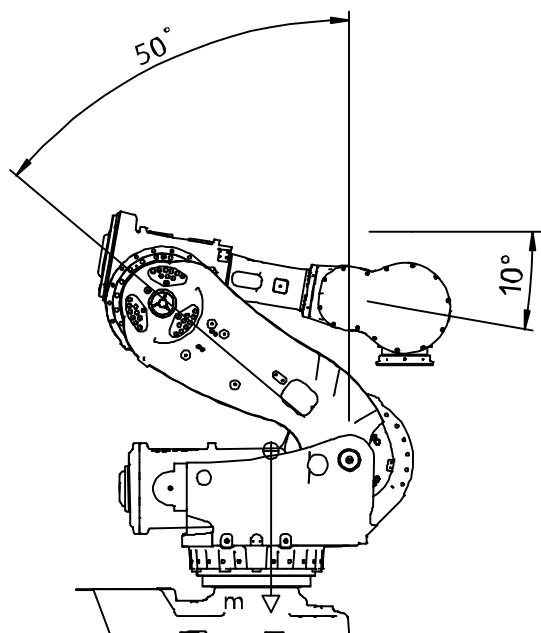
If the robot is not fastened to the foundation and standing still, the robot is not stable in the whole working area. Moving the arms will displace the center of gravity, which may cause the robot to tip over.

The shipping position is the most stable position.

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

Shipping and transport position

This figure shows the robot in its shipping position, which also is a recommended transport position.



xx0100000103



WARNING

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

2.5 On-site installation

2.5.1 Lifting robot with fork lift

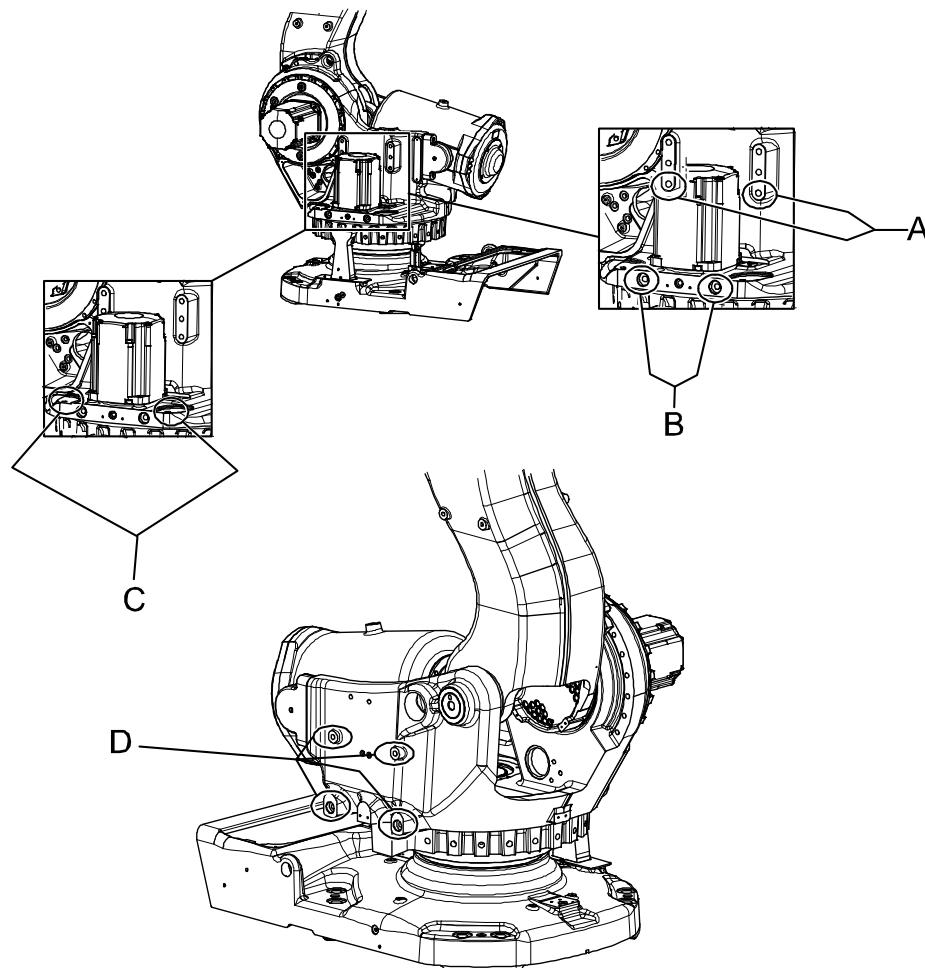
General

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.



xx0400000707

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

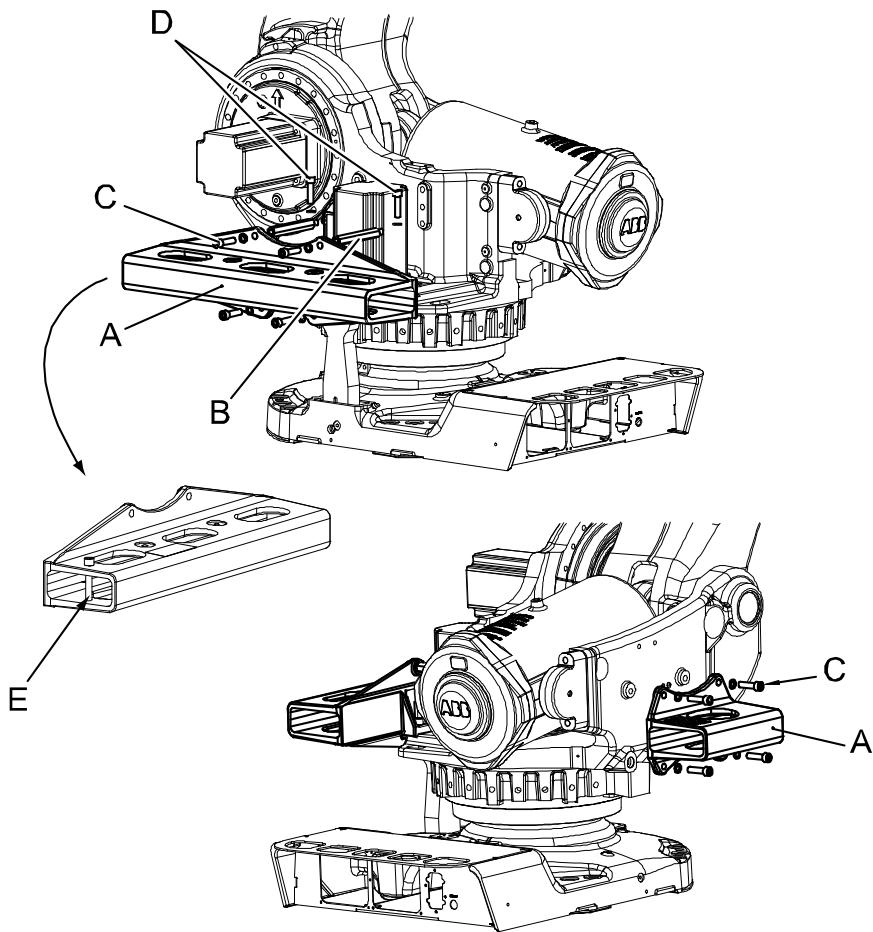
Continued

Required equipment

Equipment, etc.	Art. no.	Note
Fork lift accessory, incl. all required hardware	3HAC0604-2	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .

Fork lift accessory, 3HAC0604-2

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



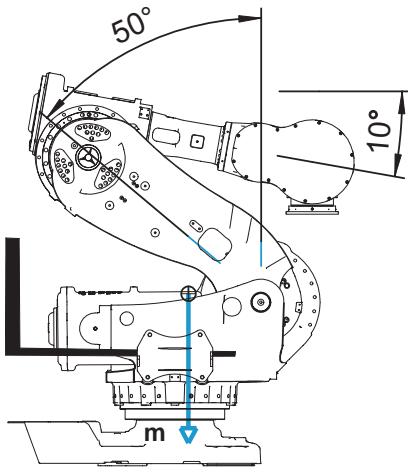
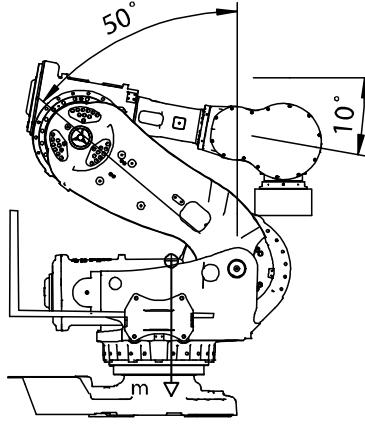
xx0200000379

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!

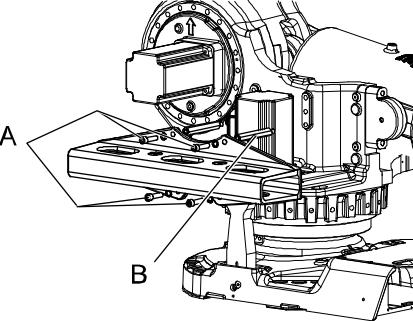
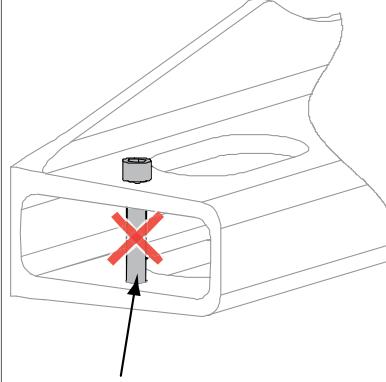
Action	Note
1 If a cooling fan for the axis 1 motor is used, it must be removed in order to use the fork lift device!	
2 Position the robot as shown in the figure to the right!  Note No load is permitted on the robot if the fork lift set 3HAC0604-2 is used!	<p>Release the brakes if required as detailed in section Manually releasing the brakes on page 89.</p>  <p>xx0200000079</p> <p>When using fork lift set 3HAC0604-2, no load is permitted on the robot!</p>  <p>xx0200000387</p>
3 Fit the two spacers to the robot and secure.	Attachment points are shown in figure Attachment points on robot on page 79 .
4  CAUTION The fork lift pocket weighs 60 kg!	

Continues on next page

2 Installation and commissioning

2.5.1 Lifting robot with fork lift

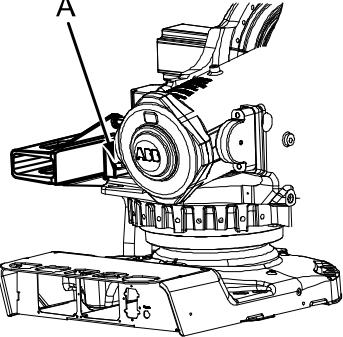
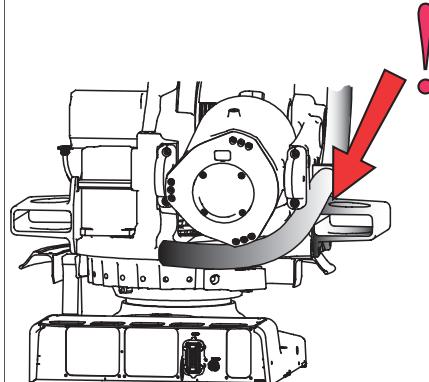
Continued

Action	Note
5 Secure the longer <i>fork lift pocket</i> to the spacers with four of the <i>horizontal attachment screws</i> and washers.  Note The screws, which are attached horizontally and vertically, are identical. However, they are tightened with different torque!	Always use original screws (or replacements of equivalent quality: M16, quality 12.9)! Attachment points on the robot are shown in figure Attachment points on robot on page 79 .  xx0400001068 A Horizontal attachment screws, 4 pcs, M16 x 60. Tightening torque: 60 Nm. B Spacers, 2 pcs.
6 Make sure the securing screw is removed from the fork lift pocket! It is only used for robot model IRB 6650S.	 xx0700000655 A Securing screw

Continues on next page

2.5.1 Lifting robot with fork lift

Continued

Action	Note
7 Secure fork lift pocket to robot with two <i>vertical attachment screws</i> and washers. (only valid for the Fork lift accessory 3HAC0604-2) Note Vertically and the horizontally attached screws are identical, but tightened with different torques!	 xx0300000464 <p>A Vertical attachment screws, 2 pcs, M16x60. Tightening torque: 270 Nm. Always use original screws (or replacements of equivalent quality: M16, quality 12.9)! Attachment points on robot are shown in figure Attachment points on robot on page 79.</p>
8 CAUTION The fork lift pocket weighs 22 kg!	
9 Secure the shorter fork lift pocket on the other side of the robot with the four remaining <i>horizontal attachment screws</i> .	4 pcs, M16x60. Tightening torque: 60 Nm. Always use original screws (or replacements of equivalent quality: M16, quality 12.9)! Attachment points on robot are shown in figure Attachment points on robot on page 79 .
10 Double-check that pockets are properly secured to the robot! Insert fork lift forks into the pockets.	 xx0200000380 <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  CAUTION 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  WARNING 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) on page 108.</i>

2.5.2 Lifting robot with lifting slings

General

This section contains a general overview of how to lift the complete robot using special lifting equipment. More detailed instructions are included with the equipment.



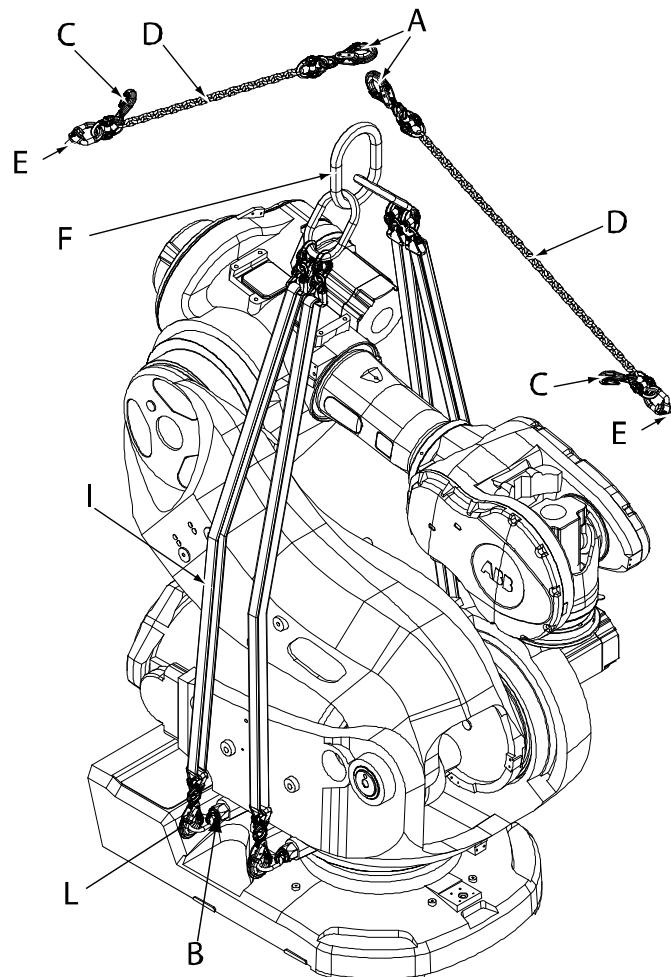
Note

Move the robot to the recommended position shown in the figure and in the instruction!

Attempting to lift a robot in any other position may result in the robot tipping over, causing severe damage or injury!

Illustration, lifting slings

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



xx0200000153

A	Load hook
B	Swivelling lifting eyes, 4 pcs
C	Shortening hook

Continues on next page

2 Installation and commissioning

2.5.2 Lifting robot with lifting slings

Continued

D	Chain
E	M12 lifting eye
F	Eye for lifting accessory
I	Lifting slings, 4 pcs
L	Hook

Required equipment

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

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 frame.

Action	Note
1 Run the overhead crane to a position above the robot.	
2 Position the robot as detailed in enclosed instruction!	Art. no. is specified in Required equipment on page 86 . Release the brakes if required as detailed in section Manually releasing the brakes on page 89 .
3 Fit the <i>lifting accessory</i> to the robot as described in the enclosed instruction!	Art. no. is specified in Required equipment on page 86 .
4  CAUTION The IRB 7600 robot weighs 2500 kg. All lifting accessories used must be sized accordingly!	
5  WARNING 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.

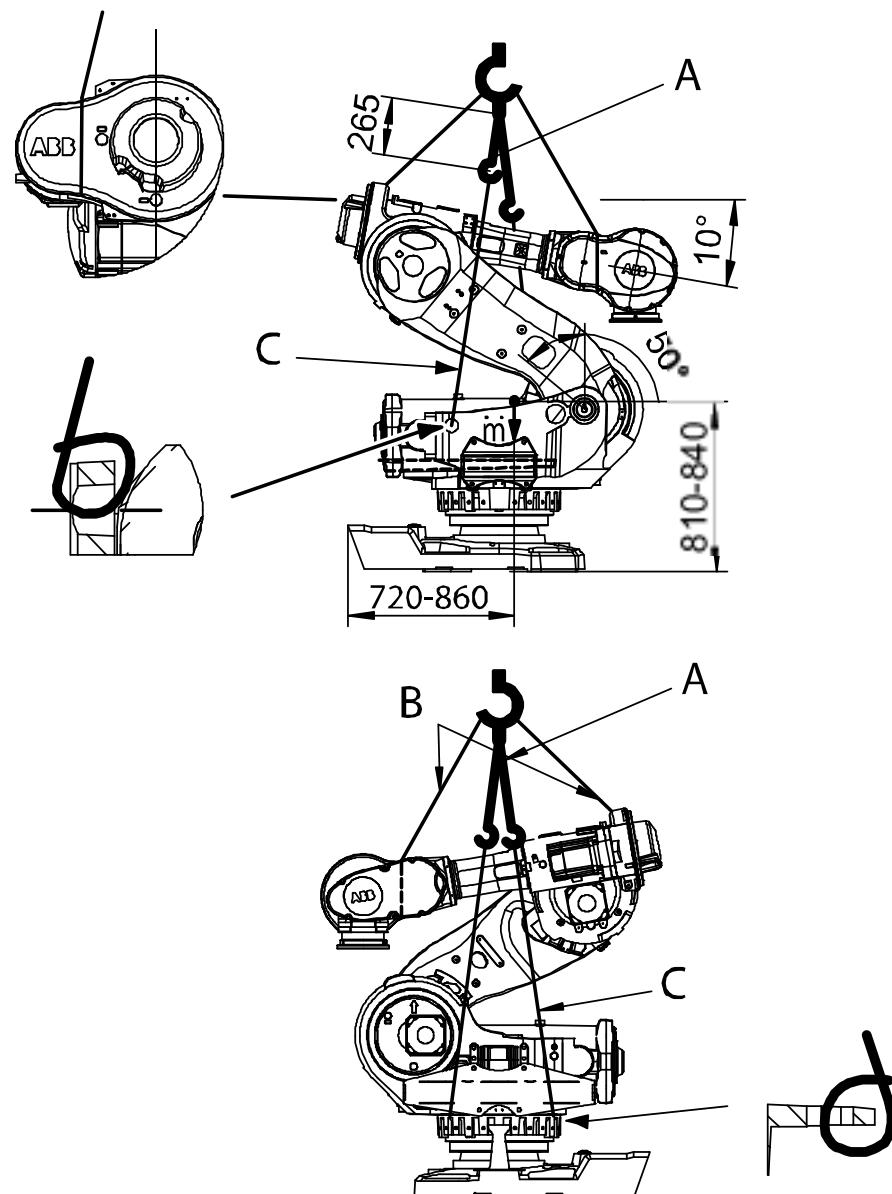
2.5.3 Lifting robot with roundslings

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	 CAUTION 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 Risk of tipping/stability on page 78 .
2	 CAUTION 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 Roundslings attached to the robot on page 87 . Lengths are specified in Required equipment on page 88 .
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 Roundslings attached to the robot on page 87 . Lengths are specified in Required equipment on page 88 .
6	Attach the two <i>roundslings, 1000 kg</i> to the upper arm and the overhead crane hook!	Shown in the figure Roundslings attached to the robot on page 87 .
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:

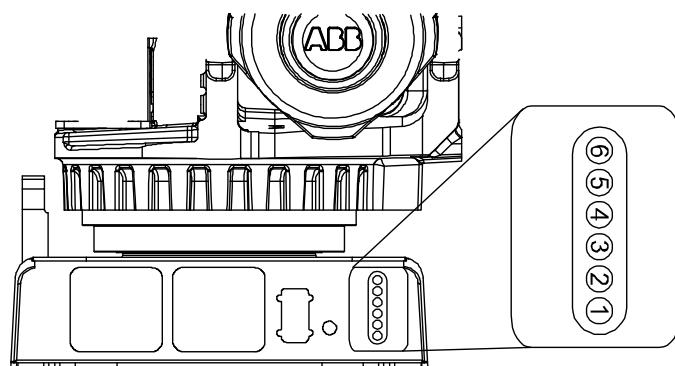
- Internal brake release unit: using push buttons on the robot. This requires either the controller to be connected or that power is supplied to the R1.MP connector, according to the section *Supplying power to connector R1.MP on page 90*.

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.

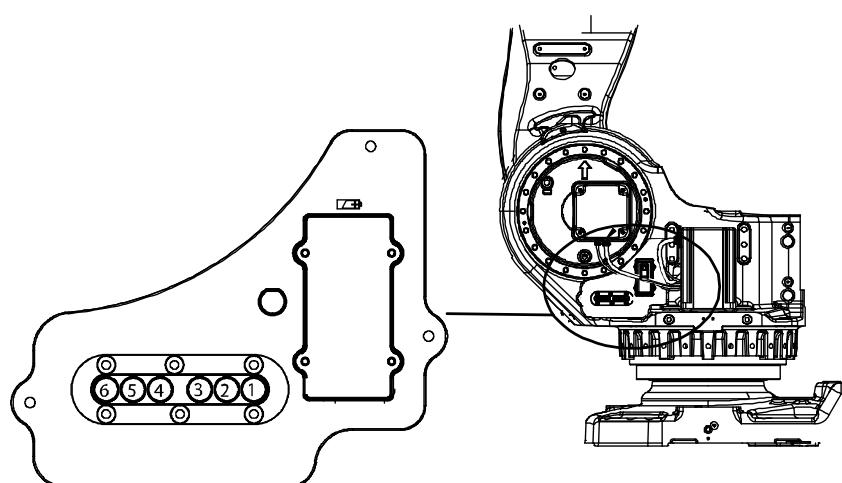


xx0200000375

- 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

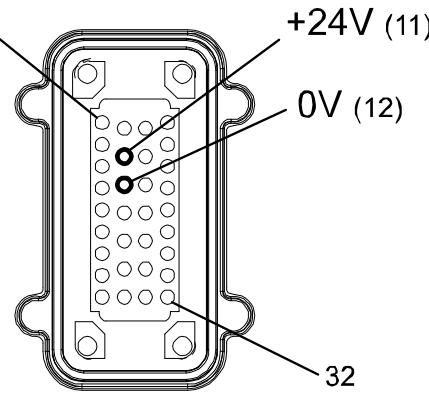
Releasing the brakes

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 Supplying power to connector R1.MP on page 90 .	Buttons are shown in figure Location of brake release unit on page 89 .
2  DANGER When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways! Make sure no personnel is near or beneath the robot arm!	
3 Release the holding brake on a particular robot axis by pressing the corresponding button on the internal brake release unit. The brake will function again as soon as the button is released.	

Supplying power to connector R1.MP

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

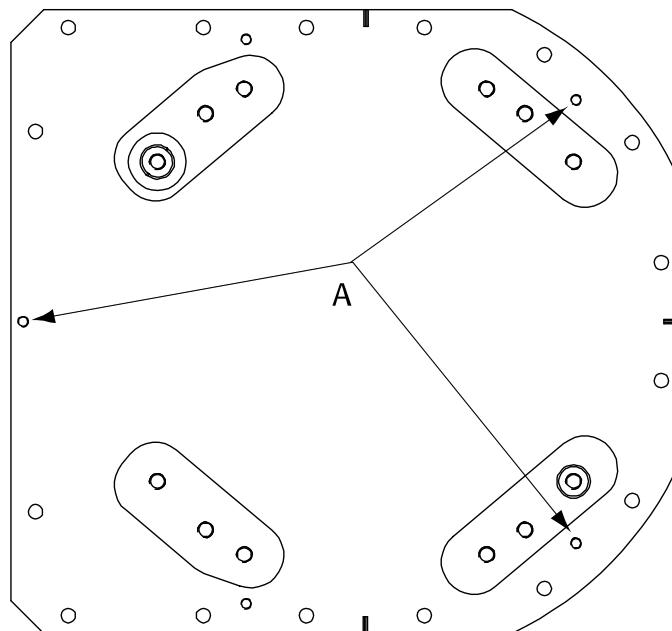
Action	Note
1  DANGER Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	
2 Supply 0V on pin 12 and 24V on pin 11.	 xx0600002937

2.5.5 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



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

Lifting, base plate

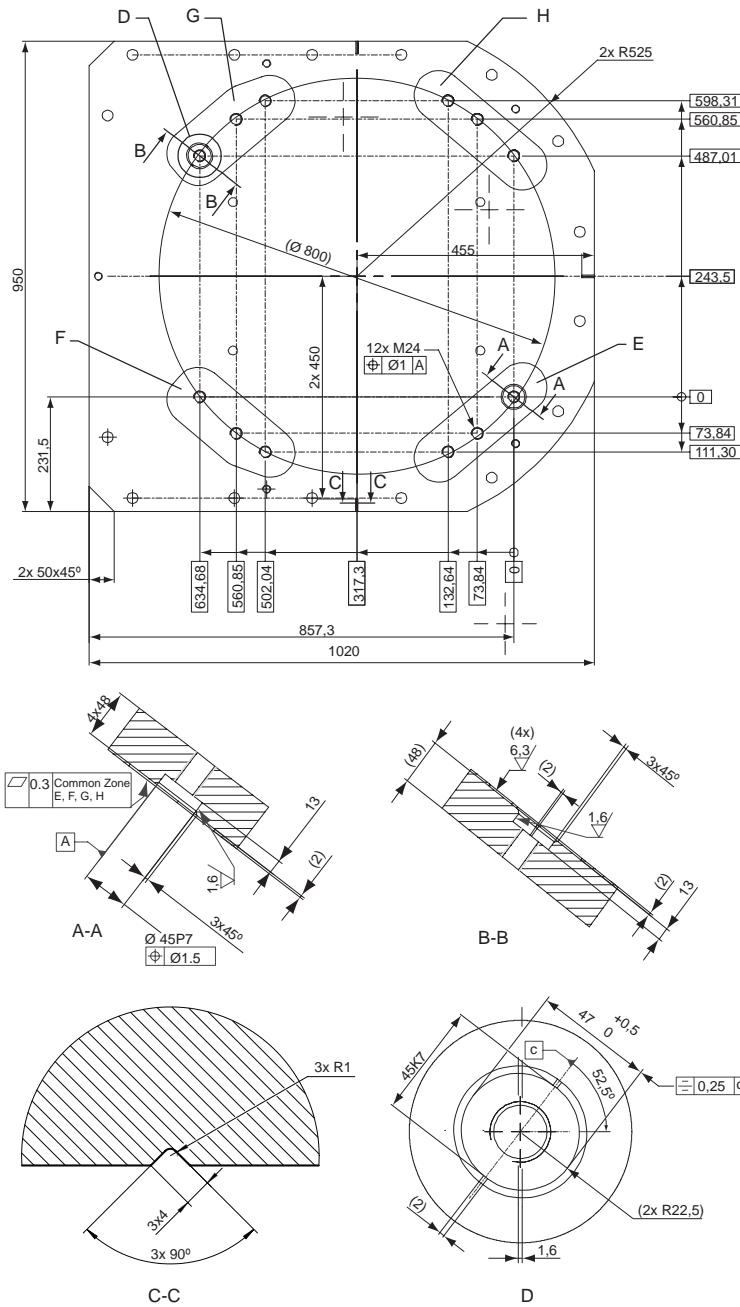
	Action	Note
1	! CAUTION The base plate weighs 353 kg. All lifting accessories used must be sized accordingly.	
2	Fit lifting eyes in specified holes.	Shown in figure Hole configuration on page 91 .
3	! CAUTION Lift and move the base plate very slowly. If the base plate starts to swing it is a risk for injuries or damage.	

2 Installation and commissioning

2.5.6 Securing the base plate

2.5.6 Securing the base plate

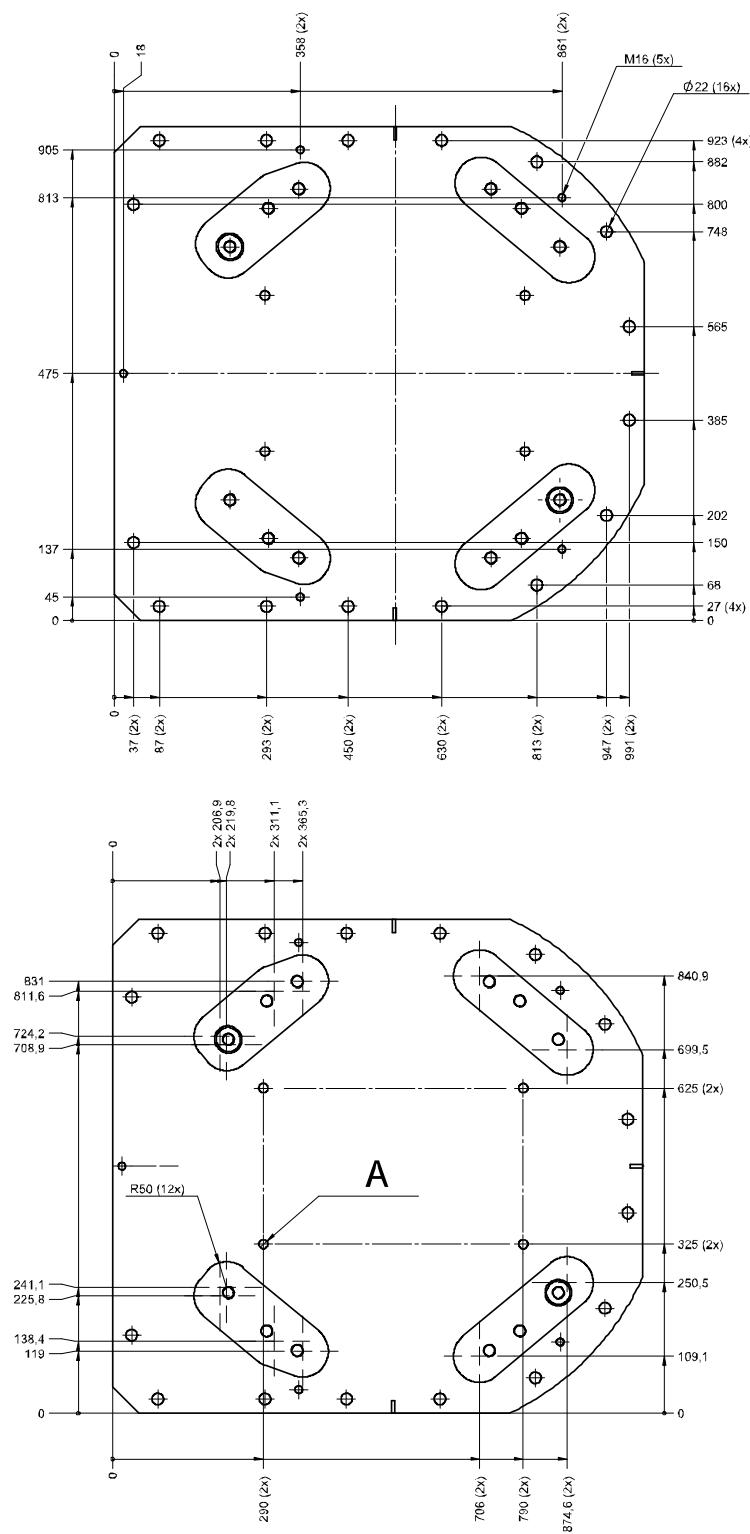
Base plate, dimensions



xx1000001053

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

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xx0400000715

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

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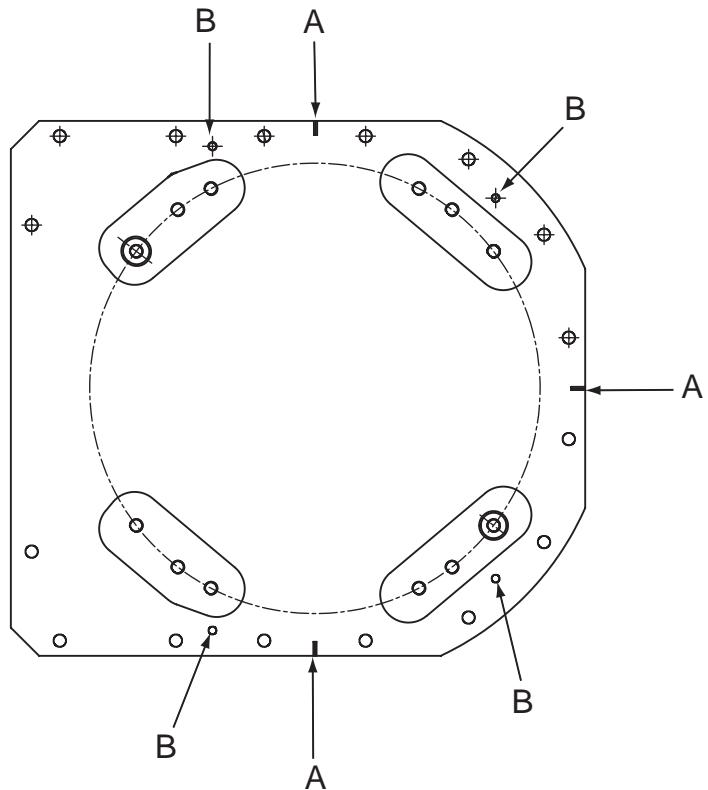
2 Installation and commissioning

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.



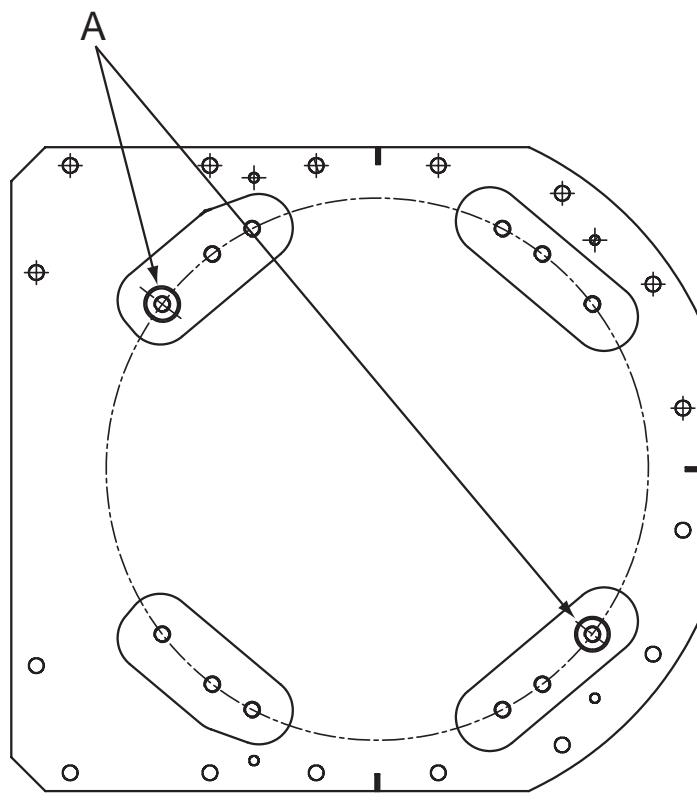
xx1500000312

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

Continues on next page

Base plate, guide sleeve holes

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



xx030000045

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

Required equipment

Equipment	Article number	Note
Base plate	3HAC12937-7	Includes <ul style="list-style-type: none"> guide sleeves, 3HAC12937-3 levelling screws, 9ADA120-79 attachment screws and washers for securing the robot to the base plate.
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
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

2 Installation and commissioning

2.5.6 Securing the base plate

Continued

Recommendations, quality

The table specifies any recommendations made by ABB:

Variable	Recommendation
Recommended bolt quality and dimension	Hilti HDA-P, M20 x 250/50 (maximum thickness of base plate = 50 mm) Hilti HDA-P, M20 x 250/100 (maximum thickness of base plate = 100 mm)
Recommended foundation quality 1	Steel fibre reinforced concrete foundation, 30 kg/m ³ , class C30 ⁱ
Recommended foundation quality 2	Sturdy concrete foundation, double reinforced by ø10 mm steel bars, distance 140 mm, class C25 ⁱ

ⁱ See recommended depth of drill hole, minimum base material thickness etc. in standards from the bolt supplier. When choosing bolts from Hilti, see standard AFTM2011.

Base plate

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

	Action	Note
1	Make sure the foundation is levelled.	
2	 CAUTION 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 Base plate, orienting grooves and leveling bolts on page 94 .
4	Lift the base plate to its mounting position.	Detailed in section Lifting the base plate on page 91 .
5	Use the base plate as a template and drill attachment holes as required by the selected bolt dimension.	Attachment holes: 16 pcs. If possible, observe the recommendations specified in section Recommendations, quality on page 96 . ABB does not assume any responsibility for other foundation qualities, due to great variations in the foundation properties.
6	Fit the base plate and use the levelling bolts to level the base plate.	Shown in figure Base plate, orienting grooves and leveling bolts on page 94 .
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.

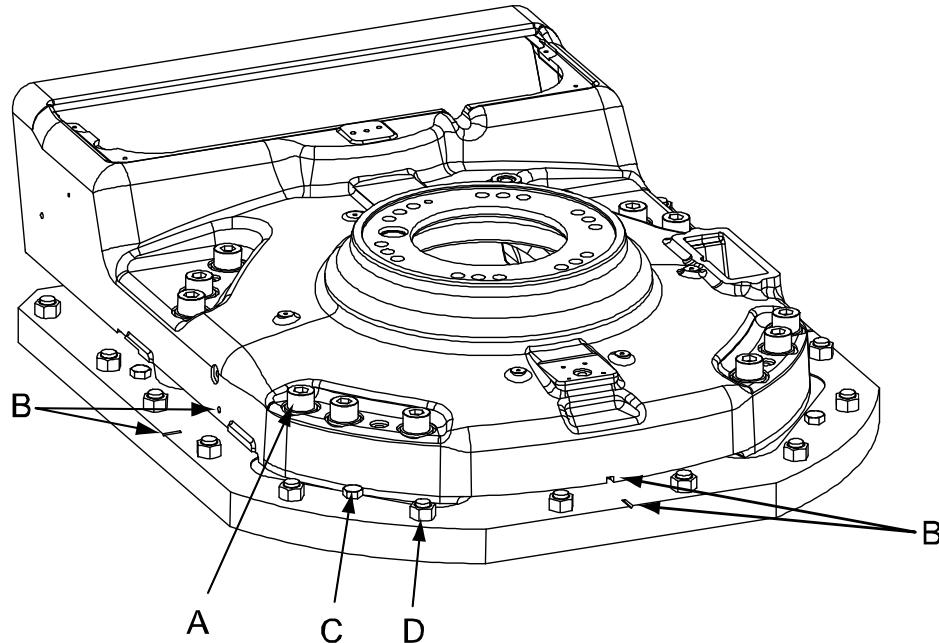
2.5.7 Orienting and securing the robot

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.



xx0100000107

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

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2 Installation and commissioning

2.5.7 Orienting and securing the robot

Continued

Securing the robot

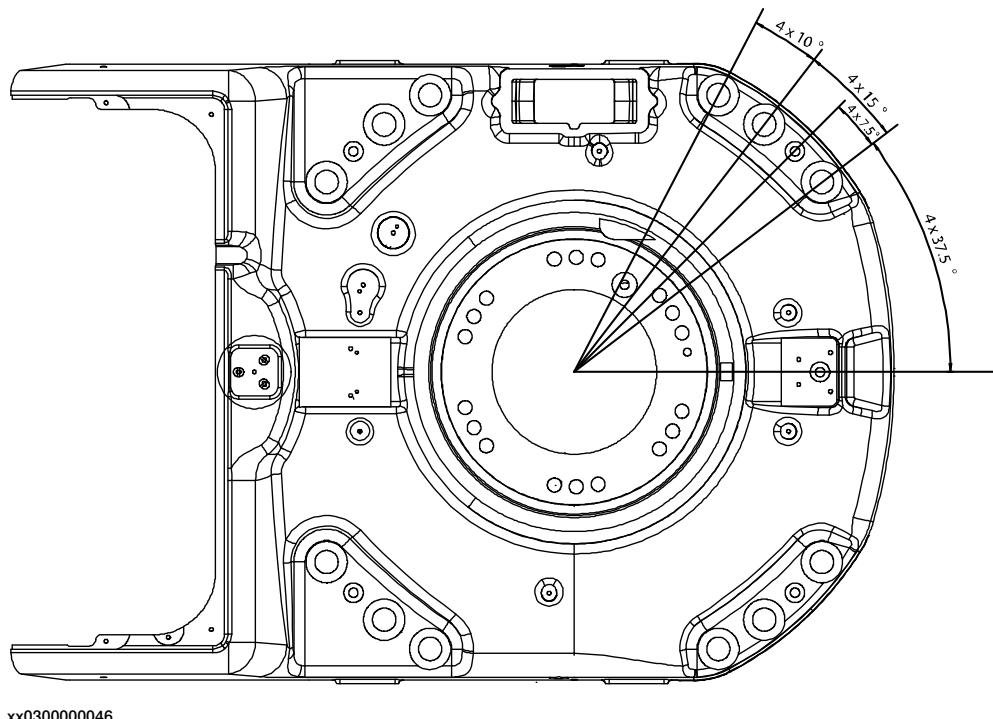
Use this procedure to secure robot to base plate after fitting plate to the foundation.

	Action	Note
1	Lift the robot.	See section Lifting robot with lifting slings on page 85 . See section Lifting robot with round-slings on page 87 .
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 Base plate, guide sleeve holes on page 95 .  Note One of the guide sleeve holes is elongated!
4	Guide the robot gently using two M24 screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the guide sleeves!
5	Fit the <i>bolts and washers</i> in the base attachment holes.	Specified in Attachment screws on page 97 . Shown in figure Illustration, robot fitted to base plate on page 97 .  Note Lightly lubricate screws before assembly!
6	Tighten bolts in a criss-cross pattern to ensure that the base is not distorted.	

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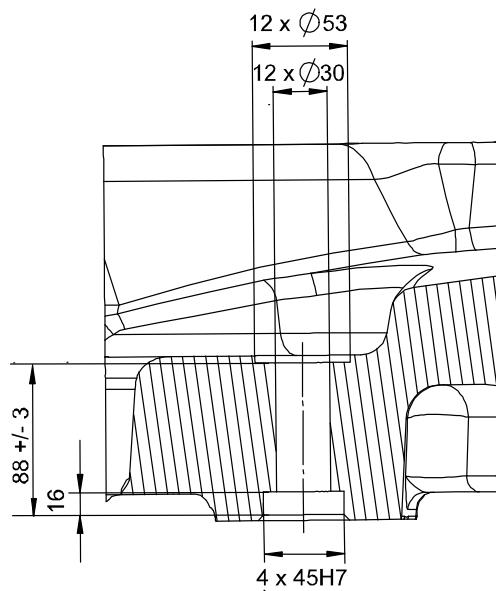
Hole configuration, base

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



Cross section, guide sleeve hole

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



2 Installation and commissioning

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.



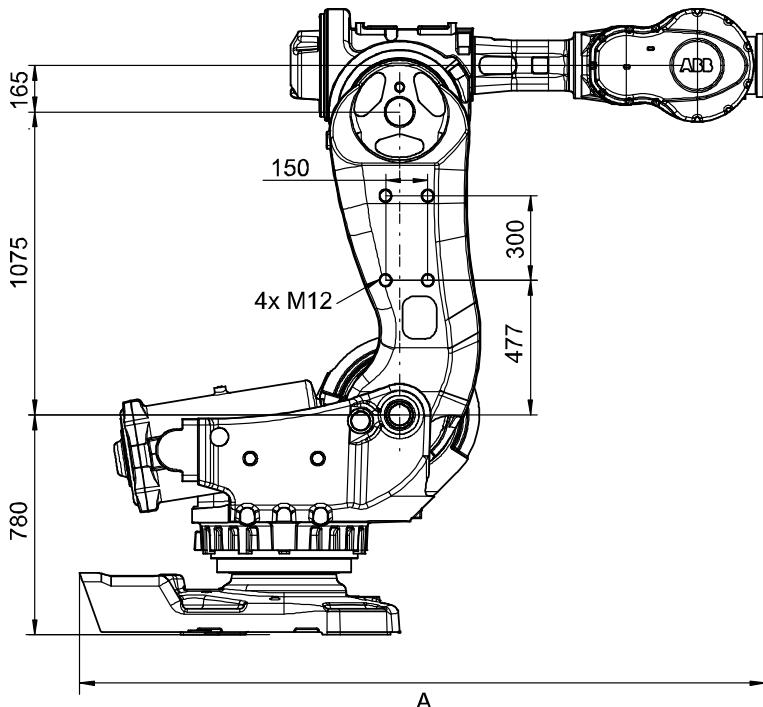
Note

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!

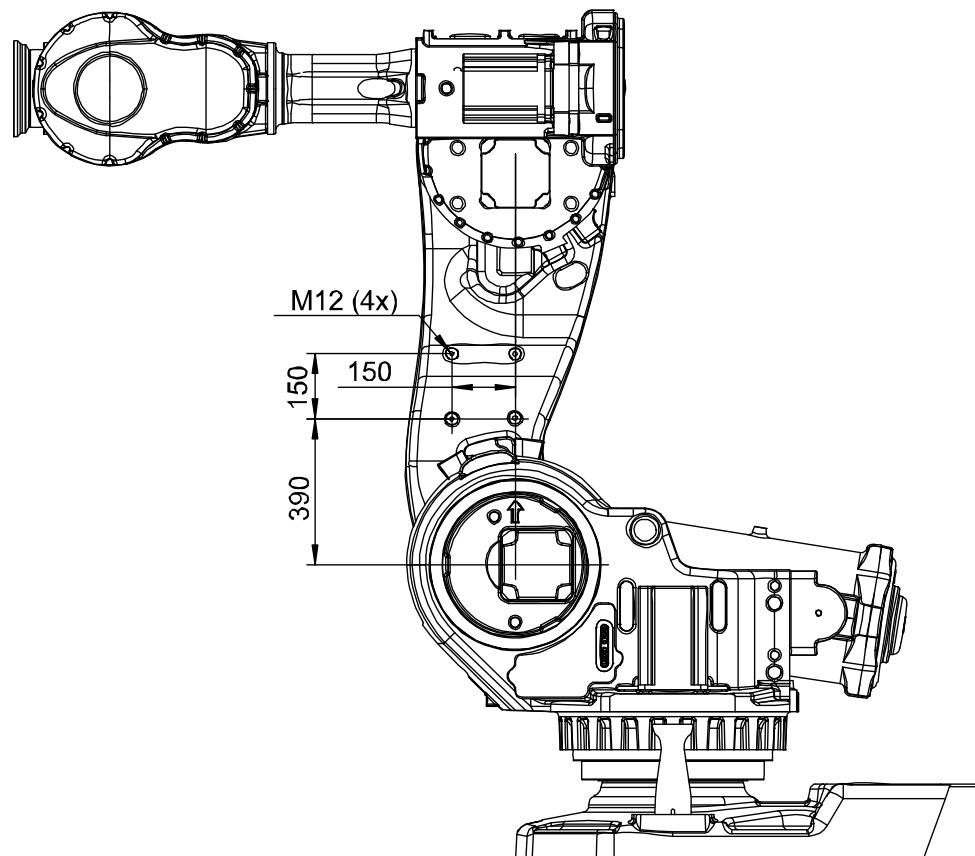


xx0700000722

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

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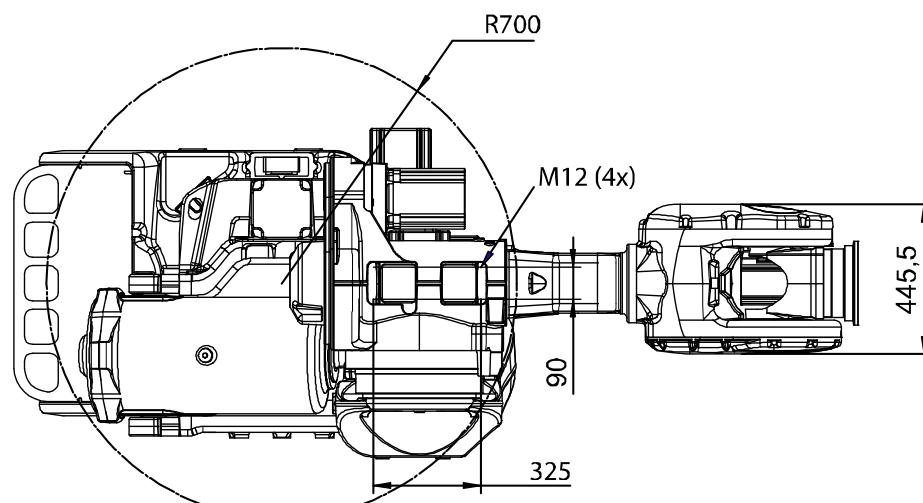
Robot variant	A
IRB 7600 - 130/3.5	3398 mm



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.



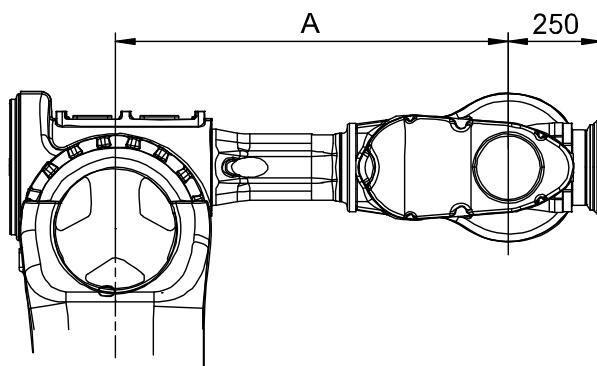
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2 Installation and commissioning

2.5.8 Fitting equipment on robot

Continued

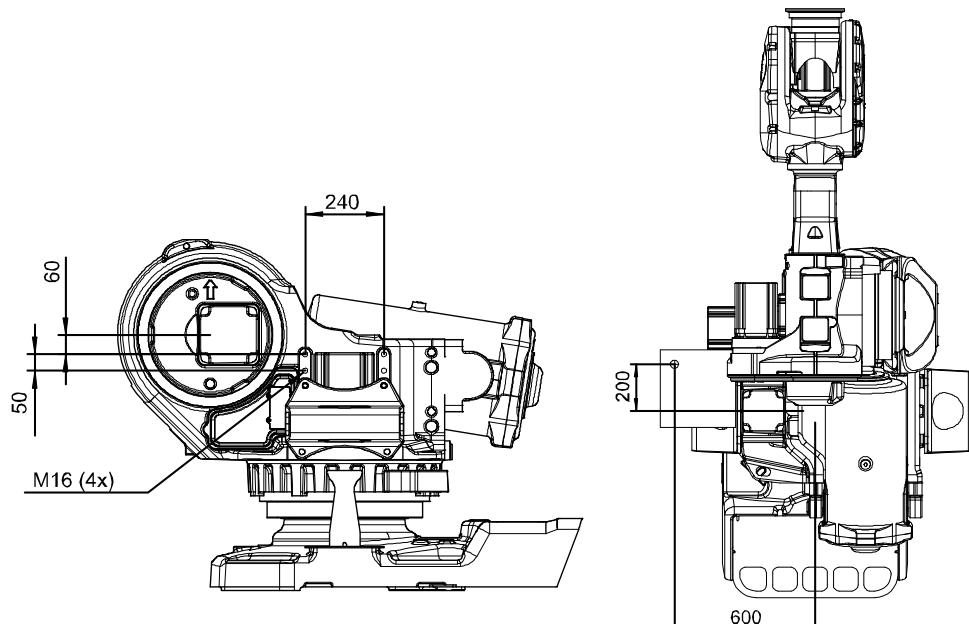


xx0300000299

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

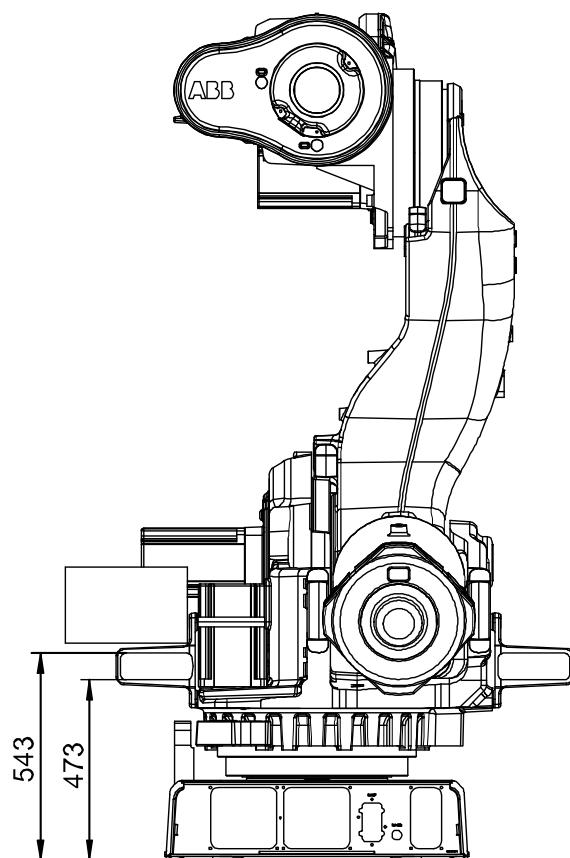
Illustration, fitting of extra equipment on frame

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



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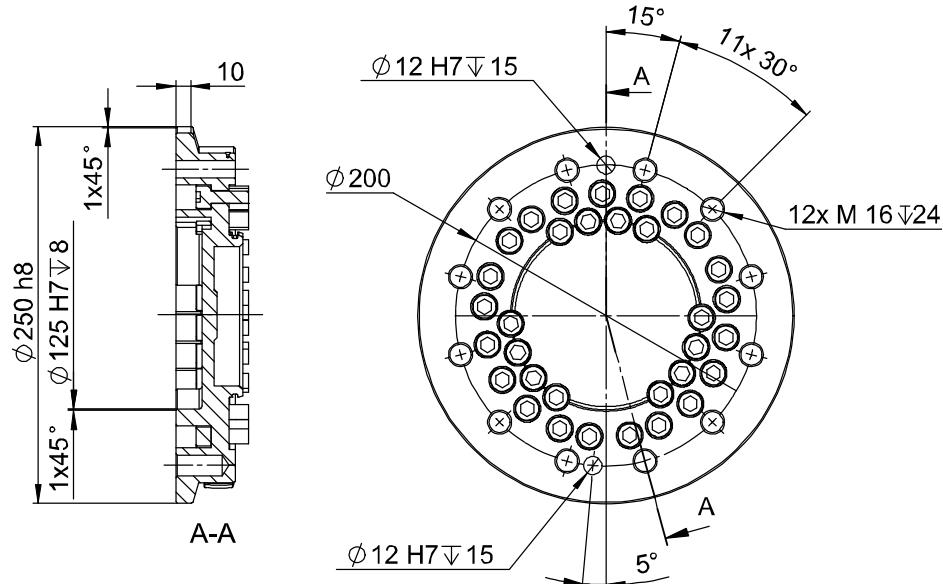
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xx0100000118

Tool flange, standard

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



xx0100000119

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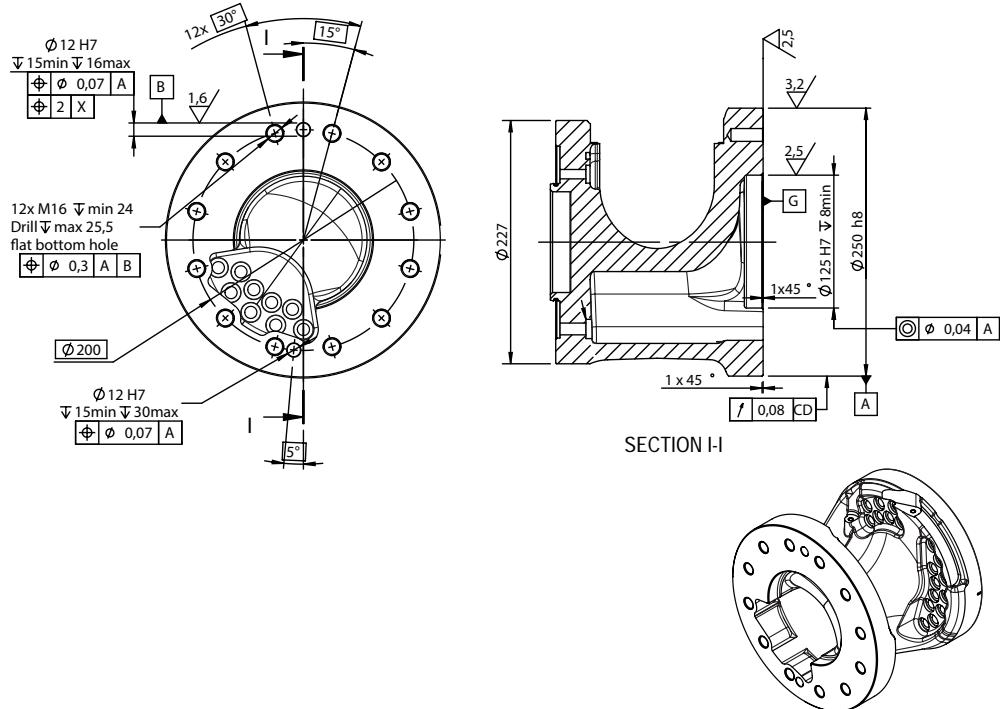
2 Installation and commissioning

2.5.8 Fitting equipment on robot

Continued

Tool flange, LeanID

The illustration below shows the tool flange for option 780-4 LeanID.



xx1600000980

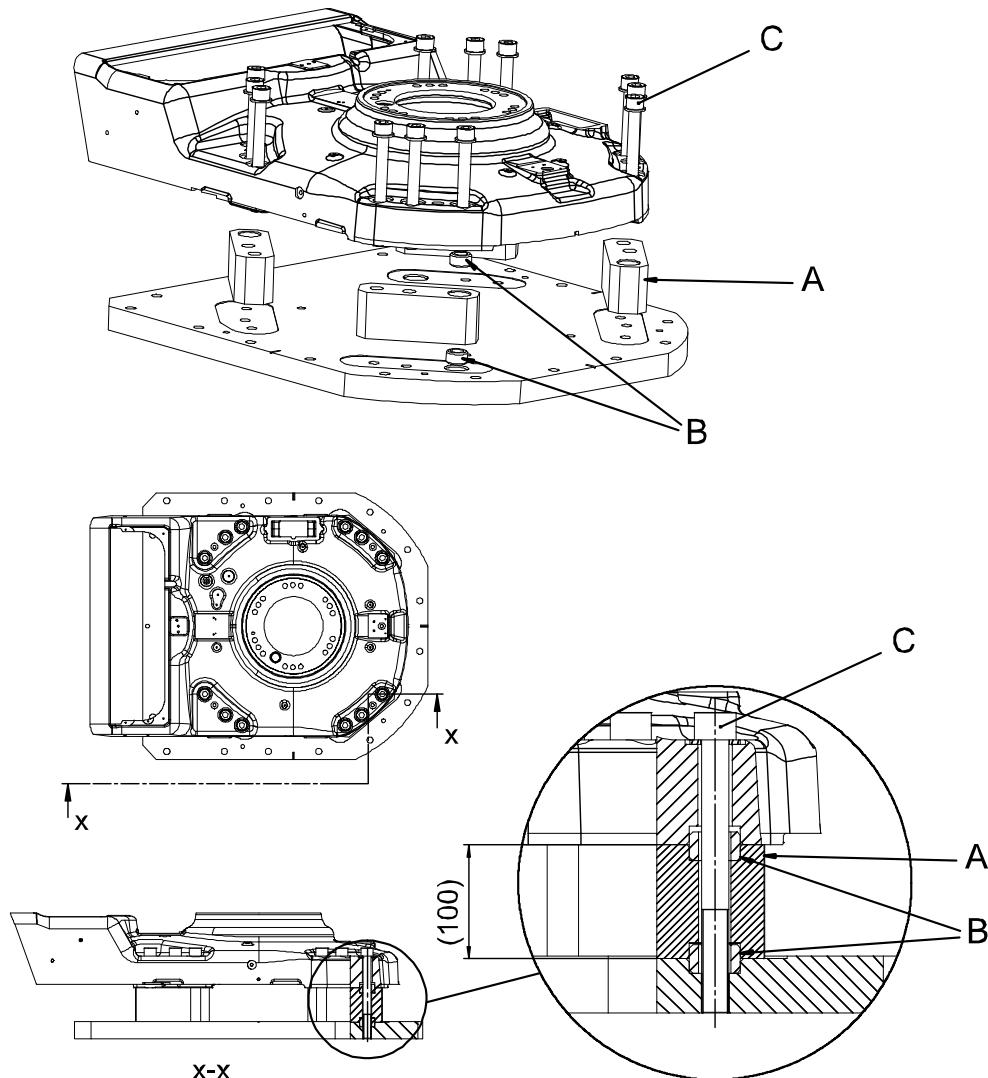
Fastener quality

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

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

2.5.9 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 Standard tools on page 445 .

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.

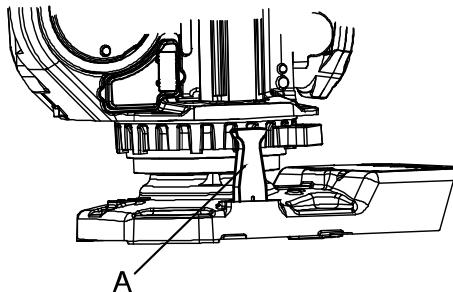
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2	Unfasten the robot from the foundation, if fastened, and lift it away with lifting slings. Make sure the robot is positioned in the most stable position; the transport position!	Detailed in section Lifting robot with lifting slings on page 85 .
3	Install the base plate to the foundation, if not used previously.	Detailed in section Securing the base plate on page 92 .
4	Fit the four <i>base spacers</i> and <i>guiding sleeves</i> to the base plate.	Shown in the figure Illustration, installation of base spacers on page 105 .
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	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

2.5.10 Extended working range, axis 1 (option 561-1)

Overview

The working range of axis 1 can be increased from standard range to extended $\pm 220^\circ$.

Extending the working range

	Action	Note/Illustration
1	Remove the mechanical stop pin from axis 1 (A).	
2	Option 561-1 requires installation of option 810-1 <i>Electronic Position Switches</i> . Configure Electronic Position Switches.	See <i>Application manual - Electronic Position Switches</i> .
3	Redefine the software 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> must be changed to 3.84 respectively -3.84. The values are in radians, that is 3.84 radians = 220 degrees.	<p>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>.</p> <p>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>.</p>

2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

General

A cooling fan can be installed on the motors of axes 1, 2 and 3.

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

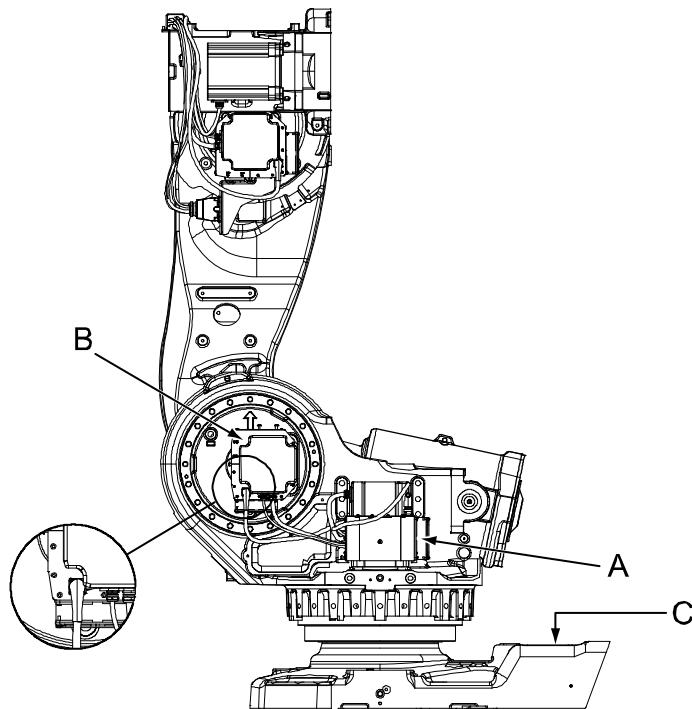
The cabling for the fans is available in different design:

- complete cabling, including connections for both cooling fans and position switches, at axes 1 and 2. Installation of this complete cabling is detailed in section *Installation of cable harness for position switches and fans on page 135*.
- 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 114*.

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.



xx1400000022

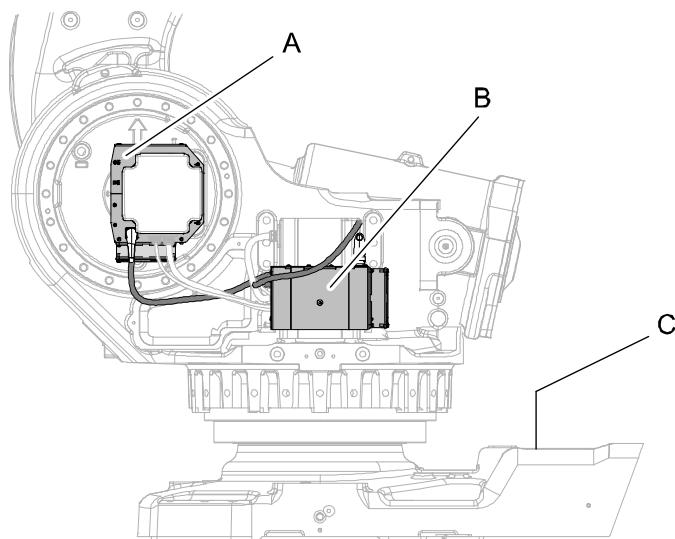
A	Cooling fan, axis 1
B	Cooling fan, axis 2
C	Rear cover plate

Continues on next page

2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

Continued

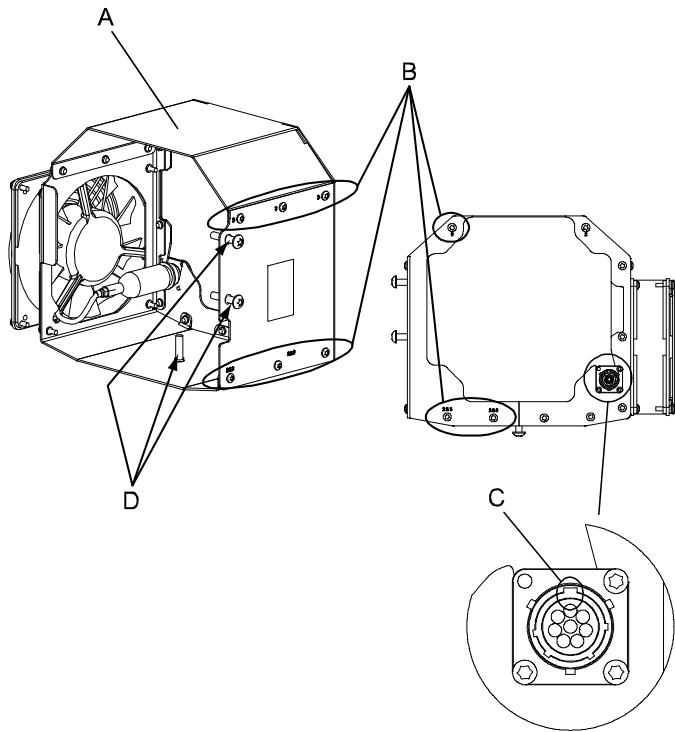


xx0700000671

A	Cooling fan, axis 2
B	Cooling fan, axis 1
C	Rear cover plate

Cooling fan

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



xx0500002158

A	Fanbox
B	Attachment screws, fanbox plates (9 pcs)

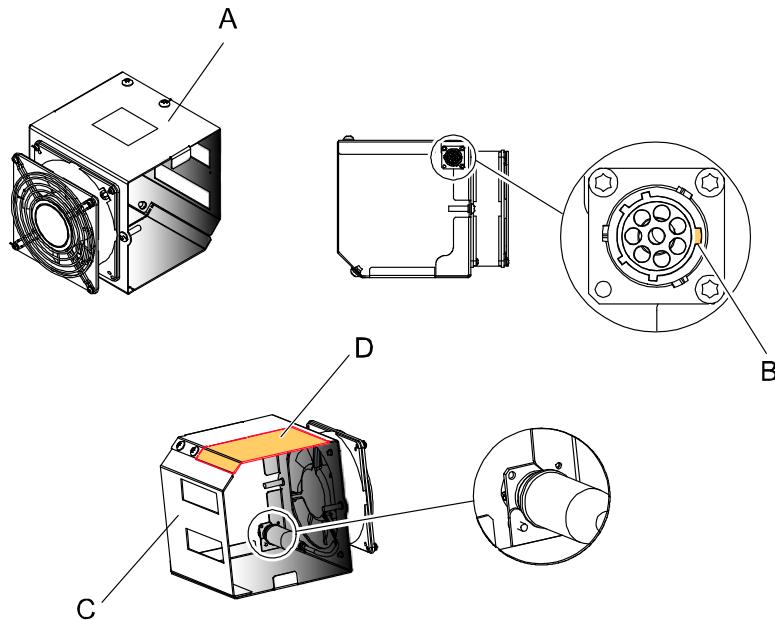
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2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

Continued

C	Groove in the connector
D	Tightening screws, fanbox (3 pcs)



xx0900000137

A	Fanbox
B	Groove in the connector
C	Back plate
D	Part of the fanbox that can be removed, if needed.

Required equipment

Equipment	Art. no.	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 Plate for customer connections, at base on page 112 .
Additional cabling to and inside the controller	-	Specified in section Position switch cables, robot base to controller (option) on page 140 .
Material set fan axes 1 and 2	3HAC023999-001	The set includes: <ul style="list-style-type: none"> • fan axes 1 & 2 cable harness • plate, customer • attachment screws and nuts.
Cable harness inside controller	3HAC025488-001	
Locking liquid	-	Loctite 243. Used for the three tightening screws.

Continues on next page

2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

Continued

Equipment	Art. no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
Circuit diagram	-	See chapter Circuit diagram on page 453 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

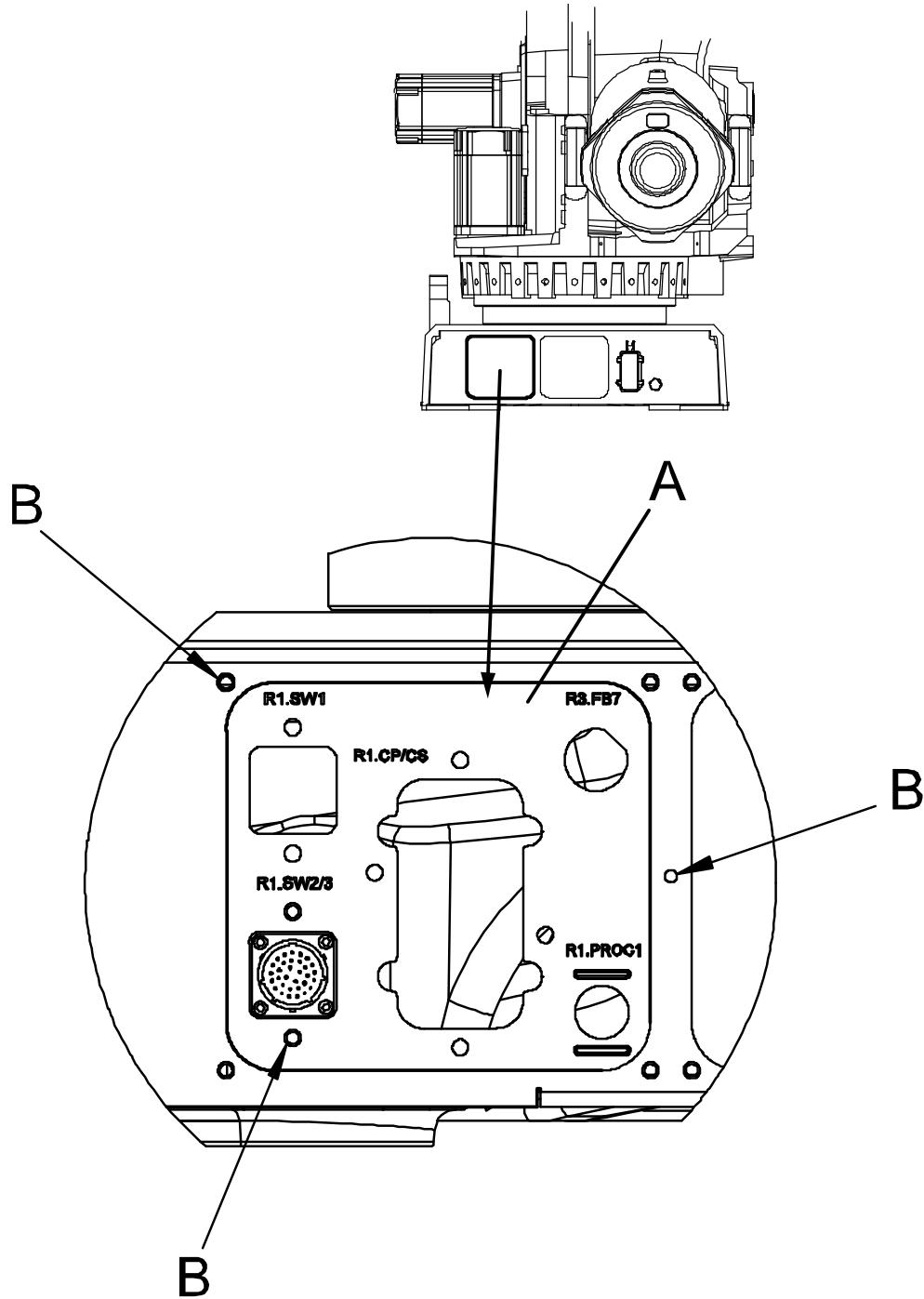
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2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

Continued

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

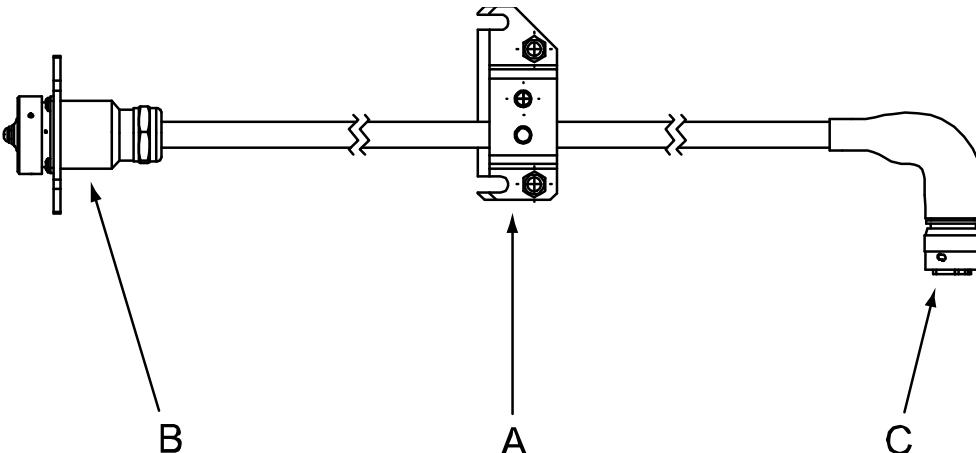
Installation, fan

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

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 Prepare the fanbox for installation: <ul style="list-style-type: none"> • disassemble the two parts of the box by removing the nine <i>attachment screws</i> • loosen the three <i>tightening screws</i>, to avoid damaging the surfaces of the motor when fitting the fanbox • turn the connector to the correct position; axis 1: groove pointing inwards, as shown in the figure Cooling fan on page 109. Positions for axis 2 and 3 are shown in the figure Location of cooling fans on page 108. 	Shown in the figure Cooling fan on page 109 .
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

2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

Continued

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.

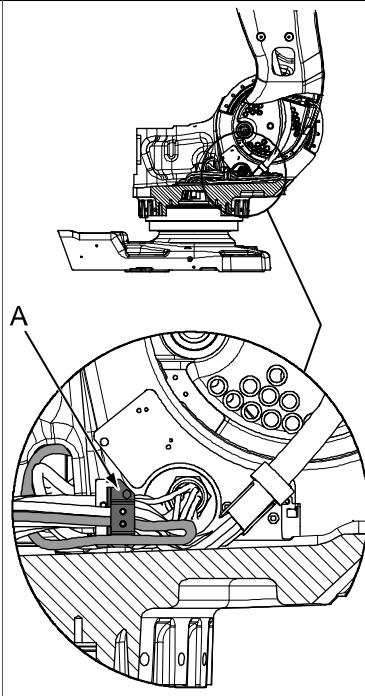
	Action	Note
1	Move the robot to its calibration position.	This is detailed in section Synchronization marks and synchronization position for axes on page 408 .
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3	Remove the <i>rear cover plate</i> from the robot base.	Shown in the figure Location of cooling fans on page 108 .
4	Remove the cable bracket (A)	Shown in the figure Separate cabling for axis 1 or 2 on page 113
5	Fit the <i>plate for customer connections</i> , if not already fitted, to the connection plate of the robot base.	Shown in the figure Plate for customer connections, at base on page 112 . Art. no. is specified in Required equipment on page 110 .
6	Run the cabling up through the base and frame, beneath the balancing device.	

Continues on next page

2 Installation and commissioning

2.5.11 Installation of cooling fan for motors (option)

Continued

Action	Note
7 Secure the <i>cable bracket</i> to the bracket of the robot cabling inside the frame. 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!	 Note <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 Separate cabling for axis 1 or 2 on page 113.</p>
8 Connect the connector R3.FAN2 to the fan of axis 1 or 2.	 Note <p>Fans on both axis 1 and 2 can not be used at the same time!</p>
9 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.	
10 Refit the rear cover plate to the robot base.	
11 Install additional cabling to and inside the controller. Also make adjustments in RobotWare, as described in the following procedure.	Cabling is specified in section Position switch cables, robot base to controller (option) on page 140 .

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 5.0: change the settings in the Modifying options dialogue, by using the Modify Controller System Wizard in the System Builder of RobotStudio. Read more about modifying the system in <i>Operating manual - RobotStudio</i>.</p>

2 Installation and commissioning

2.5.12 Installation of Foundry Plus Cable guard (option no. 908-1)

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 on the DVD delivered with the Cable guard, article number 3HAC035933-001.

2.5.13 Loads fitted to the robot, stopping time and braking distances

2.5.13 Loads fitted to the robot, stopping time and braking distances

General

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



CAUTION

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

References

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

- *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 for the robot.

2 Installation and commissioning

2.5.14 Installation of signal lamp (option)

Signal lamp

See the assembly instruction delivered with the signal lamp.

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) and software (signal from adjustable position switch)
- Axis 2, hardware (mechanical stop) and software (signal from adjustable position switch)
- Axis 3, hardware (mechanical stop) and software (signal from adjustable position switch)

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 a position switch on axis 1.

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

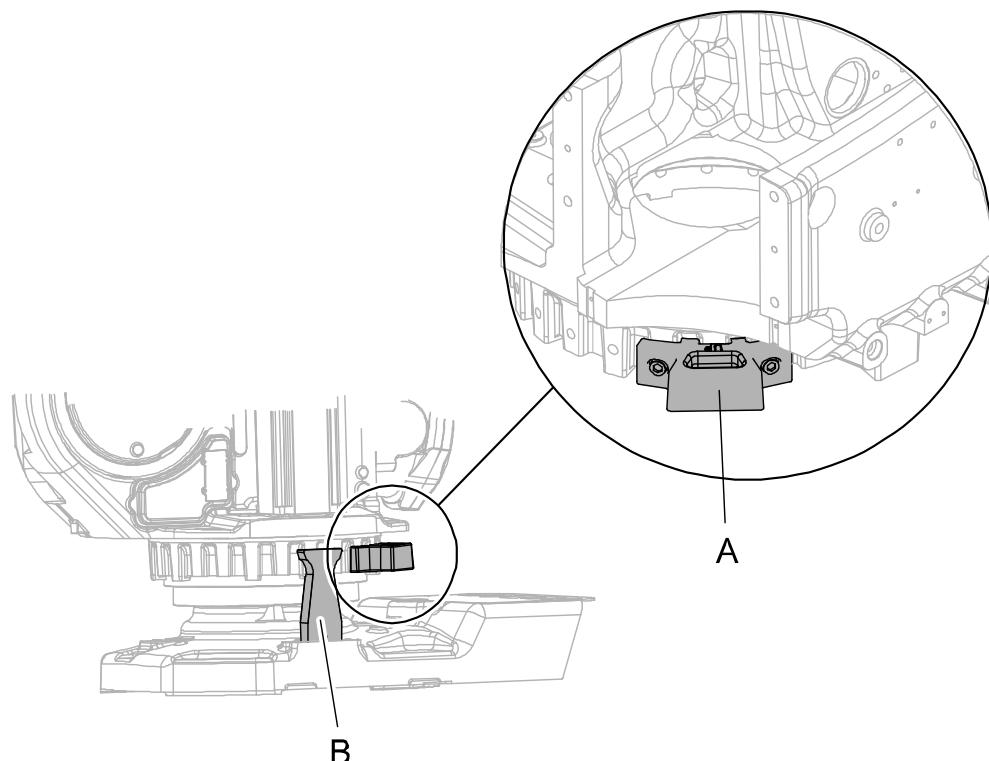
2.6.2 Mechanically restricting the working range of axis 1

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.



xx0300000049

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

2.6.2 Mechanically restricting the working range of axis 1

Continued

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 References on page 10 .

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  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 Fit the additional mechanical stop to the frame according to the figure Mechanical stops, axis 1 on page 120 .	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  WARNING If the mechanical stop pin 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

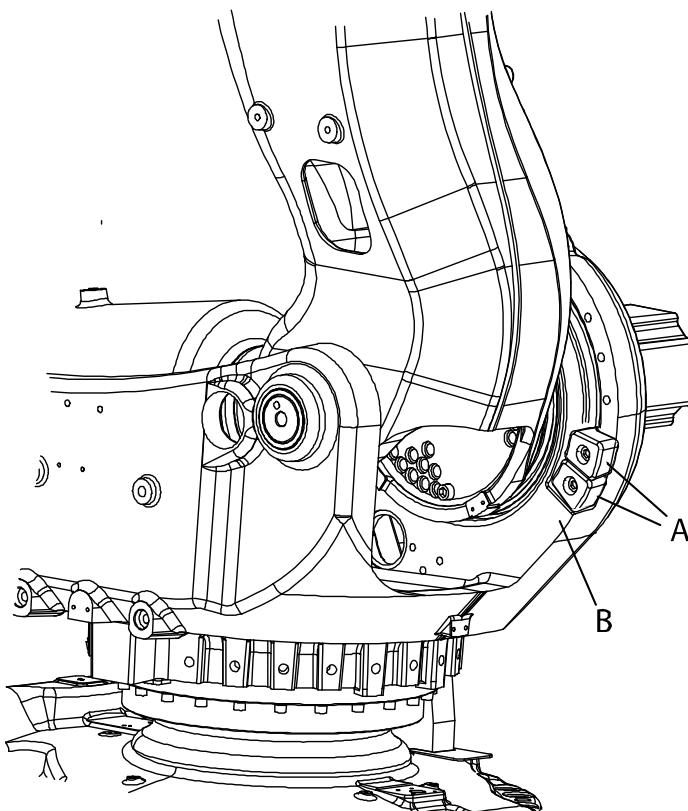
2.6.3 Mechanically restricting the working range of axis 2

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 Standard tools on page 445 .

Continues on next page

2.6.3 Mechanically restricting the working range of axis 2

Continued

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 References on page 10 .

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	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Fit and tighten the additional stops in a row, starting from the fixed stop.	Tightening torque: 115 Nm. Shown in the figure Mechanical stops, axis 2 on page 122 .
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)</i> , chapter <i>System Parameters</i> - topic <i>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	 WARNING 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

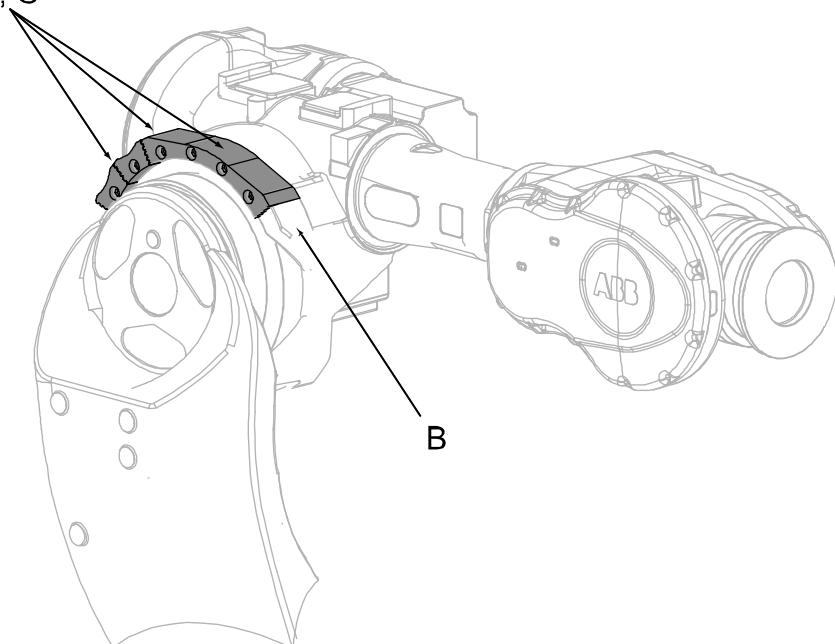
General

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

Mechanical stops, axis 3

The illustration shows the mounting position of the mechanical stops on axis 3.
The figure shows IRB 7600 but the principle is the same.

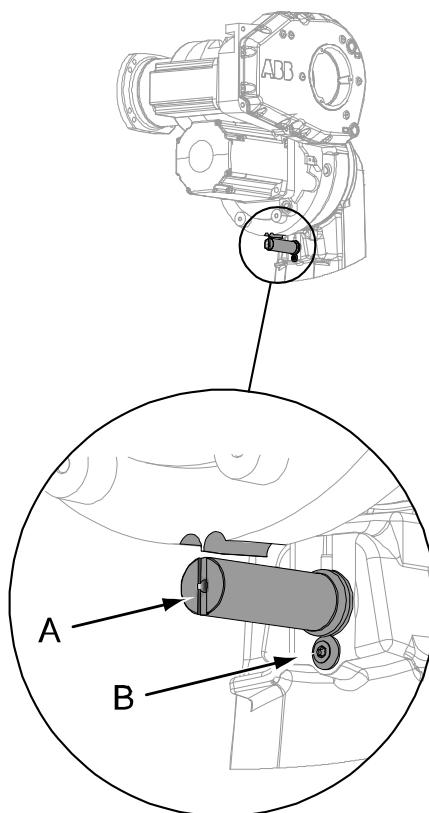
A, C



xx0300000048

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

Continues on next page



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 >=80), and five with 20°, 3HAC 12708-2. Includes attachment screws.
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
<i>User's guide - S4Cplus (Base-Ware OS 4.0) (RobotWare 4.0)</i> <i>Technical reference manual - System parameters</i>	-	Art. no. is specified in section References on page 10 .

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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Fit and tighten the additional stops in a row, starting from the fixed stop.	Tightening torque: 115 Nm. Shown in the figure Mechanical stops, axis 3 on page 124
3  Note 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  WARNING 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.	

2.6.5 Installation of position switches (option)

General

Position switches can be installed on axes 1-3. The position switches include cams as shown in the figures below. The system parameter configuration must also be updated.

The position switch kits may be delivered in one of two ways:

- Fitted by ABB Robotics on delivery. In this case, the cams must still be fitted and locked by the user. For axis 1, the cover for the cams must also be fitted.
- As kits to be completely fitted to the robot and adjusted by the user.

Required equipment

Description	Art. no.	Note
Position switch, axis 1	3HAC15715-1	Includes position switch and plate for customer connections.
Position switch, axis 2	3HAC15715-2	Includes only the position switch.
Position switch, axis 3	3HAC15715-3	Includes only the position switch.
Cabling, position switches and cooling fans, axes 1, 2 and 3	3HAC15390-1	Cabling to be installed on the robot.
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 Plate for customer connections, at base on page 134 .
Additional cabling to and inside the controller	-	Specified in section Robot cabling and connection points on page 139 .
Connector kit R1.SW1	3HAC17252-1	
Connector kit R1.SW2/3	3HAC17253-1	

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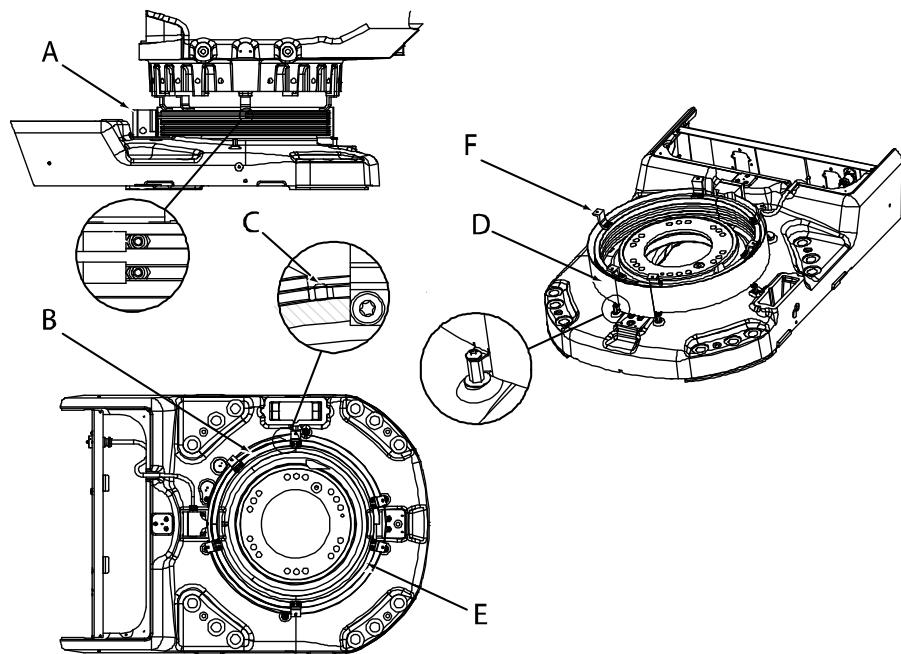
2 Installation and commissioning

2.6.5 Installation of position switches (option)

Continued

Axis 1

The illustration below shows the position switch for axis 1. There is no extra cabling installed on the robot, as for axes 2 and 3. Instead the switch is connected directly to the connector in the base, R1.SW1.

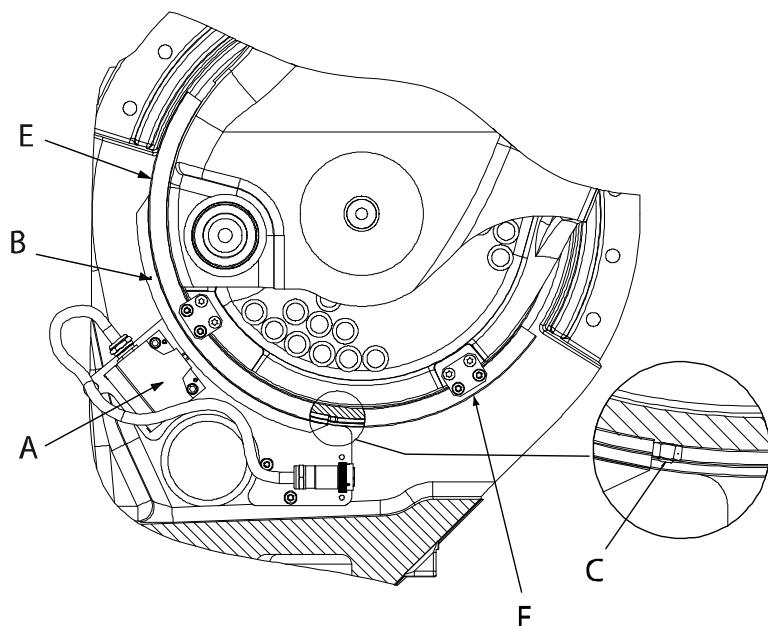


A	Position switch, axis 1
B	Cam
C	Set screw, cam (cam stop)
D	Protection sheet
E	Rail
F	Rail attachment

Continues on next page

Axis 2

The illustration below shows the position switch for axis 2. In addition to the shown components, cabling must also be installed from the switch to the robot base.



xx0100000159

A	Position switch, axis 2
B	Cam
C	Set screw, cam (cam stop)
E	Rail
F	Rail Attachment

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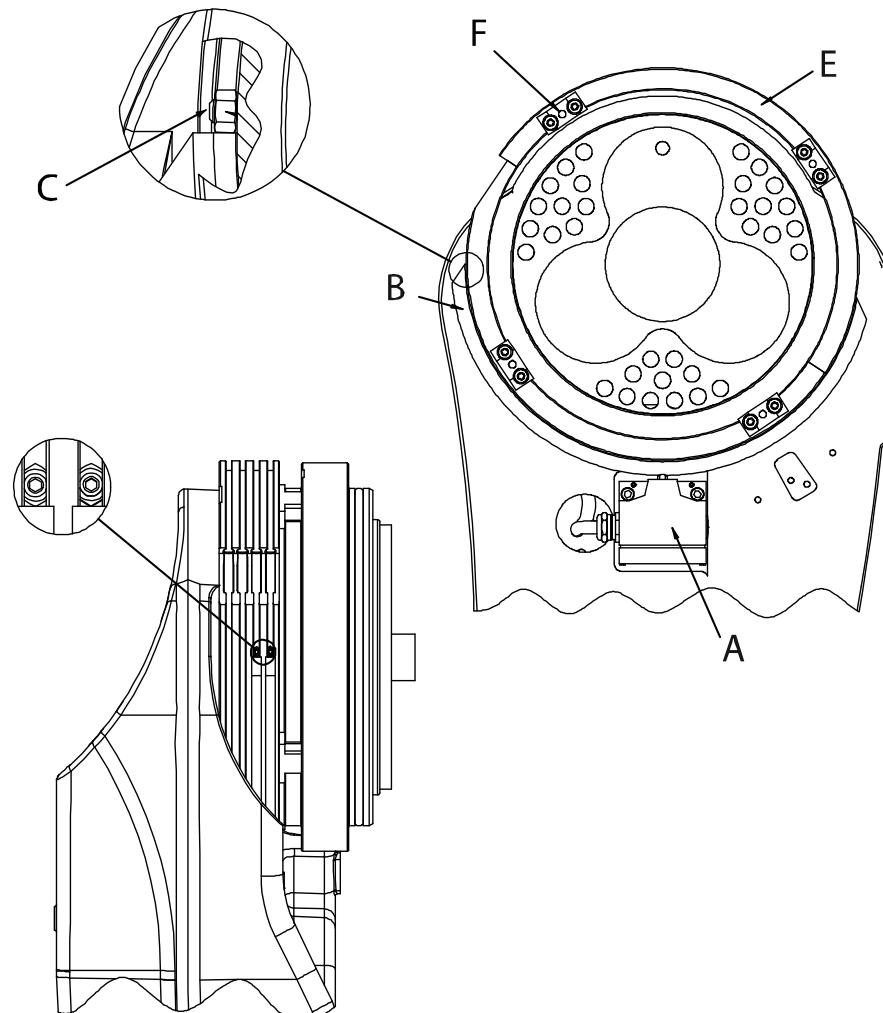
2 Installation and commissioning

2.6.5 Installation of position switches (option)

Continued

Axis 3

The illustration below shows the position switch for axis 3. In addition to the shown components, cabling must also be installed from the switch to the robot base.



xx0100000160

A	Position switch, axis 3
B	Cam
C	Set screw, cam (cam stop)
E	Rail
F	Rail attachment

Specifications

Maximum voltage/current for the position switches:

Parameter	Value
Voltage	Max. 50 VDC
Current	Max. 1 A

Continues on next page

Connections

The position switches are connected to different points on the robot system:

- XT8, screw terminal in the controller cabinet when position switch cables are used.
- R1.SW1 at the robot base. Customer connection kit is recommended, art. no. is specified in [Required equipment on page 127!](#)
- R1.SW2/3 at the robot base. Customer connection kit is recommended, art. no. is specified in [Required equipment on page 127!](#)

Further information about the cables and connection points, see section [Robot cabling and connection points on page 139](#).

Fitting and adjusting cams and stops

The instruction below details how to fit and adjust the parts of the position switches:

	Action	Note
1	Cut the cam to a suitable length.	Use a sharp knife and rubber hammer or similar.
2	Cut the edge of the cam edge to max 30°!	Shown in Illustration, cutting the cam on page 132 . If the angle is larger, this may damage the position switch!
3	Cut the part of the cam running in the profile to 90°! Also see Illustration, cutting the cam on page 132 below!	
4	Make sure the ends of the profile are chamfered to enable the cam to run through the profile.	
5	Fit the cam with the M5 screw and nut. Tighten the M5 screw to secure the cam.	Shown in Illustration, adjust and secure cams on page 132 .
6	Install the cabling for axes 2 and/or 3.	Detailed in section Installation of cable harness for position switches and fans on page 135 .

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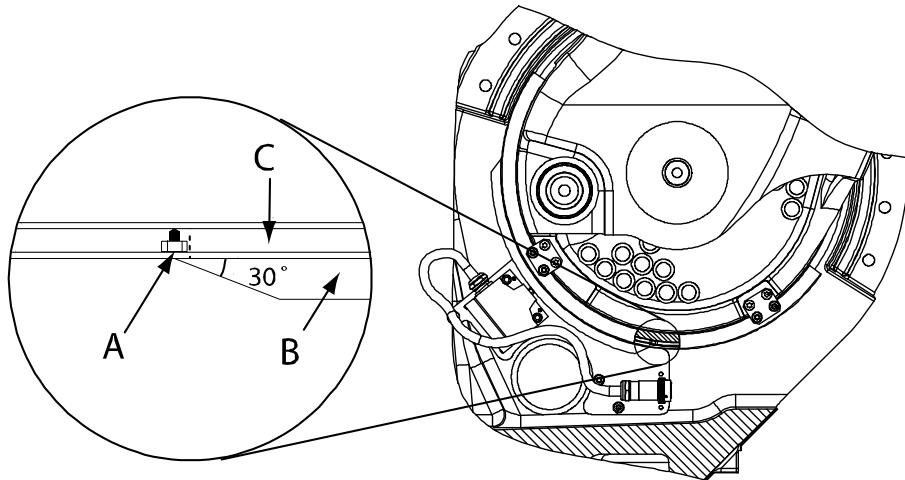
2 Installation and commissioning

2.6.5 Installation of position switches (option)

Continued

Illustration, adjust and secure cams

The illustration below show how to adjust and secure the position switch cams and profiles.

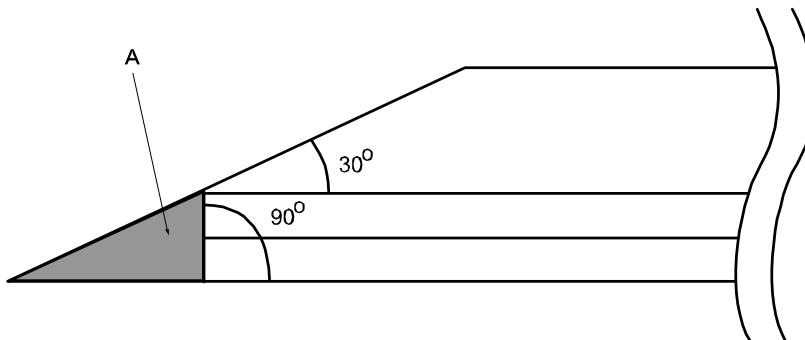


xx0100000113

A	Cam stop, M5 nut and M5 x 6 set screw
B	Adjustable cam
C	Profile

Illustration, cutting the cam

The illustration below show how to cut the position switch cam.

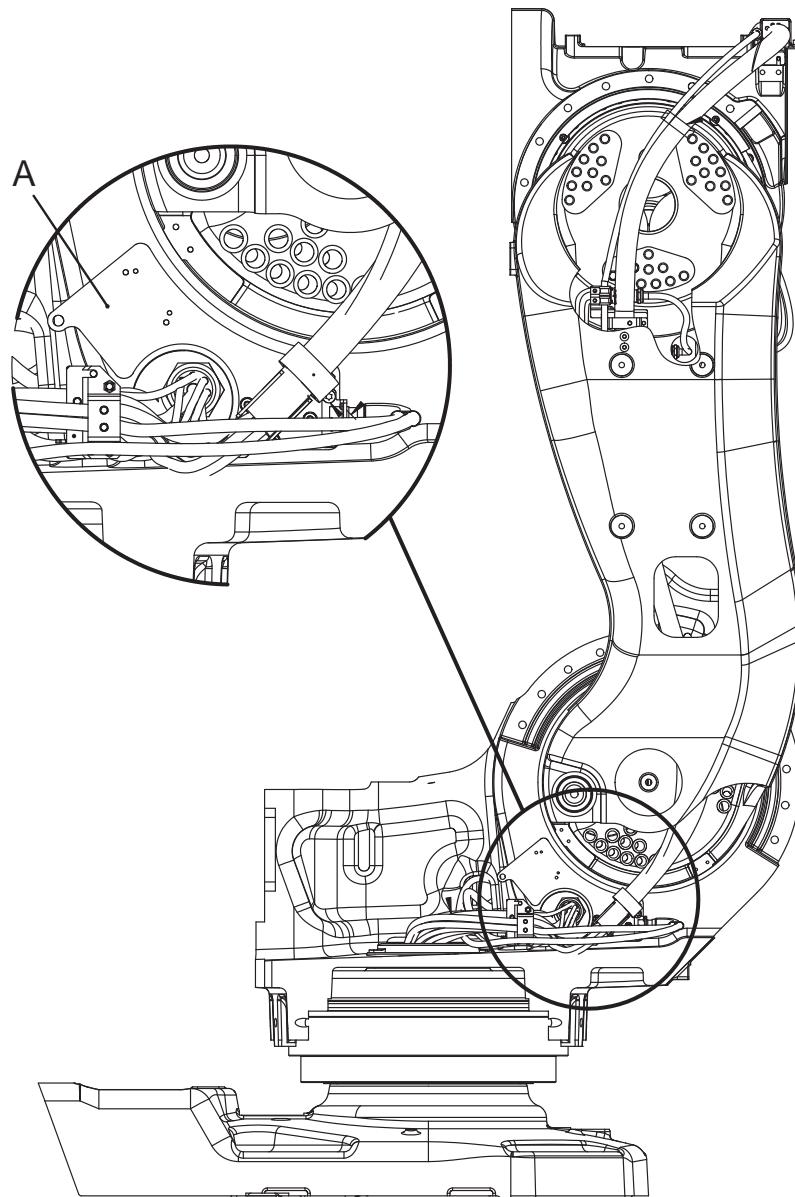


xx0100000114

A	Remove the gray section
---	-------------------------

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Illustration, attachment plate for axis-2 switch



xx1200000523

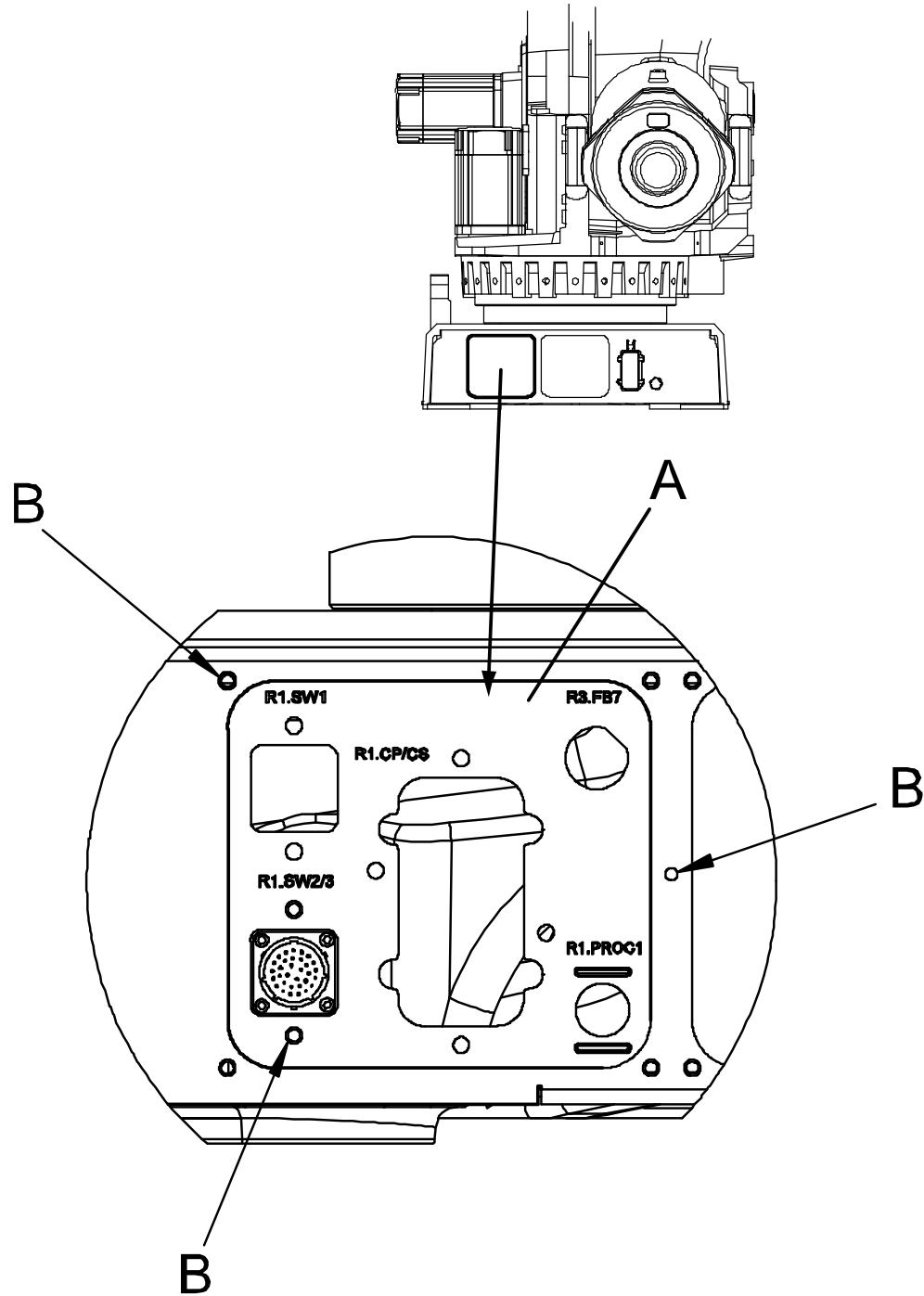
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2 Installation and commissioning

2.6.5 Installation of position switches (option)

Continued

Plate for customer connections, at base

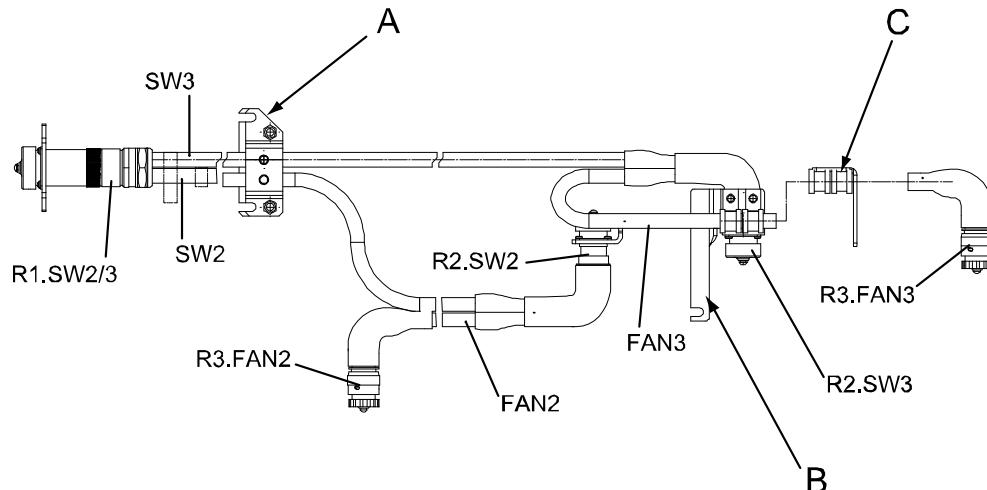


xx0500002301

A	Plate for customer connections
B	Attachment screws, 3 pcs, M6x16

Continues on next page

Cable harness for position switches and fans, axes 1-3



xx0500002305

A	Cable bracket, frame
B	Cable bracket, lower arm
C	Cable bracket, upper arm
R1.SW2/3	Connected to the robot base
R3.FAN2	Connected to the fan of axis 1 or 2
R3.FAN3	Connected to the fan of axis 3
R2.SW2	Connected to the position switch of axis 2
R2.SW3	Connected to the position switch of axis 3

Installation of cable harness for position switches and fans

The procedure below details how to fit the complete cable harness for position switches and cooling fans to the robot.

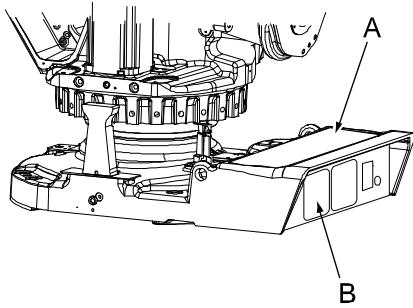
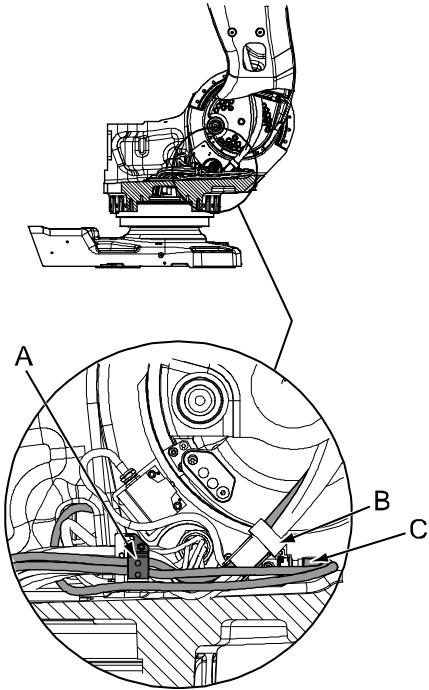
	Action	Note
1	Move the robot to its calibration position.	
2	<p> DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot <p>Before entering the robot working area.</p>	

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2 Installation and commissioning

2.6.5 Installation of position switches (option)

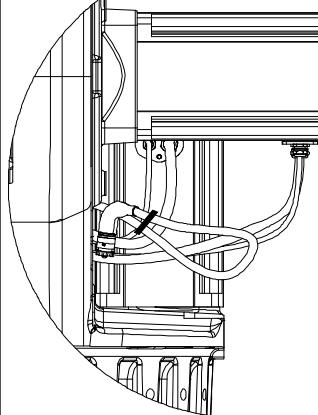
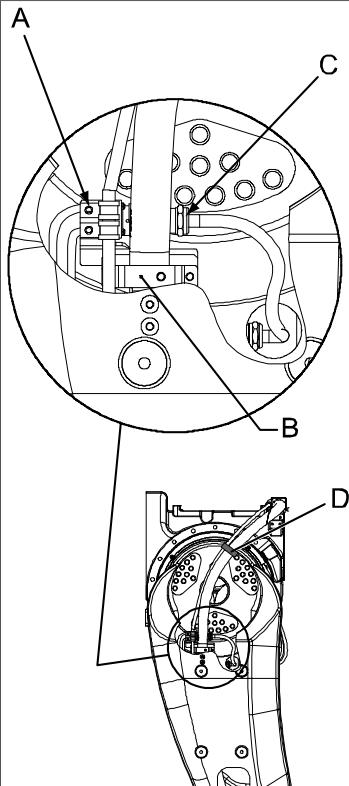
Continued

Action	Note
3 Remove the rear cover (A) from the robot base and replace the protection (B) with a plate for customer connections (if not already mounted).	 <p>xx0500002306</p> <p>Art. no. for the plate is specified in Required equipment on page 127.</p>
4 Run the cabling through the base and frame of the robot, up beneath the balancing device.	
5 Run and secure the cabling inside the frame as detailed below and as shown in the figure to the right: <ul style="list-style-type: none"> • Secure the cable bracket (A) to the bracket of the robot cabling. • Run the cable for the fan of axis 1 or 2 under the robot cabling and through the side of the frame at motor axis 1. • Secure the cabling going up to the axis 3 fan and position switch with existing velcro strap (B), attached around the robot cabling. • Connect the connector R2.SW2 to the position switch of axis 2. 	 <p>xx0500002309</p> <p>Note</p> <p>There is a risk of the balancing device damaging the fan cable if it is not protected by correct routing underneath the robot cabling!</p> <p>A Cable bracket, frame. Also shown in the figure Cable harness for position switches and fans, axes 1-3 on page 135. B Velcro strap C Connector R2.SW2</p>

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2.6.5 Installation of position switches (option)

Continued

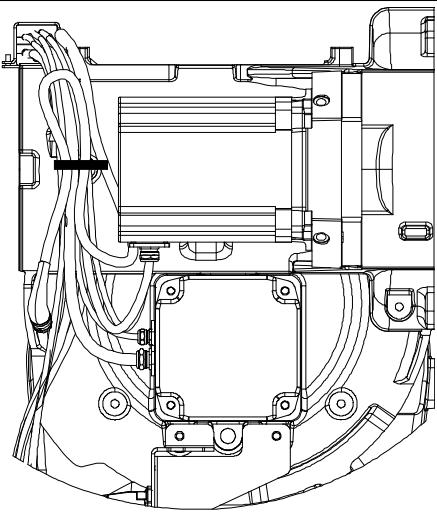
Action	Note
6 Connect the connector R3.FAN2 to the fan of either axis 1 or axis 2. If no fan is used, strap the cabling together with the motor cabling so that the connector stays close to the frame, as shown in the figure to the right.	 xx0500002312
7 Run the remaining cable harness up through the lower arm and: <ul style="list-style-type: none"> secure with the <i>bracket, lower arm</i>, as shown in the figure to the right. connect the connector R2.SW3 to the position switch of axis 3. secure the cable going to the fan of axis 3, together with the robot cabling with a velcro strap. 	 xx0500002313 <p>A Bracket, lower arm. Also shown in the figure Cable harness for position switches and fans, axes 1-3 on page 135. B Bracket for robot cabling C Connector R2.SW3 D Velcro strap</p>
8 Secure the axis 3 fan cable with the <i>bracket, upper arm</i> .	Shown in the figure Cable harness for position switches and fans, axes 1-3 on page 135 .

Continues on next page

2 Installation and commissioning

2.6.5 Installation of position switches (option)

Continued

Action	Note
9 Connect the connector R3.FAN3 to the fan of axis 3. If no fan is used, strap the cable together with the robot cabling.	 xx0500002314
10 Connect the connector R1.SW2/3 to the base of the robot. Make sure that the cabling, run through the base, frame and lower arm, is not twisted and is running free from the robot cabling.	
11 Refit the rear cover to the robot base.	
12 Install additional cabling to and inside the control cabinet.	Cabling is specified in section: <ul style="list-style-type: none">• <i>Position switch cables, robot base to controller (option) on page 140</i>

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.

Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table Robot cables on page 139 .
Position switch cables (option) Also includes fan cables.	Handles supply to and feedback from any position switch on the robot. Also handles supply to and feedback from cooling fans. Specified in the table Position switch cables, robot base to controller (option) on page 140 .
Fan cables (option)	Handles supply to and feedback from any cooling fan on the robot. Specified in the table Fan cables (option) on page 142 .
Customer cables (option)	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. See the product manual for the controller, see document number in References on page 10 .
External axes cables (option)	Handles power supply to and control of the external axes' motors as well as feedback from the servo system. See the Application manual - Additional axes and stand alone controller (M2004) or Application manual - External axes (M2000) , see document number in References on page 10 .

Robot cables

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

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

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2 Installation and commissioning

2.7.1 Robot cabling and connection points

Continued

Robot cable, power

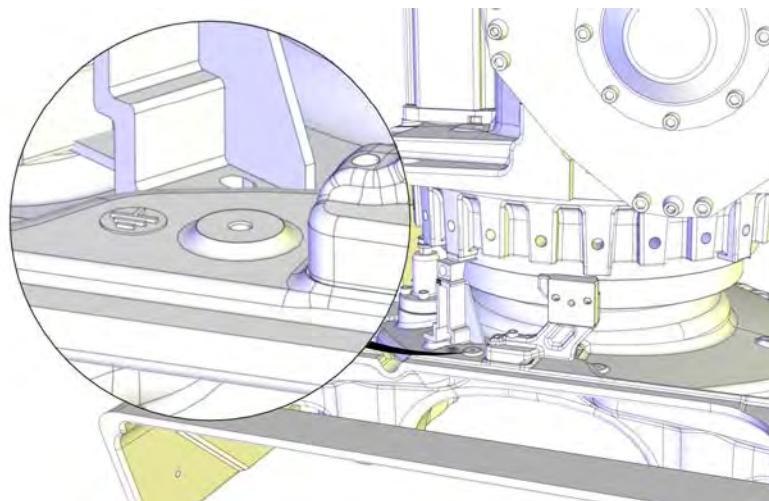
Cable	Art. no.
Robot cable, power: 7 m	3HAC026787-001
Robot cable, power: 15 m	3HAC026787-002
Robot cable, power: 22 m	3HAC026787-003
Robot cable, power: 30 m	3HAC026787-004

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

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

Position switch cables, robot base to controller (option)

These cables are *not* included in the standard delivery, but are included in the delivery if the position switch option is ordered. The position switches can also be ordered without cables. The cables are completely pre-manufactured and ready to plug in.

Continues on next page

2.7.1 Robot cabling and connection points

Continued

Cabling to be installed on the robot is specified in sections and [Installation of position switches \(option\) on page 127](#).

Cabling between robot base and controller

In a M2000 and M2000A robot system, the cables specified below are used for both position switches and cooling fans.

In a M2004 robot system, however, the cables below are only used for position switches. Cabling for the cooling fans is specified in the table [Fan cables \(option\) on page 142](#).

Cable	Art. no.	Connection point, robot	Connection point, cabinet
Position switch cable, axis 1, 7 m	3HAC13175-1	R1.SW	XS8
Position switch cable, axis 1, 15 m	3HAC13175-2	R1.SW	XS8
Position switch cable, axis 1, 22 m	3HAC13175-3	R1.SW	XS8
Position switch cable, axis 1, 30 m	3HAC13175-4	R1.SW	XS8
Position switch cable, axes 2 and 3, 7 m	3HAC13176-1	R1.SW2/3	XS58
Position switch cable, axes 2 and 3, 15 m	3HAC13176-2	R1.SW2/3	XS58
Position switch cable, axes 2 and 3, 22 m	3HAC13176-3	R1.SW2/3	XS58
Position switch cable, axes 2 and 3, 30 m	3HAC13176-4	R1.SW2/3	XS58

Cabling inside control cabinet

Additional cabling must be connected inside the control cabinet when installing position switches.

Additional cabling must also be connected inside the control cabinet when installing fans for robot systems M2000 and M2000A (fan cabling for M2004 runs all the way from the robot base to the inside of the cabinet and the additional cabling specified below is therefor not needed).

Cable	Art. no.	Connection point 1 inside cabinet	Connection point 2 inside cabinet
Bracket in the cabinet wall (M2000 and M2000A)	3HAB7286-5	-	-
Bracket in the cabinet wall (M2004)	3HAC020813-082	-	-
Harness position switch (M2000)	3HAC15899-1	XS58	XP57
Harness position switch (M2000A)	3HAC14617-1	XS58	XP57
Harness position switch axis 1 (M2004)	3HAC021117-001	XS8	XT8.1 and XT8.2
Harness position switch axes 2 and 3 (M2004)	3HAC021116-001	XS58	XT58.1 and XT58.2
Cable harness fans (M2000)	3HAC15666-1	XS57	XT31
Cable harness fans (M2000A)	3HAC17832-1	XS57	XT31:10 XT31:12

Continues on next page

2 Installation and commissioning

2.7.1 Robot cabling and connection points

Continued

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 108*](#).

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
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

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 21](#) before performing any service work!



Note

If the IRB 7600 is connected to power, always make sure that the IRB 7600 is connected to protective earth before starting any maintenance work!

For more information see:

- *Product manual - IRC5*

3 Maintenance

3.2.1 Specification of maintenance intervals

3.2 Maintenance schedule and expected 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 M2000 and M2000A is further described in the section *Service Information System, M2000* on page 228. The SIS used in M2004 is further described in the *Operating manual - Service Information System*.

3.2.2 Maintenance schedule

General

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

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

The inspection intervals *do not* specify the life of each component. Values for these are specified in the section [Expected component life on page 149](#)

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

- [Inspection activities on page 150](#)
- [Changing/replacement activities on page 192](#)
- [Cleaning activities on page 223](#)

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	-	Cleaning the IRB 7600 on page 225
Inspection	Balancing device	Every: • 6 months	Inspecting the balancing device on page 169
Inspection	Robot harness	Every: 12 months ⁱ	Inspecting the cable harness on page 175
Inspection	Information labels	Every: • 12 months	Inspecting the information labels on page 188
Inspection	Dampers	Every: • 12 months	Inspecting the damper on axes 2 to 5 on page 182
Inspection	Mechanical stops	Every: • 12 months	<ul style="list-style-type: none"> • Inspecting the axis-1 mechanical stop pin on page 178 • Inspecting the mechanical stops on axes 1, 2, and 3 on page 180

ⁱ Replace when damage or cracks is detected or life limit is approaching that specified in section [Expected component life on page 149](#).

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. To be sure which oil to use, see *Technical reference manual - Lubrication in gearboxes*.

Maintenance activity	Equipment	Interval	Detailed in section
Changing	Oil in axis-1 gearbox:	Every: <ul style="list-style-type: none">• 12,000 hours	<ul style="list-style-type: none">• Changing oil, axis-1 gearbox on page 194
Changing	Oil in axis-1 gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none">• Changing oil, axis-1 gearbox on page 194
Changing	Oil in axis-2 gearbox:	Every: <ul style="list-style-type: none">• 12,000 hours	<ul style="list-style-type: none">• Changing oil, axis-2 gearbox on page 198
Changing	Oil in axis-2 gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none">• Changing oil, axis-2 gearbox on page 198
Changing	Oil in axis-3 gearbox:	Every: <ul style="list-style-type: none">• 12,000 hours	<ul style="list-style-type: none">• Changing oil, axis-3 gearbox on page 201
Changing	Oil in axis-3 gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none">• Changing oil, axis-3 gearbox on page 201
Changing	Oil in axis-4 primary gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! <ul style="list-style-type: none">• Changing oil, axis-4 gearbox on page 204
Changing	Oil in axis-4 secondary gearbox:	Every: <ul style="list-style-type: none">• 12,000 hours	<ul style="list-style-type: none">• Changing oil, axis-4 gearbox on page 204

Continues on next page

Maintenance activity	Equipment	Interval	Detailed in section
Changing	Oil in axis-4 secondary gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! • Changing oil, axis-4 gearbox on page 204
Changing	Oil in axis-5 primary gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! • Changing oil, axis-5 gearbox on page 208
Changing	Oil in axis-5 secondary gearbox:	Every: • 12,000 hours	• Changing oil, axis-5 gearbox on page 208
Changing	Oil in axis-5 secondary gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! • Changing oil, axis-5 gearbox on page 208
Changing	Oil in axis-6 gearbox:	Every: • 12,000 hours	• Changing oil, axis-6 gearbox on page 212
Changing	Oil in axis-6 gearbox:	First change when DTC ⁱ reads: 6,000 hours Second change when DTC ⁱ reads: 24,000 hours Following changes: Every 24,000 hours	Do not mix with other oils! • Changing oil, axis-6 gearbox on page 212

ⁱ 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	-	Cleaning the IRB 7600 on page 225
Overhaul	Robot	Every: 40,000 hours	Expected component life on page 149
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert ⁱ	Replacing the SMB battery on page 215
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert ⁱⁱ	Replacing the SMB battery on page 215
Lubrication	Balancing device bearings	Every: 12,000 hours ⁱⁱⁱ	

- i 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.
- ii 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.
- iii 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		Inspecting the UL lamp on page 190
Inspection	Mechanical stop axes 1-2-3	Every: 12 months	Mechanical stops in addition to the fixed stops	Inspecting the mechanical stops on axes 1, 2, and 3 on page 180
Inspection	Position switches, axes 1-2-3	Every: 12 months		Inspecting the position switch on axes 1, 2, and 3 on page 184
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 ⁱ	40,000 hours ⁱⁱ	Not including: • Possible SpotPack harnesses • Optional upper arm harnesses
Cable harness Extreme usage ⁱⁱⁱ	20,000 hours ⁱⁱ	Not including: • Possible SpotPack harnesses • Optional upper arm harnesses
Balancing device	40,000 hours ^{iv}	
Gearboxes ^v	40,000 hours	

- ⁱ Examples of "normal usage" in regard to movement: most material handling applications and limited use of bending backwards mode of axis 3.
- ⁱⁱ Severe chemical or thermal environments, or similar environments, can result in shortened life expectancy.
- ⁱⁱⁱ Examples of "extreme usage" in regard to movement: press tending, very severe palletizing applications, major use of axis 1 movement and major use of bending backwards of axis 3.
- ^{iv} 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!
- ^v 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 228](#).

3 Maintenance

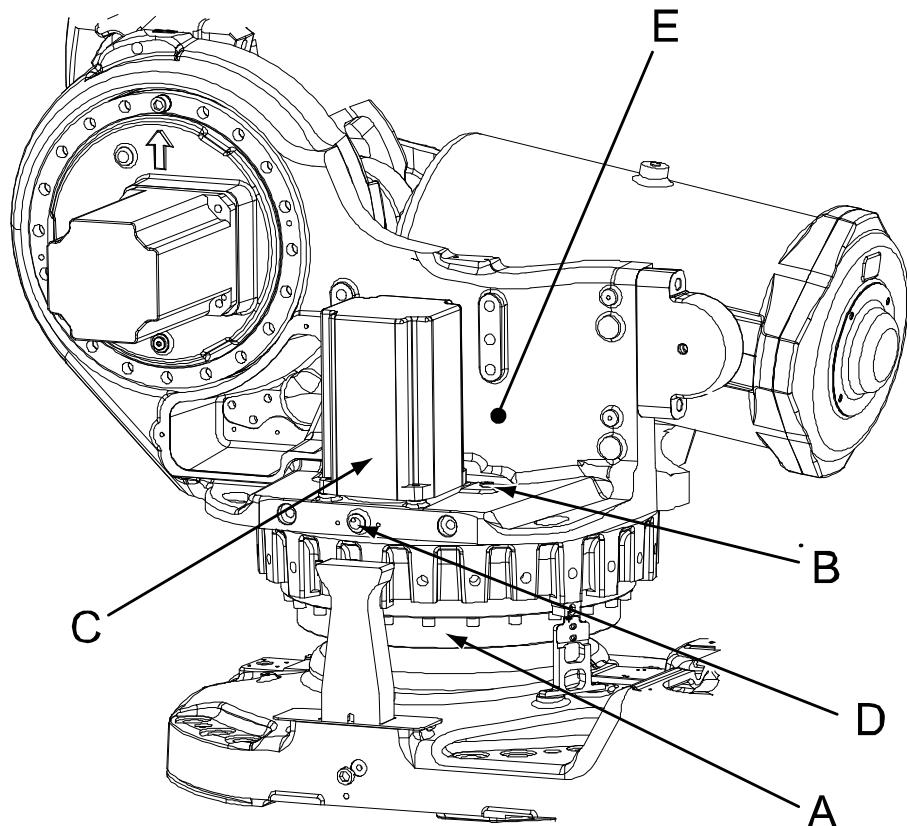
3.3.1 Inspecting the oil level in axis-1 gearbox

3.3 Inspection activities

3.3.1 Inspecting the oil level in axis-1 gearbox

Location of gearbox

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



xx0200000111

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 Type and amount of oil in gearboxes on page 192 .	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .

Continues on next page

3.3.1 Inspecting the oil level in axis-1 gearbox

Continued

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

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 150](#)) is not available.

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
4	Remove the motor, axis 1.	Detailed in section Removal, motor axis 1 on page 324 .
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 Type and amount of oil in gearboxes on page 192 . Filling and draining detailed in Changing oil, axis-1 gearbox on page 194 .
7	Refit the motor, axis 1.	Detailed in section Refitting, motor axis 1 on page 325 .
8	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in Technical reference manual - Lubrication in gearboxes .	

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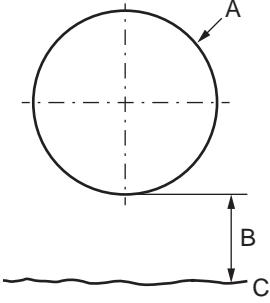
3 Maintenance

3.3.1 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 150](#)) is available.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3 Make sure that the oil temperature is +25°C ±10°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 Location of gearbox on page 150 .
5 Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
6 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Detailed in section Changing oil, axis-1 gearbox on page 194 .
7 Refit the oil plug, inspection.	Tightening torque: 24 Nm.

Continues on next page

3.3.1 Inspecting the oil level in axis-1 gearbox

Continued

Action	Note
8  WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	

3 Maintenance

3.3.2 Inspecting the oil level in axis-2 gearbox

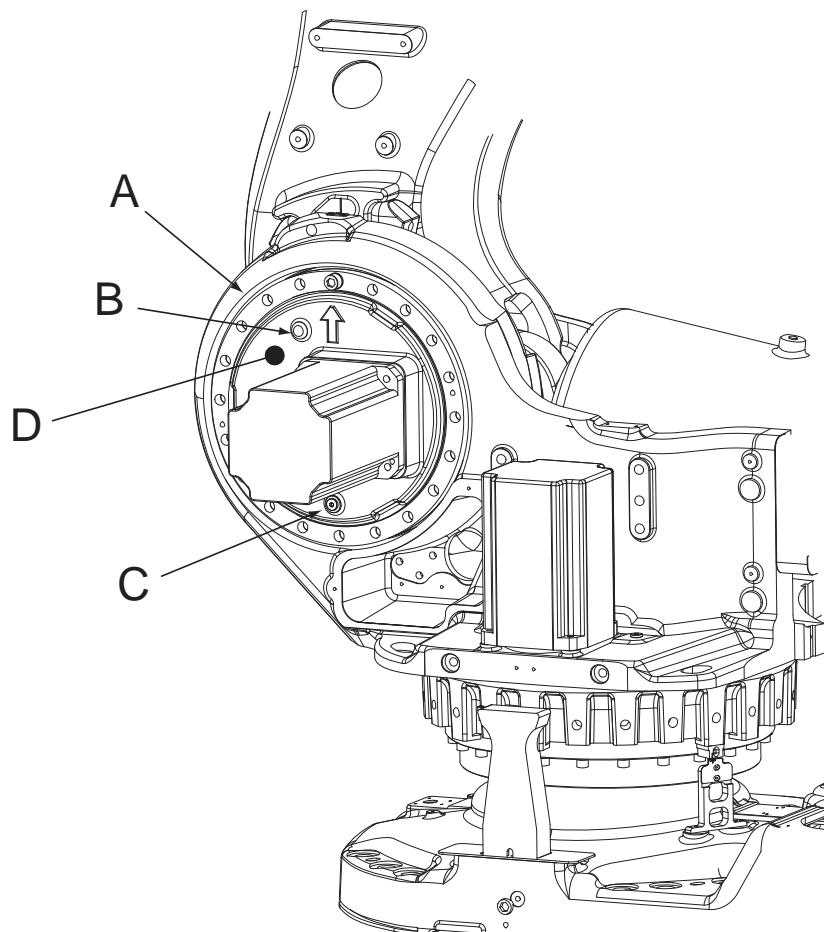
3.3.2 Inspecting the oil level in axis-2 gearbox

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.



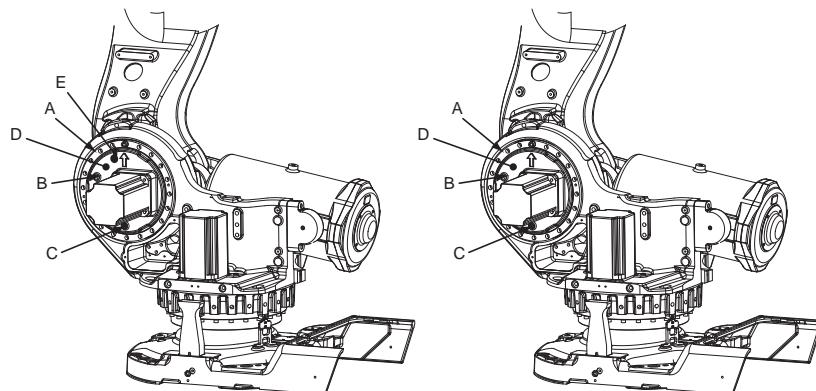
xx0300000068

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

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.



xx0200000112

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 Type and amount of oil in gearboxes on page 192 .	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Inspecting the oil level in axis-2 gearbox

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

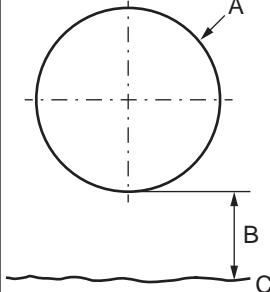
	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	

Continues on next page

3 Maintenance

3.3.2 Inspecting the oil level in axis-2 gearbox

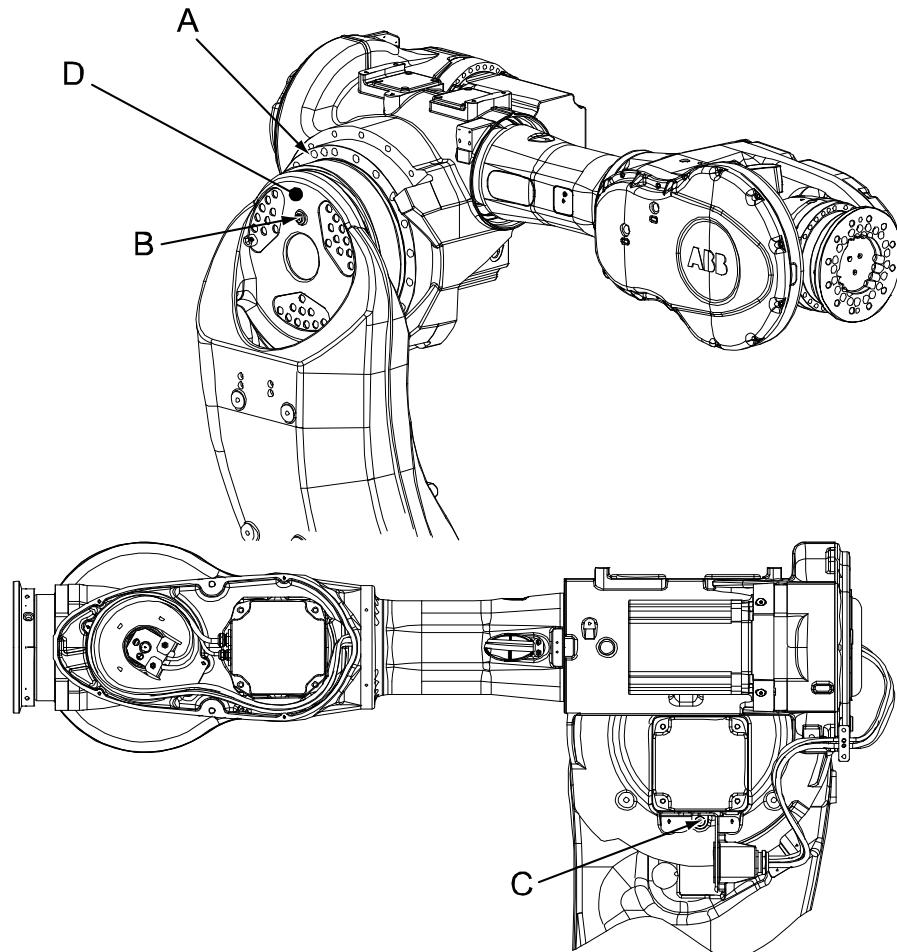
Continued

Action	Note
<p>2</p> <p> DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply <p>to the robot, before entering the robot working area.</p>	
3	Make sure that the oil temperature is +25°C ±10°C. This is a precaution to reduce the temperature dependency of the measurement.
4	Open the <i>oil plug, filling/inspection</i> (two different designs). Read more about the differences in Changing oil, axis-2 gearbox on page 198!
5	<p>Measure the oil level. Required oil level, early design: 30-45 mm 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 Oil plug, early design on page 154 or Oil plug, later design on page 155!</p>
6	Adjust the oil level, if required. Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Detailed in section Filling, oil on page 199 .
7	Refit the oil plug, filling. Tightening torque: 24 Nm.
8	<p> WARNING</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>

3.3.3 Inspecting the oil level in axis-3 gearbox

Location of gearbox

The axis-3 gearbox is located in the upper arm rotational center as shown in the 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 Type and amount of oil in gearboxes on page 192 .	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .

Continues on next page

3 Maintenance

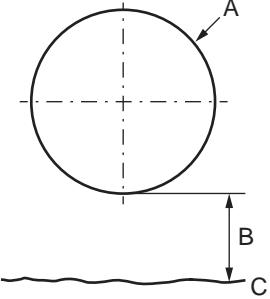
3.3.3 Inspecting the oil level in axis-3 gearbox

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-3 gearbox

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

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	Move the robot to the calibration position.	Detailed in section Synchronization marks and synchronization position for axes on page 408 .
3	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the <i>oil plug, filling/inspection</i> .	Shown in the figure Location of gearbox on page 157 !
6	Measure the oil level. Required oil level: 0-20 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil

Continues on next page

3.3.3 Inspecting the oil level in axis-3 gearbox

Continued

	Action	Note
7	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in <i>Type and amount of oil in gearboxes on page 192</i> . Detailed in section <i>Changing oil, axis-3 gearbox on page 201</i> .
8	Refit the oil plug.	Tightening torque: 24 Nm.
9	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	

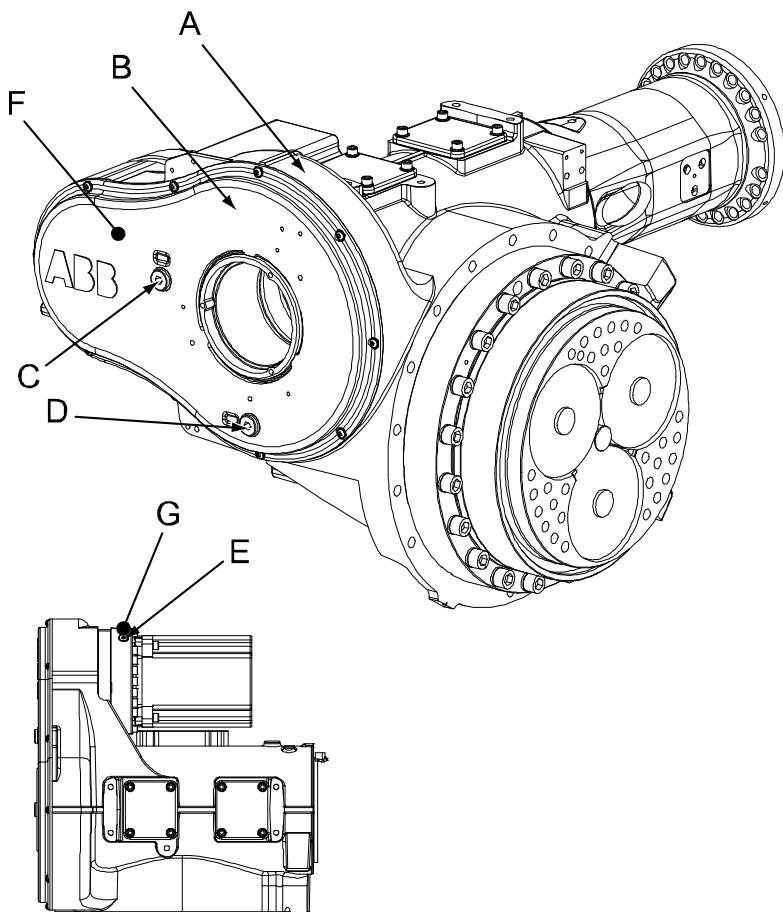
3 Maintenance

3.3.4 Inspecting the oil level in axis-4 gearbox

3.3.4 Inspecting the oil level in axis-4 gearbox

Location of gearbox

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



xx0200000107

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 Type and amount of oil in gearboxes on page 192 .	

Continues on next page

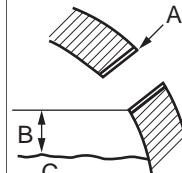
3.3.4 Inspecting the oil level in axis-4 gearbox

Continued

Equipment, etc.	Art. no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
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.

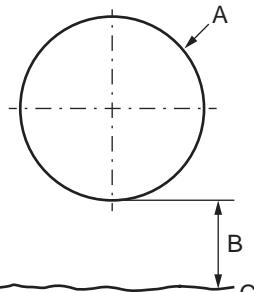
	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	Move the robot to the calibration position.	This is detailed in section Synchronization marks and synchronization position for axes on page 408 .
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the oil plug, filling/inspection, in the primary gearbox.	Shown in the figure Location of gearbox on page 160 !
6	Measure the oil level. Required oil level: 30-40 mm	 xx1400002859 A Oil plug hole B Required oil level C Gearbox oil

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3 Maintenance

3.3.4 Inspecting the oil level in axis-4 gearbox

Continued

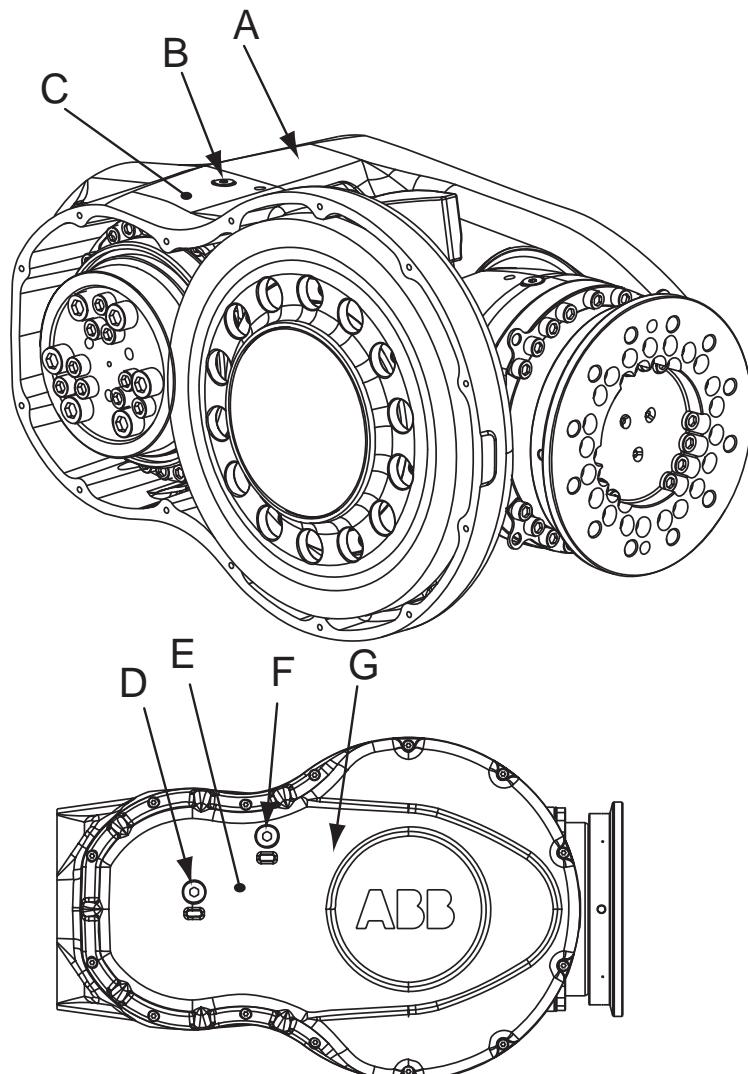
	Action	Note
7	Add oil if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Detailed in section Changing oil, axis-4 gearbox on page 204 .
8	Open the oil plug, filling/inspection, in the secondary gearbox.	Shown in the figure Location of gearbox on page 160 !
9	Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
10	Add oil if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Detailed in section Changing oil, axis-4 gearbox on page 204 .
11	Refit the oil plugs.	Tightening torque: 24 Nm.
12	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in Technical reference manual - Lubrication in gearboxes .	

3.3.5 Inspecting the oil level in axis-5 gearbox

3.3.5 Inspecting the oil level in axis-5 gearbox

Location of gearbox

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



xx0200000108

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

3 Maintenance

3.3.5 Inspecting the oil level in axis-5 gearbox

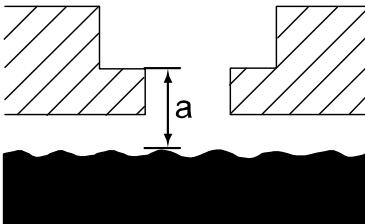
Continued

Required equipment

Equipment etc.	Art. no.	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 192 .	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
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

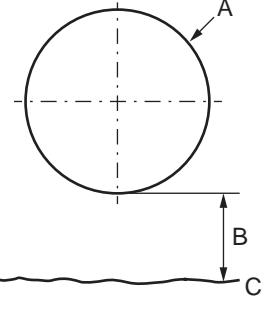
Use this procedure to inspect the oil level in the axis-5 gearbox.

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	Run the robot to the calibration position.	This is detailed in section Synchronization marks and synchronization position for axes on page 408 .
3	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the <i>oil plug, filling/inspection</i> , in the primary gearbox.	Shown in the figure Location of gearbox on page 163 .
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

3.3.5 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 Type and amount of oil in gearboxes on page 192 . Detailed in section Changing oil, axis-5 gearbox on page 208 .
8	Open the <i>oil plug, draining/inspection</i> , in the secondary gearbox.	Shown in the figure Location of gearbox on page 163 .
9	Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 <ul style="list-style-type: none"> A Oil plug hole B Required oil level C Gearbox oil
10	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Detailed in section Changing oil, axis-5 gearbox on page 208 .
11	Refit the oil plugs.	Tightening torque: 24 Nm.
12	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	

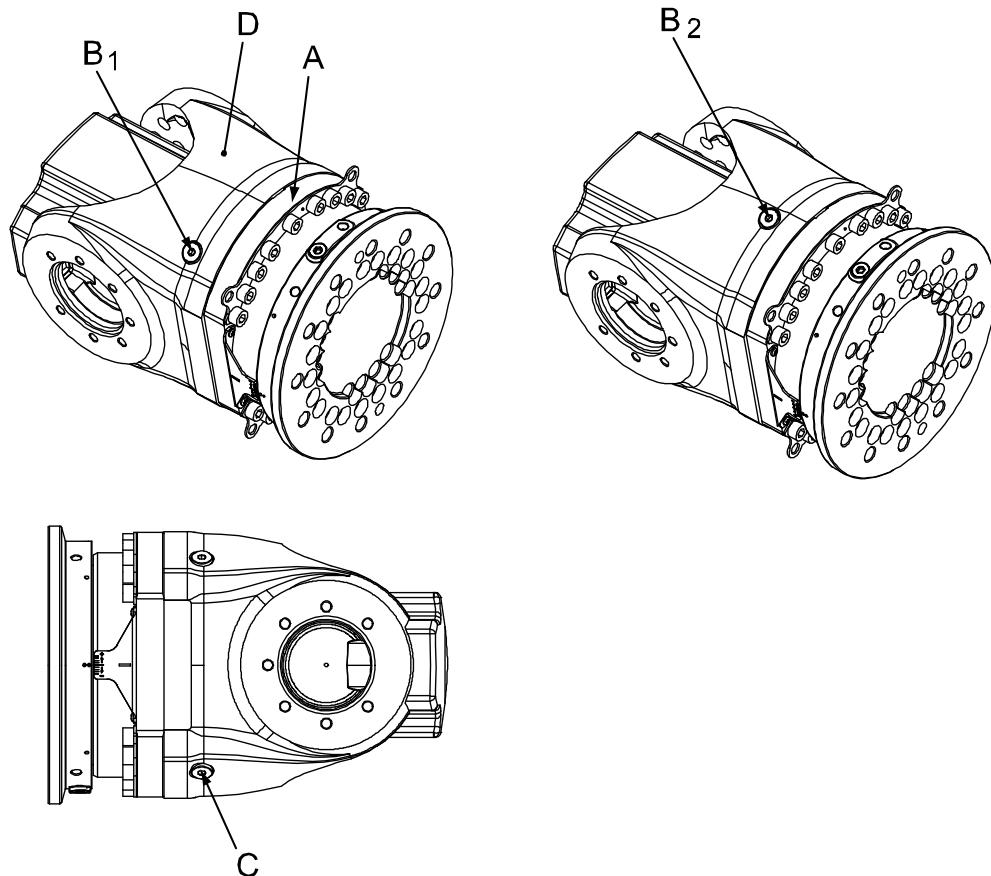
3 Maintenance

3.3.6 Inspecting the oil level in axis-6 gearbox

3.3.6 Inspecting the oil level in axis-6 gearbox

Location of gearbox

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



xx0200000114

A	Gearbox, axis 6
B	Oil plug, filling/inspection (notice the different locations of the plug, shown as B ₁ and B ₂)
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 Type and amount of oil in gearboxes on page 192 .	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .

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-6 gearbox

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

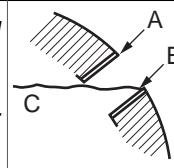
	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	Move axes 3 and 5 to a horizontal position, and make sure that the <i>oil plug, filling and inspection</i> (B1 or B2) is facing upwards.	Shown in the figure Location of gearbox on page 166 .
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Make sure that the oil temperature is $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$.	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> .	 Note This is a precaution to avoid vacuum effects by allowing air to enter at the top of the gearbox. 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 <i>oil plug, filling and inspection</i> always faces upwards. Turn axis 4 until the axis-4 angle reads: <ul style="list-style-type: none"> • -36° to -39° for oil plug position B1 • -80° to -83° for oil plug position B2 	

Continues on next page

3 Maintenance

3.3.6 Inspecting the oil level in axis-6 gearbox

Continued

Action	Note
8 Inspect the oil level in the hole for the <i>oil plug, filling and inspection</i> . The oil should reach all the way up to the external edge of the thread for the <i>oil plug, filling and inspection</i> .	 Note 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.  xx1400002786 A Oil plug hole B Required oil level C Gearbox oil
9 Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Detailed in section Changing oil, axis-6 gearbox on page 212 .
10 Refit the oil plugs.	Tightening torque: 24 Nm.
11  WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in Technical reference manual - Lubrication in gearboxes .	

3.3.7 Inspecting the balancing device

General

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

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

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 170*.

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

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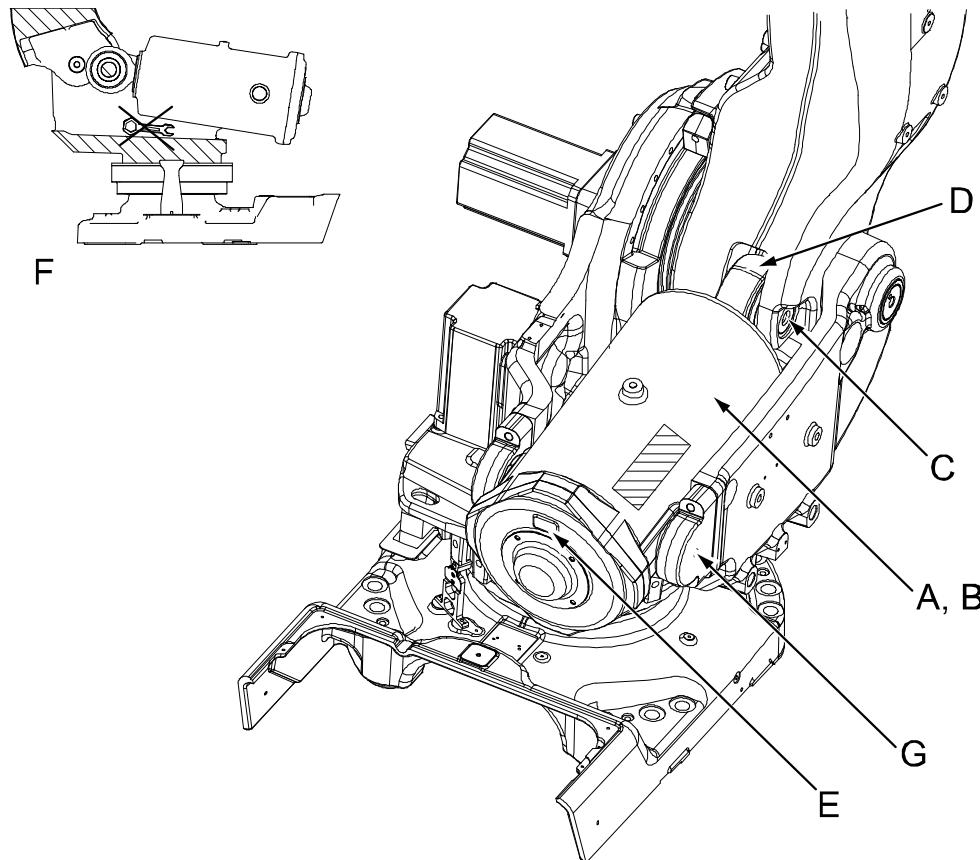
3 Maintenance

3.3.7 Inspecting the balancing device

Continued

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.



xx0300000580

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 169](#) 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">• kit with bearings, o-rings and seals only• instructions for maintenance.

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
			Includes • kit with piston rod, support shaft etc.
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 Standard tools on page 445 .
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 170](#).

	Check for dissonance from...	If dissonance is detected...
1	<ul style="list-style-type: none"> • bearing at the link ear • bearings at the balancing devices attachments. 	... 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 Replacement of spherical roller bearing, balancing device on page 302 . Art. no. for the kit and the documentation are specified in section Required equipment on page 170 . To decide whether to perform maintenance or upgrade, see section Action at detected faults on page 169 .
2	<ul style="list-style-type: none"> • balancing device (a tapping sound, caused by the springs inside the cylinder). 	... replace the balancing device or consult ABB Robotics. How to replace the device is detailed in section Replacing the balancing device on page 307 . This section also specifies the spare part number!
3	<ul style="list-style-type: none"> • piston rod (squeaking may indicate worn plain bearings, internal contamination or insufficient lubrication). 	... perform maintenance or upgrade according to given instructions in Maintenance kit, complete / Upgrade kit. Art. no. for the kit and the documentation are specified in section Required equipment on page 170 . To decide whether to perform maintenance or upgrade, see section Action at detected faults on page 169 .

Continues on next page

3 Maintenance

3.3.7 Inspecting the balancing device

Continued

Check for damage

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

The check points are shown in the figure [Inspection points, balancing device on page 170](#).

	Check for damage on...	If damage is detected...
1	<ul style="list-style-type: none">the piston rod (part of the piston rod that is visible at the front of the balancing device).	<p>... perform maintenance or upgrade according to given instructions in Maintenance kit, complete / Upgrade kit. Art. no. for the kit and the documentation are specified in section Required equipment on page 170. To decide whether to perform maintenance or upgrade, see section Action at detected faults on page 169.</p>
2	<ul style="list-style-type: none">the securing screw in the front ear shaft. <p>Also check the tightening torque (50 Nm).</p>	<p>...replace. Dimension is specified in section Required equipment on page 170.</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.

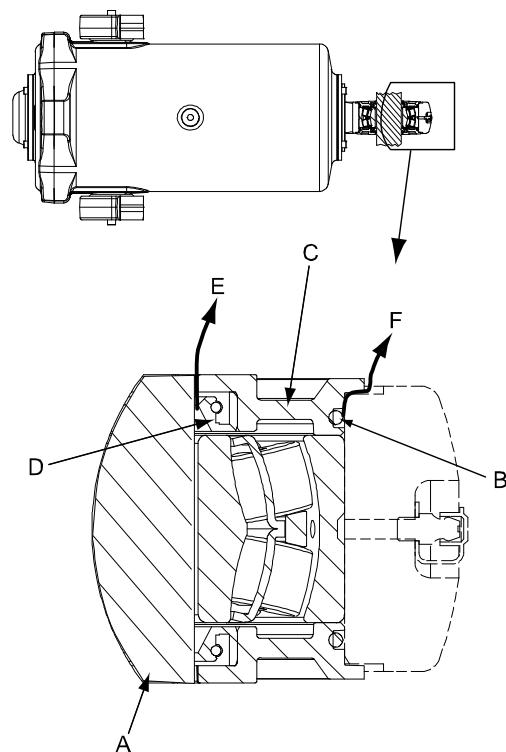
Leaks at the o-rings and/or sealings, are not acceptable and must be attended to immediately in order to avoid any damage to the bearing!

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3.3.7 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 Required equipment on page 170.</p> <p>The replacement of the complete bearing is also detailed in section Replacement of spherical roller bearing, balancing device on page 302.</p> <p>Incorrect leakage is shown in the previous figure.</p>

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3 Maintenance

3.3.7 Inspecting the balancing device

Continued

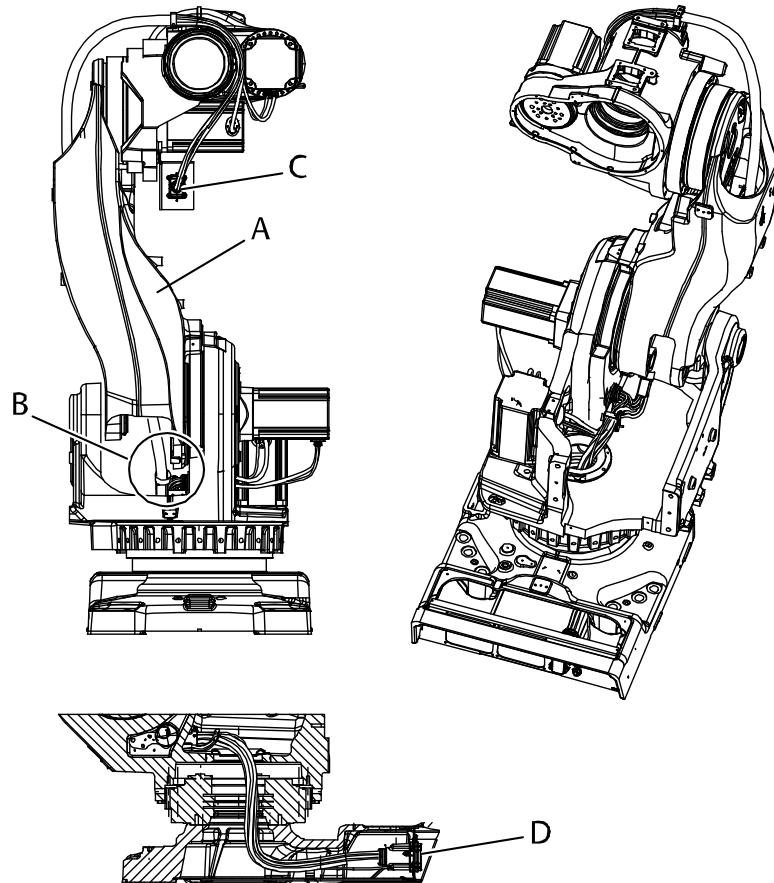
Check for contamination / lack of free space

Action
<p>1</p> <p> DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot <p>Before entering the robot working area.</p>
<p>2</p> <p>Check that there are no obstacles inside the frame, that could prevent the balancing device from moving freely. See the figure <i>Inspection points, balancing device on page 170</i>.</p> <p>Keep the areas around the balancing device clean and free from objects, such as service tools.</p>

3.3.8 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.



xx0200000097

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 Standard tools on page 445 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram		See chapter Circuit diagram on page 453 .

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3 Maintenance

3.3.8 Inspecting the cable harness

Continued

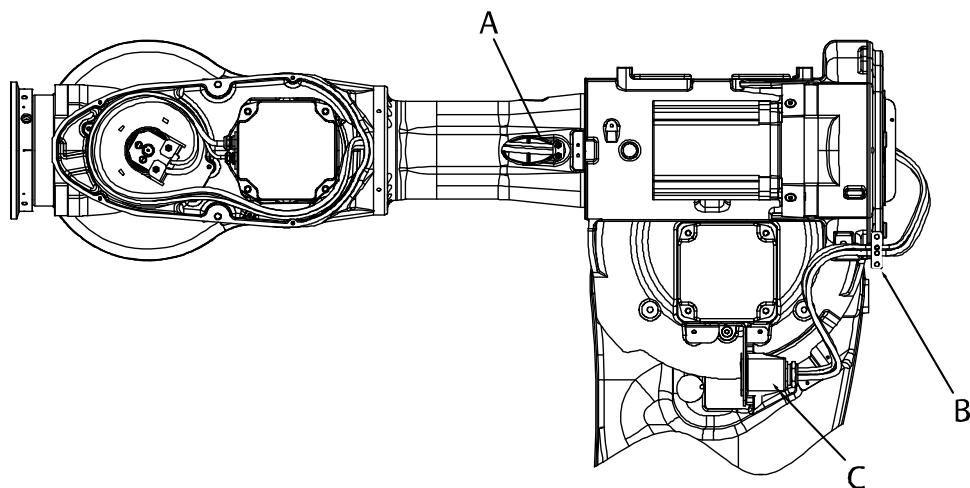
Inspection, cable harness 1-4

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

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Make 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 Location of cable harness, axes 1-4 on page 175 .
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 Location of cable harness, axes 1-4 on page 175 . 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 Replacement of cable harness, axes 1-4 on page 243 .

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

Inspection, cable harness, axes 5-6

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

Action	Note
<p>1</p>  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
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.
4	Replace the cable harness if wear, cracks or damage is detected.

Shown in the figure [Location of cabling axes 5-6 on page 176](#).

Described in section [Replacement of cable harness, axes 5-6 on page 252](#)

3 Maintenance

3.3.9 Inspecting the axis-1 mechanical stop pin

3.3.9 Inspecting the axis-1 mechanical stop pin



WARNING

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

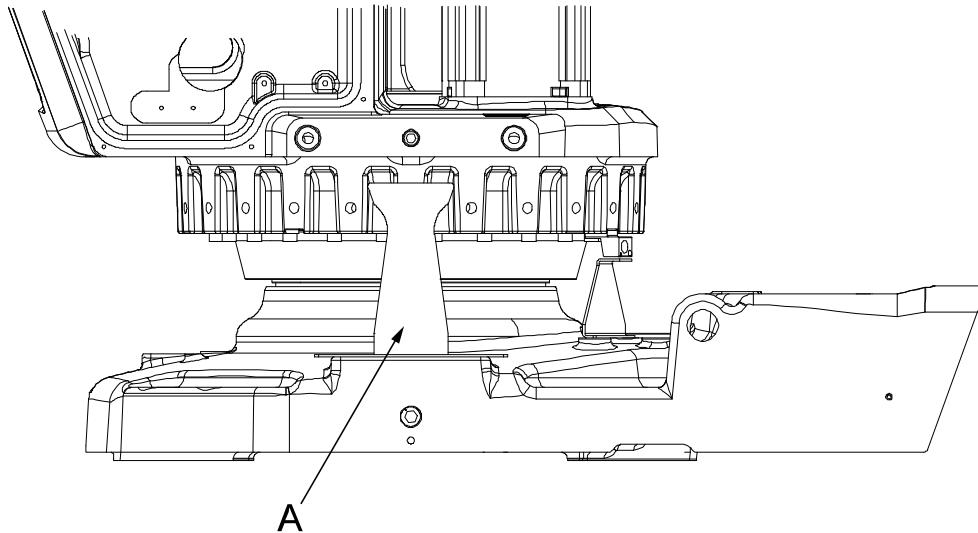


WARNING

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

Location of mechanical stop pin

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



xx0200000151

A

Mechanical stop pin

Required equipment

Visual inspection, no tools are required.

Continues on next page

Inspecting, mechanical stop pin

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

Action	Note
<p>1</p>  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
<p>2</p> Inspect the axis-1 mechanical stop pin. If the mechanical stop pin is bent or damaged, it must be replaced! <p> Note</p> <p>The expected life of gearboxes can be reduced as a result of collisions with the mechanical stop.</p>	Shown in figure Location of mechanical stop pin on page 178 .
<p>3</p> Make sure the mechanical stop pin can move in both directions.	

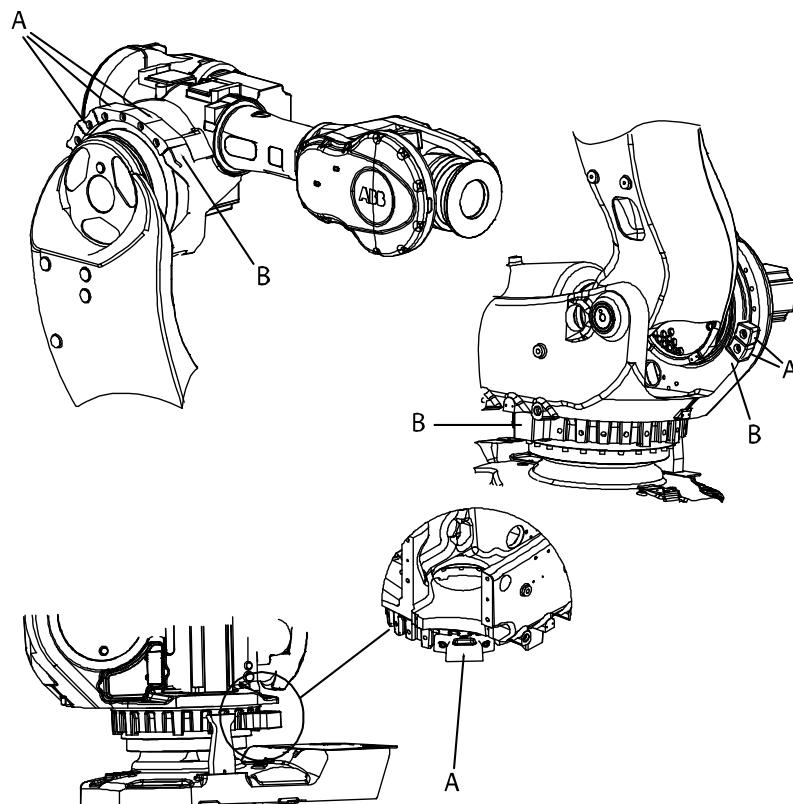
3 Maintenance

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

3.3.10 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 Standard tools on page 445 .

Continues on next page

3.3.10 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	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Check the <i>additional stops</i> on axes 1, 2 and 3 for damage.	Shown in the figure Location of the mechanical stops on page 180 .
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"> • Axis 1: M16 x 35 • Axis 2: M16 x 50 • Axis 3: M16 x 80 	Art. no. is specified in Required equipment on page 180!

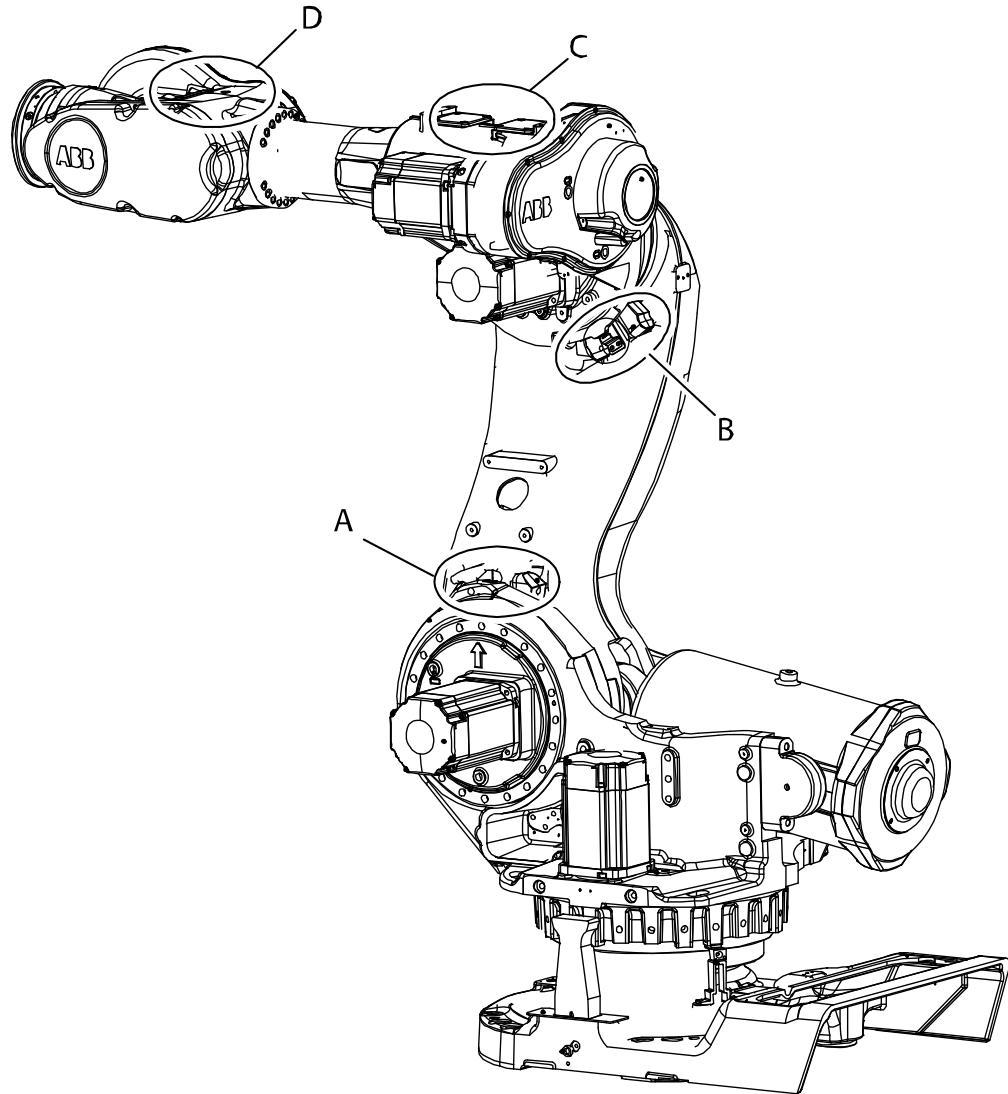
3 Maintenance

3.3.11 Inspecting the damper on axes 2 to 5

3.3.11 Inspecting the damper on axes 2 to 5

Location of dampers

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



xx0200000099

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

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 Standard tools on page 445 .

Inspection, damper axis 2-5

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

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	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 Location of dampers on page 182 .
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 Required equipment on page 182 .

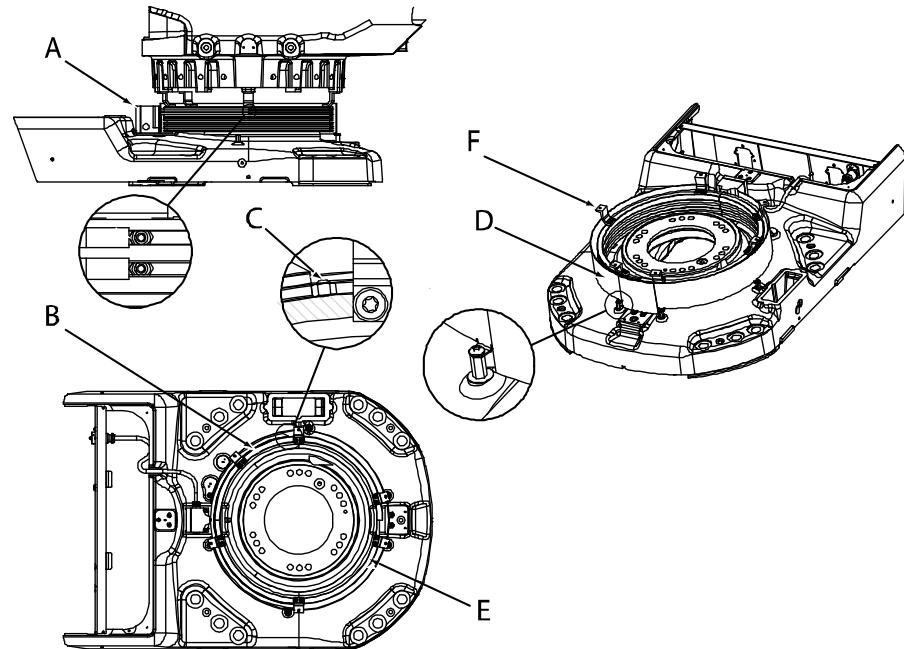
3 Maintenance

3.3.12 Inspecting the position switch on axes 1, 2, and 3

3.3.12 Inspecting the position switch on axes 1, 2, and 3

Location of position switches

The position switches, axes 1, 2 and 3, are located as shown in the figures below.



xx0100000158

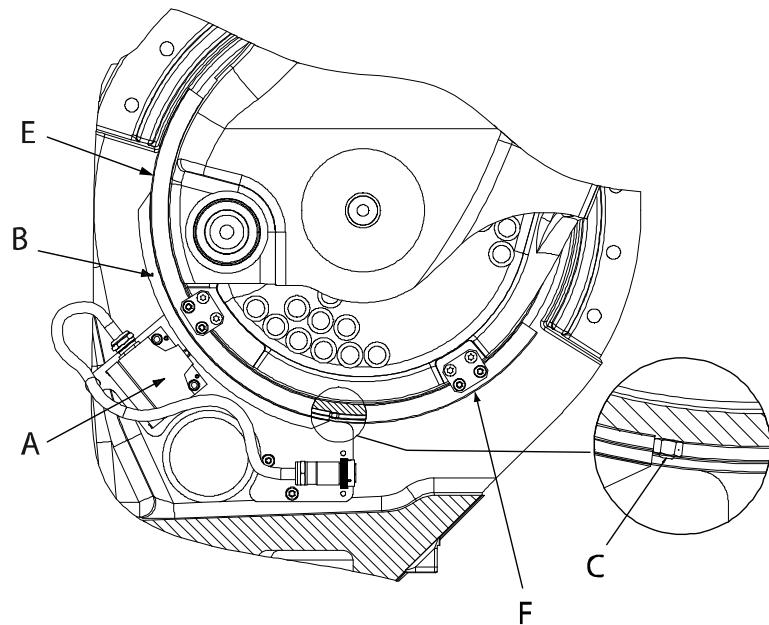
A	Position switch, axis 1
B	Cam
C	Set screw, cam
D	Protection sheet
E	Rail
F	Rail attachment

Continues on next page

3.3.12 Inspecting the position switch on axes 1, 2, and 3

Continued

The illustration below shows the position switch for axis 2.



xx0100000159

A	Position switch, axis 2
B	Cam
C	Set screw, cam
E	Rail
F	Rail attachment

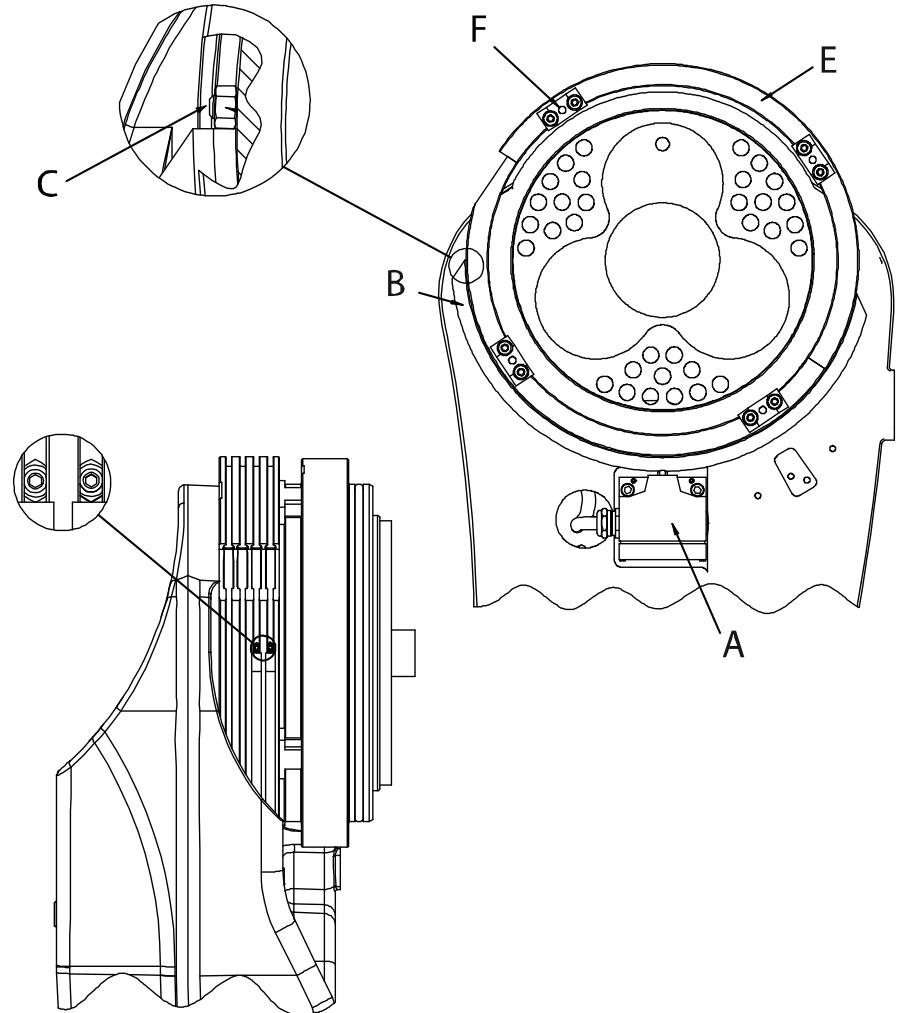
Continues on next page

3 Maintenance

3.3.12 Inspecting the position switch on axes 1, 2, and 3

Continued

The illustration below shows the position switch for axis 3.



xx0100000160

A	Position switch, axis 3
B	Cam
C	Set screw, cam
E	Rail
F	Rail attachment

Required equipment

Equipment, etc.	Spare part no.	Note
Position switch, axis 1	3HAC15715-1	To be replaced in case of detected damage.
Position switch, axis 2	3HAC15715-2	To be replaced in case of detected damage.
Position switch, axis 3	3HAC15715-2	To be replaced in case of detected damage.

Continues on next page

3.3.12 Inspecting the position switch on axes 1, 2, and 3

Continued

Equipment, etc.	Spare part no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
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, position switches

The procedure below details how to inspect the position switch, axes 1, 2 and 3.

See the figure [Location of position switches on page 184](#) to locate the different components to be inspected.

Action	
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.
2	Check the position switch! <ul style="list-style-type: none"> • Check that the rollers are easy to push in and that they roll freely.
3	Check the rail! <ul style="list-style-type: none"> • Check that the rail is firmly attached with the attachment screws.
4	Check the cams! <ul style="list-style-type: none"> • Check that the rollers has not caused any impressions on the cams. • Check that the cams are clean. Wipe them if necessary! • Check that the set screws holding the cams in position are firmly attached.
5	Check the protection sheets on axis 1! <ul style="list-style-type: none"> • Check that the three sheets are in position and not damaged. Deformation can result in rubbing against the cams! • Check that the space inside the sheets is clean enough not to disturb the function of the position switch.
6	If any damage is detected, the position switch must be replaced.

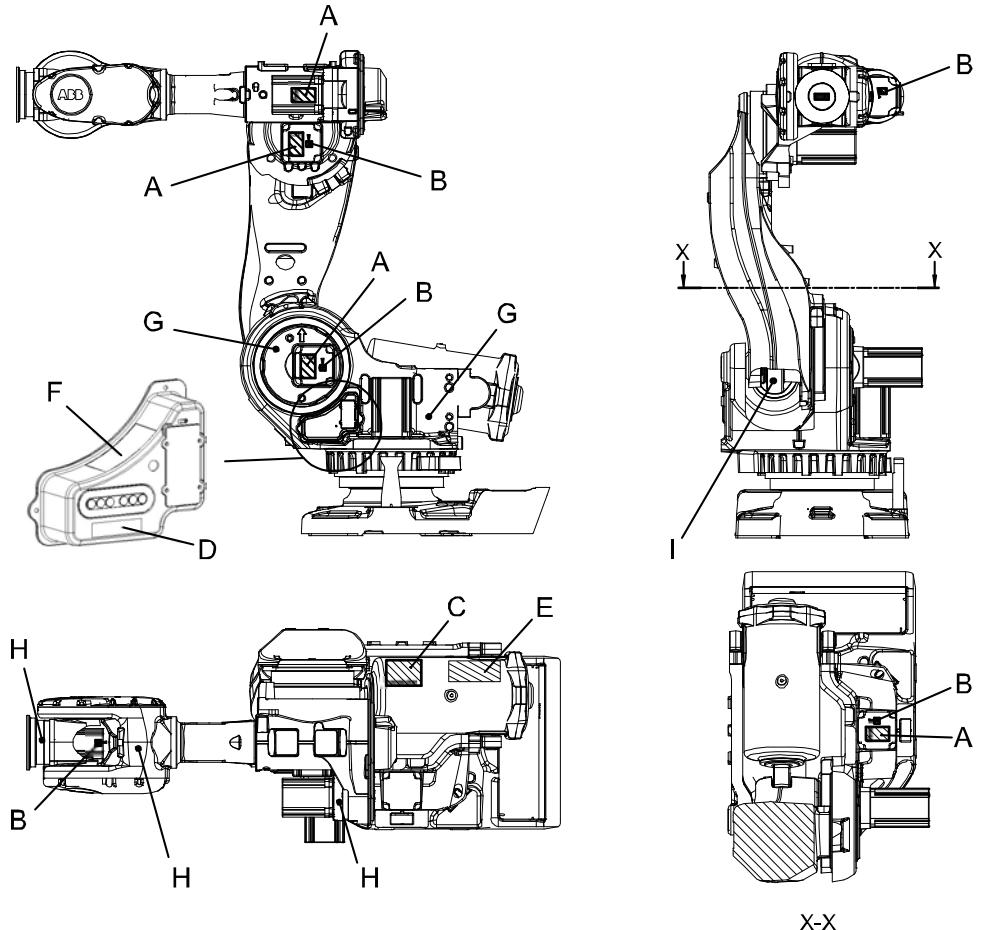
3 Maintenance

3.3.13 Inspecting the information labels

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 product labels on page 48](#).

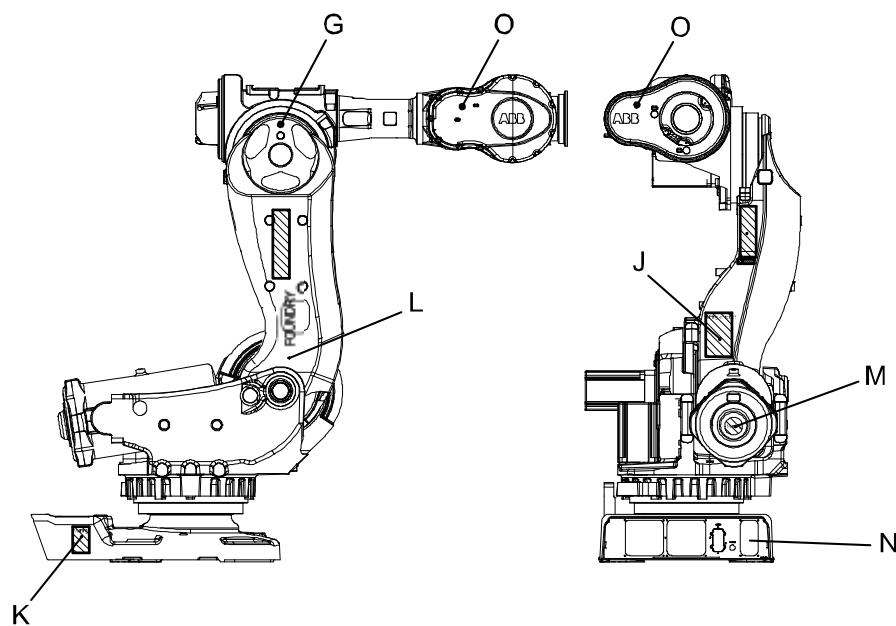


xx0200000100

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

3.3.13 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 what 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	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Inspect the labels, located as shown in the figures.	
3	Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in Spare part lists on page 451 .

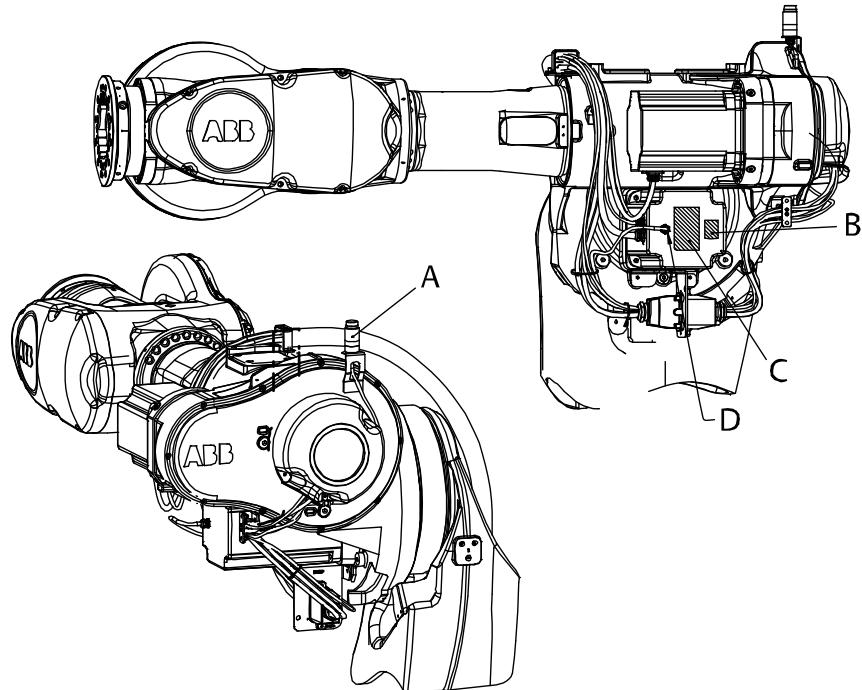
3 Maintenance

3.3.14 Inspecting the UL lamp

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.



xx0200000117

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 Standard tools on page 445 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Continues on next page

3.3.14 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">• Check whether the <i>UL-lamp</i> is broken. If so, replace it.• Check the cable connections.• Measure the voltage in connectors motor axis 3 (=24V).• Check the cabling. Replace cabling if a fault is detected.	Part no. is specified in Required equipment on page 190!

3 Maintenance

3.4.1 Type of lubrication in gearboxes

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

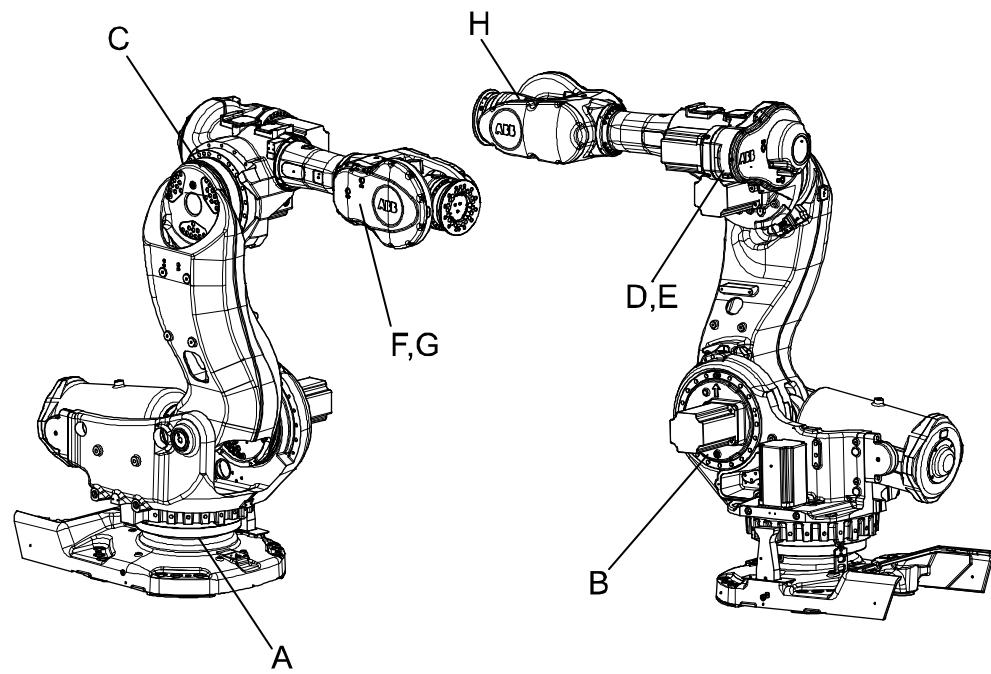
Information about the *type of lubrication*, *article number* as well as the *amount* in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* on the Documentation DVD (released twice a year). The revision of the manual published on the Documentation DVD will contain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

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

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

Location of gearboxes

The figure shows the location of the gearboxes.



Continues on next page

3.4.1 Type of lubrication in gearboxes

Continued

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

Equipment

Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: <ul style="list-style-type: none">• Orion OriCan art. no. 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	

3 Maintenance

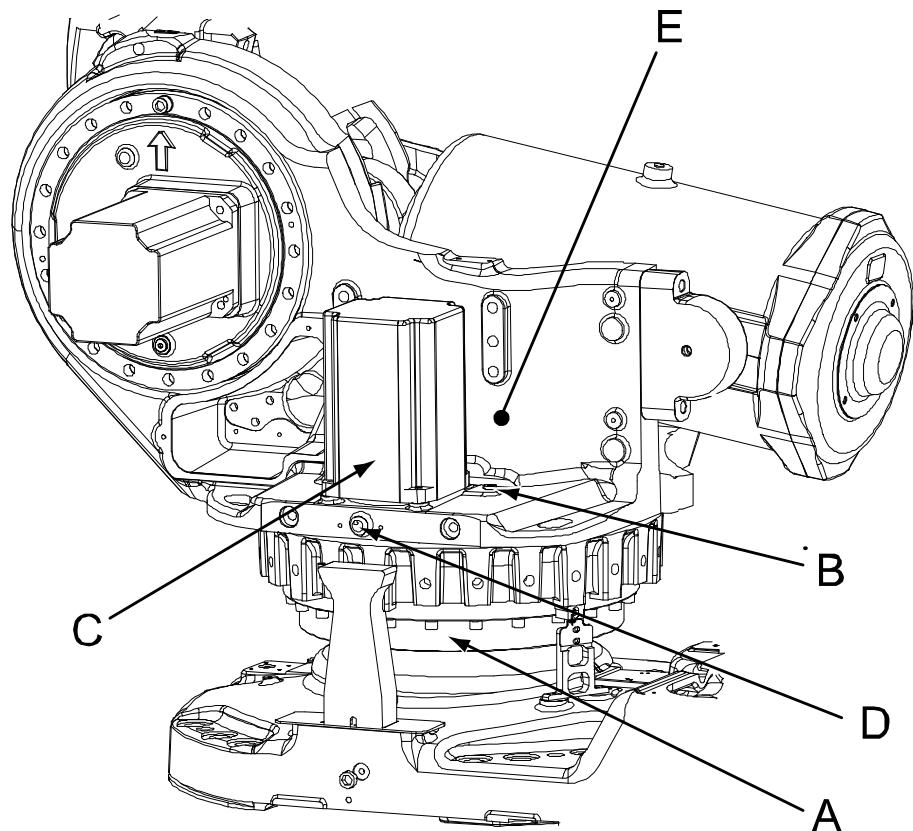
3.4.2 Changing oil, axis-1 gearbox

3.4.2 Changing oil, axis-1 gearbox

Location of 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.



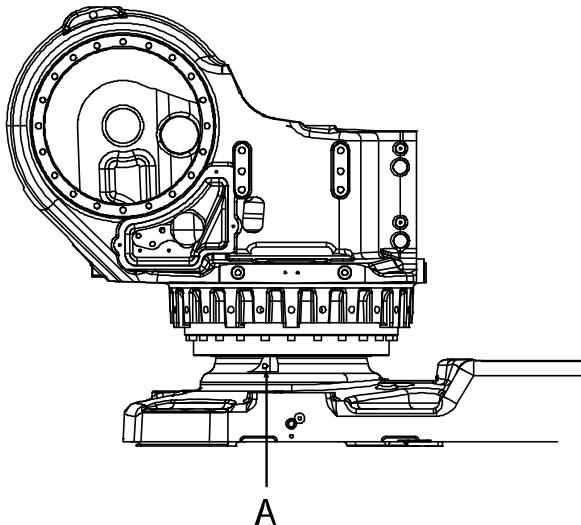
xx0200000111

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

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.



xx0300000065

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 192 .	See Type and amount of oil in gearboxes on page 192 .	
Oil collecting vessel			Capacity: 8,000 ml.
Oil exchange equipment	3HAC17313-1		Content is defined in section Special tools on page 446 .
Standard toolkit	-		Content is defined in section Standard tools on page 445 .
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

3 Maintenance

3.4.2 Changing oil, axis-1 gearbox

Continued

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 195](#).

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3 Remove 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 Oil plug in the base on page 195 instead of the hose.	
5 Place an oil vessel close to the hose end.	Vessel capacity specified in Required equipment on page 195 .
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.  CAUTION Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	 Note 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

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 195](#).

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Open the <i>oil plug, filling</i> .	Shown in the figure Location of gearbox on page 194 .
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 Inspecting the oil level in axis-1 gearbox on page 150 .	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 .
5	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	
6	Refit the <i>oil plug, filling</i> .	Tightening torque: 24 Nm.

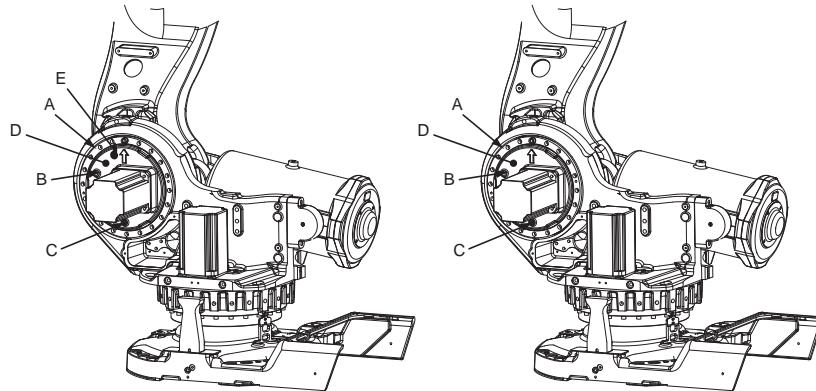
3 Maintenance

3.4.3 Changing oil, axis-2 gearbox

3.4.3 Changing oil, axis-2 gearbox

Location of oil plugs

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



xx0200000112

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 154](#).

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 192 .	See Type and amount of oil in gearboxes on page 192 .	Note! Do not mix with other oil types!
Oil collecting vessel	-		Capacity: 5,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 446 .
Standard toolkit	-		Content is defined in section Standard tools on page 445 .

Continues on next page

Draining, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 198](#).

Action	Note
 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
 CAUTION Remove the <i>oil plug, draining</i> , and drain the gearbox oil using a hose with nipple and an oil collecting vessel. Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	Shown in the figure Location of oil plugs on page 198 . Vessel capacity is specified in Required equipment on page 198 .  Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
Refit the oil plug.	Tightening torque: 24 Nm.

Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 198](#).

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

Continues on next page

3 Maintenance

3.4.3 Changing oil, axis-2 gearbox

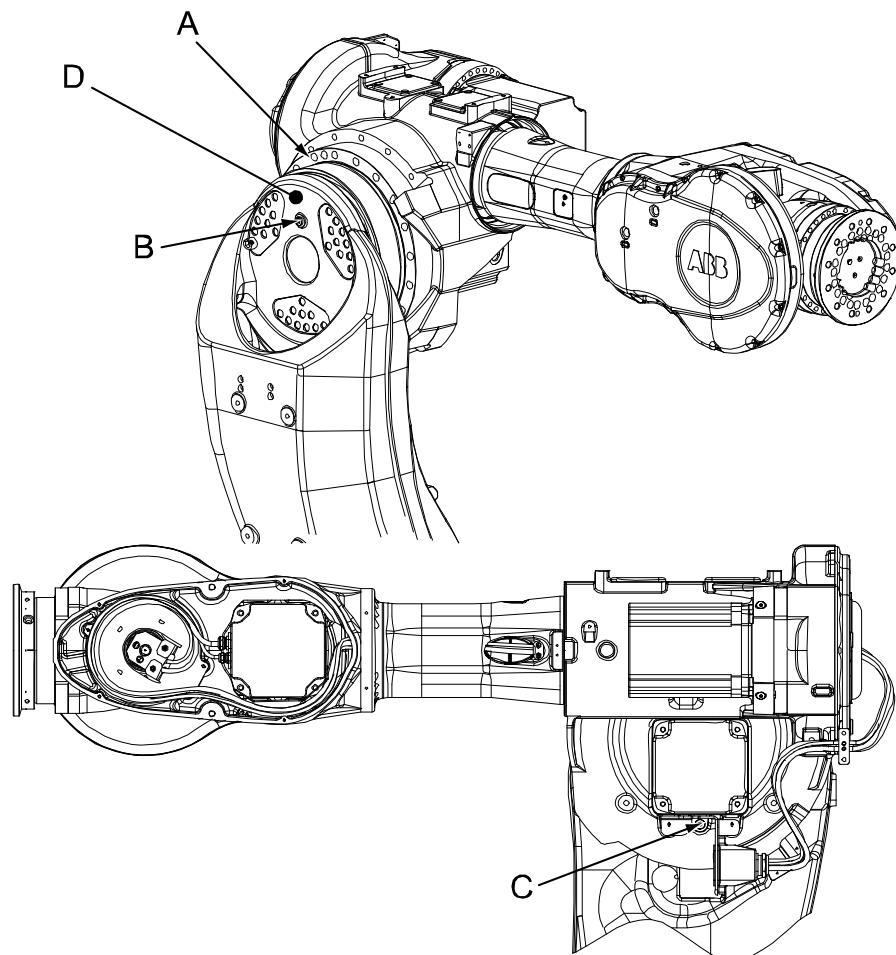
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Action	Note
2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
3 Remove the <i>oil plug for filling</i> and the plug from the <i>vent hole</i> .	Shown in the figure Location of oil plugs on page 198 .
4 Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section Inspecting the oil level in axis-2 gearbox on page 154 .	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 .
5  WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	
6 Refit the oil plug.	Tightening torque: 24 Nm.

3.4.4 Changing oil, axis-3 gearbox

Location of gearbox

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



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 Type and amount of oil in gearboxes on page 192.	See Type and amount of oil in gearboxes on page 192.	Note! Do not mix with other oil types!

Continues on next page

3 Maintenance

3.4.4 Changing oil, axis-3 gearbox

Continued

Equipment, etc.	Art. no.	Amount	Note
Oil exchange equipment	3HAC021745-001		Content is defined in section Special tools on page 446 .
Oil collecting vessel	-		Capacity: 5,000 ml.
Standard toolkit	-		Content is defined in section Standard tools on page 445 .

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 201](#).

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
3	Remove the <i>oil plug, filling</i> .	
4	Remove the <i>oil plug, draining</i> , and drain the gearbox oil using a hose with nipple and an oil collecting vessel.  CAUTION Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	Shown in the figure Location of gearbox on page 201 . Vessel capacity is specified in Required equipment on page 201 .  Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
5	Refit the oil plug.	Tightening torque: 24 Nm.

Continues on next page

Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in [Required equipment on page 201](#).

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
3	Remove the <i>oil plug, filling</i> .	Shown in the figure Location of gearbox on page 201 .
4	Refill the gearbox with clean <i>lubricating oil</i> . The correct oil level is detailed in section Inspecting the oil level in axis-3 gearbox on page 157 .	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 .
5	 WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	
6	 Note Do not mix Kyodo Yushi TMO 150 with other oil types!	
7	Refit the oil plug.	Tightening torque: 24 Nm.

3 Maintenance

3.4.5 Changing oil, axis-4 gearbox

3.4.5 Changing oil, axis-4 gearbox

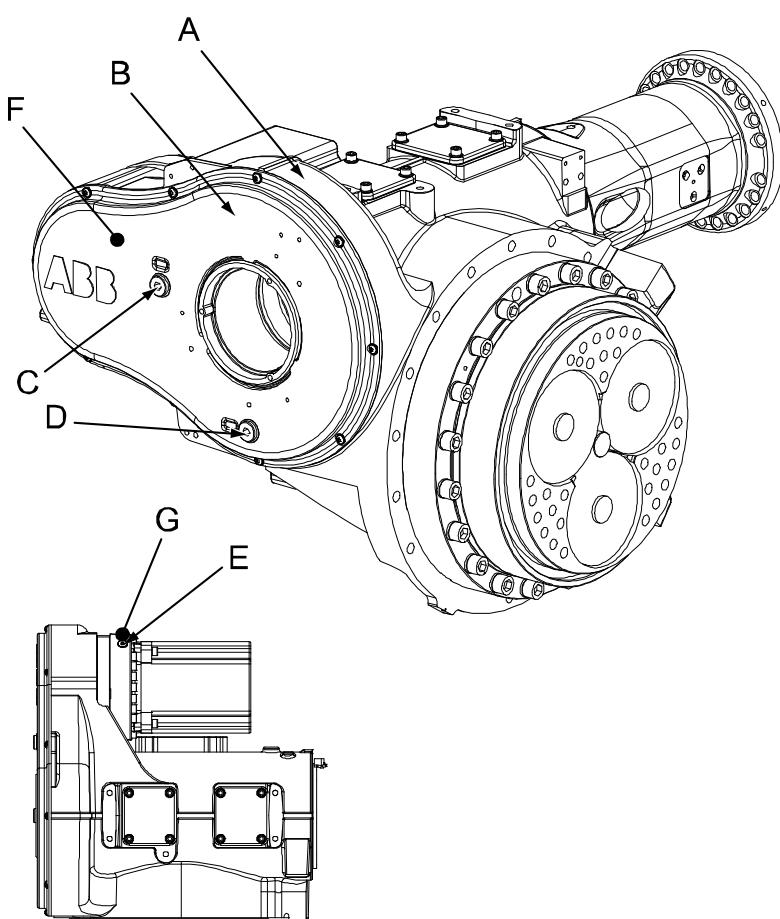
Different types of oil

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 223](#).

Location of gearbox

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



xx0200000107

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See Type and amount of oil in gearboxes on page 192 .	See Type and amount of oil in gearboxes on page 192 .	
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 Special tools on page 446 .
Standard toolkit	-		Content is defined in section Standard tools on page 445 .

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 205](#).

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	Open the <i>oil plug, draining, secondary gear</i> .	Shown in the figure Location of gearbox on page 204 .
3	Drain the oil from the secondary gearbox by running the upper arm -45° from calibration position.	Vessel capacity specified in Required equipment on page 205 .
4	Run the robot back to its calibration position.	Detailed in section Synchronization marks and synchronization position for axes on page 408 .
5	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	

Continues on next page

3 Maintenance

3.4.5 Changing oil, axis-4 gearbox

Continued

Action	Note
6 Drain the primary gear by opening the oil plug, draining, primary gearbox.  CAUTION Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	Vessel capacity specified in Required equipment on page 205 .
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 205](#).

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3 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 Type and amount of oil in gearboxes on page 192 . Shown in the figure Location of gearbox on page 204 .
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 Inspecting the oil level in axis-4 gearbox on page 160 .	Kyodo Yushi TMO 150 Shown in the figure Location of gearbox on page 204 . Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 .
5  WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	

Continues on next page

	Action	Note
6	Refit the both oil plugs, filling.	Shown in the figure <i>Location of gearbox on page 204</i> . Tightening torque: 24 Nm.

3 Maintenance

3.4.6 Changing oil, axis-5 gearbox

3.4.6 Changing oil, axis-5 gearbox

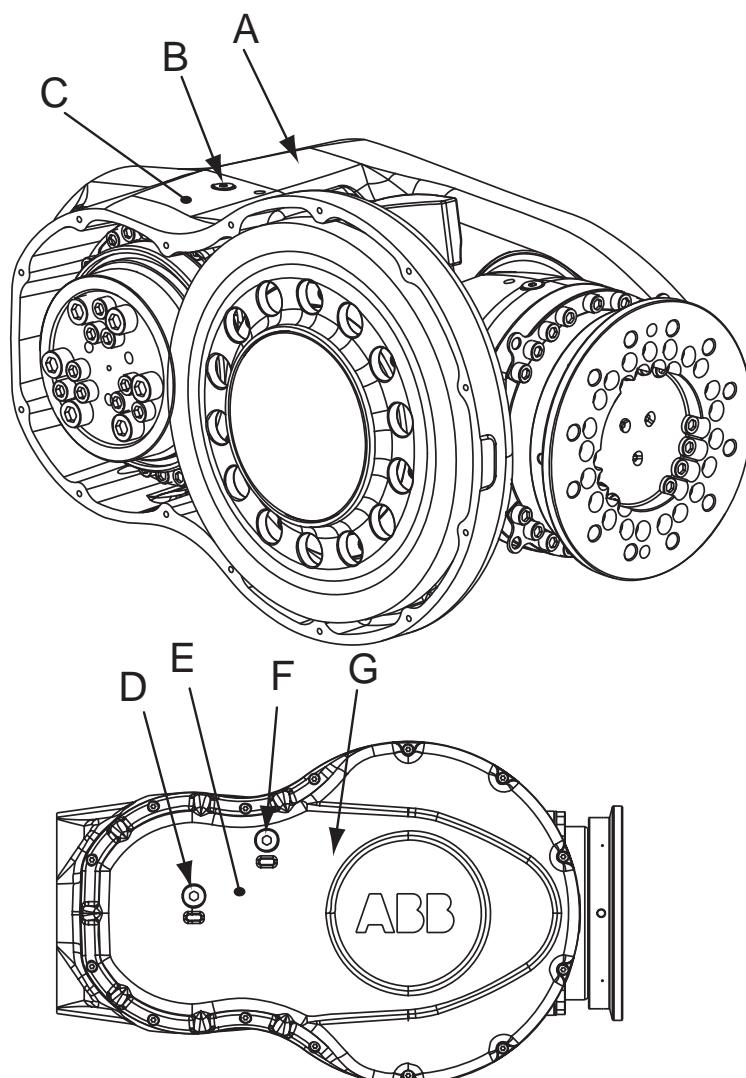
Different types of oil

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 223](#).

Location of gearbox

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



xx0200000108

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 Type and amount of oil in gearboxes on page 192 .	
Oil collecting vessel		Capacity: 1 liter
Oil collecting vessel		Capacity: 4 liters
Oil exchange equipment	3HAC17313-1	Content is defined in section Special tools on page 446 .
Standard toolkit	-	Content is defined in section Standard tools on page 445 .



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 209](#).

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Open the <i>oil plug, draining, primary gearbox</i> .	
4	Drain the oil from the primary gearbox.	Vessel capacity: 1 liter

Continues on next page

3 Maintenance

3.4.6 Changing oil, axis-5 gearbox

Continued

Action	Note
5 Run axis 4 to a position +90° from the calibration position.	
6 Open the <i>oil plug, draining/inspection, secondary gearbox</i> .	Shown in the figure Location of gearbox on page 208 .
7 Drain the oil from the secondary gear.  CAUTION Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	Vessel capacity: 4 liters
8 Refit the oil plugs.	Shown in the figure Location of gearbox on page 208 . 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 209](#).

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3 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 Inspecting the oil level in axis-5 gearbox on page 163 .	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Shown in the figure Location of gearbox on page 208 .
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 Inspecting the oil level in axis-5 gearbox on page 163 .	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 192 . Shown in the figure Location of gearbox on page 208 .

Continues on next page

Action	Note
5  WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	
6 Refit the oil plugs.	Shown in the figure Location of gearbox on page 208 . Tightening torque: 24 Nm.

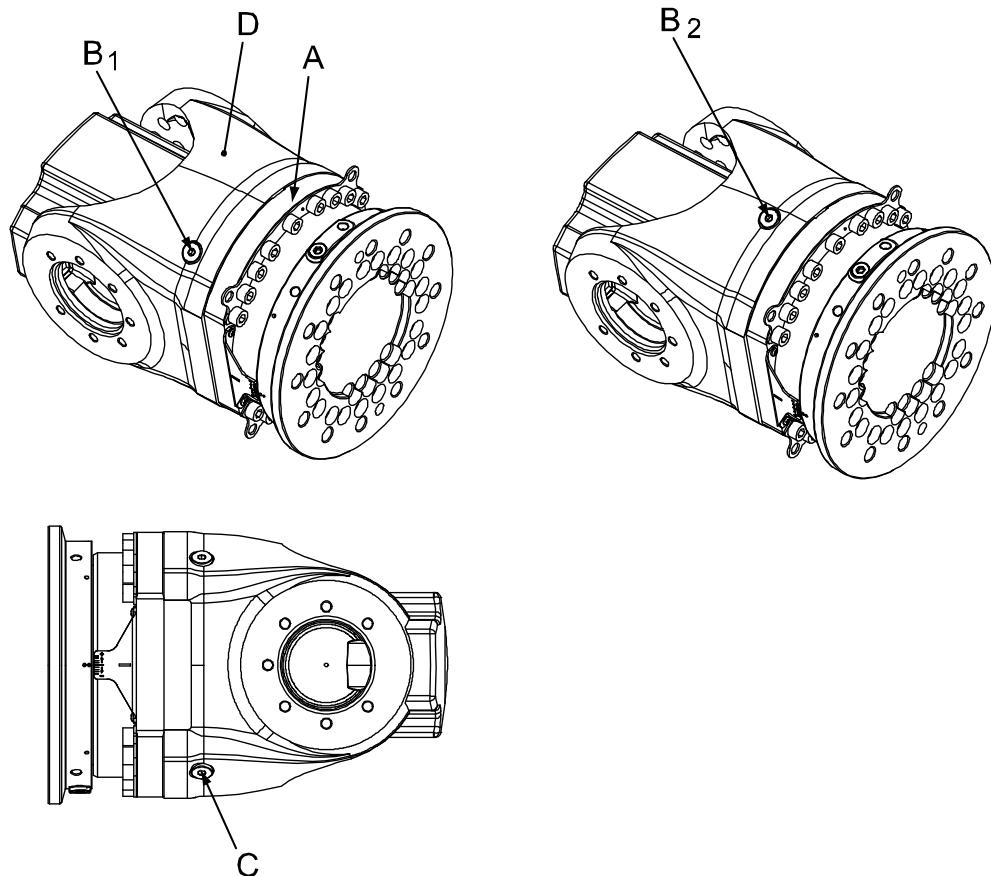
3 Maintenance

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.



xx0200000114

A	Gearbox, axis 6
B	Oil plug, filling/inspection (notice the different locations of the plug, shown as B ₁ and B ₂)
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 Type and amount of oil in gearboxes on page 192.	See Type and amount of oil in gearboxes on page 192.	
Oil collecting vessel			Vessel capacity: 1,000 ml.
Oil exchange equipment	3HAC17313-1		Content is defined in section Special tools on page 446.

Continues on next page

Equipment, etc.	Art. no.	Amount	Note
Standard toolkit	-		Content is defined in section Standard tools on page 445 .

**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 212](#).

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2	Move the wrist so that the <i>oil plug</i> , draining of axis 6 gearbox faces downwards. If the <i>oil plug</i> , <i>draining</i> is located on the turning disc, rotate the disc so that the plug faces downwards.	Shown in the figure Location of gearbox on page 212 !
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4	 CAUTION Drain as much oil as possible. See WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	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 Inspecting the oil level in axis-6 gearbox on page 166 .

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 212](#).

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 60 .	
2 Run the robot to a position where the <i>oil plug, filling</i> (<i>B1</i> or <i>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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
4 Remove the <i>oil plug, filling</i> .	Shown in the figure Location of gearbox on page 212 .
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 Type and amount of oil in gearboxes on page 192 .
6  WARNING Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in <i>Technical reference manual - Lubrication in gearboxes</i> .	
7 Refit the both oil plugs.	Tightening torque: 24 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 *Operating manual - IRC5 with FlexPendant* for instructions.



WARNING

See instructions for batteries, [WARNING - Safety risks during handling of batteries on page 59](#).

Continues on next page

3 Maintenance

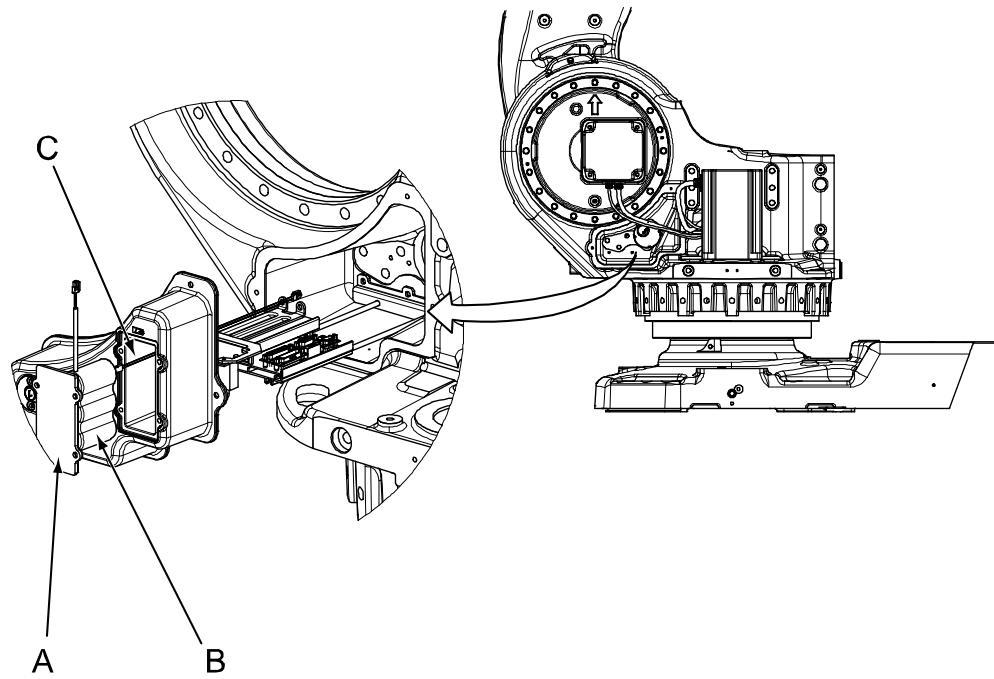
3.4.8 Replacing the SMB battery

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)

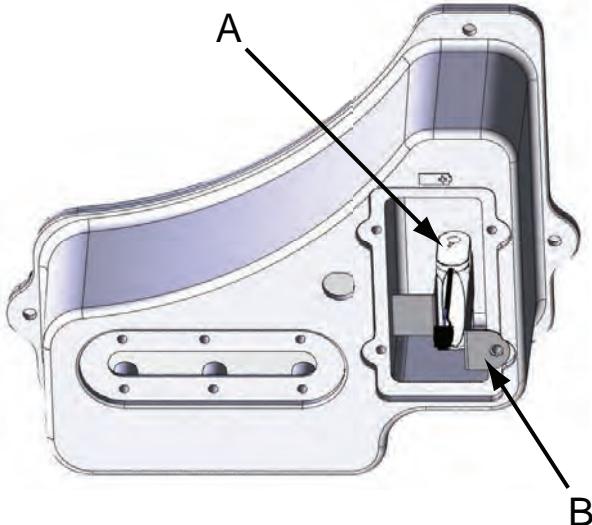


xx0200000238

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)



xx1300000308

- 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: • Spare part lists on page 451	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
Circuit diagram	-	See chapter Circuit diagram on page 453 .

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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	
4 Remove the <i>SMB battery cover</i> by unscrewing the attachment screws.	Shown in figure Location of SMB battery on page 216 .
5 Pull out the battery and disconnect the <i>battery cable</i> .	Shown in figure Location of SMB battery on page 216 .
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 Location of SMB battery on page 216 .

Refitting, battery

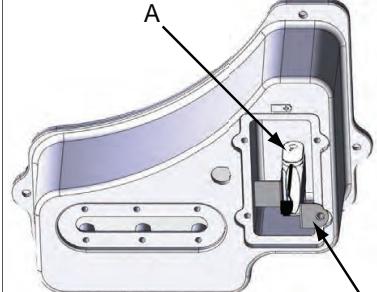
Use this procedure to refit the SMB battery.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
2  ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	

Continues on next page

3.4.8 Replacing the SMB battery

Continued

Action	Note
<p>3 Reconnect the <i>battery cable</i> and install the battery pack into the SMB/battery recess.</p> <p> Note</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 Required equipment on page 217.</p> <p>Shown in figure Location of SMB battery on page 216.</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 Location of SMB battery on page 216 .
5 Update the revolution counters.	Detailed in chapter Calibration - section Updating revolution counters on page 411 .
<p>6  DANGER</p> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55.</p>	

3 Maintenance

3.5.1 Lubrication of spherical roller bearing, balancing device

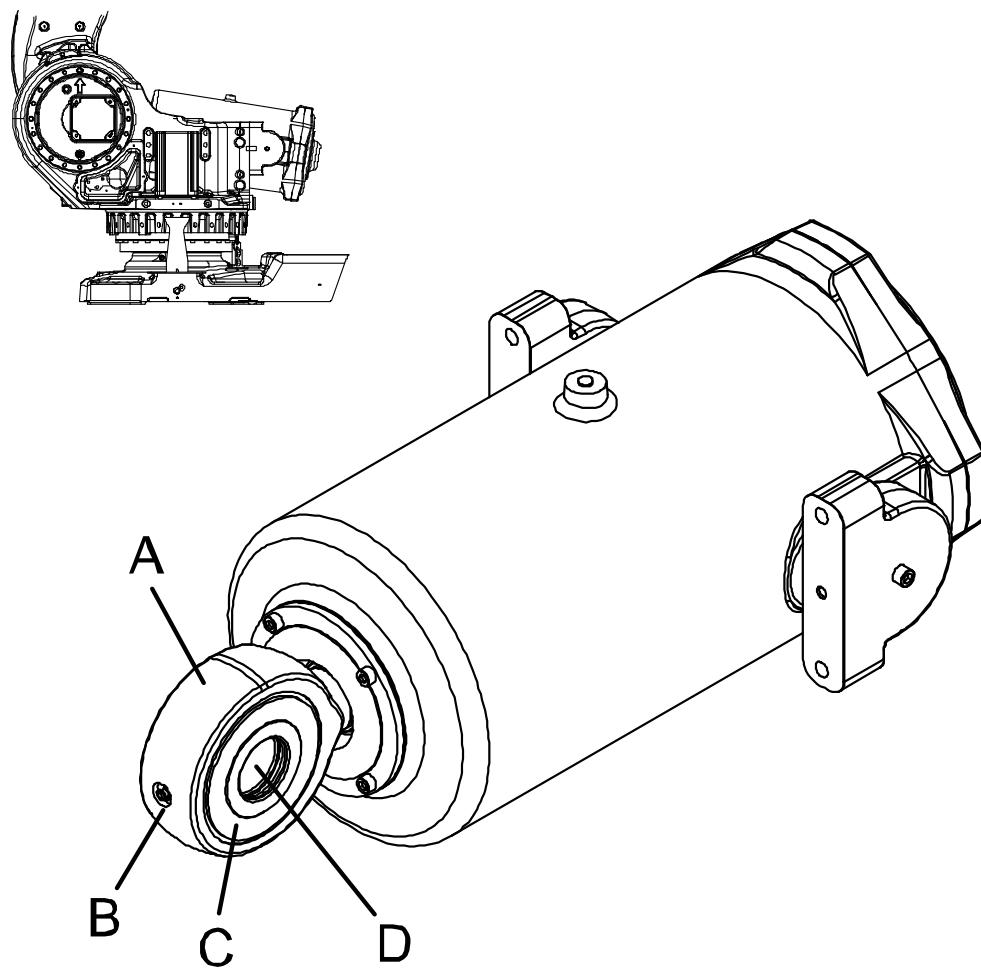
3.5 Lubrication activities

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!



xx0200000109

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

Required equipment

Equipment, etc.	Art. no.	Note
Grease	3HAC042534-001	Optimol PDO, 150 ml

Continues on next page

3.5.1 Lubrication of spherical roller bearing, balancing device

Continued

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

Lubrication, balancing device bearing (Design 1)

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

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Lubricate the spherical roller bearing through the lubrication nipple in the ear with <i>grease</i> . Fill until excessive grease is forced out between the shaft and the sealing spacer.	Art. no. and amount is specified in Required equipment on page 220! Shown in the figure Location of bearing on page 220! The balancing device must be mounted on the robot when lubricating the bearing!
3	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 - Check for leakage on page 172 .

Lubrication, balancing device bearing (Design 2)

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

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Lubricate the spherical roller bearing through the lubrication nipple in the ear with <i>grease</i> . Fill until excessive grease is forced out through the hole of the lower securing screw.	Art. no. and amount is specified in Required equipment on page 220! Shown in the figure Location of bearing on page 220! The balancing device must be mounted on the robot when lubricating the bearing!
	Refit the lower securing screw and washer.	M6 x 10, washer: D=6,4/12 T=1,6 Tightening torque: 6 Nm.

Continues on next page

3 Maintenance

3.5.1 Lubrication of spherical roller bearing, balancing device

Continued

	Action	Note
3	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 - <i>Check for leakage on page 172.</i>

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	-	$D_{inside}=4$ mm, $L= 400$ mm.
Standard toolkit	3HAC15571-1	Content is defined in section Standard tools on page 445 .

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: ± 15 degrees
- axis 4-6: maximum working range with regard to the installation (limitation: axis 4 and 5: ± 90 degrees, axis 6: ± 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

3 Maintenance

3.6.1 Flushing a contaminated gearbox

Continued

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 Service program on page 223 .
2	Drain the gearbox properly.	Described in section above: Draining the gearbox properly on page 223 .
3	Fill the gearbox with 700 ml of <i>lubricating oil</i> .	Kyodo Yushi TMO 150 Art. no . is specified in Required equipment on page 223 .
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.	

3.6.2 Cleaning the IRB 7600



WARNING

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

General

To secure high uptime it is important that the IRB 7600 is cleaned regularly. The frequency of cleaning depends on the environment in which the manipulator works. Different cleaning methods are allowed depending on the type of protection of the IRB 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 150](#).
- 2 Write down the oil level.
- 3 Inspect the oil level again after, for example, 6 months.
- 4 If the oil level is decreased then replace the gearbox.

Oil spills discolors painted surfaces

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



Note

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

Dos and don'ts!

This section specifies some special considerations when cleaning the robot.

Always!

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

Never!

- Never point the water jet at connectors, joints, sealings, or gaskets!
- Never use compressed air to clean the robot!

Continues on next page

3 Maintenance

3.6.2 Cleaning the IRB 7600

Continued

- Never use solvents that are not approved by ABB to clean the robot!
- Never spray from a distance closer than 0.4 meters!
- Never remove any covers or other protective devices before cleaning the robot!

Cleaning methods

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

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

ⁱ Perform according to section [Cleaning with water and steam on page 226](#).

Cleaning with water and steam

Instructions for rinsing with water

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

The following list defines the prerequisites:

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

¹ Typical tap water pressure and flow

Instructions for steam or high pressure water cleaning

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2,500 kN/m² (25 bar)
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters

¹ See [Cleaning methods on page 226](#) for exceptions.

² See [Cleaning methods on page 226](#) for exceptions.

Continues on next page

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

3 Maintenance

3.7.1 Using the SIS system

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 Description of Service Information System (SIS) on page 229 .
2	Define what values are adequate and suitable for your application in your production environment.	Recommendations on how to define these are given in SIS system parameters on page 232 .
3	Enter these parameters in the system.	How to do this is detailed in Setting the SIS parameters on page 233 .
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 Description of Service Information System (SIS) on page 229 .
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 Reading the SIS output logs on page 234 .
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 Exporting the SIS data on page 235 .

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 233](#). 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 234](#).

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 Setting the SIS parameters on page 233 .
Remaining time	Remaining time to next scheduled service date.

Continues on next page

3 Maintenance

3.7.2 Description of Service Information System (SIS)

Continued

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 234](#).

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 Setting the SIS parameters on page 233 .
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 234](#).

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 235](#)!

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

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 Maintenance

3.7.3 SIS system parameters

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

3.7.4 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 SIS system parameters on page 232 .

3 Maintenance

3.7.5 Reading the SIS output logs

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 Setting the SIS parameters on page 233 . Proceed with the required service as detailed in chapter Repair on page 237 or chapter Maintenance on page 143 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 Setting the SIS parameters on page 233 .
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 Setting the SIS parameters on page 233 . Proceed with the required service as detailed in chapter Repair on page 237 or chapter Maintenance on page 143 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 Setting the SIS parameters on page 233 .
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 Repair on page 237 or chapter Maintenance on page 143 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 Setting the SIS parameters on page 233 .

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

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes all repair activities recommended for the IRB 7600 and any external unit.

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

The procedures are gathered in sections, divided according to the component location on the IRB 7600.

Required equipment

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

The details of equipment are also available in different lists in the chapter [Reference information on page 437](#).

Safety information

There are general safety information and specific safety information. The specific safety information describes the danger and safety risks while performing specific steps in a procedure. Make sure to read through the chapter [Safety on page 21](#) before commencing any service work.



Note

If the IRB 7600 is connected to power, always make sure that the IRB 7600 is connected to earth before starting any repair work.

For more information see:

- *Product manual - IRC5*

4 Repair

4.2.1 Performing a leak-down test

4.2 General procedures

4.2.1 Performing a leak-down test

When to perform a leak-down test

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

Required equipment

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

Performing a leak-down test

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

4.2.2 Mounting instructions for bearings

General

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

Equipment

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

Assembly of all bearings

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

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

Assembly of tapered bearings

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

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

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

Greasing of bearings

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

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

Continues on next page

4 Repair

4.2.2 Mounting instructions for bearings

Continued

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

Grease the different types of bearings as following description:

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

4.2.3 Mounting instructions for seals

General

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

Equipment

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

Rotating seals

The procedure below describes how to fit rotating seals.



CAUTION

Please observe the following before commencing any assembly of seals:

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

	Action	Note
1	Check the seal to ensure that: <ul style="list-style-type: none"> • The seal is of the correct type (provided with cutting edge). • There is no damage to the sealing edge (feel with a fingernail). 	
2	Inspect the sealing surface before mounting. If scratches or damage are found, the seal must be replaced since it may result in future leakage.	
3	Lubricate the seal with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the seal.) Fill 2/3 of the space between the dust tongue and sealing lip with grease. The rubber coated external diameter must also be greased, unless otherwise specified.	Article number is specified in Equipment on page 241 .
4	Mount the seal correctly with a mounting tool. Never hammer directly on the seal as this may result in leakage.	

Continues on next page

4 Repair

4.2.3 Mounting instructions for seals

Continued

Flange seals and static seals

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

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

O-rings

The following procedure describes how to fit o-rings.

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

4.3 Complete robot

4.3.1 Replacement of cable harness, axes 1-4

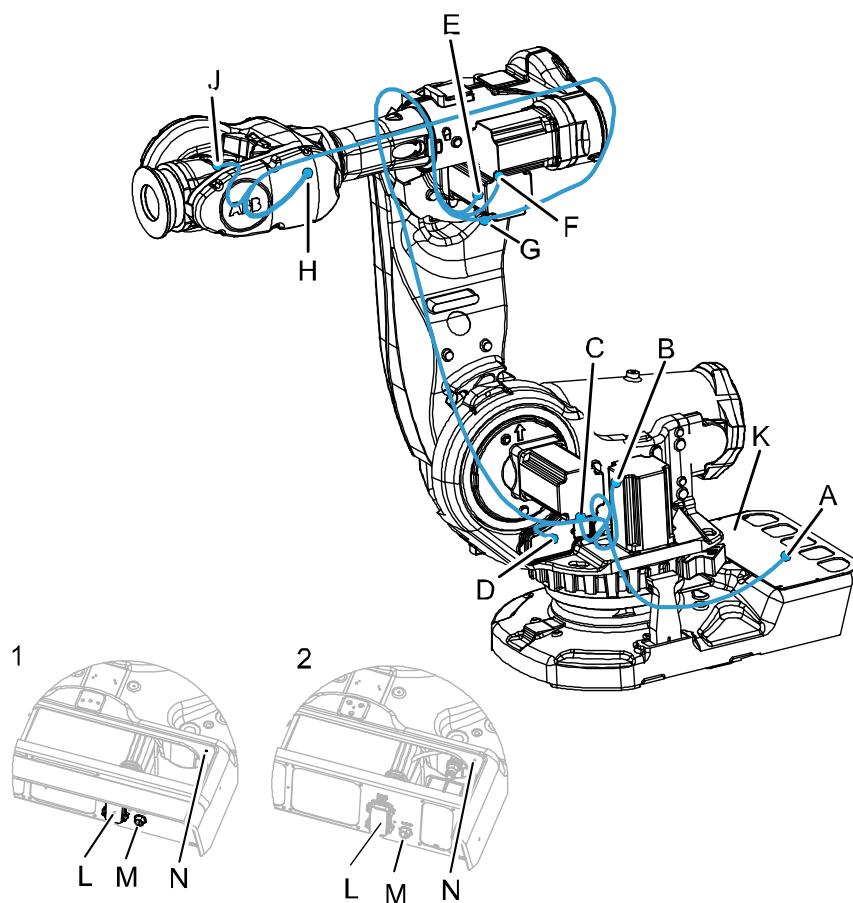
4.3 Complete robot

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 from each other! Any differences are pointed out in the procedures!



xx010000140

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

4 Repair

4.3.1 Replacement of cable harness, axes 1-4

Continued

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 638 Used to secure the attachment screws for the attachment plate inside the frame.
Standard toolkit		-	Content is defined in section Standard tools on page 455 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter Circuit diagram on page 453 .

Removal, cable harness, axes 1-4

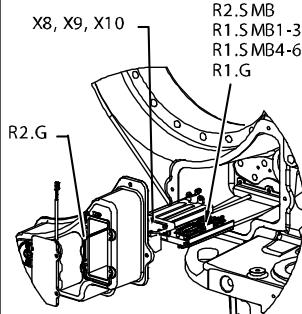
The procedure below details how to remove the cable harness, axes 1-4.

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

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4.3.1 Replacement of cable harness, axes 1-4

Continued

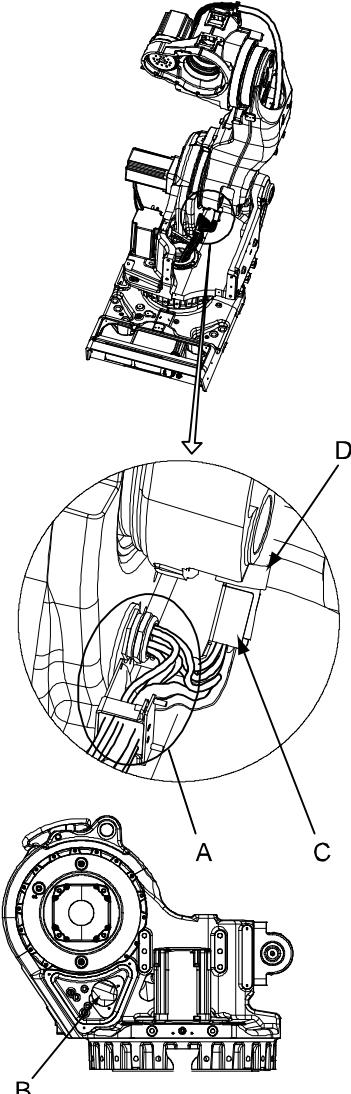
Action	Note
<p>2  DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot <p>Before entering the robot working area.</p>	
3 Remove the <i>rear cover plate</i> from the robot by removing its attachment screws.	Shown in the figure Location of cable harness on page 243 .
4 Disconnect the <i>earth cable</i> .	Attachment point is shown in the figure Location of cable harness on page 243 !
5 Disconnect connectors <i>R1.MP</i> and <i>R1.SMB</i> .	Attachment points are shown in the figure Location of cable harness on page 243 .
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 Location of cable harness on page 243 !
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 <i>R2.SMB</i> , <i>R1.SMB1-3</i> , <i>R1.SMB4-6</i> from the SMB unit. Disconnect X8, X9 and X10 if the brake release board is located in frame.	 xx0200000118

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4 Repair

4.3.1 Replacement of cable harness, axes 1-4

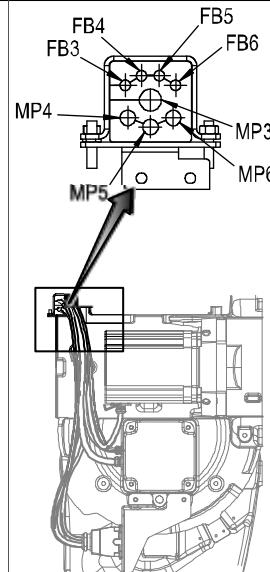
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Action	Note
10 Remove <ul style="list-style-type: none"> • the <i>cable gland</i> (A), by removing the four attachment screws from inside the SMB recess (B) • the <i>attachment plate</i> (C), by removing the attachment screws and the velcro strap (D). 	 <p>Note</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"> • A: Cable gland • B: Attachment screws, cable gland • C: Attachment plate • D: Velcro strap
11 Remove the cable gland securing the cables inside the lower arm.	

Continues on next page

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.	 xx0100000143
13 Remove the <i>velcro strap</i> from the harness at the cable fixing bracket at the arm house.	Shown in the figure Location of cable harness on page 243 .
14 Disconnect connector R2.M5/6 at the cable division point.	Shown in the figure Location of cable harness on page 243 !
15 Disconnect all connectors at motor 3 and motor 4.	Specified and shown in the figure Location of cable harness on page 243 !
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  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 In order to facilitate refitting of cable harness, move the robot to the specified position: <ul style="list-style-type: none"> • Axis 1: 0 degrees • Axis 2: 0 degrees • Axis 3: 0 degrees • Axis 4: 0 degrees • Axis 5: +90 degrees • Axis 6: no significance 	Axes 2 and 3 may be tilted slightly to improve access.

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4 Repair

4.3.1 Replacement of cable harness, axes 1-4

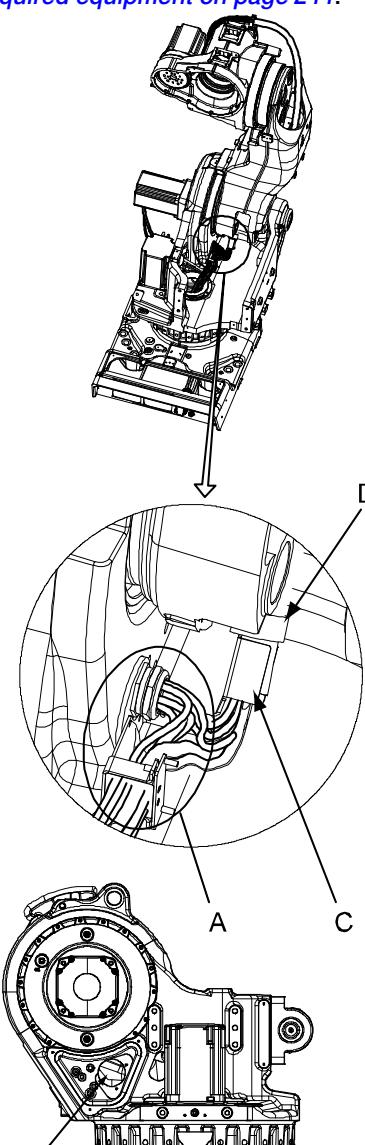
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	Action	Note
3	Pull the cable and connectors down through the cable guide in the center of the frame.	Make sure the cables are not twisted with each other or with eventual customer harnesses! Make a note of the correct positions of the connectors!
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 Location of cable harness on page 243 !
5	Reconnect the earth cable.	Attachment point is shown in the figure Location of cable harness on page 243 !
6	Refit the <i>rear cover plate</i> to the robot with its attachment screws.	Shown in the figure Location of cable harness on page 243 .
7	Reconnect all connectors at motors 1 and 2.	Specified and shown in the figure Location of cable harness on page 243 !

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4.3.1 Replacement of cable harness, axes 1-4

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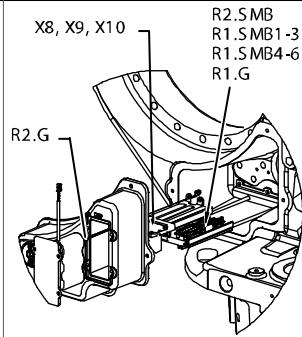
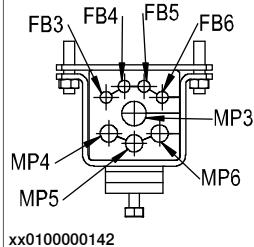
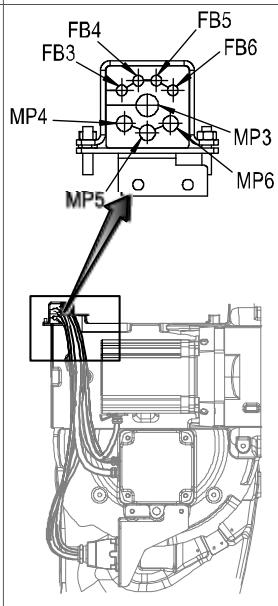
Action	Note
<p>8 Secure the cable gland (A) with four attachment screws (B) from inside the SMB recess.</p> <p>Secure the correct attachment plate (C) to the cable gland with its two attachment screws, using locking liquid.</p> <p>Refit the velcro strap (D).</p> <p>Note</p> <p>Different robot versions 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 Required equipment on page 244.</p>  <p>xx0300000560</p> <ul style="list-style-type: none"> • A: Cable gland • B: Attachment screws, cable gland • C: Attachment plate • D: Velcro strap

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4 Repair

4.3.1 Replacement of cable harness, axes 1-4

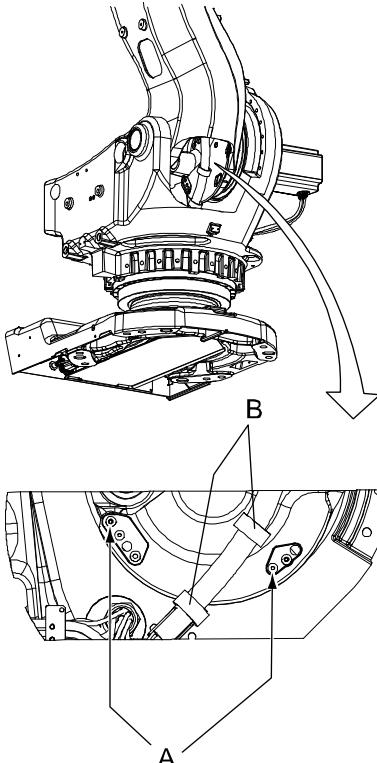
Continued

Action	Note
9 Reconnect connectors R2.SMB, R1.SMB1-3, R1.SMB4-6 to the SMB unit. Reconnect X8, X9 and X10 if the brake release board is located in frame. Reconnect R1.G if it has been disconnected.	 <p>X8, X9, X10 R2.SMB R1.SMB1-3 R1.SMB4-6 R1.G R2.G</p> <p>xx0200000118</p>
10 Secure the SMB cover with its attachment screws. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.	
11  WARNING Before continuing any service work, please observe the safety information in section WARNING - The brake release buttons may be jammed after service work on page 56!	
12 Pull the cable harness through the lower arm.	
13 Refit the cable gland securing the cables inside the lower arm.	 <p>FB3 FB4 FB5 FB6 MP3 MP4 MP5 MP6 xx0100000142</p>
14 Refit the cable gland securing the cables to the arm house. Make sure not to twist the harness!	 <p>FB4 FB5 FB3 FB6 MP4 MP3 MP5 MP6 xx0100000143</p>

Continues on next page

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 Location of cable harness on page 243!
16 Reconnect the connector R2.M5/6 gently at the cable division point. Be careful not to bend the attachment plate when fastening the screws!	Shown in the figure Location of cable harness on page 243! 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 Location of cable harness on page 243!
18 Fit a cable protection to the lower arm, if not already mounted, with two securing screws (A), M6x16. Secure the cable harness with two velcro straps (B), with a distance of approximately 180 mm. Fix the strap by wrapping it two turns around the largest cable before wrapping around the complete harness.	 xx0500002320
19 Refit the cable harness to the <i>guide plate axis 2</i> .	Shown in the figure Location of cable harness on page 243.
20 Refit the <i>velcro strap</i> at the guide plate axis 2.	Shown in the figure Location of cable harness on page 243.
21 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 Updating revolution counters on page 411.
22  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55.	

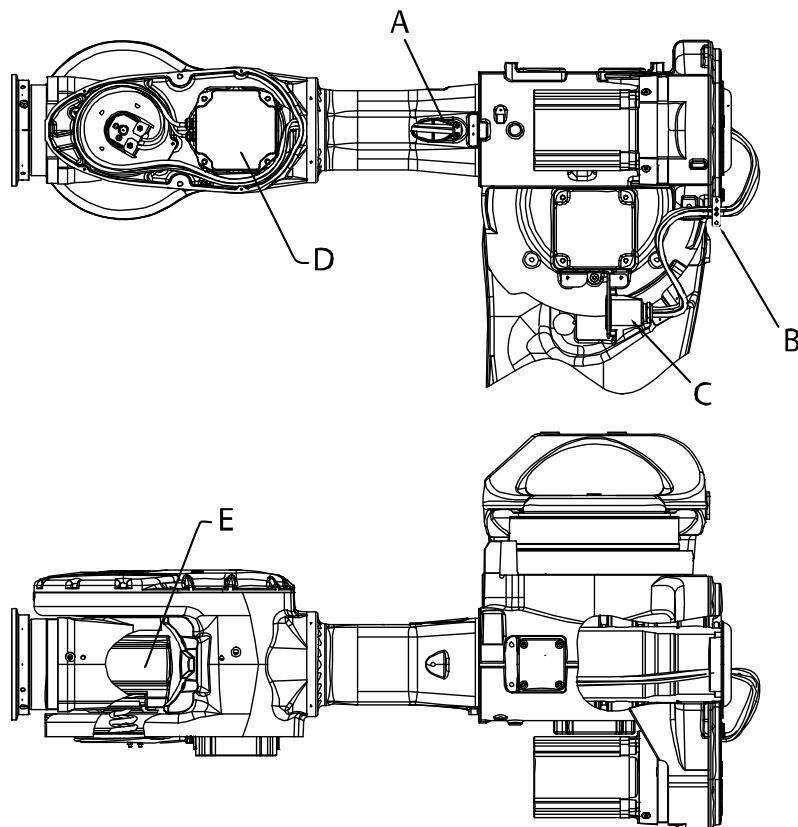
4 Repair

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.



xx0100000145

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 Standard tools on page 445 .
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

4.3.2 Replacement of cable harness, axes 5-6

Continued

Equipment, etc.	Spare part no.	Note
Circuit diagram		See chapter Circuit diagram on page 453 .

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">• Axis 4: 0 degrees• Axis 5: +90 degrees• Axis 6: no significance	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3	Remove the left hand side wrist cover by unscrewing its attachment screws.	
4	 Note 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 Location of cable harness ax 5-6 on page 252 .
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 Location of cable harness ax 5-6 on page 252 .
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">• Axis 4: 0 degrees• Axis 5: +90 degrees• Axis 6: no significance	

Continues on next page

4 Repair

4.3.2 Replacement of cable harness, axes 5-6

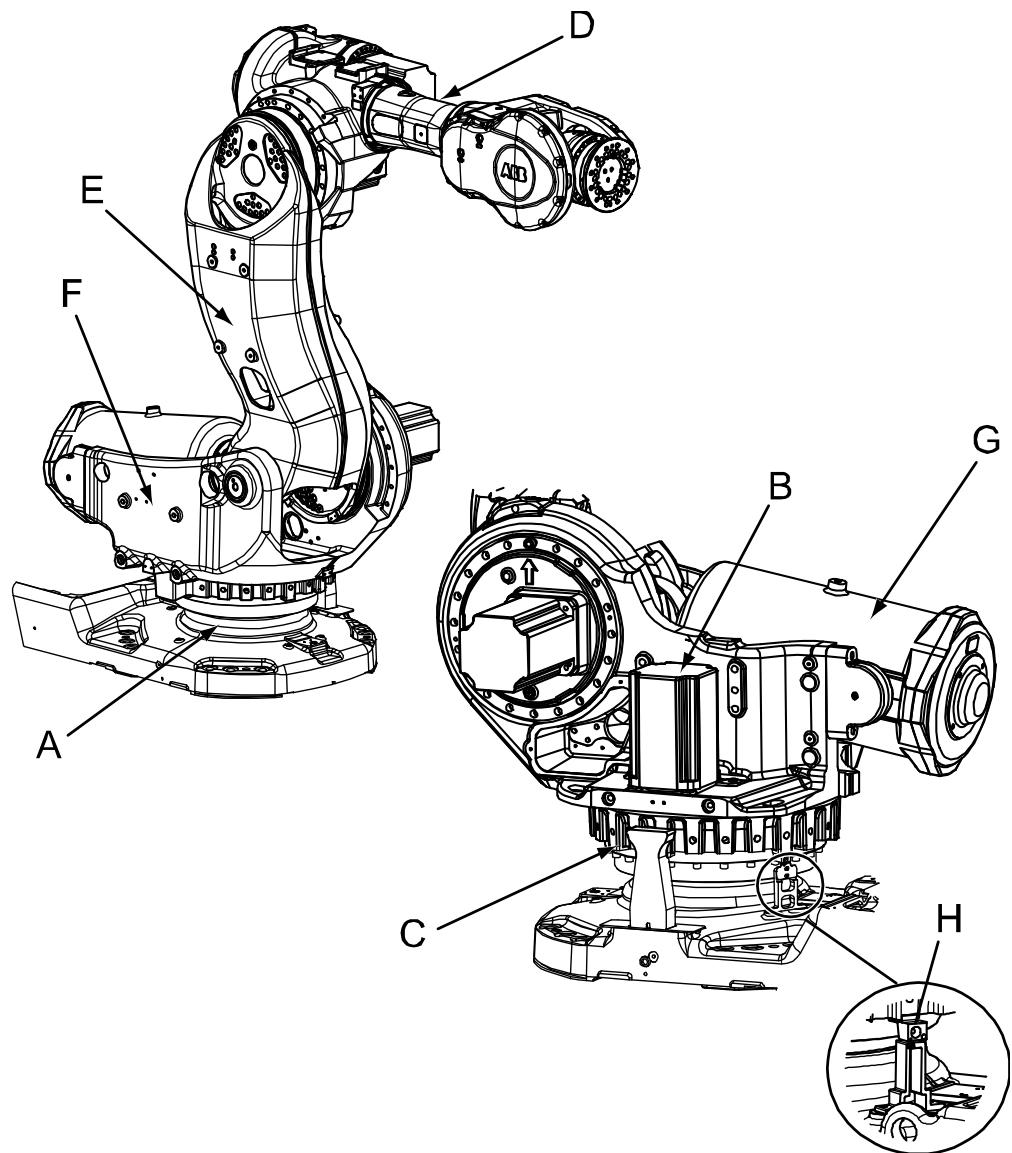
Continued

	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 Location of cable harness ax 5-6 on page 252 .
8	Secure the cable with the cable attachment inside the upper arm.	
9	Refit the left hand side wrist cover with its attachment screws.	
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 Location of cable harness ax 5-6 on page 252 . M6, 2 pcs.
11	Refit the plastic cover on the rear of the upper arm.	
12	Update the revolution counters.	Detailed in section Updating revolution counters on page 411 .

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 Standard tools on page 445 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, complete arm system

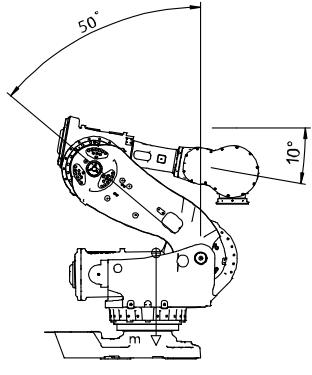
The procedure below details how to lift and remove the complete arm system.

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

Continues on next page

4.3.3 Replacement of complete arm system

Continued

Action	Note
2 Position the robot in its most stable position, as shown in the figure to the right.	If the brakes need to be released, see section Manually releasing the brakes on page 89 . 
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
4 Drain the oil from the gearbox, axis 1.	Detailed in section Changing oil, axis-1 gearbox on page 194 .
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 Removal, motor axis 1 on page 324 .
8 Run the overhead crane to a position above the robot.	
9  CAUTION The complete arm system weighs 2000 kg! All lifting equipment used must be sized accordingly!	
10 Fit the <i>lifting device</i> and adjust it as detailed in enclosed instruction.	Art. no. is specified in Required equipment on page 256 ! Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting device! Read the instructions before lifting!
11 Remove the <i>block for calibration</i> from the bottom of the frame.	Shown in the figure Location of complete arm system on page 255 !

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4 Repair

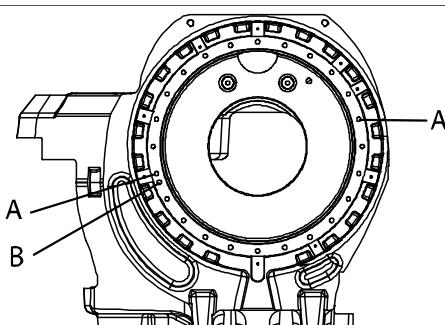
4.3.3 Replacement of complete arm system

Continued

Action	Note
12 Remove the arm system from the base by unscrewing the 24 base attachment screws.	Shown in the figure Location of complete arm system on page 255!
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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
2  CAUTION 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 Required equipment on page 256 .
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.	 xx0300000070 The figure above shows a view from below of the frame. A Attachment holes for the guide pins, M12. B Guiding hole for the spring pin located in the gearbox, axis 1.

Continues on next page

4.3.3 Replacement of complete arm system

Continued

Action	Note
6 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.	This is a complex task to be performed with outmost care in order to avoid injury or damage!
7 Refit 22 of the 24 attachment screws before the arm system is completely lowered.	
8 Remove the guide pins and secure the arm system to the base with the 24 <i>base attachment screws</i> and washers.	Shown in the figure Location of complete arm system on page 255 . 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 Screw joints on page 441 before fitting.
9 Refit the <i>block for calibration</i> at the bottom of the frame.	Shown in the figure Location of complete arm system on page 255 .
10 Refit the motor, axis 1.	Detailed in section Refitting, motor axis 1 on page 325 .
11 Perform a leak-down test.	Detailed in section Performing a leak-down test on page 238 .
12 Refill the gearbox axis 1 with lubricating oil.	Detailed in section Filling, oil, gearbox axis 1 on page 197 .
13 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
14  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

4 Repair

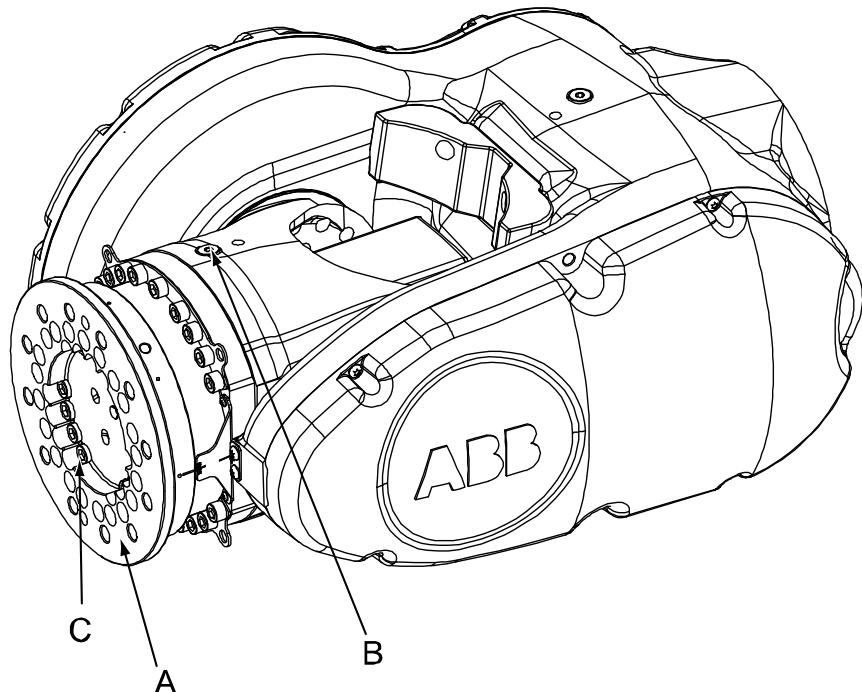
4.4.1 Replacing turning disk

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

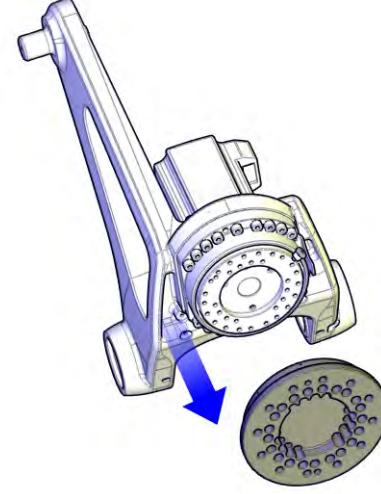
Equipment, etc.	Spare part no.	Art. no.	Note
Turning disk, dia. 250	3HAC13193-1		Does not include o-ring!
Turning disk, insulated	3HAC023124-002		
O-ring		21522012-433	Must be replaced when replacing the turning disk!
Grease		3HAB3537-1	Used to lubricate the o-ring.
Standard toolkit		-	Content is defined in section Standard tools on page 445 .

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
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Drain the oil from gearbox 6.	
3	Remove the <i>attachment screws</i> (33 pcs) securing the turning disk.	Shown in the figure Location of turning disk on page 260 .
4	Remove the <i>turning disk</i> .	 xx1000001135

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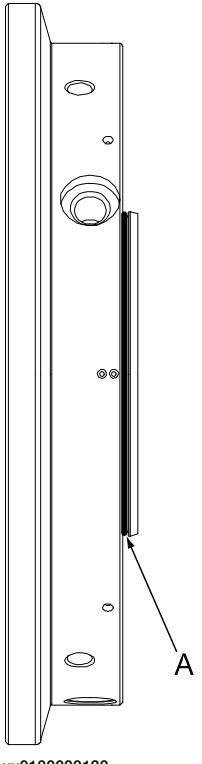
4 Repair

4.4.1 Replacing turning disk

Continued

Refitting turning disk

Use this procedure to refit the turning disk.

Action	Information
<p>1</p> <p> DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot <p>Before entering the robot working area.</p>	
<p>2 Lubricate the o-ring with <i>grease</i> and fit it to the rear of the turning disk.</p>	<p>Art. no. is specified in Required equipment on page 260.</p>  <p>xx0100000130</p> <p>O-ring, turning disk</p>
<p>3 Secure the <i>turning disk</i> with its <i>attachment screws</i>.</p>	<p>Attachment screws:</p> <ul style="list-style-type: none">• M10 x 25, 12.9 quality UNBRAKO• Tightening torque: 50 Nm. <p>Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 441 before fitting.</p>
<p>4 Refill the gearbox, axis 6, with oil.</p>	

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	Action	Information
5	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! <i>on page 55.</i>	

4 Repair

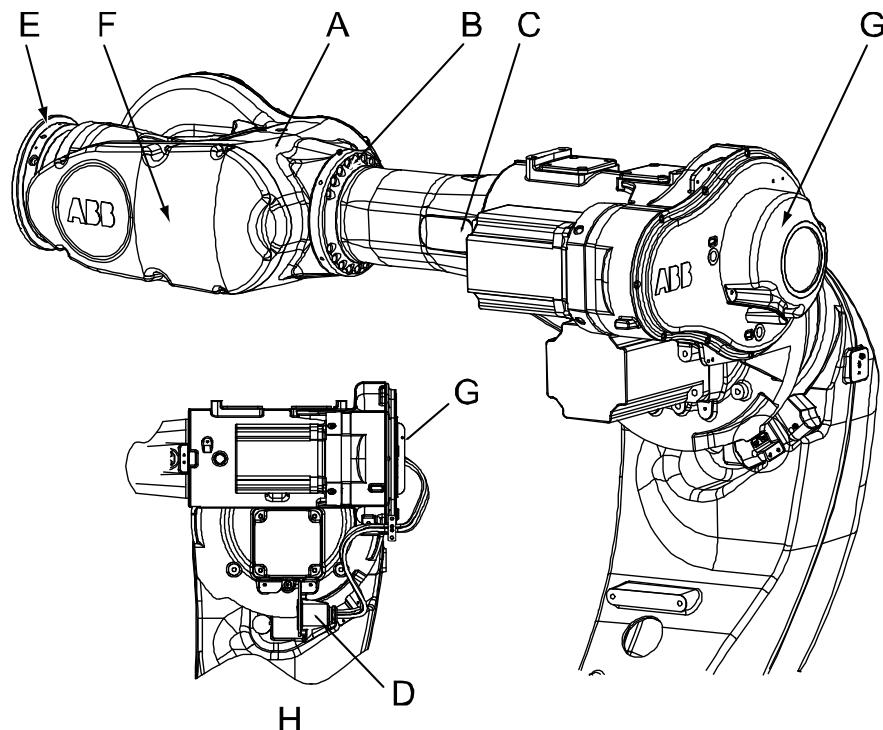
4.4.2 Replacement of complete wrist unit

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 Spare part lists on page 451 .	

Continues on next page

4.4.2 Replacement of complete wrist unit

Continued

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 Standard tools on page 445 .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	-	See chapter Circuit diagram on page 453 .

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

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	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3	Remove 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 Location of wrist unit on page 264 .
5	Remove the cover, axis 5, by unscrewing its attachment screws.	
6	 CAUTION 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 Required equipment on page 264 . 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 Location of wrist unit on page 264 .
9	Disconnect connector R2.M5/6 at the rear cable division point.	Shown in the figure Location of wrist unit on page 264 .
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
 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
 CAUTION 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 Required equipment on page 264 .
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 Required equipment on page 264 .
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 Screw joints on page 441 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 Location of wrist unit on page 264 .
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 Location of wrist unit on page 264 .
12 Refit the <i>rear cover</i> with its attachment screws.	Shown in the figure Location of wrist unit on page 264 .
13 Check the oil levels at gearboxes axis 5 and 6.	Detailed in sections: <ul style="list-style-type: none"> • Inspecting the oil level in axis-5 gearbox on page 163 • Inspecting the oil level in axis-6 gearbox on page 166

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4 Repair

4.4.2 Replacement of complete wrist unit

Continued

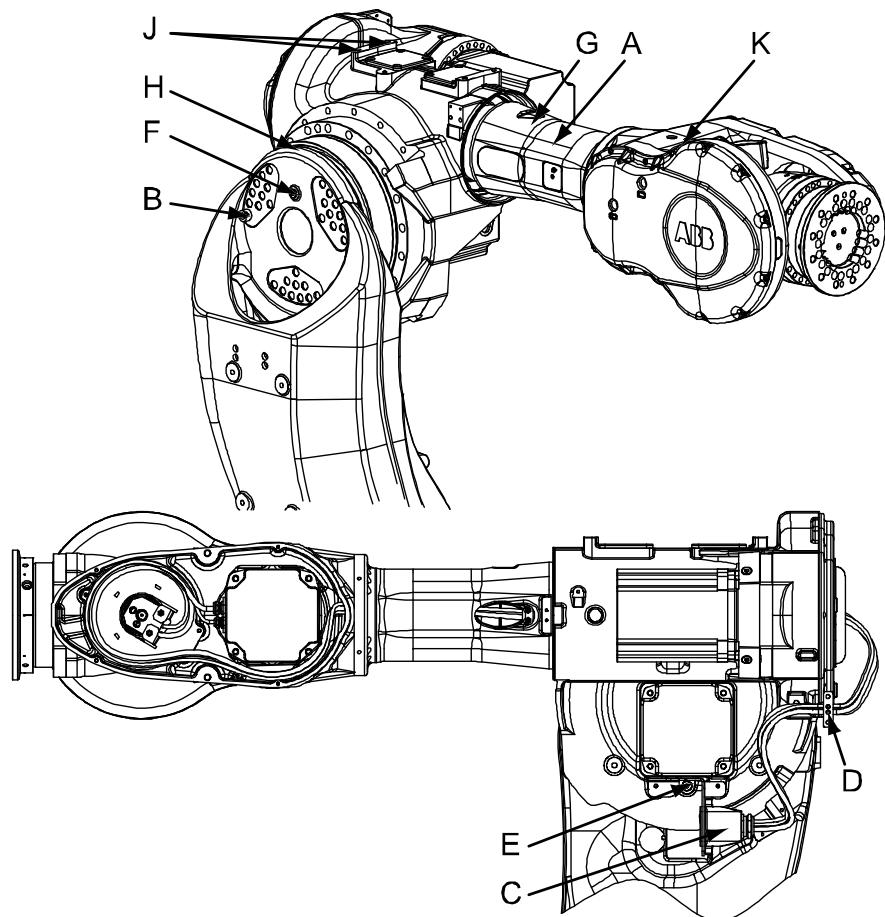
	Action	Note
14	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in <i>Calibrating with Axis Calibration method on page 416</i> . General calibration information is included in section <i>Calibration on page 403</i> .
15	Refit any equipment previously removed from the turning disk.	
16	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 55</i> .	

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

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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 Standard tools on page 445 .
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">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

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4.4.3 Replacement of complete upper arm *Continued*

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	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	 CAUTION 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 Location of upper arm on page 269 . Art. no. is specified in Required equipment on page 270 .
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 Location of upper arm on page 269 . Art. no. is specified in Required equipment on page 270 .
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 Required equipment on page 270 .
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 Changing oil, axis-3 gearbox on page 201 .
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 Location of upper arm on page 269 . 30 pcs.
15	Lift the upper arm and place it on a secure surface.	

Continues on next page

4 Repair

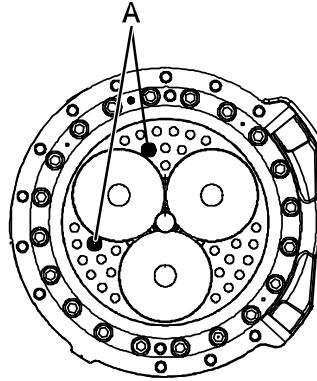
4.4.3 Replacement of complete upper arm

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	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	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 Required equipment on page 270 .  xx0200000125 Holes for guide pins in the gearbox.
3	 CAUTION 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 Location of upper arm on page 269 . Art. no. is specified in Required equipment on page 270 .
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 Location of upper arm on page 269 . Art. no. is specified in Required equipment on page 270 .
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 Required equipment on page 270 .

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 washers 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 Required equipment on page 270 .
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 Location of upper arm on page 269 .
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 Filling, oil on page 203 .
17 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
18  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

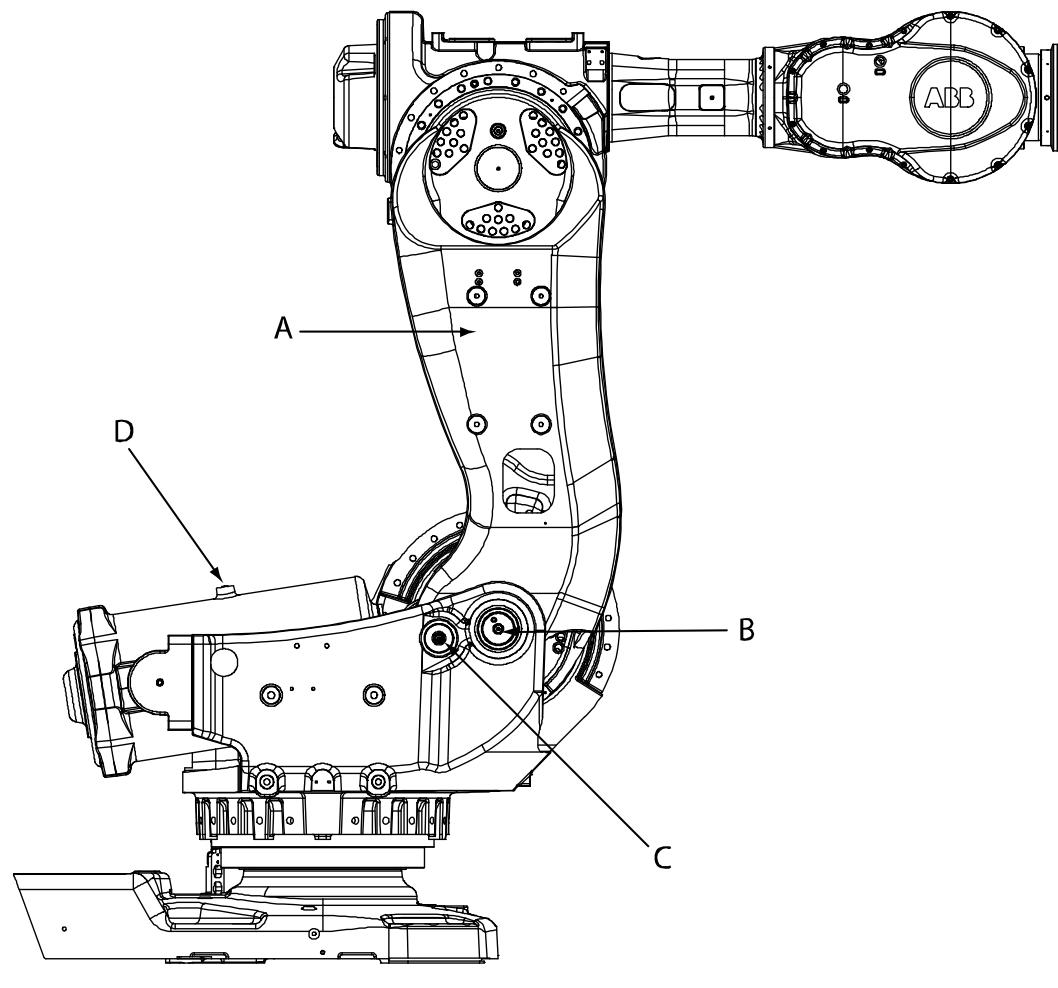
4 Repair

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

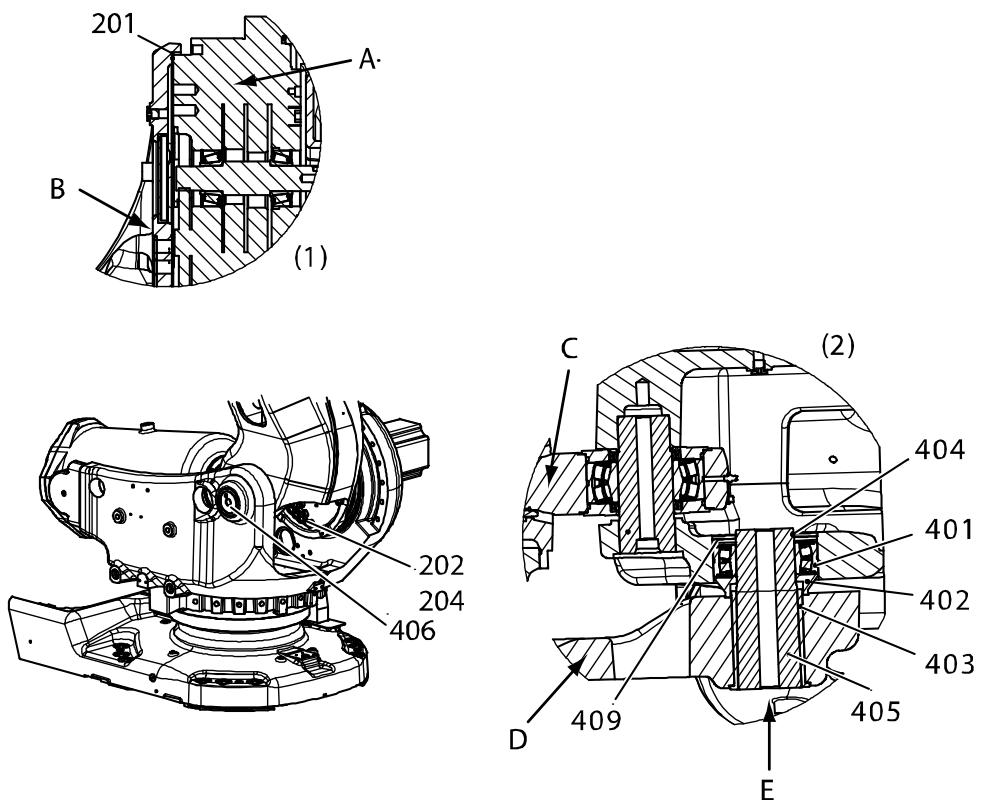
Attachment points, lower arm

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

4.4.4 Replacement of complete lower arm

Continued

xx0200000031

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

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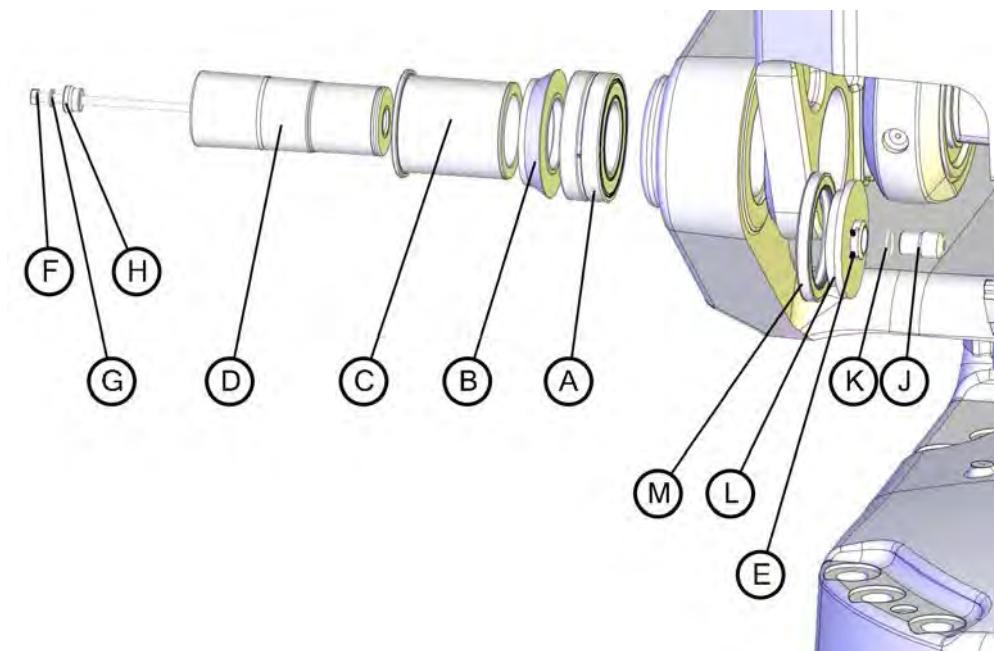
4 Repair

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.



xx1100000954

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.	Spare part no.	Art. no.	Note	
Bearing		3HAC4310-1	Always use a new bearing!	
Sealing, axis 2/3		3HAC17213-1	Always use a new sealing!	
VK cover	3HAA2166-23			

Continues on next page

4.4.4 Replacement of complete lower arm

Continued

Equipment, etc.	Spare part no.	Art. no.	Note	
Lifting tool, lower arm		3HAC14691-1	Tool that may be rented from ABB. Includes <ul style="list-style-type: none">• Guidances, 3HAC14445-1 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.	
Puller tool, balancing device shaft		3HAC12475-1	Used to pull out the shaft from the balancing device front ear.	
Hydraulic pump, 80 MPa		3HAC13086-1	To be used together with the press device, axis 2 shaft and the puller tool.	
Hydraulic pump, 150 MPa (Glycerin)		3HAC021563-012	To be used together with the press tool, axis 2 shaft and the puller tool.	
Press device, axis 2 shaft		3HAC021600-001		
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 Standard tools on page 445 .	
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">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, lower arm

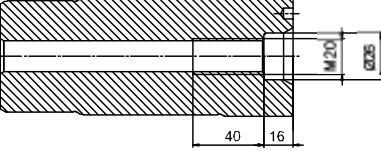
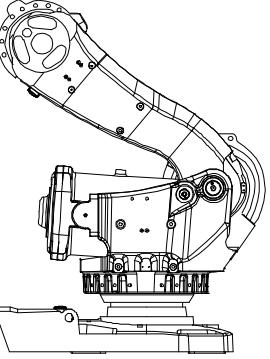
The procedure below details how to remove the complete lower arm.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3 Remove the upper arm.	Detailed in section Replacement of complete upper arm on page 269 .
4 Disconnect and remove the cables from inside the lower arm. Release any cable attachments.	Detailed in section Replacement of cable harness, axes 1-4 on page 243 .

Continues on next page

4.4.4 Replacement of complete lower arm

Continued

	Action	Note
5	Apply the <i>lifting eye</i> to the balancing device and raise to unload the device.	Art. no. is specified in Required equipment on page 276 . Attachment is shown in the figure Location of lower arm on page 274 .
6	Unload the balancing device in order to make the piston rod and front ear adjustable when pulling the front shaft out.	Detailed in section Unloading the balancing device using hydraulic press tool on page 315 .
7	Remove the securing screw from the balancing device <i>front shaft</i> .	Shown in the figure Location of lower arm on page 274 .
8	Apply the <i>shaft puller tool</i> to the shaft through the hole in the frame. The shaft has a M20 thread diameter and a 40 mm depth of thread, as shown in the figure to the right. Pull the shaft out using the puller tool and the <i>hydraulic pump</i> .	Art. no. is specified in Required equipment on page 276 .  xx0300000060  Note The dimension of the shaft puller tool is M20. Do not mix up with the shaft press tool used when mounting the shaft.
9	Lower the balancing device until it rests safely against the bottom of the frame, out of reach from the lower arm.	
10	Move the lower arm backwards to the lowest position possible.	 xx0300000015
11	 CAUTION The lower arm weighs 225 kg! All lifting equipment used must be sized accordingly!	
12	Apply the <i>lifting tool</i> to the lower arm.	Art. no. is specified in Required equipment on page 276 !
13	Drain the oil from gearbox 2.	Detailed in section Changing oil, axis-2 gearbox on page 198 .
14	Raise the tool to unload the lower arm.	

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4 Repair

4.4.4 Replacement of complete lower arm

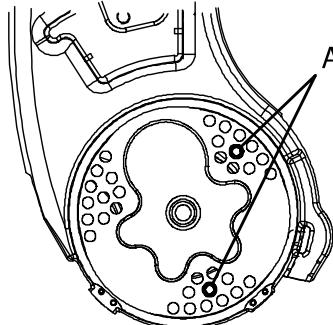
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Action	Note
15 Remove the lower arm shaft and all additional components, as detailed in section Replacement of lower arm shaft on page 283 .	
16 Remove the lower arm <i>attachment screws and washers</i> that attaches the lower arm to the gearbox 2.	Shown in the figure Attachment points, lower arm on page 274 .
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 Attachment points, lower arm on page 274 . On reassembly a new bearing must be used!
19 Remove the <i>sealing</i> from the lower arm.	Shown in the figure Attachment points, lower arm on page 274 . 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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Fit a new <i>VK-cover</i> on new lower arm or replace existing if damaged.	Spare part no. is specified in Required equipment on page 276 .
3 Fit the two <i>guidings</i> in the attachment holes of the lower arm.	Included in the lifting tool, lower arm, art. no. is specified in Required equipment on page 276 .



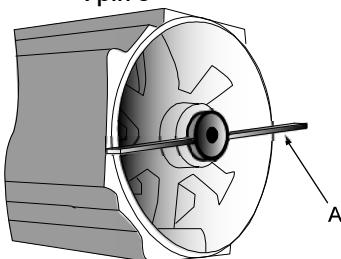
xx0200000262

Attachment holes for the two guidings.

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4.4.4 Replacement of complete lower arm

Continued

Action	Note
4 Fit the new sealing, axis 2/3 on the guidings.	Always use a new sealing when reassembling! Art. no. is specified in Required equipment on page 276 .
5  CAUTION 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.	Art. no. is specified in Required equipment on page 276 .
7 Lift the lower arm and move it to its mounting position.	
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"> • + : pin 2 • - : pin 5  xx0200000165 The rotation tool (A) is used beneath the motor cover, directly on the motor shaft as shown in the figure above! Art. no. is specified in Required equipment on page 276 .
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 Attachment points, lower arm on page 274 .
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 Replacement of lower arm shaft on page 283 .	
12 Refit and restore the balancing device.	Detailed in section Refitting, balancing device on page 311 .
13 Refit the upper arm.	Detailed in section Refitting, upper arm on page 272 .
14 Perform a leak-down test.	Detailed in section Performing a leak-down test on page 238 .
15 Refill the axis 2 gearbox with oil.	Detailed in section Filling, oil on page 199 .

Continues on next page

4 Repair

4.4.4 Replacement of complete lower arm

Continued

	Action	Note
16	Refit and reconnect all cables inside the lower arm. Refit removed cable attachments.	Detailed in section Refitting, cable harness, axes 1-4 on page 247 .
17	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
18	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

4.4.5 Replacement of lower arm shaft

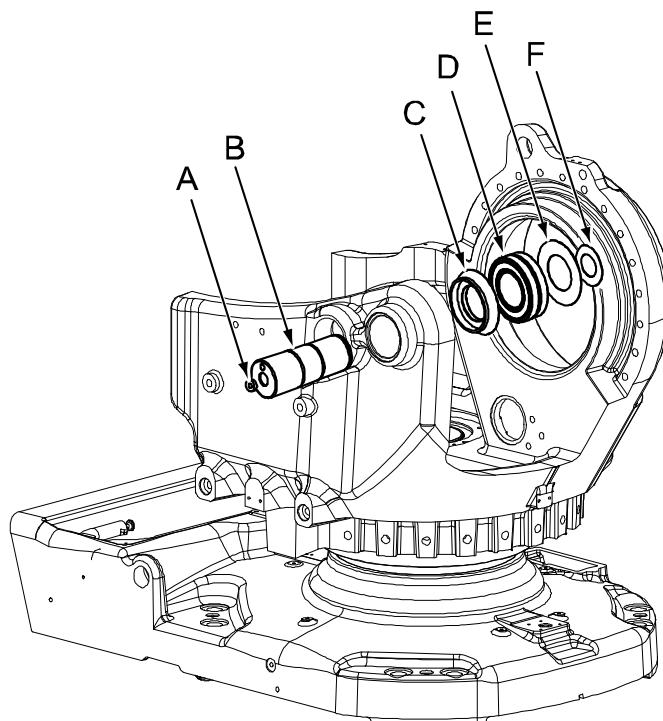
Prerequisites

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 274](#) 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

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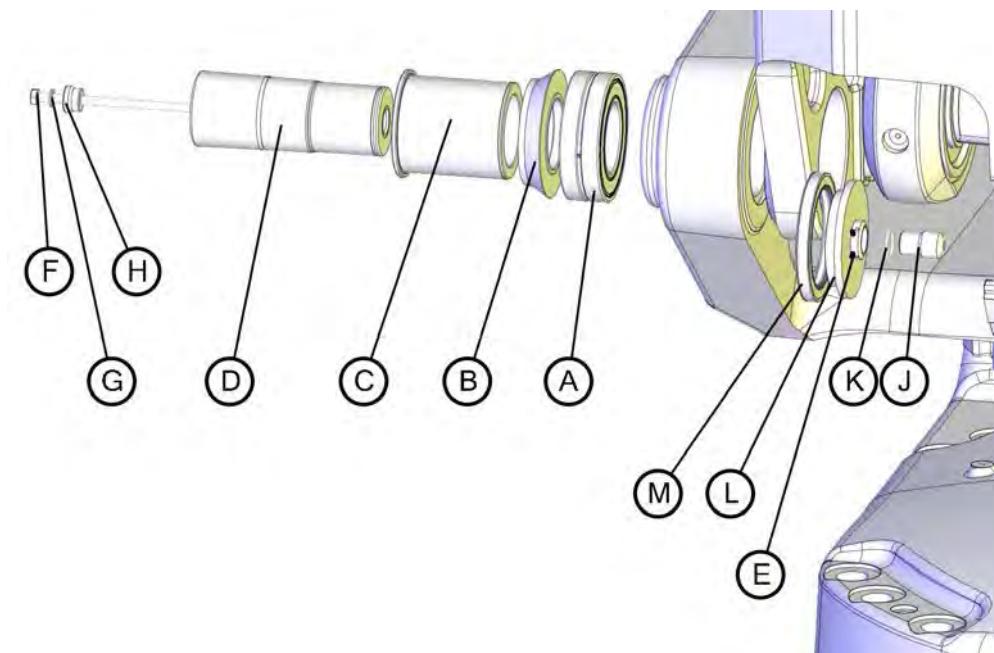
4 Repair

4.4.5 Replacement of lower arm shaft

Continued

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.



xx1100000954

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	Art. no.	Note
Bearing	For spare part number see: • <i>Spare part lists on page 451.</i>	Always use a new bearing when reassembling!
Puller device, axis 2 shaft	3HAC021563-001	
Press device, axis 2 shaft	3HAC021600-001	

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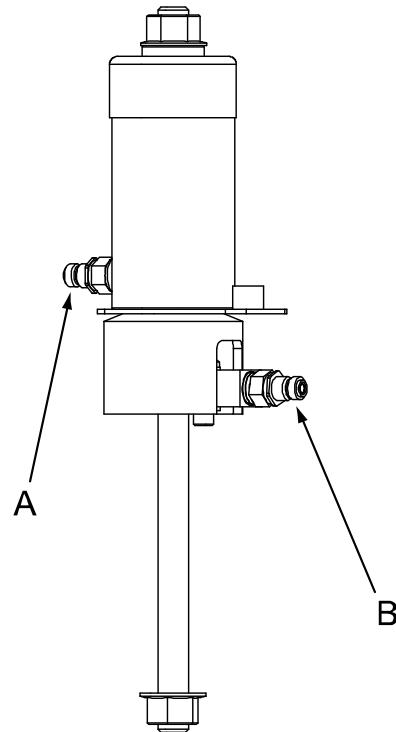
4.4.5 Replacement of lower arm shaft

Continued

Equipment	Art. no.	Note
Hydraulic pump, 80 MPa	3HAC13086-1	
Hydraulic pump, 150 MPa (Glycerin)	3HAC021563-012	
Press tool, axis 2 bearing	3HAC13453-1	
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: • Mercasol 3106
Locking liquid (only for robots with protection Foundry Plus and Foundry Prime)	3HAB7116-1	Loctite 243

Puller device for removal of axis 2 shaft

The illustration below shows the puller tool used to remove the lower arm shaft (axis 2 shaft).



xx0400001029

A	Nipple for the hydraulic pump
B	Nipple for the glycerin pump

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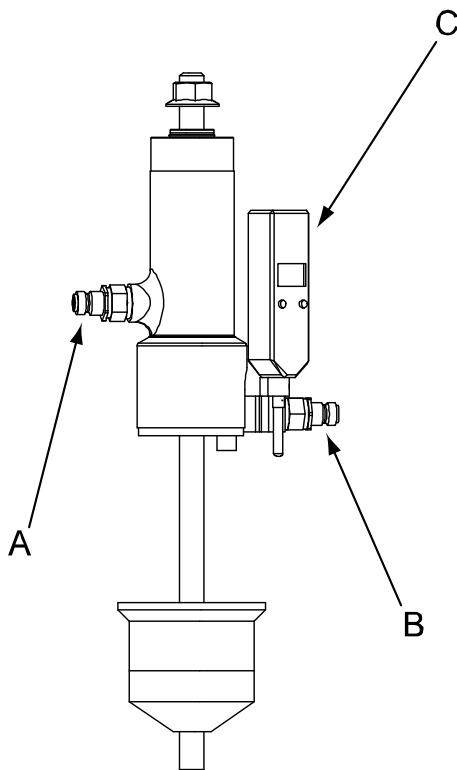
4 Repair

4.4.5 Replacement of lower arm shaft

Continued

Press device for refitting of axis 2 shaft

The illustration below shows the press tool used to refit the lower arm shaft (axis 2 shaft).



xx0400001030

A	Nipple for the hydraulic pump
B	Nipple for the glycerin pump
C	Indicator

Removal, lower arm shaft from robot with protection Standard

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

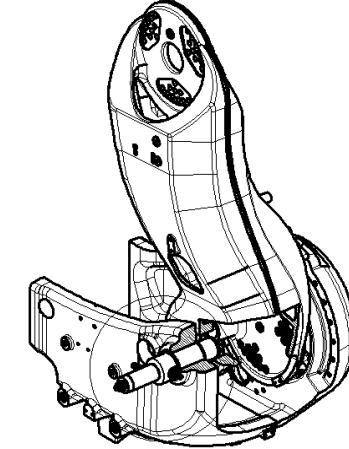
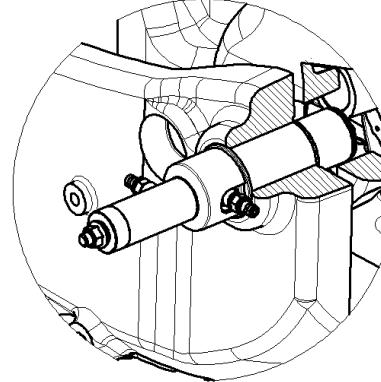
If encountering any problems when removing the shaft, contact ABB Robotics!

Action	Note/Illustration
1  WARNING This procedure is a step in the complete procedure of removing the lower arm! Make sure all the preceding steps specified in Replacement of lower arm shaft on page 283 are made before removing the lower arm shaft!	
2 Remove the protection plug.	Shown in the figure Components, lower arm shaft for robots with protection Standard on page 283 !

Continues on next page

4.4.5 Replacement of lower arm shaft

Continued

Action	Note/Illustration
3 Remove the <i>protection washer</i> and the <i>retaining ring</i> .	Shown in the figure <i>Components, lower arm shaft for robots with protection Standard on page 283!</i> Use a plier for the retaining ring.
4 Fit the <i>puller device</i> to the shaft as shown in the figure to the right.	Art. no. is specified in <i>Required equipment on page 284!</i>
	  xx030000010
5 Fit both the <i>hydraulic pump</i> and the <i>glycerin pump</i> to the puller device.	Art. no. is specified in <i>Required equipment on page 284.</i> The attachments on the tool are shown in figure <i>Puller device for removal of axis 2 shaft on page 285.</i>
6 Increase the pressure of the glycerin pump and, at the same time, pull out the shaft with the puller tool by increasing the pressure of the hydraulic pump.	Note! Do not exceed the limit of maximum pressure classified for the pumps!
7 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 <i>Replacement of complete lower arm on page 274.</i>	

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4 Repair

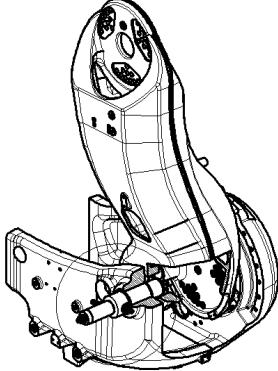
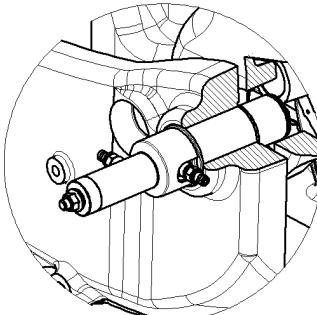
4.4.5 Replacement of lower arm shaft

Continued

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  WARNING This procedure is a step in the complete procedure of removing the lower arm! Make sure all the preceding steps specified in Replacement of lower arm shaft on page 283 are made before removing the lower arm shaft!	
2 Remove the two set screws.	Shown in the figure Components, lower arm shaft for robots with protection Foundry Plus on page 284 .
3 Remove the <i>shaft sealing cover</i> .	
4 Remove the <i>sealing cover</i> .	
5 Remove the <i>radial sealing</i> , if the lower arm is to be replaced with a new one. If the same lower arm is refitted, the radial sealing can be left in the lower arm.	
6 Remove the <i>hexagon bolt</i> with the <i>washer</i> and <i>shaft tap</i> .	
7 Fit the <i>puller device</i> to the shaft as shown in the figure to the right.	Art. no. is specified in Required equipment on page 284 !   xx0300000010

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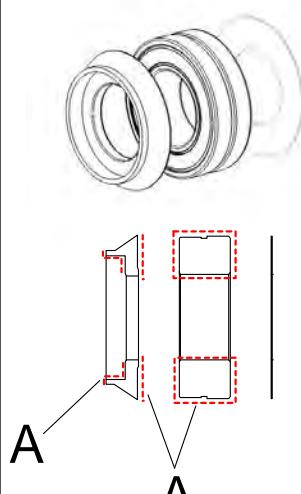
4.4.5 Replacement of lower arm shaft

Continued

Action	Note
8 Fit both the <i>hydraulic pump</i> and the <i>glycerin pump</i> to the puller device.	Art. no. is specified in Required equipment on page 284 . The attachments on the tool are shown in figure Puller device for removal of axis 2 shaft on page 285 .
9 Increase the pressure of the glycerin pump and, at the same time, pull out the shaft with the puller tool by increasing the pressure of the hydraulic pump.	Note! Do not exceed the limit of maximum pressure classified for the pumps!
10 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 Replacement of complete lower arm on page 274 .	

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 Clean the shaft with <i>isopropanol</i> and lubricate it with <i>grease</i> .	Art. no. is specified in Required equipment on page 284 !
2 If the robot is going to work in a water jet application cell: Apply Mercasol 3106 on the Support shaft axis 2. • Apply Mercasol 3106 on both sides of the thrust washer, all around the bearing and on surface on the shaft.	 Apply mercas • A: Mercasol on marked areas.
3 Push the shaft in by hand.	
4 Refit the <i>thrust washer</i> to the shaft.	Also shown in the figure Components, lower arm shaft for robots with protection Standard on page 283 !
5 Apply the <i>press device</i> , <i>axis 2 shaft</i> against the shaft.	Art. no. is specified in Required equipment on page 284 !
6 Tighten the M16 nut.	Tightening torque: 20 Nm.

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4 Repair

4.4.5 Replacement of lower arm shaft

Continued

Action	Note/Illustration
7 Fit both the <i>hydraulic pump</i> and the <i>glycerin pump</i> to the press device.	Art. no. is specified in Required equipment on page 284 . The attachments on the tool are shown in the figure Press device for refitting of axis 2 shaft on page 286 .
8 Set the <i>indicator</i> on the press device to zero.	Shown in the figure Press device for refitting of axis 2 shaft on page 286 .
9 Press in the shaft with the hydraulic cylinder by setting the pressure of the hydraulic pump to approximately 35-55 MPa and the pressure of the glycerin pump to 55 MPa.	
10 Increase the pressure of the both pumps alternately until the correct value is reached with the indicator on the press tool.	Correct value: 2.45 mm ± 0.15 mm.  Note Do not exceed the limit of maximum pressure classified for the pumps!
11 When a correct value is reached, release the pressure from the glycerin pump first, then from the hydraulic pump (approximately 1/2 minute after), in order to avoid movement of the shaft.	
12 Remove the press device, axis 2 shaft.	
13 Apply grease to the location of the shaft where the bearing is to be mounted.	Art. no. is specified in Required equipment on page 284
14 Press in the new <i>bearing</i> with the <i>press tool, axis 2 bearing</i> .	Always use a new bearing when reassembling! Art. no. is specified in Required equipment on page 284 .
15 Refit the <i>protection washer</i> and the <i>retaining ring</i> .	Shown in the figure Components, lower arm shaft for robots with protection Standard on page 283 .
16 Refit the <i>protection plug</i> .	
17 Proceed with the refitting procedure of the lower arm, detailed in section Replacement of complete lower arm on page 274 .	

Refitting, lower arm shaft on robot with protection Foundry Plus

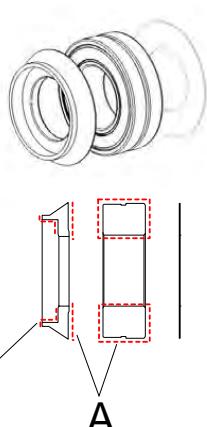
Use this procedure to refit the lower arm shaft if the robot has protection Foundry Plus.

Action	Note/Illustration
1 Clean the shaft with <i>isopropanol</i> and lubricate it with <i>grease</i> .	Art. no. is specified in Required equipment on page 284 !

Continues on next page

4.4.5 Replacement of lower arm shaft

Continued

Action	Note/Illustration
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"> • Apply Mercasol 3106 on both sides of the thrust washer, all around the bearing and on surface on the shaft. 	 <p>Apply mercas 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 <i>Components, lower arm shaft for robots with protection Foundry Plus on page 284!</i>
5 Apply the <i>press device, axis 2 shaft</i> against the shaft.	Art. no. is specified in <i>Required equipment on page 284!</i>
6 Tighten the M16 nut.	Tightening torque: 20 Nm.
7 Fit both the <i>hydraulic pump</i> and the <i>glycerin pump</i> to the press device.	Art. no. is specified in <i>Required equipment on page 284</i> . The attachments on the tool are shown in the figure <i>Press device for refitting of axis 2 shaft on page 286</i> .
8 Set the <i>indicator</i> on the press device to zero.	Shown in the figure <i>Press device for refitting of axis 2 shaft on page 286</i> .
9 Press in the shaft with the hydraulic cylinder by setting the pressure of the hydraulic pump to approximately 35-55 MPa and the pressure of the glycerin pump to 55 MPa.	
10 Increase the pressure of the both pumps alternately until the correct value is reached with the indicator on the press tool.	Correct value: $2.45 \text{ mm} \pm 0.15 \text{ mm}$. Note! Do not exceed the limit of maximum pressure classified for the pumps!
11 When a correct value is reached, release the pressure from the glycerin pump first, then from the hydraulic pump (approximately 1/2 minute after), in order to avoid movement of the shaft.	
12 Remove the press device, axis 2 shaft.	
13 Apply <i>grease</i> to the location of the shaft where the bearing is to be mounted.	Art. no. is specified in <i>Required equipment on page 284</i>

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4 Repair

4.4.5 Replacement of lower arm shaft

Continued

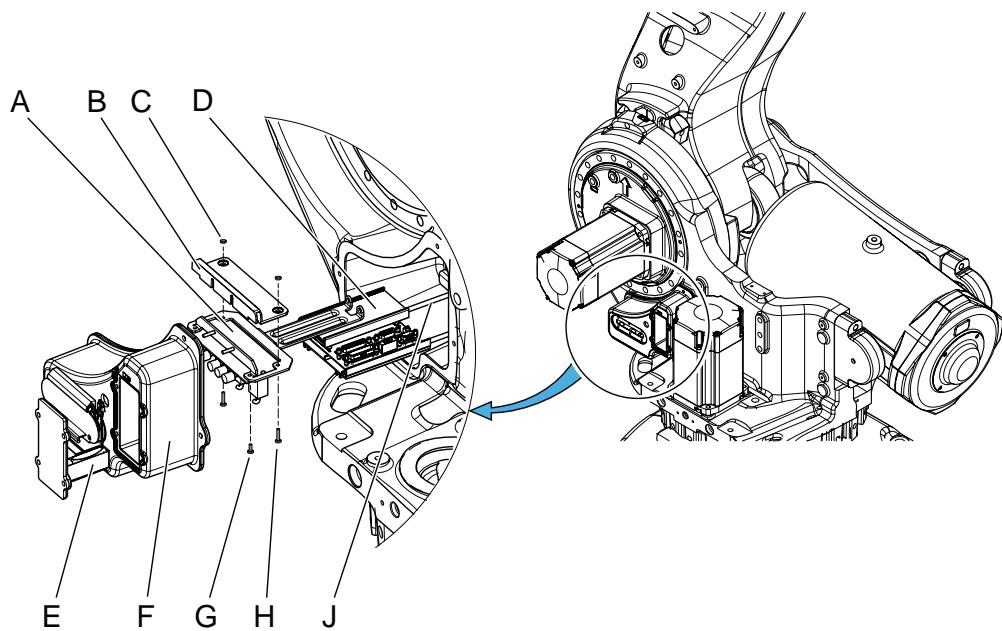
Action	Note/Illustration
14 Press in the new <i>bearing</i> with the <i>press tool, axis 2 bearing</i> .	Always use a new bearing when reassembling! Art. no. is specified in Required equipment on page 284 .
15 Fit a <i>radial sealing</i> to the lower arm, if there is none left during removal of the arm.	Shown in the figure Components, lower arm shaft for robots with protection Foundry Plus on page 284 .
16 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.	
17 Fit the <i>shaft for the sealing cover</i> onto the hexagon bolt and tighten the bolt with torque: 24 Nm.	
18 Check the <i>o-ring</i> in the sealing cover. Replace if damaged.	
19 Refit the <i>sealing cover</i> onto the shaft. Press it tightly against the radial sealing while tightening the set screws. Use locking liquid.	
20 Proceed with the refitting procedure of the lower arm, detailed in section Replacement of complete lower arm on page 274 .	

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.



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



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

4 Repair

4.5.1 Replacing the SMB unit

Continued

Equipment, etc.	Art. no.	Note
SMB unit	For spare part number, see: Spare part lists on page 451 .	
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
Circuit diagram	-	See chapter Circuit diagram on page 453 .

Removing, SMB unit

Use this procedure to remove the SMB unit.

	Action	Note
1	Move the robot to the calibration position.	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3	 xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	
4	Remove the <i>SMB cover</i> by unscrewing its attachment screws.	Shown in the figure Location of SMB unit on page 293 .
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 <i>guide pins</i> that secure the board.	Shown in the figure Location of SMB unit on page 293 .
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
8	Disconnect the <i>battery cable</i> from the SMB unit.	Shown in the figure Location of SMB unit on page 293 .

Continues on next page

Refitting, SMB unit

Use this procedure to refit the SMB unit.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	 xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58 .	
3	Connect the <i>battery cable</i> to the SMB unit.	Shown in the figure Location of SMB unit on page 293 .
4	Connect all connectors to the SMB board: R1.SMB1-3, R1.SMB4-6 and R2.SMB	Art. no. is specified in Required equipment on page 293 . Shown in the figure Location of SMB unit on page 293 .
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.	
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 Location of SMB unit on page 293 .
9	Update the revolution counter!	See Updating revolution counters on page 411 .
10	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

4 Repair

4.5.2 Replacement of brake release board

4.5.2 Replacement of brake release board

Different designs

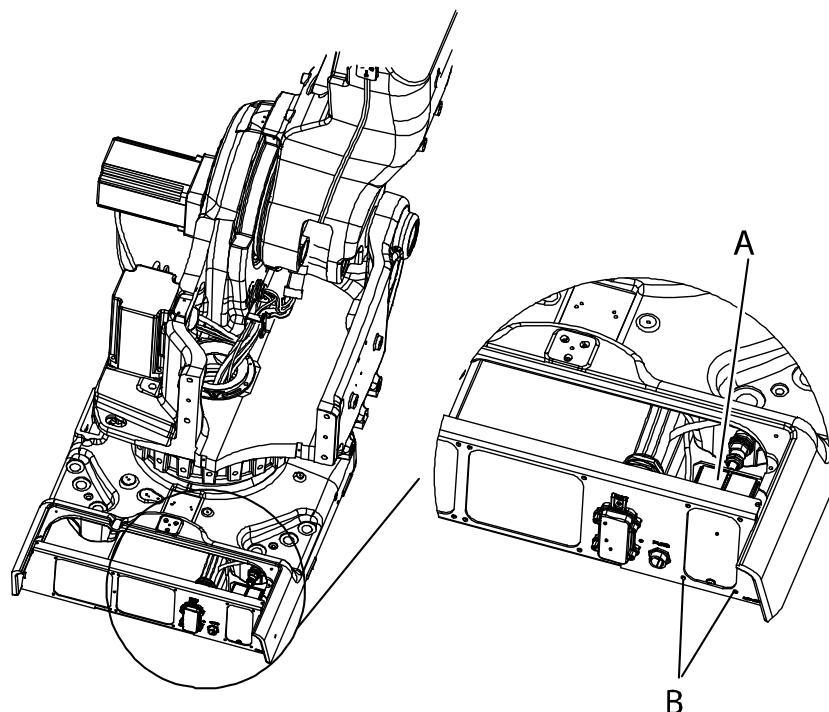
Depending on the robot version, the brake release board may be located either at the base or at the frame. The following two figures show the different locations.

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.



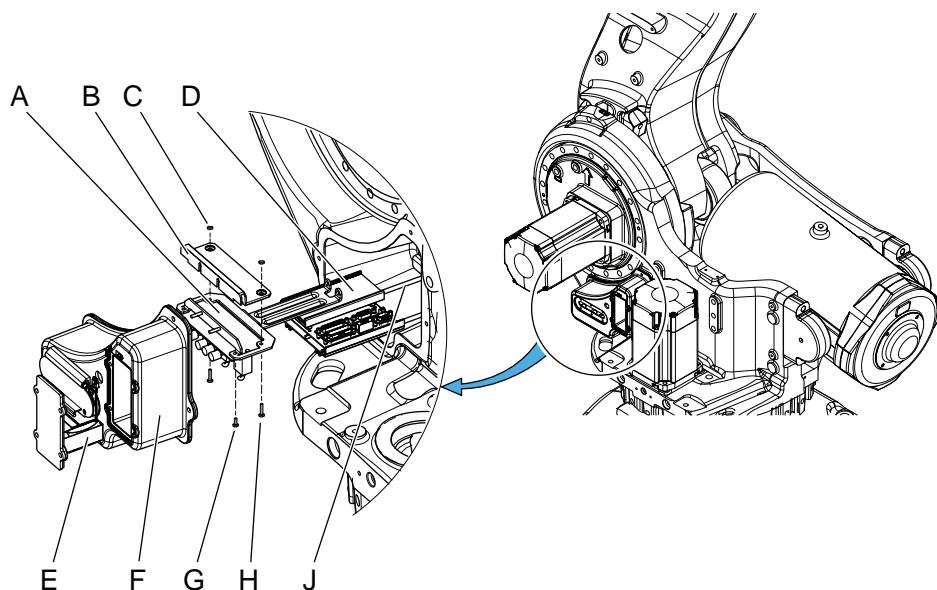
xx0200000127

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 no.	Note
Brake release circuit without buttons, at base	3HAC14219-1	Brake release at the base, according to figure Location of brake release board, base on page 296 . Includes brake release unit 3HAC14228-1.
Brake release circuit with buttons, at base	3HAC12989-1	Brake release at the base, according to figure Location of brake release board, base on page 296 . Includes brake release board 3HAC16036-1.
Brake release board with buttons, at frame	3HAC16036-1	Brake release unit at the frame, according to figure Location of brake release board, frame on page 297 .
Push button guard	3HAC2744-1	

Continues on next page

4 Repair

4.5.2 Replacement of brake release board

Continued

Equipment, etc.	Spare part no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
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 296](#).

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
2	 xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	
3	Remove the cover at the rear of the base.	
4	Unscrew the four attachment screws, <i>brake release circuit</i> on the outside of the base.	Shown in the figure Location of brake release board, base on page 296 .
5	Disconnect the cable from the brake release circuit and remove the circuit from the base.	

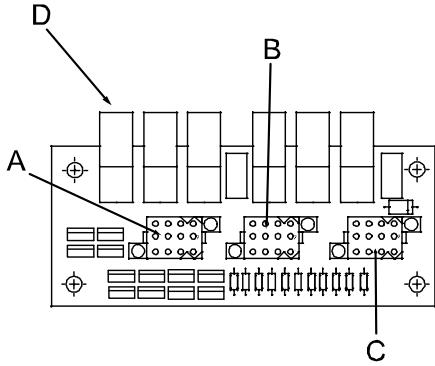
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4.5.2 Replacement of brake release board

Continued

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 297](#).

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	 xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	
3	Remove the <i>push button guard</i> from the SMB cover.	Shown in the figure Location of brake release board, frame on page 297 . 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 Location of brake release board, frame on page 297 .
5	Disconnect the connectors X8, X9 and X10 from the brake release board.	 xx0200000129 <ul style="list-style-type: none"> • A: Connector X8 • B: Connector X9 • C: Connector X10 • D: Push buttons for each axis
6	Unscrew the two <i>attachment screws</i> , <i>brake release unit</i> .	Shown in the figure Location of brake release board, frame on page 297 .

Continues on next page

4 Repair

4.5.2 Replacement of brake release board

Continued

Action	Note
7 Unscrew the two attachment screws and nuts, brake unit cover, and remove the brake unit cover.	Shown in the figure Location of brake release board, frame on page 297!
8 Remove the brake release board from the plate.	Shown in the figure Location of brake release board, frame on page 297!

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 296](#).

Action	Note
1  xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	
2 Place the <i>brake release unit</i> in the base of the robot.	Spare part no. is specified in Required equipment on page 297 . Shown in the figure Location of brake release board, base on page 296 .
3 Reconnect the cable to the brake release unit.	
4 Secure the <i>SMB cover</i> with its attachment screws.	Shown in the figure Location of brake release board, base on page 296 .
5 Refit the cover of the rear of the base.	

Refitting of brake release board, located on frame

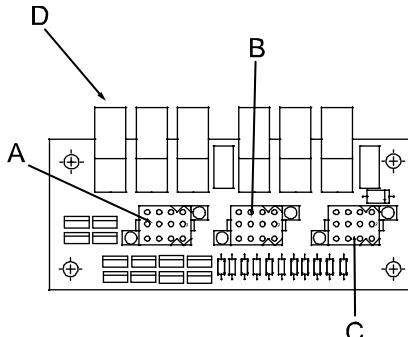
The procedure below details how to refit the brake release board, located on the side of the frame. See the figure [Location of brake release board, frame on page 297](#).

Action	Note
1  xx0200000023 WARNING! The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 58	
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.	Shown in the figure Location of brake release board, frame on page 297 . Spare part no. is specified in Required equipment on page 297 .

Continues on next page

4.5.2 Replacement of brake release board

Continued

Action	Note
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 <i>attachment screws and nuts, brake unit cover</i> .	
5 Connect the connectors X8, X9 and X10 to the brake release board.	 <p>xx0200000129</p> <p>A Connector X8 B Connector X9 C Connector X10 D Push buttons</p>
6 Refit the <i>SMB cover</i> with its attachment screws.	Shown in the figure Location of brake release board, frame on page 297 .
7  WARNING Before continuing any service work, please observe the safety information in section WARNING - The brake release buttons may be jammed after service work on page 56!	
8 Refit the <i>push button guard</i> on the SMB cover.	Shown in the figure Location of brake release board, frame on page 297 .
9 If the battery has been disconnected the revolution counters must be updated.	Detailed in section Updating revolution counters on page 411 .
10  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

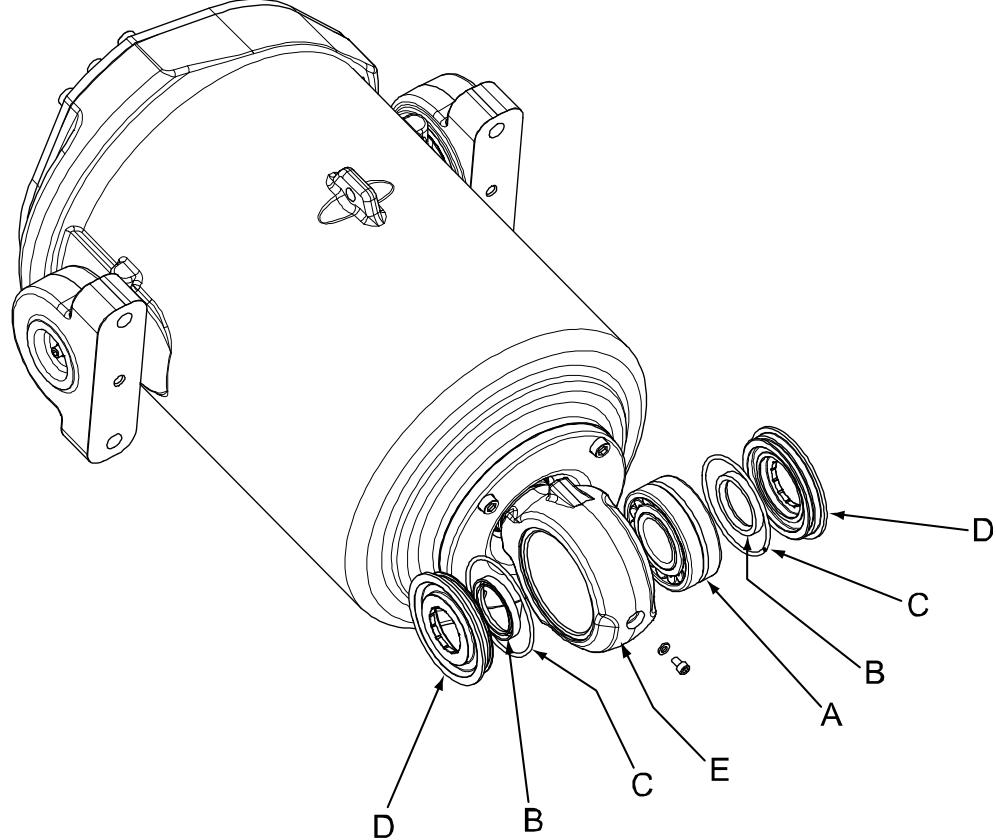
4 Repair

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		3HAB3537-1	For lubrication of the components.

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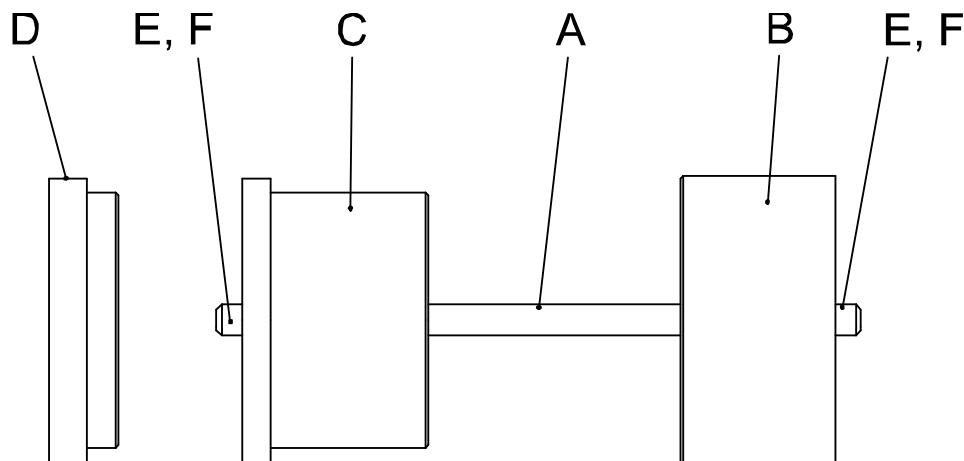
4.5.3 Replacement of spherical roller bearing, balancing device

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.

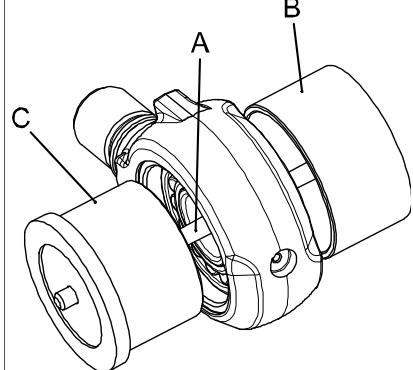
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

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 Replacing the balancing device on page 307 .
3 Remove the both <i>sealing spacers</i> with a screwdriver or any equal tool.	Shown in the figure Location of bearing on page 302 .
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.	 xx0500002255 <ul style="list-style-type: none"> A Threaded bar 3HAC15945-1 B Dolly 3HAC15948-1 C Press tool 3HAC15941-1
6 Press out the bearing from the front ear.	

Refitting, spherical roller bearing

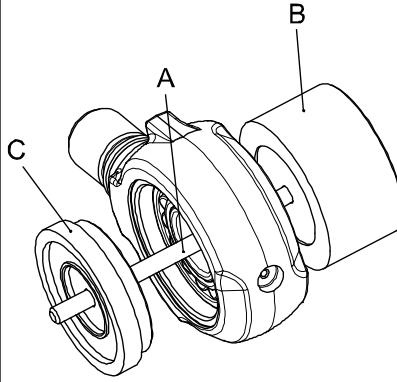
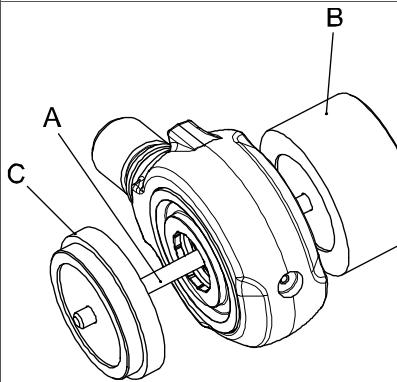
Use this procedure to refit the spherical roller bearing to the balancing device front ear.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 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 Insert the threaded bar through the new bearing 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. Secure with the nut and washer at each end.	Spare part no. is specified in Required equipment on page 302 .  xx0500002257 A Threaded bar 3HAC15945-1 B Dolly 3HAC15948-1 C Press tool 3HAC15846-1
4 Press in the bearing properly inside the ear.	
5 Apply grease to the new sealing rings and o-rings and fit one of each to the new sealing spacers. Also, grease the sealing spacers.	Spare part no:s are specified in Required equipment on page 302 .
6 Press in the sealing spacers with the press tools, as shown in the figure to the right. Secure the press tool and dolly with nuts and washers.  Note Fit the sealing spacers one at a time!	  xx0500002258 A Threaded bar 3HAC15945-1 B Dolly 3HAC15948-1 C Press tool 3HAC15846-1
7 Refit the balancing device to the robot.	Detailed in section Refitting, balancing device on page 311 .
8 Lubricate the spherical roller bearing in the ear.  Note The balancing device must be mounted on the robot when lubrication is performed!	Detailed in section Lubrication of spherical roller bearing, balancing device on page 220
9 Make sure no incorrect leakage occurs. It could indicate damaged o-rings.	This is detailed in section Check for leakage on page 172 .

Continues on next page

4 Repair

4.5.3 Replacement of spherical roller bearing, balancing device

Continued

	Action	Note
10	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! <i>on page 55.</i>	

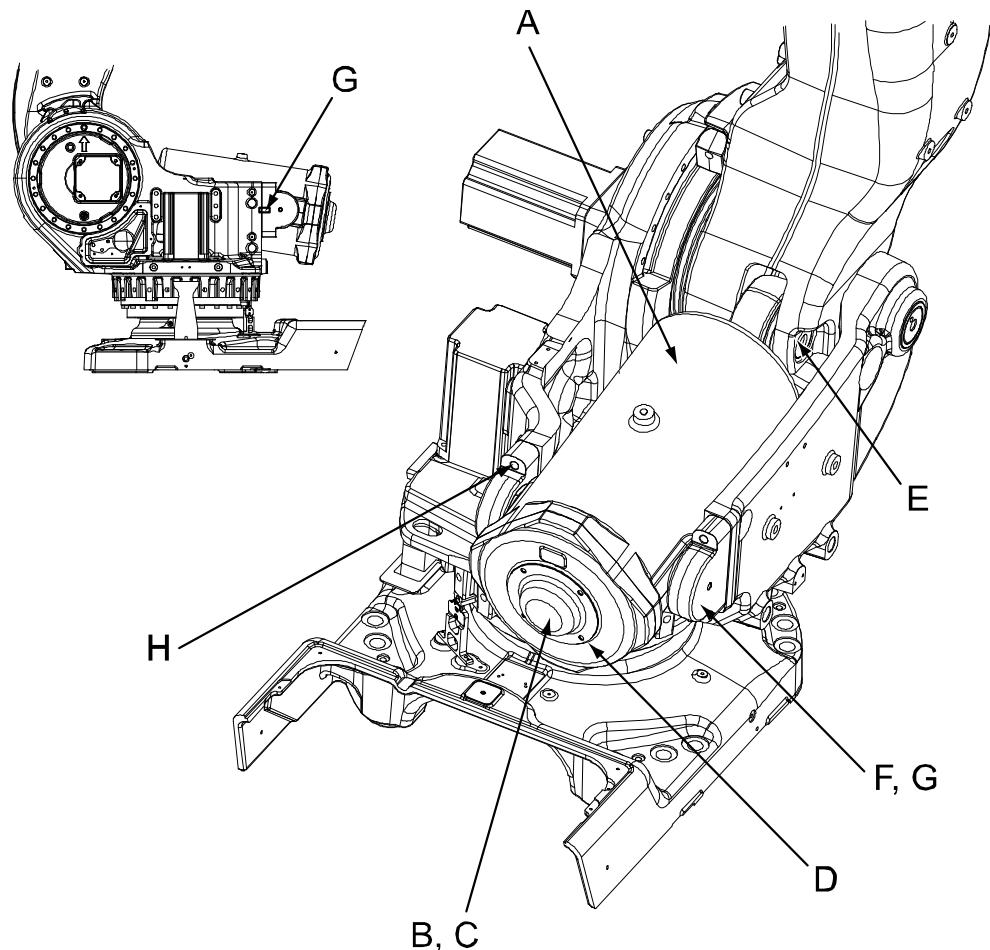
4.5.4.1 Replacing the balancing device

4.5.4 Replacement of balancing device

4.5.4.1 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

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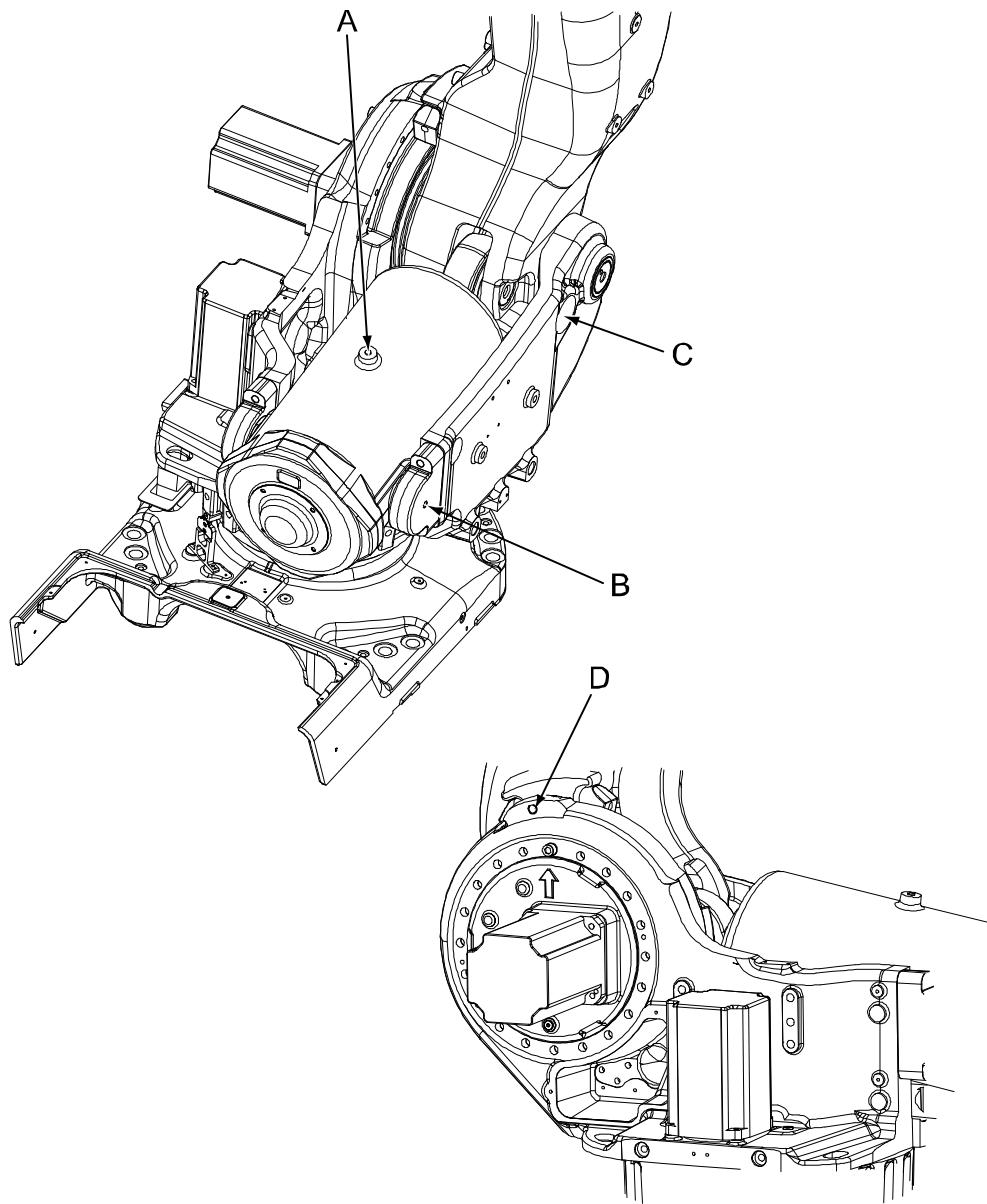
4 Repair

4.5.4.1 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

4.5.4.1 Replacing the balancing device
Continued

Required equipment

Equipment	Spare part no.	Art. no.	Note
Balancing device	See <i>Spare part lists on page 451</i> .		Includes: <ul style="list-style-type: none"> • balancing device 3HAC14675-1 or 3HAC023018-001 • o-ring 3HAB3772-44 (2 pcs)
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		3HAB3537-1	For lubricating the o-rings and the shaft.
Grease		3HAA1001-294	150 ml, Optimol PDO 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.
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 tool, balancing device		3HAC020902-001	
Puller tool, balancing device shaft		3HAC12475-1	
Press tool, balancing device shaft		3HAC17129-1	
Hydraulic cylinder		3HAC11731-1	To be used with the press and puller tools.
Hydraulic pump, 80 MPa		3HAC13086-1	To be used with the hydraulic cylinder.
Standard toolkit		-	Content is defined in section <i>Standard tools on page 445</i> .

Continues on next page

4 Repair

4.5.4.1 Replacing the balancing device

Continued

Equipment	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.

Removal, balancing device

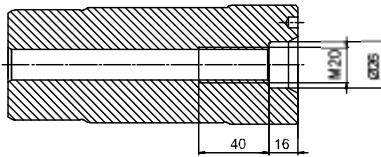
The procedure below details how to remove the balancing device.

	Action	Note
1	Move the lower arm to a position close to the calibration position.	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3	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 Attachment points, balancing device on page 308 . Art. no. is specified in Required equipment on page 309 !
4	 CAUTION 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 Required equipment on page 309 ! Attachments are shown in the figure Attachment points, balancing device on page 308 .
6	Unload the balancing device with the <i>press tool</i> in order to make the piston rod and front ear adjustable when pulling the shaft out.	Art. no. is specified in Required equipment on page 309 ! Detailed in section Unloading the balancing device using hydraulic press tool on page 315 .
7	Remove the securing screw and washer from the <i>balancing device shaft</i> .	Shown in the figure Location of balancing device on page 307 !

Continues on next page

4.5.4.1 Replacing the balancing device

Continued

Action	Note
8 Apply the <i>puller tool, balancing device shaft</i> to the shaft through the hole in the frame. The shaft has a M20 thread diameter, as shown in the figure to the right. Pull the shaft out using the puller tool and the <i>hydraulic pump</i> .	Art. no. is specified in Required equipment on page 309 ! The hole in the frame is shown in the figure Attachment points, balancing device on page 308 !  xx0300000060  Note The dimension of the shaft puller tool is M20. Do not mix up with the shaft press tool used when mounting the shaft.
9 Restore the balancing device.	Detailed in section Restoring the balancing device using a hydraulic press tool on page 319 .
10 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!	Shown in the figure Attachment points, balancing device on page 308 ! Dimensions for the securing screws are specified in Required equipment on page 309 .
11 Remove the two <i>bearing attachments</i> from the frame by unscrewing their four <i>attachment screws</i> .	Shown in the figure Location of balancing device on page 307 ! Make sure the parallel pins inside are not lost!
12 Fit two <i>guide pins</i> through the upper holes of the bearing attachments, to the frame.	Art. no. is specified in Required equipment on page 309 !
13 Lift the balancing device gently backwards to a secure area, allowing the bearing attachments to slide on the guide pins.	 Note Make sure not to burden the guide pins with the weight of the balancing device!

Refitting, balancing device

The procedure below details how to refit the balancing device.

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

Continues on next page

4 Repair

4.5.4.1 Replacing the balancing device

Continued

	Action	Note
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 Required equipment on page 309! Attachment hole is shown in the figure Attachment points, balancing device on page 308 .
3	Secure the <i>bearing attachments</i> to the balancing device with <i>securing screws</i> .	Shown in the figure Attachment points, balancing device on page 308! Dimension of the securing screws is specified in Required equipment on page 309 .
4	Refit the two <i>parallel pins</i> in the frame.	Shown in the figure Location of balancing device on page 307 !
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 Required equipment on page 309! Attachments are shown in the figure Attachment points, balancing device on page 308 .
7	 CAUTION 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.	 Note Make sure not to burden the guide pins with the weight of the balancing device!
9	Remove the guide pins.	
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 Location of balancing device on page 307 ! 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 Screw joints on page 441 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.	

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4.5.4.1 Replacing the balancing device
Continued

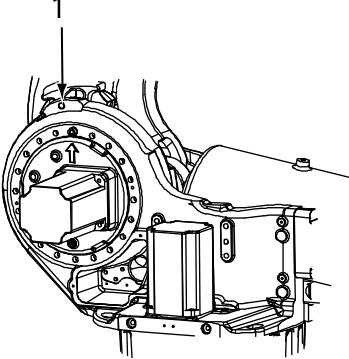
	Action	Note
13	Unload the balancing device with the <i>press tool</i> .	Detailed in section Unloading the balancing device using hydraulic press tool on page 315 . Art. no. is specified in Required equipment on page 309 ! For an easier reassembling of the shaft, the piston rod may be pressed out more than necessary and then pressed in when fitting the shaft.
14	Lubricate the shaft with grease.	Art. no. is specified in Required equipment on page 309 !
15	Apply the <i>shaft press tool</i> to the lubricated <i>shaft</i> . Fit the shaft to the piston shaft front eye through the hole in the frame, using the <i>shaft press tool</i> and the <i>hydraulic pump</i> .	The hole in the frame is shown in the figure Attachment points, balancing device on page 308 ! Art. no. is specified in Required equipment on page 309 !  Note Make sure the shaft is pressed all the way to the bottom.
16	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 Required equipment on page 309 !
17	Lubricate the bearing in the ear with <i>grease</i> through the lubricating nipple, with a <i>grease pump</i> . Fill until excessive grease pierces between the shaft and the sealing spacer.	Art. no. and amount are specified in Required equipment on page 309 ! Lubrication is further detailed in section Lubrication of spherical roller bearing, balancing device on page 220 .
18	Restore the balancing device.	Detailed in section Restoring the balancing device using a hydraulic press tool on page 319 .
19	 DANGER 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!	

Continues on next page

4 Repair

4.5.4.1 Replacing the balancing device

Continued

Action	Note
20 Remove the locking screw that secures the lower arm to the frame.	 xx0200000454 1 Attachment hole for the securing screw.
21  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 55</i> .	

4.5.4.2 Unloading the balancing device using hydraulic press tool

4.5.4.2 Unloading the balancing device using hydraulic press tool**Prerequisite**

This section details how to unload the balancing device using the hydraulic press tool.

The lower arm must be secured before unloading the balancing device! How to secure the lower arm is detailed in the current repair activity, for example removal of the balancing device.

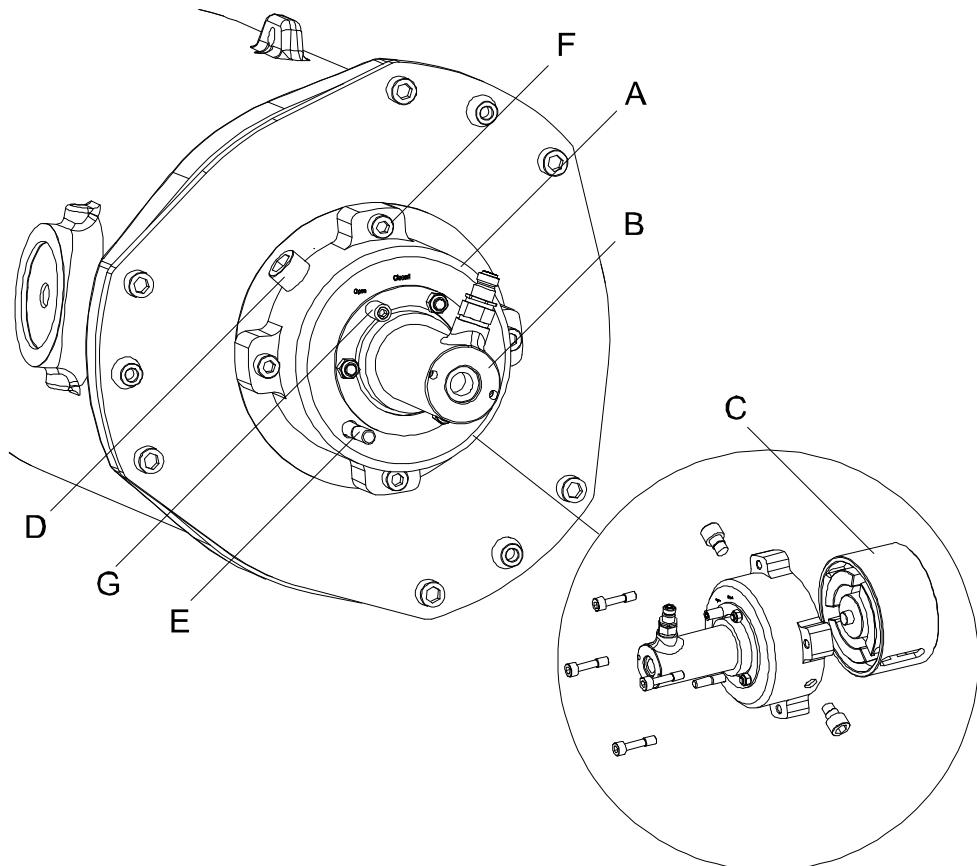
**DANGER**

There is a high tensioned spring inside the balancing device, incorrect handling may cause injuries and damage property.

Press tool and hydraulic cylinder

The figure below shows the hydraulic cylinder mounted on the press tool.

The press tool includes two press devices that are used to different models of the balancing device.



xx0200000174

A	Press block
B	Hydraulic cylinder

Continues on next page

4 Repair

4.5.4.2 Unloading the balancing device using hydraulic press tool

Continued

C	Press device
D	Bolt, press device
E	Moving pin with marking
F	Bolt (4 pcs)
G	Pin, attached to the fix plate

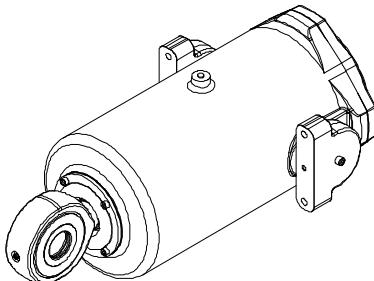
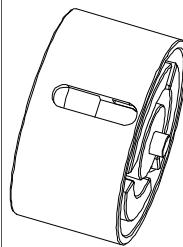
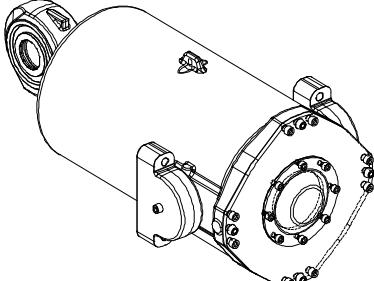
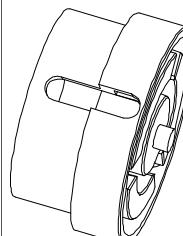
Required equipment

Equipment, etc.	Art. no.	Note
Press tool, balancing device	3HAC020902-001	Includes <ul style="list-style-type: none">• press device 3HAC15767-2• press device 3HAC18100-1 Choose the correct device, depending on model of balancing device.
Hydraulic cylinder	3HAC11731-1	To be used with the press tool.
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with the hydraulic cylinder.
Standard toolkit	-	Content is defined in section Standard tools on page 445 .

Using the correct press device

The different designs of the balancing device require different versions of the press device, included in the complete press tool. The table below specifies which press device to use to which balancing device.

The article number of the balancing device may be found on a label at the rear of the balancing device.

Balancing device	Press device
Art. no: 3HAC14675-2  xx0300000605	Art. no: 3HAC15767-2 (for balancing device 3HAC14675-1)  xx0300000600
Art. no: 3HAC023018-001  xx0700000423	Art. no: 3HAC18100-1 (for balancing device 3HAC023018-001)  xx0300000599

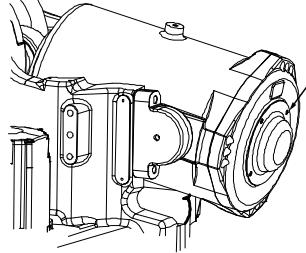
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4.5.4.2 Unloading the balancing device using hydraulic press tool

Continued

Unloading the balancing device

The procedure below details how to use the press tool in order to unload the balancing device. How to remove the press tool, is detailed in section [Restoring the balancing device using a hydraulic press tool on page 319](#).

Action	Note
1 Fit the <i>moving pin</i> to the current press device.	Choose the correct press device, according to the table Using the correct press device on page 316 . The moving pin is shown in the figure Press tool and hydraulic cylinder on page 315 .
2 Fit the correct press device and moving pin to the press tool. Secure with the <i>bolt</i> , <i>press device</i> .  Note Make sure the bolt is secured properly!	Shown in the figure Press tool and hydraulic cylinder on page 315 .
3 Remove the <i>rear cover</i> of the balancing device, by unscrewing the <i>attachment screws</i> .  DANGER DO NOT! remove any other screws than the rear cover attachment screws.	 xx0200000175 <ul style="list-style-type: none"> E: Rear cover attachment screws, 4 pcs
4 Remove the o-ring from the balancing device end.	
5 Remove the support shaft.	
6 Fit the <i>press tool</i> to the rear of the balancing device with enclosed <i>bolts</i> . Tighten them properly!	Art. no. is specified in Required equipment on page 316 . See the figure Press tool and hydraulic cylinder on page 315 .
7 Fit the <i>hydraulic cylinder</i> to the press tool.	Art. no. is specified in Required equipment on page 316 . See the figure Press tool and hydraulic cylinder on page 315 .
8 Connect the <i>hydraulic pump</i> to the cylinder.	Art. no. is specified in Required equipment on page 316 .
9 Increase the pressure and press until the marking on the <i>moving pin</i> indicates the correct position (in level with the pressure block).	See the figure Press tool and hydraulic cylinder on page 315 . Do not apply more pressure than necessary, it could damage bearings and sealings at the shaft.
10 Turn the <i>fix plate</i> to position "Closed" in order to lock the tool in loaded condition.	See the figure Press tool and hydraulic cylinder on page 315 .
11 Unload the hydraulic cylinder.	

Continues on next page

4 Repair

4.5.4.2 Unloading the balancing device using hydraulic press tool

Continued

	Action	Note
12	The hydraulic cylinder may now be removed from the tool, when necessary.	

4.5.4.3 Restoring the balancing device using a hydraulic press tool

4.5.4.3 Restoring the balancing device using a hydraulic press tool**Overview**

This section details how to restore the balancing device and how to remove the press tool from the device.

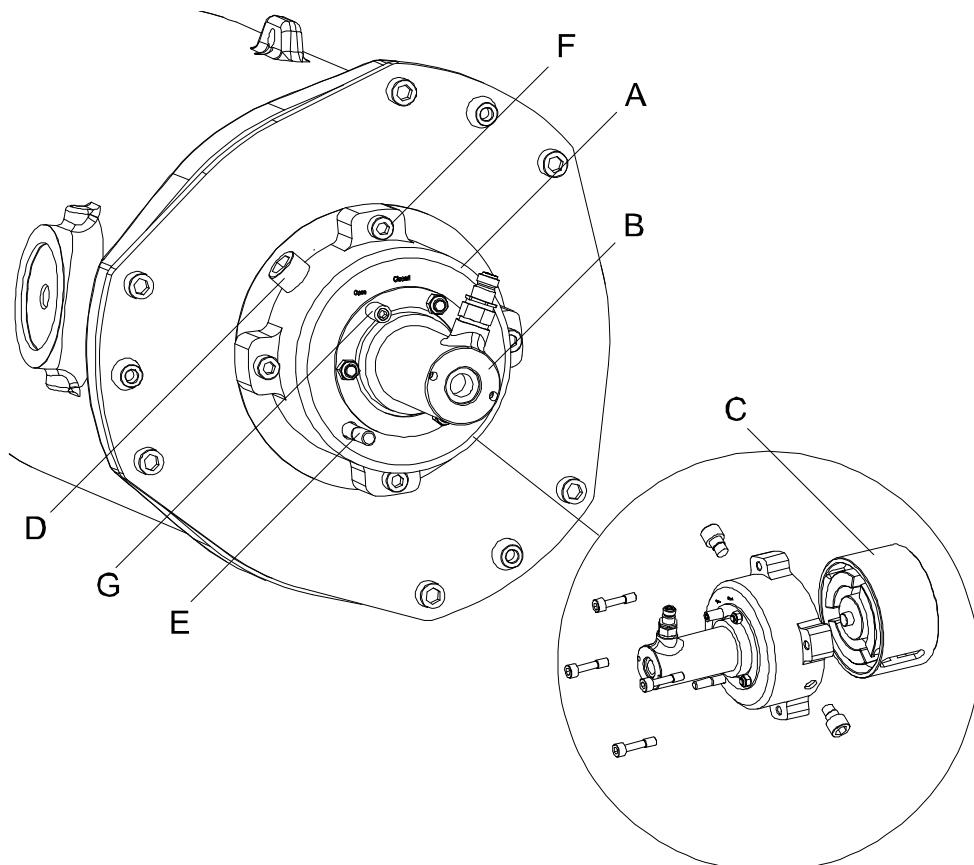
**DANGER**

There is a high tensioned spring inside the balancing device, incorrect handling may cause injuries and damage property.

Press tool and hydraulic cylinder

The figure below shows the hydraulic cylinder mounted on the press tool.

The press tool includes two press devices that are used to different models of the balancing device.



xx0200000174

A	Press block
B	Hydraulic cylinder
C	Press device
D	Bolt, press device
E	Moving pin with marking

Continues on next page

4 Repair

4.5.4.3 Restoring the balancing device using a hydraulic press tool

Continued

F	Bolt (4 pcs)
G	Pin, attached to the fix plate

Required equipment

Equipment, etc.	Art. no.	Note
Hydraulic cylinder	3HAC11731-1	To be used with press tool.
Hydraulic pump, 80 MPa	3HAC13086-1	To be used with hydraulic cylinder.
Locking liquid	-	Loctite 577 Used to secure the attachment screws of the rear cover at the end of the balancing device.
Standard toolkit	3HAC15571-1	Content is defined in section Standard tools on page 445 .
Sikaflex 521FC		

Restoring the balancing device

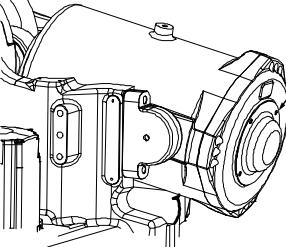
The procedure below details how to restore the balancing device, that is removing the press tool.

	Action	Note
1	Refit the <i>hydraulic cylinder</i> to the press tool, in case it has been removed.	Shown in the figure Press tool and hydraulic cylinder on page 319 .
2	Press with the cylinder and the hydraulic pump until the <i>fix plate</i> is movable again. Turn the pin on the fix plate to position "Open".	Shown in the figure Press tool and hydraulic cylinder on page 319! Do not apply more pressure than necessary, it could damage bearings and sealings at the shaft.
3	Unload the hydraulic cylinder and make sure the <i>moving pin</i> indicates that the tool has returned to its starting position.	Shown in the figure Press tool and hydraulic cylinder on page 319!
4	Remove the hydraulic cylinder.	
5	Remove the press tool by unscrewing the <i>bolts</i> .	Shown in the figure Press tool and hydraulic cylinder on page 319!
6	Lubricate and refit the o-ring at the end of the balancing device.	Make sure the o-ring is seated properly! Replace if damaged.
7	Refit the support shaft to the balancing device.	
8	Lubricate and refit the o-ring on the support shaft.	Make sure the o-ring is seated properly! Replace if damaged.

Continues on next page

4.5.4.3 Restoring the balancing device using a hydraulic press tool

Continued

Action	Note
9 Refit the rear cover to the balancing device with its attachment screws, using locking liquid. Apply sikaflex 521FX on the cover.	 xx0200000175 <ul style="list-style-type: none"> E: 4 pcs: M10x30, tightening torque: 50 Nm. Locking liquid is specified in Required equipment on page 320 .
10  DANGER The rear cover of the balancing device is a safety device for the piston rod during operation! Make sure the cover is properly secured before commissioning of the robot!	

4 Repair

4.6.1 Replacement of motor, axis 1

Note

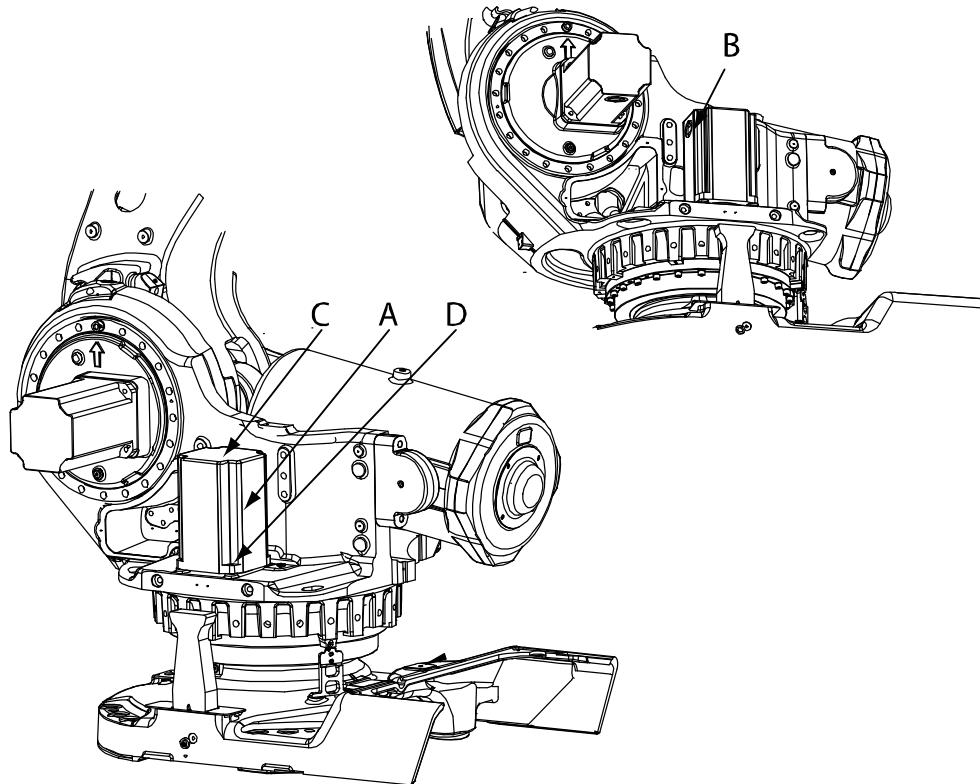
This procedure requires calibration of the robot.

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

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

Location of motor

The motor axis 1 is located on the left hand side of the robot as shown in the figure below.



xx0100000123

A	Motor, axis 1
B	Cable gland cover, motor axis
C	Cover for connector access
D	Motor attachment screws

Continues on next page

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion	See Spare part lists on page 451 .		Includes <ul style="list-style-type: none"> • motor • pinion • o-ring 21522012-430.
O-ring	21522012-430		Must be replaced when reassembling the motor.
Mobilux EP 2	-	-	Used to lubricate the motor clutch.
Grease		3HAB3537-1	Used to lubricate the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!
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 Standard tools on page 445 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter Circuit diagram on page 453 .

Continues on next page

4 Repair

4.6.1 Replacement of motor, axis 1

Continued

Deciding calibration routine

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

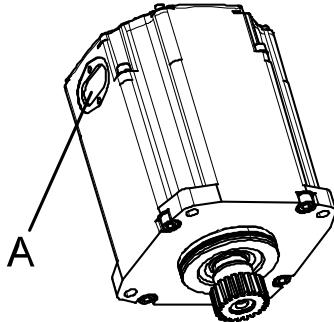
Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor axis 1

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

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

Continues on next page

Action	Note
4 Remove the cable gland cover at the cable exit by unscrewing its two attachment screws.  Note Make sure the gasket is not damaged!	 xx0200000199 • A: Cable gland cover
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 Required equipment on page 323 .
7 In order to release the brakes, connect the 24 VDC power supply.	Connect to connector R2.MP1 • +: pin 2 • -: pin 5
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 Location of motor on page 322 . Art. no. is specified in Required equipment on page 323 .
9  CAUTION 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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art no. is specified in Required equipment on page 323 .

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4 Repair

4.6.1 Replacement of motor, axis 1

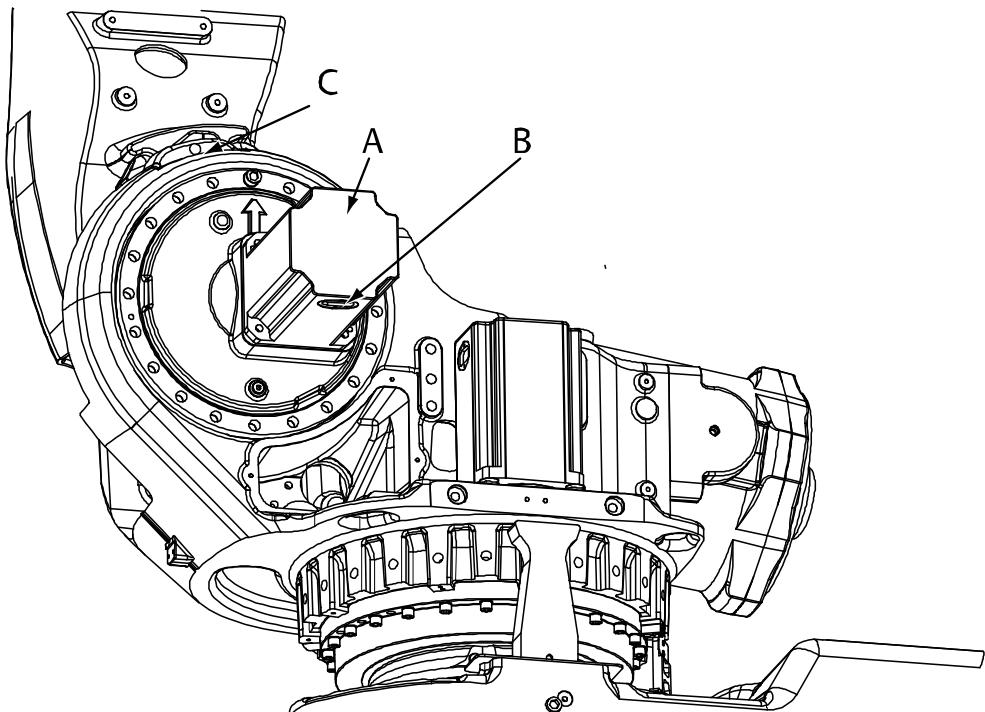
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	Action	Note
3	 CAUTION The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
4	Apply the <i>lifting tool, motor axis 1, 4, 5</i> to the motor.	Art no. is specified in Required equipment on page 323 .
5	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP1 • +: pin 2 • -: pin 5
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 motor cable 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 Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
14	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

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.



xx0100000124

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 (IRB 7600 - 500/2.3, IRB 7600 - 400/2.55, IRB 7600 - 340/2.8, IRB 7600 - 150/3.5)	See Spare part lists on page 451 .		Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 2152 2012-430
Motor axis 2 (IRB7600 - 500/2.55, IRB7600 - 325/3.1)	See Spare part lists on page 451 .		Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 2152 2012-430
O-ring	21522012-430		Must be replaced when re-assembling motor!
Grease		3HAB3537-1	For lubricating the o-ring.
Locking screw		3HAA1001-266	M16 x 60 For securing the lower arm.

Continues on next page

4 Repair

4.6.2 Replacement of motor axis 2

Continued

Equipment, etc.	Spare part no.	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. Guides are to be used in pairs!
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 Standard tools on page 445 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter Circuit diagram on page 453 .

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"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor

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 Location of motor on page 327 .
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

Continues on next page

4 Repair

4.6.2 Replacement of motor axis 2

Continued

Action	Note
4 Lock the lower arm by inserting the <i>lock screw</i> into the hole.	Art. no. and dimension is specified in Required equipment on page 327 .
5 Drain the oil from gearbox, axis 2.	Detailed in the section Changing oil, axis-2 gearbox on page 198 .
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 Location of motor on page 327 . Make sure the gasket is not damaged!
8 Disconnect all connectors beneath the motor cover.	
9  DANGER Secure the weight of the lower arm properly before releasing the brakes of motor, axis 2! When releasing the holding brakes of the motor, the lower arm will be movable and may fall down!	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 • +: pin 2 • -: pin 5
11 Remove the motor by unscrewing its four attachment screws and plain washers.	
12 Fit the two <i>guide pins</i> in two of the <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 327 . Shown in the figure Location of motor on page 327 .
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 Required equipment on page 327 . Shown in the figure Location of motor on page 327 . 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 Required equipment on page 327 .
15  CAUTION 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.	

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Refitting, motor

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

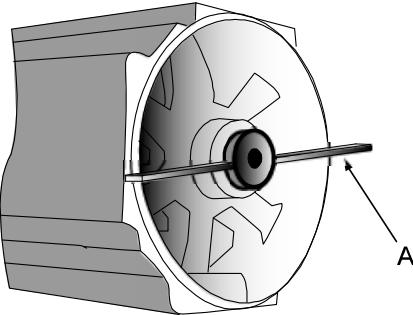
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in Required equipment on page 327 .
3	In order to release the brake, remove the cover on top of the motor and connect the 24 VDC power supply.	Connect to connector R2.MP2 <ul style="list-style-type: none"> • +: pin 2 • -: pin 5
4	Fit the <i>lifting tool, motor axis 2, 3, 4</i> to the motor.	Art. no. is specified in Required equipment on page 327 .
5	Fit the two <i>guide pins</i> in the two lower <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 327 . Shown in the figure Location of motor on page 327 .
6	 CAUTION 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. Make sure that the motor is turned the right direction, that is the cables facing downwards.	
8	Remove the lifting tool and allow the motor to rest on the guide pins.	

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4 Repair

4.6.2 Replacement of motor axis 2

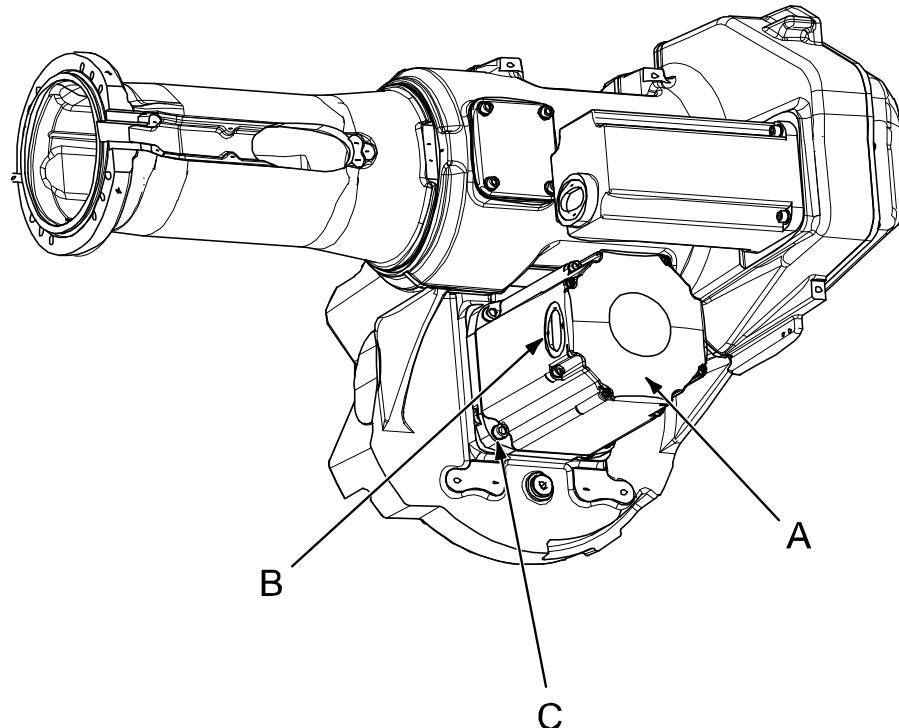
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Action	Note
9 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear (see the figure to the right). Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox axis 2 and that it does not get damaged.	Art. no. is specified in Required equipment on page 327 .  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in the figure above. <ul style="list-style-type: none">• A: Rotation tool
10 Remove the guide pins.	
11 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 Screw joints on page 441 before fitting.
12 Disconnect the brake release voltage.	
13 Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
14 Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure Location of motor on page 327 .
15 Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
16 Remove the lock screw from the <i>hole for lock screw</i> .	Shown in the figure Location of motor on page 327 .
17 Perform a leak down test.	Detailed in Performing a leak-down test on page 238 .
18 Refill the gearbox with oil.	Detailed in the section Changing oil, axis-2 gearbox on page 198 .
19 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
20  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

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.



xx0200000186

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 Spare part lists on page 451 .		Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 21522012-430.
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		3HAB3537-1	For lubricating the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!

Continues on next page

4 Repair

4.6.3 Replacement of motor, axis 3

Continued

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 Standard tools on page 445 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter Circuit diagram on page 453 .

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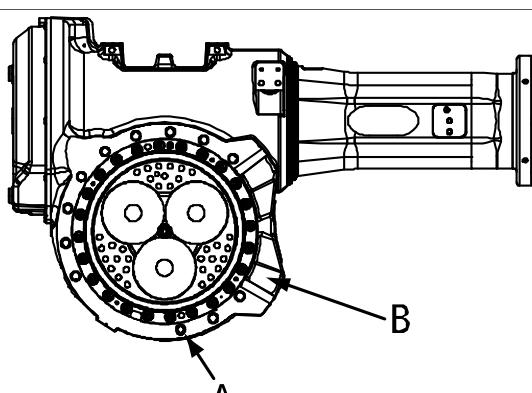
Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor

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

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Unload the upper arm of the robot by either: <ul style="list-style-type: none"> • Move the robot to a position where the turning disk rests against the foundation (recommended). • Use a fork lift to rest the upper arm onto. • Use lifting slings and an overhead crane to rest the upper arm. • Use a mechanical stop to rest the upper arm. Fit the mechanical stop in the attachment hole (A) with tightening torque: 115 Nm. 	 xx0300000051 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!

Continues on next page

4 Repair

4.6.3 Replacement of motor, axis 3

Continued

Action	Note
3  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4 Drain the oil from gearbox axis 3.	Detailed in section Changing oil, axis-3 gearbox on page 201 .
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 Location of motor on page 333 . Make sure the gasket is not damaged!
8 Disconnect all connectors beneath the motor cover.	
9 Unscrew the motors four <i>attachment screws and plain washers</i> .	Shown in the figure Location of motor on page 333 .
10 Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	Art. no. is specified in Required equipment on page 333 .
11 Press the motor out of position by fitting <i>removal tool, motor</i> to the remaining motor attachment screw holes.	Art. no. is specified in Required equipment on page 333 . Always use the removal tools in pairs!
12 Apply the <i>lifting tool, motor axis 2 ,3, 4</i> to the motor.	Art. no. is specified in Required equipment on page 333 .
13  CAUTION 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!

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Refitting, motor

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

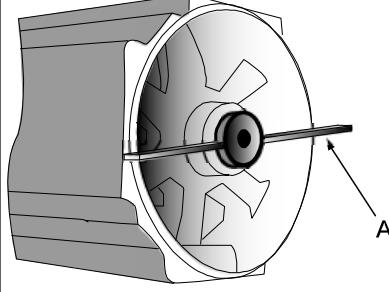
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate it with <i>grease</i> .	Art no. is specified in Required equipment on page 333 .
3	Fit the <i>lifting tool, motor axis 2, 3, 4</i> to the motor.	Art no. is specified in Required equipment on page 333 .
4	Fit the two <i>guide pins</i> in the two lower <i>motor attachment holes</i> .	Art no. is specified in Required equipment on page 333 . Shown in the figure Location of motor on page 333
5	 CAUTION The motor weighs 32 kg! All lifting equipment used must be sized accordingly!	
6	Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear.	
7	Remove the lifting tool and allow the motor to stay on the guide pins.	
8	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP3 <ul style="list-style-type: none"> • +: pin 2 • -: pin 5

Continues on next page

4 Repair

4.6.3 Replacement of motor, axis 3

Continued

Action	Note
9 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox, axis 3.	Art no. is specified in Required equipment on page 333 . Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above. • A: Rotation tool.
10 Remove the guide pins.	
11 Secure the motor with four attachment screws and plain washers. If required, use the extension 300mm for bits 1/2".	4 pcs: M10 x 40, tightening torque: 50 Nm. Art. no. is specified in Required equipment on page 333 .
12 Disconnect the brake release voltage.	
13 Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
14 Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed! Shown in the figure Location of motor on page 333 .
15 Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
16 Remove the equipment used to unload the upper arm.	
17 Perform a leak-down test.	Detailed in the section Performing a leak-down test on page 238 .
18 Refill the gearbox with oil.	Detailed in the section Changing oil, axis-3 gearbox on page 201 .
19 Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .

Continues on next page

	Action	Note
20	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage!</i> on page 55.	

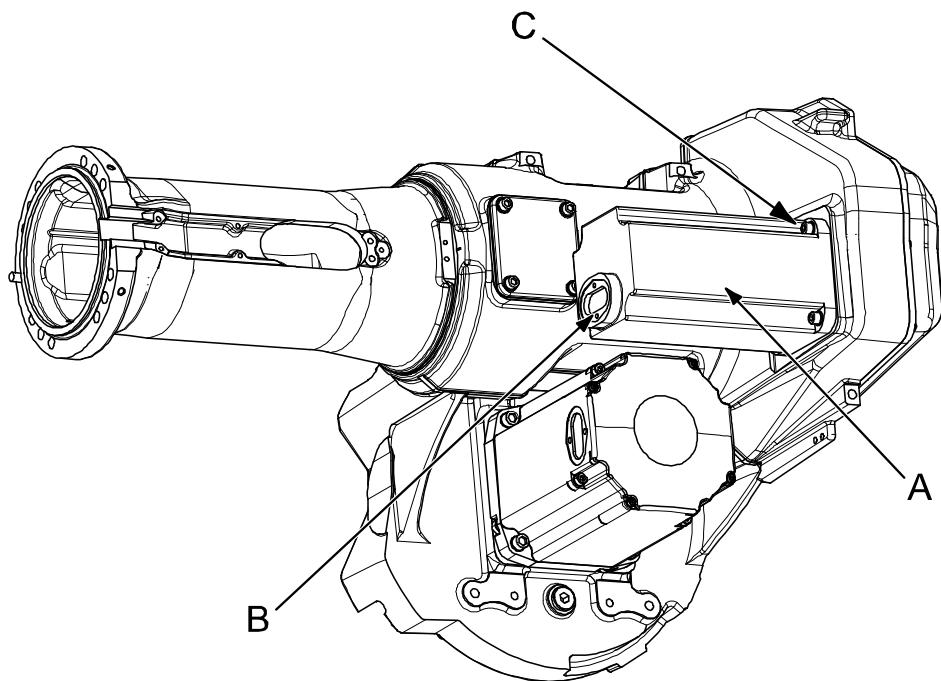
4 Repair

4.6.4 Replacement of motor, axis 4

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 Spare part lists on page 451 .	Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 21522012-430
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	3HAB3537-1	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

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 Standard tools on page 445 .
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram		See chapter Circuit diagram on page 453 .

Deciding calibration routine

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

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

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4 Repair

4.6.4 Replacement of motor, axis 4

Continued

Action	Note
<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417. Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, motor 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 Move the upper arm to one of the basic positions: <ul style="list-style-type: none"> upper arm is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time. 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. 	
3  DANGER Turn off all: <ul style="list-style-type: none"> electric power supply to the robot hydraulic pressure supply to the robot air pressure supply to the robot Before entering the robot working area.	
4 In horizontal position: unload the upper arm to avoid movement of the axis, with one of the given methods: <ul style="list-style-type: none"> move the upper arm to a position where the turning disk rests against the foundation (recommended) use a fork lift or an overhead crane and lifting slings to rest the weight of the upper arm. 	
5 In horizontal position: drain the gearbox, axis 4.	Detailed in section Draining, oil, gearbox axis 4 on page 205 .

Continues on next page

	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 Location of motor on page 340 . 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 • +: pin 2 • -: pin 5
10	 CAUTION The motor weighs 22 kg! All lifting equipment used must be sized accordingly!	
11	Unscrew the motors four attachment screws and plain washers.	Shown in the figure Location of motor on page 340 .
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 Required equipment on page 340 . Always use the removal tools in pairs!
14	Fit the <i>lifting tool</i> to the motor.	Choose the correct lifting tool: • lifting tool, motor axis 1, 4 and 5, if the upper arm is positioned vertically. • lifting tool, motor axis 2, 3 and 4, if the upper arm is positioned horizontally. Art. no. is specified in Required equipment on page 340 .
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.

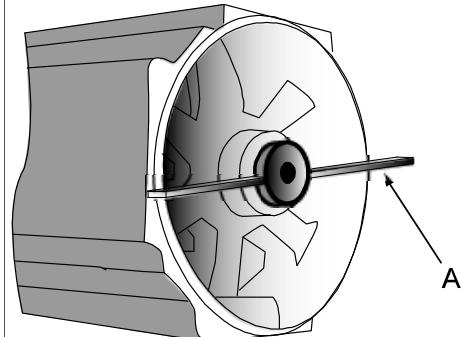
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	

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4 Repair

4.6.4 Replacement of motor, axis 4

Continued

Action	Note
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the <i>o-ring</i> with <i>grease</i> .	Art. no. is specified in Required equipment on page 340 .
3  CAUTION The motor weighs 22 kg! All lifting equipment used must be sized accordingly!	
4 Fit the <i>lifting tool</i> to the motor.	Choose the correct lifting tool: <ul style="list-style-type: none">• lifting tool, motor axis 1, 4 and 5, if the upper arm is positioned vertically• lifting tool, motor axis 2, 3 and 4, if the upper arm is positioned horizontally. Art. no. is specified in Required equipment on page 340 .
5 In order to release the brakes, connect the 24 VDC power supply.	Connect to connector R2.MP4: <ul style="list-style-type: none">• +: pin 2• -: pin 5
6 Fit the two <i>guide pins</i> in two of the <i>motor attachment holes</i> .	Art. no. is specified in Required equipment on page 340 . Shown in the figure Location of motor on page 340 .
7 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!
8 Use the <i>rotation tool</i> in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear, axis 4.	Art. no. is specified in Required equipment on page 340 . Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above. <ul style="list-style-type: none">• A: Rotation tool.
9 Remove the guide pins.	

Continues on next page

4.6.4 Replacement of motor, axis 4

Continued

	Action	Note
10	Secure the motor with four attachment screws and plain washers. If required, use the <i>extension 300mm for bits 1/2"</i> .	4 pcs: M10 x 80, tightening torque: 50 Nm. Art. no. is specified in Required equipment on page 340 .
11	Disconnect the brake release voltage.	
12	Reconnect all connectors beneath the motor cover.	
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>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure Location of motor on page 340 .
15	Perform a leak-down test if the gearbox has been drained.	Detailed in the section Performing a leak-down test on page 238 .
16	Refill the gearbox with oil if drained.	Detailed in the section Filling, oil, gearbox axis 4 on page 206 .
17	Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
18	 DANGER <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55.</p>	

4 Repair

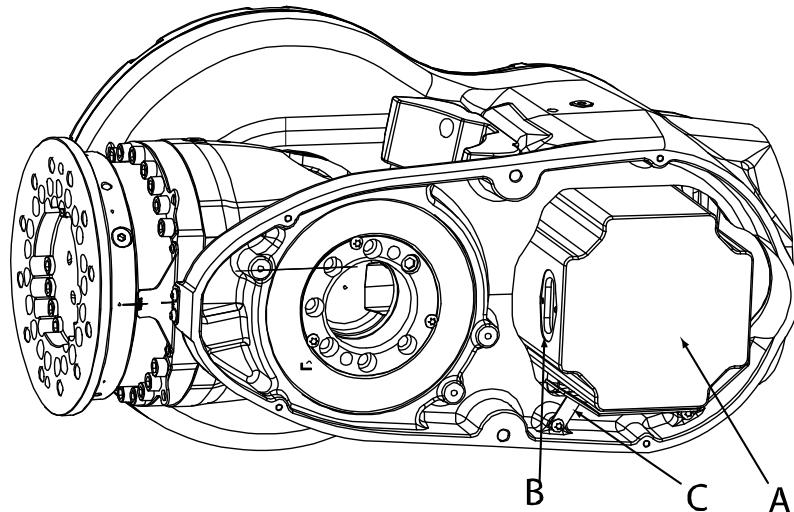
4.6.5 Replacement of motor, axis 5

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 Spare part lists on page 451 .	Includes: <ul style="list-style-type: none">• motor• pinion• o-ring 21522012-430
O-ring	21522012-430	Must be replaced when replacing motor!
Grease	3HAB3537-1	For lubricating the o-ring.
Standard toolkit	-	Content is defined in section Standard tools on page 445 .
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!

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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 Circuit diagram on page 453 .

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, motor 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.	

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4 Repair

4.6.5 Replacement of motor, axis 5

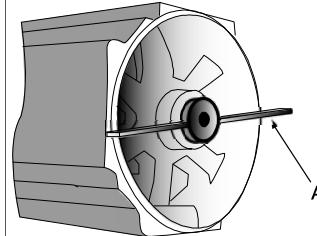
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Action	Note
2 Move the robot to a position where the motor in axis 5 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.	
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
4 Remove the 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 Location of motor on page 346 .
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 Location of motor on page 346 .
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">• +: pin 2• -: pin 5
10  CAUTION 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 Required equipment on page 346 .
12 Fit the <i>lifting tool, motor axis 1, 4, 5</i> to the motor.	Art. no. is specified in Required equipment on page 346 .
13 Fit the two <i>guide pins</i> in two of the motor attachment screw holes.	Art. no. is specified in Required equipment on page 346 .
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 Required equipment on page 346 . 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  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the o-ring with <i>grease</i> .	Art. no. is specified in Required equipment on page 346 .
3  CAUTION 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 • +: pin 2 • -: pin 5
6 Fit the two <i>guide pins</i> in two of the motor attachment holes.	Art. no. is specified in Required equipment on page 346 .
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 Required equipment on page 346 .  xx0200000165 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 Required equipment on page 346 .
10 Disconnect the brake release voltage.	
11 Reconnect all connectors beneath the motor cover.	

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4 Repair

4.6.5 Replacement of motor, axis 5

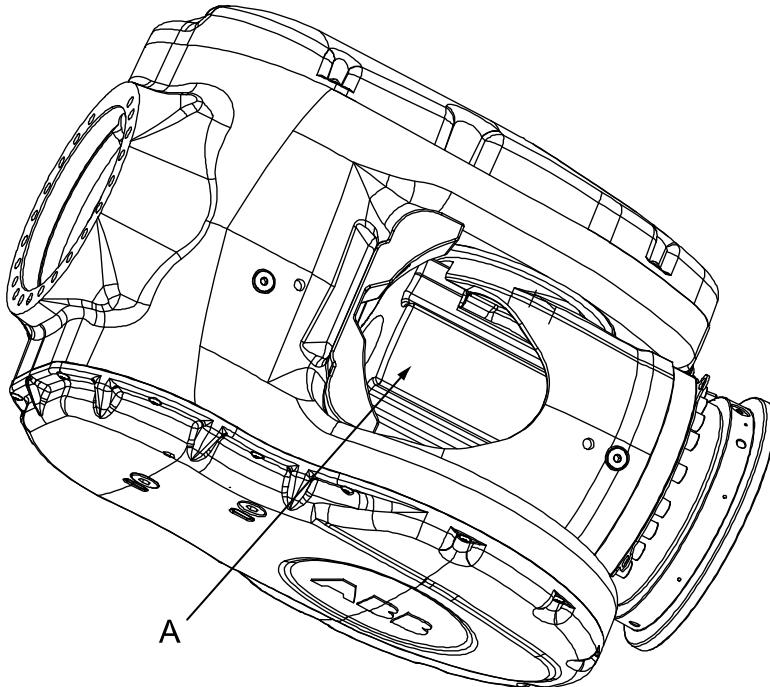
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	Action	Note
12	Refit the <i>cable gland cover</i> at the cable exit with its two attachment screws.	Shown in the figure Location of motor on page 346 .
13	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
14	Refit the <i>heat protection plate</i> with its two attachment screws.	Shown in the figure Location of motor on page 346 .
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 Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
18	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

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.



xx0100000128

A	Motor, axis 6
---	---------------

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor, axis 6	See spare part number in Spare part lists on page 451 .		Includes: <ul style="list-style-type: none">• motor• pinion• o-ring
O-ring	21522012-430		Must be replaced when reassembling motor!
Gasket	3HAC12877-1		Protection Standard. Must be replaced when replacing motor
Gasket	3HAC033206-001		Protection Foundry Plus Must be replaced when replacing motor
Gasket, cover	3HAC033489-001		Must be replaced when opening cover.
Removal tool, motor M10x		3HAC14972-1	Always use the removal tools in pairs!

Continues on next page

4 Repair

4.6.6 Replacement of motor, axis 6

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
Extension 300mm for bits 1/2"		3HAC12342-1	
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Grease		3HAB3537-1	For lubricating the o-ring.
Loctite 574, Flange sealant		12340011-116	Option Foundry Plus
Standard toolkit		-	Content is defined in section Standard tools on page 445 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram		-	See chapter Circuit diagram on page 453 .

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>

Continues on next page

Action	Note
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

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 355](#).

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Move the robot to one of the recommended positions: <ul style="list-style-type: none"> • 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. • 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. 	
3  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4 In horizontal position: drain the oil from the axis 6 gearbox.	Detailed in section Draining oil, gearbox axis 6 on page 213 .
5 Remove the rear motor cover by unscrewing the five attachment screws.	
6 Disconnect all connectors beneath the cover.	
7 In order to release the brake, connect the 24 VDC power supply.	Connect to connector R3.MP6 <ul style="list-style-type: none"> • +: pin 2 • -: pin 5
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 Required equipment on page 351 .

Continues on next page

4 Repair

4.6.6 Replacement of motor, axis 6

Continued

Action	Note
9 If required, press the motor out of position by fitting <i>removal tool, motor</i> to the motor attachment screw holes.	Art. no. is specified in Required equipment on page 351 . 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 355](#).

Action	Note
1 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the <i>o-ring</i> with <i>grease</i> .	Art. no. is specified in Required equipment on page 351 .
2 In order to release the brake, connect the 24 VDC power supply.	Connect to connector R3.MP6 <ul style="list-style-type: none">• +: pin 2• -: pin 5
3 Fit the two <i>guide pins</i> in two of the motor attachment holes.	Art. no. is specified in Required equipment on page 351 .
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 Required equipment on page 351 .
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 Performing a leak-down test on page 238 .
11 Refill the gearbox with oil, if it has been drained.	Detailed in section Filling oil, gearbox axis 6 on page 214 .

Continues on next page

Action	Note
12 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
13  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

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.

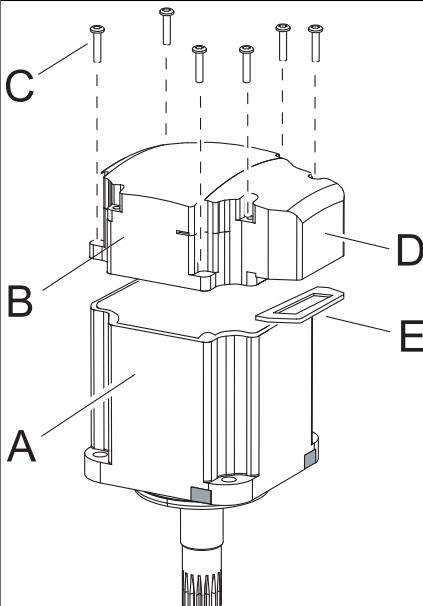
Action	Note
1 Move the robot to one of the recommended positions: <ul style="list-style-type: none"> to a position where the motor in axis 6 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time. to a position where the motor in 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. 	
2  DANGER Turn off all: <ul style="list-style-type: none"> electric power supply to the robot hydraulic pressure supply to the robot air pressure supply to the robot Before entering the robot working area.	
3 In horizontal position: drain the oil from the axis 6 gearbox.	Detailed in section: Draining oil, gearbox axis 6 on page 213 .

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4 Repair

4.6.6 Replacement of motor, axis 6

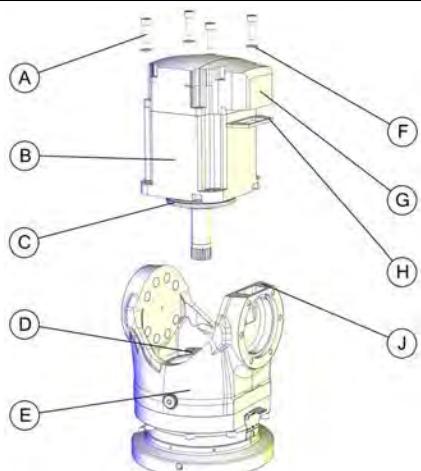
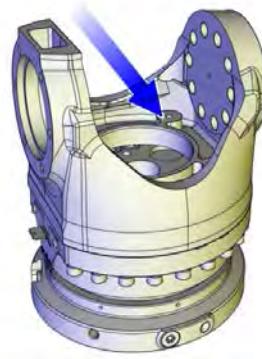
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Action	Note
4 Remove the rear motor cover by unscrewing the five attachment screws.	 <p>xx1500002524</p> <ul style="list-style-type: none">• A: Motor unit• B: Connection box• C: Attachment screw (5 pcs)• D: Rear motor cover• E: Gasket
5 Continue to remove the motor unit, according to step 6 and forwards in Removal, motor on page 353 .	
6  Note Keep the old <i>rear motor cover</i> with the air nipple.	

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4.6.6 Replacement of motor, axis 6

Continued

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"> A: Attachment screw (4pcs) Mercasol 3106 B: Motor unit C: O-ring D: Sikaflex in screw recesses E: Tilt house F: Washer G: Rear motor cover H: Sealing J: Loctite 574
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, Refitting, motor on page 354 .	

4 Repair

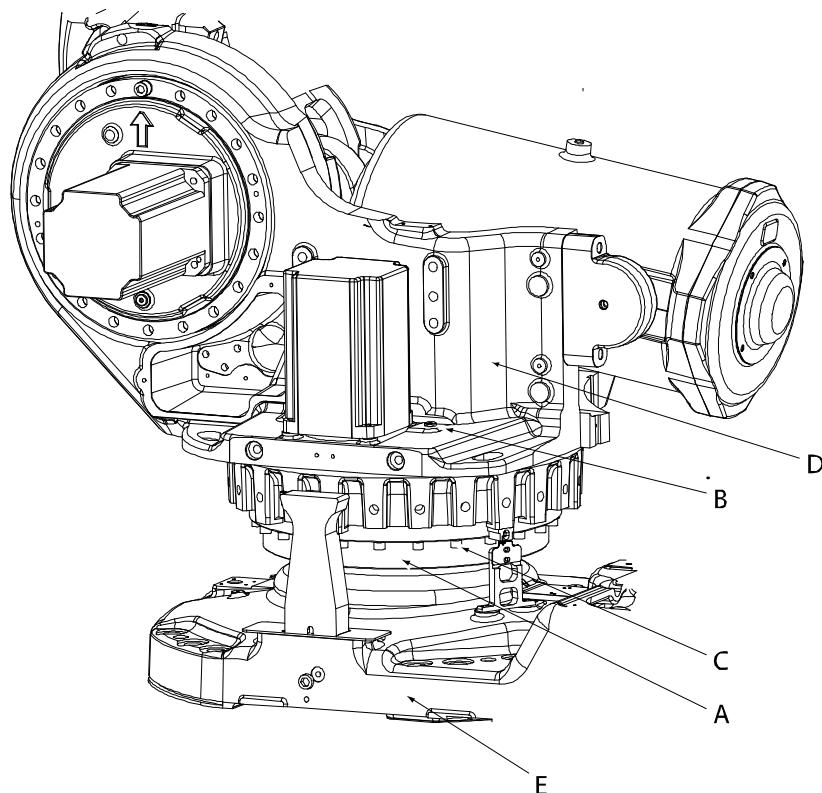
4.7.1 Replacing the axis 1 gearbox

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: <ul style="list-style-type: none">• Spare part lists on page 451.	Includes: <ul style="list-style-type: none">• gearbox• all o-rings and sealing rings
O-ring		3HAB3772-54	Replace if damaged!
O-ring		3HAB3772-55	Replace if damaged!

Continues on next page

4.7.1 Replacing the axis 1 gearbox
Continued

Equipment, etc.	Art. no.	Note
Sealing ring	3HAC11581-4	Replace if damaged!
Grease	3HAB3537-1	For lubricating the o-rings.
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 Standard tools on page 445 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Deciding calibration routine

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

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

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4 Repair

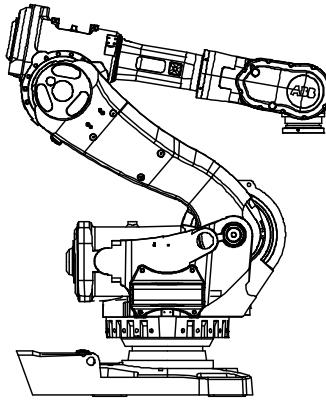
4.7.1 Replacing the axis 1 gearbox

Continued

Action	Note
<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, gearbox axis 1

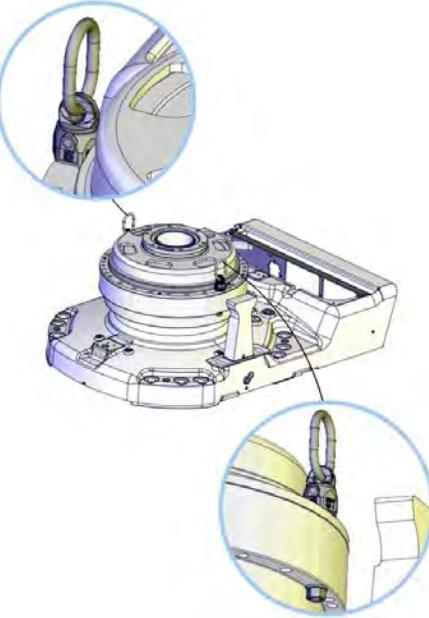
Use this procedure to remove gearbox, axis 1.

Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Move the robot to its most stable position, shown in the figure to the right.	 xx0300000022
3  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
4 Drain the axis 1 gearbox.	See Changing oil, axis-1 gearbox on page 194 .
5 Remove the complete arm system.	Detailed in section Replacement of complete arm system on page 255 .
6 Unfasten the robot base from the foundation by removing the base attachment screws.	

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4.7.1 Replacing the axis 1 gearbox

Continued

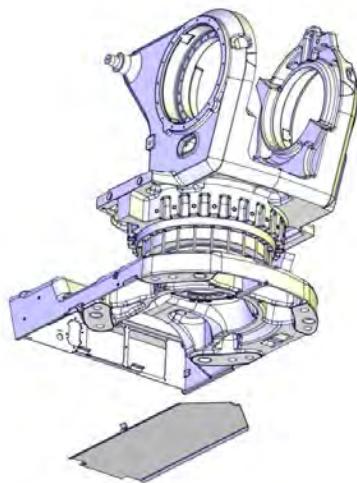
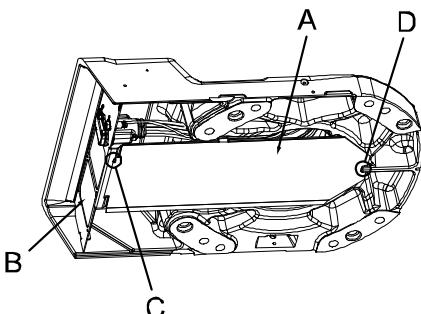
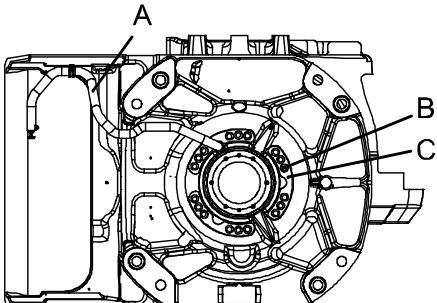
Action	Note
7 Attach the <i>lifting accessory, base and gear 1</i> and the <i>lifting tool (chain)</i> to the gearbox and base.	 xx1000001395 <p>Specified in <i>Required equipment on page 358.</i></p>
8  CAUTION The base and axis 1 gearbox weighs 310 kg + 200 Kg. All lifting accessories used must be sized accordingly!	
9 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.	Art. no. is specified in <i>Required equipment on page 358.</i>
10 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!	 xx1000000364 <p>A Support base (4 pcs)</p>

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4 Repair

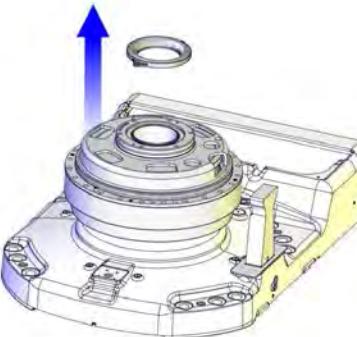
4.7.1 Replacing the axis 1 gearbox

Continued

Action	Note
<p>11 Remove the bottom plate from underneath the base in order to get access to the attachment screws. It may be necessary to also remove the rear connector plate.</p>	 <p>xx1000001385</p>  <p>xx0300000612</p> <ul style="list-style-type: none"> A Bottom plate B Rear connector plate C Attachment screw D Groove
<p>12 Unscrew the attachment screws and remove the washers.</p>	 <p>xx0200000227</p> <p>A view from below:</p> <ul style="list-style-type: none"> • A: Oil drain hose • B: Attachment screws, gearbox axis 1, 18 pcs • C: Washers, 3 pcs

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4.7.1 Replacing the axis 1 gearbox
Continued

Action	Note
13 Remove the cable guide in the center of gearbox 1 by unscrewing its attachment screws.	 xx1000001387
14 ! CAUTION 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.  Note Move the protective pipe over to the new gearbox.	 xx1400000786

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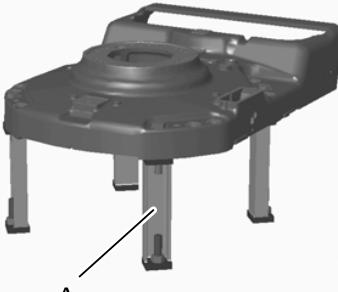
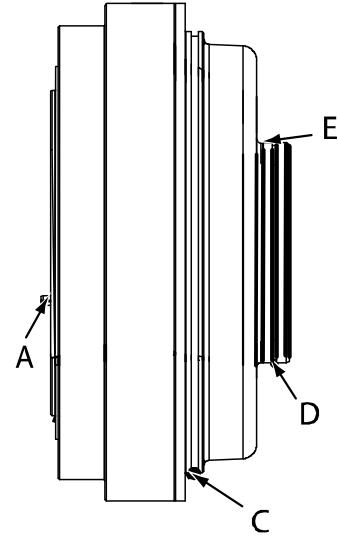
4 Repair

4.7.1 Replacing the axis 1 gearbox

Continued

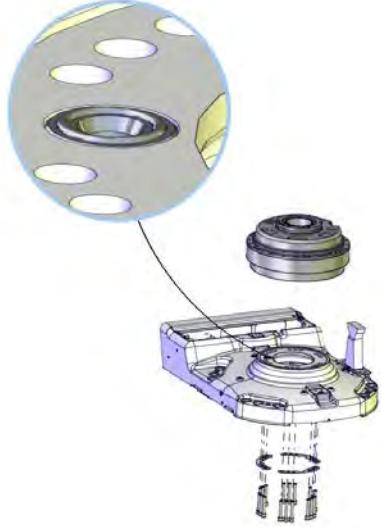
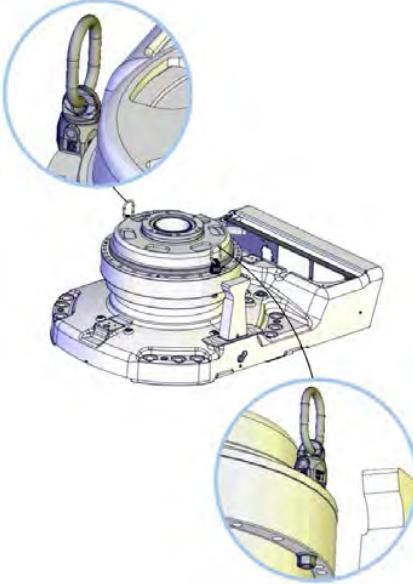
Refitting, gearbox axis 1

Use this procedure to refit gearbox, axis 1.

	Action	Note
1	Fit the <i>support, base and gear 1</i> to the base. Mounting of the support, base and gear 1 is detailed in section Removal, gearbox axis 1 on page 360 .	 xx1000000364 A Support base (4 pcs)
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> . Art no. is specified in Required equipment on page 358 .	 xx0200000055 <ul style="list-style-type: none">• A: Guide pin• C: O-ring 3HAB 3772-54• D: O-ring 3HAB 3772-55• E: Sealing ring 3HAC 11581-4

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4.7.1 Replacing the axis 1 gearbox
Continued

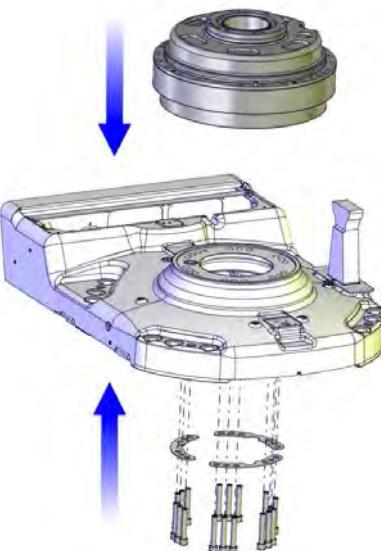
Action	Note
3 Make sure the small o-ring around the oil hole is fitted properly!	 xx1000001392
4 Attach the <i>lifting accessory, base and gear 1</i> and the <i>lifting tool (chain)</i> to the gearbox.	Specified in Required equipment on page 358 .  xx1000001395
5 Fit two <i>guide pins</i> in two of the attachment holes in the gearbox, parallel to each other.	Specified in Required equipment on page 358 .
6  CAUTION The gearbox weighs 200 Kg. All lifting accessories used must be sized accordingly!	

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4 Repair

4.7.1 Replacing the axis 1 gearbox

Continued

Action	Note
7 Lift the gearbox. Make sure the guide pin in the bottom face of the gearbox is properly aligned with the base.	 xx1000001389
8 Lift gearbox axis 1 onto the guide pins and lower it carefully to its mounting position.	Always use guide pins in pairs!

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4.7.1 Replacing the axis 1 gearbox

Continued

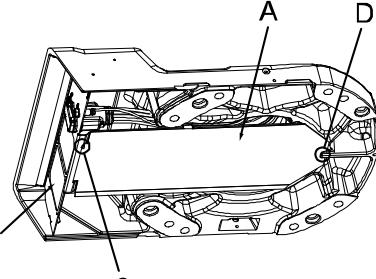
Action	Note
9 Secure the gearbox with its <i>attachment screws</i> and washers.	<p>18 pcs, M16 x 90, 12.9 quality UN-BRAKO. Tightening torque: 300 Nm Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 441 before fitting.</p> <p>xx0200000227</p> <p>A view from below:</p> <ul style="list-style-type: none"> • A: Oil drain hose • B: Attachment screws, gearbox axis 1, 18 pcs • C: Washers, 3 pcs
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. If removed, also refit the rear connector plate.</p> <p> Note</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"> • A: Bottom plate • B: Rear connector plate • C: Attachment screw • D: Groove
12	<p> CAUTION</p> <p>The base and axis 1 gearbox weighs 310 kg + 200 Kg. 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 Orienting and securing the robot on page 97 .
15	<p>Refit the complete arm system.</p> <p> CAUTION</p> <p>This is a complex task to be performed with utmost care in order to avoid injury or damage!</p>	Detailed in section Replacing the axis 1 gearbox on page 358 .
16	Perform a leak-down test.	See section Performing a leak-down test on page 238 .
17	Refill the gearbox with oil.	See Changing oil, axis-1 gearbox on page 194 .
18	Recalibrate the robot.	<p>Pendulum Calibration is described in Operating manual - Calibration Pendulum, enclosed with the calibration tools.</p> <p>Axis Calibration is described in Calibrating with Axis Calibration method on page 416.</p> <p>General calibration information is included in section Calibration on page 403.</p>

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4.7.1 Replacing the axis 1 gearbox

Continued

Action	Note
19  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 55.</i>	

4 Repair

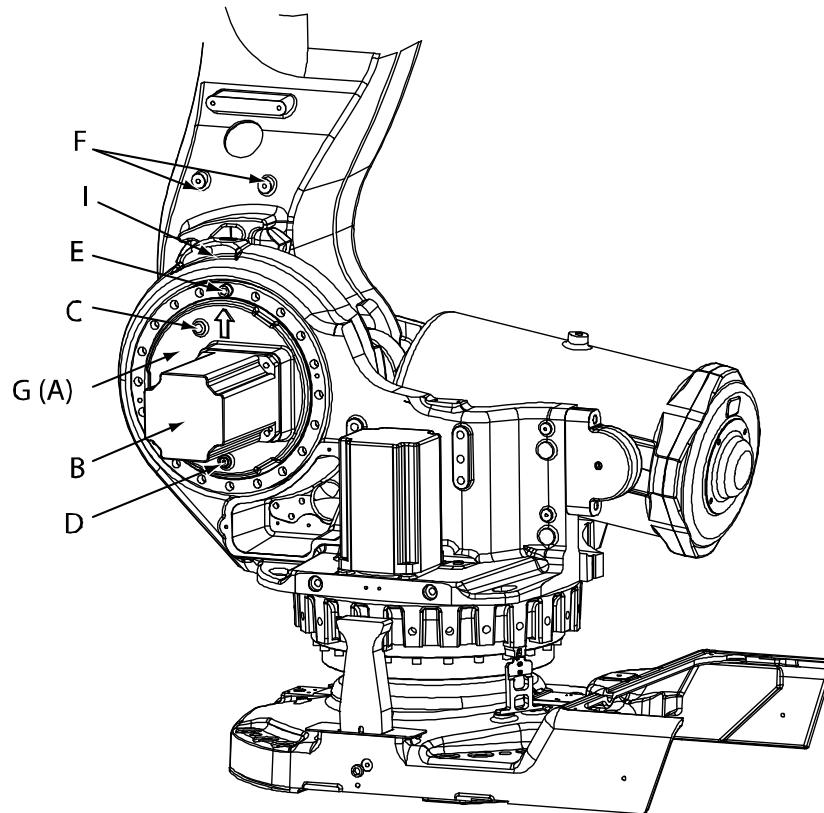
4.7.2 Replacement of gearbox, axis 2

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 no.	Art. no.	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		3HAB3537-1	For lubricating the o-ring.
Standard toolkit		-	Content is defined in section Standard tools on page 445 .
Lifting tool, gearbox axis 2		3HAC12731-1	
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.

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4 Repair

4.7.2 Replacement of gearbox, axis 2

Continued

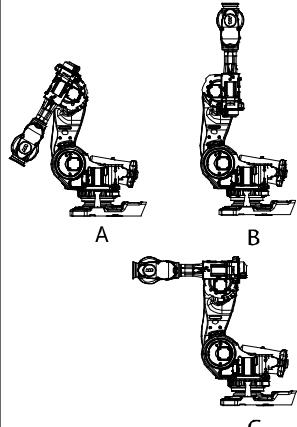
Deciding calibration routine

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 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, gearbox

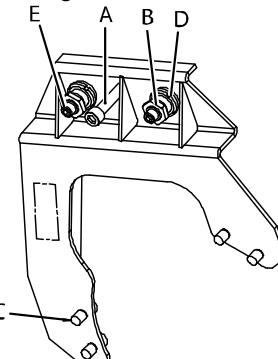
The procedure below details how to remove gearbox, axis 2.

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 Run the robot to the calibration position. The upper arm may be directed in three different ways, shown in figure to the right. The lowered position, as in figure A, is recommended as it gives the least load on the tool.	 xx0200000260

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4.7.2 Replacement of gearbox, axis 2

Continued

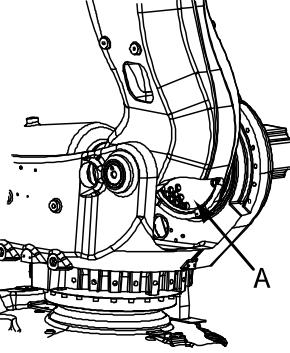
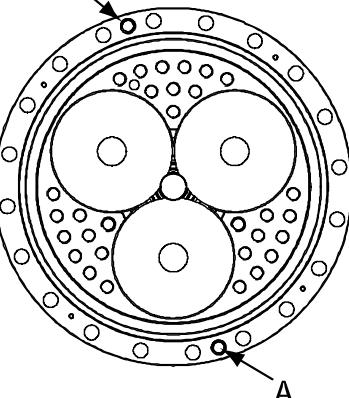
Action	Note
4  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
5 If the robot is fitted with moveable mechanical stops on axis 2 (not stock 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 Required equipment on page 371! Shown in the figure Location of gearbox on page 370!
7 Fit the <i>fixture, lower arm</i> to prevent the lower arm from falling. <ul style="list-style-type: none"> • Make sure that both adjusters (B) on the fixture are screwed back. • Align the fixture with the frame and lower arm. • Tighten the four M16 bolts (C) on the <i>inside of the frame, in attachment holes</i>, with tightening torque: 220 Nm. • Screw in the two adjusters (B) until they rest against the flats on the lower arm. Tighten by hand. • Lock, using the two ring nuts (D). • Tighten the two M12 bolts (E) in the <i>attachment holes, fixture lower arm</i> with tightening torque: 91 Nm. 	Art. no. is specified in Required equipment on page 371! Attachment holes for the fixture are shown in the figure Location of gearbox on page 370! Make sure the fixture is pressed tightly against the lower arm before securing with screws!  xx0200000261 <ul style="list-style-type: none"> • A: Locking screw, lower arm
8 Unload the balancing device shaft by using a specific press tool.	Detailed in section Unloading the balancing device using hydraulic press tool on page 315 .
9 Drain the gearbox, axis 2.	Detailed in section Draining, oil on page 199 .
10 Remove the motor, axis 2.	Detailed in section Removal, motor on page 329 .

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4 Repair

4.7.2 Replacement of gearbox, axis 2

Continued

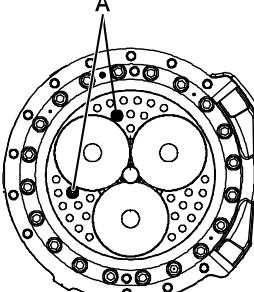
Action	Note
11 Remove the 30 rear gearbox attachment screws (A) from inside the lower section of the lower arm.	 xx0300000064
12 Remove the <i>motor attachment</i> by unscrewing the front gearbox attachment screws.	Shown in the figure Location of gearbox on page 370!
13 Fit the <i>lifting tool, gearbox 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 Required equipment on page 371 .
14  CAUTION 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 Required equipment on page 371 .
16 Fit two guide pins in 180° relation to each other instead of the removed front attachment screws.	Art. no. is specified in Required equipment on page 371 .
17 If required, apply an M16 screw to the hole shown in the figure to press it free.	Art. no. is specified in Required equipment on page 371 .  xx0200000033 <ul style="list-style-type: none"> • A: M16 holes for pressing the gearbox out
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 Required equipment on page 371!

Refitting, gearbox axis 2

The procedure below details how to refit the gearbox, axis 2.

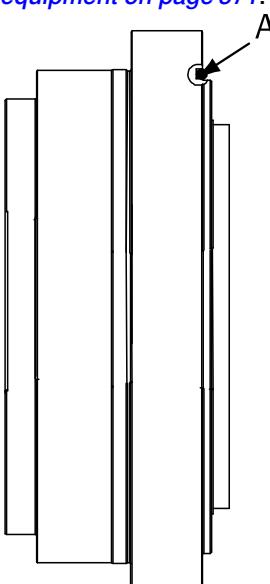
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Fit the <i>guide pins, sealing axis 2/3</i> on gearbox, axis 2. Only the holes showed in figure beside are allowed to be used to the guide pins!	 xx0200000125 Holes for guide pins, sealing axis 2/3 on gearbox 2. Always use a new sealing when reassembling! Art. no. is specified in Required equipment on page 371 .
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.	Art. no. is specified in Required equipment on page 371 .
5	Fit the cleaned friction washer onto the guide pins.	
6	Fit the <i>lifting tool, gearbox axis 2</i> , to the gearbox.	Art. no. is specified in Required equipment on page 371 .

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4 Repair

4.7.2 Replacement of gearbox, axis 2

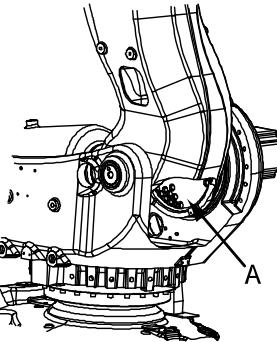
Continued

Action	Note
7 Make sure the <i>o-ring</i> is fitted to the rear of the gearbox. Lightly <i>grease</i> the <i>o-ring</i> .	Art. no. is specified in Required equipment on page 371 .  xx0100000136 A O-ring, gearbox, axis 2
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: 300 Nm. Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 441 before fitting.
13 Remove the guide pins and tighten the remaining two screws as above.	

Continues on next page

4.7.2 Replacement of gearbox, axis 2

Continued

Action	Note
14 Insert and secure 28 of the 30 attachment screws on the inside of the lower arm.	 <p>xx0300000064</p> <p>Tightening torque: 300 Nm. Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 441 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 Refitting, motor on page 331 .
17 Perform a leak-down test.	Detailed in section Performing a leak-down test on page 238 .
18 Refill the gearbox with oil.	Detailed in section Filling, oil on page 199 .
19 Restore the balancing device by removing the balancing device tools.	Detailed in section Restoring the balancing device on page 320 .
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 Recalibrate the robot.	<p>Pendulum Calibration is described in Operating manual - Calibration Pendulum, enclosed with the calibration tools.</p> <p>Axis Calibration is described in Calibrating with Axis Calibration method on page 416.</p> <p>General calibration information is included in section Calibration on page 403.</p>
25  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

4 Repair

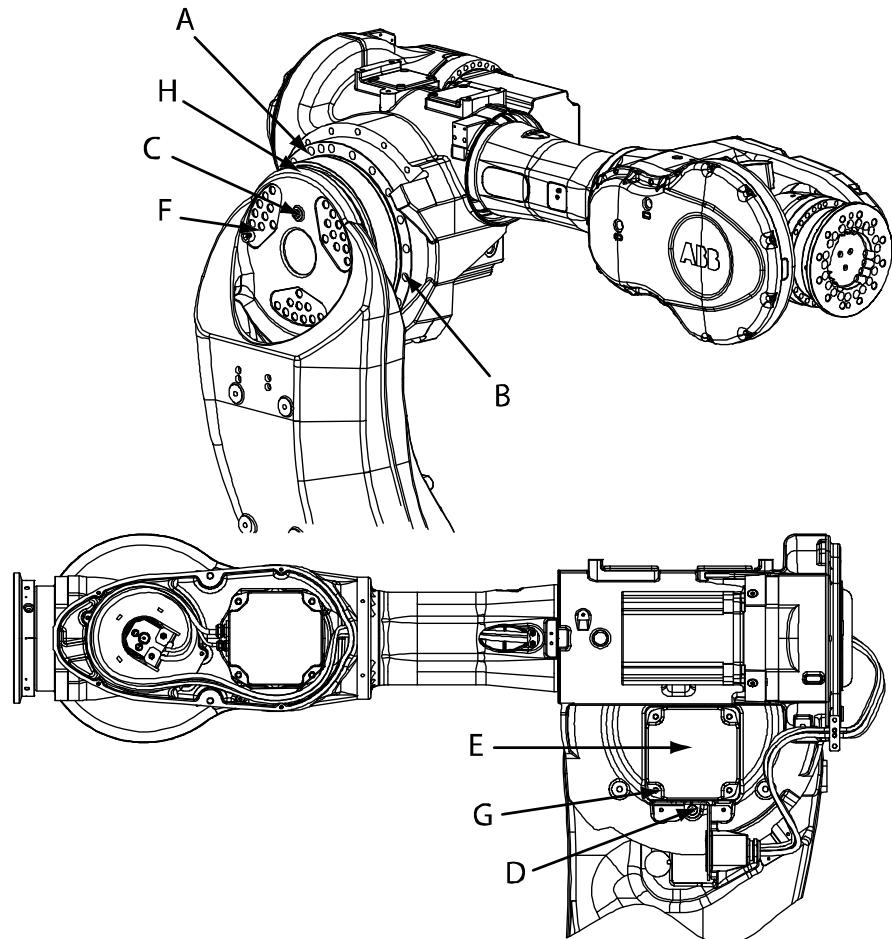
4.7.3 Replacement of gearbox, axis 3

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*.



xx0100000137

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

Required equipment

Equipment, etc.		Art. no.	Note
Gearbox		For spare part number, see Spare part lists on page 451 .	Includes <ul style="list-style-type: none"> • gearbox • o-ring. Does not include the sealing, axis 2/3!
O-ring		3HAB3772-51	1 pc on the gearbox. Replace if damaged.
Grease		3HAB3537-1	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 eye M16		3HAC14457-4	
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 Standard tools on page 445 .
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.

Continues on next page

4 Repair

4.7.3 Replacement of gearbox, axis 3

Continued

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

Deciding calibration routine

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

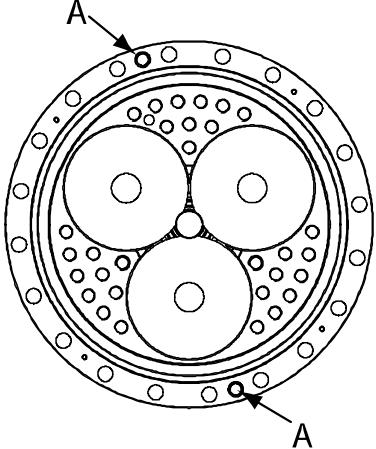
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, 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.	

Continues on next page

Action	Note
<p>2  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.</p>	
3 Secure the upper arm in a horizontal position using round slings.	Art. no. is specified in Required equipment on page 379 .
4 Remove the <i>motor, axis 3</i> .	<p>Detailed in section Removal, motor on page 335.</p> <p> Note When removing the motor axis 3, the brake on axis 3 is released. Make sure the upper arm is secured and disabled to move!</p>
5 Remove the <i>upper arm</i> .	Detailed in section Removal, upper arm on page 271 .
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 Required equipment on page 379 .
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 Location of gearbox on page 378 .
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 Required equipment on page 379 .
10 Fit the <i>lifting eye</i> to the gearbox, in one of the attachment screw holes that attaches the gearbox to the lower arm . If required, use screws in the holes (A) shown in the figure to the right to press the gearbox free.	<p>Art. no. is specified in Required equipment on page 379.</p>  <p>xx0200000033</p> <ul style="list-style-type: none"> • A: M16 holed for pressing the gearbox out

Continues on next page

4 Repair

4.7.3 Replacement of gearbox, axis 3

Continued

	Action	Note
11	 CAUTION The gearbox weighs 125 kg! All lifting accessories used must be sized accordingly!	
12	Remove the gearbox, with guidance from the guide pins, using an overhead crane or similar.	

Refitting, gearbox axis 3

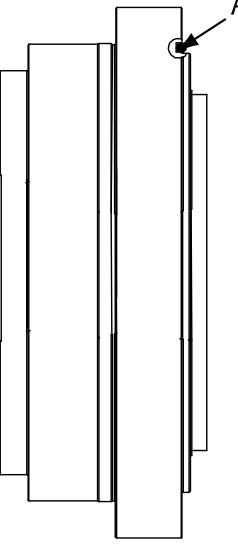
The procedure below details how to refit gearbox, axis 3.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
2	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 Required equipment on page 379 .
4	 CAUTION The gearbox weighs 125 kg! All lifting accessories used must be sized accordingly!	
5	Fit the <i>lifting eye</i> to the gearbox.	Art. no. is specified in Required equipment on page 379 .

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4.7.3 Replacement of gearbox, axis 3

Continued

Action	Note
6 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>Art. no. is specified in Required equipment on page 379.</p>  <ul style="list-style-type: none"> A: O-ring, gearbox axis 3
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 Secure the gearbox with 18 of the 20 gearbox attachment screws. Remove the guide pins and tighten the remaining two screws.	20 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 Screw joints on page 441 before fitting.
12 Refit the upper arm with a new sealing, axis 2/3 .	Art. no. is specified in Required equipment on page 379 . Detailed in section Refitting, upper arm on page 272 .
13 Refit the motor.	Detailed in section Refitting, motor on page 337 .
14 Recalibrate the robot!	Pendulum Calibration is described in Operating manual - Calibration Pendulum , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .

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4 Repair

4.7.3 Replacement of gearbox, axis 3

Continued

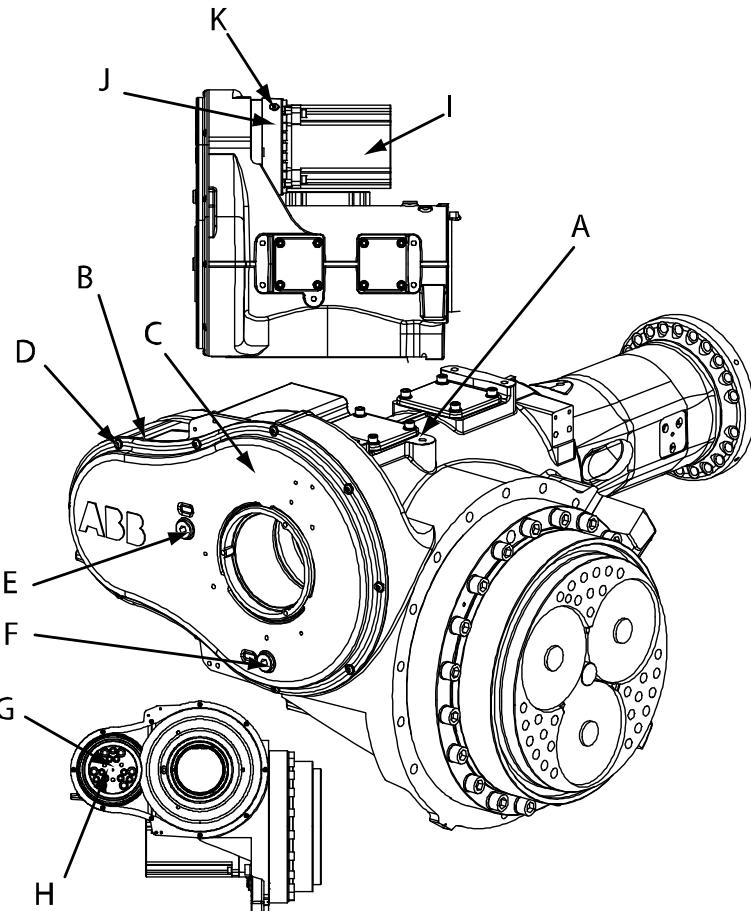
	Action	Note
15	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 55.</i>	

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

4 Repair

4.7.4 Replacement of gearbox, axis 4

Continued

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		3HAB3537-1	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 Standard tools on page 445 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Deciding calibration routine

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

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

Continues on next page

Action	Note
<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, 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  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3 Drain the oil from the primary gearbox through the oil plug, draining.	Detailed further in section Changing oil, axis-4 gearbox on page 204 .
4 Drain the oil from the secondary gearbox through the <i>oil plug, draining</i> .	Shown in the figure Location of gearbox on page 385 . Draining is further detailed in section Changing oil, axis-4 gearbox on page 204 .
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 Location of gearbox on page 385 .
7 Loosen the <i>gear attachment screws</i> but do not remove the gear Z3.	Shown in the figure Location of gearbox on page 385 .
8 Remove the motor, axis 4.	Detailed in section Removal, motor axis 4 on page 342 .
9 Remove gear Z3 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 Location of gearbox on page 385 .

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4 Repair

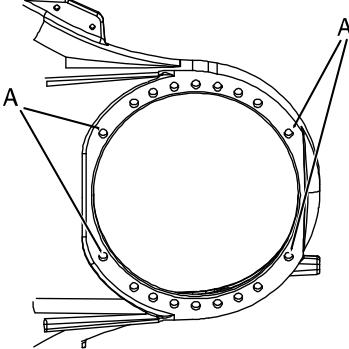
4.7.4 Replacement of gearbox, axis 4

Continued

	Action	Note
10	Remove the <i>motor flange attachment screws</i> and plain washers.	Shown in the figure Location of gearbox on page 385 .
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	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the 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 Required equipment on page 386 .
3	Lubricate the gearbox, motor and motor attachment mating surfaces with <i>grease</i> .	Art. no. is specified in Required equipment on page 386 .
4	Fit four <i>guide pins</i> symmetrically in the attachment holes in the upper arm housing.	 xx0200000067 A Attachment holes for guide pins, M10 Art. no. is specified in Required equipment on page 386 .
5	Fit two new <i>friction washers</i> onto the guide pins.	 Note Spare part no. is specified in Required equipment on page 386 . Make sure the surface beneath the friction washers is clean and dry!

Continues on next page

4.7.4 Replacement of gearbox, axis 4

Continued

Action	Note
6 Push in the <i>gearbox, axis 4, and the motor flange</i> . If necessary, use screws in the attachment holes to press in the motor flange.	Shown in the figure Location of gearbox on page 385 .  Note Make sure the motor flange is oriented correctly by observing the oil plugs as shown in the figure Replacement of gearbox, axis 4 on page 385 .
7 Secure the motor flange to the upper arm housing with 16 of the 18 washers and attachment screws. Secure with locking liquid.	18 pcs: M10 x 40; tightening torque: 65 Nm.
8 Remove the guide pins and secure the remaining two attachment screws as specified in previous step.	
9 Refit the motor, axis 4.	Detailed in section Refitting, motor axis 4 on page 343 .
10 Refit gear Z3 to the gearbox with its <i>gear attachment screws</i> .	Shown in the figure Location of gearbox on page 385 . 9 pcs: M12 x 50; tightening torque: 115 Nm. 6 pcs: M16 x 60: tightening torque: 300 Nm.
11 Replace the gasket, <i>cover axis 4</i> .	Art. no. is specified in Required equipment on page 386 .
12 Refit the <i>cover, axis 4 gearbox</i> with its <i>attachment screws</i> and secure with locking liquid.	Tightening torque: 10 Nm. Shown in the figure Location of gearbox on page 385 .
13 Perform a leak-down test.	Detailed in section Performing a leak-down test on page 238 .
14 Refill the primary gearbox with oil.	This is detailed in section Filling, oil, gearbox axis 4 on page 206 .
15 Refill the secondary gearbox with oil.	This is detailed in section Filling, oil, gearbox axis 4 on page 206 .
16 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
17  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

4 Repair

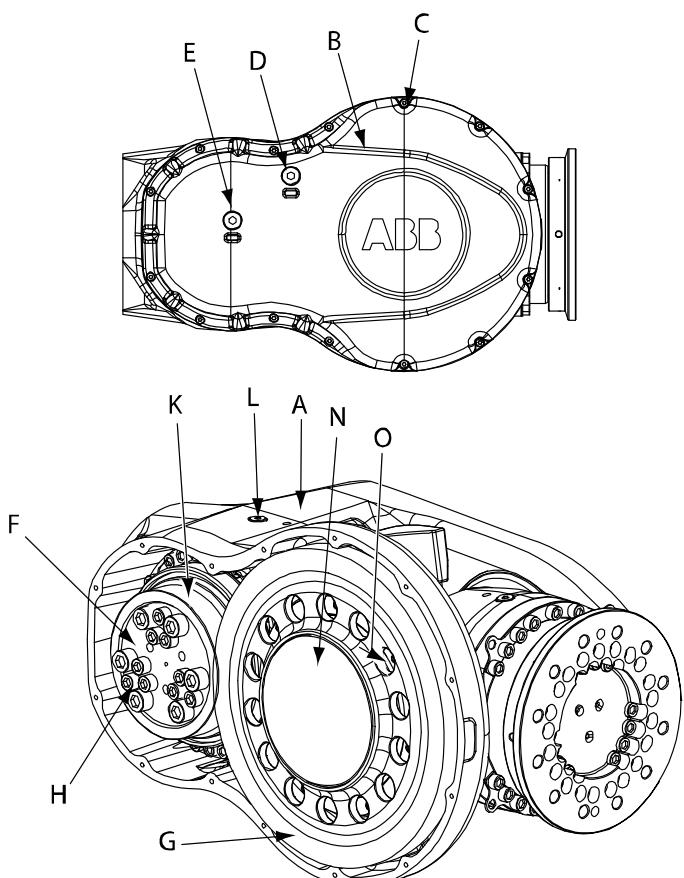
4.7.5 Replacement of gearbox, axis 5

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

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		3HAB3537-1	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 <i>Standard tools on page 445</i> .
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

4 Repair

4.7.5 Replacement of gearbox, axis 5

Continued

Deciding calibration routine

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

Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, 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  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3 Drain the oil from the primary gearbox.	Detailed in section Changing oil, axis-5 gearbox on page 208 .
4 Drain the oil from the secondary gearbox.	Detailed in section Changing oil, axis-5 gearbox on page 208 .
5 Remove the motor, axis 5.	Detailed in section Replacement of motor, axis 5 on page 346 .
6 Remove the cover, axis 5 gearbox by unscrewing its attachment screws.	Shown in the figure Location of gearbox on page 390!

Continues on next page

	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 Location of gearbox on page 390! 6 pcs: M16 x 60. 9 pcs: M12 x 50.
8	Remove the wheel unit.	Detailed in following section (Removal, wheel unit on page 393).
9	Remove the gearbox, axis 5 by unscrewing its attachment screws and removing the washers.	Shown in the figure Location of gearbox on page 390! 18 pcs: M10 x 40.
10	Apply two lifting eyes to the gearbox, axis 5, in opposite positions.	Art. no. is specified in Required equipment on page 391!
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.

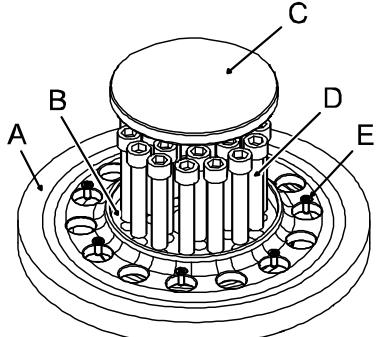
	Action	Note
1	Drain the oil from the secondary gearbox.	Detailed in section Changing oil, axis-5 gearbox on page 208 .
2	Remove the cover, axis 5 gearbox by unscrewing its attachment screws.	Shown in the figure Location of gearbox on page 390!
3	Make a short cut in the center of the VK-cover and remove it from the wheel unit by bending it off.	Shown in the figure Location of gearbox on page 390!  Note 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 Location of gearbox on page 390 and in the figure below! 7 pcs: M6 x 16.

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4 Repair

4.7.5 Replacement of gearbox, axis 5

Continued

Action	Note
5 Remove the <i>attachment screws</i> , gear Z4.	 xx0200000068 <ul style="list-style-type: none"> 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
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 Required equipment on page 391!
7 Remove the wheel unit by gently lifting it straight out.	

Refitting, gearbox axis 5

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 Make sure the 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 Required equipment on page 391 .
3 Fit two <i>guide pins</i> in the housing.	Art. no. is specified in Required equipment on page 391 .
4 Refit the two new <i>friction washers</i> (2 pcs) in the wrist housing.	Art. no. is specified in Required equipment on page 391 .
5 Apply two <i>lifting eyes</i> to the gearbox, axis 5 , in opposite positions.	Art. no. is specified in Required equipment on page 391 .
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 Location of gearbox on page 390 .

Continues on next page

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 Location of gearbox on page 390 .
8 Remove the guide pins and fit the remaining two attachment screws as specified in the previous step.	
9 Refit the gear Z3 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 Location of gearbox on page 390 . Reused screws may be used, providing they are lubricated as detailed in section Screw joints on page 441 before fitting.
10 Refit the wheel unit.	Detailed in the following procedures (Refitting, wheel unit on page 396).
11 Replace the <i>gasket</i> .	Art. no. is specified in Required equipment on page 391 .
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 Location of gearbox on page 390 .
13 Refit the motor, axis 5.	Detailed in section Refitting, motor axis 5 on page 349 .
14 Perform a leak-down test.	Detailed in section Performing a leak-down test on page 238 .
15 Refill the primary gearbox with oil.	Detailed further in section Filling oil, axis-5 gearbox on page 210 .
16 Refill the secondary gearbox with oil.	Detailed further in section Filling oil, axis-5 gearbox on page 210 .
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 <i>Calibrating with Axis Calibration method on page 416</i> . General calibration information is included in section Calibration on page 403 .
18  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

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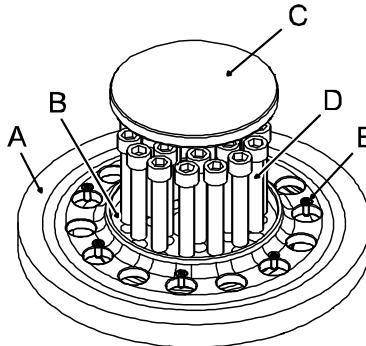
4 Repair

4.7.5 Replacement of gearbox, axis 5

Continued

Refitting, wheel unit

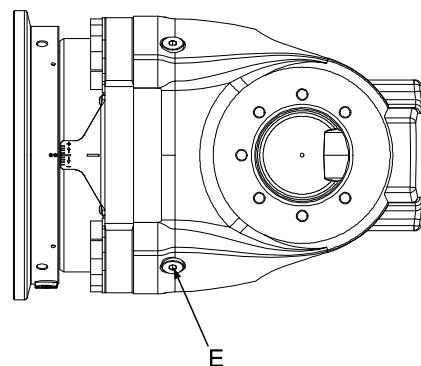
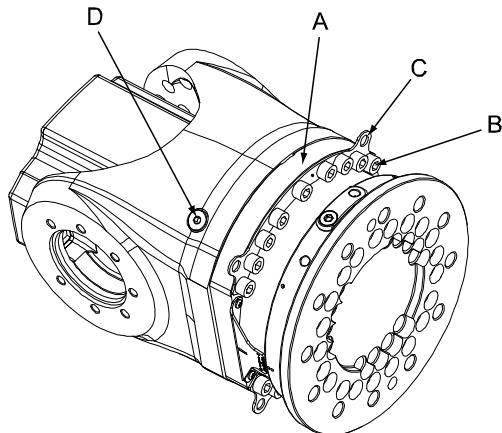
The procedure below details how to refit the wheel unit.

	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 Required equipment on page 391 .
3	Apply <i>removal tool</i> to the center hole of the gear Z4.	Art. no. is specified in Required equipment on page 391 .
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.	 Note 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.	 xx0200000068 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
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 Screw joints on page 441 before fitting.
9	Refit the VK-cover.	Art. no. is specified in Required equipment on page 391 . Shown in the figure Location of gearbox on page 390 .
10	Proceed with step 11 in the refitting detailed in the previous procedure (procedure Refitting, gearbox axis 5 on page 394).	

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.		Art. no.	Note
Gearbox		For spare part number, see Spare part lists on page 451 .	Includes o-ring.
Washers		3HAC10122-13	Not included in the gearbox. Replace if damaged!

Continues on next page

4 Repair

4.7.6 Replacement of gearbox, axis 6

Continued

Equipment, etc.		Art. no.	Note
O-ring		3HAB3772-49 3HAB3772-83	Must be replaced when re-assembling gearbox!
Grease		3HAB3537-1	For lubricating the o-ring.
Flange sealant		12340011-116	Loctite 574
Standard toolkit		-	Content is defined in section Standard tools on page 445 .
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Deciding calibration routine

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

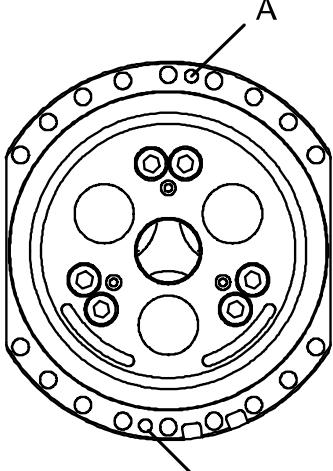
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 417 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .

Continues on next page

Action	Note
If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, gearbox

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

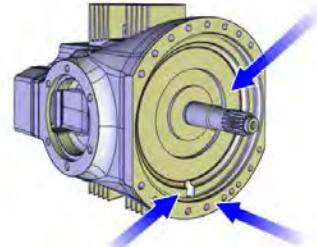
Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply to the robot• hydraulic pressure supply to the robot• air pressure supply to the robot Before entering the robot working area.	
3 Drain the oil from gearbox, axis 6.	Detailed in the section Draining oil, gearbox axis 6 on page 213 .
4 Remove the <i>turning disk</i> .	Detailed in the section Removing turning disk on page 261 .
5 Remove the gearbox by unscrewing its 18 attachment screws and two washers.	Shown in the figure Location of gearbox on page 397 .
6 If required, apply M10 screws to the holes shown in the figure to the right, to press the gearbox out.	 xx0200000220 <ul style="list-style-type: none"> • A: M10 holes for pressing out the gearbox

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4 Repair

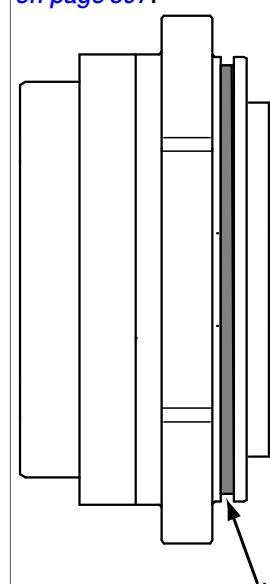
4.7.6 Replacement of gearbox, axis 6

Continued

Action	Note
Foundry Plus: Remove old Loctite 574 flange sealant residues and other contamination from the contact surfaces.	 xx1400001123
7 Remove the gearbox axis 6 by lifting it out carefully.	Be careful not to damage the motor pinion!

Refitting, gearbox

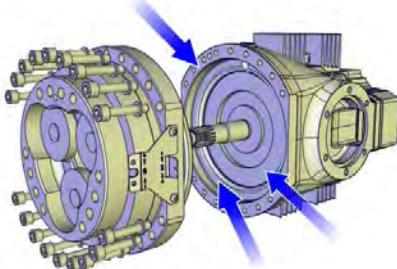
The procedure below details how to refit gearbox, axis 6.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2 Make sure the <i>o-ring</i> is fitted to the rear of the gearbox. Lubricate the <i>o-ring</i> with <i>grease</i> .	Art. no. is specified in <i>Required equipment on page 397</i> .  xx0200000221 • A: O-ring, gearbox axis 6

Continues on next page

4.7.6 Replacement of gearbox, axis 6

Continued

Action	Note
3 Release the holding brake of motor axis 6.	Detailed in the section Manually releasing the brakes on page 89 .
4 Foundry Plus: Apply Loctite 574 flange sealant on the contact surface.	 xx1400001122
5 Insert the <i>gearbox, axis 6</i> into the wrist unit.	Art. no. is specified in Required equipment on page 397 . Shown in the figure Location of gearbox on page 397 . Make sure the gears of the gearbox mate with the gears of the motor!
6 Fit the both washers and secure the gearbox with the <i>attachment screws</i> .	Shown in the figure Location of gearbox on page 397 . 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 Screw joints on page 441 before fitting.
7 Refit the <i>turning disk</i> .	Detailed in the section Refitting turning disk on page 262 .
8 Perform a <i>leak-down test</i> .	Detailed in the section Performing a leak-down test on page 238 .
9 Refill the gearbox with oil.	Detailed in the section Filling oil, gearbox axis 6 on page 214 .
10 Recalibrate the robot.	Pendulum Calibration is described in Operating manual - Calibration Pendulum , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 416 . General calibration information is included in section Calibration on page 403 .
11  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 55 .	

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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 416](#).

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

Calibration terminology

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

5 Calibration

5.1.2 Calibration methods

5.1.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	<p>The calibrated robot is positioned at calibration position.</p> <p>Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.</p> <p>For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.</p>	Axis Calibration or Calibration Pendulum ⁱ Levelmeter calibration (alternative method)
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">Mechanical tolerances in the robot structureDeflection due to load <p>Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot.</p> <p>Absolute accuracy calibration data is found on the SMB (serial measurement board) in the robot.</p> <p>For robots with RobotWare 5.05 or older, the absolute accuracy calibration data is delivered in a file, absacc.cfg, supplied with the robot at delivery. The file replaces the calib.cfg file and identifies motor positions as well as absolute accuracy compensation parameters.</p> <p>A robot calibrated with absolute accuracy has a sticker next to the identification plate of the robot.</p> <p>To regain 100% absolute accuracy performance, the robot must be recalibrated for absolute accuracy!</p>  <p>ABSOLUTE ACCURACY</p> <p>xx0400001197</p>	CalibWare

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

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Brief description of calibration methods

Calibration Pendulum method

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

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

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

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 7600 and is the most accurate method for the standard calibration. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

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

An introduction to the calibration method is given in this manual, see [Calibrating with Axis Calibration method on page 416](#).

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

Levelmeter calibration - alternative method

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

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

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

CalibWare - Absolute Accuracy calibration

To achieve a good positioning in the Cartesian coordinate system, Absolute Accuracy calibration is used as a TCP calibration. The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field 5.0*.

If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance.

Continues on next page

5 Calibration

5.1.2 Calibration methods

Continued

For most cases after motor and transmission replacements that do not include taking apart the robot structure, standard calibration is sufficient. Standard calibration also supports wrist exchange.

References

Article numbers for the calibration tools are listed in the section [Special tools on page 446](#).

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 recalibrated using the calibration methods supplied by ABB. Calibrate the robot carefully with standard calibration, according to information in this manual.

If the robot has *absolute accuracy* calibration, it is also recommended, but not always necessary to calibrate for new absolute accuracy.

The resolver values will change when parts affecting the calibration position are replaced on the robot, for example motors or parts of the transmission.

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See

[Updating revolution counters on page 411](#). This will occur when:

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

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

The robot is rebuilt

If the robot is rebuilt, for example, after a crash or when the reach ability of a robot is changed, it needs to be recalibrated for new resolver values.

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

5 Calibration

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

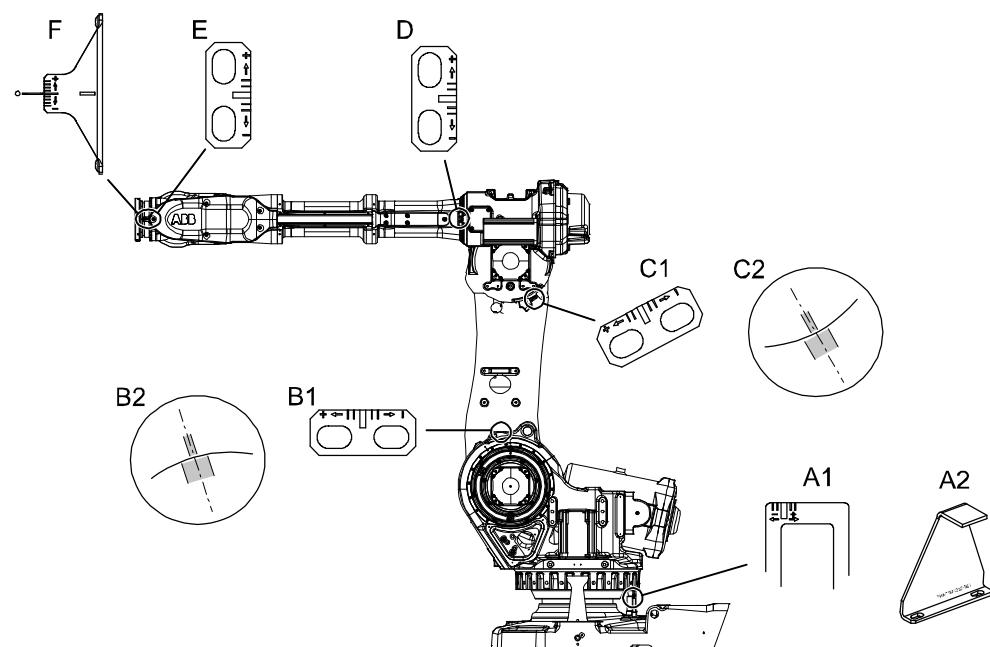
Introduction

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

Synchronization marks, IRB 7600

The illustration below shows the location of the synchronization marks on specific plates and directly in the casting at axes 2 and 3.

The figure shows IRB 6600, but the scales and their positions are the same.



xx0200000176

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

Continues on next page

5.2.1 Synchronization marks and synchronization position for axes

Continued

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 Calibration

5.2.2 Calibration movement directions for all axes

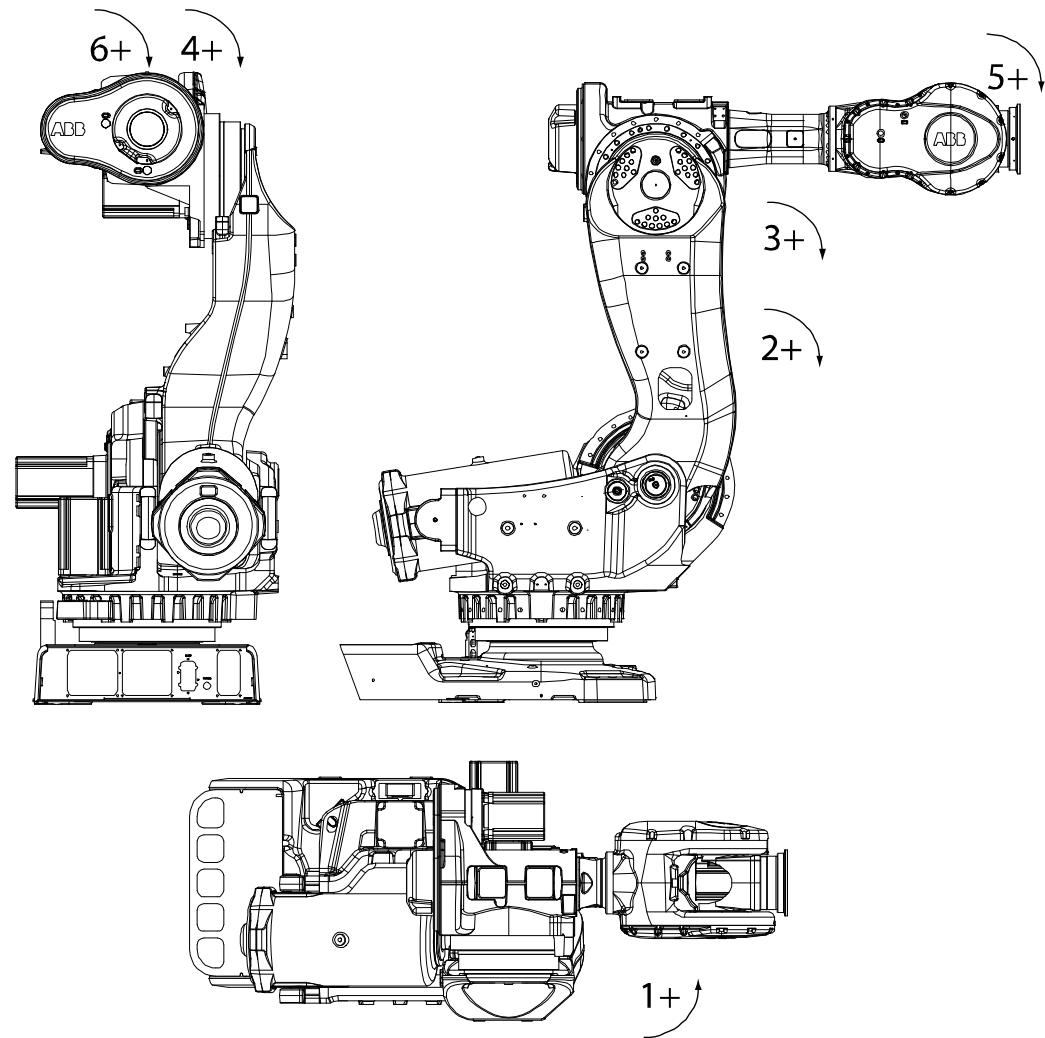
Overview

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

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

Manual movement directions, 6 axes

Note! The graphic shows an IRB 7600. The positive direction is the same for all 6-axis robots, except the positive direction of axis 3 for IRB 6400R, which is in the opposite direction!



xx0200000089

5.3 Updating revolution counters

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

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

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks.	See Synchronization marks and synchronization position for axes on page 408 .
3	When all axes are positioned, update the revolution counter.	Step 2 - Updating the revolution counter with the TPU on page 412 (BaseWare 4.0). Step 2 - Updating the revolution counter with the FlexPendant on page 413 .

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

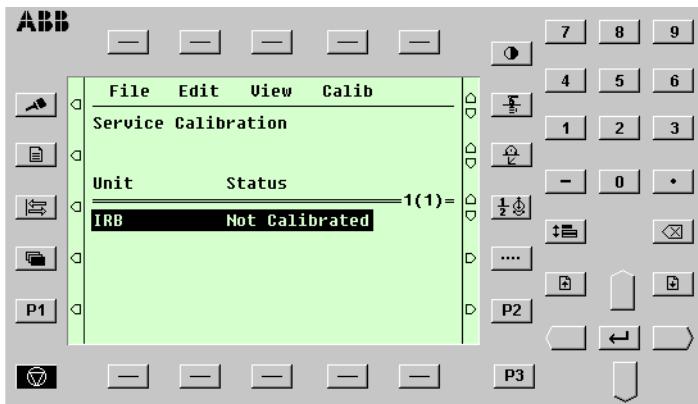
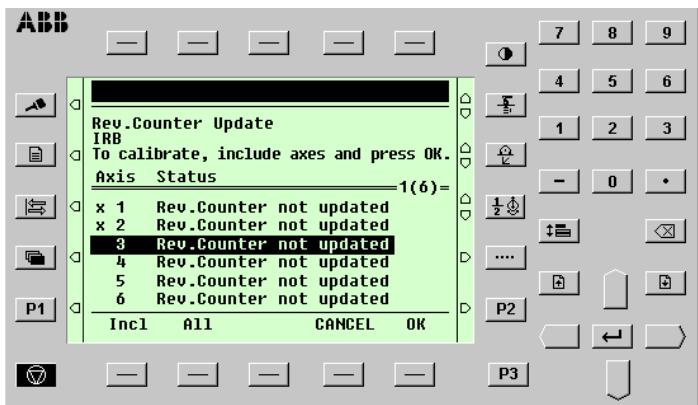
5 Calibration

5.3 Updating revolution counters

Continued

Step 2 - Updating the revolution counter with the TPU

Use this procedure to update the revolution counter with the TPU (BaseWare 4.0).

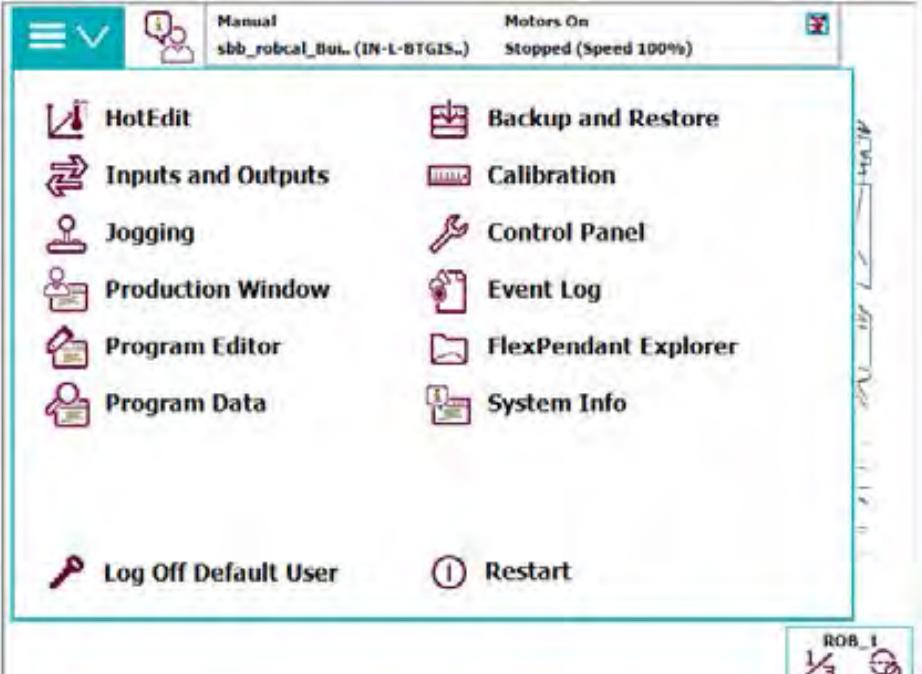
Action	Note
1 Press the button Miscellaneous then ENTER to select the service window.  xx0100000194	
2 Select Calibration from the View menu. The Calibration window appears. If there is more than one unit connected to the manipulator, they will be listed in the window.  xx0100000201	
3 Select the desired unit and choose Rev Counter Update from the Calib menu. The Revolution Counter Update window appears.  xx0100000202	
4 Select the desired axis and press Incl to include it (it will be marked with an x) or press All to select all axes.	
5 Press OK when all axes that are to be updated are marked with an x. CANCEL returns to the Calibration window.	
6 Press OK again to confirm and start the update. CANCEL returns to the Revolution Counter Update window.	

Continues on next page

	Action	Note
7	At this point, it is <i>recommended</i> that the revolution counter values are saved to a diskette.	Not required.
8	<p>! CAUTION</p> <p>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 <i>Checking the synchronization position</i> on page 429.</p>	

Step 2 - Updating the revolution counter with the FlexPendant

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

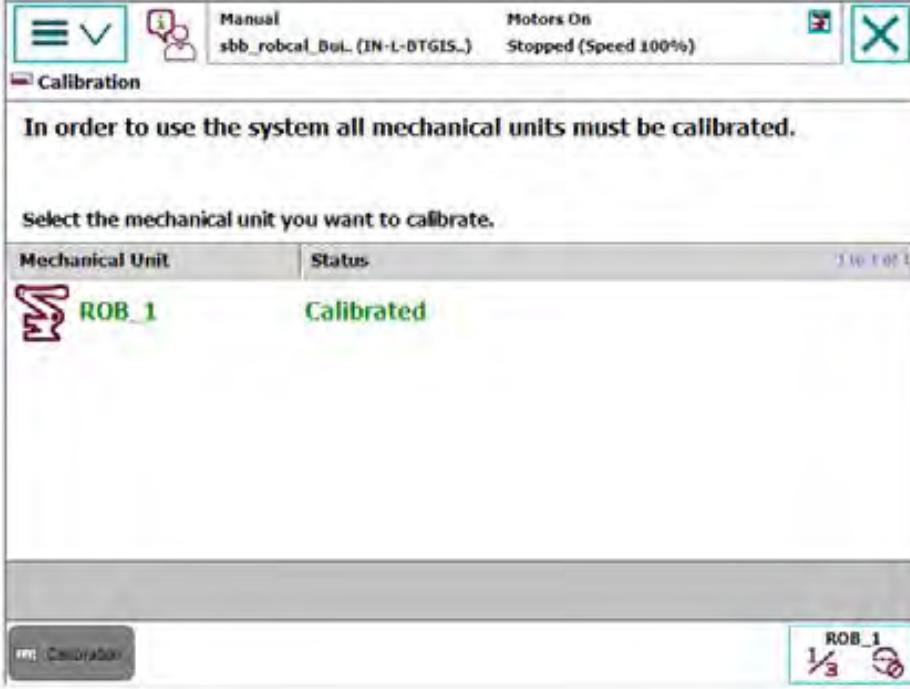
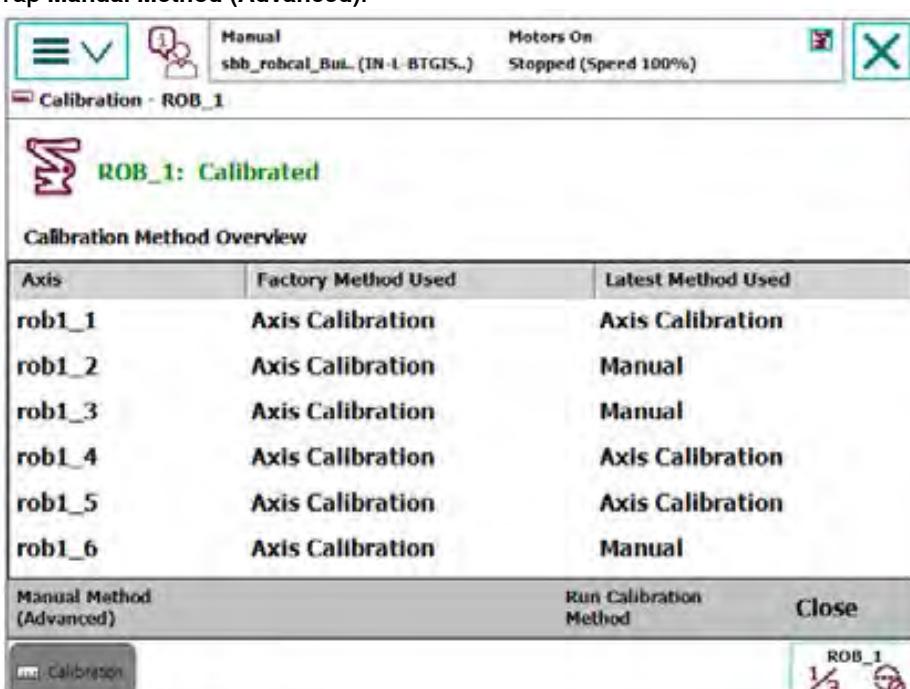
	Action
1	On the ABB menu, tap Calibration.
	 <p>The screenshot shows the ABB FlexPendant software interface. At the top, there's a toolbar with icons for Home, Manual, and Motors On. Below that is a status bar showing 'sbb_robcal_Bui. (IN-L-BTGIS..)' and 'Stopped (Speed 100%)'. The main menu area has two columns of icons. The left column includes HotEdit, Inputs and Outputs, Jogging, Production Window, Program Editor, and Program Data. The right column includes Backup and Restore, Calibration, Control Panel, Event Log, FlexPendant Explorer, and System Info. At the bottom of the menu, there are two buttons: 'Log Off Default User' and 'Restart'. In the bottom right corner, there's a small window labeled 'ROB_1' with a progress bar at 1/3. The bottom of the screen displays the text 'xx1500000942'.</p>

Continues on next page

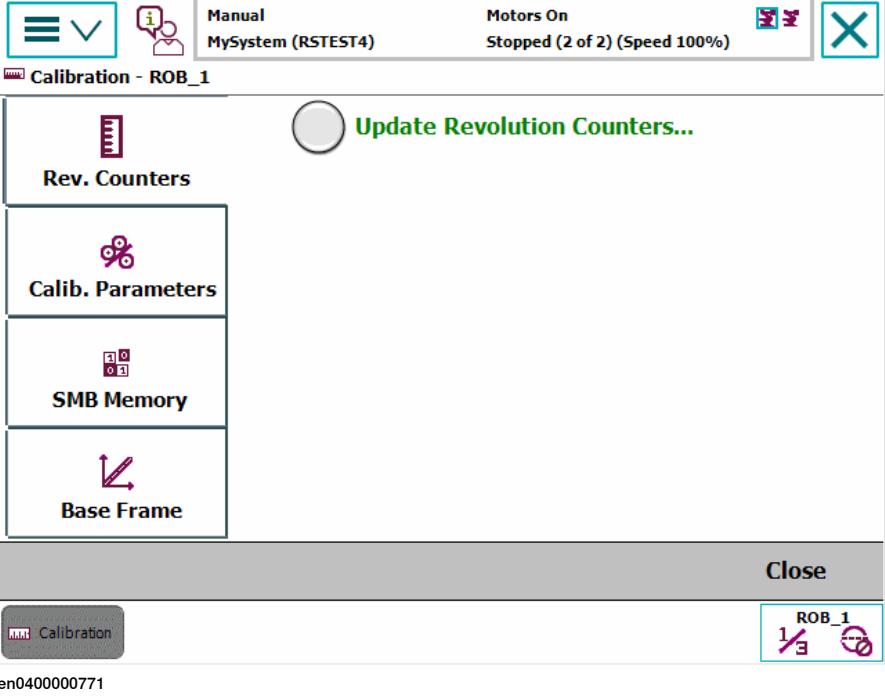
5 Calibration

5.3 Updating revolution counters

Continued

	Action																					
2	<p>All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p>  <p>In order to use the system all mechanical units must be calibrated.</p> <p>Select the mechanical unit you want to calibrate.</p> <table border="1"><thead><tr><th>Mechanical Unit</th><th>Status</th></tr></thead><tbody><tr><td>ROB_1</td><td>Calibrated</td></tr></tbody></table> <p>xx1500000943</p>	Mechanical Unit	Status	ROB_1	Calibrated																	
Mechanical Unit	Status																					
ROB_1	Calibrated																					
3	<p>This step is valid for RobotWare 6.02 and later.</p> <p>Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration.</p> <p>Tap Manual Method (Advanced).</p>  <p>Calibration Method Overview</p> <table border="1"><thead><tr><th>Axis</th><th>Factory Method Used</th><th>Latest Method Used</th></tr></thead><tbody><tr><td>rob1_1</td><td>Axis Calibration</td><td>Axis Calibration</td></tr><tr><td>rob1_2</td><td>Axis Calibration</td><td>Manual</td></tr><tr><td>rob1_3</td><td>Axis Calibration</td><td>Manual</td></tr><tr><td>rob1_4</td><td>Axis Calibration</td><td>Axis Calibration</td></tr><tr><td>rob1_5</td><td>Axis Calibration</td><td>Axis Calibration</td></tr><tr><td>rob1_6</td><td>Axis Calibration</td><td>Manual</td></tr></tbody></table> <p>Manual Method (Advanced)</p> <p>Run Calibration Method</p> <p>Close</p> <p>xx1500000944</p>	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
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

Action
4 A screen is displayed, tap Rev. Counters. 
5 Tap Update Revolution Counters.... A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: <ul style="list-style-type: none">• Tap Yes to update the revolution counters.• Tap No to cancel updating the revolution counters. Tapping Yes displays the axis selection window.
6 Select the axis to have its revolution counter updated by: <ul style="list-style-type: none">• Ticking in the box to the left• Tapping Select all to update all axes. Then tap Update.
7 A dialog box is displayed, warning that the updating operation cannot be undone: <ul style="list-style-type: none">• Tap Update to proceed with updating the revolution counters.• Tap Cancel to cancel updating the revolution counters. Tapping Update updates the selected revolution counters and removes the tick from the list of axes.
8  CAUTION If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See Checking the synchronization position on page 429 .

5 Calibration

5.4.1 Description of Axis Calibration

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:

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



WARNING

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



WARNING

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

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



WARNING

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

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

Continues on next page

Routines in the calibration procedure

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

Fine calibration routine

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

Reference calibration routine

Choose this routine to create reference values and to calibrate the robot when the robot is dressed with tools, process cabling or other equipment.

Also choose this routine if the robot is wall mounted or suspended.

If calibrating the robot with reference calibration there must be reference values created before repair is made to the robot, if values are not already available.

Creating new values requires possibility to move the robot. The reference values contain positions of all axes, torque of axes and technical data about the tool installed. The reference value is unique for the current setup of the robot and will be named according to tool name, date etc.

Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.

When reference calibration is performed, the robot is restored to the status given by the reference values.

Update revolution counters

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

Validation

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

Position of robot axes

The axis chosen for calibration is automatically run by the calibration program to its calibration position during the calibration procedure.

In order for the axis to be able to be moved to calibration position, or in order for getting proper access to the calibration bushing, other axes might need to be jogged to positions different from 0 degrees. Information about which axes are allowed to be jogged will be given on the FlexPendant. These axes are marked with **Unrestricted** in the FlexPendant window.

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.



WARNING

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

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

Examining the calibration tool

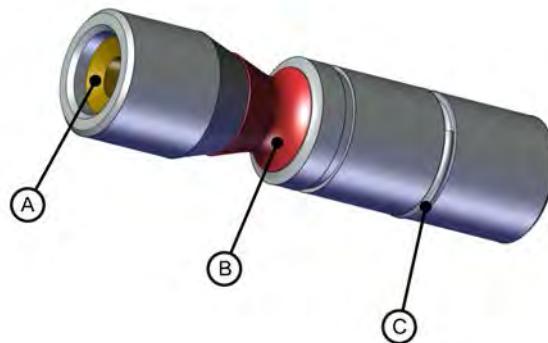
Check prior to usage

Before using the calibration tool, make sure that the tube insert, the plastic protection and the steel spring ring are present.



WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

A	Tube insert
B	Plastic protection
C	Steel spring ring

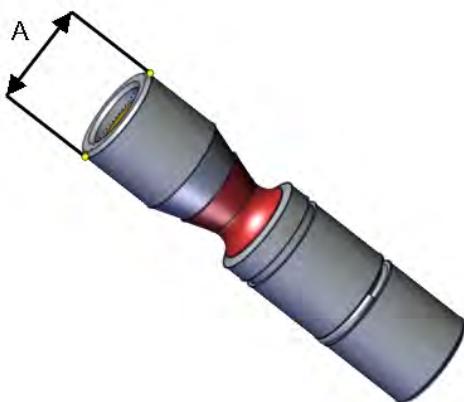
Periodic check of the calibration tool

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within Ø12g4 mm, Ø8g4 mm or Ø6g5 mm (depending on calibration tool size).

Continues on next page

- Straightness within 0.005 mm.



xx1500000951

A	Outer diameter
---	----------------

Identifying the calibrating tools

It is possible to make the pins identifiable with, for example, an RFID chip. The procedure of how to install an RFID chip is described below.



Note

The pin identifier is NOT delivered from ABB, it is a customized solution.

	Action	Note
1	<p>It is possible to use any RFID solution, with the correct dimensions. ABB has verified function on some suppliers fulfilling the requirements of NFC compatible devices (13.56 Mhz) according to ISO 14443 or ISO 15693.</p> <p> Note</p> <p>The maximum dimensions on the RFID chip must not exceed Ø7.9 mm x 8.0 mm, Ø5.9 mm x 8.0 mm or Ø3.9 mm x 8.0 mm (depending on calibration tool size).</p>	
2	<p>There is a cavity on one end of the calibration tool in which the RFID chip can be installed.</p> <p>Install the RFID chip according to supplier instructions.</p> <p>Install the chip in flush with the tool end.</p>	

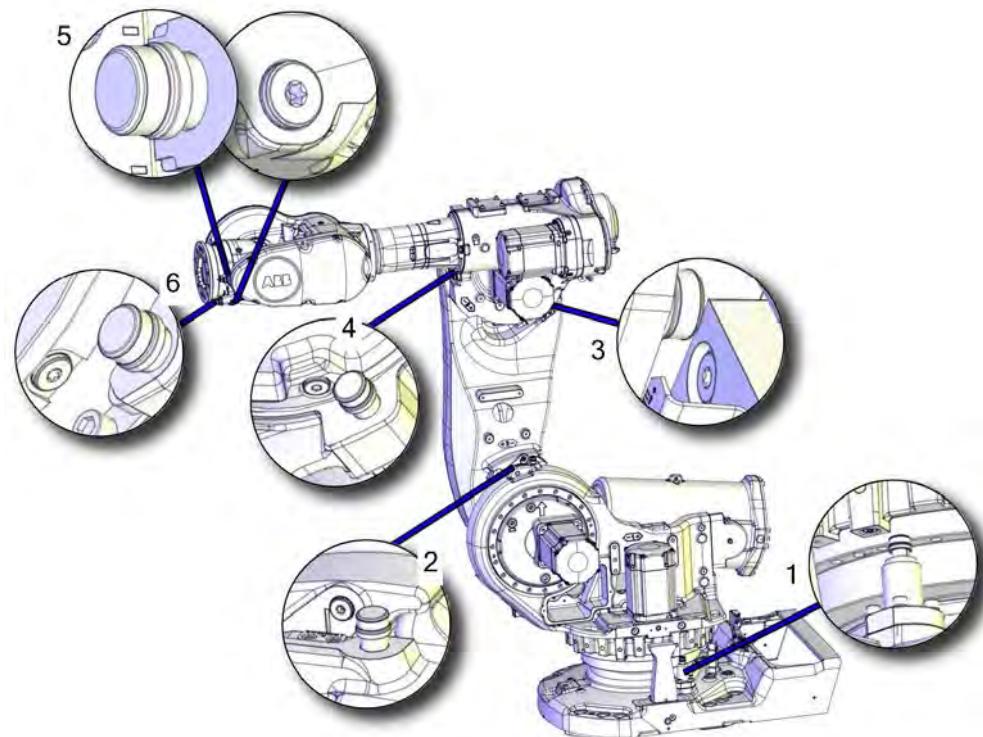
5 Calibration

5.4.3 Location of calibration items

5.4.3 Location of calibration items

Location of calibration items

A fixed calibration pin and a bushing for the movable calibration tool are located on each axis as follows.



xx1500000894

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 in the bushing. Replace damaged parts with new, if needed.

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

5.4.4 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 sequence.

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

- 1 Choose calibration routine. The routines are described in [Routines in the calibration procedure on page 417](#).
- 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  DANGER While conducting the calibration, the robot needs to be connected to power. Make sure that the robots working area is empty, as the robot can make unpredicted movements.	
2 Wipe the calibration tool clean.  Note The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.

Starting the calibration procedure

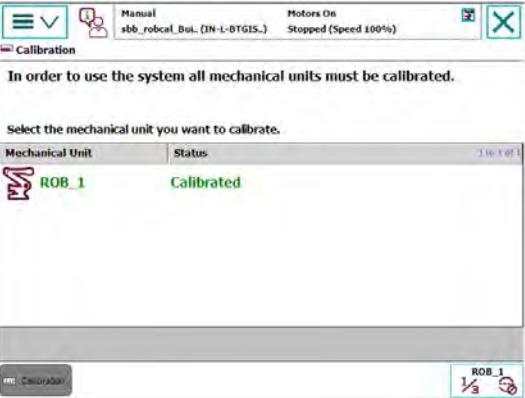
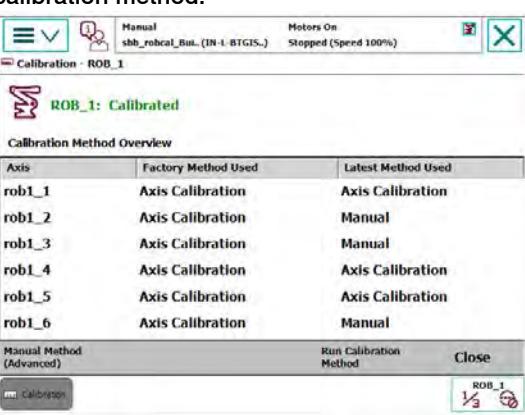
Use this procedure to call for the Axis Calibration method on the FlexPendant.

Action	Note
1 On the ABB menu, tap Calibration. 	

Continues on next page

5.4.4 Axis Calibration - Running the calibration procedure

Continued

Action	Note
<p>2 All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p> 	
<p>3 Calibration method used at factory for each axis is shown, as well as calibration method used for the robot during last field calibration. Tap Run Calibration Method. The software will automatically call for the procedure for the valid calibration method.</p> 	The FlexPendant will give all information needed to proceed with Axis Calibration.
<p>4 Follow the instructions given on the FlexPendant.</p>	A brief overview of the sequence that will be run on the FlexPendant is given in Overview of the calibration procedure on the FlexPendant on page 421 .

Restarting an interrupted calibration procedure

If the Axis Calibration procedure is interrupted before the calibration is finished, the RobotWare program needs to be started again. Use this procedure to take required action.

Situation	Action
The three-position enabling device on the FlexPendant has been released during robot movement.	Press and hold the three-position enabling device and press Play.

Continues on next page

5 Calibration

5.4.4 Axis Calibration - Running the calibration procedure

Continued

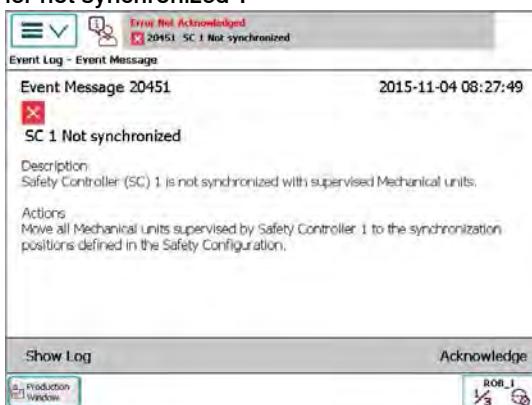
Situation	Action
The RobotWare program is terminated with PP to Main.	<p>Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See Starting the calibration procedure on page 422.</p> <p>If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in Calibration movement directions for all axes on page 410</p>

Axis Calibration with SafeMove option

To be able to run Axis Calibration SafeMove needs to be unsynchronized. The Axis Calibration routine recognizes if the robot is equipped with SafeMove and will force SafeMove to unsynchronize automatically.

However, SafeMove may generate other warning messages anytime during the Axis Calibration routine.

Safety controller not synchronized - SafeMove message

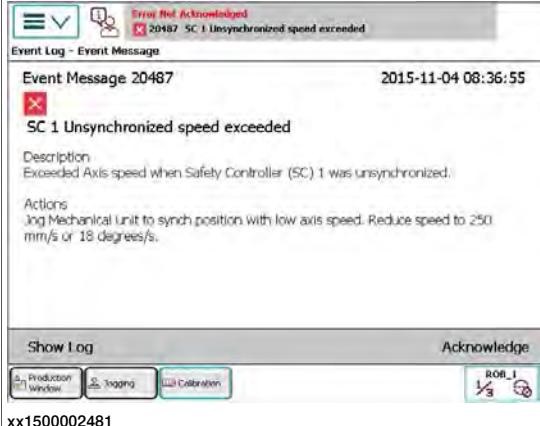
	Action	Note
1	<p>SafeMove generates the message "Safety controller not synchronized".</p> 	
2	<p>Confirm unsynchronized state by pressing Acknowledge to continue Axis Calibration procedure.</p>	
3	<p>Restart Axis Calibration procedure by pressing Play.</p>	

Continues on next page

5.4.4 Axis Calibration - Running the calibration procedure

Continued

Unsynchronized speed exceeded - SafeMove message while saving robot data

Action	Note
<p>1 SafeMove generates the message "Unsynchronized speed exceeded" while saving robot data.</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays a single message: 'Event Message 20467 SC 1 Unsynchronized speed exceeded'. The message details: 'SC 1 Unsynchronized speed exceeded', 'Description: Exceeded Axis speed when Safety Controller (SC) 1 was unsynchronized.', and 'Actions: Stop Mechanical Unit to synch position with low axis speed. Reduce speed to 250 mm/s or 18 degrees/s.' Below the message are buttons for 'Show Log' and 'Acknowledge', and tabs for 'Production Window', 'Logging', 'Calibration', and 'SafeMove Visualizer'. The status bar at the bottom shows 'xx1500002481'.</p>	
2 Press Acknowledge to continue Axis Calibration procedure.	
3 Restart Axis Calibration procedure by pressing Play.	

Unsynchronized time limit expired - SafeMove message anytime during Axis Calibration routine

Action	Note
<p>1 SafeMove generates the message "Unsynchronized time limit expired" (anytime).</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays a single message: 'Event Message 20468 SC 1 Unsynchronized time limit expired'. The message details: 'Available time to move the Robot when unsynchronized has expired for Safety Controller (SC) 1.', and 'Actions: 1. Do a Confirm stop by pressing the Motors ON push button or activate System input. 2. Synchronize SC 1.' Below the message are buttons for 'Next', 'Previous', and 'OK', and tabs for 'Production Window', 'Calibration', 'SafeMove Visualizer', and 'SafeMove Visualizer'. The status bar at the bottom shows 'xx1500002482'.</p>	
2 Press OK to continue Axis Calibration procedure.	
3 Restart Axis Calibration procedure by pressing Play.	

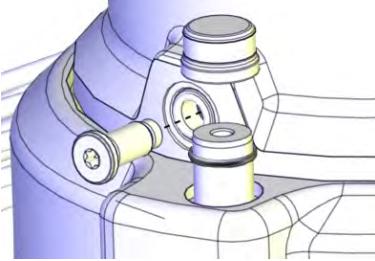
Continues on next page

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.	 xx1500000952
2	Reinstall the protective cover on the fixed calibration pin and the protective plug on the bushing on each axis, directly after the axis is calibrated. Replace the cover/plug with new spare part, if missing or damaged.	Protection cover and plug set: 3HAC056806-001.

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 Verifying the calibration

Introduction

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

Verifying the calibration

Use this procedure to verify the calibration result.

Action	Note
1 Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See Checking the synchronization position on page 429 .
2 Adjust the <i>synchronization marks</i> when the calibration is done, if necessary.	This is detailed in section Synchronization marks and synchronization position for axes on page 408 .
3 Write down the values on a new label and stick it on top of the calibration label. The label is located on the lower arm.	
4 Remove any calibration equipment from the robot.	

5.7 Checking the synchronization position

Introduction

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

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

Using a MoveAbsJ instruction 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 Synchronization marks and synchronization position for axes on page 408 and Updating revolution counters on page 411 .

Using a MoveAbsJ instruction

Use this procedure to create a program that runs all the robot axes to their synchronization position.

	Action	Note
1	On ABB menu tap Program editor .	
2	Create a new program.	
3	Use MoveAbsJ in the Motion&Proc menu.	
4	Create the following program: <pre>MoveAbsJ [[0,0,0,0,0,0], [9E9,9E9,9E9,9E9,9E9,9E9]] \NoEOffs, v1000, fine, tool0</pre>	
5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See Synchronization marks and synchronization position for axes on page 408 and Updating revolution counters on page 411 .

Continues on next page

5 Calibration

5.7 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 Jogging 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 Synchronization marks and synchronization position for axes on page 408 and Updating revolution counters on page 411 .

Using the jogging window

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

Action	Note
1 On the ABB menu, tap Jogging.	
2 Tap Motion mode to select group of axes to jog.	
3 Tap to select the axis to jog, axis 1, 2, or 3.	
4 Manually run the robots axes to a position where the axis position value read on the FlexPendant, is equal to zero.	
5 Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See Synchronization marks and synchronization position for axes on page 408 and Updating revolution counters on page 411 .

6 Decommissioning

6.1 Environmental information

Hazardous material

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

Dispose components properly to prevent health or environmental hazards.

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

Oil and grease

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

Also note that:

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

6 Decommissioning

6.2 Scrapping of robot

6.2 Scrapping of robot

Important when scrapping the robot



DANGER

When a robot is disassembled while being scrapped, it is very important to remember the following before disassembling starts, in order to prevent injuries:

- Always remove all batteries from the robot. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.

6.3 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 Standard tools on page 445 .
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 Replacing the balancing device on page 307 .
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

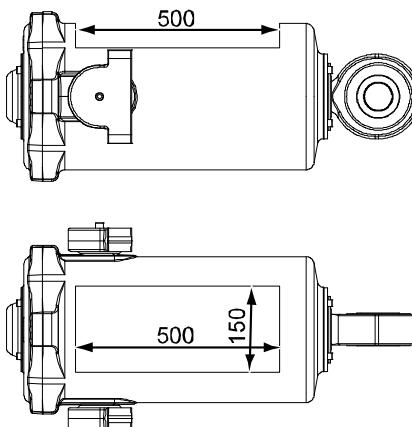
6 Decommissioning

6.3 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  DANGER There is stored energy built up by high tensioned compression springs inside the balancing device! When a coil is cut the released tension creates a spatter of sparks and flames. The working area must be free of flammable materials. Position the balancing device so that the spatter will be directed away from personnel.	
2 Clamp the device at the working location. Place the device at ground level so that the hole and spring coils are cut from a more safe distance.	
3  DANGER The hole must be cut as specified in the figure. Pieces can be ejected from the cylinder at high speed if the hole is cut larger than specified!	
4 Cut a hole in the housing as shown in the figure.	Use a cutting torch with a long shaft. The measurements shown below are maximum values!  xx020000082

Continues on next page

	Action	Note
5	 DANGER <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	Cut the coils of the springs inside the housing as specified below: <ul style="list-style-type: none">• Outer spring: cut at least five coils!• Middle spring: cut at least four coils!• Inner spring: cut at least four coils!	Use a cutting torch with a long shaft.
7	Double-check the number of coils cut and make sure all the tension in the springs are removed.	

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7 Reference information

7.1 Introduction

General

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

7 Reference information

7.2 Applicable safety standards

7.2 Applicable safety standards

Standards, EN ISO

The robot system is designed in accordance with the requirements of:

Standard	Description
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Robots and robotic devices -- Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1 ⁱ	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 ⁱⁱ	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 ⁱⁱ	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

ⁱ Only robots with protection Clean Room.

ⁱⁱ Only valid for arc welding robots. Replaces EN IEC 61000-6-4 for arc welding robots.

European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design
EN 953	Safety of machinery - General requirements for the design and construction of fixed and movable guards

Other standards

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740 (option 429-1)	Safety standard for robots and robotic equipment

Continues on next page

7 Reference information

7.2 Applicable safety standards

Continued

Standard	Description
CAN/CSA Z 434-03 (option 429-1)	Industrial robots and robot Systems - General safety requirements

7 Reference information

7.3 Unit conversion

7.3 Unit conversion

Converter table

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

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

7.4 Screw joints

General

This section describes how to tighten the various types of screw joints on the IRB 7600.

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

UNBRAKO screws

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

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

Gleitmo treated screws

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

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

Screws lubricated in other ways

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

In such cases, proceed as follows:

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

Lubricant	Article number
Molycote 1000 (molybdenum disulphide grease)	11712016-618

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard** torques are specified in the following tables. Any **special** torques are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct* tightening torque for each type of screw joint.
- Only use *correctly calibrated* torque keys.

Continues on next page

7 Reference information

7.4 Screw joints

Continued

- Always *tighten the joint by hand*, and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not jerk*. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is 10%!

Oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with slotted or cross-recess head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670
M24	680	960	1150

Lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molykote 1000, Gleitmo 603 or equivalent with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque (Nm) Class 10.9, lubricated ⁱ	Tightening torque (Nm) Class 12.9, lubricated ⁱ
M8	28	35
M10	55	70
M12	96	120
M16	235	280
M20	460	550
M24	790	950

ⁱ Lubricated with Molykote 1000, Gleitmo 603 or equivalent

Continues on next page

Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one or both* connectors are made of *brass*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque Nm - Nominal	Tightening torque Nm - Min.	Tightening torque Nm - Max.
1/8	12	8	15
1/4	15	10	20
3/8	20	15	25
1/2	40	30	50
3/4	70	55	90

7 Reference information

7.5 Weight specifications

7.5 Weight specifications

Definition

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

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

Example

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

	Action	Note
	 CAUTION The robot weighs 2500 kg. All lifting accessories used must be sized accordingly!	

7.6 Standard tools

General

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

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

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

Contents, standard toolkit

Qty	Tool	Rem.
1	Ring-open-end spanner 8-19 mm	
1	Socket head cap 5-17 mm	
1	Torx socket no: 20-60	
1	Box spanner set	
1	Torque wrench 10-100 Nm	
1	Torque wrench 75-400 Nm	
1	Ratchet head for torque wrench 1/2	
2	Hexagon-headed screw M10x100	
1	Hex bit socket head cap no. 14 socket 40 mm L=100 mm	
1	Hex bit socket head cap no. 14 socket 40 mm L=20 mm	To be shortened to 12 mm
1	Hex bit socket head cap no. 6 socket 40 mm L=145 mm	
1	Hex bit socket head cap no. 6 socket 40mm bit L=220 mm	

7 Reference information

7.7 Special tools

7.7 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section [Standard tools on page 445](#), 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 Standard tools on page 445)	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	1	3HAC12731-1
Measuring tool	1	6896134-GN
Motor press pinion	1	3HAC021883-001
Oil injector / max 500 MPa	1	3HAC021590-001
Press tool, axis 2 bearing	1	3HAC13453-1
Puller device, axis 2 shaft	1	3HAC021563-001
Press device, axis 2 shaft	1	3HAC021600-001
Press tool, balancing device	1	3HAC020902-001
Press tool, balancing device shaft	1	3HAC17129-1
Puller tool, balancing device shaft	1	3HAC12475-1
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"> • Guidances, 3HAC14445-1

Continues on next page

7 Reference information

7.7 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	
Levelmeter 2000 kit	6369901-347	Includes one sensor.
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	<p>Includes:</p> <ul style="list-style-type: none">• Vacuum pump with regulator, hose and coupling• Couplings and adapters• Pump (manual) with hose and coupling• Graduated measuring glass• Oil gun• User instructions.

7 Reference information

7.8 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.

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

8 Spare part lists

8.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document on the documentation DVD.

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9 Circuit diagram

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but delivered as separate documents on the documentation DVD. See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRC5</i>	<i>3HAC024480-011</i>
<i>Circuit diagram - IRC5 Compact</i>	<i>3HAC049406-003</i>
<i>Circuit diagram - IRC5 Panel Mounted Controller</i>	<i>3HAC026871-020</i>
<i>Circuit diagram - Euromap</i>	<i>3HAC024120-004</i>
<i>Circuit diagram - Spot welding cabinet</i>	<i>3HAC057185-001</i>

Robots

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 120</i>	<i>3HAC031408-003</i>
<i>Circuit diagram - IRB 140 type C</i>	<i>3HAC6816-3</i>
<i>Circuit diagram - IRB 260</i>	<i>3HAC025611-001</i>
<i>Circuit diagram - IRB 360</i>	<i>3HAC028647-009</i>
<i>Circuit diagram - IRB 460</i>	<i>3HAC036446-005</i>
<i>Circuit diagram - IRB 660</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 760</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 1200</i>	<i>3HAC046307-003</i>
<i>Circuit diagram - IRB 1410</i>	<i>3HAC2800-3</i>
<i>Circuit diagram - IRB 1600/1660</i>	<i>3HAC021351-003</i>
<i>Circuit diagram - IRB 1520</i>	<i>3HAC039498-007</i>
<i>Circuit diagram - IRB 2400</i>	<i>3HAC6670-3</i>
<i>Circuit diagram - IRB 2600</i>	<i>3HAC029570-007</i>
<i>Circuit diagram - IRB 4400/4450S</i>	<i>3HAC9821-1</i>
<i>Circuit diagram - IRB 4600</i>	<i>3HAC029038-003</i>
<i>Circuit diagram - IRB 6400RF</i>	<i>3HAC8935-1</i>
<i>Circuit diagram - IRB 6600 type A</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6600 type B</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6620</i>	<i>3HAC025090-001</i>

Continues on next page

9 Circuit diagram

9.1 Circuit diagrams

Continued

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6640</i>	<i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6650S</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6660</i>	<i>3HAC025744-001</i> <i>3HAC029940-001</i>
<i>Circuit diagram - IRB 6700</i>	<i>3HAC043446-005</i>
<i>Circuit diagram - IRB 7600</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 14000</i>	<i>3HAC050778-003</i>
<i>Circuit diagram - IRB 910SC</i>	<i>3HAC056159-002</i>

9.2 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	

9 Circuit diagram

9.3 Validity of circuit diagram 3HAC13347-1

9.3 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 455](#).

Index

A

- Absolute Accuracy, calibration, 405
- aluminum
 - disposal, 431
- ambient humidity
 - operation, 72
 - storage, 72
- ambient temperature
 - operation, 72
 - storage, 72
- assembly instructions, 63
- Axis Calibration, 416
 - calibration tool
 - article number, 418, 421
 - examining, 418
 - installation position, 420
 - overview of method, 416
 - procedure on FlexPendant, 421
 - protective cover and protection plug, 420–421

B

- balancing device
 - risk, 27
- balancing device, replacement, 307
- balancing device bearing, replacement, 302
- base plate
 - guide pins, 92
 - securing, 92
- batteries
 - disposal, 431
 - handling, 59
- battery
 - replacing, 215, 293
- battery pack
 - replacing, interval, 148
- battery shutdown
 - service routine, 215, 293
- brakes
 - testing function, 37

C

- cabinet lock, 25
- cable harness axes 1-4, replacement, 243
- cabling
 - position switches, 127
- cabling, robot, 139
- cabling, robot axes 1-4, 244
- cabling, robot axes 5-6, 252
- cabling between robot and controller, 139
- calibrating
 - robot, 416
 - roughly, 411
- calibrating robot, 416
- calibration
 - Absolute Accuracy type, 404
 - alternative method, 405
 - Levelmeter calibration, 405
 - rough, 411
 - standard type, 404
 - verification, 428
 - when to calibrate, 407
- calibration, Absolute Accuracy, 405
- calibration manuals, 406
- calibration marks, 408

calibration position

- jogging to, 430
- jogging to, TPU, 430
- scales, 408

calibration scales, 408

CalibWare, 404

carbon dioxide extinguisher, 35

cast iron

- disposal, 431

cleaning, 225

climbing on robot, 26

connecting the robot and controller, cabling, 139

connection

- external safety devices, 23

copper

- disposal, 431

D

damage to mechanical stop, 178

danger levels, 46

dimensions

- frame, 102
- lower arm, 100
- upper arm, 101

direction of axes, 410

E

emergency stop

- buttons, 43
- definition, 42

enabling device, 39

environmental information, 431

EPS, 107

equipment on robot, 100

ESD

- damage elimination, 58
- sensitive equipment, 58
- wrist strap connection point, 58

expected life, 149

extended working range, axis 1, 107

extra equipment

- fastener quality, 104
- frame, 102
- lower arm, 100
- robot, 100
- upper arm, 101

F

fastener quality for extra equipment, 104

fence dimensions, 34

fire extinguishing, 35

fitting equipment on robot, 100

FlexPendant

- jogging to calibration position, 430
- MoveAbsJ instruction, 429
- updating revolution counters, 413

fork lift, 79

foundation

- requirements, 72

frame

- dimensions, 102

G

gearbox axis 1, replacement, 358

gearbox axis 3, replacement, 378

gearbox axis 6, replacement, 397

gearboxes

location of, 192
grease
 disposal, 431
guide pins, base plate, 92

H

hanging
 installed hanging, 26
hazardous material, 431
height
 installed at a height, 26
hold-to-run, 39
hot components
 risk, 26
humidity
 operation, 72
 storage, 72

I

information labels location, 188
inspecting
 information labels, 188
 mechanical stop, 178
inspecting oil levels
 axis-6, 166
 axis-5, 163
 axis-4, 160
 axis-3, 157
 axis-2, 154
 axis-1, 150
installation
 mechanical stop axis 1, 120
 mechanical stop axis 2, 122
 mechanical stop axis 3, 124
installing
 position switches, 127
installing equipment on robot, 100
instructions for assembly, 63
intervals for maintenance, 145

L

labels
 robot, 48
leak-down test, 238
Levelmeter calibration, 405
lifting accessory, 444
lifting robot
 with fork lift, 79
 with lifting slings, 85
 with roundslings, 87
lifting slings, robot, 85
Lithium
 disposal, 431
loads on foundation, 71
lower arm
 dimensions, 100
lower arm shaft, replacement, 283
lubrication
 amount in gearboxes, 192
 type of lubrication, 192

M

main power
 switching off, 57
main switch
 controller cabinet, 57
 control module, 57

drive module, 57
maintenance schedule, 145
mechanical stop
 axis 1, 120
 axis 2, 122
 axis 3, 124
mechanical stop location, 178
motor axis 1, replacement, 322
motor axis 2, replacement, 327
motor axis 3, replacement, 333
motor axis 4, replacement, 340
motor axis 6, replacement, 351
motor brakes
 releasing, 89
MoveAbsJ instruction, 429
 TPU, 429

N

negative directions, axes, 410
neodymium
 disposal, 431
NiCad
 disposal, 431
nodular iron
 disposal, 431

O

oil
 amount in gearboxes, 192
 disposal, 431
 type of oil, 192
oil change
 safety risks, 60
oil level
 gearbox axis-6, 166
 gearbox axis-5, 163
 gearbox axis-4, 160
 gearbox axis-3, 157
 gearbox axis-2, 154
 gearbox axis-1, 150
operating conditions, 72

P

pedestal
 installed on pedestal, 26
plastic
 disposal, 431
position switches
 cabling on robot, 127
 installing, 127
positive directions, axes, 410
protection classes, 73
protection standards, 438
protection type, 73
protective equipment, 25
protective stop, 44
protective wear, 25

R

releasing motor brakes, 89
replacement
 balancing device, 307
 bearing, balancing device, 302
 cable harness axes 1-4, 243
 gearbox axis 1, 358
 gearbox axis 3, 378
 gearbox axis 6, 397

- lower arm shaft, 283
motor axis 1, 322
motor axis 2, 327
motor axis 3, 333
motor axis 4, 340
motor axis 6, 351
requirements on foundation, 72
responsibility and validity, 23
restricting
 working range axis 1, 107, 120
 working range axis 2, 122
 working range axis 3, 124
revolution counters
 storing on FlexPendant, 413
 storing on TPU, 412
 updating, 411
risk of tipping, 78
robot
 labels, 48
 protection class, 73
 protection types, 73
 symbols, 48
roundslings attached to robot, 87
rubber
 disposal, 431
- S**
- safety
 brake testing, 37
 emergency stop, 42
 ESD, 58
 fence dimensions, 34
 fire extinguishing, 35
 introduction, 21
 moving robots, 54
 reduced speed function, 38
 release robot arm, 36
 robot system, 23
 service, 23
 signal lamp, 41
 signals, 46
 signals in manual, 46
 symbols, 46
 symbols on robot, 48
 test run, 55
 working range, 40
 wrist strap, 58
safety equipment
 mechanical stop, 120
 mechanical stop axis 2, 122
 mechanical stop axis 3, 124
 position switches, 127
safety risk
 electric parts, 32
 hot parts, 28
 hydraulic system, 30
 installation, 25
 oil change, 60
 operational disturbance, 31
 pneumatic system, 30
 service work, 25
 tools, 29
 voltage, 32
 work pieces, 29
safety signals
 in manual, 46
safety standards, 438
safety stop, 44
safety zones, 26
scales on robot, 408
schedule for maintenance, 145
securing
 base plate, 92
 securing, robot, 97
 securing, upper arm, 335
 securing the robot to foundation, attachment screws, 97
signal lamp, 41
signals
 safety, 46
SMB
 replacing, 293
SMB battery
 extension of lifetime, 215, 293
 replacing, 215, 293
special tools, 446
stability, 78
standards
 ANSI, 438
 CAN, 438
 EN, 438
 EN IEC, 438
 EN ISO, 438
 safety, 438
states
 emergency stop, 42
steel
 disposal, 431
storage conditions, 72
symbols
 safety, 46
synchronization position, 411
sync marks, 408
- T**
- temperatures
 operation, 72
 storage, 72
testing
 brakes, 37
three-position enabling device, 39
tightening torque
 mechanical stop axis 1, 121
 mechanical stop axis 2, 123
tools
 Axis Calibration, 448
 calibration equipment, Levelmeter, 448
 Calibration Pendulum, 448
 for service, 446
 oil exchange equipment, 449
torques on foundation, 71
TPU
 jogging to calibration position, 430
 MoveAbsJ instruction, 429
 updating revolution counters, 412
transporting the robot, 68
transport support, 68
- U**
- updating revolution counters, 411
upper arm
 dimensions, 101
- V**
- validity and responsibility, 23

verifying calibration, 428

W

weight, 71

balancing device, 310, 312

base plate, 91, 96

complete arm system, 257–258

gearbox, 374, 382

lower arm, 279, 281

motor, 343–344, 348–349

robot, 84, 86, 88, 361, 363, 365, 368, 444

upper arm, 271–272

wrist unit, 266–267

working range

IRB 7600 - 150/3.5, 74

IRB 7600 - 340/2.8, 75

IRB 7600 - 400/2.55, 76

IRB 7600 - 500/2.3, 77

IRB 7600 - 500/2.55, 76

restricting axis 1, 120

restricting axis 2, 122

restricting axis 3, 124

Z

zero position

checking, 429

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