



Product manual

IRB 140

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IRB 140-6/0.8 type C
IRB 140T-6/0.8 type C

IRC5

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Original instructions.

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

Table of contents

Overview of this manual	9
Product documentation, IRC5	13
How to read the product manual	15
1 Safety	17
1.1 Introduction to safety information	17
1.2 General safety information	18
1.2.1 Introduction to general safety information	18
1.2.2 Safety in the manipulator system	19
1.2.3 Protective stop and emergency stop	21
1.2.4 Safety risks	22
1.2.4.1 Safety risks during installation and service work on robots	22
1.2.4.2 CAUTION - Hot parts may cause burns!	25
1.2.4.3 Safety risks related to tools/work pieces	26
1.2.4.4 Safety risks related to pneumatic/hydraulic systems	27
1.2.4.5 Safety risks during operational disturbances	28
1.2.4.6 Risks associated with live electric parts	29
1.2.5 Safety actions	31
1.2.5.1 Safety fence dimensions	31
1.2.5.2 Fire extinguishing	32
1.2.5.3 Emergency release of the robot arm	33
1.2.5.4 Brake testing	34
1.2.5.5 Risk of disabling function "Reduced speed 250 mm/s"	35
1.2.5.6 Safe use of the jogging device	36
1.2.5.7 Work inside the working range of the robot	37
1.2.5.8 Signal lamp (optional)	38
1.3 Safety signals and symbols	39
1.3.1 Safety signals in the manual	39
1.3.2 Safety symbols on product labels	41
1.4 Safety related instructions	47
1.4.1 DANGER - Moving robots are potentially lethal!	47
1.4.2 DANGER - First test run may cause injury or damage!	48
1.4.3 DANGER - Make sure that the main power has been switched off!	49
1.4.4 WARNING - The unit is sensitive to ESD!	51
1.4.5 WARNING - Safety risks during handling of batteries	54
1.4.6 WARNING - Safety risks during work with gearbox lubricants (oil or grease)	55
2 Installation and commissioning	57
2.1 Introduction	57
2.2 Unpacking	58
2.2.1 Pre-installation procedure	58
2.2.2 Working range, IRB 140	62
2.2.3 Risk of tipping/stability	64
2.3 On-site installation	65
2.3.1 Lifting the manipulator with lifting slings	65
2.3.2 Lifting and turning the manipulator	66
2.3.3 Manually releasing the brakes	69
2.3.4 Orienting and securing the manipulator	72
2.3.5 Fitting equipment on manipulator	73
2.3.6 Loads	75
2.3.7 Setting the system parameters for a suspended or tilted robot	76
2.3.8 Bolt pattern	81
2.3.9 Installation of signal lamp (option)	83
2.4 Restricting the working range	84
2.4.1 Restricting the working range	84

Table of contents

2.5	Electrical connections	85
2.5.1	Customer connections on manipulator	85
3	Maintenance	87
3.1	Introduction	87
3.2	Maintenance schedules	88
3.2.1	Specification of maintenance intervals	88
3.2.2	Maintenance schedule	89
3.3	Inspection activities	91
3.3.1	Inspection, damper axes 2, 3 and 5	91
3.3.2	Inspecting the robot cabling	93
3.3.3	Inspection, timing belts	94
3.3.4	Inspecting oil level gearbox axis 1	97
3.3.5	Inspecting oil level gearbox axis 2	100
3.3.6	Inspecting oil level gearbox axis 3	103
3.3.7	Inspecting oil level gearbox axis 4	105
3.3.8	Inspecting oil level gearbox axes 5-6	108
3.4	Cleaning activities	111
3.4.1	Cleaning the IRB 140 type C	111
3.5	Changing/ replacing activities	114
3.5.1	Type of lubrication in gearboxes	114
3.5.2	Changing the oil in axes 5 and 6 gearboxes	115
4	Repair	119
4.1	Introduction	119
4.2	General procedures	120
4.2.1	Mounting instructions for bearings	120
4.2.2	Mounting instructions for seals	122
4.2.3	Replacing parts on the robot	124
4.3	Complete robot	126
4.3.1	Replacement of cable harness	126
4.3.2	Replacement of complete upper arm	134
4.3.3	Replacement of complete lower arm	140
4.3.4	Replacement of base	144
4.4	Upper arm	148
4.4.1	Replacing the wrist unit, IRB 1600	148
4.4.2	Replacing the damper, axis 3	152
4.4.3	Replacement of damper, axis 5	154
4.4.4	Replacement of cover, arm housing	156
4.5	Lower arm	159
4.5.1	Replacement of lower arm cover and gasket	159
4.5.2	Replacing the damper, axis 2	163
4.6	Frame and base	165
4.6.1	Replacement of cover, console	165
4.6.2	Replacement of console	168
4.6.3	Replacing the serial measurement unit and the battery pack	172
4.6.4	Replacement of control cable	178
4.7	Motors	182
4.7.1	Replacement of motor, axis 1	182
4.7.2	Replacement of motor, axis 2	186
4.7.3	Replacement of motor and timing belt, axis 3	191
4.7.4	Replacement of motor, axis 4, IRB 1600	197
4.7.5	Replacement of motor and timing belt, axes 5 or 6	201
4.7.6	Adjustments and measurements	207
4.7.6.1	Measuring the gear play, axis 5	207
4.7.6.2	Measuring the gear play, axis 6	209
4.8	Gearboxes	211
4.8.1	Replacement of gearbox, axes 1-2 and damper, axis 1	211
4.8.2	Service work on gearbox, axis 4	217

5 Calibration information	219
5.1 When to calibrate	219
5.2 Calibration methods	220
5.3 Synchronization marks and synchronization position for axes	222
5.4 Calibration movement directions for all axes	223
5.5 Updating revolution counters	224
5.6 Checking the synchronization position	227
6 Decommissioning	229
6.1 Environmental information	229
6.2 Scrapping of robot	230
7 Robot description	231
7.1 Type C of IRB 140	231
8 Reference information	233
8.1 Introduction	233
8.2 Applicable standards	234
8.3 Unit conversion	236
8.4 Screw joints	237
8.5 Weight specifications	240
8.6 Standard tools	241
8.7 Special tools	242
8.8 Performing a leak-down test	243
8.9 Lifting accessories and lifting instructions	244
9 Spare part lists	245
9.1 Spare part lists and illustrations	245
10 Circuit diagram	247
10.1 Circuit diagrams	247
Index	249

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Overview of this manual

About this manual

This manual contains instructions for:

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

Usage

This manual should be used during:

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

Who should read this manual?

This manual is intended for:

- installation personnel
 - maintenance personnel
 - repair personnel.
-

Prerequisites

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

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

Organization of chapters

The manual is organized in the following chapters:

Chapter	Contents
Safety, service	Safety information that must be read through before performing any installation or service work on robot. Contains general safety aspects as well as more specific information about 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 in the work of planning periodical maintenance.
Repair	Step-by-step procedures that describe how to perform repair activities of the robot. Based on available spare parts.
Calibration information	Procedures that does 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.

Continues on next page

Overview of this manual

Continued

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

References

Reference	Document ID
<i>Circuit diagram - IRB 140 type C</i>	3HAC6816-3
<i>Operating manual - General safety information</i> ⁱ	3HAC031045-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC 639.	3HAC021313-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC1000.	3HAC047136-001
<i>Product specification - IRB 140</i>	3HAC041346-001
<i>Product manual, spare parts - IRB 140</i>	3HAC049099-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - Calibration Pendulum</i>	3HAC16578-1
<i>Operating manual - Service Information System</i>	3HAC050944-001
<i>Technical reference manual - Lubrication in gearboxes</i>	3HAC042927-001
<i>Technical reference manual - RAPID Instructions, Functions and Data types</i>	3HAC050917-001
<i>Application manual - CalibWare Field 5.0</i>	3HAC030421-001

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

Revisions

Revision	Description
-	First edition, see also Type C of IRB 140 on page 231 .
A	IRB 140-6/0.8 and IRB 140T-6/0.8 added.
B	<i>Clean Room</i> added. Changes made in: <ul style="list-style-type: none">• <i>Prerequisites</i> in section <i>Overview</i>• <i>Oil change</i> in section <i>Maintenance</i>
C	Content updated in section: <ul style="list-style-type: none">• <i>Making robot ready for operation, Clean room , Additional installation procedure.</i>
D	Content updated in section: <ul style="list-style-type: none">• <i>Repair, exchange of parts on Clean room robots</i>• <i>Maintenance, Cleaning of robot</i>• <i>Maintenance schedule:</i> Interval for replacement of battery pack changed.• Section <i>What is an emergency stop?</i> added to chapter <i>Safety</i>.

Continues on next page

Revision	Description
E	<p>Content updated in sections:</p> <ul style="list-style-type: none"> • Article numbers added or replaced in sections Replacement of complete upper arm on page 134, Replacement of complete lower arm on page 140, Replacement of gearbox, axes 1-2 and damper, axis 1 on page 211, and Type C of IRB 140 on page 231.
F	<p>Content updated in sections:</p> <ul style="list-style-type: none"> • Required equipment updated in Replacement of motor and timing belt, axis 3 on page 191. • Spare part list updated regarding Foundry Plus cable guard and new wrist. • Circuit diagrams are not included in this document but delivered as separate files. See Circuit diagram on page 247. • List of standards updated, see Applicable standards on page 234. • Sealing compound updated in Replacing parts on the robot on page 124. • Decommissioning chapter added. <p>The chapter Safety updated with:</p> <ul style="list-style-type: none"> • Updated safety signal graphics for the levels Danger and Warning, see Safety signals in the manual on page 39. • New safety labels on the manipulators, see Safety symbols on product labels on page 41. • Revised terminology: <i>robot</i> replaced with <i>manipulator</i>.
G	<p>This revision includes the following additions:</p> <ul style="list-style-type: none"> • New section, Restricting the working range on page 84. • Lifting and turning the manipulator on page 66. <p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • Corrected amount of oil in axes 3, 5, and 6, see Amount of oil. • Updates in chapter Calibration.
H	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • Corrected article number for VK cover, see Replacement of complete upper arm on page 134 and Replacement of motor and timing belt, axes 5 or 6 on page 201.
J	<p>This revision includes the following updates:</p> <ul style="list-style-type: none"> • A new block, about general illustrations, added in section How to read the product manual on page 15. • The option Foundry Plus Cable Guard is removed. • Some general tightening torques have been changed/added, see updated values in Screw joints on page 237. • The figure of the base is updated in concerned sections. • Added WARNING - Safety risks during handling of batteries on page 54.

Continues on next page

Overview of this manual

Continued

Revision	Description
K	This revision includes the following updates: <ul style="list-style-type: none">Information regarding disassembly of Clean Room robots added to concerned repair instructions.Changed the instruction for how to fit the o-ring of the axis-4 motor when refitting the motor, see Replacement of motor, axis 4, IRB 1600 on page 197.Added figures that show an alternative layout inside the base, see Replacing the serial measurement unit and the battery pack on page 172.All data about type of lubrication in gearboxes is moved from the manual to a separate lubrication manual, see Type and amount of oil in gearboxes on page 114.Corrected article number for battery pack.A new SMB unit and battery is introduced, with longer battery lifetime.
L	This revision includes the following updates: <ul style="list-style-type: none">Added information about risks when scrapping a decommissioned robot, see Scrapping of robot on page 230.<i>Spare parts and exploded views</i> are not included in this document but delivered as a separate document. See Spare part lists Product manual, spare parts - IRB 140.
M	This revision includes the following updates: <ul style="list-style-type: none">Minor corrections.
N	This revision includes the following updates: <ul style="list-style-type: none">Updated section Setting the system parameters for a suspended or tilted robot on page 76.Turning disk fixture is removed from special tools for Levelmeter calibration.
P	This revision includes the following updates: <ul style="list-style-type: none">Removed note in Installation of signal lamp.
Q	Published in release R16.2. The following updates are done in this revision: <ul style="list-style-type: none">Added a procedure for how to lift and rotate the robot, see Lifting and turning the manipulator on page 66.Section Amount of oil is removed from the manual, since the data has been moved to the separate lubrication manual, see Type and amount of oil in gearboxes on page 114.
R	Published in release R17.1. The following updates are done in this revision: <ul style="list-style-type: none">Added a procedure for how inspect the oil level, see Inspection activities on page 91.

Product documentation, IRC5

Categories for user documentation from ABB Robotics

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

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

Product manuals

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

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

Technical reference manuals

The technical reference manuals describe reference information for robotics products.

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

Continues on next page

Application manuals

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

An application manual generally contains information about:

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

Operating manuals

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

The group of manuals includes (among others):

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

How to read the product manual

Reading the procedures

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

References to figures

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

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

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

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

References to required equipment

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

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

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

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

Safety information

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

Read more in the chapter [Safety on page 17](#).

Illustrations

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

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

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1 Safety

1.1 Introduction to safety information

Overview

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

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

1 Safety

1.2.1 Introduction to general safety information

1.2 General safety information

1.2.1 Introduction to general safety information

Definitions

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

Sections

The general safety information is divided into the following sections.

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

1.2.2 Safety in the manipulator system

Validity and responsibility

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

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

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

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

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

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

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

Connection of external safety devices

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

Limitation of liability

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

Related information

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

Continues on next page

1 Safety

1.2.2 Safety in the manipulator system

Continued

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

1.2.3 Protective stop and emergency stop

Overview

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

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

1.2.4 Safety risks

1.2.4.1 Safety risks during installation and service work on robots

Overview

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

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

General risks during installation and service

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

Spare parts and special equipment

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

Personal protective equipment

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

Nation/region specific regulations

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

Non-voltage related risks

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

Continues on next page

1.2.4.1 Safety risks during installation and service work on robots

Continued

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

To be observed by the supplier of the complete system

When integrating the robot with external devices and machines:

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

Complete robot

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

Continues on next page

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

Continued

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

Cabling

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

Gearboxes and motors

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

1.2.4.2 CAUTION - Hot parts may cause burns!

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

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

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

Elimination

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

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

1 Safety

1.2.4.3 Safety risks related to tools/work pieces

1.2.4.3 Safety risks related to tools/work pieces

Safe handling

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

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

Safe design

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

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



CAUTION

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

1.2.4.4 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.



Note

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

Residual energy

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

Safe design

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

1 Safety

1.2.4.5 Safety risks during operational disturbances

General

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

Qualified personnel

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

Extraordinary risks

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

1.2.4.6 Risks associated with live electric parts

Voltage related risks, general

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

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

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

All work must be performed:

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

Voltage related risks, IRC5 controller

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

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

Continues on next page

1 Safety

1.2.4.6 Risks associated with live electric parts

Continued

Voltage related risks, robot

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

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

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

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

1.2.5 Safety actions

1.2.5.1 Safety fence dimensions

General

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

Dimensioning

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

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

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

1 Safety

1.2.5.2 Fire extinguishing



Note

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

1.2.5.3 Emergency release of the robot arm

Description

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

How to release the brakes is detailed in the section:

- [Manually releasing the brakes on page 69.](#)

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

Increased injury

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



DANGER

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

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

1 Safety

1.2.5.4 Brake testing

1.2.5.4 Brake testing

When to test

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

How to test

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

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

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

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



Note

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

1 Safety

1.2.5.6 Safe use of the jogging device

1.2.5.6 Safe use of the jogging device

Three-position enabling device

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

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



Note

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

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

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

Hold-to-run function

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

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

1.2.5.7 Work inside the working range of the robot



WARNING

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

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



WARNING

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

1 Safety

1.2.5.8 Signal lamp (optional)

1.2.5.8 Signal lamp (optional)

Description

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

Function

The lamp is active in MOTORS ON mode.

Further information

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

1.3 Safety signals and symbols

1.3.1 Safety signals in the manual

Introduction to safety signals

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

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

Danger levels

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

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

Continues on next page

1 Safety

1.3.1 Safety signals in the manual

Continued

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

1.3.2 Safety symbols on product labels

Introduction to labels

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

Symbols are used in combinations on the labels, describing each specific warning.

The descriptions in this section are generic, the labels can contain additional information such as values.



Note

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

Types of labels

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

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

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

Symbols on safety labels

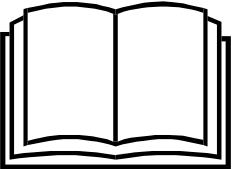
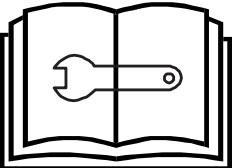
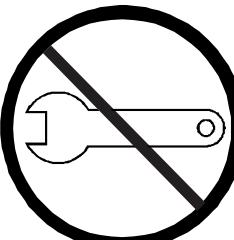
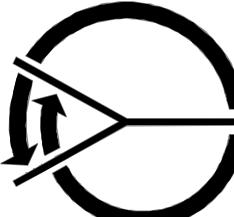
Symbol	Description
	Warning! Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion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

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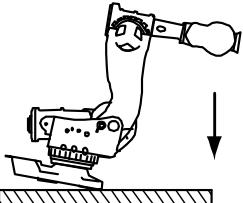
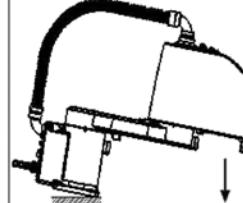
1 Safety

1.3.2 Safety symbols on product labels

Continued

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

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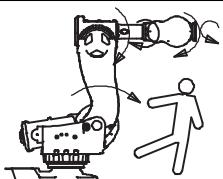
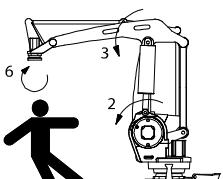
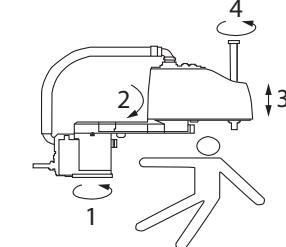
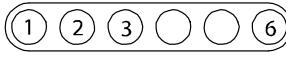
Symbol	Description
 xx0900000810	Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened.
  3HAC 057068-001	
  xx0900000817	Crush Risk of crush injuries.
 xx0900000818	Heat Risk of heat that can cause burns.

Continues on next page

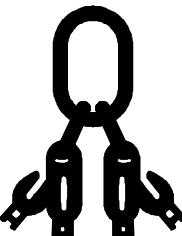
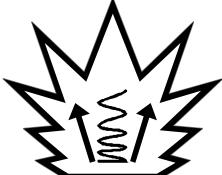
1 Safety

1.3.2 Safety symbols on product labels

Continued

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

Continues on next page

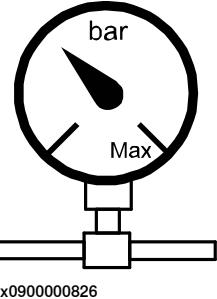
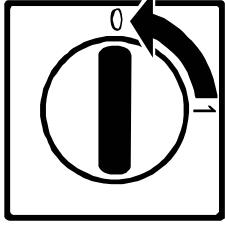
Symbol	Description
 xx1000001242	Chain sling with shortener
 xx0900000822	Lifting of robot
 xx0900000823	Oil Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	Mechanical stop
 xx1000001144	No mechanical stop
 xx0900000825	Stored energy Warns that this part contains stored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

Continues on next page

1 Safety

1.3.2 Safety symbols on product labels

Continued

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

1.4.1 DANGER - Moving robots are potentially lethal!

1.4 Safety related instructions

1.4.1 DANGER - Moving robots are potentially lethal!

Description

Any moving robot is a potentially lethal machine.

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

Elimination

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

1 Safety

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

Description

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

Elimination

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



DANGER

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

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

Collision risks



CAUTION

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

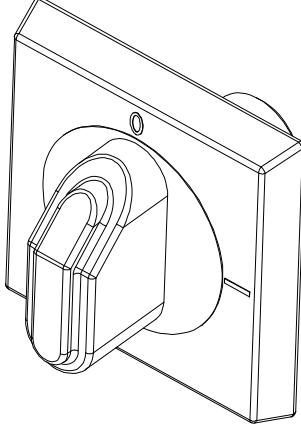
1.4.3 DANGER - Make sure that the main power has been switched off!

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

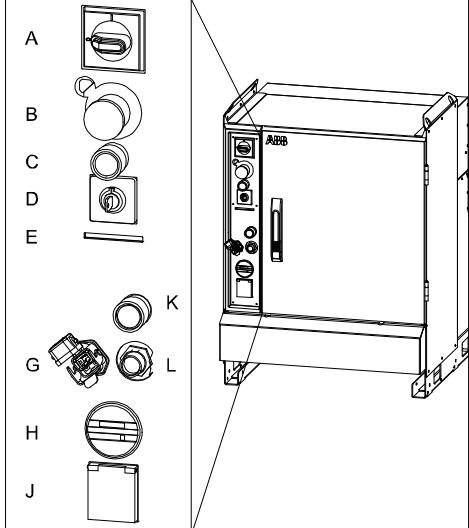
Description

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

Elimination, IRC5 Panel Mounted Controller

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

Elimination, IRC5 Single Cabinet Controller

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

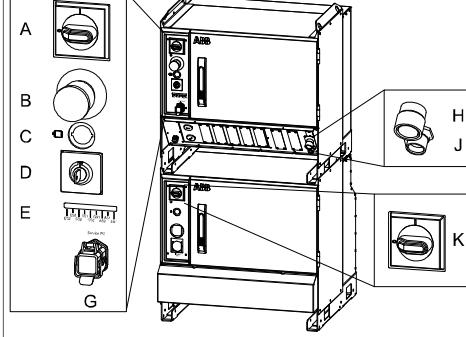
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1 Safety

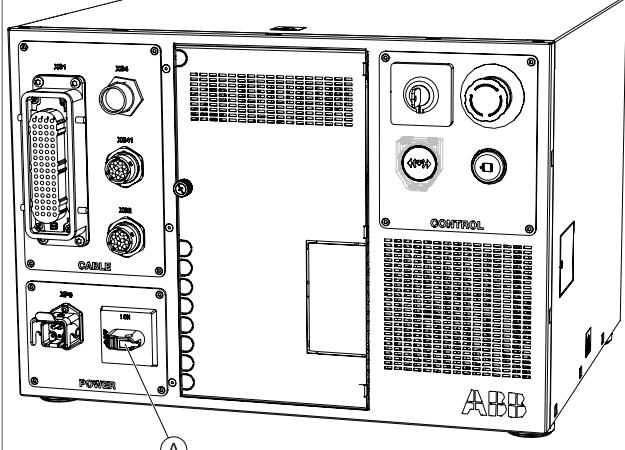
1.4.3 DANGER - Make sure that the main power has been switched off!

Continued

Elimination, IRC5 Dual Cabinet Controller

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

Elimination, IRC5 Compact Controller

	Action	Note/illustration
1	Switch off the main power switch on the controller cabinet.	Note that the position of the main switch can vary depending on the year model.  xx0900000313 A: Main power switch
2	Disconnect the input power cable from the wall socket.	

1.4.4 WARNING - The unit is sensitive to ESD!

1.4.4 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.

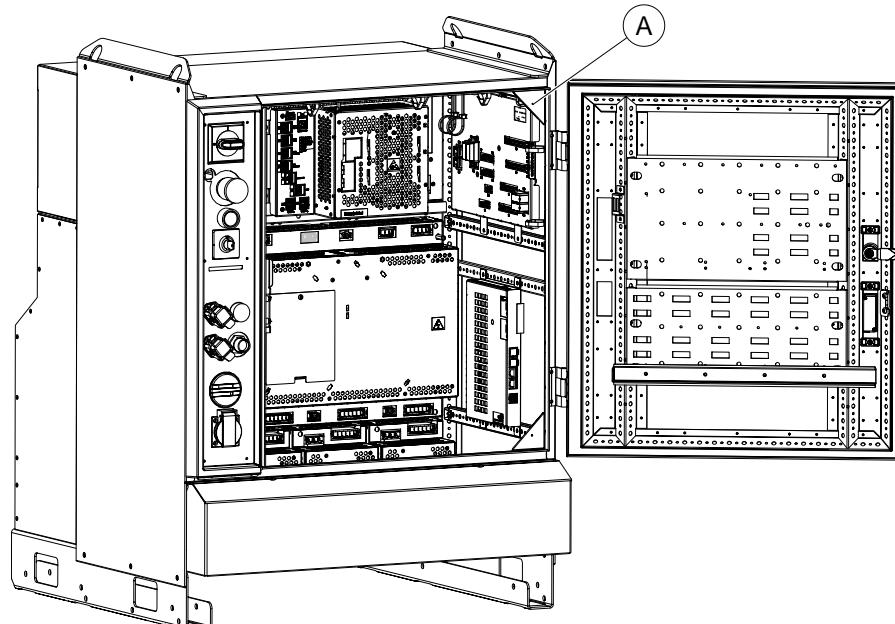
Elimination

	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



xx1300000856

A	Wrist strap button
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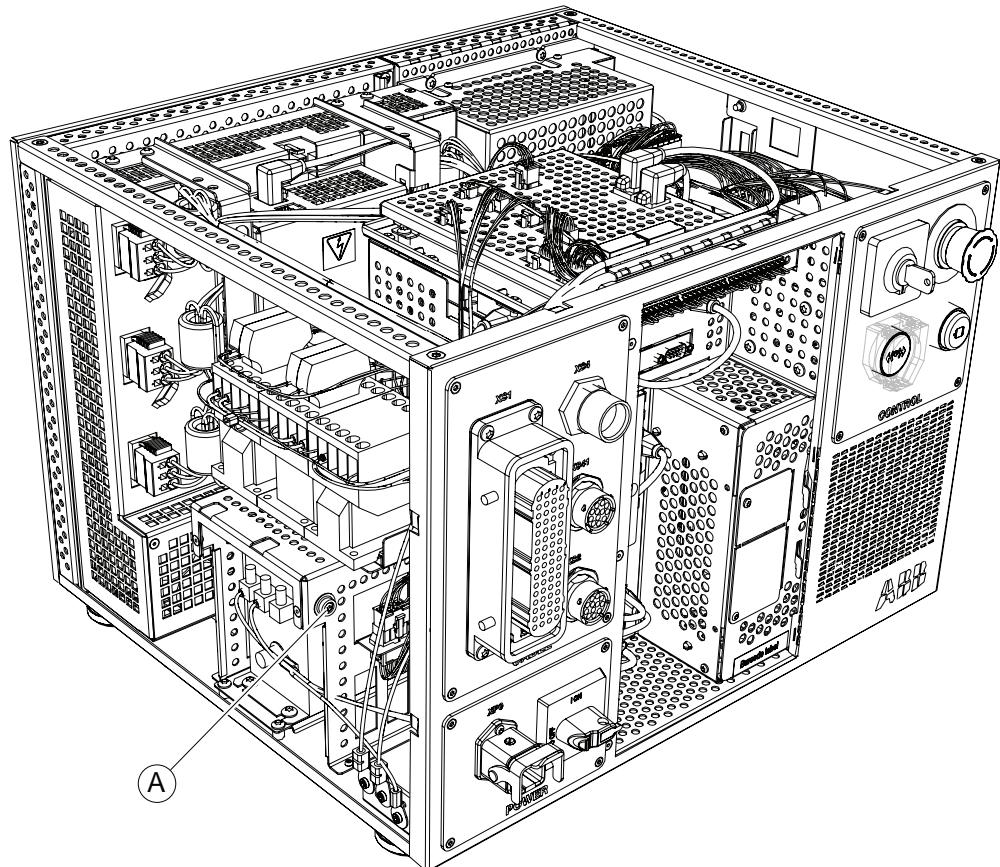
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1 Safety

1.4.4 WARNING - The unit is sensitive to ESD!

Continued

IRC5 Compact Controller



xx1400001622

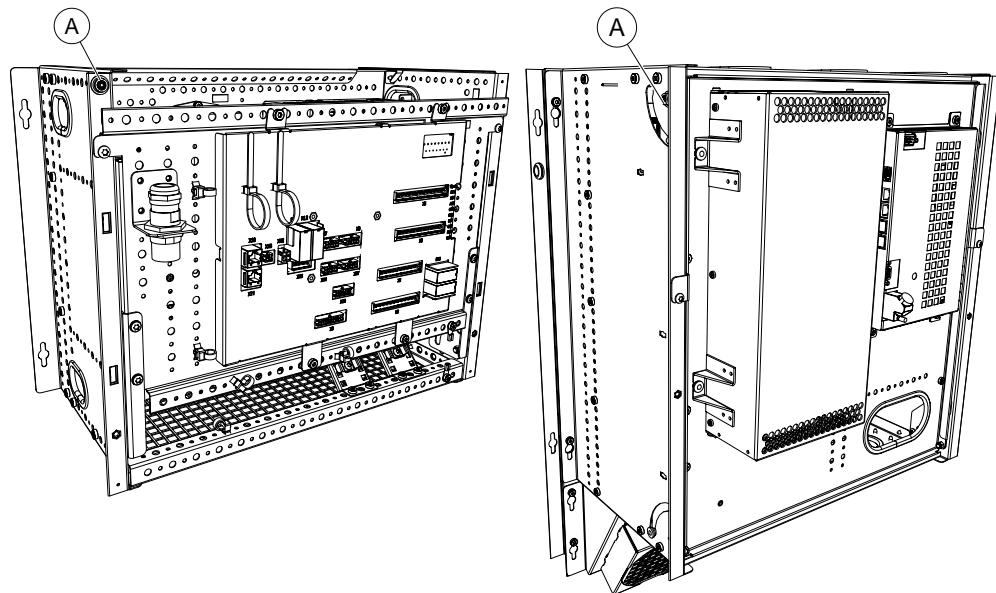
A	Wrist strap button
---	--------------------

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1.4.4 WARNING - The unit is sensitive to ESD!

Continued

Panel Mounted Controller



xx1300001960

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

1 Safety

1.4.5 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 58 .
2	Use safety glasses when handling the batteries.	
3	In the event of leakage, wear gloves and chemical apron.	
4	In the event of fire, use self-contained breathing apparatus.	

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

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

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

**Note**

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

**Note**

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

**Note**

Appropriate disposal regulations must be observed.

**Note**

Take special care when handling hot lubricants.

Warnings and elimination

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

Continues on next page

1 Safety

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

Continued

Warning	Description	Elimination/Action
 xx010000002 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>
 xx010000004 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>
 xx010000003 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>	

2 Installation and commissioning

2.1 Introduction

General

This chapter contains assembly instructions and information for installing the IRB 140 type C at the working site.

More detailed technical data can be found in the *Product specification* for the IRB 140 type C, such as:

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

Safety information

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

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



Note

If the IRB 140 type C 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

2.2.1 Pre-installation procedure

2.2 Unpacking

2.2.1 Pre-installation procedure

Introduction

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

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage.  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 58
6	If the robot is not installed directly, it must be stored as described in: Storage conditions, robot on page 60
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: Operating conditions, robot on page 60
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 59• Protection classes, robot on page 61• Requirements, foundation on page 60
9	Before moving the robot, please observe the stability of the robot: Risk of tipping/stability on page 64
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: On-site installation on page 65
11	Install required equipment, if any. <ul style="list-style-type: none">• Installation of signal lamp (option) on page 83

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 140 type C	100 kg

Continues on next page



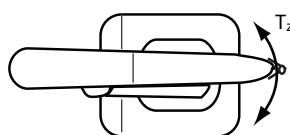
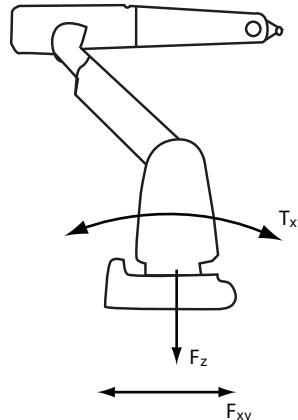
Note

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

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

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



xx1100000521

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

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



Note

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

Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$\pm 1020 \text{ N}$	$\pm 2000 \text{ N}$
Force z	$-1000 \pm 620 \text{ N}$	$-1000 \pm 1250 \text{ N}$
Torque xy	$\pm 700 \text{ Nm}$	$\pm 1500 \text{ Nm}$
Torque z	$\pm 250 \text{ Nm}$	$\pm 470 \text{ Nm}$

Continues on next page

2 Installation and commissioning

2.2.1 Pre-installation procedure

Continued

Wall mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	± 1750 N	± 2800 N
Force z	± 850 N	± 1600 N
Torque xy	± 1020 Nm	± 1710 Nm
Torque z	± 250 Nm	± 485 Nm

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	± 1020 N	± 2000 N
Force z	+ 1000 ± 620 N	+ 1000 ± 1250 N
Torque xy	± 700 Nm	± 1500 Nm
Torque z	± 250 Nm	± 470 Nm

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.5 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Maximum tilt	5°	
Minimum resonance frequency	22 Hz	

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+45° C

Continues on next page

Parameter	Value
Maximum ambient temperature	+5° C
Maximum ambient humidity	95% at constant temperature

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
Manipulator, protection type Clean Room	IP 67
Manipulator, protection type Wash	IP 67

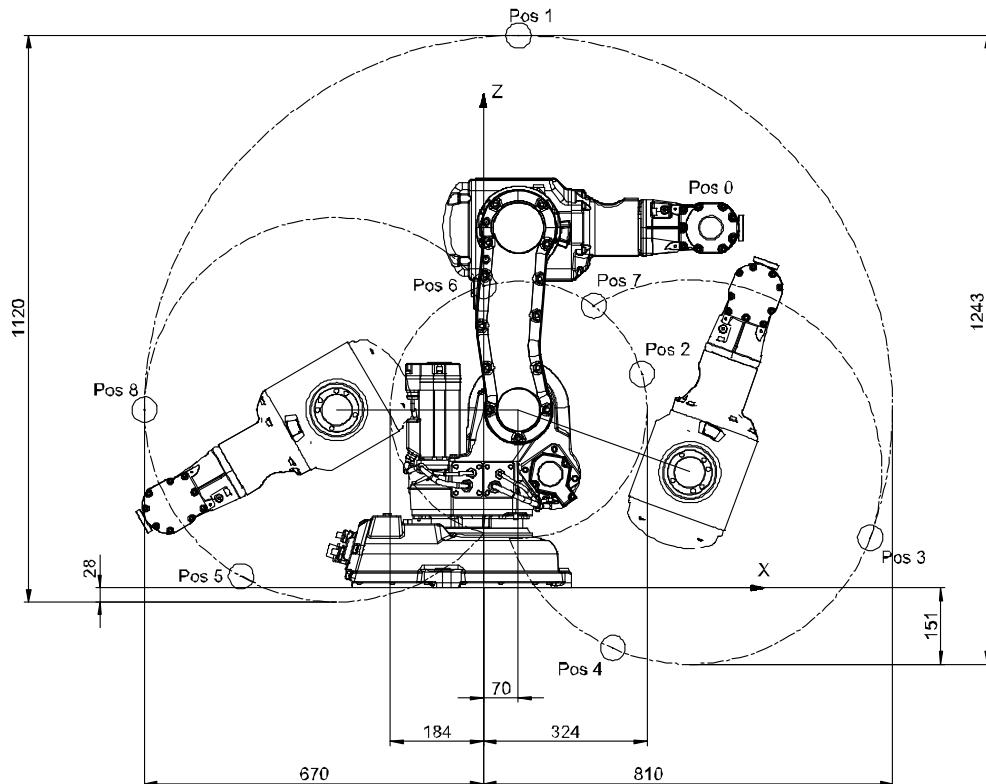
2 Installation and commissioning

2.2.2 Working range, IRB 140

2.2.2 Working range, IRB 140

Working range axis 2 -3

The illustration below shows the unrestricted working range axis 2-3.



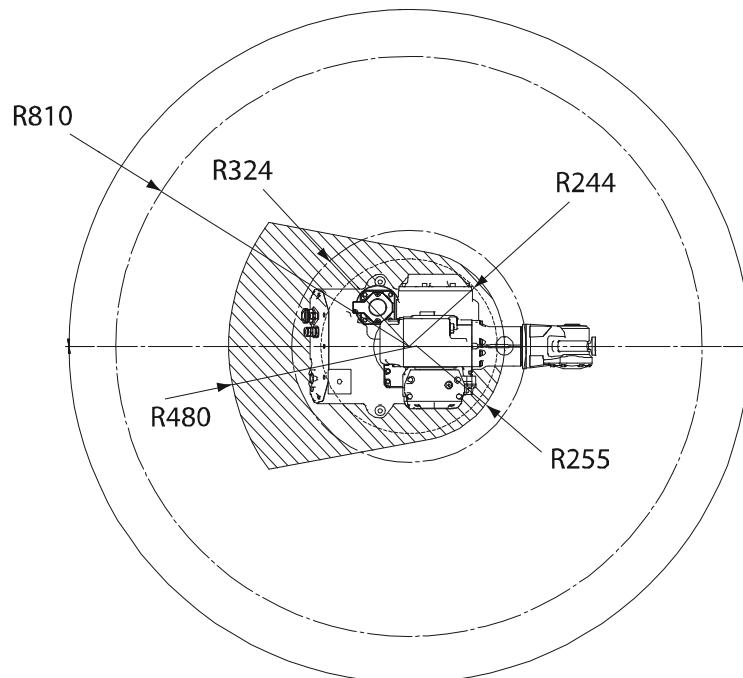
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Pos.	Position at wrist centre		Angle (degrees)	
	X	Z	Axis 2	Axis 3
0	450	712	0°	0°
1	70	1092	0°	-90°
2	314	421	0°	+50°
3	765	99	+110°	-90°
4	255	-119	+110°	+4°
5	-480	23	-90°	-150°
6	1	596	-90°	+50°
7	218	558	+110°	-230°
8	-670	352	-90°	-90°

Continues on next page

Working range axis 1

The illustrations below shows the unrestricted working range of axis 1.



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2 Installation and commissioning

2.2.3 Risk of tipping/stability

Risk of tipping

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

The shipping position is the most stable position.

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



WARNING

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

2.3 On-site installation

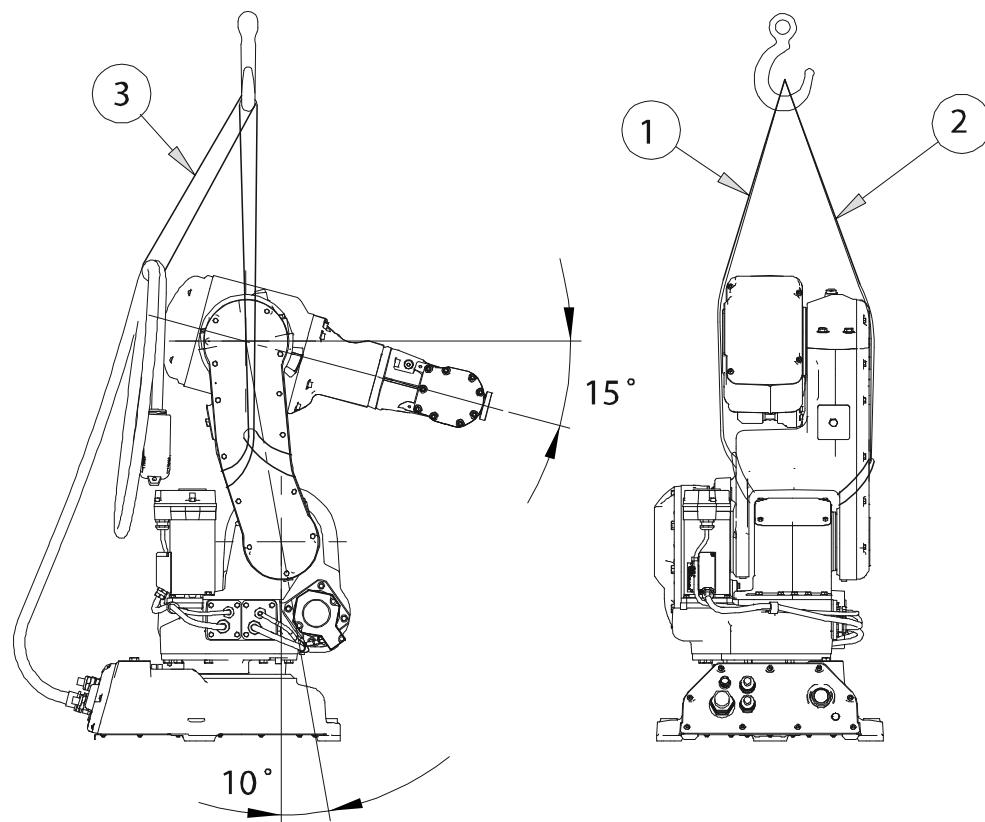
2.3.1 Lifting the manipulator with lifting slings

Introduction

This section details how to lift the manipulator using lifting slings.

Equipment	Note
Sling line for manipulator	Length: 2 m. Load: 500 kg.
Sling line for control cable	

Illustration



1	Sling line for manipulator
2	Sling line for manipulator
3	Sling line for control cable

How to lift the manipulator

- 1 Adjust the manipulator to lifting position according to the illustration.
- 2 Put one sling line around each leg on the lower arm (positions 1 and 2).
- 3 Use another sling line to secure the lifting of the control cable (position 3).

2 Installation and commissioning

2.3.2 Lifting and turning the manipulator

2.3.2 Lifting and turning the manipulator

Required equipment

Equipment	Article number	Note
Lifting slings	-	2 pcs Length: 2 m. Lifting capacity: 1,000 kg (too narrow slings risk to damage the sealings on the axis-2 shaft).
Overhead crane or fork lift	-	

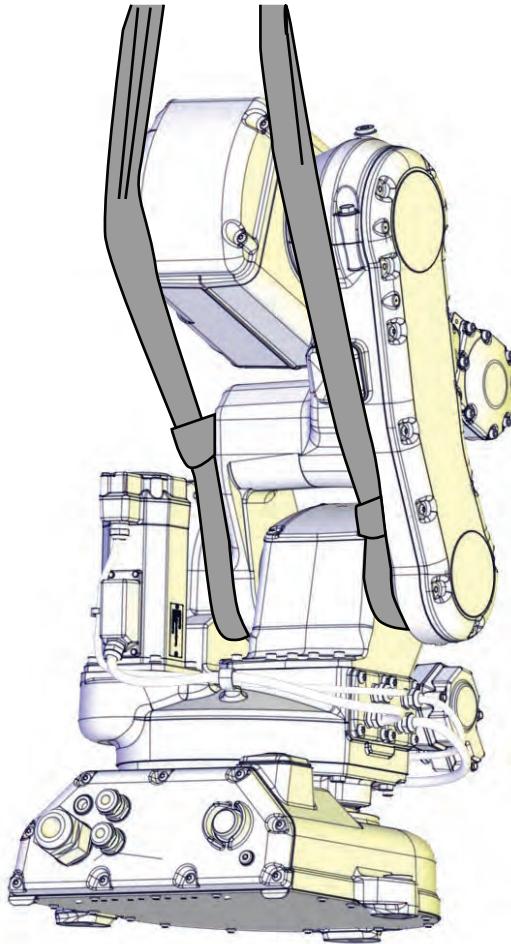
Lifting slings attached to the robot

The figure shows lifting slings attached to the robot, rigged as choker hitches, for lifting and turning the robot for installation on a wall or inverted.



WARNING

The robot will tip forward when lifting it off the ground.

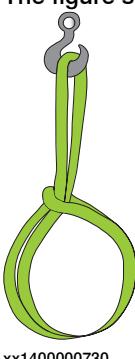
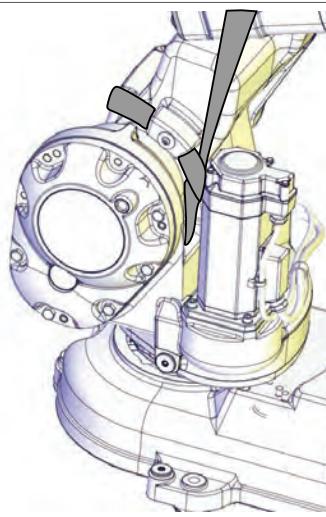
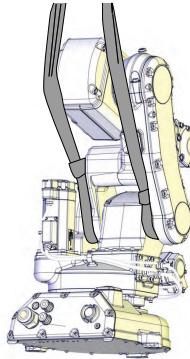


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Lifting and turning the robot

The procedure details how to lift and turn the robot for installation on a wall or inverted.

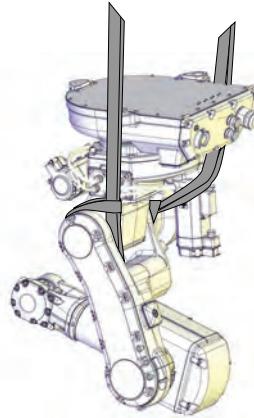
	Action	Note
1	<p>Move axis-2 to approximately -20° and axis-3 to approximately +50°. Remaining axes can be positioned as suitable, depending on equipment installed on the robot.</p>	
2	<p>Rig the lifting sling as a choker hitch by passing the lifting sling around the axis-2 gearbox, underneath the axis-2 damper, then through itself, then attaching it to the overhead crane or fork lift. The figure shows the principle of a choker hitch.</p>  <p>xx1400000730</p> <p>If necessary, use an extra lifting sling to lengthen the reach between the sling and the overhead crane/fork lift. To facilitate the installation of the slings, the axis-2 damper can be removed temporarily.</p>	 <p>xx1600000348</p>
3	<p>Rig the lifting sling as a choker hitch by passing the lifting sling around the lower arm shaft, then through itself, then attaching it to the overhead crane or fork lift. If necessary, use an extra lifting sling to lengthen the reach between the sling and the overhead crane/fork lift.</p>	 <p>xx1600000347</p>
4	Loosen the robot from the foundation.	
5	<p>! CAUTION The IRB 140 type C robot weighs 100 kg. All lifting accessories used must be sized accordingly!</p>	

Continues on next page

2 Installation and commissioning

2.3.2 Lifting and turning the manipulator

Continued

	Action	Note
6	<p>Lift the robot while holding touch of the robot with your hands in order to carefully tip it forward.</p> <p>Keep tipping the robot forward until it hangs either horizontally or completely inverted.</p> <p> WARNING</p> <p>The robot will tip forward when lifting it off the ground.</p>	<p>The figure shows the robot rotated 180°.</p>  <p>xx1600000544</p>
7	<p>Secure the robot at its working site on the wall or inverted according to Orienting and securing the manipulator on page 72.</p> <p>Reinstall the axis-2 damper, if removed.</p>	

2.3.3 Manually releasing the brakes

General

The section below details how to release the holding brakes of each axis' motor.

This may be done in one of three ways:

- using the brake release unit when the robot is connected to the controller.
- using the brake release unit when the robot is disconnected from the controller, but connected to an external power supply at the connector R1.MP.
- using an external voltage supply directly on the motor connector.

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

Use this procedure to release the holding brakes with the internal brake release unit.

	Action	Note
1	The brake release button (A) is located at the base of the robot.	 xx0200000069
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 brakes by pushing the brake release button. The brake will function again as soon as the button is released.	

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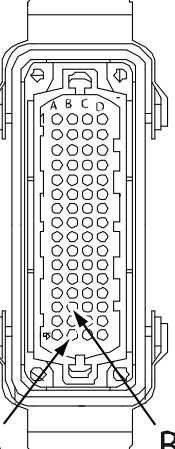
2 Installation and commissioning

2.3.3 Manually releasing the brakes

Continued

Using the brake release unit with an external power supply

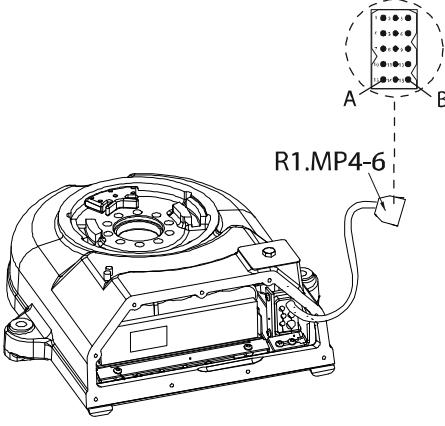
This section details how to release the holding brakes with the internal brake release unit using an external voltage supply. This is done if the robot is not connected to the controller.

Action	Note
1  DANGER Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	Also, be careful not to interchange the 24V and 0V pins. If they are mixed up, damage can be caused to a resistor diode and to the system board.
2 Connect an external power supply to connector XP1.	 xx0200000071 Supply: <ul style="list-style-type: none">A: B16 24V DCB: B14 0V
3 Push the brake release button to release the holding brakes, according to the previous procedure.	

Continues on next page

Using external power supply

This section details how to release the holding brakes using an external voltage supply. If the positions of the robot axes are to be changed without connecting the controller, an external voltage supply (24 V DC) must be connected to enable the brake release buttons on the robot.

	Action	Note/Illustration
1	Remove the screws and dismount the cover on the back of the robot base.	 xx0200000072 <ul style="list-style-type: none">• A: 13 0V• B: 15 24V DC
2	Locate the R1.MP4-6 connector and disconnect.	
3	Connect an external power supply to release the holding brake on all axis.	

2 Installation and commissioning

2.3.4 Orienting and securing the manipulator

General

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

Bolting requirements

When bolting a mounting plate or frame to a concrete floor, follow the general instructions for expansion-shell bolts. The screw joint must be able to withstand the stress loads defined in section [Loads on foundation, robot on page 59](#).



Note

When the robot is to be mounted in a tilted or a suspended position, the guide sleeves must be used to secure the bolted joint.

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:	M12
Quality	Quality 8.8
Suitable washer:	Thickness: 2.5 mm Outer diameter: 24 mm Inner diameter: 13.4 mm
Tightening torque:	85 Nm

Hole configuration and cross section

The bolt pattern requirements are shown in section [Bolt pattern on page 81](#).

Guide sleeves

Two guide sleeves can be fitted to the two rear bolt holes to allow the same robot to be remounted without re-adjusting the program.

Equipment	Art. no.
Guide sleeves	3HAC 9519-1

2.3.5 Fitting equipment on manipulator

General

The manipulator features mounting holes for additional equipment.

In addition to the stock mounting holes, extra mounting holes may be added on the manipulator under certain conditions. These special conditions are specified in the *Product specification - IRB 140*.

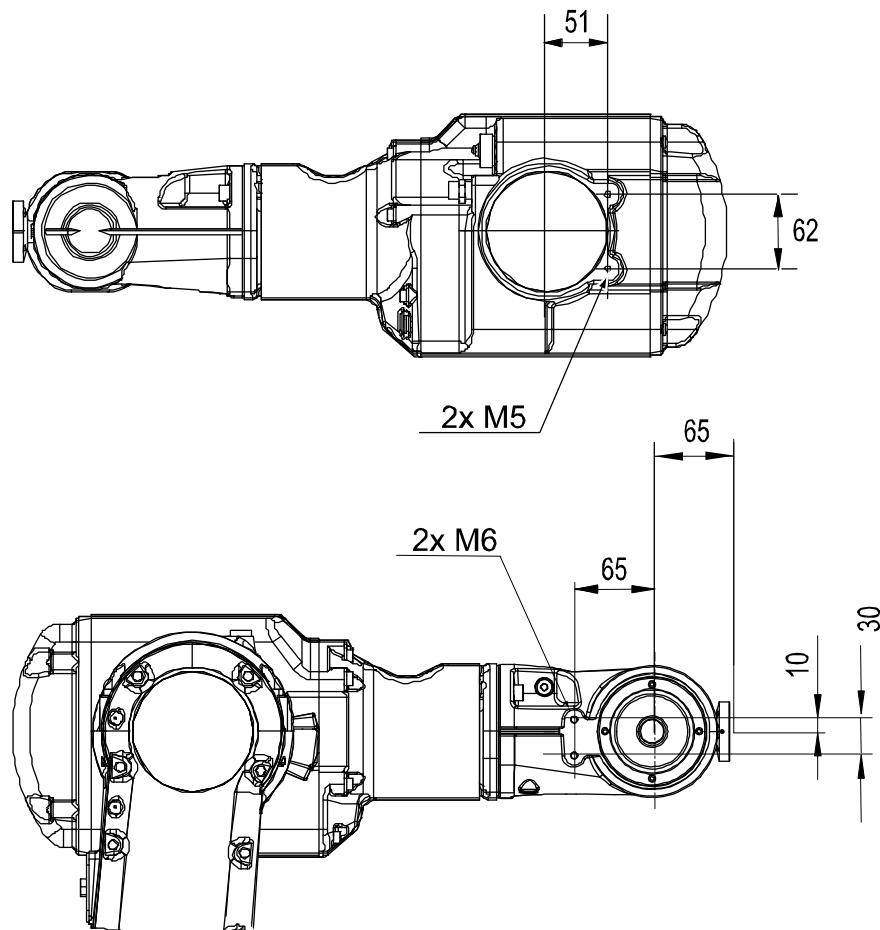


Note

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

Illustration, holes on upper arm

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



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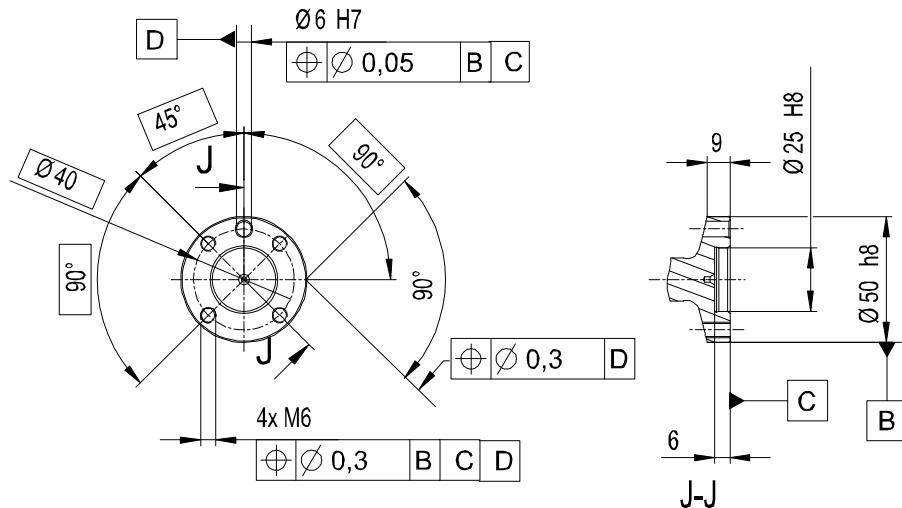
2 Installation and commissioning

2.3.5 Fitting equipment on manipulator

Continued

Illustration, holes on mounting flange

The illustration below shows the stock holes available for fitting equipment on the mounting flange.



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Fastener quality

When fitting tools on the turning disk, use only screws with quality 12.9. When fitting equipment on other places, standard screws with quality 8.8 can be used.

2.3.6 Loads

Introduction

Any loads mounted on the manipulator must be defined correctly and carefully (with regard to the position of the center of gravity and inertia factor) to avoid jolting movements and overloading the motors. If this is not done correctly operation stops can occur.

References

Load diagrams, permitted extra loads (equipment) and their positions as specified in the product specification. The loads must also be defined in the software as detailed in *Operating manual - IRC5 with FlexPendant*.

Brake performance

Manipulator motor brake performance depends on any loads attached. For further information about brake performance, please contact ABB.

2 Installation and commissioning

2.3.7 Setting the system parameters for a suspended or tilted robot

General

The robot is configured for mounting parallel to the floor, without tilting, on delivery. The method for mounting the robot in a suspended (upside down) or tilted position is basically the same as for floor mounting, but the system parameters that describe the mounting angle (how the robot is oriented relative to the gravity) must be redefined.



Note

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



Note

The allowed mounting positions are described in the product specification for the robot. The requirements on the foundation are described in [Requirements, foundation on page 60](#).

System parameters



Note

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

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

Gravity Beta

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

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

Gravity Alpha

If the robot is mounted on a wall (rotated around the x-axis), then the robot base frame and the system parameter *Gravity Alpha* must be redefined. The value of *Gravity Alpha* should then be $\pm\pi/2$ ($\pm 3.141593/2$).

Continues on next page

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



Note

The system parameter *Gravity Alpha* is not supported for all robot types. It is not supported for IRB 140, IRB 1410, IRB 1600ID, IRB 2400, IRB 4400, IRB 6400R, IRB 6400 (except for IRB 6400 200/2.5 and IRB 6400 200/2.8), IRB 6600, IRB 6650, IRB 6650S and IRB 7600 (except for IRB 7600 325/3.1).

If the robot does not support *Gravity Alpha*, then use *Gravity Beta* along with the recalibration of axis 1 to define the rotation of the robot around the x-axis.



Note

The parameter is supported for all robots on track when the system parameter *7 axes high performance motion* is set, see *Technical reference manual - System parameters*.

Gamma Rotation

Gamma Rotation defines the orientation of the robot foot on the travel carriage (track motion).

Mounting angles and values

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

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

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

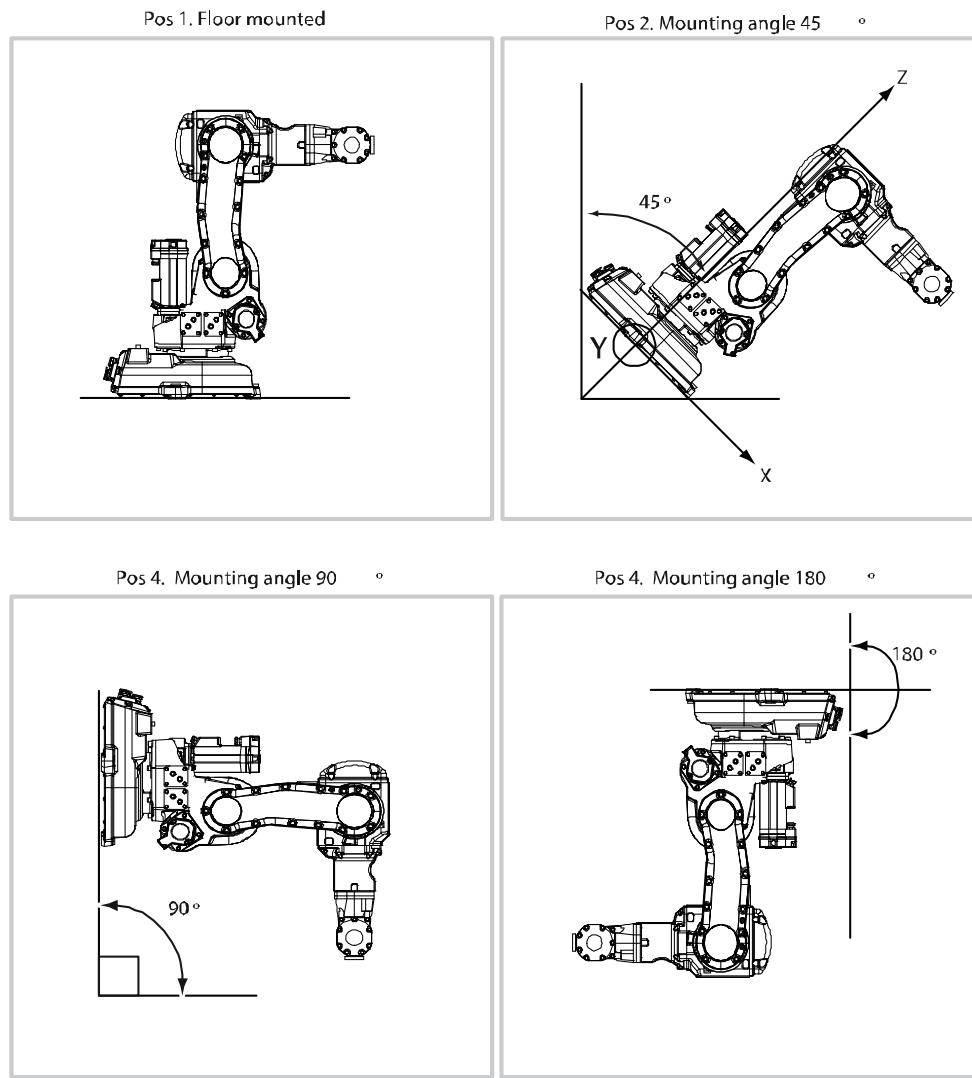
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2 Installation and commissioning

2.3.7 Setting the system parameters for a suspended or tilted robot

Continued

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



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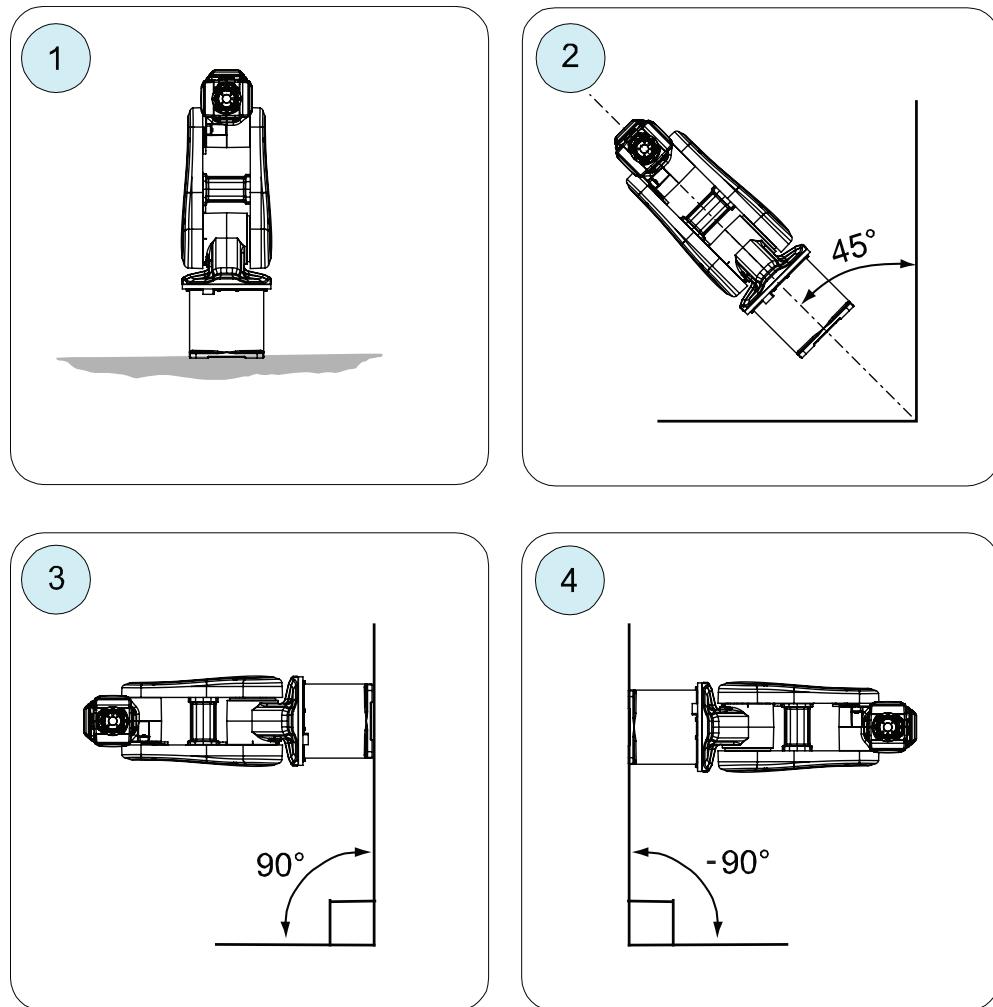
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2.3.7 Setting the system parameters for a suspended or tilted robot

Continued

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

The following illustration shows the IRB 120, but the same principle applies for all robots.



xx1500000532

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



Note

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

Continues on next page

2 Installation and commissioning

2.3.7 Setting the system parameters for a suspended or tilted robot

Continued

Defining the parameter in the IRC5 software

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

How to calculate a new value is detailed in [Mounting angles and values on page 77](#).

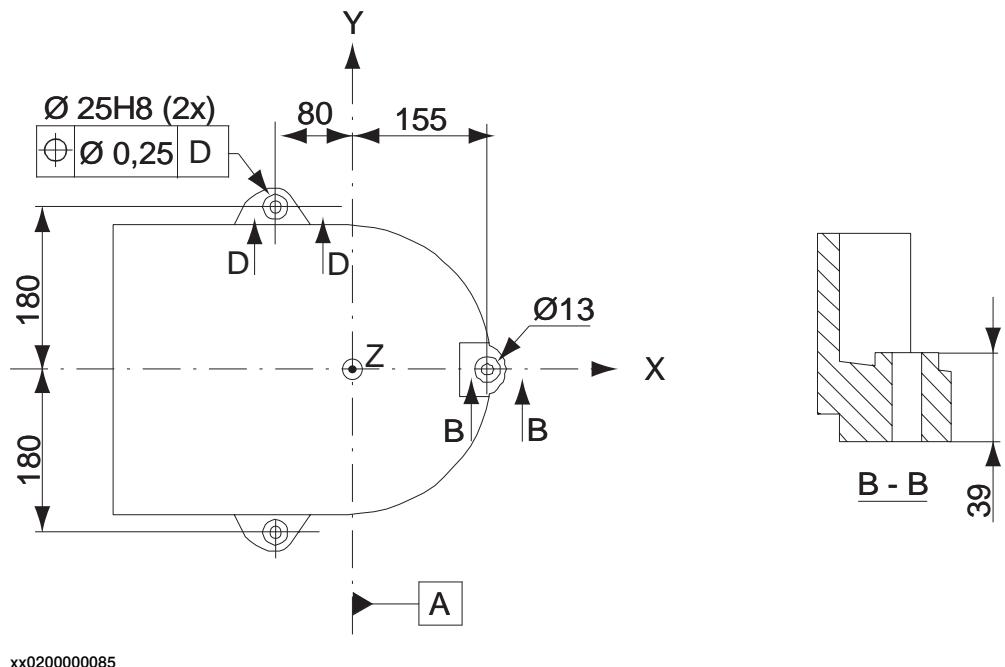
The system parameters are described in *Technical reference manual - System parameters*.

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

2.3.8 Bolt pattern

Hole configuration

The illustration below shows the hole configuration used when securing the manipulator:



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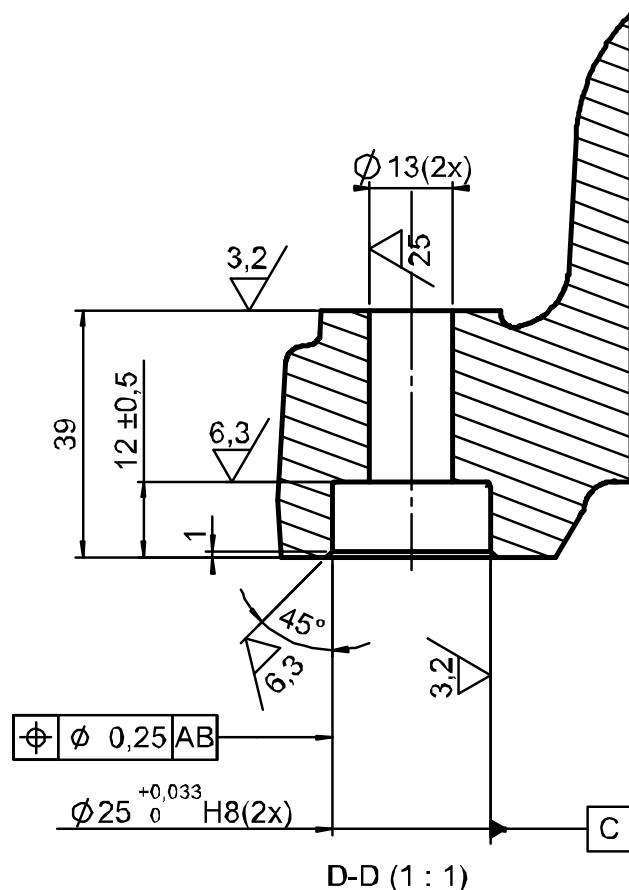
2 Installation and commissioning

2.3.8 Bolt pattern

Continued

Cross section, guide sleeve hole

The illustration below shows the cross section of the guide sleeve holes:



xx0200000086

2.3.9 Installation of signal lamp (option)

Signal lamp

See the assembly instruction delivered with the signal lamp.

2 Installation and commissioning

2.4.1 Restricting the working range

2.4 Restricting the working range

2.4.1 Restricting the working range

Introduction

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



WARNING

The working space can only be limited using software, for this reason the limited area cannot be classified as a safe zone. All work within this zone is prohibited.

System parameters

The system parameters that must be changed (*Upper joint bound* and *Lower joint bound*) are described in *Technical reference manual - System parameters*.

Limiting devices

Examples of limiting devices are listed below.

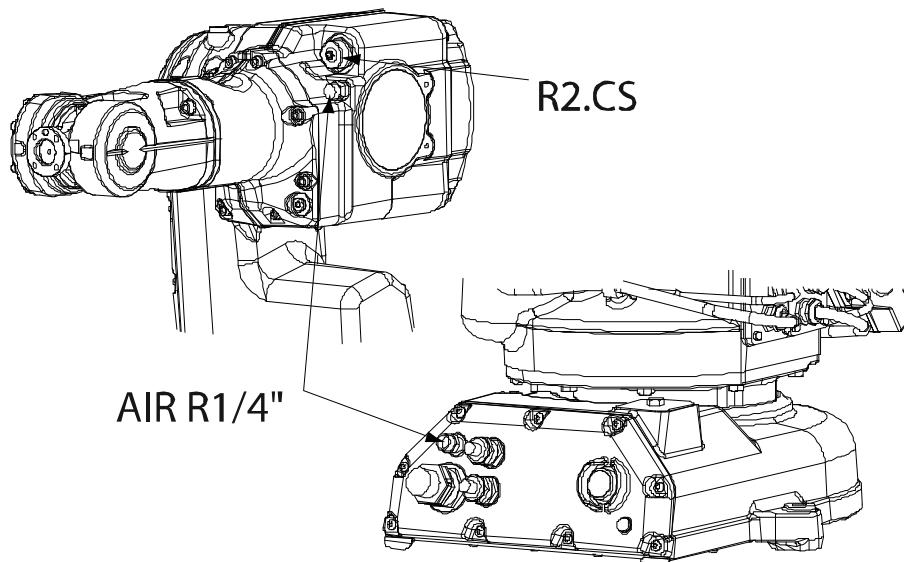
- 1 Light curtains.
- 2 Tread mats.
- 3 Other similar devices.
- 4 Software.

2.5 Electrical connections

2.5.1 Customer connections on manipulator

General

For connection of extra equipment on the manipulator there are cables integrated into the manipulator's cabling. There are both air and electrical connectors on the manipulator.



xx0200000074

Connections

Connections	Description
For air on base / upper arm	R1/4" Max. 8 bar/hose inner diameter: 6.5 mm
Signal connector on upper arm	FCI UT 071412SH44N connector Number of signals: 12 signals, 49V, 500mA

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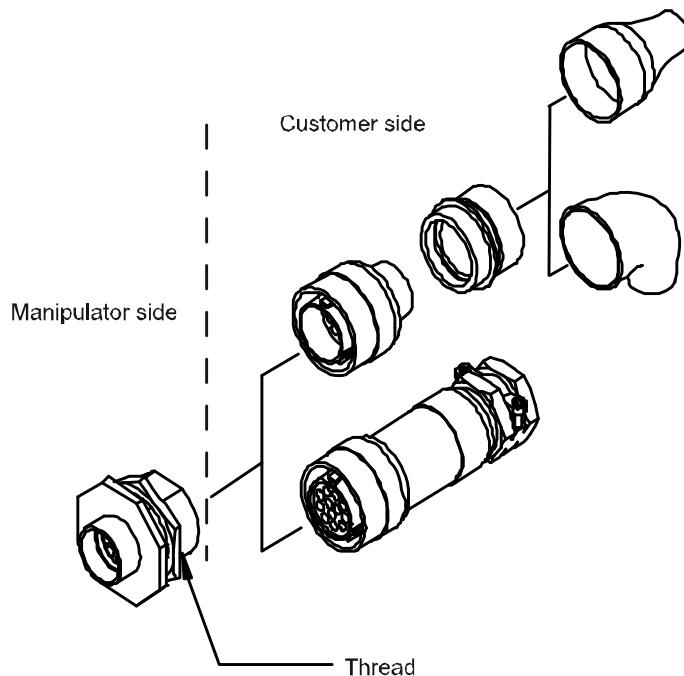
2 Installation and commissioning

2.5.1 Customer connections on manipulator

Continued

Recommended parts

To connect power and signal conductors to the upper arm connector, the following parts are recommended



xx0200000132

ABB's recommended contact set, for connector R2.CS (3HAC 12497-1) contains:

- Multipole connector 12 pin
- Adapter Tin plated 12 pin
- Pins for cable area 0.25-0.5 mm²
- Pins for cable area 0.5-1.5 mm²
- Shrinking hose, bootled shaped
- Shrinking hose angled

The connection set is delivered in a plastic bag also containing a Technical and assembly instruction.

3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 140 type C.

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

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

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

Safety information

Observe all safety information before conducting any service work!

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



Note

If the IRB 140 type C is connected to power, always make sure that the IRB 140 type C 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 schedules

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 140 type C:

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

3.2.2 Maintenance schedule

General

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

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

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

Activities and intervals, standard equipment

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

The table below specifies the required maintenance activities and intervals:

Maintenance activity	Equipment	Interval	Detailed in section:
Inspection	Robot	Regularly i For Clean Room robots: Daily	Check for abnormal wear or contamination
Inspection	Damper, axes 2-3	Regularly i	Inspection, damper axes 2, 3 and 5 on page 91
Inspection	Cable harnesses	Regularly i	Inspecting the robot cabling on page 93
Inspection	Timing belts	36 mths	Inspection, timing belts on page 94
Inspection	Oil	12 mths	Inspection activities on page 91
Changing	Gearbox 5, oil	36 months	Changing the oil in axes 5 and 6 gearboxes on page 115
Changing	Gearbox 6, oil	36 months	Changing the oil in axes 5 and 6 gearboxes on page 115
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert ii	Replacing the serial measurement unit and the battery pack on page 172
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert iii	Replacing the serial measurement unit and the battery pack on page 172

Continues on next page

3 Maintenance

3.2.2 Maintenance schedule

Continued

Maintenance activity	Equipment	Interval	Detailed in section:
Cleaning	Complete robot	Regularly ⁱ	Cleaning the IRB 140 type C on page 111

- i "Regularly" implies that the activity is to be performed regularly, but the actual interval may not be specified by the robot manufacturer. The interval depends on the operation cycle of the robot, its working environment and movement pattern. Generally, the more contaminated environment, the shorter intervals. The more demanding movement pattern (sharper bending cable harness), the shorter intervals.
- ii 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.
- iii The battery low alert (38213 **Battery charge low**) is displayed when remaining backup capacity (robot powered off) is less than 2 months. The typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.

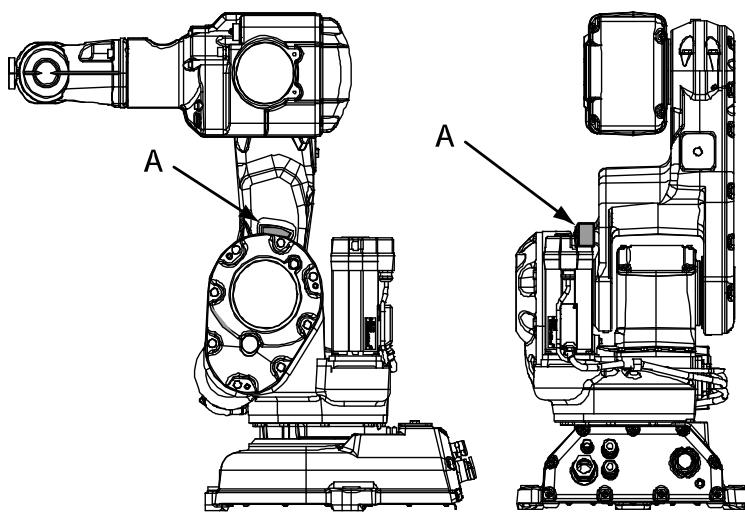
3.3.1 Inspection, damper axes 2, 3 and 5

3.3 Inspection activities

3.3.1 Inspection, damper axes 2, 3 and 5

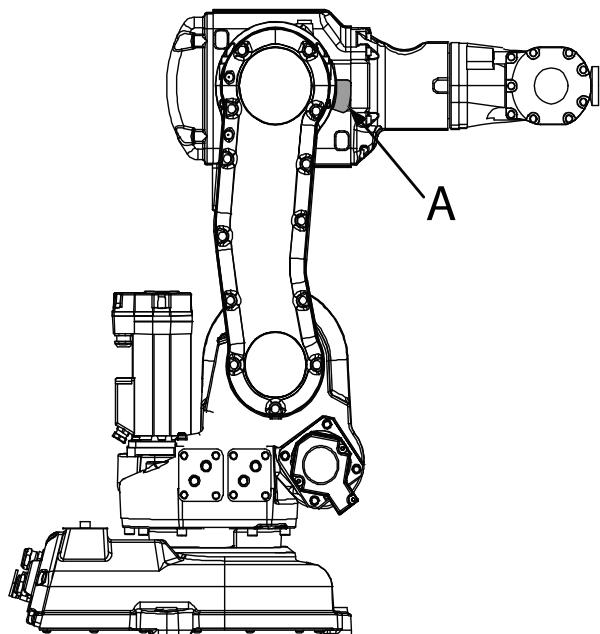
Location of dampers

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



xx0200000426

A	Damper, axis 2
---	----------------



xx0200000427

A	Damper, axis 3
---	----------------

Continues on next page

3 Maintenance

3.3.1 Inspection, damper axes 2, 3 and 5

Continued

Required equipment

Equipment	Art. no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 241 .

Inspection, dampers

The procedure below details how to inspect the dampers.

	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 that are larger than 1 mm.	Shown in the figure Location of dampers on page 91 .
3	Check attachment screws for deformation.	
4	If any damage is detected, the damper must be replaced with a new one!	Replacement is detailed in sections: <ul style="list-style-type: none">• Replacing the damper, axis 2 on page 163• Replacing the damper, axis 3 on page 152• Replacement of damper, axis 5 on page 154.

3.3.2 Inspecting the robot cabling

Introduction



CAUTION

Always read the specific instructions if the robot has protection type Clean Room, before doing any repair work, see [Replacing parts on the robot on page 124](#)

Location of robot cabling

The robot cabling comprises the cabling between the robot and controller cabinet as well as the externally visible cabling around motors 1 and 2.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).

Required tools and equipment

Visual inspection, no tools are required.

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

Inspection, robot cabling

Use this procedure to inspect the robot cabling.

	Action	Note
1	 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	Visually inspect: <ul style="list-style-type: none"> • the control cabling between the robot and control cabinet • the cabling to motors 1 and 2. Look for abrasions, cuts or crush damages.	
3	Replace the cabling if wear or damage is detected. This is detailed in section Replacement of cable harness on page 126 .	

3 Maintenance

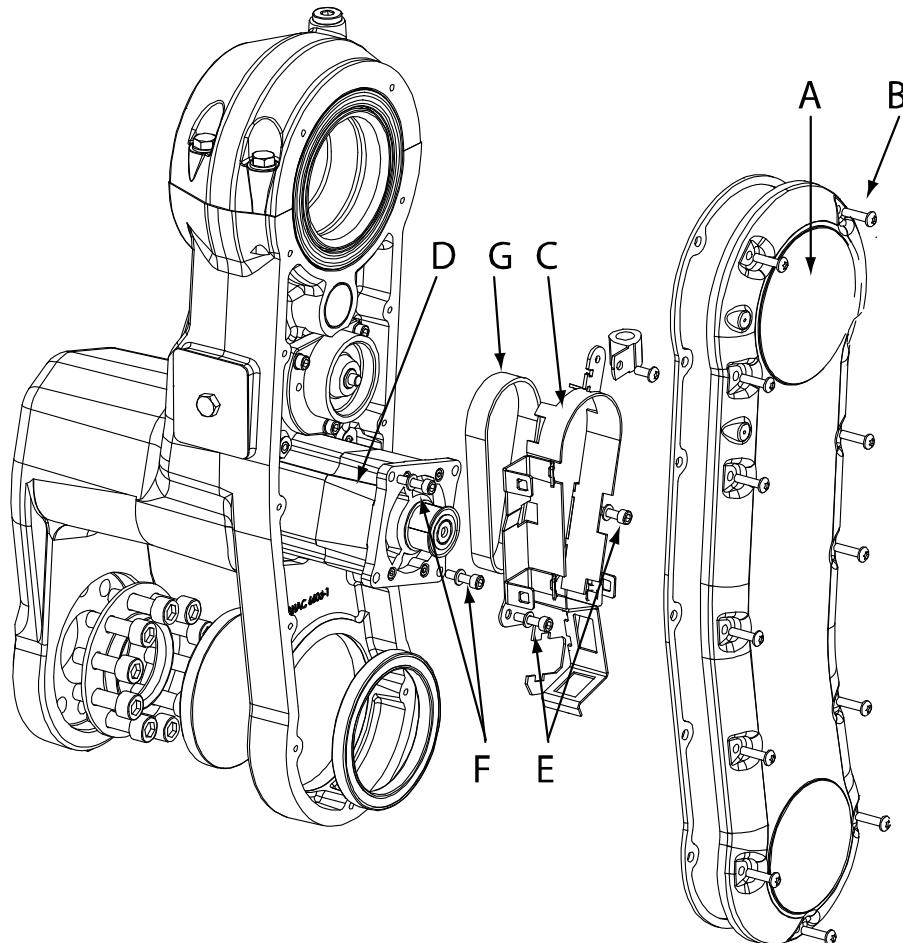
3.3.3 Inspection, timing belts

3.3.3 Inspection, timing belts

Location of timing belts

Axes 3, 5 and 6 are fitted with timing belts. These are located as shown in the figures below.

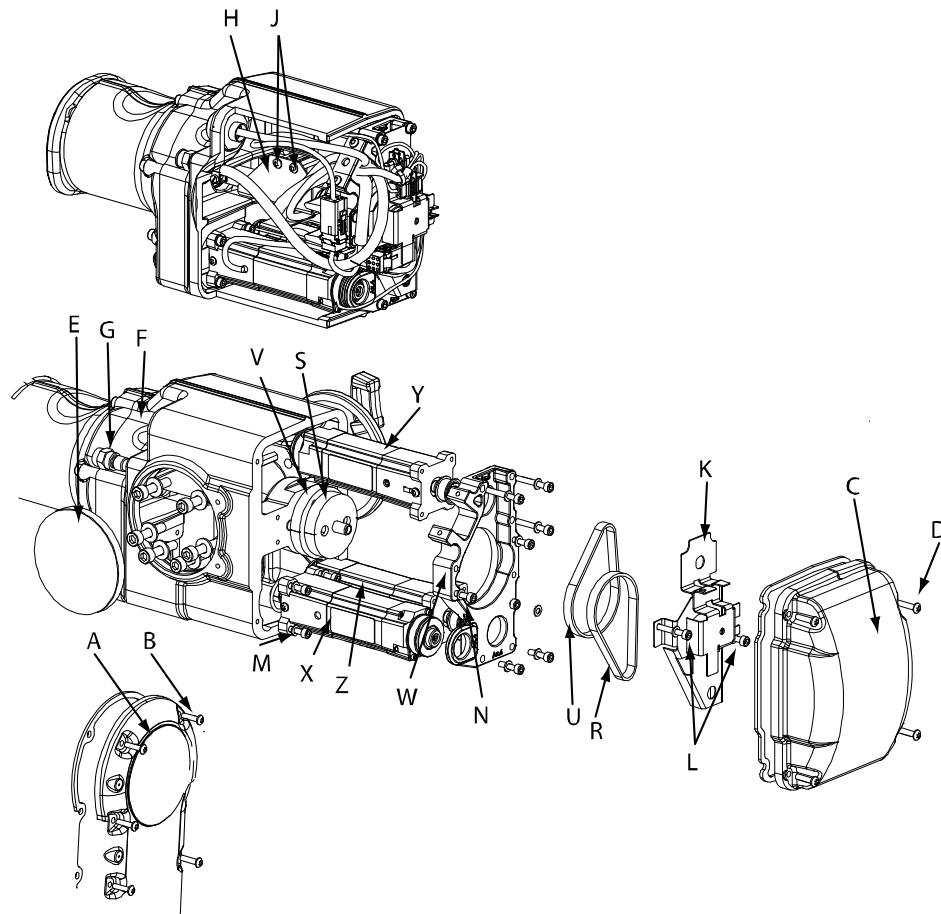
A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000448

G	Timing belt, axis 3
---	---------------------

Continues on next page



xx0600003261

R	Timing belt, axis 6
U	Timing belt, axis 5

Required equipment

Equipment, etc.	Art. no.	Note
Standard toolkit	3HAC020812-001	Content is defined in section Standard tools on page 241 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Continues on next page

3 Maintenance

3.3.3 Inspection, timing belts

Continued

Inspection

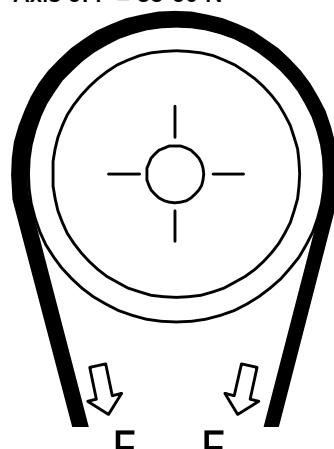
The procedure below details how to inspect the timing belts.



WARNING

Please observe the following before commencing any repair work on the manipulator:

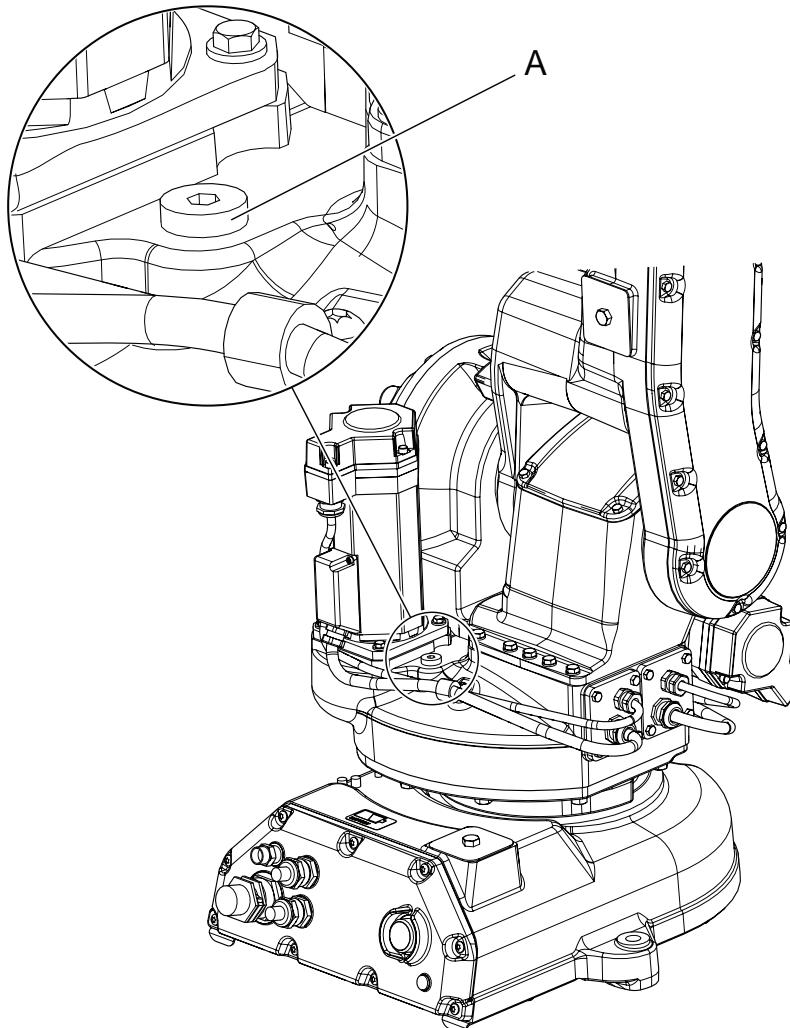
- Some parts are *HOT* after running the robot, e.g. motors and lights! Burns may result from touching them!
- Turn off all electrical power, hydraulic and pneumatic pressure supplies to the robot!
- When replacing motors/reducers, make sure that those parts of the robot which could move unexpectedly are mechanically blocked as specified in the individual procedures.

	Action	Note
1	Gain access to each belt by removing covers, etc.	These procedures are detailed in sections <i>Replacement of motor and timing belt, axis 3 on page 191</i> and <i>Replacement of motor and timing belt, axes 5 or 6 on page 201</i> .
2	Check each belt for damage.	Replace the timing belts if found defective as detailed in sections <i>Replacement of motor and timing belt, axis 3 on page 191</i> and <i>Replacement of motor and timing belt, axes 5 or 6 on page 201</i> .
3	Check each belt for tension. If the belt tension is not correct, it should be adjusted.	<p>The belt tension should be:</p> <ul style="list-style-type: none">• Axis 3: $F = 35-60 \text{ N}$• Axis 5: $F = 35-60 \text{ N}$• Axis 6: $F = 35-60 \text{ N}$  <p>xx020000474</p> <p>Belt tension adjustment is detailed in sections <i>Replacement of motor and timing belt, axis 3 on page 191</i> and <i>Replacement of motor and timing belt, axes 5 or 6 on page 201</i>.</p>

3.3.4 Inspecting oil level gearbox axis 1

Location of oil plugs

The oil plug axis 1 gearbox is located as shown in the figure.



xx1700000416

A	Oil plug, filling, draining, inspection
---	---

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 114 .
Standard toolkit	Content is defined in section Standard tools on page 241 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

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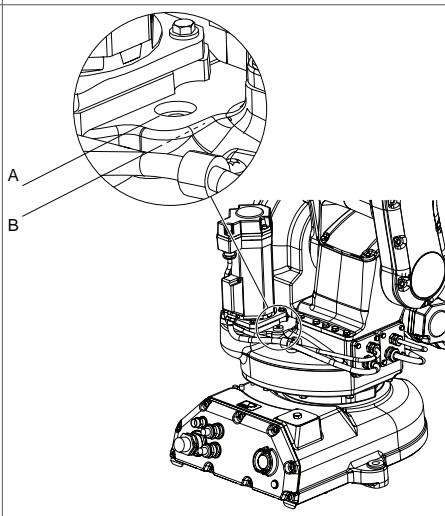
3 Maintenance

3.3.4 Inspecting oil level gearbox axis 1

Continued

Inspecting oil level

Use this procedure to inspect the oil level in the axis 1 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working area.	
3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4 Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none">• 34 ± 5 mm below the upper edge of the oil plug hole (A) and (B).	 <p>xx1700000422</p>
5 Add oil if required.	See Technical reference manual - Lubrication in gearboxes

Continues on next page

3.3.4 Inspecting oil level gearbox axis 1

Continued

	Action	Note
6	<p>Refit the oil plug, filling.</p> <p> Note</p> <p>Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.</p>	<p>Tightening torque:</p> <ul style="list-style-type: none">• 10 Nm
7	<p>Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 124.</p> <p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	

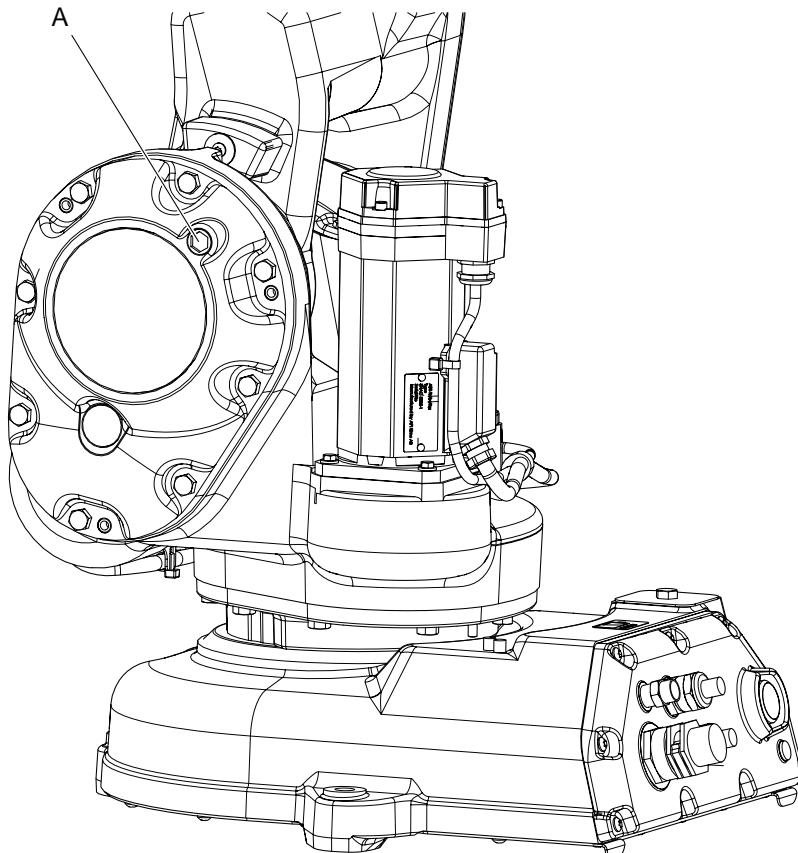
3 Maintenance

3.3.5 Inspecting oil level gearbox axis 2

3.3.5 Inspecting oil level gearbox axis 2

Location of oil plugs

The oil plug axis 2 gearbox is located as shown in the figure.



xx1700000417

A	Oil plug, filling, draining, inspection
---	---

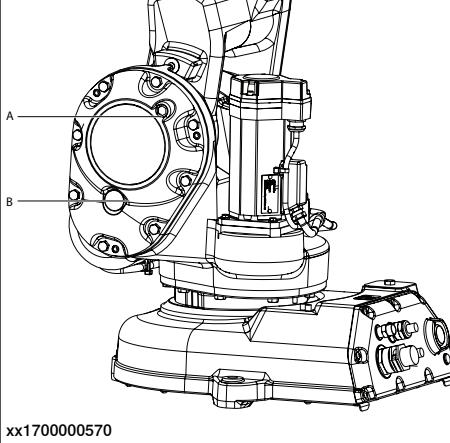
Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 114 .
Standard toolkit	Content is defined in section Standard tools on page 241 .
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

Inspecting oil level

Use this procedure to inspect the oil level in the axis 1 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4 Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none"> • 125 -25 mm below the lower edge of the oil plug hole (A) and (B).  Note If it is not possible to measure the oil level, drain all oil out and refill with initial amount according to Technical reference manual. 	
5 Add oil if required.	See Technical reference manual - Lubrication in gearboxes
6 Refit the oil plug, filling.  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: <ul style="list-style-type: none"> • 10 Nm

Continues on next page

3 Maintenance

3.3.5 Inspecting oil level gearbox axis 2

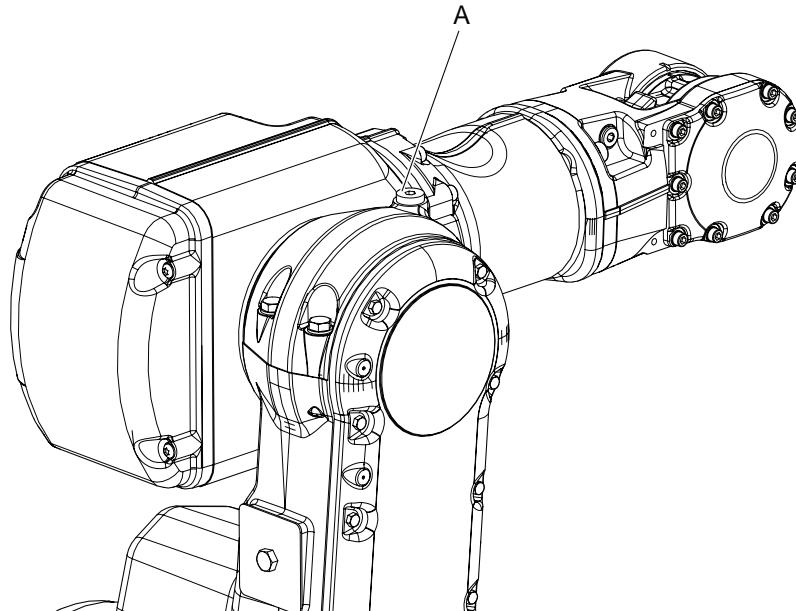
Continued

	Action	Note
7	<p>Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 124.</p> <p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	

3.3.6 Inspecting oil level gearbox axis 3

Location of oil plugs

The oil plug axis 3 gearbox is located as shown in the figure.



xx1700000418

A	Oil plug, filling, draining, inspection
---	---

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 114 .
Standard toolkit	Content is defined in section Standard tools on page 241 .
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

Use this procedure to inspect the oil level in the axis 1 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

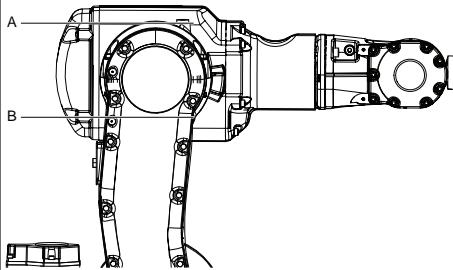
	Action	Note
1	WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	

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3 Maintenance

3.3.6 Inspecting oil level gearbox axis 3

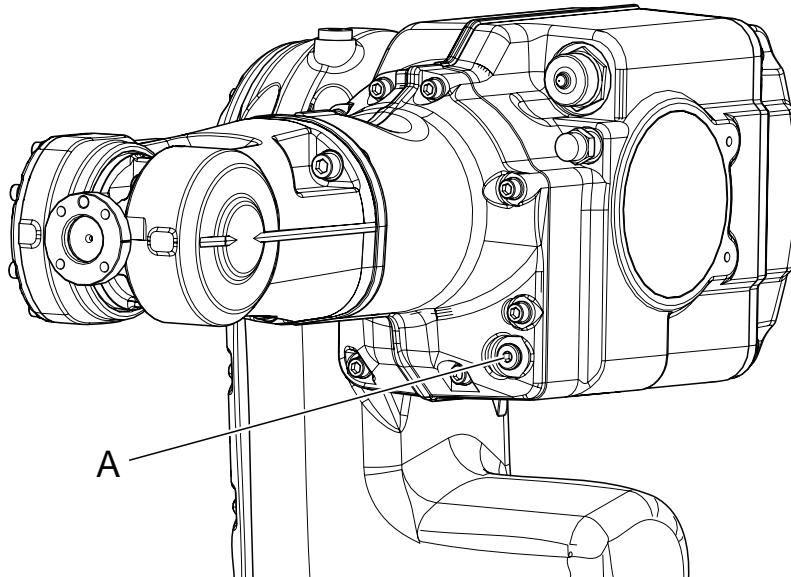
Continued

	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	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none"> • 148 ±5 mm below the upper edge of the oil plug hole (A) and (B). 	 xx1700000571
5	Add oil if required.	See <i>Technical reference manual - Lubrication in gearboxes</i>
6	Refit the oil plug, filling.  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: <ul style="list-style-type: none"> • 10 Nm
7	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 124 .  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

3.3.7 Inspecting oil level gearbox axis 4

Location of oil plugs

The oil plug axis 4 gearbox is located as shown in the figure.



xx1700000419

A	Oil plug, filling, draining, inspection
---	---

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 114 .
Standard toolkit	Content is defined in section Standard tools on page 241 .
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

Use this procedure to inspect the oil level in the axis 1 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

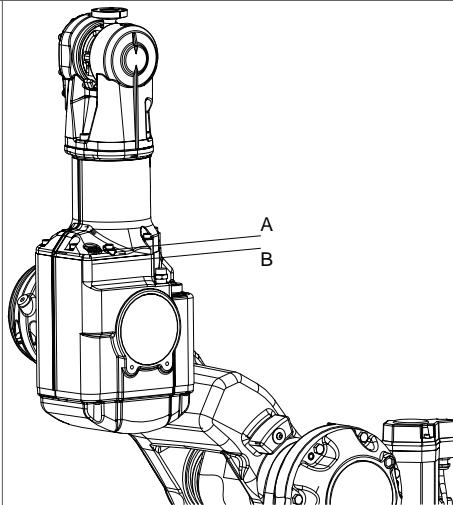
	Action	Note
1	WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	

Continues on next page

3 Maintenance

3.3.7 Inspecting oil level gearbox axis 4

Continued

Action	Note
<p>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.</p>	
<p>3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.</p>	
<p>4 Measure the oil level at the oil plug hole. Required oil level:<ul style="list-style-type: none"> • 15 ± 3 mm below the lower edge of oil plug hole (A) and (B). </p>	
<p>5 Add oil if required.</p>	<p>See <i>Technical reference manual - Lubrication in gearboxes</i></p>
<p>6 Refit the oil plug, filling.  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.</p>	<p>Tightening torque:<ul style="list-style-type: none"> • 10 Nm </p>

Continues on next page

3.3.7 Inspecting oil level gearbox axis 4

Continued

	Action	Note
7	<p>Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 124.</p> <p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	

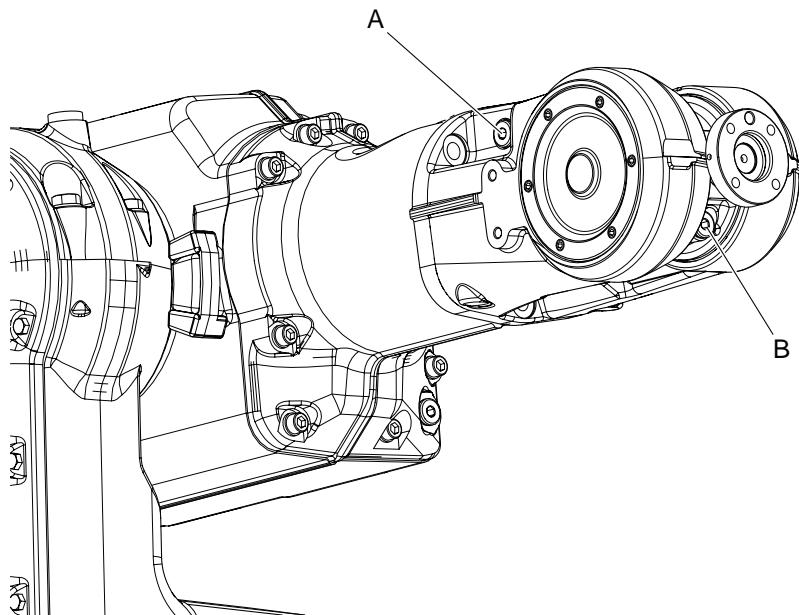
3 Maintenance

3.3.8 Inspecting oil level gearbox axes 5-6

3.3.8 Inspecting oil level gearbox axes 5-6

Location of oil plugs

The oil plug axis 5 gearbox is located as shown in the figure.



xx1700000420

A	Oil plug, filling, draining, inspection
B	Oil plug, ventilation hole

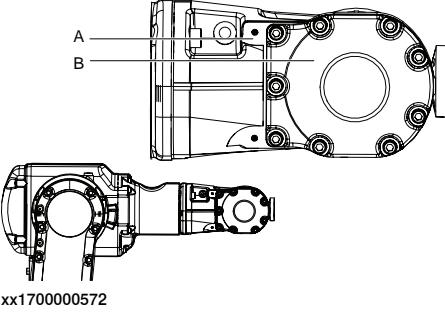
Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 114 .
Standard toolkit	Content is defined in section Standard tools on page 241 .
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

Inspecting oil level

Use this procedure to inspect the oil level in the axis 1 gearbox. A suspended robot must be taken down and secured standing on the floor for inspection.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
2  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4 Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none"> • 23 ± 3 mm below the lower edge of the oil plug hole (A) and (B). 	 xx1700000572
5 Add oil if required.	See Technical reference manual - Lubrication in gearboxes
6  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: <ul style="list-style-type: none"> • 10 Nm

Continues on next page

3 Maintenance

3.3.8 Inspecting oil level gearbox axes 5-6

Continued

	Action	Note
7	<p>Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 124.</p> <p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	

3.4 Cleaning activities

3.4.1 Cleaning the IRB 140 type C



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 140 type C 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 140 type C.



Note

Always verify the protection type of the robot before cleaning.

Dos and don'ts!

This section specifies some special considerations when cleaning the robot.

Always!

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

Never!

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

Continues on next page

3 Maintenance

3.4.1 Cleaning the IRB 140 type C

Continued

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.
Wash	Yes	Yes. With light cleaning detergent or spirit.	Yes. It is highly recommended that the water contains a rust-prevention solution.	Yes ⁱⁱ . It is highly recommended that the water and steam contains rust preventive, without cleaning detergents.
Clean room	Yes	Yes. With light cleaning detergent, spirit or isopropyl alcohol.	No	No

ⁱ Perform according to section [Cleaning with water and steam on page 112](#).

ⁱⁱ Perform according to section [Cleaning with water and steam on page 112](#).

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

¹ See [Cleaning methods on page 112](#) for exceptions.

² See [Cleaning methods on page 112](#) for exceptions.

Continues on next page

The following list defines the prerequisites:

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

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

3.5.1 Type of lubrication in gearboxes

3.5 Changing/ replacing activities

3.5.1 Type of lubrication in gearboxes

Introduction

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



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 124](#).

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.

Equipment

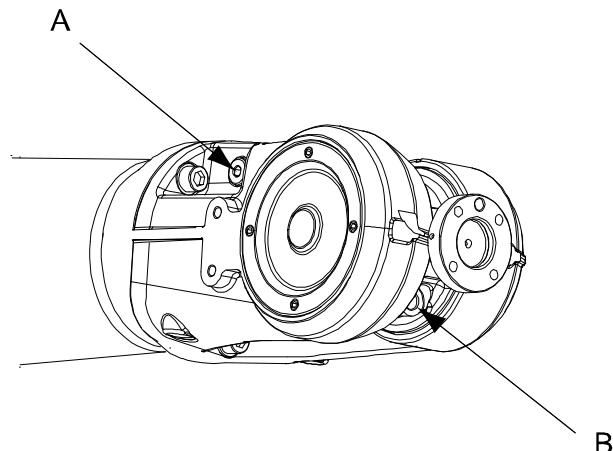
Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: <ul style="list-style-type: none">• Orion OriCan article number 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	

3.5.2 Changing the oil in axes 5 and 6 gearboxes

Location of oil plugs

The gearboxes for axes 5 and 6 are located in the wrist unit as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0600002846

A	Oil plug, draining and filling
B	Oil plug, vent hole

Required equipment

Equipment, etc.	Note
Lubricating oil	Information about the oil is found in Technical reference manual - Lubrication in gearboxes . See Type and amount of oil in gearboxes on page 114 .
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Standard toolkit	Content is defined in section Standard tools on page 241 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

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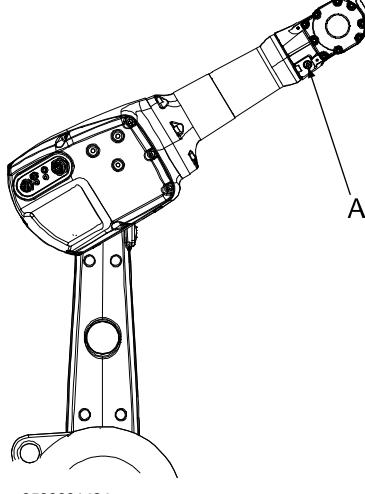
3 Maintenance

3.5.2 Changing the oil in axes 5 and 6 gearboxes

Continued

Draining, wrist unit

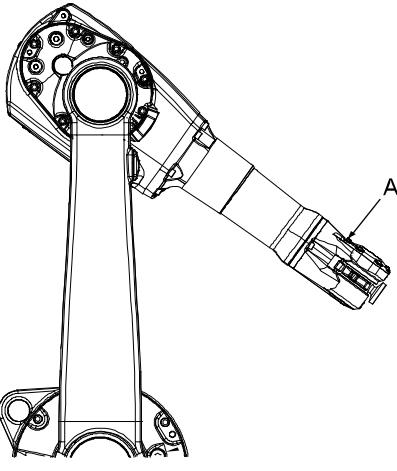
The procedure below details how to drain oil from the gearboxes in the wrist unit.

Action	Note/Illustration
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  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section <i>WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55</i> .	
3 Position the robot as shown in the figure to the right: <ul style="list-style-type: none">• upper arm: upwards for a standing robot• axis 4: 180°, to a position where the oil plug (A), faces downwards. Note! The total amount of oil will not be drained. There will remain approximately 50 ml in the wrist unit.	The capacity of the vessel must be sufficient to take the complete amount of oil.  xx0500001434 A Oil plug, draining and filling The position for an <i>inverted robot</i> is the opposite!
4 Remove the both <i>oil plugs</i> . Both oil plugs must be removed in order to drain the wrist unit properly.	Shown in the figure <i>Location of oil plugs on page 115</i> .
5 Refit the oil plug, vent hole.	

Continues on next page

Filling oil, wrist unit

The procedure below details how to fill oil in the gearboxes in the wrist unit.

	Action	Note/Illustration
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	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 55 .	
3	Remove the <i>oil plug, draining and filling</i> .	Shown in the figure Location of oil plugs on page 115!
4	Position the robot as shown in the figure to the right: <ul style="list-style-type: none"> • upper arm: downwards for a standing robot • axis 4: 90°, to a position where the oil plug (A), faces upwards. Fill oil in the wrist unit through the oil plug.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 114 .  xx0500001435 <ul style="list-style-type: none"> • A: Oil plug, draining and filling The position for an <i>inverted robot</i> is the opposite.
5	Refit the oil plug.	

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes all repair activities recommended for the IRB 140 type C and any external unit.

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



WARNING

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

Required equipment

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

The details of equipment are also available in different lists in the chapter [Reference information on page 233](#).

Safety information

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



Note

If the IRB 140 type C is connected to power, always make sure that the IRB 140 type C is connected to earth before starting any repair work.

For more information see:

- *Product manual - IRC5*

4 Repair

4.2.1 Mounting instructions for bearings

4.2 General procedures

4.2.1 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

Continues on next page

4.2.1 Mounting instructions for bearings

Continued

grease when mounted, as excessive grease will be pressed out from the bearing when the robot is started.

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

Grease the different types of bearings as following description:

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

4 Repair

4.2.2 Mounting instructions for seals

4.2.2 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 122 .
4 Mount the seal correctly with a mounting tool. Never hammer directly on the seal as this may result in leakage.	
5 Make sure no grease left on the robot surface.	

Continues on next page

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.	
6 Make sure that no grease is left on the robot surface.	

4 Repair

4.2.3 Replacing parts on the robot

4.2.3 Replacing parts on the robot

General

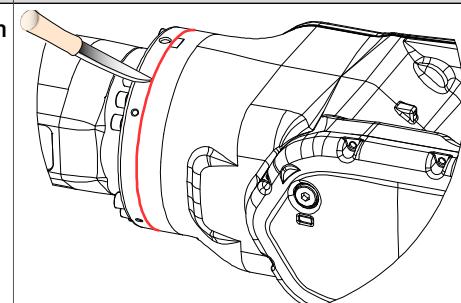
Follow the procedures in this section whenever breaking the surface paint of the robot during replacement of parts.

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

Required equipment

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

Removing

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

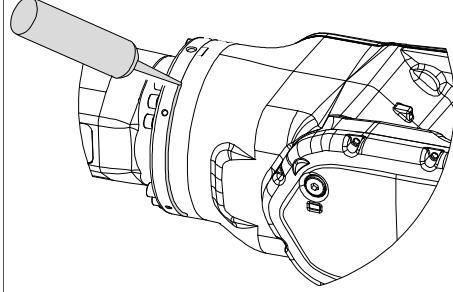
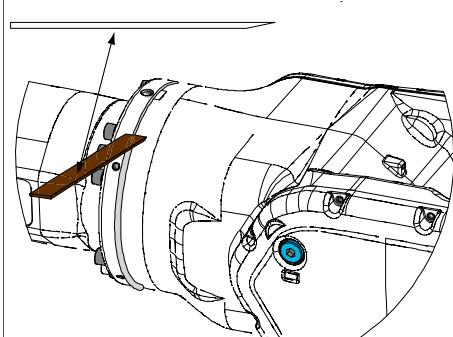
Refitting

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

Continues on next page

4.2.3 Replacing parts on the robot

Continued

Action	Description
3 Seal all refitted joints with Sikaflex 521FC.	 xx0900000122
4 Use the tooling pin to even out the surface of the Sikaflex seal.	 xx0900000125
5 Wait 15 minutes.	Sikaflex 521FC skin dry time (15 minutes).
6  Note Always read the instruction in the product data sheet in the paint repair kit for Foundry Prime.	3HAC035355-001
7 Use Touch up paint Clean Room, white to paint the joint.  Note Always read the instruction in the product data sheet in the paint repair kit for Clean Room.	3HAC036639-001
 Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

4 Repair

4.3.1 Replacement of cable harness

4.3 Complete robot

4.3.1 Replacement of cable harness

Location of cable harness

The cable harness runs from the base to the motors of axes 3-6.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Cable harness	3HAC 7370-1		Standard and Foundry versions Clean room version Includes cabling: <ul style="list-style-type: none">• Cable harness, power axis 1-3• Cable harness, power axis 4-6• Cable harness, signals axis 1-3• Cable harness, signals axis 4-6• Cable harness, customer connections
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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		3HAC 6816-3	See chapter Circuit diagram on page 247 .

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Removal, cable harness

The procedure below details how to remove the cable harness.

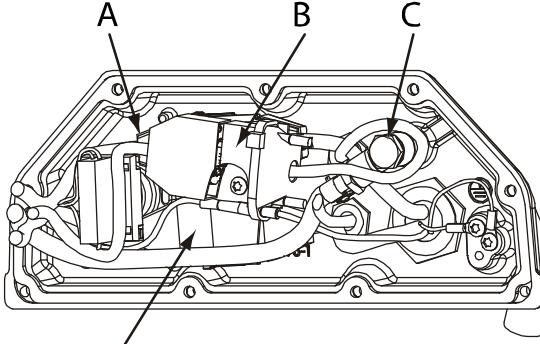
**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

**CAUTION**

The cable packs are sensitive to mechanical damage! They must be handled with care, especially the connectors, in order to avoid damaging them!

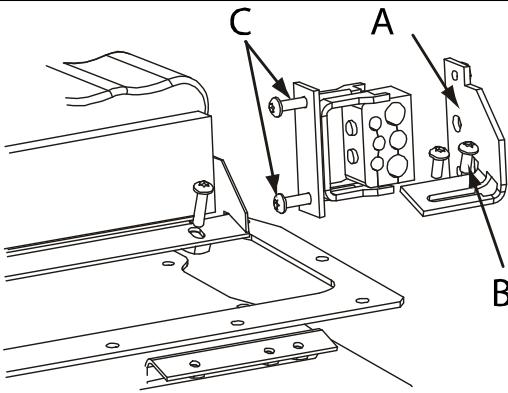
	Action	Note/Illustration
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Remove the serial measurement board.	Detailed in section Replacing the serial measurement unit and the battery pack on page 172 .
3	Disconnect connectors in the manipulator base.	 xx0300000090 Connectors: <ul style="list-style-type: none"> • A: R1.MP1-3 • B: R1.CS • C: Air hose • D: R1.MP4-6

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4 Repair

4.3.1 Replacement of cable harness

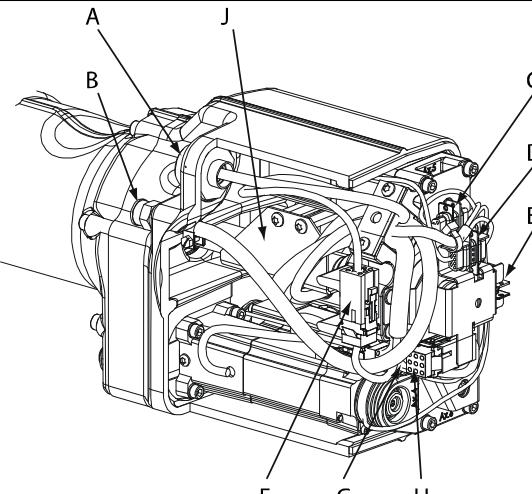
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	Action	Note/Illustration
4	Remove the cable holder by unscrewing its attachment screws.	 <p>xx0300000091</p> <ul style="list-style-type: none">• A: Cable holder• B: Attachment screws• C: Cable securing screws
5	Remove the cables from the cable holder by unscrewing the cable securing screws.	See figure above!
6	Remove the <i>cover, arm housing</i> .	Detailed in section Replacement of cover, arm housing on page 156 .
7	Remove the <i>lower arm cover</i> .	Detailed in section Replacement of lower arm cover and gasket on page 159 .
8	Gently knock out the <i>VK cover</i> .	Detailed in section Removing the VK cover on page 137 .

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4.3.1 Replacement of cable harness

Continued

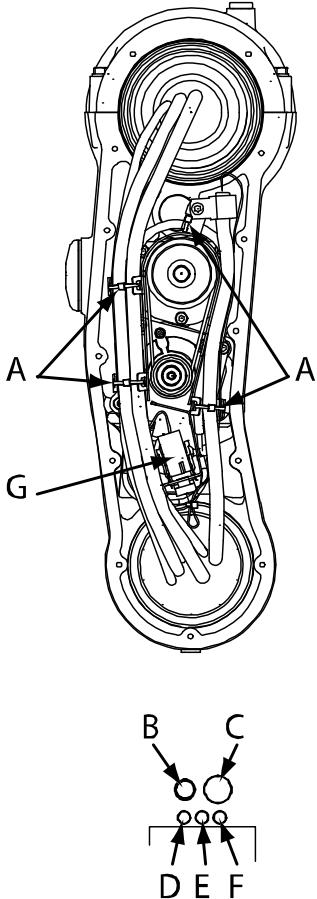
Action	Note/Illustration
9 Disconnect connectors in the rear of the upper arm.	 <p>xx0300000092</p> <p>Connectors:</p> <ul style="list-style-type: none"> • A: R2.CS • B: Pressurized air connection • C: R3.FB4 • D: R3.FB5 • E: R3.FB6 • F: R3.MP5 • G: R3.MP4 • H: R3.MP6 <p>Parts:</p> <ul style="list-style-type: none"> • J: Shield
10 Remove the <i>shield</i> by unscrewing its attachment screws.	See figure above!
11 Cut any cable ties securing the cabling inside the lower arm.	

Continues on next page

4 Repair

4.3.1 Replacement of cable harness

Continued

Action	Note/Illustration
12 Disconnect the connectors inside the lower arm.	 <p>xx0200000449</p> <ul style="list-style-type: none"> G: Connectors R3.MP3 and R3.FB3
13 Pull the cables out of the upper arm.	
14 Remove the cover, console.	Detailed in section Replacement of cover, console on page 165 .
15 Disconnect the connectors inside the console and undo the cable holders.	<p>Connectors:</p> <ul style="list-style-type: none"> R3.MP1 R3.MP2 R3.FB1 R3.FB2
16 Gently pull the cabling from the base up through the console.	
17 Gently pull the cabling out of the lower arm.	

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Refitting, cable harness

The procedure below details how to refit the cable harness.

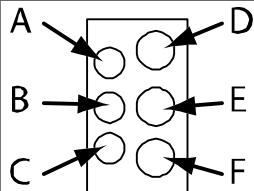
**WARNING**

Please observe the following before commencing any repair work on the manipulator:

- - Motors and gears are *HOT* after running the robot! Burns may result from touching the motors or gears!
- - Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!
- - Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, e.g. to secure the lower arm with fixtures if removing motor, axis 2.

**CAUTION**

The cable packs are sensitive to mechanical damage! They must be handled with care, especially the connectors, in order to avoid damaging them!

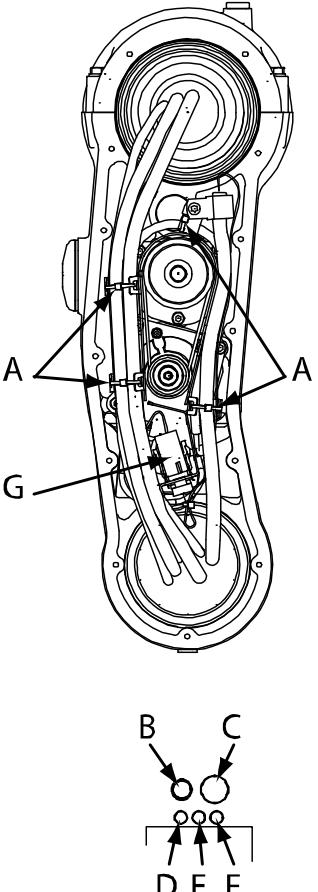
Action	Note/Illustration
1 Refit in reverse order to what is detailed above. Detailed below are some recommendations on how to route the cables.	
2 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
3 Cable distribution in the cable holder in the manipulator base.	 xx0300000093 Cables: <ul style="list-style-type: none"> • A: Signal • B: Signal • C: Customer signal • D: Power cable, axes 4-6 • E: Pressurized air supply • F: Power cable, axes 1-3

Continues on next page

4 Repair

4.3.1 Replacement of cable harness

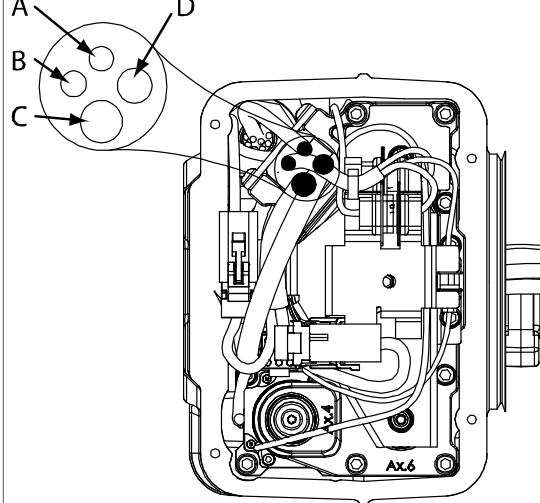
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Action	Note/Illustration
4 Cable layout in the lower arm.	 <p>xx0200000449</p> <ul style="list-style-type: none">• A: Cable ties• B: Pressurized air hose• C: Power cables, axes 4, 5 and 6• D: Customer cables, signal• E: Signal cables, axes 4, 5 and 6• F: Signal cable, axis 3• G: Connectors R3.MP3 and R3.FB3

Continues on next page

4.3.1 Replacement of cable harness

Continued

Action	Note/Illustration
5 Cable holder in the upper arm.	 <p>xx0300000094</p> <p>Cables:</p> <ul style="list-style-type: none"> • A: Customer signal • B: Signal • C: Pressurized air supply • D: Power cables
6 Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	<p> Note</p> <p>After all repair work, wipe the Clean Room robot free from particles with spirit on a lint free cloth.</p>

4 Repair

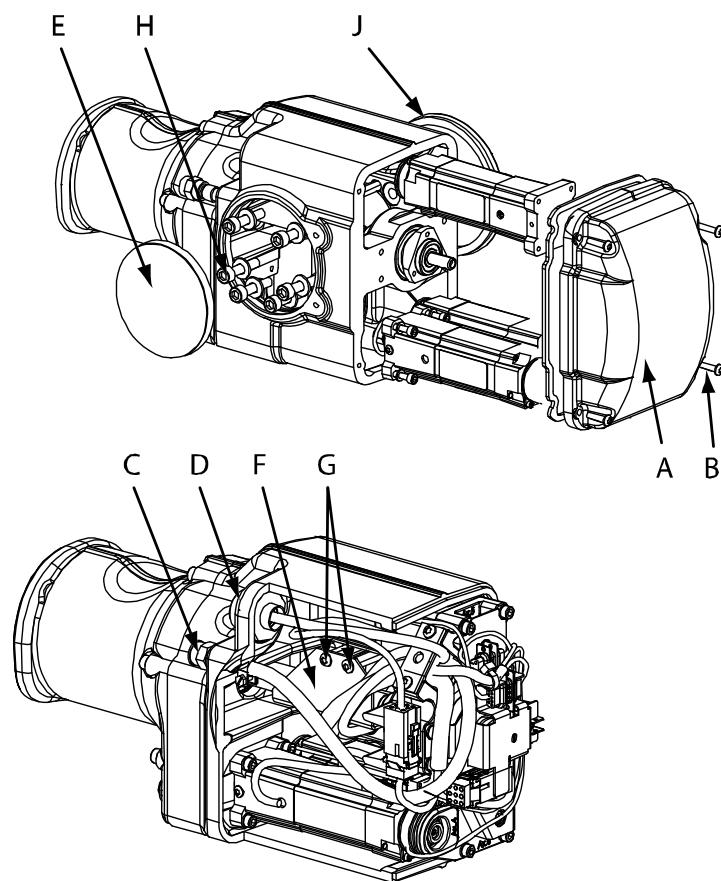
4.3.2 Replacement of complete upper arm

4.3.2 Replacement of complete upper arm

Location of upper arm

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

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000446

A	Cover, armhousing
B	Attachment screws, cover armhousing, (4 pcs)
C	CS-connector
D	Pressurized air connector
E	VK cover
F	Cable guide
G	Attachment screws, cable guide
H	Attachment screws, upper arm (6 pcs)
J	Sealing ring

Continues on next page

Required equipment

Equipment	Spare part no.	Art. no.	Note
Upper arm	See Spare part lists on page 245 .		Includes all required sealings and gaskets.
Sealing ring		3HAB3732-13	To be replaced if damaged only. Included in the upper arm assembly.
VK cover		3HAA2166-13	
Gasket upper arm cover		3HAC7867-1	
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
Special socket		-	For fitting the CS-connector.
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.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Removal, upper arm

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

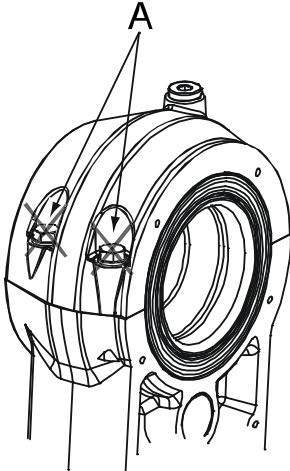
	Action	Note
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Run the manipulator arm to a horizontal position.	
3	Remove all brackets securing any exterior cabling to the upper arm by unscrewing their attachment screws respectively.	

Continues on next page

4 Repair

4.3.2 Replacement of complete upper arm

Continued

Action	Note
4 Remove the rear <i>cover armhousing</i> by unscrewing its four attachment screws.	Shown in the figure Location of upper arm on page 134!
5 DO NOT under any circumstance unscrew the six screws on top of the lower arm! Doing so will cause the manipulator to require a complete rebuild!	 xx0300000101 <ul style="list-style-type: none"> A: DO NOT touch these screws! (NOTE! Only two screws shown!)
6 Disconnect all cables to/from motors 4-6.	Connectors <ul style="list-style-type: none"> R3.MP4 R3.MP5 R3.MP6 R3.FB4 R3.FB5 R3.FB6
7 Disconnect any connector from the CS-connector.	Shown in the figure Location of upper arm on page 134!
8 Use a <i>special socket</i> to remove the CS-connector from the housing and pull it into the upper arm assembly.	Shown in the figure Location of upper arm on page 134! Art. no. specified in section Required equipment on page 135!
9 Remove the <i>pressurized air connector</i> from the housing and pull it into the upper arm assembly.	Shown in the figure Location of upper arm on page 134! Art. no. specified in section Required equipment on page 135!
10 Remove the <i>VK-cover</i> from the upper arm/lower arm joint.	Shown in the figure Location of upper arm on page 134! Detailed in section Removing the VK cover on page 137.
11 Remove the <i>cable guide</i> by unscrewing its two attachment screws.	Shown in the figure Location of upper arm on page 134!
12 Gently pull all cables and hoses out.	
13 Remove the upper arm by unscrewing its six attachment screws.	Shown in the figure Location of upper arm on page 134!
14 Lift the upper arm and place it on a secure surface.	

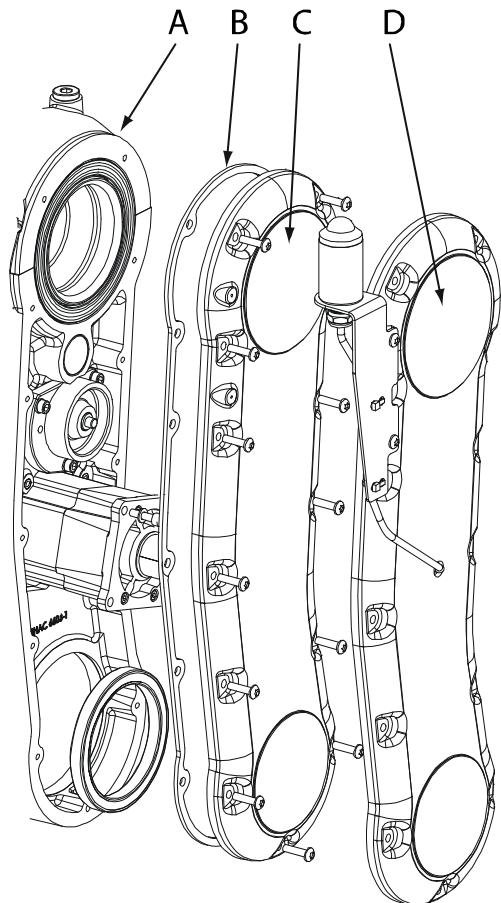
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4.3.2 Replacement of complete upper arm

Continued

Removing the VK cover

The procedure below details how to remove the VK cover from the upper arm.



xx0200000433

A	Lower arm
B	Lower arm cover gasket
C	Cover l. arm, spare (without lamp unit)
D	Cover l. arm, spare (with lamp unit)

	Action	Note
1	Remove the lower arm cover by unscrewing its attachment screws.	
2	Tap the <i>VK cover</i> with a long blunt edged bar through the hole in the lower arm to press it out.	Make sure to press the circumference of the <i>VK cover</i> evenly to avoid damaging it. Shown in the figure in section Location of upper arm on page 134!
3	If the <i>VK cover</i> is damaged, it must be replaced on refitting.	Specified in section Replacement of complete upper arm on page 134.

Continues on next page

4 Repair

4.3.2 Replacement of complete upper arm

Continued

Refitting

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

Action	Note
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2 Check the <i>sealing ring</i> to see whether it is damaged. Replace if it is damaged!	Shown in the figure Location of upper arm on page 134! Art. no. specified in section Required equipment on page 135!
3 Lift the upper arm into position.	
4 Secure the upper arm with its six <i>attachment screws</i> .	Shown in the figure Location of upper arm on page 134! Tightening torque: 35 Nm ± 3 Nm
5 Gently pull all cables and hoses through the hole in the upper arm.	
6 Reconnect all connectors to motors 4-6.	Connectors <ul style="list-style-type: none">• R3.MP4• R3.MP5• R3.MP6• R3.FB4• R3.FB5• R3.FB6
7 Refit the <i>cable guide</i> with its two <i>attachment screws</i> .	Shown in the figure Location of upper arm on page 134!
8 Pull the <i>pressurized air connector</i> through the housing and secure it into fitting in the upper arm assembly.	Shown in the figure Location of upper arm on page 134!
9 Pull the <i>CS-connector</i> through the housing and secure it into the fitting in the upper arm assembly. Use a <i>special socketto</i> secure it.	Shown in the figure Location of upper arm on page 134! Art. no. specified in section Required equipment on page 135!
10 Reconnect any connector previously connected externally to the CS connector.	
11 Fit a new <i>VK-cover</i> to the upper arm/lower arm joint. Gently knock it into position.	Shown in the figure Location of upper arm on page 134! Art. no. specified in section Required equipment on page 135! Use a plastic mallet or similar.
12 Refit the rear cover armhousing with its four <i>attachment screws</i> .	Shown in the figure Location of upper arm on page 134!
13 Refit any brackets securing any exterior cabling to the upper arm with their attachment screws respectively.	

Continues on next page

4.3.2 Replacement of complete upper arm

Continued

Action	Note
14 Clean Room robots: seal and paint the joints that have been opened. See <i>Replacing parts on the robot on page 124</i>	
15 Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section <i>Calibration information on page 219</i> .

**DANGER**

When performing the first test run after a service activity (repair, installation or maintenance), it is vital that:

- all the service tools and other foreign objects are removed from the manipulator!
- all normal safety equipment is installed properly, e.g. FlexPendant enabling device.
- all personnel are standing at a safe distance from the manipulator, i.e. out of its reach behind safety fences, etc.
- special attention is paid to the function of the part that has been serviced.

4 Repair

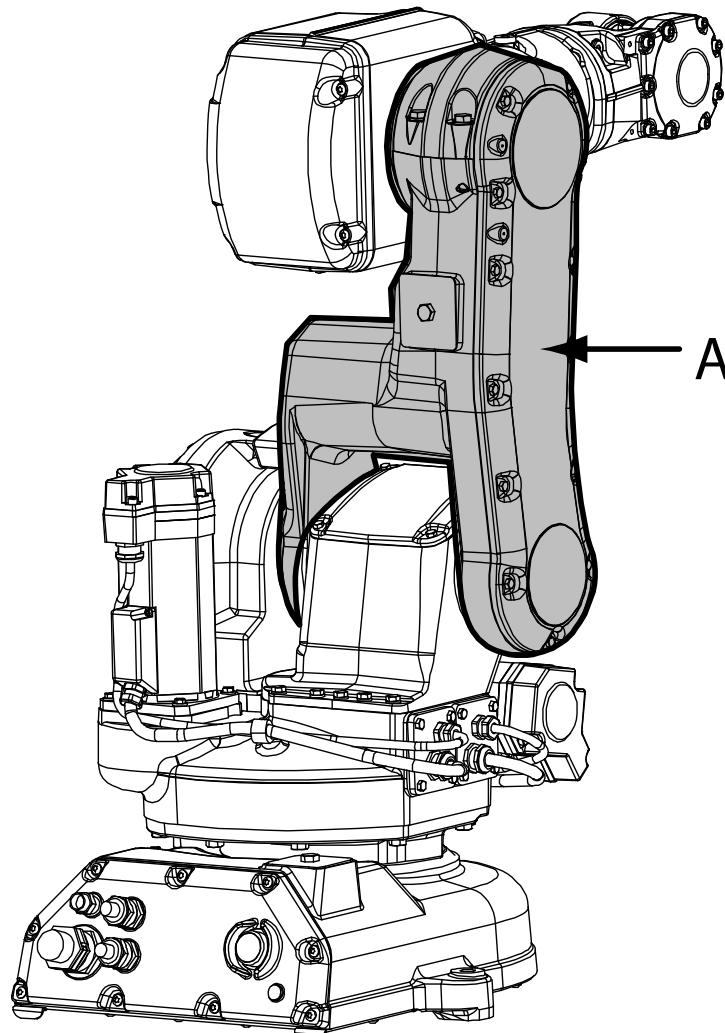
4.3.3 Replacement of complete lower arm

4.3.3 Replacement of complete lower arm

Location of lower arm

The lower arm is located between upper arm and frame as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000469

A	Lower arm
---	-----------

Required equipment

Equipment	Spare part no.	Art. no.	Note
Lower arm, spare	3HAC034935-001		Standard and Foundry versions Includes all required bearings, oil and VK cover.

Continues on next page

4.3.3 Replacement of complete lower arm

Continued

Equipment	Spare part no.	Art. no.	Note
Lower arm, spare	3HAC034937-001		Clean room versions Includes all required bearings, oil and VK cover.
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
Lifting device for lower arm			Lifting capacity >16 kg
Special socket		-	For fitting the CS-connector
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, lower arm

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

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

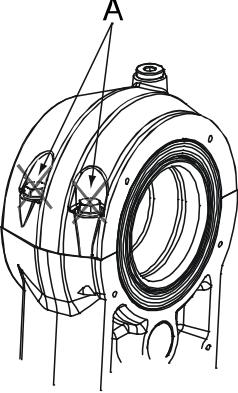
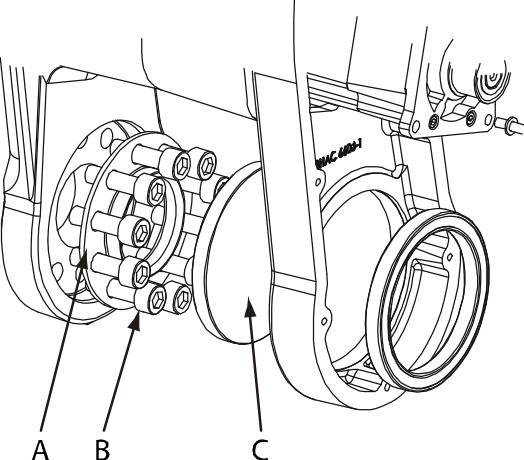
	Action	Information
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Remove the console.	Detailed in section Replacement of console on page 168 .

Continues on next page

4 Repair

4.3.3 Replacement of complete lower arm

Continued

Action	Information
3 DO NOT under any circumstance unscrew the six screws on top of the lower arm! Doing so will cause the manipulator to require a complete rebuild!	 xx0300000101 <p>Parts:</p> <ul style="list-style-type: none"> A: DO NOT touch these screws! (Note! Only 2 screws are shown.)
4 Remove the VK cover by pressing a screwdriver, or similar, through it and pulling.	 xx0300000097 <p>Parts:</p> <ul style="list-style-type: none"> A: Washer B: Lower arm attachment screws (10 pcs) C: VK cover
5 Unscrew the <i>lower arm attachment screws</i> . Also remove the washer.	Shown in the figure above!
6 Raise the lifting device to remove the lower arm.	

Refitting, lower arm

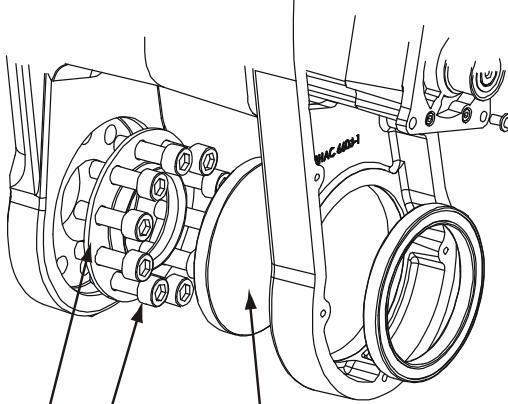
The procedure below details how to refit the complete lower arm.

Action	Note
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2 Fit the lifting device and lift the lower arm into position.	

Continues on next page

4.3.3 Replacement of complete lower arm

Continued

Action	Note
3 Fit the lower arm to gearbox, axis 2, and secure it with its attachment screws and washers.	 <p>xx0300000097</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Washer B: Lower arm attachment screws (10 pcs) C: VK cover <p>Tightening torque: 35 Nm ± 3 Nm</p>
4 Fit a new <i>VK</i> cover by gently tapping it into position.	Shown in the figure above!
5 Refit the console.	Detailed in section Replacement of console on page 168 .
6 Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	<p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>
7 Recalibrate the robot.	<p>Calibration is detailed in a separate calibration manual enclosed with the calibration tools.</p> <p>General Calibration information is included in section, Calibration information on page 219</p>

4 Repair

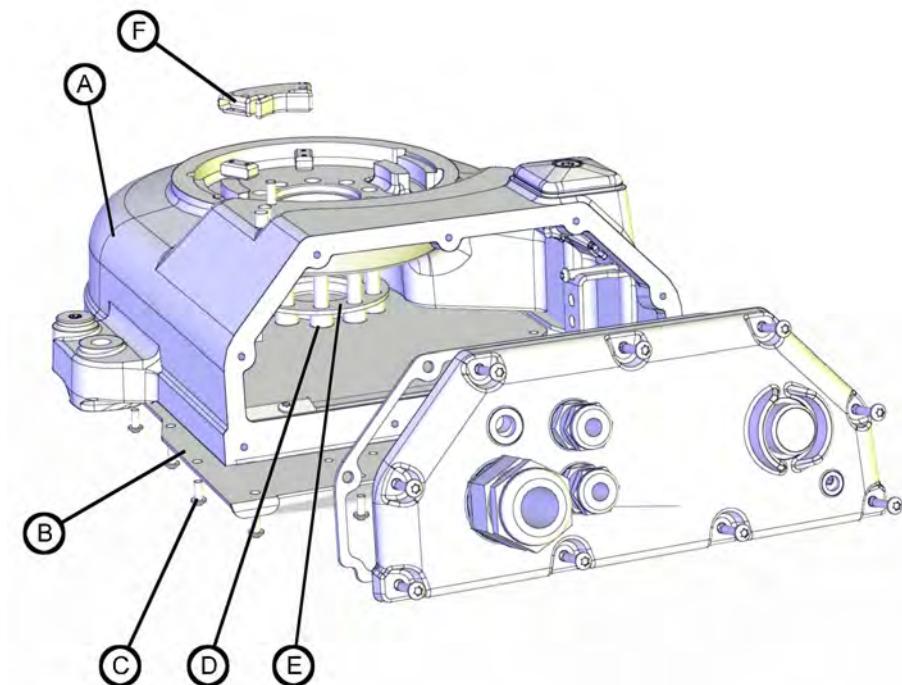
4.3.4 Replacement of base

4.3.4 Replacement of base

Location of base

The base is located at the bottom of the robot as shown in the figure below.

A more detailed view of the components and its position may be found in *Spare part lists and exploded views*.



xx0200000423

A	Base
B	Bottom plate
C	Attachment screws, bottom plate (26 pcs)
D	Attachment screws and washers, gearbox/base (10 pcs each)
E	Damper, axis 1
F	Washer

Required equipment

Equipment	Spare part no.	Art. no.	Note
Base, spare	For spare part number, see: • Spare part lists on page 245 .		Standard and Foundry versions. Includes parallel pin 3HAC 3785-2.
Base, spare	For spare part number, see: • Spare part lists on page 245 .		Clean room versions. Includes parallel pin 3HAC 3785-2.

Continues on next page

Equipment	Spare part no.	Art. no.	Note
Lifting slings		-	
Locking liquid			Loctite 574 For sealing the base to the gearbox 1-2.
Grease		3HAB3537-1	For lubricating the V-ring.
Isopropanol			For cleaning the mating surfaces.
Standard toolkit		-	Content is defined in section Standard tools on page 241 .
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, base

The procedure below details how to remove the base from 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 Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
3	Remove the axis 1 and 2 motors.	Detailed in sections: <ul style="list-style-type: none"> • Replacement of motor, axis 1 on page 182 • Replacement of motor, axis 2 on page 186
4	Remove the cable harness.	Detailed in section Replacement of cable harness on page 126 .
5	Remove the serial measurement unit.	Detailed in section Replacing the serial measurement unit and the battery pack on page 172 .
6	Remove the complete upper arm.	Detailed in section Replacement of complete upper arm on page 134 .

Continues on next page

4 Repair

4.3.4 Replacement of base

Continued

	Action	Note
7	Remove the complete lower arm.	Detailed in section Replacement of complete lower arm on page 140 .
8	Unfasten the base from the installation site by removing the attachment bolts from the foundation.	
9	Fit the <i>lifting slings</i> to the robot, lift it and place it with the side of the lower arm downwards on a work bench.	
10	Remove the <i>bottom plate</i> .	Shown in the figure Location of base on page 144 .
11	Secure the weight of the base and remove the <i>gearbox/base attachment screws and washer</i> .	Shown in the figure Location of base on page 144 .
12	Separate the base from the gearbox unit.	

Refitting, base

The procedure below details how to refit the base 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	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
3	Place the robot with the side of the lower arm downwards on a workbench.	
4	Clean the mating surfaces between the base and the gearbox unit with isopropanol.	
5	Lubricate the mating surface on the base with Loctite 574.	
6	Lift the base to mounting position.	
7	Secure the base to the gearbox unit with the <i>gearbox/base attachment screws and washer</i> .	Shown in the figure Location of base on page 144 . Tightening torque: 35 Nm ± 3Nm
8	Refit the <i>bottom plate</i> and secure it with its <i>attachment screws</i> .	Shown in the figure Location of base on page 144 .
9	Turn the robot to stand upright.	
10	Secure the base to the foundation.	Attachment bolt and tightening torque are specified in section Attachment screws on page 72
11	Refit the complete lower arm.	Detailed in section Replacement of complete lower arm on page 140 .

Continues on next page

	Action	Note
12	Refit the complete upper arm.	Detailed in section <i>Replacement of complete upper arm on page 134</i> .
13	Refit motors 1 and 2.	Detailed in sections <i>Replacement of motor, axis 1 on page 182</i> and <i>Replacement of motor, axis 2 on page 186</i> respectively.
14	Refit the serial measurement unit.	Detailed in section <i>Replacing the serial measurement unit and the battery pack on page 172</i> .
15	Refit the cable harness.	Detailed in section <i>Replacement of cable harness on page 126</i> .
16	Clean Room robots: seal and paint the joints that have been opened. See <i>Replacing parts on the robot on page 124</i>	
	 Note	
	After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
17	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section <i>Calibration information on page 219</i> .
18	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48</i> .	

4 Repair

4.4.1 Replacing the wrist unit, IRB 1600

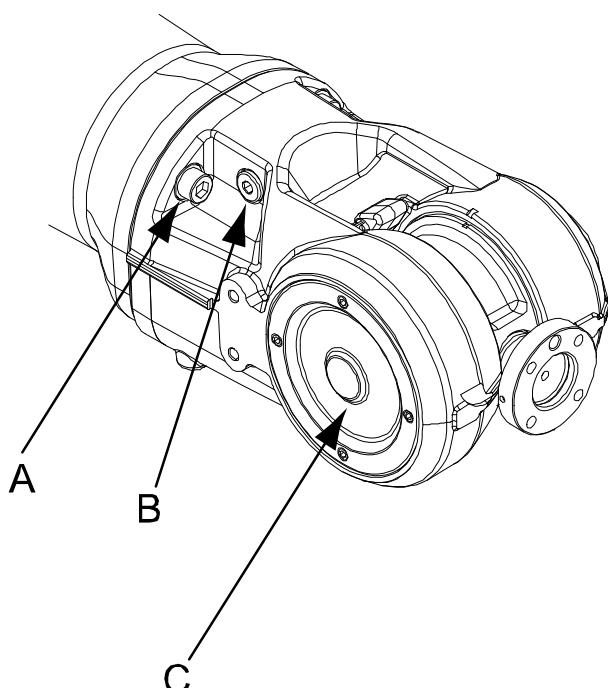
4.4 Upper arm

4.4.1 Replacing the wrist unit, IRB 1600

Location of wrist unit

The wrist unit is located in the frontmost part of the upper arm.

A more detailed view of the components and its position may be found in *Spare parts - Spare part lists and exploded views*.



xx0600002847

A	Attachment screws, wrist unit (3 pcs)
B	Oil plug (only one shown)
C	Wrist unit

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Wrist Stand-ard/Foundry			Standard and Foundry versions. O-ring sealing plate not included! Note! The wrist, stand-ard/Foundry is not interchangeable with art. no. 3HAC 10475-1!
Wrist unit (CR)	3HAC 026569-003		Clean room versions O-ring sealing plate not included!

Continues on next page

4.4.1 Replacing the wrist unit, IRB 1600

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
O-ring sealing plate			Must be replaced. Note! The o-ring sealing plate is not interchangeable with art.no. 3HAC 7191-1!
Grease		3HAC 3537-1	For lubricating the o-ring sealing plate.
Standard toolkit		-	Content is defined in section Standard tools on page 241 .
Arm		3HAC 9037-1	For adjusting the gear play, motor/pinion.
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, wrist unit

The procedure below details how to remove the complete wrist 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	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
3	Drain the oil from the wrist unit.	Detailed in section Changing the oil in axes 5 and 6 gearboxes on page 115 .
4	Remove the wrist unit by unscrewing its three attachment screws.	Shown in the figure in section Location of wrist unit on page 148 .

Refitting, wrist unit

The procedure below details how to refit the complete wrist unit.

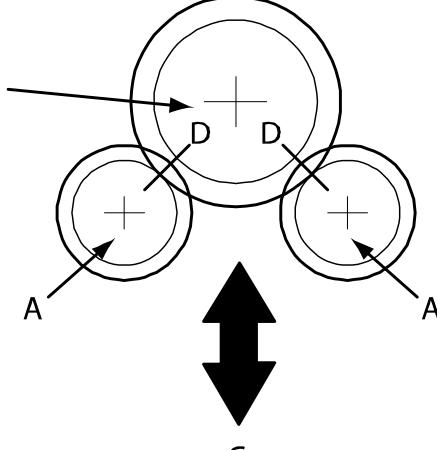
	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	

Continues on next page

4 Repair

4.4.1 Replacing the wrist unit, IRB 1600

Continued

Action	Note
2 Move the robot to a position where the upper arm is vertical.	
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 Lightly lubricate the o-ring sealingplate with grease.	Art. no. is specified in section Required equipment on page 148 .
5 In order to release the brake, connect the 24 VDC power supply to motors:	Connect to connector R3.MP5 or 6: <ul style="list-style-type: none"> • +: pin 7 • -: pin 8
6 Fit the <i>o-ring sealingplate</i> and the <i>wrist unit</i> to the upper arm with the attachment screws, but do not tighten them.	<i>Do not tighten its attachment screws!</i> Use a new o-ring! Spare part no. is specified in Required equipment on page 148 .
7 Fit the <i>arm</i> to the rear of the motor.	Art. no. is specified in section Required equipment on page 148 .
8 Manually push the wrist to adjust the wrist in relation to the gear in the gearbox. The gear play must be checked according to subsections Measuring the gear play, axis 5 on page 207 and Measuring the gear play, axis 6 on page 209	 xx0200000445 A Wrist unit, axes 5 and 6 gears B Drive shafts from motors, axes 5 and 6 gears C Adjustment direction D Gear play
9 Tighten the wrist unit attachment screws.	Tightening torque: 28 Nm.
10 Check the gear play by moving axes 5 and 6 by hand.	The gear play should be as described in subsection Measuring the gear play, axis 5 on page 207 and Measuring the gear play, axis 6 on page 209 to pass the test.
11 Perform a leak-down test.	Detailed in section Performing a leak-down test on page 243 .

Continues on next page

4.4.1 Replacing the wrist unit, IRB 1600

Continued

	Action	Note
12	Refill the wrist unit with oil.	Detailed in section Changing the oil in axes 5 and 6 gearboxes on page 115 .
13	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	<p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>
14	Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .
15	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

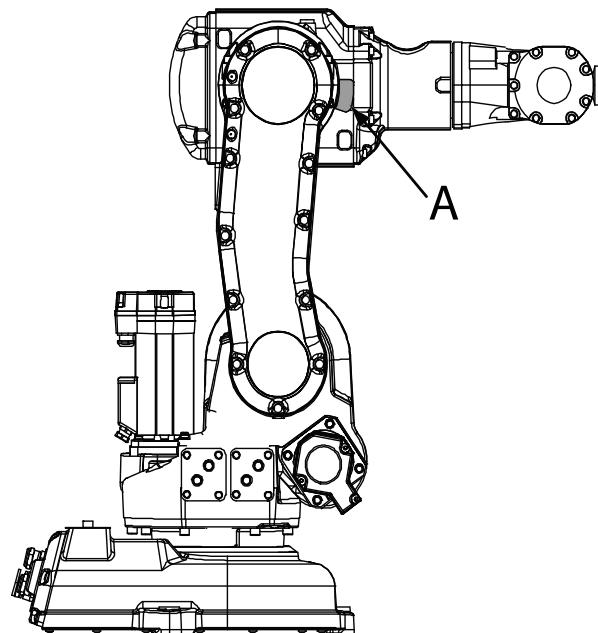
4 Repair

4.4.2 Replacing the damper, axis 3

4.4.2 Replacing the damper, axis 3

Location of damper, axis 3

A more detailed view of the components and its position may be found in *Spare part lists and exploded views*.



xx0200000427

A	Damper, axis 3
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Required equipment

Equipment, etc.	Art. no.	Note
Damper, axis 3	3HAC 7881-1	
Standard toolkit		Content is defined in section Standard tools on page 241 .

Removing the damper axis 3

Use this procedure to remove the damper.

	Action	Note
1	Run the robot to a position where it is best to enable access to the access 3 damper.	Shown in the figure Location of damper, axis 3 on page 152 .
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.	

Continues on next page

	Action	Note
3	Remove the damper by gently prying it from the cast tab.	

Refitting the damper axis 3

Use this procedure to refit the damper.

	Action	Note
1	Run the robot to a position where it is best to enable access to the location where the axis 3 damper is fitted.	Shown in the figure Location of damper, axis 3 on page 152 .
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	Refit the damper by gently pressing it onto the cast tab on the upper arm.	
4	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

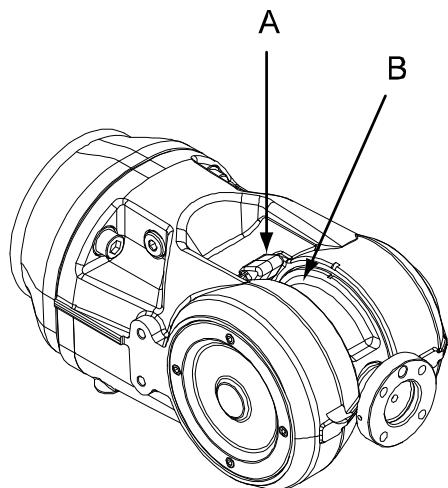
4 Repair

4.4.3 Replacement of damper, axis 5

4.4.3 Replacement of damper, axis 5

Location of damper, axis 5

The damper, axis 5, is located as shown in the figure below!



xx0600002806

A	Damper, axis 5
B	Recess

Required equipment

Equipment, etc.	Spare part no.	Note
Damper, axis 5	3HAB 8964-1	
Standard toolkit		Content is defined in section Standard tools on page 241 .

Removal, damper axis 5

The procedure below details how to remove the damper, axis 5.

	Action	Note
1	Run the robot to a position that enables the end of the <i>damper</i> to be pushed into the <i>recess</i> in the wrist unit.	Shown in the figure Location of damper, axis 5 on page 154 .
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	Unhook the end of the damper, and push it into the recess.	
4	Manually move the wrist (robot axis 5) away from the damper to pull it out.	

Continues on next page

Refitting, damper axis 5

The procedure below details how to refit the damper, axis 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	Push the end of the damper into the gap between the wrist unit and upper arm.	Make sure the damper is turned the correct way!
3	Manually move the wrist (robot axis 5) in order to pull the damper into position.	
4	Fold out the damper hooks to secure it in position.	
5	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48.</i>	

4 Repair

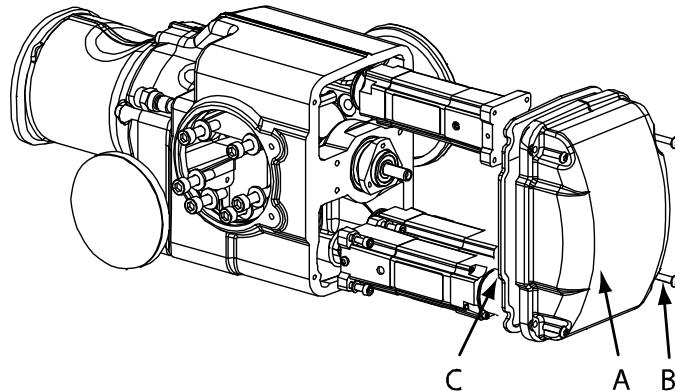
4.4.4 Replacement of cover, arm housing

4.4.4 Replacement of cover, arm housing

Location of cover, armhousing

The cover, armhousing is located on the rear of the upper arm as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000464

A	Cover, arm housing
B	Attachment screws, cover, armhousing
C	Gasket, upper arm cover

Required equipment

Equipment, etc.	Spare part. no.	Art. no.	Note
Cover, arm housing	3HAC 10473-1		Standard and Foundry version Includes gasket 3HAC 7867-1
Cover, arm housing	3HAC 10473-3		Clean Room versions Includes gasket 3HAC 7867-1
Gasket, upper arm cover		3HAC 7867-1	
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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

Removal

The procedure below details how to remove the cover, armhousing.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

	Action	Note
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Manually, run the robot to a position that enables access to the rear of the upper arm.	
3	Remove the <i>cover, armhousing</i> by unscrewing its attachment screws.	Shown in the figure Location of cover, armhousing on page 156 . NOTE! Do not damage the gasket inside the cover!

Refitting

The procedure below details how to refit cover, armhousing.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2	Manually, run the robot to a position that enables access to the rear of the upper arm.	Shown in the figure Location of cover, armhousing on page 156 .

Continues on next page

4 Repair

4.4.4 Replacement of cover, arm housing

Continued

Action	Note
3 Make sure the gasket inside the <i>cover, arm housing</i> has not been damaged.	Replace if damaged. Shown in the figure Location of cover, armhousing on page 156 .
4 Secure the cover, arm housing to the upper arm with its attachment screws.	
5 Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

4.5.1 Replacement of lower arm cover and gasket

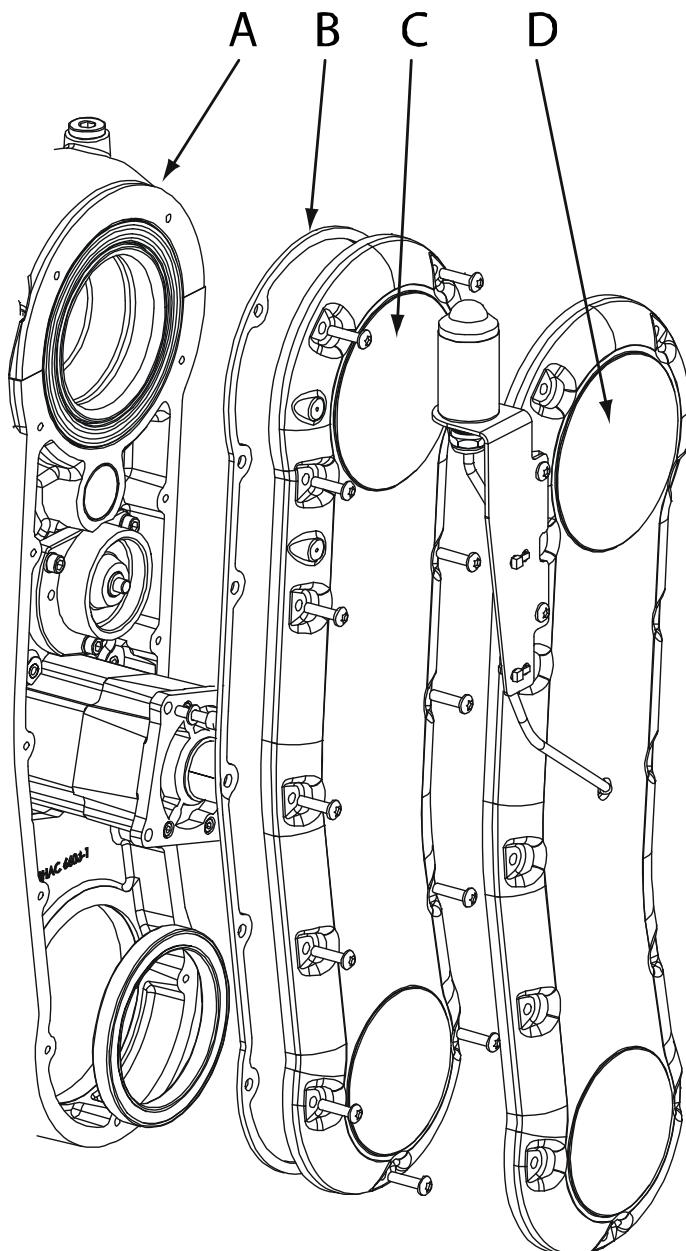
4.5 Lower arm

4.5.1 Replacement of lower arm cover and gasket

Location of lower arm cover and gasket

The lower arm cover and gasket are located as shown in the figure below.

A more detailed view of the components and its position may be found in section [Spare part lists on page 245](#).



xx0200000433

A	Lower arm
B	Gasket lower-arm cover

Continues on next page

4 Repair

4.5.1 Replacement of lower arm cover and gasket

Continued

C	Cover l. arm, spare (without lamp unit)
D	Cover l. arm, spare (with lamp unit)

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Lower arm	For spare part number, see: • Spare part lists on page 245 .		
Cover, lower arm, spare, Std/F	3HAC 10471-1		Standard and Foundry versions No lamp unit included Includes gasket 3HAC 7869-1
Cover, lower arm, spare, CR	3HAC 10471-3		Clean room versions No lamp unit included Includes gasket 3HAC 7869-1
Gasket lower-arm cover	3HAC 7869-1		
Isopropanol		1177 1012-208	For cleaning sealing surfaces
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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, lower arm cover and gasket

The procedure below details how to remove the lower arm cover and gasket.



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Continues on next page

4.5.1 Replacement of lower arm cover and gasket

Continued

Action	Note
1  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2 Remove the <i>lower arm cover</i> by unscrewing its attachment screws.	Shown in the figure Location of lower arm cover and gasket on page 159 .
3 If the gasket is to be replaced, proceed below! Use a knife to gently remove the old gasket from the cover.	
4 Clean the sealing surface with <i>isopropanol</i> , making sure it is completely clean and free from scratches and burrs.	Art. no. specified in section Required equipment on page 160 .

Refitting, lower arm cover and gasket

The procedure below details how to refit the lower arm cover and gasket.

**WARNING**

Please observe the following before commencing any repair work on the manipulator:

- - Motors and gears are *HOT* after running the robot! Burns may result from touching the motors or gears!
- - Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!
- - Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, e.g. to secure the lower arm with fixtures if removing motor, axis 2.

Action	Note
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2 If the <i>Gasket lower-arm cover</i> is to be replaced, proceed below. If not, see further down!	Shown in the figure Location of lower arm cover and gasket on page 159 .
3 Remove the protective backing from the self-adhesive gasket and fit it onto the cover sealing surface.	Make absolutely sure it is correctly located!
4 Refit the <i>lower arm cover</i> with its attachment screws.	Shown in the figure Location of lower arm cover and gasket on page 159 .

Continues on next page

4 Repair

4.5.1 Replacement of lower arm cover and gasket

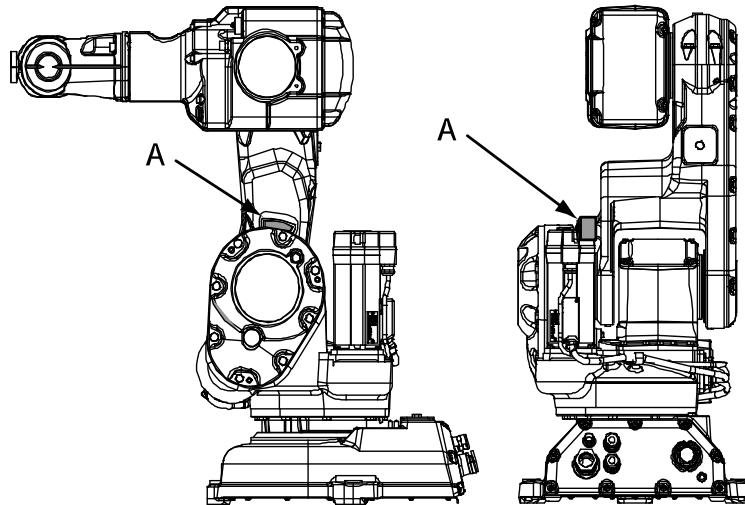
Continued

Action	Note
5 Clean Room robots: seal and paint the joints that have been opened. See <i>Replacing parts on the robot on page 124</i>  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

4.5.2 Replacing the damper, axis 2

Location of damper, axis 2

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000426

A	Damper, axis 2
---	----------------

Required equipment

Equipment, etc.	Art. no.	Note
Damper, axis 2	3HAC 7880-1	
Standard toolkit	-	Content is defined in section Standard tools on page 241 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Removing the damper

Use this procedure to remove the damper.

	Action	Note
1	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Run the robot to a position where it is best to enable access to the attachment screw of the damper.	

Continues on next page

4 Repair

4.5.2 Replacing the damper, axis 2

Continued

Action	Note
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 damper by unscrewing the attachment screw and washer.	

Refitting the damper

Use this procedure to refit the damper.

Action	Note
1 Run the robot to a position where it is best to enable access to the attachment screw of the damper.	
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 Secure the damper with the attachment screw and washer.	1 pc: M6 x 16.
4  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 48.</i>	

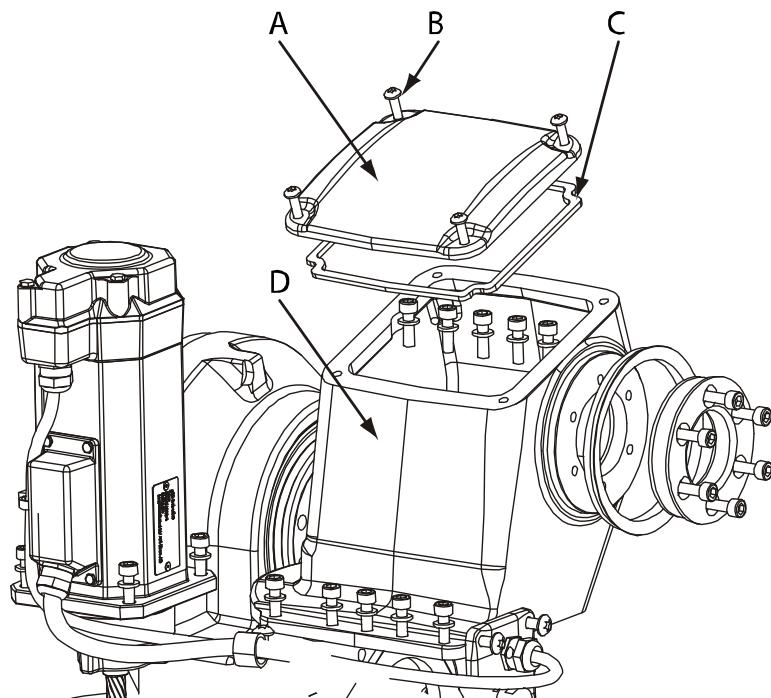
4.6 Frame and base

4.6.1 Replacement of cover, console

Location of cover, console

The cover, console is located on top of the console as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000462

A	Cover, console
B	Attachment screws, cover, console (4 pcs)
C	Gasket
D	Console

Required equipment

Equipment, etc.	Spare part. no.	Art. no.	Note
Cover, console, spare	3HAC 10472-1		Standard and Foundry version Includes gasket 3HAC 7868-1
Cover, console, spare	3HAC 10472-3		Clean Room versions Includes gasket 3HAC 7868-1
Gasket, cover console		3HAC 7868-1	

Continues on next page

4 Repair

4.6.1 Replacement of cover, console

Continued

Equipment, etc.	Spare part. no.	Art. no.	Note
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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

The procedure below details how to remove the cover, console.



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Action	Note
1 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2 Manually, run the robot to a position that enables access to the top of the <i>console</i> .	Shown in the figure Location of cover, console on page 165 .
3 Remove the <i>cover, console</i> by unscrewing its attachment screws.	NOTE! Do not damage the gasket inside the cover!

Continues on next page

Refitting

The procedure below details how to refit cover, console.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2	Manually, run the robot to a position that enables access to the top of the <i>console</i> .	Shown in the figure Location of cover, console on page 165 .
3	Make sure the gasket inside the <i>cover, console</i> has not been damaged.	Replace if damaged. Shown in the figure Location of cover, console on page 165 .
4	Secure the cover, console to the console with its attachment screws.	
5	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

4 Repair

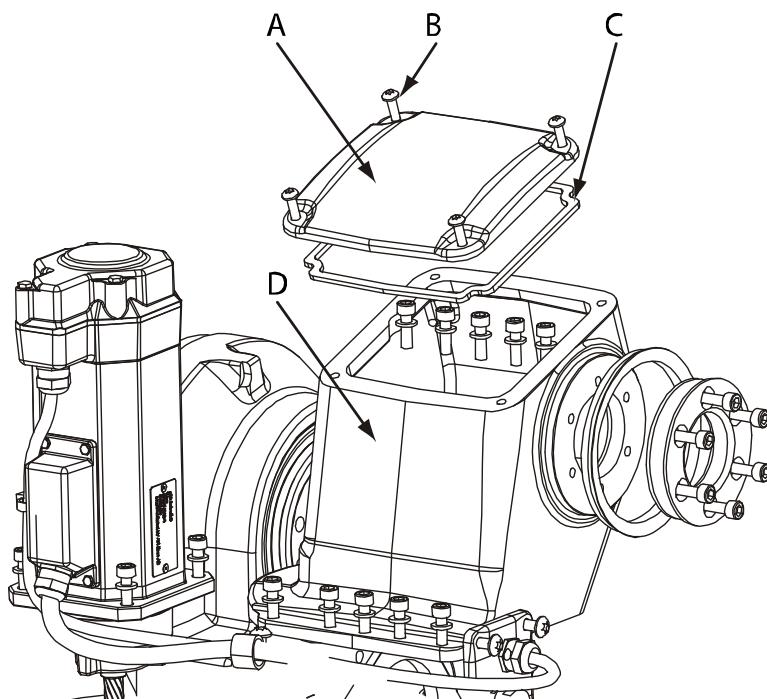
4.6.2 Replacement of console

4.6.2 Replacement of console

Location of console

The console is located on top of gearbox, axes 1-2 as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000462

A	Cover, console
B	Attachment screws, cover, console (4 pcs)
C	Gasket
D	Console

Required equipment

Equipment, etc.	Spare part. no.	Art. no.	Note
Console, spare	3HAC 10478-1		Standard and Foundry version
Console, spare	3HAC 10478-3		Clean Room versions
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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

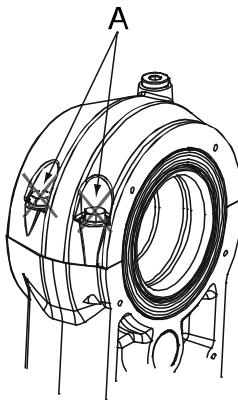
Removal

The procedure below details how to remove the cover, console.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

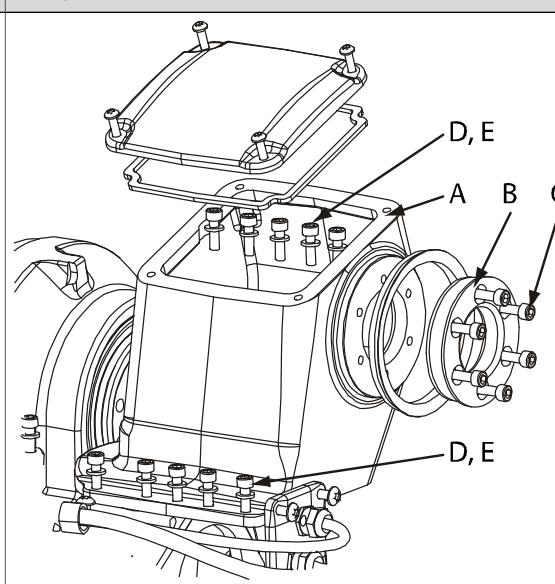
	Action	Note/Illustration
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Remove the cable harness.	Detailed in section Replacement of cable harness on page 126 .
3	Remove the serial measurement board.	Detailed in section Replacing the serial measurement unit and the battery pack on page 172 .
4	Remove the complete upper arm.	Detailed in section Replacement of complete upper arm on page 134 .
5	DO NOT under any circumstance unscrew the six screws on top of the lower arm! Doing so will cause the manipulator to require a complete rebuild!	 xx0300000101 Parts: <ul style="list-style-type: none"> • A: DO NOT touch these screws! (Note! Only two screws shown!)
6	Remove the motor of axis 3.	Detailed in section Replacement of motor and timing belt, axis 3 on page 191 .
7	Attach the lifting device to the lower arm.	

Continues on next page

4 Repair

4.6.2 Replacement of console

Continued

Action	Note/Illustration
8 Remove the bearing hub by unscrewing its attachment screws.	 <p>xx0300000096</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Console • B: Bearing hub • C: Bearing hub attachment screws (6 pcs) • D: Console attachment screws (10 pcs) • E: Washers (10 pcs)
9 Remove the <i>console</i> by unscrewing its <i>attachment screws</i> .	Shown in the figure above!

Refitting

The procedure below details how to refit cover, console.



WARNING

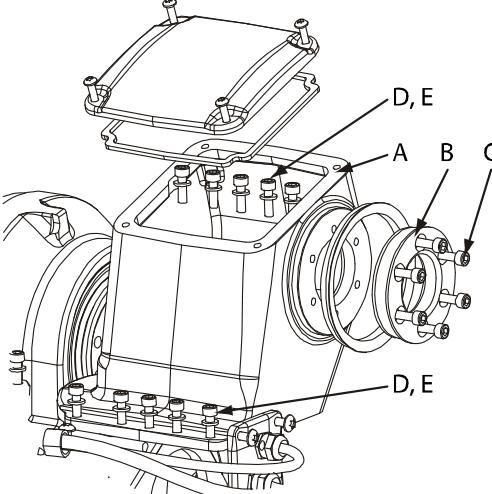
Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Action	Note/Illustration
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	

Continues on next page

4.6.2 Replacement of console Continued

Action	Note/Illustration
2 Refit the console and secure it with its attachment screws and washers.	 <p>xx0300000096</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Console • B: Bearing hub • C: Bearing hub attachment screws (6 pcs) • D: Console attachment screws (10 pcs) • E: Washers (10 pcs) <p>Tightening torque: 11 Nm ± 1 Nm</p>
3 Refit the <i>bearing hub</i> and secure it with its <i>attachment screws</i> .	Shown in the figure above! Tightening torque: 15 Nm ± 1 Nm
4 Refit the complete upper arm.	Detailed in section Replacement of complete upper arm on page 134 .
5 Refit motor 3 and timing belt.	Detailed in section Replacement of motor and timing belt, axis 3 on page 191 .
6 Refit the serial measurement board.	Detailed in section Replacing the serial measurement unit and the battery pack on page 172 .
7 Refit the cable harness.	Detailed in section Replacement of cable harness on page 126 .
8 Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	
<p> Note</p> <p>After all repair work, wipe the robot free from particles with spirit on a lint free cloth.</p>	
9 Recalibrate the robot!	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .

4 Repair

4.6.3 Replacing the serial measurement unit and the battery pack



Note

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

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

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



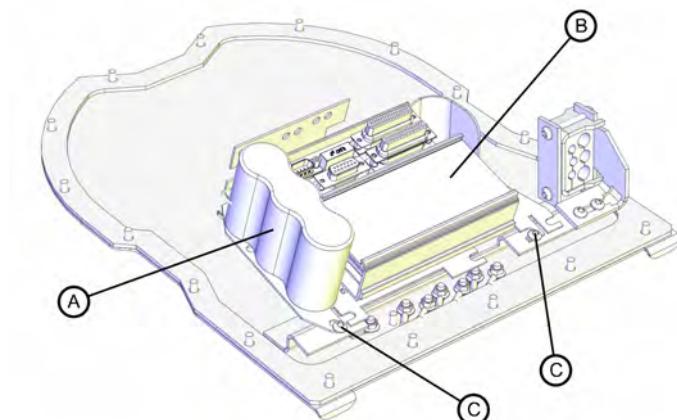
WARNING

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

Location of serial measurement unit and battery pack

The serial measurement unit and battery pack are located inside the manipulator base as shown in the figure below (different layouts are shown).

DSQC 633A



xx1200000831

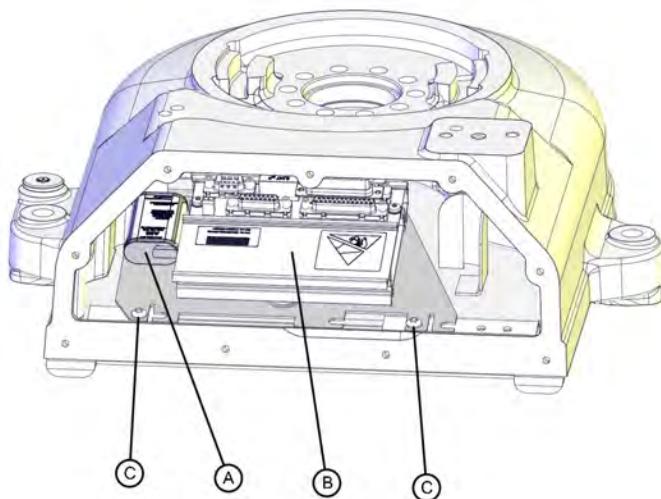
A	Battery pack with 2-pole battery contact
B	Serial measurement board (SMB), DSQC 633A
C	SMB attachment screws (2 pcs)

Continues on next page

4.6.3 Replacing the serial measurement unit and the battery pack

Continued

RMU101



xx1300000279

A	Battery pack RMU with 3-pole battery contact
B	Serial measurement board (SMB), RMU 101
C	Attachment screws (2 pcs)

Required equipment

All spare parts are listed in *Spare parts in Product manual, spare parts - IRB 1600/1660*.

**Note**

There are different variants of SMB units and batteries. The variant with the 3-pole battery contact has longer lifetime for the battery.

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

Equipment, etc.	Note
Serial measurement unit	See <i>Spare parts in Product manual, spare parts - IRB 1600/1660</i> .
Battery pack	See <i>Spare parts in Product manual, spare parts - IRB 1600/1660</i> .
Cable tie	Indoors
Gasket base-cover	Replace only if required!
Standard toolkit, IRB 140	Content is defined in section Standard tools on page 241 .
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 247 .

Continues on next page

4 Repair

4.6.3 Replacing the serial measurement unit and the battery pack

Continued

Removal

The procedure below details how to remove the serial measurement unit and battery pack.



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.



DANGER

Follow these instruction to prevent the unit to be damaged from ESD:

- The unit is sensitive to electrostatic discharge. It will be destroyed if subjected to electrostatic voltages.
- Before handling, make sure you are grounded through a special ESD wrist bracelet or similar.



CAUTION

This component is classified as hazardous waste and must be disposed of accordingly!

If in doubt of the correct disposal procedure, please contact your local environmental authority!



CAUTION

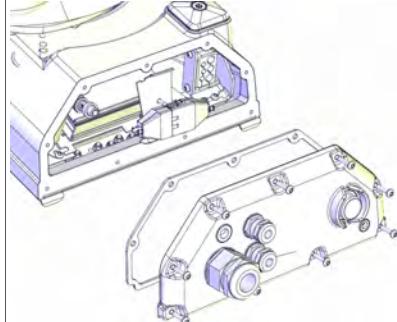
The cable packs are sensitive to mechanical damage! They must be handled with care, especially the connectors, in order to avoid damaging them!

	Action	Note
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See <i>Replacing parts on the robot on page 124</i>	
2	Set the robot system to MOTORS OFF state.	This will simplify calibration of the robot after replacement since no coarse calibration will be required.

Continues on next page

4.6.3 Replacing the serial measurement unit and the battery pack

Continued

Action	Note
3 Remove the <i>rear cable cover</i> from the base of the robot by unscrewing its attachment screws.	 xx1200000830
4 Remove the <i>serial measurement unit</i> by unscrewing its attachment screws. The removal is simplified by pushing the unit to the side and then pulling it backwards.	Shown in the figure Location of serial measurement unit and battery pack on page 172!
5 If only the battery is to be replaced, disconnect the cables to the battery only! Disconnect all connectors from the serial measurement unit.	Connectors <ul style="list-style-type: none">• R2.SMB• R2.FB1-3• R2.FB4-6• R2.G
6 Lift the board out.	
7 If the battery pack is to be replaced, proceed below! Cut the cable tie and disconnect the battery connector to remove the <i>battery pack</i> . Battery includes protection circuits. Replace it only with the specified spare part in the refitting instruction or with an ABB approved equivalent.	Shown in the figure Location of serial measurement unit and battery pack on page 172!

Refitting

The procedure below details how to refit the serial measurement unit and battery pack.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Continues on next page

4 Repair

4.6.3 Replacing the serial measurement unit and the battery pack

Continued



DANGER

Follow these instruction to prevent the unit to be damaged from ESD:

- The unit is sensitive to electrostatic discharge. It will be destroyed if subjected to electrostatic voltages.
- Before handling, make sure you are grounded through a special ESD wrist bracelet or similar.



CAUTION

This component is classified as Hazardous waste and must be disposed of accordingly!

If in doubt of the correct disposal procedure, please contact your local environmental authority!



CAUTION

The cable packs are sensitive to mechanical damage! They must be handled with care, especially the connectors, in order to avoid damaging them!

	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2	Connect the new battery pack to the serial measurement unit and secure it with a cable tie.	
3	Reconnect all connectors to the unit.	Connectors <ul style="list-style-type: none">• R2.SMB• R2.FB1-3• R2.FB4-6• R2.G
4	Place the serial measurement unit <i>in position inside the manipulator base</i> and secure it with its four attachment screws.	Shown in the figure Location of serial measurement unit and battery pack on page 172!
5	Make sure the gasket sealing the <i>rear cable cover</i> has not been damaged. Replace the gasket if required.	Shown in the figure Location of serial measurement unit and battery pack on page 172! Art. no. specified in section Required equipment on page 173!
6	Making sure all cables are correctly located behind the <i>rear cable cover</i> , refit it into position. Make sure no cables or other equipment fitted behind the cover get pinched by the cover.	Shown in the figure Location of serial measurement unit and battery pack on page 172!
7	Secure the rear cable cover to the base of the robot with its attachment screws.	Shown in the figure Location of serial measurement unit and battery pack on page 172!

Continues on next page

4.6.3 Replacing the serial measurement unit and the battery pack

Continued

	Action	Note
8	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
9	Recalibrate the robot!	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .

4 Repair

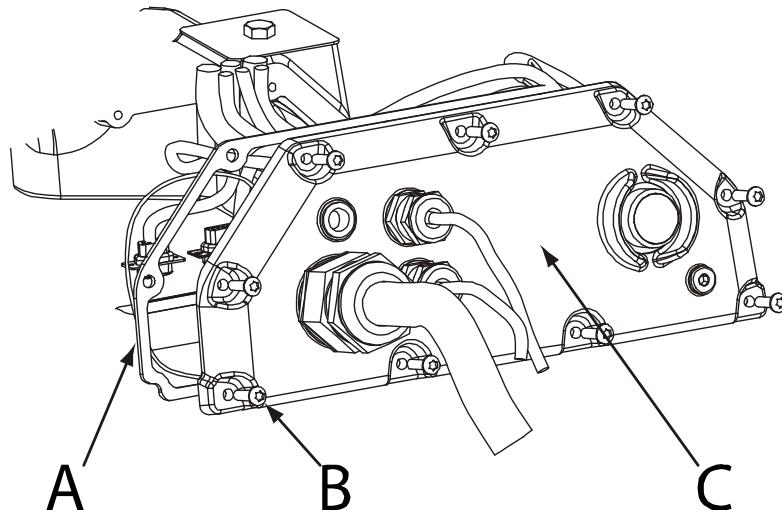
4.6.4 Replacement of control cable

4.6.4 Replacement of control cable

Location of control cable

The control cable is located on the rear of the manipulator base as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



A	Gasket, base-cover
B	Attachment screws and washers (9 pcs each), control cable
C	Control cable, spare

Required equipment

Equipment, etc.	Spare part. no.	Art. no.	Note
Control cable, spare	3HAC 10476-1		3 m Standard and Foundry versions Cover gasket included
Control cable, spare	3HAC 10477-1		7 m Standard and Foundry versions Cover gasket included
Control cable, spare	3HAC 11331-1		15 m Standard and Foundry versions Cover gasket included
Control cable, spare	3HAC 13090-1		22 m Standard and Foundry versions Cover gasket included

Continues on next page

Equipment, etc.	Spare part. no.	Art. no.	Note
Control cable, spare	3HAC 13089-1		30 m Standard and Foundry versions Cover gasket included
Control cable, spare	3HAC 10476-4		3 m Clean Room versions Cover gasket included
Control cable, spare	3HAC 10477-2		7 m Clean Room versions Cover gasket included
Control cable, spare	3HAC 11331-2		15 m Clean Room versions Cover gasket included
Control cable, spare	3HAC 13090-2		22 m Clean Room versions Cover gasket included
Control cable, spare	3HAC 13089-2		30 m Clean Room versions Cover gasket included
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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

The procedure below details how to remove the control cable.



WARNING

Please observe the following before doing any repair work on the manipulator:

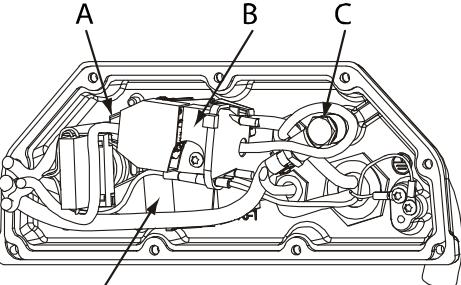
- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Continues on next page

4 Repair

4.6.4 Replacement of control cable

Continued

	Action	Note
1	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Make sure the robot system has been switched off, and that no power is supplied to the manipulator.	
3	Remove the <i>Control cable, spare</i> by unscrewing its attachment screws.	Shown in the figure Location of control cable on page 178 . Make sure the gasket does not get damaged!
4	Disconnect connectors inside the manipulator base.	 xx0300000090 Connectors: <ul style="list-style-type: none"> • A: R1.MP1-3 • B: R1.CS • C: Air hose • D: R1.MP4-6
5	Pull the cable out of the manipulator base.	
6	Disconnect the connectors from the control cabinet.	

Refitting

The procedure below details how to refit control cable.



WARNING

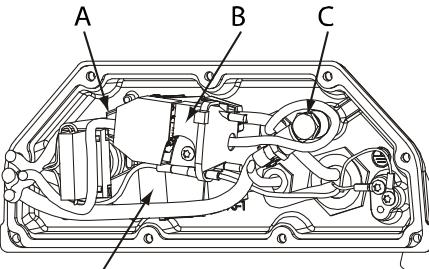
Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Continues on next page

4.6.4 Replacement of control cable

Continued

	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2	Place the <i>control cable</i> on the floor with the manipulator base cover close to the manipulator.	Shown in the figure Location of control cable on page 178 .
3	Connect the connectors inside the manipulators base.	 <p>xx0300000090</p> <p>Connectors:</p> <ul style="list-style-type: none"> • A: R1.MP1-3 • B: R1.CS • C: Air hose • D: R1.MP4-6
4	Fit a <i>new gasket</i> when refitting the cover.	Included in the spare part
5	Fit the cover onto the manipulator base and secure it with its attachment screws.	Shown in the figure Location of control cable on page 178 .
6	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	
	 Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

4 Repair

4.7.1 Replacement of motor, axis 1

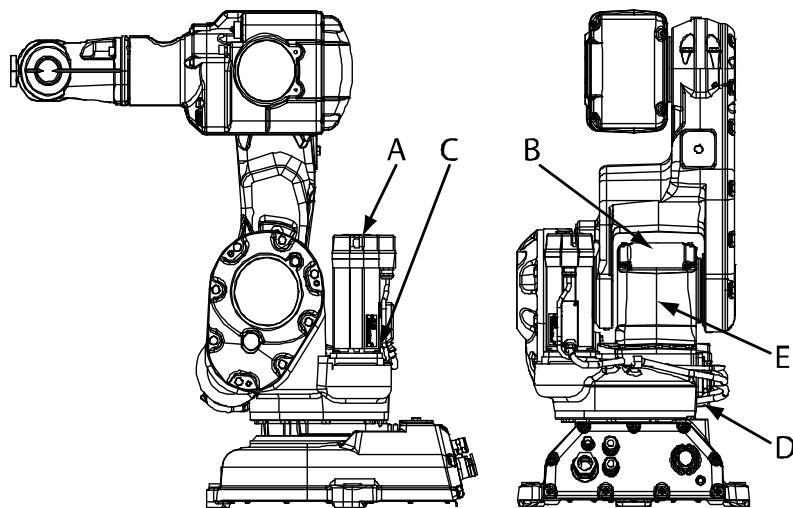
4.7 Motors

4.7.1 Replacement of motor, axis 1

Location of motor axis 1

The motor axis 1 is located on the rear of the manipulator as shown in the figure below:

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000407

A	Motor, axis 1
B	Cover for connector access
C	Motor attachment screws (4 pcs)
D	Cable gland attachment screws (4 pcs)
E	Console

Required equipment

Equipment, etc.	Art no.	Note
Rot. ac motor with pinion	For spare part number, see: • Spare part lists on page 245 .	
O-ring	21522012-426	Must be replaced when replacing motor! Included in the spare parts motor kits
Grease	3HAB3537-1	Used to lubricate the o-ring
Standard toolkit	3HAC020812-001	Content is defined in section Stand- ard tools on page 241 .
Arm	3HAC9037-1	For adjusting the gear play, motor/pin- ion

Continues on next page

Equipment, etc.	Art no.	Note
Power supply		24 VDC, max. 1,5 A For releasing the brakes
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 247 .

Removal

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



CAUTION

If the manipulator normally works in an inverted position, it must be removed from this position and placed on the floor before the work detailed in this instruction may be carried out!



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.



Note

Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

	Action	Note
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Remove the cover for connector access on top of the motor by unscrewing its four attachment screws.	Shown in the figure Location of motor axis 1 on page 182 . Detailed in section Replacement of cover, console on page 165 .

Continues on next page

4 Repair

4.7.1 Replacement of motor, axis 1

Continued

Action	Note
3 Disconnect the motor 1 connectors inside the console.	Connectors: <ul style="list-style-type: none">• R3.MP1• R3.FB1
4 Cut any cable ties and remove any brackets securing the cables.	
5 Remove the cable gland by removing its attachment screws, and pull the cables out from the console.	Shown in the figure Location of motor axis 1 on page 182 .
6 In order to release the brakes, connect the 24 VDC power supply:	Connect to connector R3.MP1 <ul style="list-style-type: none">• +: pin 7• -: pin 8
7 Remove the motor by unscrewing its four attachment screws and plain washers.	Shown in the figure Location of motor axis 1 on page 182 .
8 Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
9 Remove the motor by gently lifting it straight up.	

Refitting

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



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.



Note

Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

Action	Note
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2 Make sure the mating surfaces on the motor and the gearbox are clean and free from burrs.	
3 Make sure the <i>o-ring</i> on the circumference of the motor is seated properly. Lightly lubricate the <i>o-ring</i> with grease.	Art. no. is specified in section Required equipment on page 182 .
4 In order to release the brake, connect the 24 VDC power supply:	Connect to connector R2.MP1 <ul style="list-style-type: none">• +: pin 7• -: pin 8

Continues on next page

4.7.1 Replacement of motor, axis 1

Continued

	Action	Note
5	Fit the motor, making sure the motor pinion is properly mated to gearbox 1.	Make sure the motor is turned the right way, i.e. connections rearwards. Make sure the motor pinion does not get damaged!
6	Fit the motor with four attachment screws and plain washers.	Tightening torque: approx 2 Nm
7	Fit the Arm to the end of the motor shaft.	Art. no. is specified in section Required equipment on page 182 .
8	Adjust the motor in relation to the gear in the gearbox. Use the Arm tool to wiggle the motor shaft back and forth to feel the play.	There should be a barely noticeable gear play.
9	Tighten the motor attachment screws.	Tightening torque: approx 11 Nm ± 1 Nm
10	Disconnect the brake release voltage.	
11	Make sure the <i>cable gland gasket</i> has not been damaged. Replace, if it has.	Art. no. is specified in section Required equipment on page 182 .
12	Push the cables into the console, and refit the cable gland with its attachment screws.	
13	Perform a <i>leak-down test</i> .	Detailed in section Performing a leak-down test on page 243 .
14	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
15	Recalibrate the robot!	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .

4 Repair

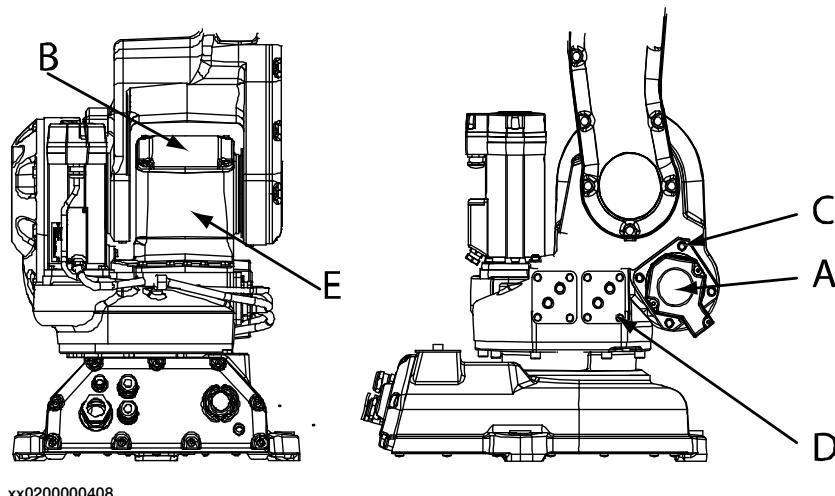
4.7.2 Replacement of motor, axis 2

4.7.2 Replacement of motor, axis 2

Location of motor axis 2

The motor axis 2 is located on the front of the robot as shown in the figure.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



A	Motor, axis 2
B	Cover for connector access
C	Motor attachment screws (4 pcs)
D	Cable gland attachment screws (4 pcs)
E	Console

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Rot. ac motor with pinion		For spare part number, see: • Spare part lists on page 245	
O-ring	21522012-426	21522012-426	Must be replaced when replacing motor.
Grease	3HAB3537-1	3HAB3537-1	For lubricating the o-ring.
Isopropanol	-	-	For cleaning mating surfaces.
Standard toolkit		-	Content is defined in section Standard tools on page 241 .
Rotation tool, motor	3HAC9037-1	3HAC9037-1	For adjusting the gear play, motor/pinion
Power supply		-	24 VDC, 1.5 A. For releasing the brakes.

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.
Circuit diagram		-	See chapter <i>Circuit diagram on page 247</i> .

Deciding calibration routine

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

	Action	Note
1	<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 Pendulum Calibration in <i>Operating manual - Calibration Pendulum</i>.</p>
	<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal, motor axis 2

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

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

Continues on next page

4 Repair

4.7.2 Replacement of motor, axis 2

Continued

	Action	Note
3	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
4	Remove the <i>cover for connector access</i> on top of the motor by unscrewing its four attachment screws.	Shown in the figure Location of motor axis 2 on page 186 .
5	Disconnect the motor connectors inside the console.	Connectors: <ul style="list-style-type: none"> • R3.MP2 • R3.FB2
6	Cut any cable ties and remove any brackets or clamps securing the cables.	
7	Remove the cable gland by removing its <i>attachment screws</i> , and pull the cables out from the console.	Shown in the figure Location of motor axis 2 on page 186 .
8	 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!	
9	In order to release the brakes, connect the 24 VDC power supply to the motor.	Connect to connector R3.MP2 <ul style="list-style-type: none"> • +: pin 7 • -: pin 8
10	 WARNING Oil will be running out of the motor attachment hole when removing the motor! It may also be hot! Take any necessary measures to collect the oil.	
11	Remove the motor by unscrewing its four <i>attachment screws</i> and plain washers.	Shown in the figure Location of motor axis 2 on page 186 .
12	Remove the motor by gently pulling it out, making sure the motor pinion does not get damaged while moving it away from the gear.	
13	Disconnect the brake release voltage.	
14	Remove any remaining oil from the gearbox by siphoning it off.	

Refitting, motor axis 2

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

	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	

Continues on next page

4.7.2 Replacement of motor, axis 2

Continued

	Action	Note
2	Make sure the mating surfaces on the motor and the gearbox are clean and free from burrs. If necessary, clean the surfaces with isopropanol.	
3	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 section Required equipment on page 186 .
4	In order to release the brakes, connect the 24 VDC power supply to the motor.	Connect to connector R3.MP2: • +: pin 7 • -: pin 8
5	Remove the <i>motor cover</i> from top of the motor.	Shown in the figure Location of motor axis 2 on page 186 .
6	Fit the <i>rotation tool</i> to the end of the motor shaft.	Art. no. is specified in section Required equipment on page 186 .
7	Fit the motor, making sure the motor pinion is properly mated to gearbox 2. Use the rotation tool to rotate the motor pinion, when mating it to the gear.	Make sure the motor is turned the right way, i.e. connections rearwards. Make sure the motor pinion does not get damaged!
8	Secure the motor with four attachment screws and plain washers, but do not tighten yet.	Tightening torque: approx 2 Nm.
9	Adjust the motor in relation to the gear in the gearbox. Use the rotation tool to wiggle the motor shaft back and forth to feel the play. Tap with a plastic mallet.	There should be a barely noticeable gear play.
10	Refit the motor cover to the top of the motor. Be careful not to damage the cables!	
11	Tighten the motor attachment screws.	Tightening torque: approx 11 Nm ± 1 Nm
12	Disconnect the brake release voltage.	
13	Make sure the <i>cable gland cover gasket</i> has not been damaged. Replace if it has.	Art. no. is specified in section Required equipment on page 186 .
14	Push the cables into the console, and refit the cable gland with its attachment screws.	
15	Refit all cable ties and brackets.	
16	Perform a leak-down test.	Detailed in section Performing a leak-down test on page 243 .
17	Refill the gearbox with oil.	Oil: Mobilgear 600 XP 320 Art.no: 11712016-604 Volume: 1000 ml
18	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

Continues on next page

4 Repair

4.7.2 Replacement of motor, axis 2

Continued

	Action	Note
19	Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .
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 48 .	

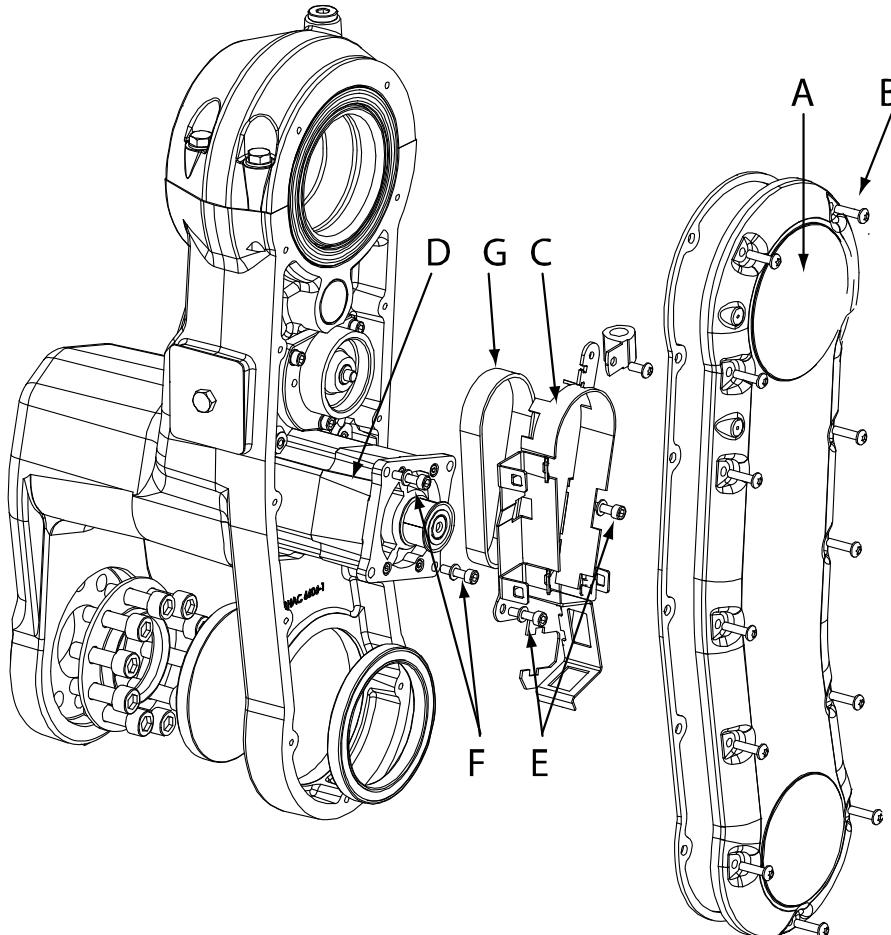
4.7.3 Replacement of motor and timing belt, axis 3

4.7.3 Replacement of motor and timing belt, axis 3

Location of motor axis 3

The motor axis 3 is located behind the lower arm cover on the right hand side of the manipulator as shown in the figure below.

For a more detailed view of the components and its position, see [Spare part lists on page 245](#).



xx0200000448

A	Lower arm cover
B	Attachment screws, lower arm cover (13 pcs)
C	Belt shield
D	Motor 3
E	Attachment screws, belt shield (3 pcs)
F	Attachment screws, motor 3 (4 pcs)
G	Belt

Continues on next page

4 Repair

4.7.3 Replacement of motor and timing belt, axis 3

Continued

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Rotating AC motor with pinion	3HAC7866-1 3HAC021756-001		
Timing belt		3HAC6793-1	
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
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 247 .

Removing the motor, axis 3

Use this procedure to remove the motor, axis 3.



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.



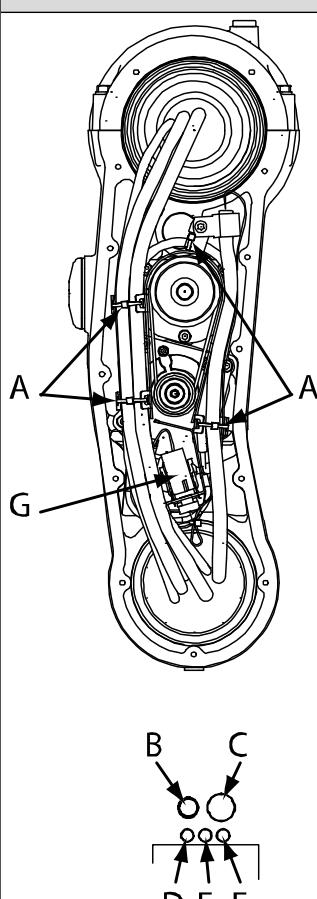
Note

Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

	Action	Note
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Remove any equipment hindering access to the <i>lower arm cover</i> .	Shown in the figure in section Location of motor axis 3 on page 191 .
3	Remove the lower arm cover by unscrewing its <i>attachment screws</i> .	Shown in the figure in section Location of motor axis 3 on page 191 .

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4.7.3 Replacement of motor and timing belt, axis 3
Continued

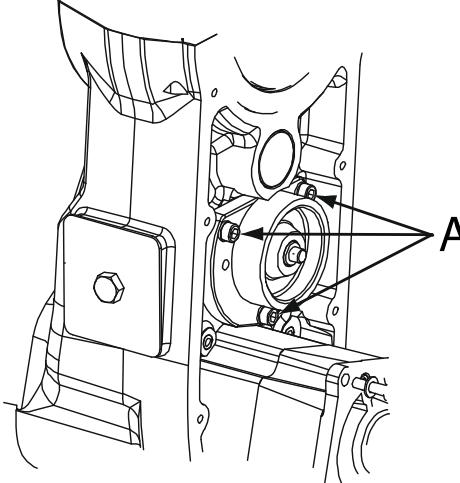
Action	Note
4 Cut the cable ties to simplify accessing the motor.	 xx0200000449 <ul style="list-style-type: none"> • A: Cable ties • B: Pressurized air hose • C: Power cables, axes 4, 5 and 6 • D: Customer cables, signal • E: Signal cables, axes 4, 5 and 6 • F: Signal cable, axis 3 • G: Connectors R3.MP3 and R3.FB3
5 Disconnect motor connectors.	Connectors: <ul style="list-style-type: none"> • R3.MP3 • R3.FB3 • R3.H1 (if Safety lamp is fitted) • R3.H2 (if Safety lamp is fitted)

Continues on next page

4 Repair

4.7.3 Replacement of motor and timing belt, axis 3

Continued

Action	Note
6 DO NOT under any circumstance unscrew the three screws securing the belt wheel! Doing so will cause the manipulator to require a complete rebuild!	 xx0300000102 <p>Parts:</p> <ul style="list-style-type: none"> DO NOT touch these screws! (3 pcs)
7 Remove the <i>belt shield</i> by unscrewing its two <i>attachment screws</i> .	Shown in the figure in section Location of motor axis 3 on page 191 .
8 Remove the remaining motor <i>attachment screws</i> .	Shown in the figure in section Location of motor axis 3 on page 191 .
9 Remove the belt.	Shown in the figure in section Location of motor axis 3 on page 191 .
10 Remove the <i>motor</i> .	Shown in the figure in section Location of motor axis 3 on page 191 .

Refitting the motor, axis 3

Use this procedure to refit the motor, axis 3.



WARNING

Please observe the following before doing any repair work on the manipulator:

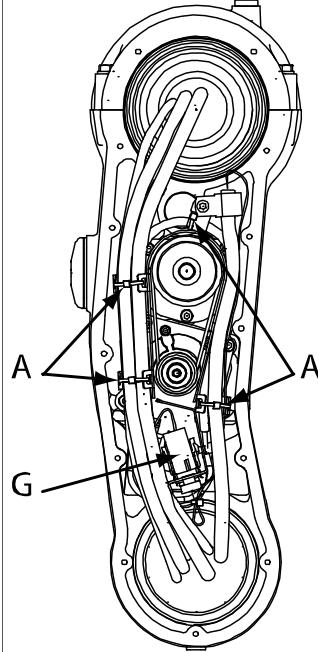
- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Action	Note
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2 Make sure the mating surfaces on the motor and the lower arm are clean and free from burrs.	

Continues on next page

4.7.3 Replacement of motor and timing belt, axis 3

Continued

	Action	Note
3	Fit the motor in the lower arm.	
4	Fit the <i>belt</i> .	Shown in the figure in section Location of motor axis 3 on page 191 .
5	Tighten the two motor attachment screws slightly, but <i>not</i> completely.	
6	Adjust the position of the motor in such a way that the correct belt tension is achieved.	Correct belt tension F=35 - 60 N
7	DO NOT adjust the belt tension using the intermediate wheel securing screws.	
8	Fit the belt shield and secure it with the two remaining screws.	Tightening torque: 4 Nm ± 0.5 Nm
9	Tighten the last motor attachment screws.	Tightening torque: 4 Nm ± 0.5 Nm
10	Refit the cabling as shown.	 <p>xx0200000449</p> <ul style="list-style-type: none"> • A: Cable ties • B: Pressurized air hose • C: Power cables, axes 4, 5 and 6 • D: Customer cables, signal • E: Signal cables, axes 4, 5 and 6 • F: Signal cable, axis 3 • G: Connectors R3.MP3 and R3.FB3

Continues on next page

4 Repair

4.7.3 Replacement of motor and timing belt, axis 3

Continued

Action	Note
11 Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
12 Recalibrate the robot!	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .

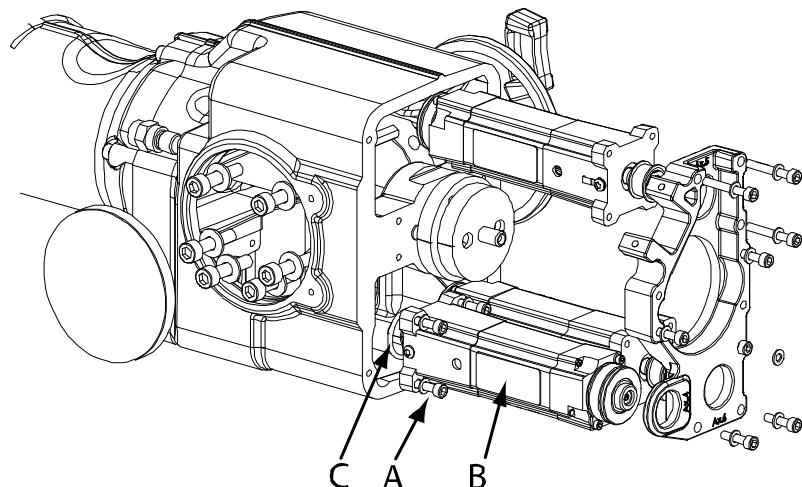
4.7.4 Replacement of motor, axis 4, IRB 1600

4.7.4 Replacement of motor, axis 4, IRB 1600

Location of motor

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

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0600003262

A	Attachment screws, motor 4 (3 pcs)
B	Motor, axis 4
C	O-ring

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Rot. ac motor with pinion	For spare part number, see: • Spare part lists on page 245		Does not include the o-ring!
O-ring		3HAC3772-24	Must be replaced when replacing motor!
Grease		3HAB3537-1	Used for lubricating the o-ring.
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
Power supply		-	24 VDC, max. 1,5 A. For releasing the brakes.
Rotation tool, motor		3HAC9037-1	For adjusting the gear play.

Continues on next page

4 Repair

4.7.4 Replacement of motor, axis 4, IRB 1600

Continued

Equipment, etc.	Spare part no.	Art. no.	Note
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter <i>Circuit diagram on page 247</i> .

Deciding calibration routine

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

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

Removal, motor axis 4

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

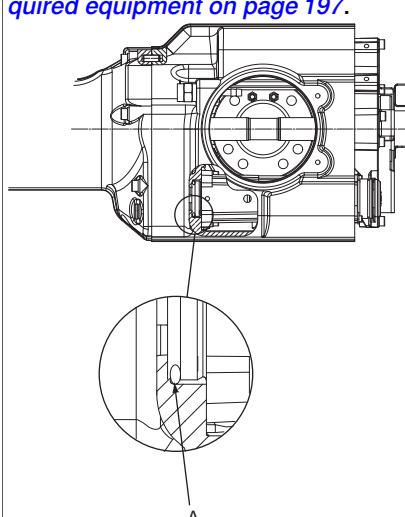
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply• air pressure supply to the robot, before entering the robot working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

Continues on next page

Action	Note
3  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
4 Manually move the robot to a position where the upper arm points straight down.	This will enable the motor 4 to be removed without draining the oil in the gearbox.
5 Remove the motors for axes 5 and 6.	Detailed in section Replacement of motor and timing belt, axes 5 or 6 on page 201 .
6 In order to release the brakes, connect the 24 VDC power supply to the motor.	Connect to connector R3.MP4 • +: pin 7 • -: pin 8
7 Remove the <i>motor, axis 4</i> by unscrewing the motor attachment screws.	Shown in the figure Location of motor on page 197 .
8 Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
9 Remove the motor by gently lifting it out.	Make sure the motor pinion is not damaged!
10 Remove the o-ring from the arm housing.	

Refitting, motor axis 4

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

Action	Note
1 Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2 Clean the mating surfaces on the <i>motor</i> and the gearbox.	Shown in the figure Location of motor on page 197 .
3 Lightly lubricate a new <i>o-ring</i> (A) and put it in the bottom of the machined hole of the arm housing.	Art. no. is specified in section Required equipment on page 197 .  xx1200000823

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4 Repair

4.7.4 Replacement of motor, axis 4, IRB 1600

Continued

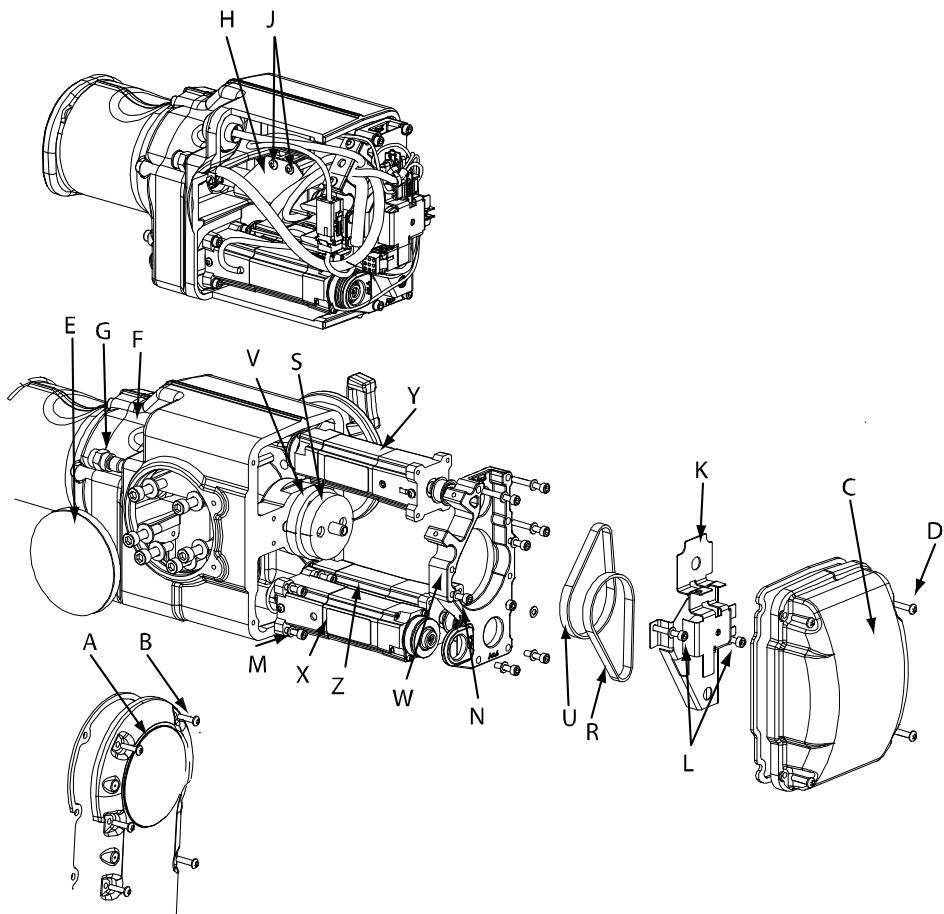
	Action	Note
4	In order to release the brakes, connect the 24 VDC power supply to the motor.	Connect to connector R3.MP4 <ul style="list-style-type: none"> • +: pin 7 • -: pin 8
5	Fit the motor with the attachment screws, compressing the o-ring in axial direction. Until the motor shaft is adjusted to the gear, as described in following steps, only tighten the screws lightly.	Shown in the figure Location of motor on page 197 . Tightening torque: approx. 2 Nm.
6	Fit the <i>rotational tool</i> to the end of the motor shaft.	Art. no. is specified in section Required equipment on page 197 .
7	Adjust the motor in relation to the gear in the gearbox. Use the arm tool to wiggle the motor shaft back and forth to feel the play.	There should be a barely noticeable gear play.
8	Tighten the motor <i>attachment screws</i> .	Shown in the figure Location of motor on page 197 . Tightening torque: 6 Nm ± 0.6 Nm.
9	Refit motors 5 and 6.	Detailed in section Replacement of motor and timing belt, axes 5 or 6 on page 201 .
10	Perform a leak-down test.	Detailed in section Performing a leak-down test on page 243 .
11	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	
	 Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
12	Recalibrate the robot!	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .
13	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 48 .	

4.7.5 Replacement of motor and timing belt, axes 5 or 6

4.7.5 Replacement of motor and timing belt, axes 5 or 6**Location of motor and timing belt, axes 5 or 6**

The motor and timing belt axes 5 or 6 are located in the rear of the upper arm as shown in the figure below.

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0600003261

A	Lower arm cover
B	Attachment screws, lower arm cover
C	Cover, armhousing
D	Attachment screws, cover armhousing (4 pcs)
E	VK cover
F	Pressurized air hose (on front of upper arm)
G	CS connector
H	Cable guide
J	Attachment screws, cable guide

Continues on next page

4 Repair

4.7.5 Replacement of motor and timing belt, axes 5 or 6

Continued

K	Belt shield
L	Attachment screws, belt shield
M	Motor attachment screws, 4 pcs per motor
N	Attachment screws, motor console
R	Timing belt, axis 6
S	Pulley, axis 6
U	Timing belt, axis 5
V	Pulley, axis 5
W	Motor console, ax. 5-6
X	Motor, axis 4
Y	Motor, axis 5
Z	Motor, axis 6

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Rot. ac motor with pinion	3HAC021757-001		Axis 4 Standard, Clean room and Foundry versions
Rot. ac motor with pinion	3HAC021758-001		Axes 5 and 6 Standard, Clean room and Foundry versions
Timing belt	3HAC6779-1		Axes 5 and 6
VK cover		3HAA2166-13	
Standard toolkit		3HAC020812-001	Content is defined in section Standard tools on page 241 .
Special socket 30 mm			For fitting the CS-connector
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		3HAC6816-3	See chapter Circuit diagram on page 247 .
Sonic Tension Meter			Model 505C

Continues on next page

Removal

The procedure below details how to remove motor, axis 5 or 6.

**WARNING**

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

**Note**

Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

	Action	Note
1	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See Replacing parts on the robot on page 124	
2	Run the robot to a position where the upper arm is close to horizontal	
3	Remove the <i>lower arm cover</i> by unscrewing its attachment screws.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201 !
4	Remove the <i>rear cover armhousing</i> by unscrewing its four attachment screws.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201 !
5	Disconnect all cables to/from motors 4-6.	Connectors: • R3.MP4 • R3.MP5 • R3.MP6 • R3.FB4 • R3.FB5 • R3.FB6
6	Disconnect any connector from the CS-connector.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201 !
7	Use a <i>special socket</i> to remove the CS-connector from the housing and pull it into the upper arm assembly.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201 ! Art. no. specified in section Required equipment on page 202

Continues on next page

4 Repair

4.7.5 Replacement of motor and timing belt, axes 5 or 6

Continued

	Action	Note
8	Remove the <i>pressurized air connector</i> from the housing and pull it into the upper arm assembly.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Art. no. specified in section Required equipment on page 202!
9	Remove the <i>VK-cover</i> from the upper arm/lower arm joint.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Detailed in section Removing the VK cover on page 137.
10	Remove the <i>cable guide</i> by unscrewing its two <i>attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
11	Gently pull the cables out of the upper arm.	
12	Remove the <i>belt shield</i> by unscrewing its <i>attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
13	Loosen the <i>motor attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
14	Remove the <i>pulley</i> and <i>belt</i> from motor, axis 6.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
15	Remove the <i>pulley</i> and <i>belt</i> from motor, axis 5.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
16	Remove the <i>motor console</i> , ax. 5-6 by unscrewing its <i>attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!

Refitting

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



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.



Note

Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!

Continues on next page

4.7.5 Replacement of motor and timing belt, axes 5 or 6

Continued

	Action	Note
1	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	
2	Make sure the mating surfaces on the motor and the console are clean and free from burrs.	
3	Fit the motors in the <i>motor console</i> without tightening the attachment screws.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
4	Fit the motor console in the upper arm housing. Secure with its <i>attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Tightening torque: 4 Nm ± 0.5 Nm
5	Fit <i>timingbelt</i> , axis 5.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
6	Tighten the motor attachment screws to enable the motor to be shifted slightly.	This will facilitate adjustment of the belt tension.
7	Adjust the belt tension axis 5.	Correct belt tension F=25 - 50 N
8	Secure the motor with its attachment screws including the ones in the motor console.	Tightening torque: 4 Nm ± 0.5 Nm
9	Fit <i>timing belt</i> , axis 6.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
10	Repeat the belt adjustment procedure detailed above for the remaining motor axis 6.	Correct belt tension F=20 - 40 N
11	Secure the motor with its attachment screws.	Tightening torque: 4 Nm ± 0.5 Nm
12	Fit the <i>belt shield</i> with its attachment screws.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Tightening torque: 4 Nm ± 0.5 Nm
13	Pull the <i>pressurized air connector</i> through the housing and secure it into fitting in the upper arm assembly.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Art. no. specified in section Required equipment on page 202
14	Pull the <i>CS-connector</i> through the housing and secure it into the fitting in the upper arm assembly. Use a <i>special socketto</i> secure it.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Art. no. specified in section Required equipment on page 202
15	Reconnect any connector to the CS-connector.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!

Continues on next page

4 Repair

4.7.5 Replacement of motor and timing belt, axes 5 or 6

Continued

	Action	Note
16	Reconnect all cables to/from motors 4-6.	Connectors • R3.MP4 • R3.MP5 • R3.MP6 • R3.FB4 • R3.FB5 • R3.FB6
17	Refit the <i>cable guide</i> with its two <i>attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
18	Fit a new <i>VK-cover</i> to the upper arm/lower arm joint. Gently knock it into position.	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201! Art. no. specified in section Required equipment on page 202 Use a plastic mallet or similar.
19	Refit the rear cover armhousing with its four <i>attachment screws</i> .	Shown in the figure in section Location of motor and timing belt, axes 5 or 6 on page 201!
20	Refit any brackets securing any exterior cabling to the upper arm with their attachment screws respectively.	
21	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	
22	Recalibrate the robot.	Calibration is detailed in a separate calibration manual enclosed with the calibration tools. General calibration information is included in section Calibration information on page 219 .

4.7.6 Adjustments and measurements

4.7.6.1 Measuring the gear play, axis 5

General

After reassembly due to repair work or any other reason, the gear play must be checked to ensure the repetition accuracy of the robot positioning. The procedure for axis 5 is detailed below.

Certain measurement tools must be fashioned to enable measuring. The dimensions of these are specified.

Required equipment

Equipment, etc.	Art no.	Note
Standard toolkit	3HAC020812-001	Content is defined in section Standard tools on page 241 .
Arm	3HAC 9037-1	For adjusting the gear play, motor/pinion
Measurement dial with magnetic base		Measuring accuracy 0.01mm
Power supply		24 VDC, max. 1.5 A For releasing the brakes
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.



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Measurement

The procedure below details how to measure the gear play for axis 5.

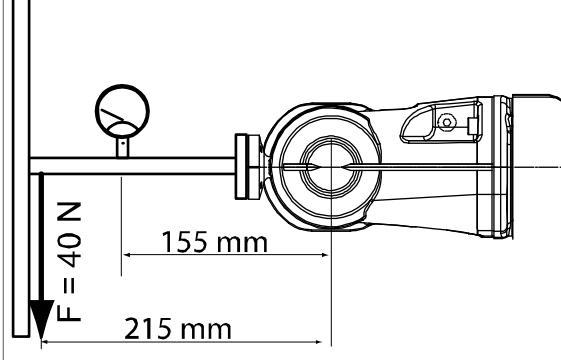
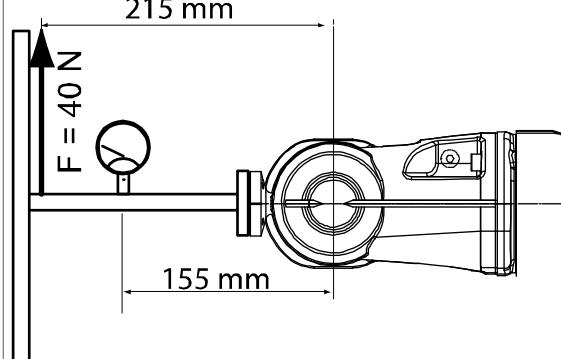
	Action	Note
1	Manually, turn axis 4 90°.	

Continues on next page

4 Repair

4.7.6.1 Measuring the gear play, axis 5

Continued

	Action	Note
2	Fit the dial fitting arm and dial to the manipulator turning disk as shown in the figure. Apply the 40 N load as shown.	 xx0200000457
3	Remove the load and read Value 1.	
4	Apply 40 N load as shown.	 xx0200000458
5	Remove the load and read Value 2.	
6	Calculate the gear play value.	Gear play value = value 1 - value 2
7	Determine whether or not the value is OK.	OK < 0.18 mm (4.1 arc minutes)

4.7.6.2 Measuring the gear play, axis 6

General

After reassembly due to repair work or any other reason, the gear play must be checked to ensure the repetition accuracy of the robot positioning. The procedure for axis 6 is detailed below.

Certain measurement tools must be fashioned to enable measuring. The dimensions of these are specified.

Required equipment

Equipment, etc.	Art no.	Note
Standard toolkit	3HAC020812-001	Content is defined in section Standard tools on page 241 .
Arm	3HAC 9037-1	For adjusting the gear play, motor/pinion
Measurement dial with magnetic base		Measuring accuracy 0.01 mm
Power supply		24 VDC, max. 1.5 A For releasing the brakes
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.



WARNING

Please observe the following before doing any repair work on the manipulator:

- Motors and gears are HOT after running the robot! Touching the motors and gears may result in burns!
- Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot!
- Take any necessary measures to ensure that the manipulator does not collapse as parts are removed, for example secure the lower arm with fixtures if removing motor, axis 2.

Measurement

The procedure below details how to measure the gear play for axis 6.

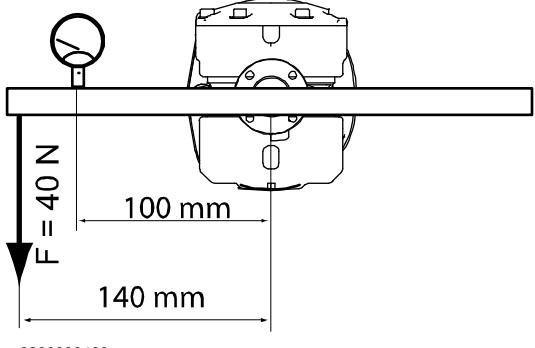
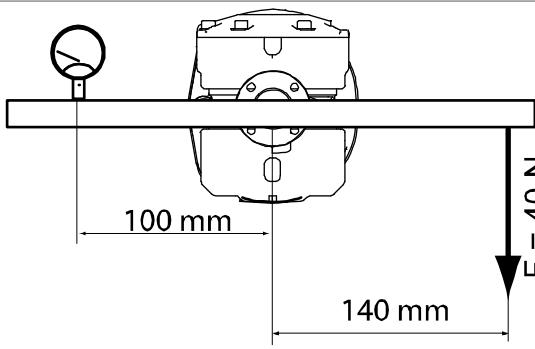
	Action	Note
1	Manually, turn axis 4 90°.	

Continues on next page

4 Repair

4.7.6.2 Measuring the gear play, axis 6

Continued

	Action	Note
2	Fit the dial fitting arm and dial to the manipulator turning disk as shown in the figure. Apply the 40 N load as shown.	 xx0200000460
3	Remove the load and read Value 1.	
4	Apply 40 N load as shown.	 xx0200000461
5	Remove the load and read Value 2.	
6	Calculate the gear play value.	Gear play value = value 1 - value 2
7	Determine whether or not the value is OK.	OK < 0.30 mm (10.3 arc minutes)

4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

4.8 Gearboxes

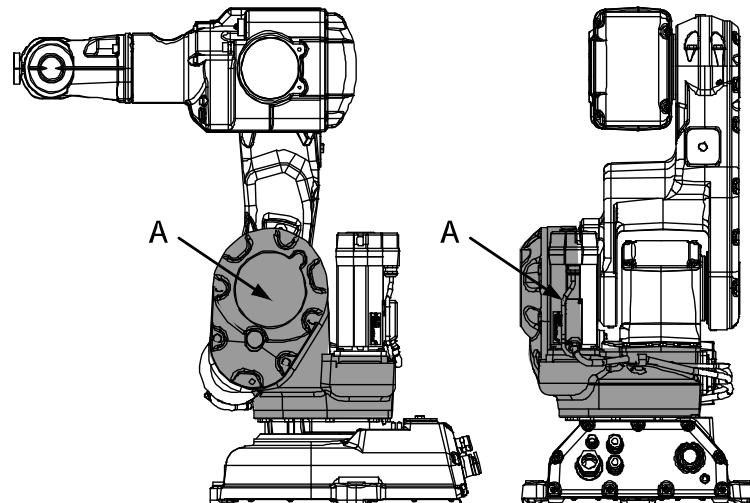
4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

Location of gearbox unit, axes 1-2

The gearboxes of axes 1 and 2 are located as shown in the figure below. Note that both gearboxes, 1 and 2, are a single unit!

The damper, axis 1, is shown in the figure in the procedure!

A more detailed view of the components and its position may be found in chapter [Spare part lists on page 245](#).



xx0200000422

A	Gearbox unit, axes 1-2
---	------------------------

Required equipment

Equipment	Art. no.	Note
Gearbox, axis 1 and 2	For spare part number, see: • Spare part lists on page 245 .	Includes: <ul style="list-style-type: none">• gearbox• all required lubricant• all o-rings and sealing rings.
Damper, axis 1	3HAC7527-1	
Isopropanol	-	For cleaning the mating surfaces before fitting.
Flange sealing	12340011-116	2 ml
Locking liquid	-	Loctite 574
Sealing ring	3HAC6965-1	Replace only when damaged!
Lifting slings	-	
Standard toolkit		Content is defined in section Standard tools on page 241 .

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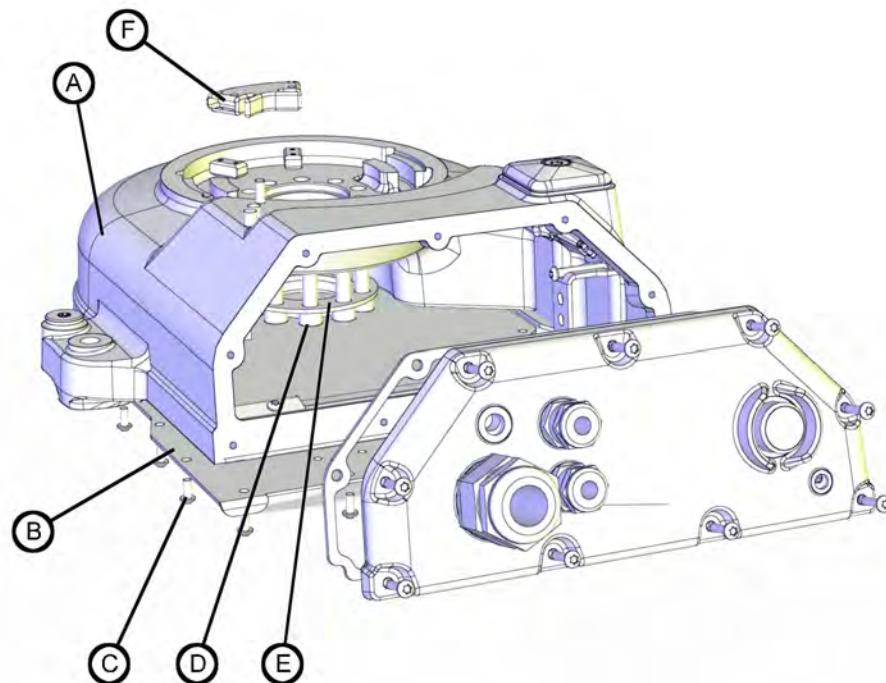
4 Repair

4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

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.

Illustration, base



xx0200000423

A	Base
B	Bottom plate
C	Attachment screws, bottom plate (26 pcs)
D	Attachment screws and washers, gearbox/base (10 pcs each)
E	Damper, axis 1
F	Washer

Continues on next page

4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

*Continued***Removal, gearbox unit axes 1-2**

The procedure below details how to remove the complete gearbox unit, axes 1-2.

	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 Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room robot! See <i>Replacing parts on the robot on page 124</i>	
3	Remove the oil plug and drain all oil from gearbox axis 1 using a drain pump.	
4	Remove the oil plug and drain all oil from gearbox axis 2 using a drain pump.	
5	Remove the motor, axis 2.	Detailed in section <i>Replacement of motor, axis 2 on page 186</i> .
6	Remove the motor, axis 1.	Detailed in section <i>Replacement of motor, axis 1 on page 182</i> .
7	Remove the cable harness.	Detailed in section <i>Replacement of cable harness on page 126</i> .
8	Remove the serial measurement board.	Detailed in section <i>Replacing the serial measurement unit and the battery pack on page 172</i> .
9	Remove the upper arm.	Detailed in section <i>Replacement of complete upper arm on page 134</i> .
10	Remove the lower arm.	Detailed in section <i>Replacement of complete lower arm on page 140</i> .
11	Unfasten the base from the installation site by removing the attachment bolts from the foundation.	
12	 CAUTION The gearbox unit weighs 30 kg. All lifting accessories used must be sized accordingly!	
13	Fit the lifting slings to the base/gearbox unit and place it with the lower arm side downwards, on top of a suitable workbench.	

Continues on next page

4 Repair

4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

Continued

	Action	Note
14	Remove the <i>bottom plate</i> by unscrewing its 26 attachment screws.	Shown in the figure Illustration, base on page 212 .
15	Secure the weight of the base with lifting slings.	
16	Remove the <i>gearbox/base attachment screws and washer</i> .	Shown in the figure Illustration, base on page 212 .
17	Separate the base from the gearbox unit.	

Removal of damper, axis 1

The procedure below details how to remove the damper, axis 1.

	Action	Note
1	Open the base of the robot.	Detailed in section Removal, gearbox unit axes 1-2 on page 213 .
2	Remove the damper, axis 1.	

Refitting of damper, axis 1

The procedure below details how to refit the damper, axis 1.

	Action	Note
1	Fit the <i>damper, axis 1</i> .	Shown in the figure Refitting, gearbox unit axes 1-2 on page 214 .
2	Proceed with assembling the robot.	Detailed in section Refitting, gearbox unit axes 1-2 on page 214 .

Refitting, gearbox unit axes 1-2

The procedure below details how to refit the complete gearbox unit, axes 1-2.

	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 gearbox unit weighs 30 kg. All lifting accessories used must be sized accordingly!	
3	Clean Room robots: clean the joints that have been opened. See Replacing parts on the robot on page 124	

Continues on next page

4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

Continued

	Action	Note
4	Place the gearbox unit with the lower arm side downwards on a suitable workbench.	
5	Clean the mating surfaces of the base and of the gearbox unit with isopropanol.	
6	Fit a small amount of Loctite 574 on the mating surface in the gearbox unit.	Shown in the figure Illustration, base on page 212 .
7	Fit the base to the gearbox unit and secure it with the <i>attachment screws</i> and the washer.	Shown in the figure Illustration, base on page 212 . 20 pcs, tightening torque: 35 Nm ± 3 Nm.
8	Refit the <i>bottom plate</i> and secure it with its <i>attachment screws</i> .	Shown in the figure Location of gearbox unit, axes 1-2 on page 211 .
9	Fit the <i>lifting slings</i> to the base/gearbox unit, turn it right side up and move it to the installation site.	
10	Secure the base to the foundation	Attachment bolts and the tightening torque are specified in section Attachment screws on page 72
11	Refit the lower arm.	Detailed in section Replacement of complete lower arm on page 140 .
12	Refit the upper arm.	Detailed in section Replacement of complete upper arm on page 134 .
13	Refit the serial measurement board.	Detailed in section Replacing the serial measurement unit and the battery pack on page 172 .
14	Refit the cable harness.	Detailed in section Replacement of cable harness on page 126 .
15	Refit the motors, axes 1 and 2.	Detailed in sections: <ul style="list-style-type: none">• Replacement of motor, axis 1 on page 182• Refitting, motor axis 2 on page 188.
16	Perform a leak-down test.	Detailed in section Performing a leak-down test on page 243 .
17	Fill the two gearboxes with oil.	Axis 1 gearbox: Oil: Mobilgear 600 XP 320 Art.no: 11712016-604 Volume: 1200 ml Axis 2 gearbox: Oil: Mobilgear 600 XP 320 Art.no: 11712016-604 Volume: 1000 ml
18	Clean Room robots: seal and paint the joints that have been opened. See Replacing parts on the robot on page 124	
	 Note	
	After all repair work, wipe the robot free from particles with spirit on a lint free cloth.	

Continues on next page

4 Repair

4.8.1 Replacement of gearbox, axes 1-2 and damper, axis 1

Continued

	Action	Note
19	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. General calibration information is included in section <i>Calibration information on page 219</i> .
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! on page 48</i> .	

4.8.2 Service work on gearbox, axis 4

General

The gearbox, axis 4, is intended to run without requiring any repairs or maintenance work. This implies that it must under *no circumstances* be opened or serviced.

If it requires replacement, the complete upper arm is to be replaced. This procedure is detailed in section *Replacement of complete upper arm on page 134*.

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5 Calibration information

5.1 When to calibrate

When to calibrate

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

The resolver values are changed

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

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See [Updating revolution counters on page 224](#). This will occur when:

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

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

The robot is rebuilt

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

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

5 Calibration information

5.2 Calibration methods

5.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	<p>The calibrated robot is positioned at calibration position.</p> <p>Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.</p> <p>For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.</p>	Calibration Pendulum 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> <p>3HAC 14257-1</p>	CalibWare

Brief description of calibration methods

Calibration Pendulum method

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

Continues on next page

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

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

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.

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 242](#).

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

5 Calibration information

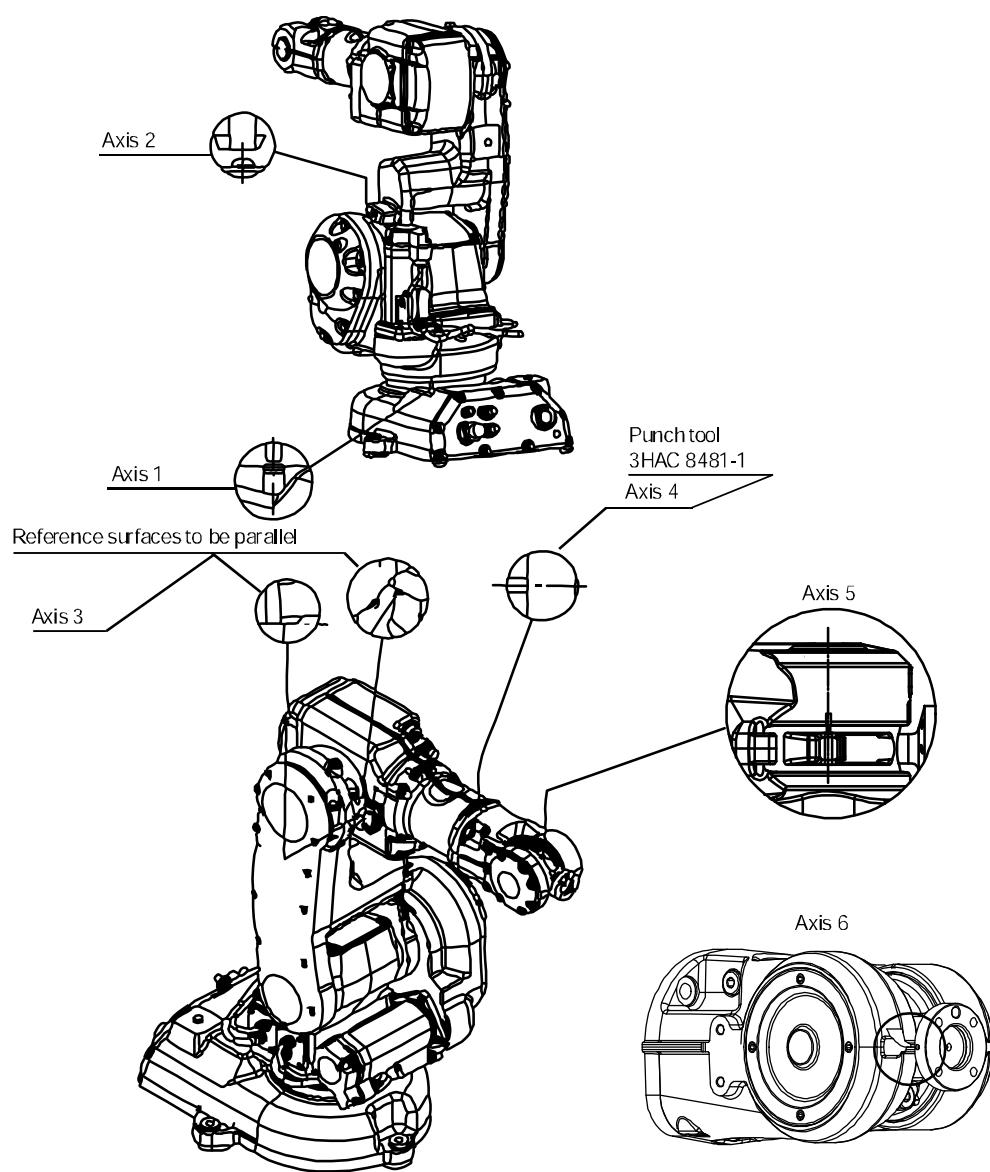
5.3 Synchronization marks and synchronization position for axes

Introduction

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

Synchronization marks, IRB 140

The illustration below shows the calibration scale positions on IRB 140.



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5.4 Calibration movement directions for all axes

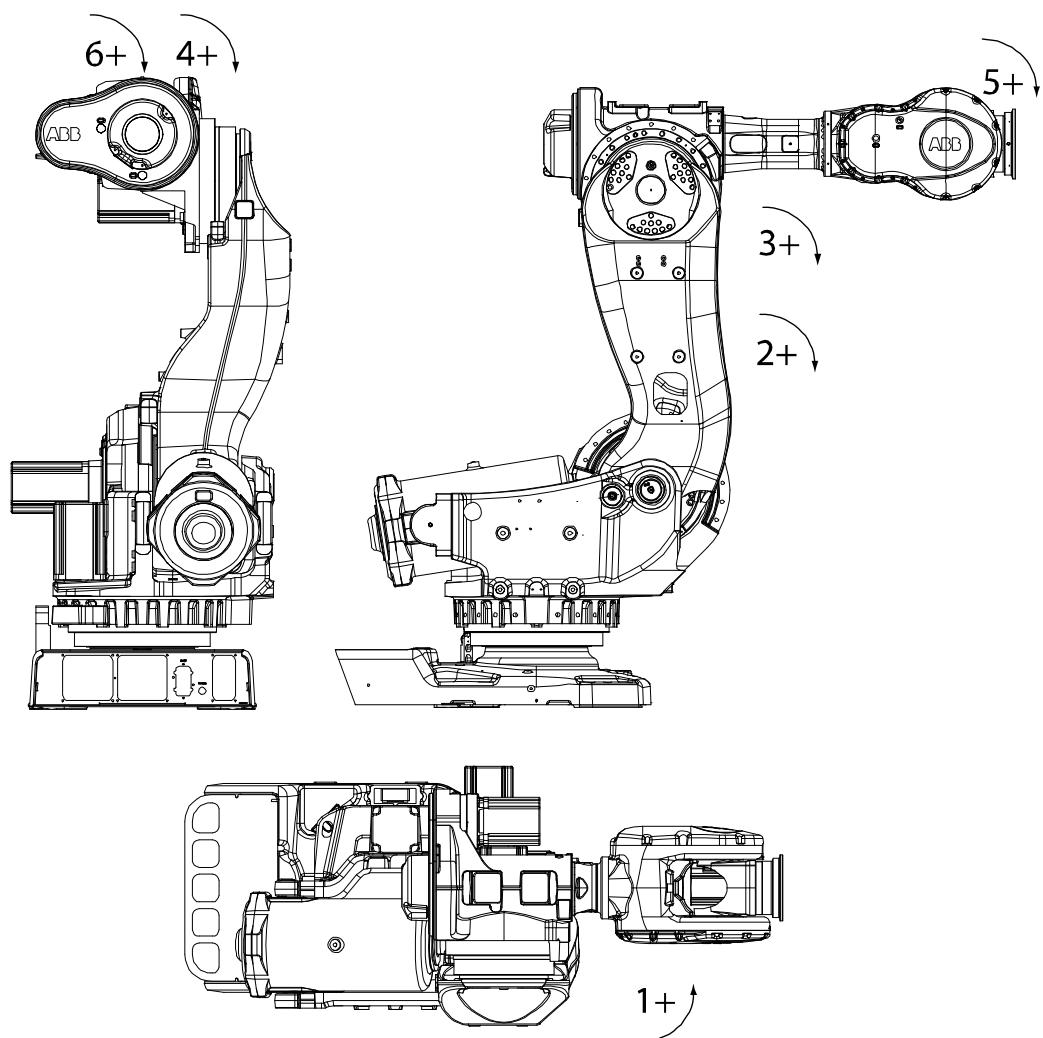
Overview

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

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

Manual movement directions, 6 axes

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



xx0200000089

5 Calibration information

5.5 Updating revolution counters

5.5 Updating revolution counters

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

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

Action	Note
1 Select axis-by-axis motion mode.	
2 Jog the manipulator to align the synchronization marks. IRB 140, 1400, 2400, 4400, 6600ID/6650ID, 6640ID: Axes 5 and 6 must be positioned together!	See Synchronization marks and synchronization position for axes on page 222 .
3 When all axes are positioned, update the revolution counter.	Step 2 - Updating the revolution counter with the FlexPendant on page 225 .

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:

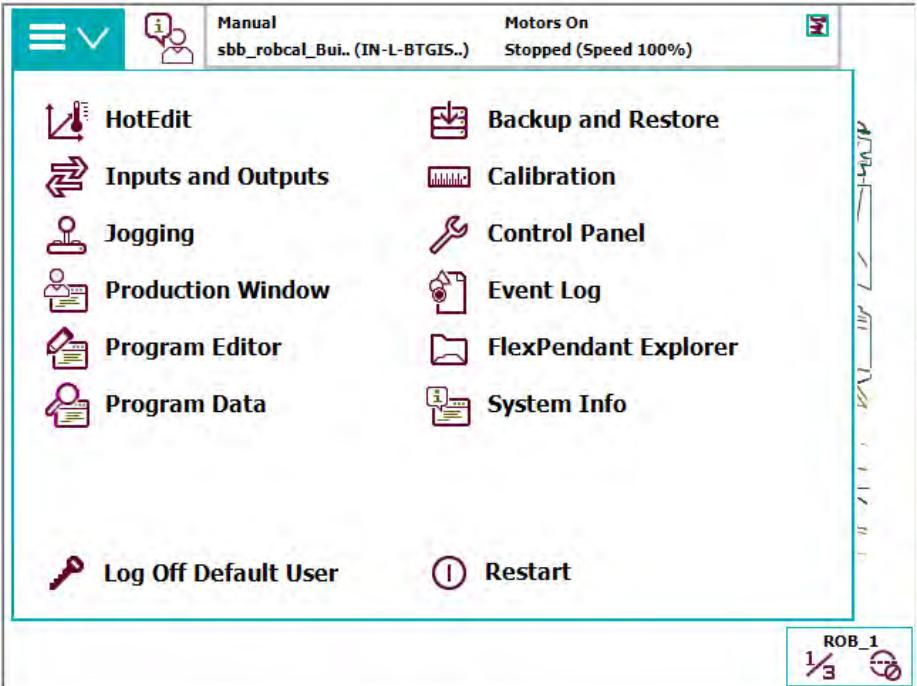
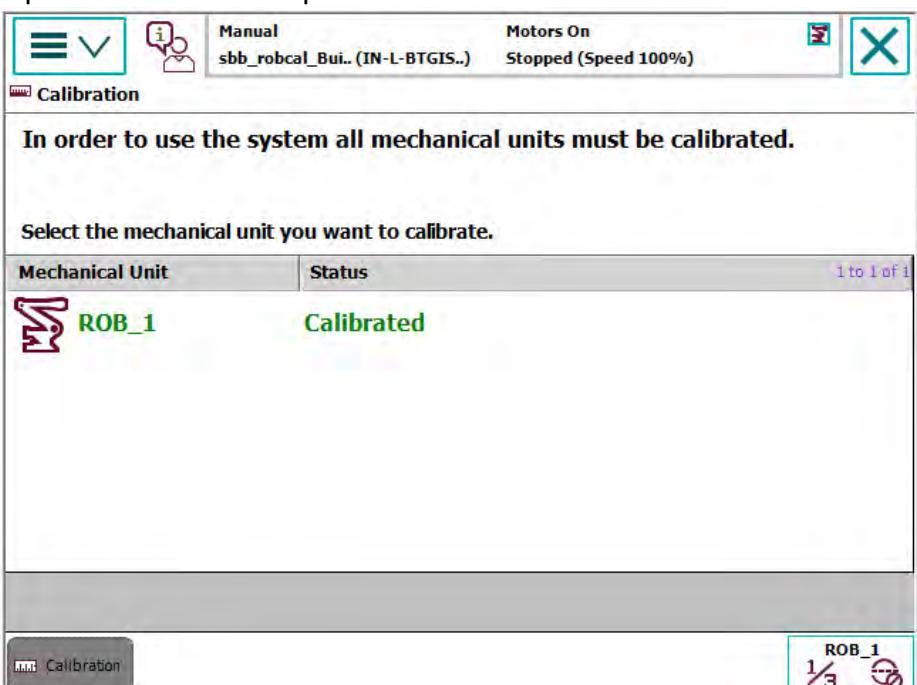
Manipulator variant	Axis 4	Axis 6
IRB 140	Yes	Yes

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).

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Step 2 - Updating the revolution counter with the FlexPendant

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

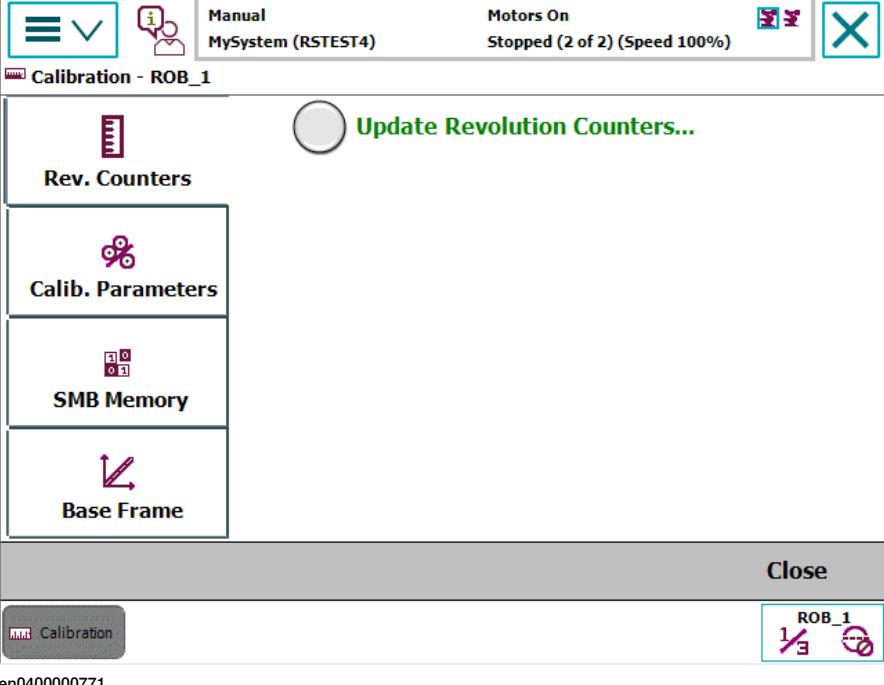
Action
<p>1 On the ABB menu, tap Calibration.</p>  <p>The screenshot shows the ABB menu interface. At the top, it says 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below the menu bar is a list of icons and their corresponding functions: HotEdit, Backup and Restore; Inputs and Outputs, Calibration; Jogging, Control Panel; Production Window, Event Log; Program Editor, FlexPendant Explorer; Program Data, System Info. At the bottom left is a 'Log Off Default User' button, and at the bottom right is a 'Restart' button. The 'Calibration' icon is highlighted with a red box.</p>
<p>2 All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p>  <p>The screenshot shows the 'Calibration' screen. At the top, it says 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below the title, it says 'In order to use the system all mechanical units must be calibrated.' A table titled 'Select the mechanical unit you want to calibrate.' shows one entry: 'Mechanical Unit' (ROB_1) and 'Status' (Calibrated). At the bottom left is a 'Calibration' button, and at the bottom right is a 'ROB_1' button with a red box around it.</p>

Continues on next page

5 Calibration information

5.5 Updating revolution counters

Continued

Action
<p>3 A screen is displayed, tap Rev. Counters.</p> 
<p>4 Tap Update Revolution Counters..... A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions:</p> <ul style="list-style-type: none"> Tap Yes to update the revolution counters. Tap No to cancel updating the revolution counters. <p>Tapping Yes displays the axis selection window.</p>
<p>5 Select the axis to have its revolution counter updated by:</p> <ul style="list-style-type: none"> Ticking in the box to the left Tapping Select all to update all axes. <p>Then tap Update.</p>
<p>6 A dialog box is displayed, warning that the updating operation cannot be undone:</p> <ul style="list-style-type: none"> Tap Update to proceed with updating the revolution counters. Tap Cancel to cancel updating the revolution counters. <p>Tapping Update updates the selected revolution counters and removes the tick from the list of axes.</p>
<p>7  CAUTION</p> <p>If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury!</p> <p>Check the synchronization position very carefully after each update. See Checking the synchronization position on page 227.</p>

5.6 Checking the synchronization position

Introduction

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

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

Using a **MoveAbsJ** instruction

Use this procedure to create a program that runs all the robot axes to their synchronization position.

	Action	Note
1	On ABB menu tap 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]] \NoEOoffs, v1000, fine, tool0</pre>	
5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See Synchronization marks and synchronization position for axes on page 222 and Updating revolution counters on page 224 .

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 222 and Updating revolution counters on page 224 .

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6 Decommissioning

6.1 Environmental information

Hazardous material

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

Dispose components properly to prevent health or environmental hazards.

Material	Example application
Batteries, NiCad or Lithium	Serial measurement board
Copper	Cables, motors
Cast iron/nodular iron	Base, lower arm, upper arm
Steel	Gears, screws, base frame, and so on.
Neodymium	Brakes, motors
Plastic/rubber	Cables, connectors, drive belts, and so on.
Oil, grease	Gearboxes
Aluminium	Covers, synchronization brackets

Oil and grease

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

Also note that:

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

6 Decommissioning

6.2 Scrapping of robot

6.2 Scrapping of robot

Important when scrapping the robot



DANGER

When a robot is disassembled while being scrapped, it is very important to remember the following before disassembling starts, in order to prevent injuries:

- Always remove all batteries from the robot. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.

7 Robot description

7.1 Type C of IRB 140

Type C new upper arm and wrist

Type C of IRB 140 has a new upper arm, complete and a new wrist unit. As a result of this, the following parts differ from earlier versions:

- Upper arm, complete
 - Wrist unit
 - O-ring sealing plate
-

How to know which type the robot is?

The robots using RobotWare version 5.07.01 or newer have the new upper arm.

Use this procedure to check which RobotWare version is installed:

- 1 On the FlexPendant ABB menu, tap **System Info**.
- 2 Tap **System properties**. The RobotWare version is displayed on the right side.

Contact ABB if you are unsure of the type.

Which parts are interchangeable and which are not?

The following parts are not interchangeable:

- The wrist unit with spare part no. 3HAC026569-001 is not interchangeable with spare part no. 3HAC10475-1.
- The o-ring sealing plate with spare part no. 3HAC025420-001 is not interchangeable with spare part no. 3HAC 7191-1.

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8 Reference information

8.1 Introduction

General

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

8 Reference information

8.2 Applicable standards

8.2 Applicable standards



Note

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

Standards, EN ISO

The product is designed in accordance with the requirements of:

Standard	Description
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Robots and robotic devices -- Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1 ⁱ	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 ⁱⁱ	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 ⁱⁱ	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

ⁱ Only robots with protection Clean Room.

ⁱⁱ Only valid for arc welding robots. Replaces EN IEC 61000-6-4 for arc welding robots.

European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design

Continues on next page

Other standards

Standard	Description
ANSI/RIA R15.06	Safety requirements for industrial robots and robot systems
ANSI/UL 1740	Safety standard for robots and robotic equipment
CAN/CSA Z 434-14	Industrial robots and robot Systems - General safety requirements

8 Reference information

8.3 Unit conversion

8.3 Unit conversion

Converter table

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

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

8.4 Screw joints

General

This section describes how to tighten the various types of screw joints on the IRB 140 type C.

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

8 Reference information

8.4 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

8 Reference information

8.5 Weight specifications

8.5 Weight specifications

Definition

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

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

Example

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

	Action	Note
	 CAUTION The robot weighs 100 kg. All lifting accessories used must be sized accordingly!	

8.6 Standard tools

General

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

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

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

Contents, standard toolkit

Qty	Tool
1	Ring-open-end spanner 8-19 mm
1	Socket head cap 2.5-17 mm
1	Torx socket no: 20-60
1	Torque wrench 10-100 Nm
1	Small screwdriver
1	Plastic mallet
1	Ratchet head for torque wrench 1/2"
1	Socket head cap no: 5, socket 1/2" bit L 20 mm
1	Socket head cap no: 6, socket 1/2" bit L 20 mm
1	Socket head cap no: 8, socket 1/2" bit L 20 mm
1	Small cutting plier
1	T-handle with ball head

8 Reference information

8.7 Special tools

8.7 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section [Standard tools on page 241](#), and of special tools, listed directly in the instructions and also gathered in this section.

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.

Description	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual.

8.8 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.	

8 Reference information

8.9 Lifting accessories and lifting instructions

General

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

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

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

9 Spare part lists

9.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document on the documentation DVD.

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10 Circuit diagram

10.1 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

10 Circuit diagram

10.1 Circuit diagrams

Continued

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 6620 / IRB 6620LX</i>	<i>3HAC025090-001</i>
<i>Circuit diagram - IRB 6640</i>	<i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6650S</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 6660</i>	<i>3HAC025744-001</i> <i>3HAC029940-001</i>
<i>Circuit diagram - IRB 6700</i>	<i>3HAC043446-005</i>
<i>Circuit diagram - IRB 7600</i>	<i>3HAC13347-1</i> <i>3HAC025744-001</i>
<i>Circuit diagram - IRB 14000</i>	<i>3HAC050778-003</i>
<i>Circuit diagram - IRB 910SC</i>	<i>3HAC056159-002</i>

Index

A

Absolute Accuracy, calibration, 221
 aluminum
 disposal, 229
 ambient humidity
 operation, 60
 storage, 60
 ambient temperature
 operation, 60
 storage, 60
 assembly instructions, 57

B

base
 brake release buttons, 69
 replacing, 144
 screws, tightening torque, 146
 spare part number, 144
 batteries
 disposal, 229
 handling, 54
 battery
 replacing, 172
 battery pack
 replacing, interval, 89
 battery shutdown
 service routine, 172
 brake release unit
 releasing the brakes, 69
 brakes
 testing function, 34
 brakes, releasing
 external power supply to connector R1.MP, 70
 manually, 69
 power supply to motor axis 2, 188
 power supply to motor axis 4, 199

C

cabinet lock, 22
 calibrating
 roughly, 224
 calibration
 Absolute Accuracy type, 220
 alternative method, 221
 Levelmeter calibration, 221
 rough, 224
 standard type, 220
 when to calibrate, 219
 calibration, Absolute Accuracy, 221
 calibration manuals, 221
 calibration marks, 222
 calibration position
 jogging to, 227
 scales, 222
 calibration scales, 222
 CalibWare, 220
 carbon dioxide extinguisher, 32
 cast iron
 disposal, 229
 cleaning, 111
 climbing on robot, 23
 connection
 external safety devices, 19
 copper

disposal, 229
 cracks, damper, 92

D

damage, damper, 92
 damper, axis 2, 91
 attachment screw, 164
 replacing, 163
 spare part number, 163
 damper, axis 3
 inspection, 91
 replacing, 152
 spare part number, 152
 damper, axis 5
 inspection, 91
 replacing, 154
 spare part number, 154
 danger levels, 39
 direction of axes, 223

E

enabling device, 36
 environmental information, 229
 ESD
 damage elimination, 51
 sensitive equipment, 51
 wrist strap connection point, 51

F

fence dimensions, 31
 figures
 brake release buttons, 69
 power supply to connector R1.MP, 70
 fire extinguishing, 32
 FlexPendant
 jogging to calibration position, 227
 MoveAbsJ instruction, 227
 updating revolution counters, 225
 foundation
 requirements, 60
 frame
 replacing, 211
 spare part number, 211

G

gearbox, axes 1-2
 replacing, 211
 spare part number, 211
 gearboxes
 location of, 114
 gearboxes, axes 5 and 6
 oil change, 115
 Gravity Alpha, 77
 Gravity Beta, 76
 grease
 disposal, 229

H

hanging
 installed hanging, 23
 hazardous material, 229
 height
 installed at a height, 23
 hold-to-run, 36
 hot components
 risk, 23
 humidity

- operation, 60
storage, 60
- I**
- illustrations
 - brake release buttons, 69
 - power supply to connector R1.MP, 70
 - inspecting
 - robot cabling, 93
 - inspection, 91
 - instructions for assembly, 57
 - inverted installation, 66
- L**
- labels
 - robot, 41
 - leak-down test, 243
 - Levelmeter calibration, 221
 - lifting accessory, 240
 - lifting and turning the robot, 66
 - Lithium
 - disposal, 229
 - loads on foundation, 59
 - lubrication
 - amount in gearboxes, 114
 - type of lubrication, 114
- M**
- main power
 - switching off, 49–50
 - main power switch, 50
 - main switch
 - controller cabinet, 49
 - control module, 50
 - drive module, 50
 - motor axis 2
 - brake release with power supply, 188
 - replacing, 186
 - spare part number, 186
 - tightening torque, 189
 - motor axis 4
 - brake release with power supply, 199
 - replace, 197
 - screws, tightening torque, 200
 - spare part number, 197
 - MoveAbsJ instruction, 227
- N**
- negative directions, axes, 223
 - neodymium
 - disposal, 229
 - NiCad
 - disposal, 229
 - nodular iron
 - disposal, 229
- O**
- oil
 - amount in gearboxes, 114
 - disposal, 229
 - type of oil, 114
 - oil change
 - gearbox axes 5 and 6, 115
 - safety risks, 55
 - wrist unit, 115
 - operating conditions, 60
- P**
- pedestal
 - installed on pedestal, 23
 - plastic
 - disposal, 229
 - position, robot
 - when draining wrist unit, 116
 - when filling oil in wrist unit, 117
 - positive directions, axes, 223
 - product standards, 234
 - protection classes, 61
 - protection type, 61
 - protective equipment, 22
 - protective wear, 22
 - push button unit
 - releasing the brakes, 69
- R**
- releasing brakes
 - external power supply to connector R1.MP, 70
 - manually, 69
 - requirements on foundation, 60
 - responsibility and validity, 19
 - restricting
 - working range, 84
 - revolution counters
 - storing on FlexPendant, 225
 - updating, 224
 - risk of tipping, 64
 - robot
 - labels, 41
 - protection class, 61
 - protection types, 61
 - symbols, 41
 - robot cabling
 - inspecting, 93
 - robot position
 - when draining wrist unit, 116
 - when filling oil in wrist unit, 117
 - rubber
 - disposal, 229
- S**
- safety
 - brake testing, 34
 - ESD, 51
 - fence dimensions, 31
 - fire extinguishing, 32
 - introduction, 17
 - moving robots, 47
 - reduced speed function, 35
 - release robot arm, 33
 - robot, 19
 - service, 19
 - signal lamp, 38
 - signals, 39
 - signals in manual, 39
 - symbols, 39
 - symbols on robot, 41
 - test run, 48
 - working range, 37
 - wrist strap, 51
 - safety risk
 - electric parts, 29
 - hot parts, 25
 - hydraulic system, 27
 - installation, 22

- oil change, 55
- operational disturbance, 28
- pneumatic system, 27
- service work, 22
- tools, 26
- voltage, 29
- work pieces, 26
- safety signals
 - in manual, 39
- safety standards, 234
- safety zones, 23
- scales on robot, 222
- signal lamp, 38
- signals
 - safety, 39
- SMB
 - replacing, 172
- SMB battery
 - extension of lifetime, 172
 - replacing, 172
- special tools, 242
- stability, 64
- standards, 234
 - ANSI, 235
 - CAN, 235
 - EN, 234
 - EN IEC, 234
 - EN ISO, 234
- steel
 - disposal, 229
- storage conditions, 60
- suspended mounting, 76
- symbols
 - safety, 39
- synchronization position, 224
- sync marks, 222
- system parameter
 - Gravity Alpha, 77
 - Gravity Beta, 76
- T**
- temperatures
- operation, 60
- storage, 60
- testing
 - brakes, 34
- three-position enabling device, 36
- tightening torques, attachment screws
 - base-gearbox unit, 146
 - motor axis 2, 189
 - motor axis 4, 200
 - wrist unit, 150
- tools
 - calibration equipment, Levelmeter, 242
 - Calibration Pendulum, 242
 - for service, 242
 - rotational tool, article number, 197
- torques on foundation, 59
- U**
- updating revolution counters, 224
- V**
- validity and responsibility, 19
- VK-covers, spare part number
 - at base, 144
- W**
- wall mounted, 66
- wall mounting, 76
- weight, 58
 - gearbox 1, 213–214
 - robot, 67, 240
- working range
 - restricting, 84
- wrist unit
 - oil change, 115
 - replacing, 148
 - screws, tightening torque, 150
 - spare part number, 148
- Z**
- zero position
 - checking, 227

Contact us

ABB AB, Robotics
Robotics and Motion
S-721 68 VÄSTERÅS, Sweden
Telephone +46 (0) 21 344 400

ABB AS, Robotics
Robotics and Motion
Nordlysvegen 7, N-4340 BRYNE, Norway
Box 265, N-4349 BRYNE, Norway
Telephone: +47 22 87 2000

ABB Engineering (Shanghai) Ltd.
Robotics and Motion
No. 4528 Kangxin Highway
PuDong District
SHANGHAI 201319, China
Telephone: +86 21 6105 6666

ABB Inc.
Robotics and Motion
1250 Brown Road
Auburn Hills, MI 48326
USA
Telephone: +1 248 391 9000

www.abb.com/robotics