ROBOTICS

Product manual

IRB 6620

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Product manual

IRB 6620 - 150/2.2

IRC5

Document ID: 3HAC027151-001

Revision: Y

Original instructions.

Table of contents

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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.

Product manual scope

The manual covers covers all variants and designs of the IRB 6620. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Organization of chapters

The manual is organized in the following chapters:

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

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Chapter	Contents
Calibration	Calibration procedures and general information about calibration.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards, etc.
Spare parts and exploded views	Complete spare part list and complete list of robot components, shown in the exploded views.
Circuit diagrams	Reference to the circuit diagram for the robot.

References

Reference	Document ID
Product specification - IRB 6620	*3HAC025861-001*
Product manual, spare parts - IRB 6620	*3HAC049109-001*
Product manual - DressPack/SpotPack IRB 6620	*3HAC027309-001*
Circuit diagram - IRB 6620 / IRB 6620LX	*3HAC025090-001*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Product manual - IRC5 IRC5 with main computer DSQC 639.	*3HAC021313-001*
Product manual - IRC5 IRC5 with main computer DSQC1000.	*3HAC047136-001*
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*
Operating manual - Calibration Pendulum	*3HAC16578-1*
Operating manual - Service Information System	*3HAC050944-001*
Application manual - Additional axes and stand alone controller	*3HAC051016-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Technical reference manual - System parameters	*3HAC050948-001*
Application manual - CalibWare Field	*3HAC030421-001*

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

Revisions

Revision	Description
-	First edition
A	Changes made in: • Prerequisites in section Overview • Oil change in section Maintenance
B	Changes made in: • Oil change Shell Tivela S 150 is changed to Kyodo Yushi TMO 150. • New sections added "Robot transportation precautions" and "Securing the robot". • Foundry Plus option added.

Continues on next page

Revision	Description
C	This revision includes the following additions and/or changes: • Section *What is an emergency stop?* added to chapter Safety' • Section *Maintenance schedule* in chapter Maintenance: Intervals for inspection activities and oilchanges have been revised • Section *Maintenance schedule* in chapter Maintenance: Overhaul of robot is new • Section *Maintenance schedule* in chapter Maintenance: The information about Service Information System (SIS) has been updated • Section *Maintenance schedule* in chapter Maintenance: Intervals for replacement of battery pack changed • Section *Expected lifetime* in chapter Maintenance: The lifetime of certain parts has been revised • Section *Cleaning of robot* updated
D	This revision includes the following additions and/or changes: • Section *Lifting and turning tool* added to the *Installation* chapter. • Section *Foundry Plus,Cable guard* added to chapter *Installation*. • Updated spare part numbers in lists for cable harness and wrist.
E	This revision includes the following additions and/or changes: • Added oil levels for tilted robots, see *Inspecting the oil level in axis-1 gearbox on page 118*, and *Inspecting the oil level in axis-2 gearbox on page 120*. • Corrected item number reference in part list, see *Spare parts - Upper arm* in *Product manual, spare parts - IRB 6620*. • Circuit diagrams are not included in this document but delivered as separate files. See *Circuit diagram on page 351*. • List of standards updated, see *Applicable standards on page 337*. The chapter *Safety* updated with: • Updated safety signal graphics for the levels *Danger* and *Warning*, see *Safety signals in the manual on page 21*. • New safety labels on the manipulators, see *Safety symbols on manipulator labels on page 23*. • Revised terminology: *robot* replaced with *manipulator*.
F	This revision includes the following updates: • Maximum deviation changed, see *Securing the base plate on page 77*. • Updated instructions for replacing motor axis 6 on Foundry Plus robots.
G	This revision includes following additions and/or changes: • Removed information about lubricating attachment screws, section *Inspecting the additional mechanical stops on page 139*.

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Revision	Description
H	This revision includes the following updates: • A new block, about general illustrations, added in section *How to read the product manual on page 17*. • Robot designations are adjusted in sub-headings in section *Robot transportation precautions on page 42*. • Some general tightening torques have been changed/added, see updated values in *Screw joints on page 340*. • Added information about batteries. • The maximum allowed deviation in levelity of the base plate is changed, see *Securing the base plate on page 77*. • Added information about how to check oil level and change oil in the axis-1 gearbox of a suspended robot, see *Inspecting the oil level in axis-1 gearbox on page 118* and *Changing oil, axis-1 gearbox on page 149*. • Reference to Hilti standard added to the foundation recommendation for the base plate and class designation for foundation is changed to european standard C25/C30 (previously Swedish standard K25/K30), see *Securing the base plate on page 77*. • 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 147*. • Added section *Inspection of air hoses (Foundry Prime) on page 146*.
J	This revision includes the following updates: • Corrected location of label for lifting, see *Inspecting the information labels on page 135*. • Spare part number for wrist (standard) was wrong. Has been corrected. • A new SMB unit and battery is introduced, with longer battery lifetime.
K	This revision includes the following updates: • New instruction for inspection of oil level. • Added information about risks when scrapping a decommissioned robot, see *Scrapping of robot on page 335*. • *Spare parts and exploded views* are not included in this document but delivered as a separate document. See *Product manual, spare parts - IRB 6620*.
L	This revision includes the following updates: • The maximum allowed deviation in levelness of the base plate and foundation is changed, see *Securing the base plate on page 77*. • Changed dimension of cable holder carrier screw, see *Replacement of cable harness, upper end on page 189*. • Added tightening torque for R1.SMB and 7th axis connector, ses *Replacement of cable harness, lower end (axes 1-2) on page 182*. • Minor corrections.
M	This revision includes the following updates: • Split fork lift accessory instruction in two sections. • Improvements Foundry Plus (retrofit sets) added throughout the manual. New wrist cover and improved sealing on arm house cover, and more. • Minor corrections.
N	This revision includes the following updates: • Minor corrections.

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Revision	Description
P	This revision includes the following updates: • Minor corrections. • Description about the revolution indicator. • Changed filling oil plug to inspection oil plug in inspection of level axis 3. • Information updated and added in the calibration chapter.
Q	This revision includes the following updates: • New standard calibration method is introduced (Axis Calibration). See *Calibration on page 301*.
R	Published in release R16.2. The following updates are made in this revision: • Drawing of base plate is not available for purchase, faulty information removed in *Securing the base plate on page 77*. • Corrections due to updates in terminology.
S	Published in release R17.2. The following updates are made in this revision: • Caution about removing metal residues added in sections about SMB boards. • Information about minimum resonance frequency added. • Bending radius for static floor cables added. • Updated list of applicable standards. • Added text regarding overhaul in section specification of maintenance intervals. • Section *Start of robot in cold environments on page 111* added. • Updated information regarding replacement of brake release board. • Updated information regarding disconnecting and reconnecting battery cable to serial measurement board. • Definition of reference calibration clarified.
T	Published in release R18.1. The following updates are made in this revision: • Information added about fatigue to Axis Calibration tool, see *Calibration tools for Axis Calibration on page 316*. • Added sections in *General procedures on page 174*. • Safety restructured. • New spare part number brake release board (was DSQC563, 3HAC16035-1) • Corrections of required equipment, see *Mechanically restricting the working range of axis 1 on page 103*. • Note added to calibration chapter to emphasize the requirement of equally dressed robot when using previously created reference calibration values. • Information about myABB Business Portal added. • Added Nickel in Environmental information.
U	Published in release 19B. The following updates are made in this revision: • New touch up color Graphite White available. See *Cut the paint or surface on the robot before replacing parts on page 180*.
V	Published in release 19C. The following updates are made in this revision: • Information about a mandatory check of cable harness added to *Updating revolution counters on page 309*. • Removed information regarding the revolution indicator throughout the manual. • Note added about the need to calibrate if the robot is other than floor mounted. See *When to calibrate on page 305*.

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Revision	Description
W	Published in release 20B. The following updates are made in this revision: • Clarified and added information in mounting instructions for rotating sealings, see *Mounting instructions for sealings on page 177*. • Clarified text about position of robot and added table with dependencies between axes during Axis Calibration. • Added information about Wrist Optimization in calibration chapter. • Replaced article number and name of grease, previously 3HAB3537-1.
X	Published in release 21B. The following updates are made in this revision: • Information regarding documentation of Installation of Foundry Plus Cable guard (option no. 908-1) is changed since DVDs are removed. See *Installation of Foundry Plus Cable guard (option no. 908-1) on page 107*. • Text regarding fastener quality is updated, see *Fastener quality on page 98*.
Y	Published in release 21C. The following updates are made in this revision: • Info about option Extended working range included, see *Extended working range, axis 1 (option 561-1) on page 101*.

Product documentation

Categories for user documentation from ABB Robotics

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

Tip

All documents can be found via myABB Business Portal, *www.abb.com/myABB*.

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

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Operating manuals

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

How to read the product manual

Reading the procedures

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

References to figures

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

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

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

	Action	Note/Illustration
8.	Remove the *rear attachment screws, gearbox.*	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 *sealing, axis 2* 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 19*.

Illustrations

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

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

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1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Spare parts and equipment

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

1.1.2 Requirements on personnel

General

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

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

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

Personal protective equipment

Use personal protective equipment, as stated in the instructions.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

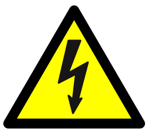
Introduction to safety signals

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

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

Hazard levels

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

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

Continues on next page

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

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

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

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

Note

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

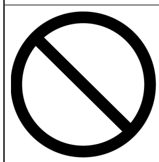
Types of symbols

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

The safety labels are language independent, they only use graphics. See *Symbols on safety labels on page 23*.

The information labels can contain information in text.

Symbols on safety labels

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

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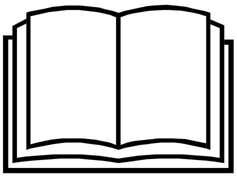
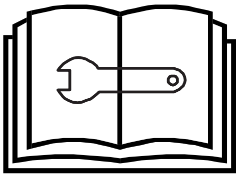
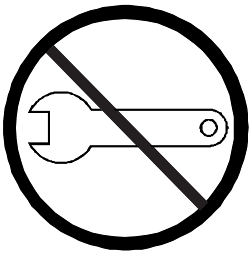
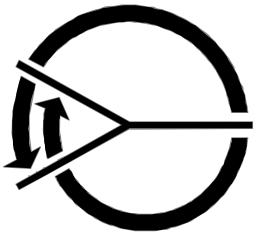
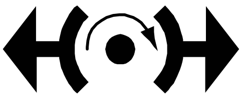
Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*. • EPS: *Application manual - Electronic Position Switches*.
 xx0900000816	**Before disassembly, see product manual**
 xx0900000815	**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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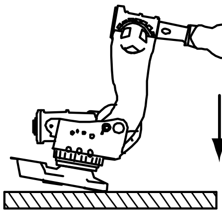
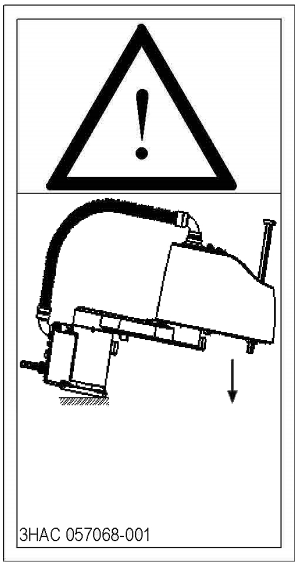
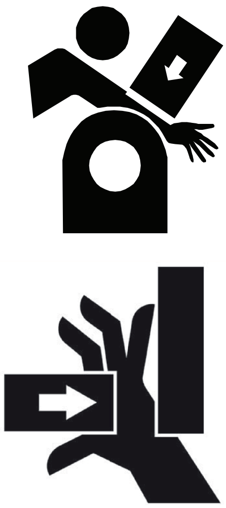
Symbol	Description
 xx0900000810  xx1500002402	**Tip risk when loosening bolts** The robot can tip over if the bolts are not securely fastened.
 xx0900000817	**Crush** Risk of crush injuries.

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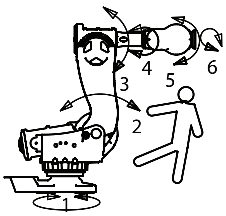
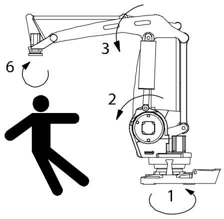
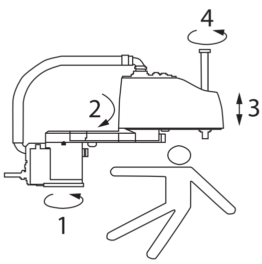
1.2.2 Safety symbols on manipulator labels

Continued

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

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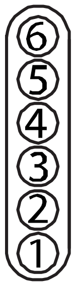
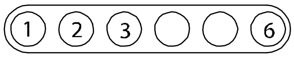
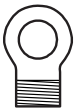
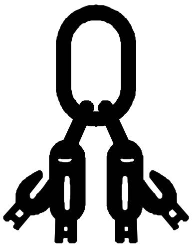
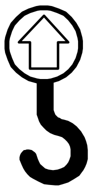
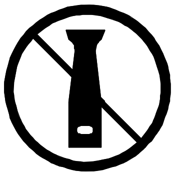
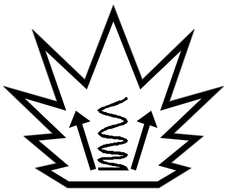
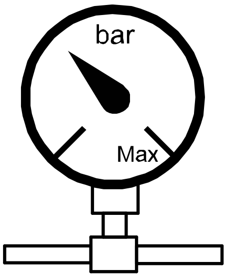
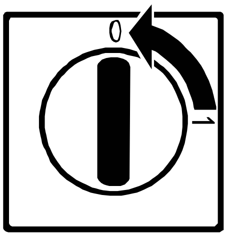
Symbol	Description
 xx0900000820  xx1000001140	**Brake release buttons**
 xx0900000821	**Lifting bolt**
 xx1000001242	**Chain sling with shortener**
 xx0900000822	**Lifting of robot**
 xx0900000823	**Oil** Can be used in combination with prohibition if oil is not allowed.
 xx0900000824	**Mechanical stop**

Continues on next page

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

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

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

1.4 Installation and commissioning

National or regional regulations

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

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

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

Layout

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

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

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

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

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

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

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

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

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

Allergenic material

See *Environmental information on page 333* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

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

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

Electrical safety

The mains power must be installed to fulfill national regulations.

Continues on next page

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

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

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

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

Note

Use a CARBON DIOXIDE (CO_2) extinguisher in the event of a fire in the robot.

Safety devices

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

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

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

Other hazards

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

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

- Water
- Compressed air
- Hydraulics

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

Continues on next page

Pneumatic or hydraulic related hazards

> **Note**
>
> The pressure in the complete pneumatic or hydraulic systems must be released before service and maintenance.
>
> All components in the robot system that remain pressurized after switching off the power to the robot must be marked with clearly visible drain facilities and a warning sign that indicates the hazard of stored energy.

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

Dump valves should be used in case of emergency.

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

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

Verify the safety functions

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

1.5 Operation

1.5.1 Unexpected movement of robot arm

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

1.6 Maintenance and repair

1.6.1 Maintenance and repair

General

Corrective maintenance must only be carried out by personnel trained on the robot.

Maintenance or repair must be done with all electrical, pneumatic, and hydraulic power switched off, that is, no remaining hazards.

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

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

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

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

Hot surfaces

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

Allergic reaction

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

Gearbox lubricants (oil or grease)

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

Note

Take special care when handling hot lubricants.

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

Continues on next page

Warning	Description	Elimination/Action
Allergic reaction	When working with lubricants there is a risk of an allergic reaction.	Make sure that protective gear like goggles and gloves are always worn.
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.
Do not overfill	Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may: • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely.	Make sure not to overfill the gearbox when filling it with oil or grease. After filling, verify that the level is correct.
Do not mix types of oil	Mixing types of oil may cause severe damage to the gearbox.	When filling gearbox oil, do not mix different types of oil unless specified in the instructions. Always use the type of oil specified for the product.
Heat up the oil	Warm oil drains quicker than cold oil.	Run the robot before changing the gearbox oil, if possible.
Specified amount depends on drained volume	The specified amount of oil or grease is based on the total volume of the gearbox. When changing the lubricant, the amount refilled may differ from the specified amount, depending on how much has previously been drained from the gearbox.	After filling, verify that the level is correct.
Contaminated oil in gearboxes	For lifetime reasons always drain as much oil as possible from the gearbox. The magnetic oil plugs will gather residual metal chips.	

Hazards related to batteries

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

Continues on next page

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

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

Operating temperatures are listed in *Operating conditions, robot on page 54*.

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

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

Related information

See also the safety information related to installation and operation.

1.6.2 Emergency release of the robot axes

Description

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

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 74*.

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

Increased injury

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

DANGER

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

Make sure no personnel is near or beneath the robot.

1.6.3 Brake testing

When to test

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

How to test

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

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

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

Note

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

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

1.7 Troubleshooting

General

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

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

DANGER

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

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

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

Related information

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

1.8 Decommissioning

General

See section *Decommissioning on page 333*.

Unexpected movement of robot arm

WARNING

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

A robot may perform unexpected limited movement.

WARNING

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

2 Installation and commissioning

2.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 6620 at the working site.

See also the product manual for the robot controller.

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

Safety information

Before any installation work is commenced, all safety information must be observed.

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter *Safety on page 19* before performing any installation work.

Note

Always connect the IRB 6620 and the robot to protective earth and residual current device (RCD) before connecting to power and starting any installation work.

For more information see:

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

2.2 Robot transportation precautions

General

This section describes ABB approved transportation precautions for ABB robots.

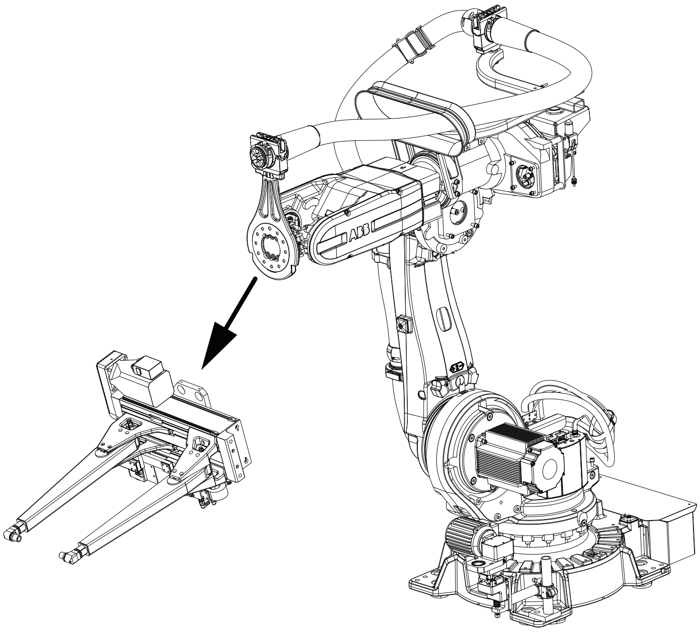
CAUTION

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

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

Method 1 - recommended method

Transportation according to method 1 is strongly recommended by ABB.



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

- Always remove the tool before transportation of the robot.
- Always place the robot in the ABB recommended transport position, described in section *Risk of tipping/stability on page 59*.
- Always read and follow the instructions in section *Pre-installation procedure on page 51*

Method 2 - transportation with a tool mounted to the robot

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

Continues on next page

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

- Always read and follow the instructions in section *Securing the robot with a transport support on page 48*
- Always place the robot in the ABB recommended transport position for robot with tool, described in sub section *Transport position with a transport support on page 45*.
- Always use the recommended transport support described in sub section *Recommended transport support on page 46*.

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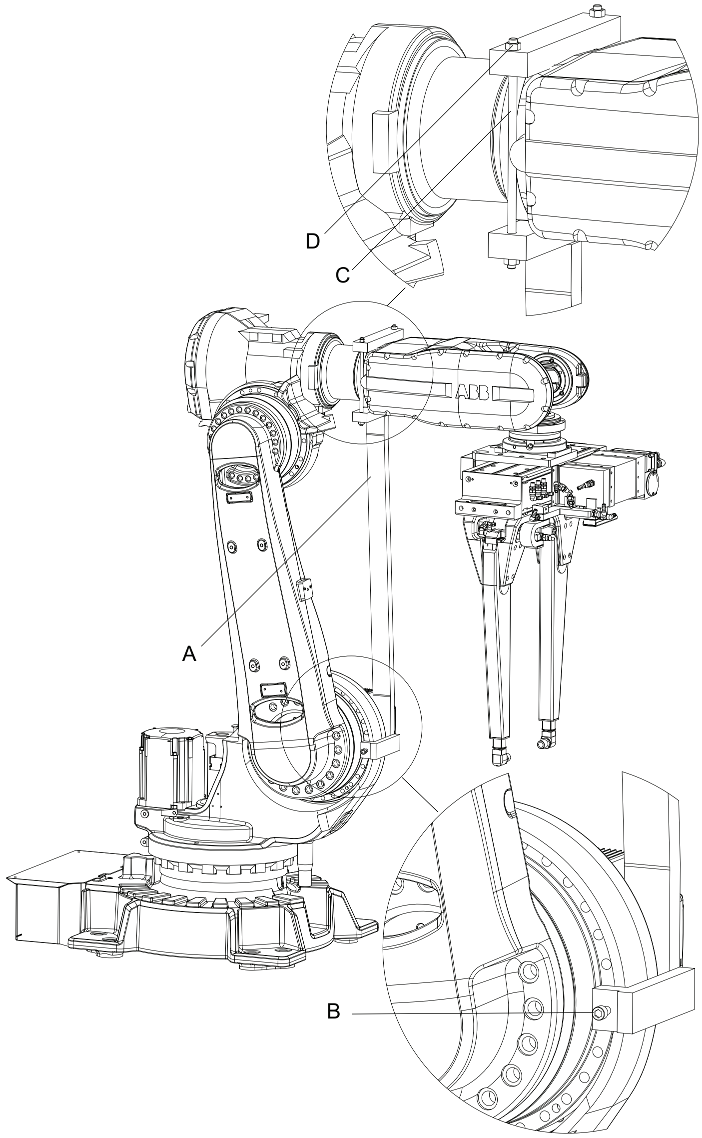
IRB 6620



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A	Transport Support
B	Hexagon socket head cap screw M10x50
C	Threaded bar M10x280
D	Nut M10

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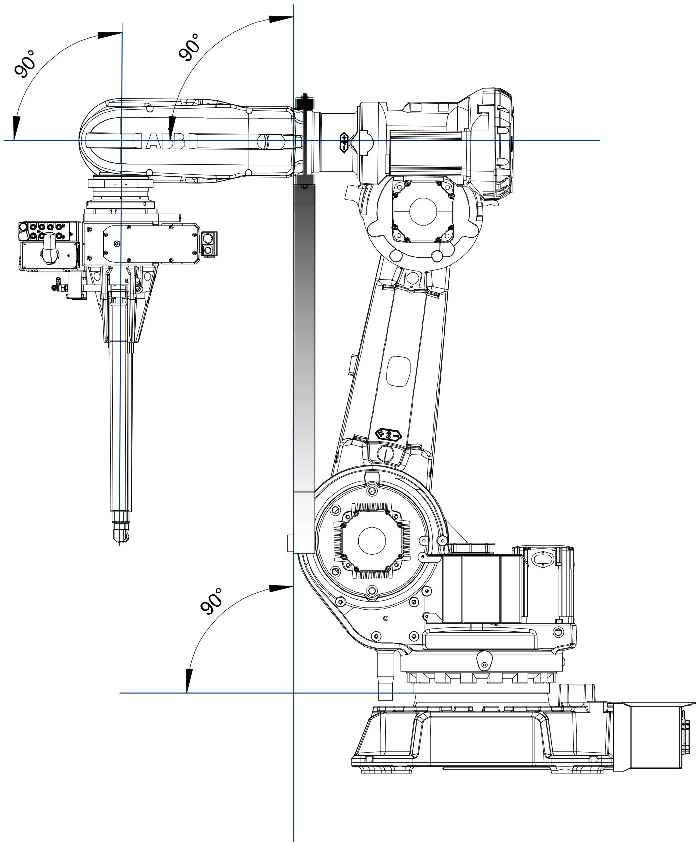
Transport position with a transport support

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

IRB 6620



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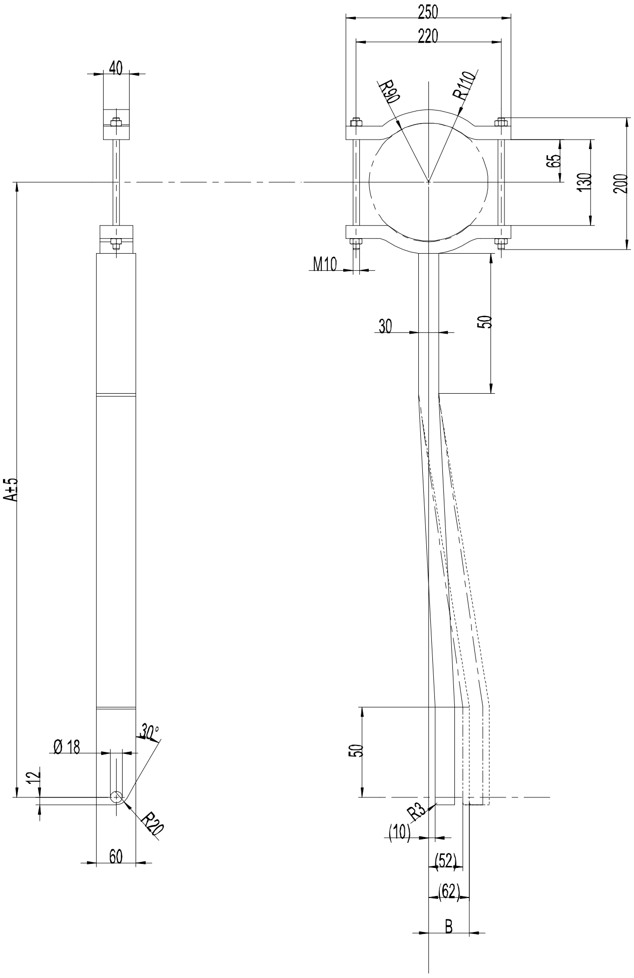
Recommended transport support

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

IRB 6620

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



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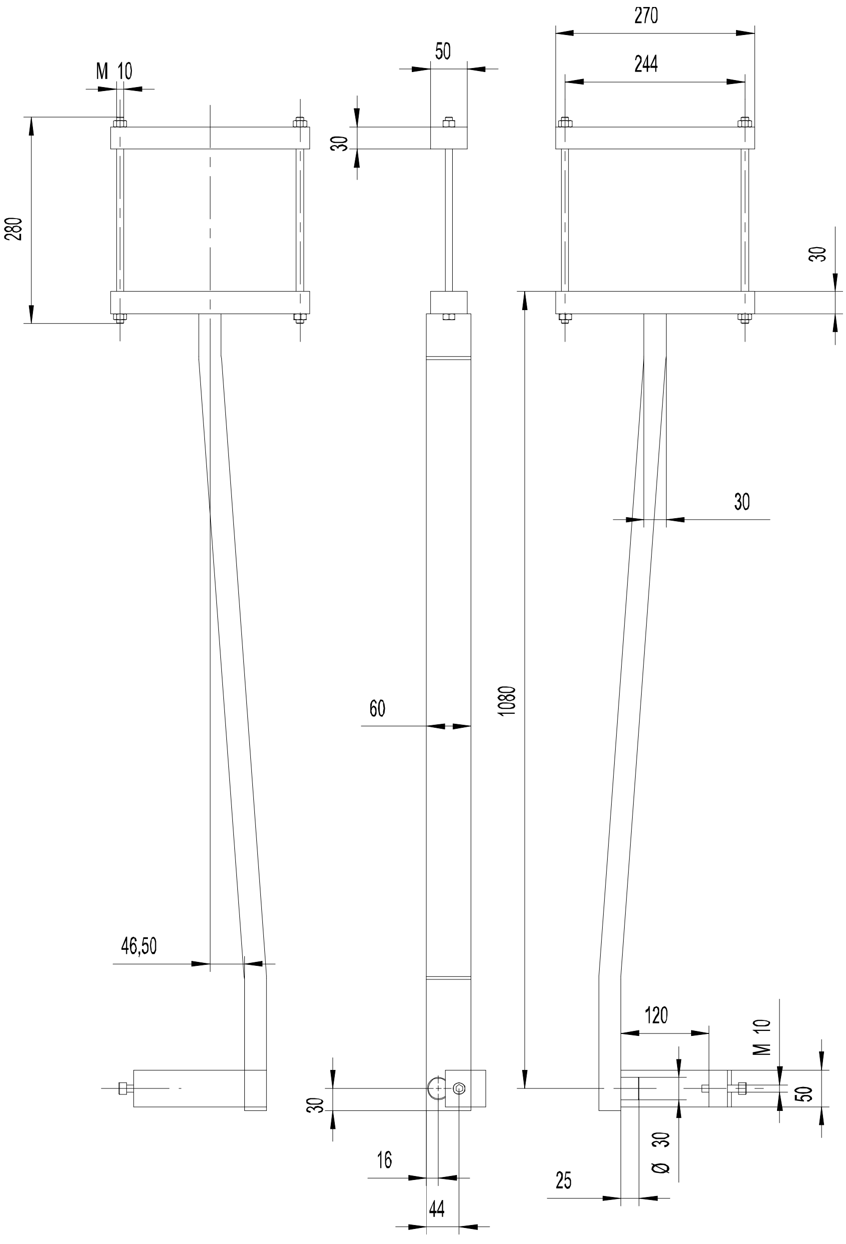
IRB 6620



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2.3 Securing the robot with a transport support

General

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

DANGER

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

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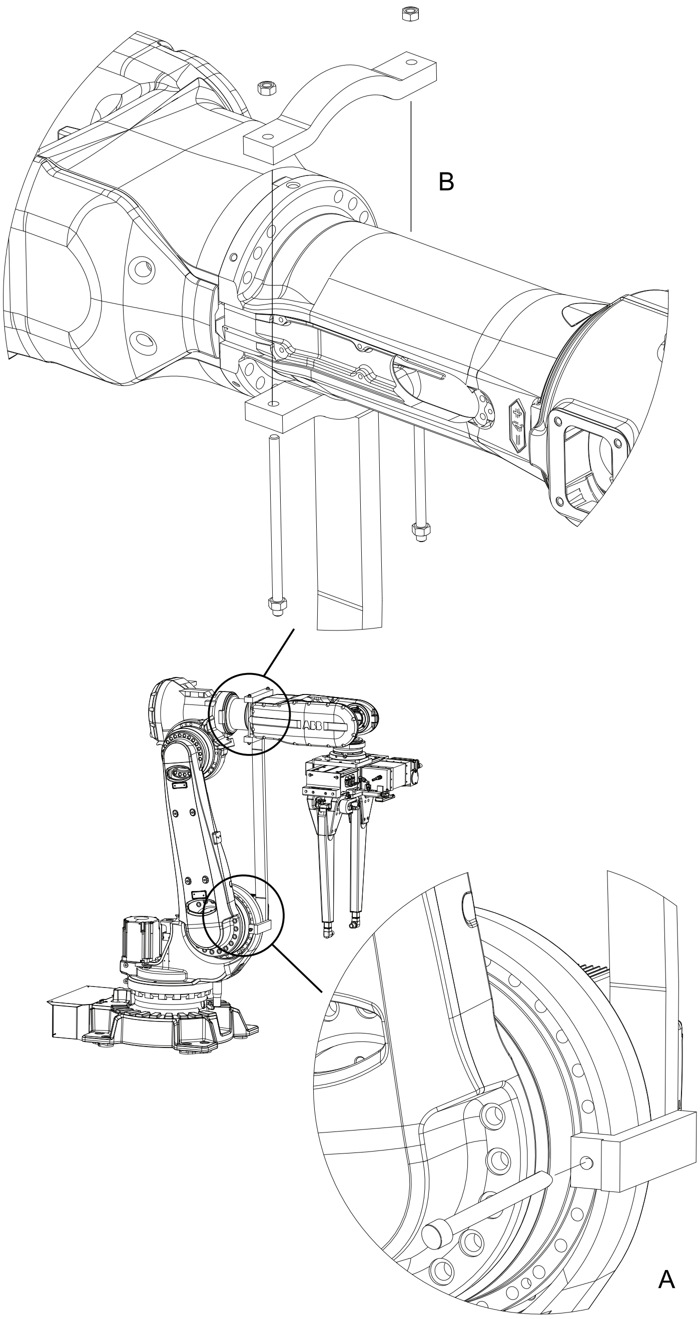
Fitting the transport support

Illustration for fitting the transport support



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Fitting the transport support

	Action	Note
1	Fit the transport support's lower end to the robot using the recommended screw joint, (A) in figure.	Do not tighten the screw. See attachment point for the specific robot in the section *Transport position with a transport support on page 45*.

Continues on next page

	Action	Note
2	Jog the robot into a position as near above as possible to the recommended transport position for the specific robot, as specified in section *Transport position with a transport support on page 45*.	**CAUTION** Do not try to jog the robot to the exact position (max distance 1mm).
3	Use the brake release for axis 3 to reach the final resting position on the transport support, see the section *Manually releasing the brakes on page 74*.	See attachment point for the specific robot in the section *Transport position with a transport support on page 45*
4	Tighten all the attachment screws, (A) and (B), in the figure with the brake release for axis 3 still activated starting with the lower attachment screw.	**CAUTION** Do not attempt to tighten any attachment screws without first releasing the brakes. This can seriously damage the robot.
5	Use the brake release for axis 5 and 6 to reach the final resting position for the tool, see the section *Manually releasing the brakes on page 74*	

2.4 Unpacking

2.4.1 Pre-installation procedure

Introduction

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

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage. **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 (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 52*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 54*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 54*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 52* • *Protection classes, robot on page 54* • *Requirements, foundation on page 53*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 59*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 61*
11	Install required equipment, if any. • *Signal lamp (option) on page 100*

Continues on next page

Weight, robot

The table shows the weight of the robot.

The weight does not include the weight of the DressPack.

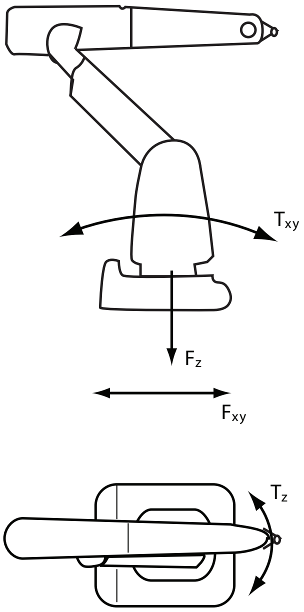
Robot model	Weight
IRB 6620	900 kg

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

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.



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

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

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

Continues on next page

WARNING

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

Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	± 7.3 kN	± 15.5 kN
Force z	11.0 ±2.0 kN	11.0 ±3.7 kN
Torque xy	± 18.0 kNm	± 37.2 kNm
Torque z	± 4.4 kNm	± 10.4 kNm

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	± 7.3 kN	± 15.5 kN
Force z	- 11.0 ±2.0 kN	- 11.0 ±3.7 kN
Torque xy	± 18.0 kNm	± 37.2 kNm
Torque z	± 4.4 kNm	± 10.4 kNm

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Maximum tilt	15°	The limit for the maximum payload on the robot is reduced if the robot is tilted from 0°. Contact ABB for further information about acceptable loads.

Continues on next page

Requirement	Value	Note
Minimum resonance frequency	22 Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment.[i] For information about compensating for foundation flexibility, see *Application manual - Controller software IRC5*, section *Motion Process Mode*.

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

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

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

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

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 54 [i]
Manipulator, protection type Foundry Plus	IP 67

i The upper arm, including the wrist, has protection class IP 67.

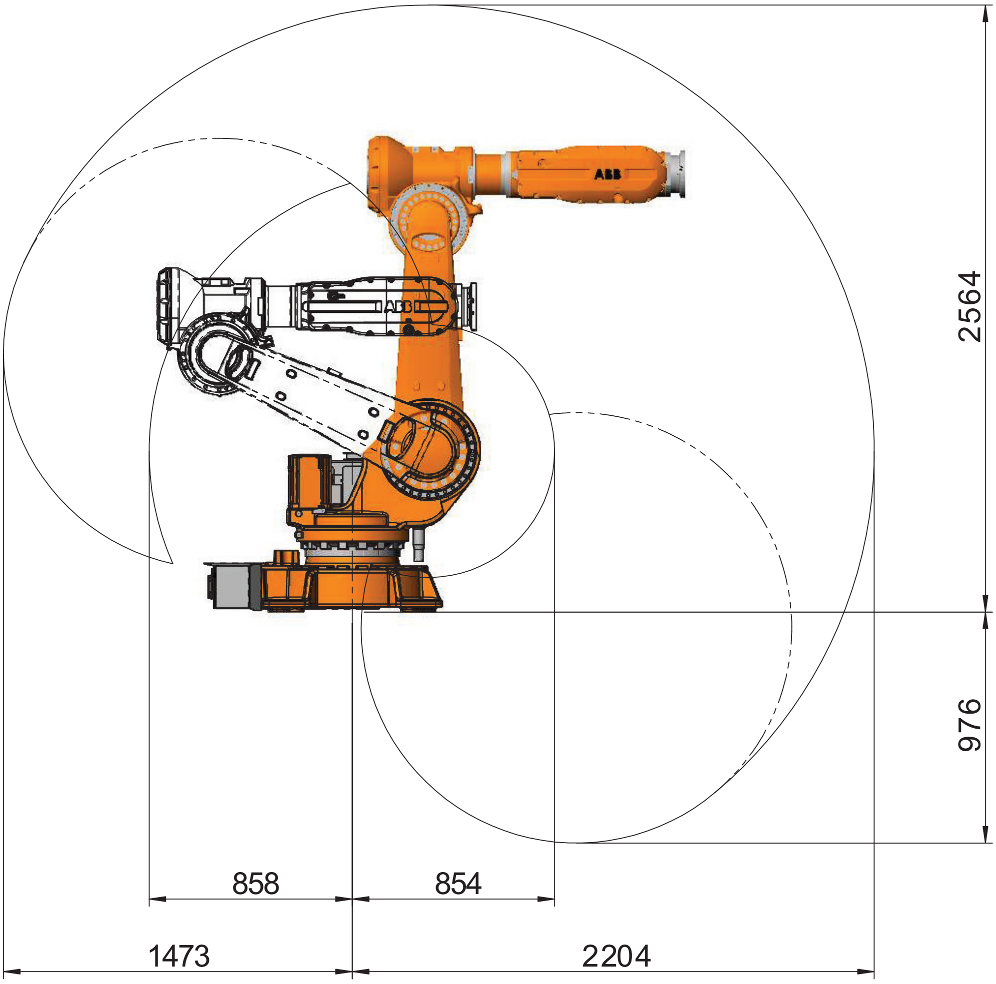
2.4.2 Working range and type of motion

Working range

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

Floor mounted

The illustration below shows the unrestricted working range when the robot is floor mounted:



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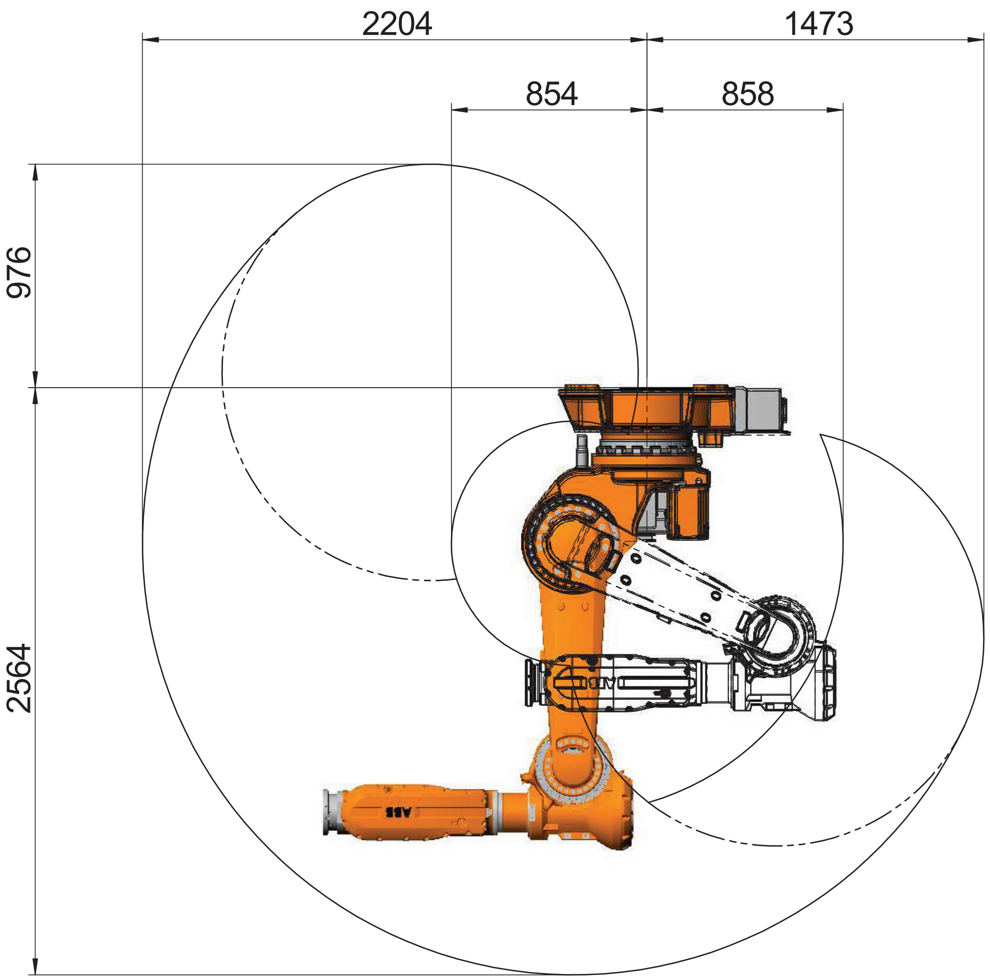
Suspended mounted

The illustration below shows the unrestricted working range when the robot is mounted suspended:



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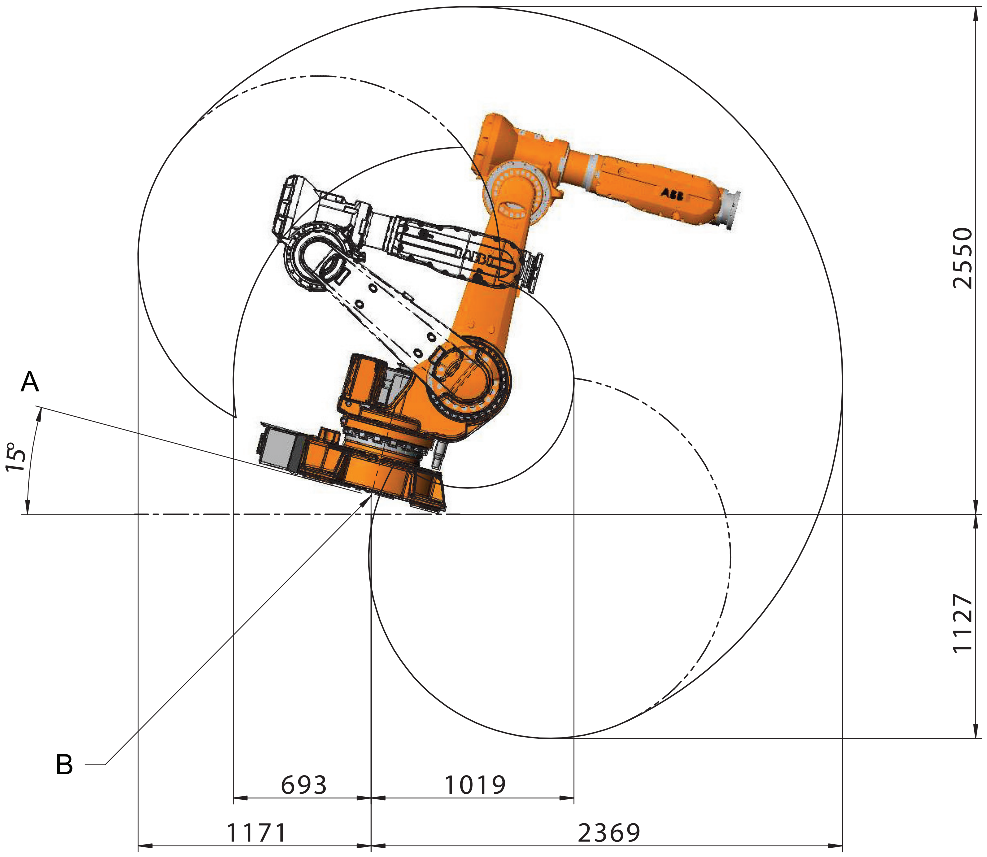
Floor mounted in 15° angle

The illustration below shows the unrestricted working range when the robot is floor mounted in 15° angle:



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A	**Note**! Maximum tilt angle is 15°
B	Intersection between base and axis 1 center

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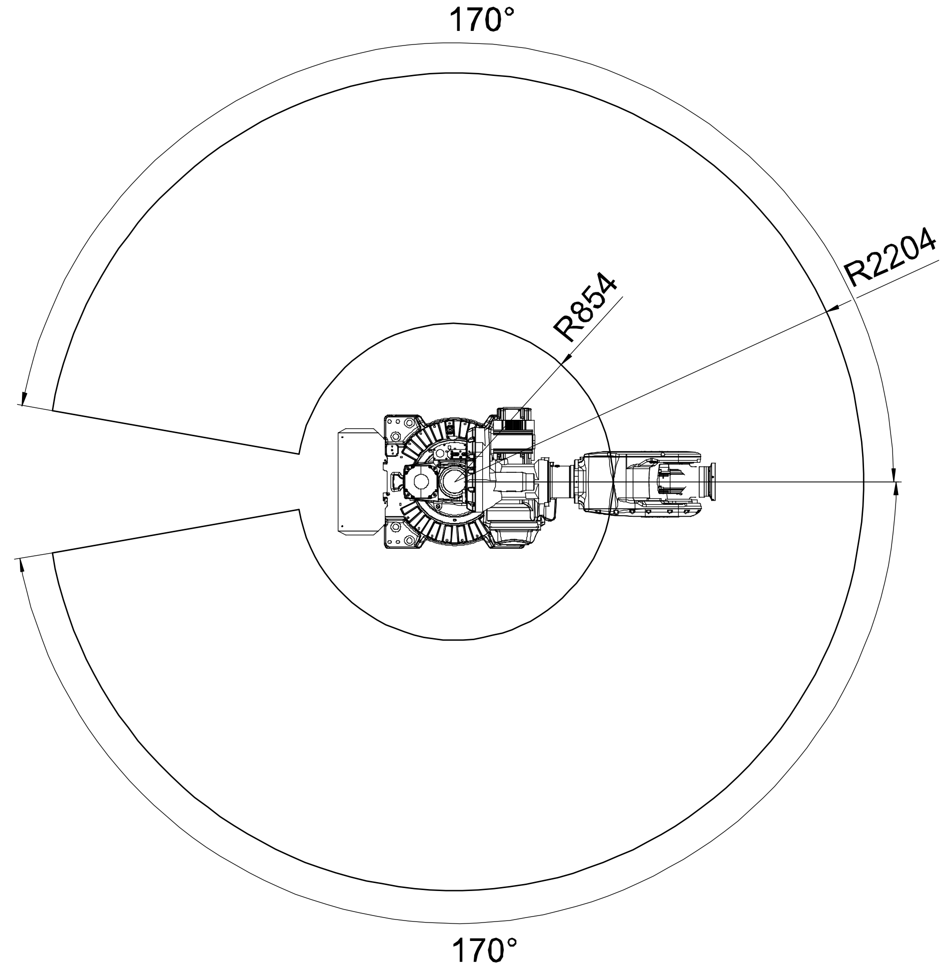
Turning radius - floor mounted

The turning radius for the robot when floor mounted, is shown in the figure below.



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Type of motion

Axis	Type of motion	Range of movement	Note
1	Rotation motion	+ 170° to - 170°	
2	Arm motion	+ 140° to - 65°	
3	Arm motion	+ 70° to - 115°	Limitations with dresspack
4	Wrist motion	+ 300° to - 300°	
5	Bend motion	+ 130° to - 130°	Limitations with dresspack
6	Turn motion	+ 300° to - 300° default	Max. ±96 revolutions [1]

[1] The default working range can be extended by changing parameter values in the software. Option*Advanced Motion* is required.

2.4.3 Risk of tipping/stability

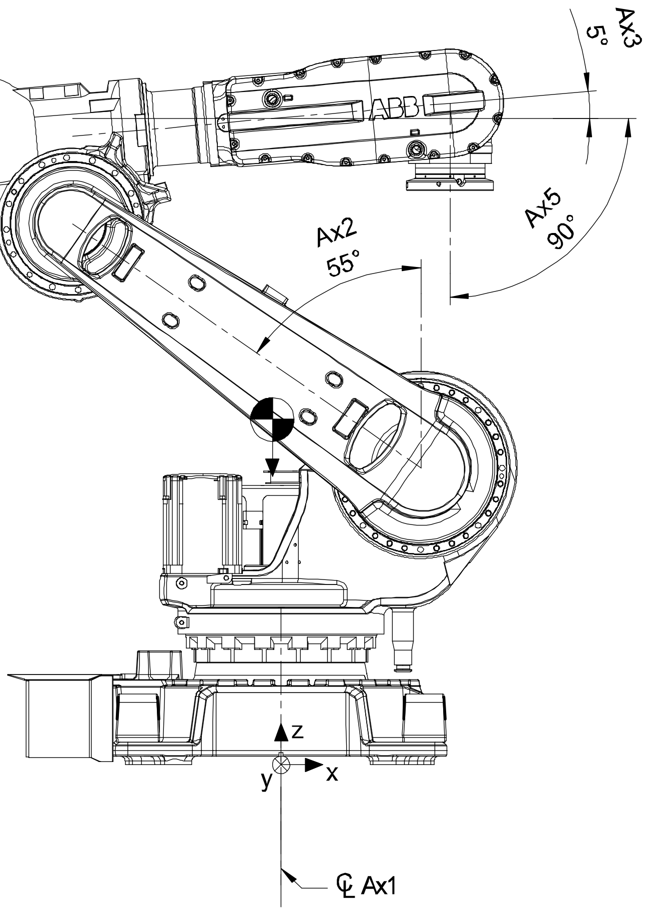
Risk of tipping

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

The shipping position is the most stable position.

Shipping and transportation position

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



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WARNING

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

2.4.4 The unit is sensitive to ESD

Description

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

Safe handling

Use one of the following alternatives:

- Use a wrist strap.

  Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly.
- Use an ESD protective floor mat.

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

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

2.5 On-site installation

2.5.1 Lifting the robot with fork lift accessory

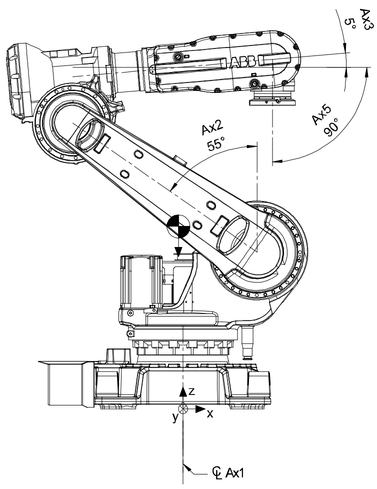
2.5.1.1 Fitting the fork lift accessory

Required equipment

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

Equipment	Art. no.	Note
Fork lift pocket set	3HAC025040-003	The fork lift accessory set contains: • fork lift pocket 3HAC025528-001, with CE-Marking fitted (4 pcs) • attachment screws M20x60 Steel 8.8-A3F (8 pcs) • Drawing Fork lift accessory set • manual *Directions for use - Fork lift accessory for IRB 6620, 6640, 460*
Fork lift truck	-	The operator must be fully trained and authorized to operate a fork lift truck.

Preparations before fitting the fork lift pockets

	Action	Note
1	Remove any tools fitted on the axis-6 turning disk. **Note** No tool is permitted to be fitted on the robot when lifting the robot with the fork lift accessory!	DressPack, if used, can stay fitted as long as the tool fitted on the turning disk is removed.
2	Jog the robot to its shipping position. See figures for the different IRB models. **Note** The figures shows the shipping position of an *undressed* robot. If the robot is dressed, this must be taken into consideration when the robot is being lifted.	 xx0600002935

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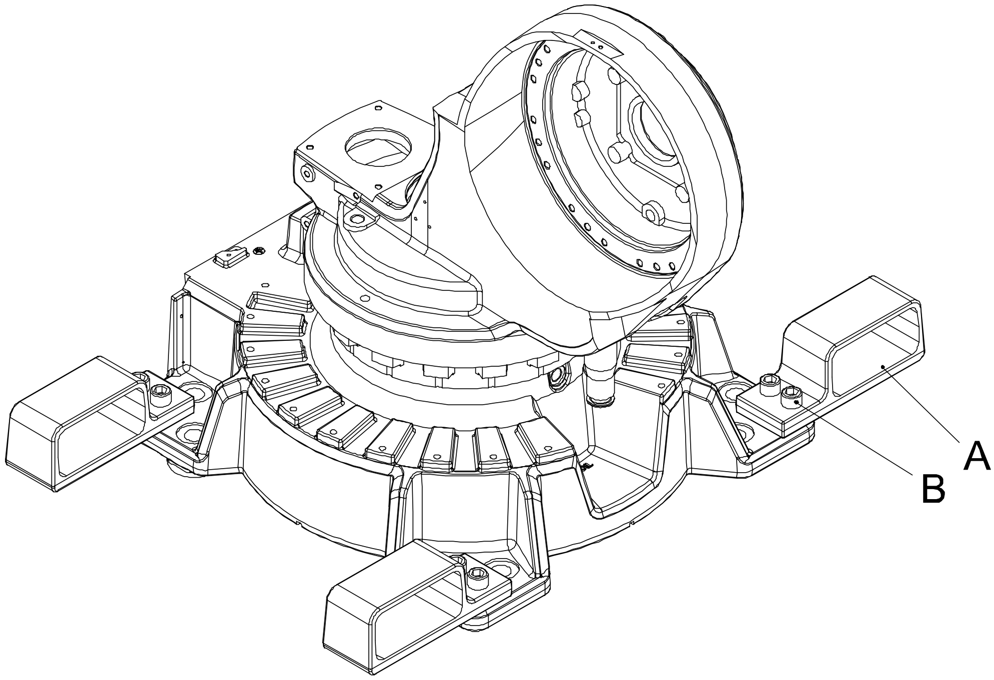
	Action	Note
3	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	

Attachment points on the robot

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



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

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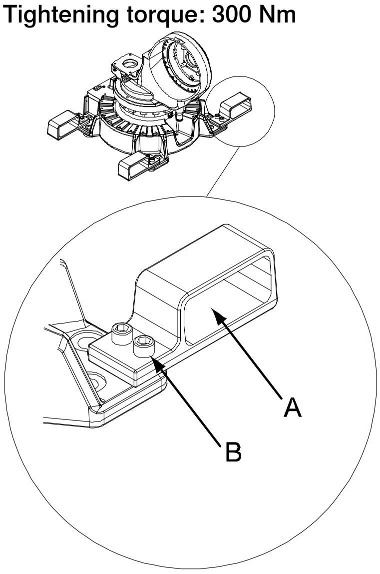
Fitting the fork lift accessory set

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

2.5.1.2 Lifting the robot with fork lift truck

General

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

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

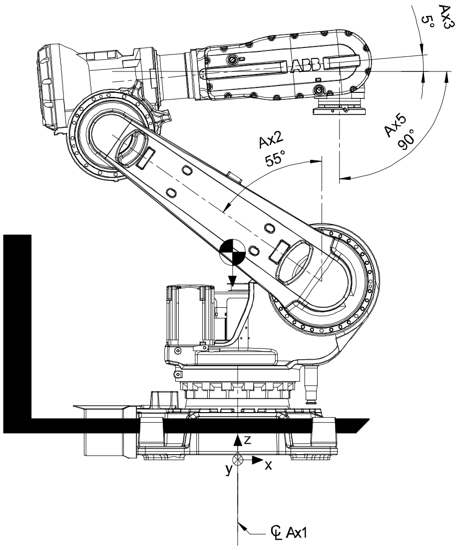
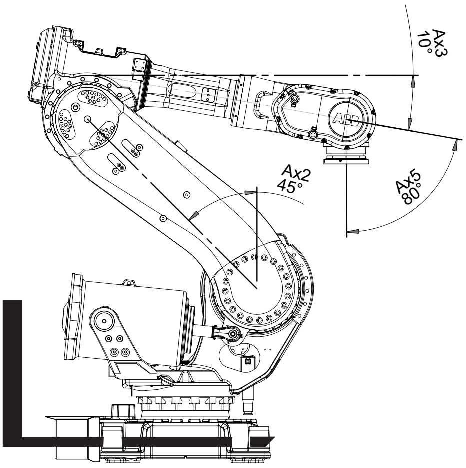
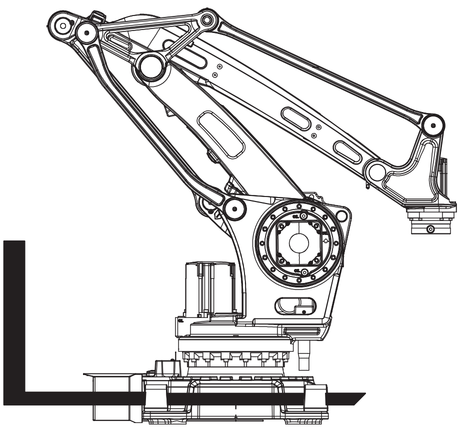
Required equipment

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

Lifting the robot with fork lift truck

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

Continues on next page

	Action	Note
4	Insert fork lift forks into the pockets. **CAUTION** Lifting the robot with fork lift shall only be done with all four fork lift pockets fitted! If lifting with fewer than four fork lift pockets fitted, there is a risk of accidents!	IRB 6620  xx0600002911 IRB 6640  xx0600003401 IRB 460  xx1000001159

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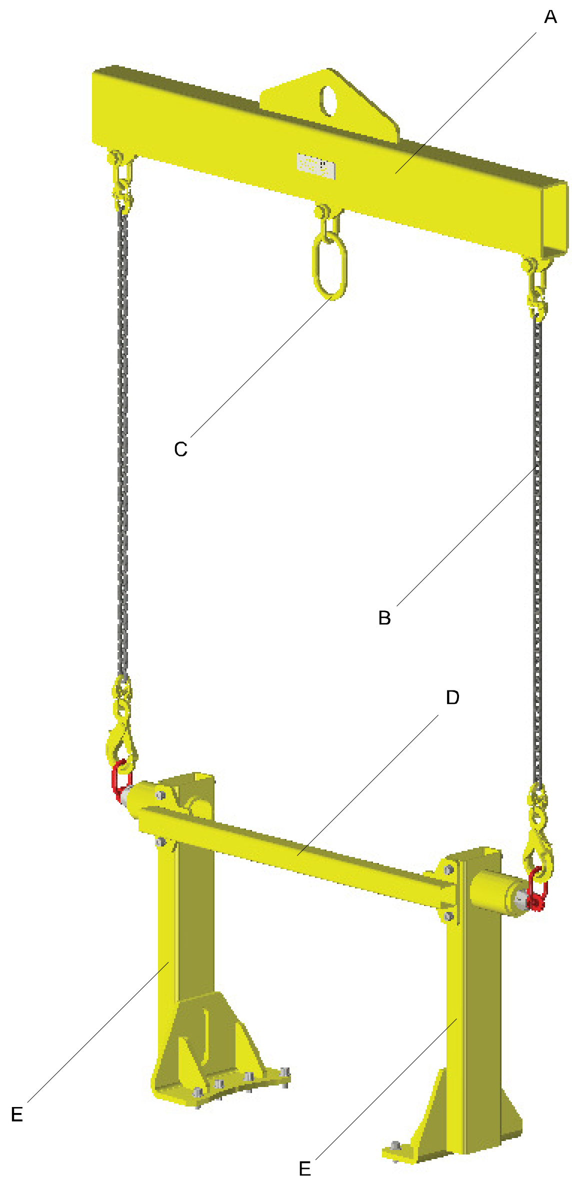
	Action	Note
5	Remove the attachment bolts securing the robot to the foundation.	
6	**CAUTION** The IRB 6620 robot weighs 900 kg. All lifting accessories used must be sized accordingly!	
7	Carefully lift the robot. **WARNING** Personnel must not, under any circumstances, be present under the suspended load!	
8	Move the robot slowly to its new position.	**Note** Move the robot with low speed!
9	Secure the robot to the foundation **DANGER** Do not power the robot up until it is secured properly to the foundation.	
10	Remove the fork lift accessories.	

2.5.2 Lifting the robot with lifting and turning tool

The lifting and turning tool

The lifting and turning tool 3HAC025792-001is used for lifting and turning of the IRB 6620.

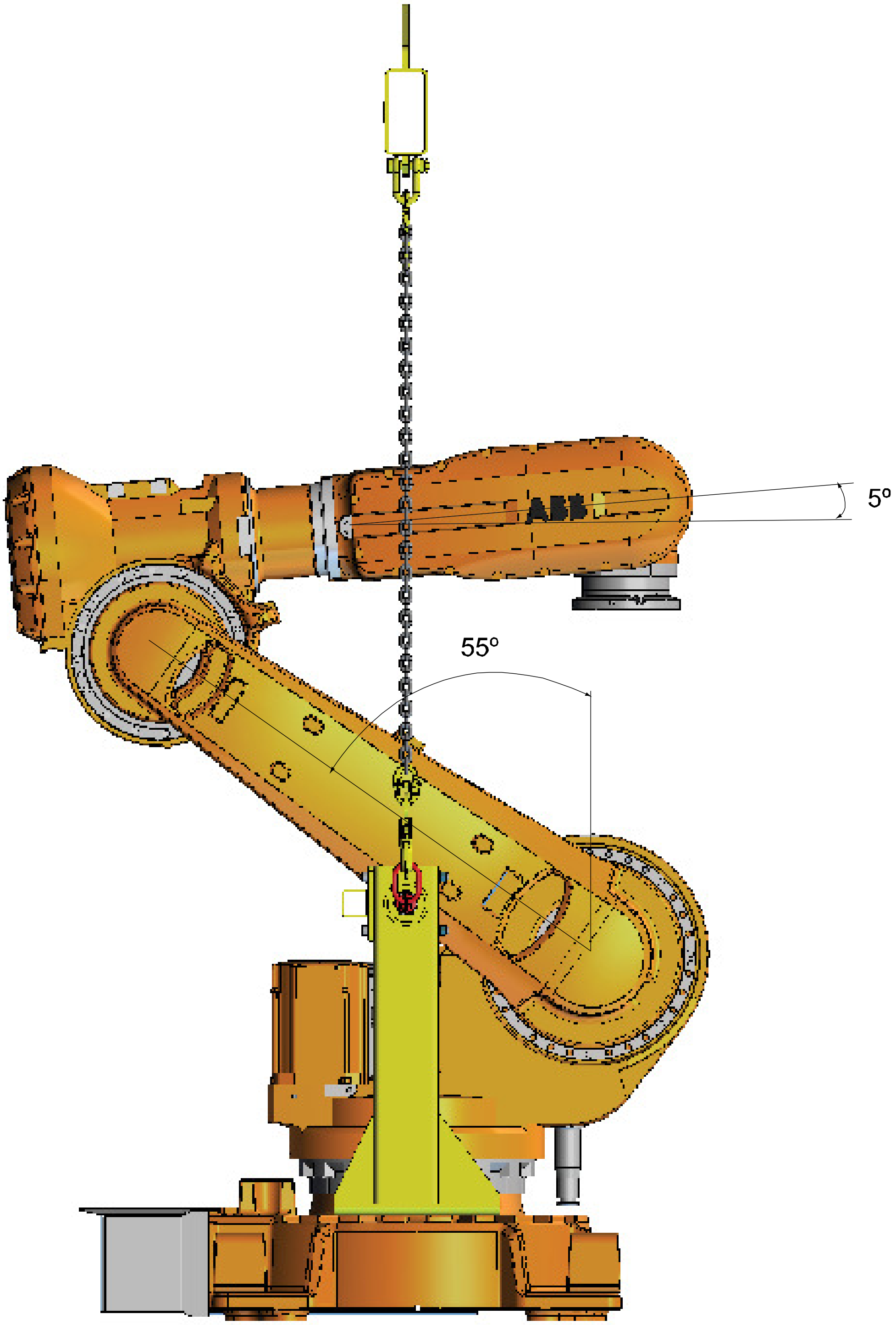


xx0900000325

A	Upper lifting beam
B	Chains
C	Lifting eye
D	Lower lifting beam
E	Lifting hold (Left and Right)

Continues on next page

Lifting position



xx0900000330

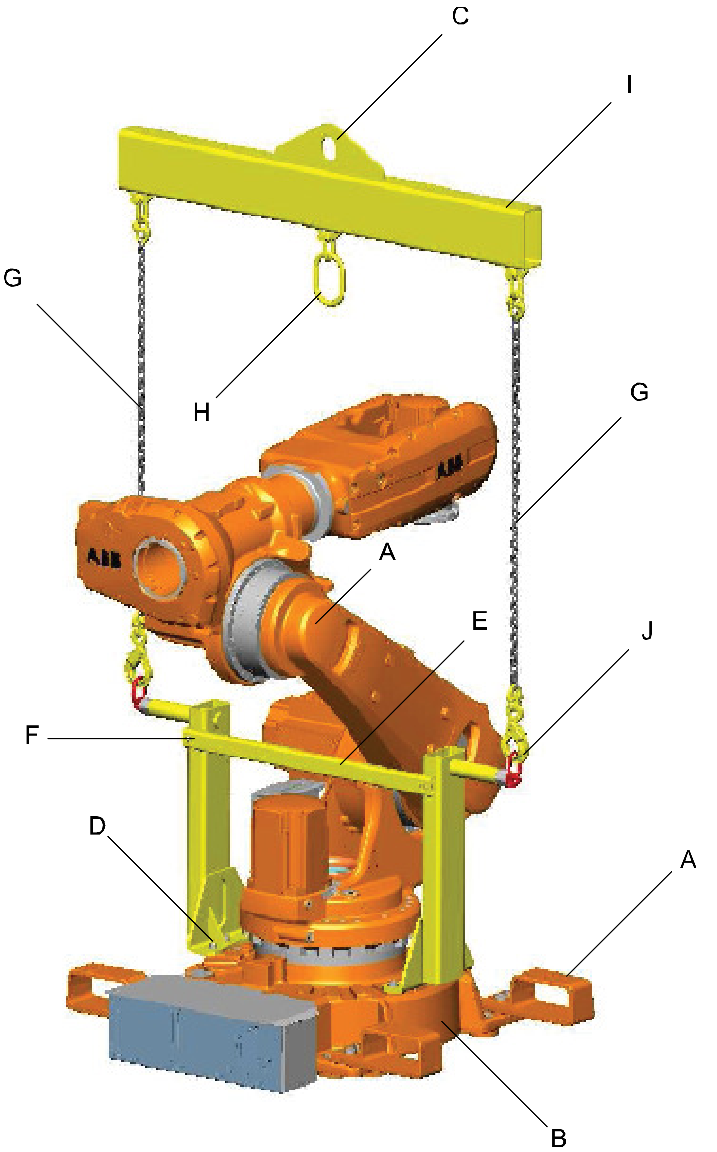
	Action	Note
1	Jog the robot axis to a position suitable for lifting	Lifting position according to figure.

Continues on next page

Turning procedure

Fitting the lifting and turning tool

The figure shows the lifting and turning tool fitted to the robot.



xx0900000327

A	Lifting accessories for forks
B	Robot base
C	Lifting eye upper beam
D	Attachment bolts in robot base
E	Distribution beam
F	Attachment bolts for distribution beam
G	Lifting chains
H	Chain block lifting eye
I	Upper beam

Continues on next page

J	Lifting hooks

Turning the robot

	Action	Information
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Fit the four lifting accessories for forks on the robot base	Tightening torque 300Nm
3	Fit the lifting tool 3HAC025792-001 to the robot base using the eight attachment screws	Tightening torque 90Nm
4	Lift the upper beam using a overhead crane	
5	Attach the upper beam to the lower beam using the lifting chains.	
6	Lift slowly until the chains are tensioned. Make sure that no cabling is damaged while lifting.	
7	Attach the chain block to the upper beam lifting eye.	**Note** Use a suitable chain block for minimum lifting weight 500 kg and with chain length minimum 3 m.

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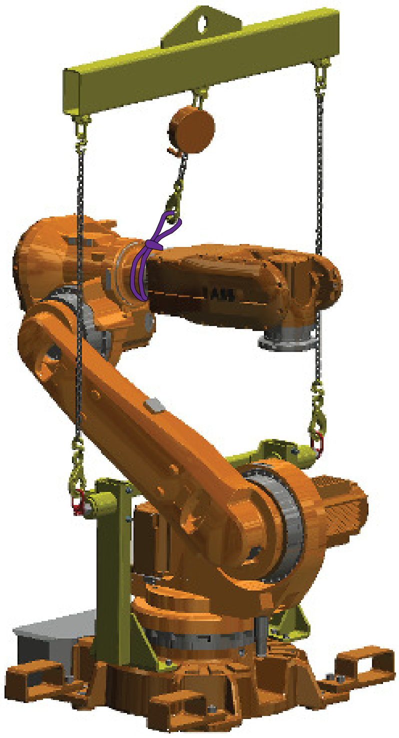
	Action	Information
8	Use lifting slings to secure the robot shown in figure.	 xx0900000332
9	Lift slowly until the load moves. Lift until the distance between the floor and robot is at least 350 mm.	
10	Turn the robot using the chain block.	
11	If the robot is to be moved to the installation location, use a forklift.	

2.5.3 Lifting robot with roundslings

General

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

Sling specification

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

Lifting with roundslings

	Action	Note
1	Position robot in a secure transport position.	
2	Attach *lifting eye bolts* in the rear M20 holes.	Shown in figure *Attachment points on page 73*.
3	Attach roundslings to robot according to figure *Attachment points on page 73*.	
4	**Note** Make sure that the roundslings do not lie against sensitive parts, for example harness and customer equipment!	
5	When attaching the **roundsling A** on the upper arm, put it in a U-shape through the hole in the wrist.	Shown in the figure *Attachment points on page 73*.
6	When attaching the **roundsling B** on the upper arm, put it in a sling around the gearbox axis 4 and on the inside of motor axis 4.	Shown in the figure *Attachment points on page 73*.
7	When attaching the *roundsling C* , *note* that it shall be routed on the inside of the cable harness of motor axis 2, in order not to damage the harness!	Shown in the figure *Attachment points on page 73*.
8	**CAUTION** The IRB 6620 robot weighs 900 kg. All lifting accessories used must be sized accordingly!	

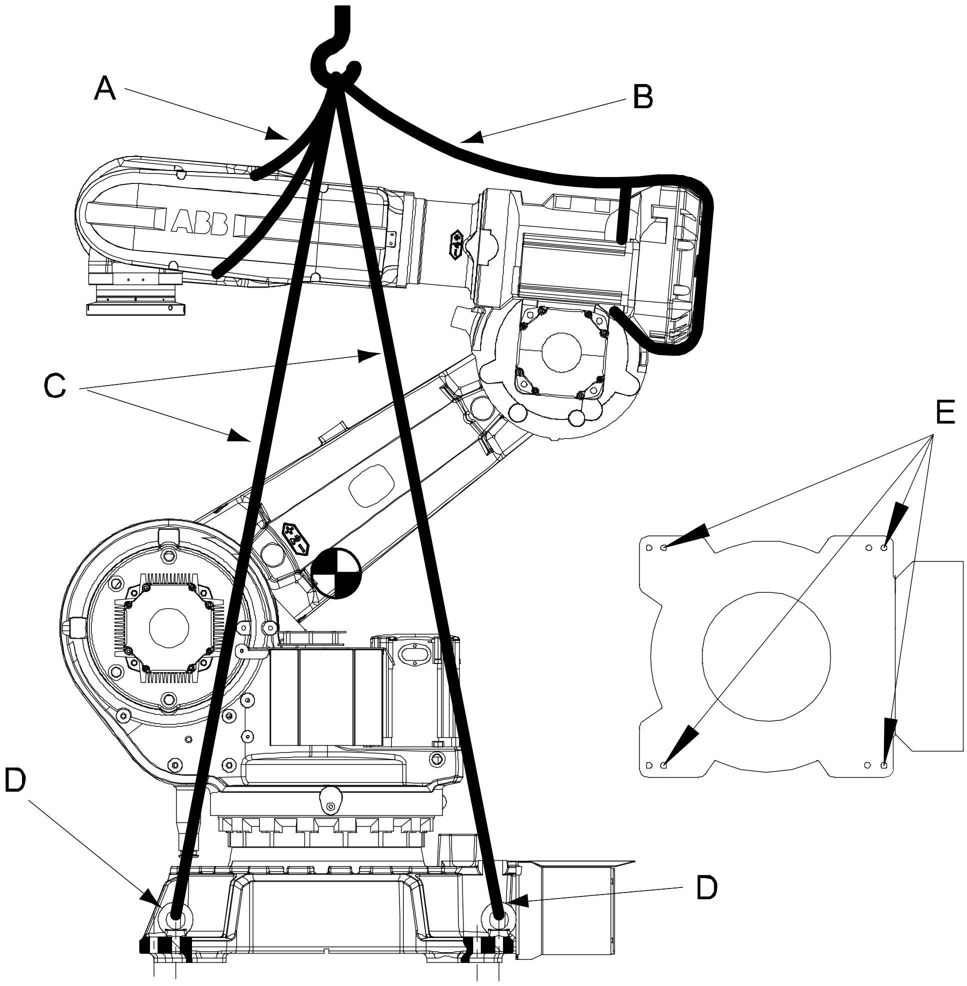
Continues on next page

	Action	Note
9	**WARNING** Personnel must not, under any circumstances, be present under the suspended load!	

Attachment points

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

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



xx0600002921

A	Roundsling upper arm, 2.5 m.
B	Roundsling upper arm, 2 m.
C	Roundsling robot, 2.5 m (4 pcs).
D	Lifting eye, M20 (4 pcs)
E	Holes for lifting eyes in the robotbase. (Rear holes)

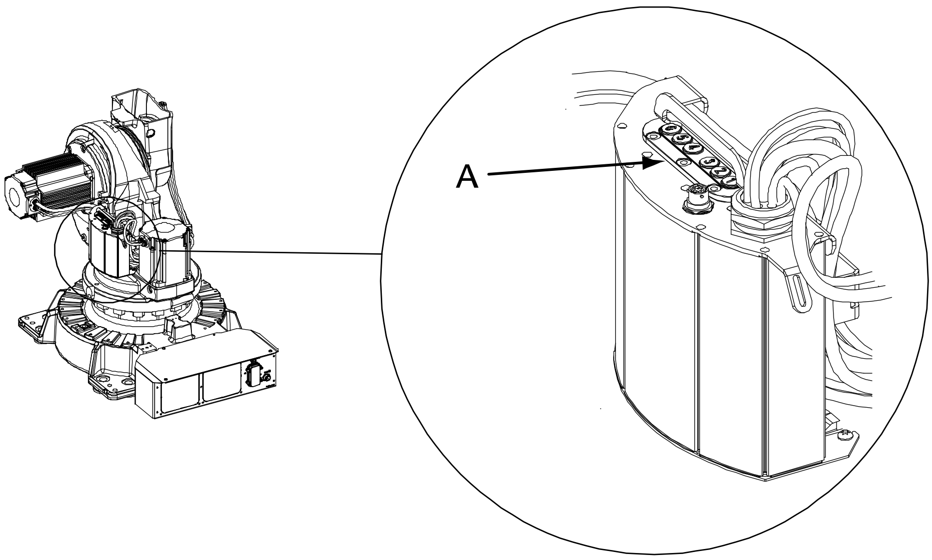
2.5.4 Manually releasing the brakes

Introduction to manually releasing the brakes

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

Location of brake release unit

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



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Releasing the brakes

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

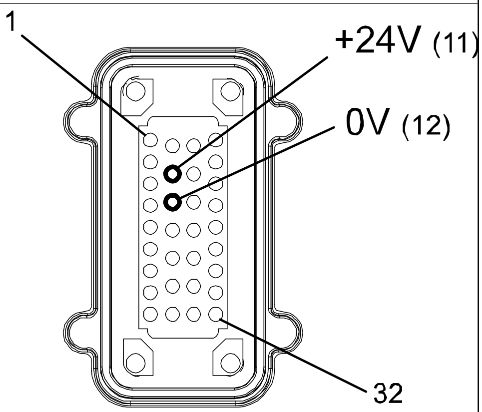
	Action	Note
1	The internal brake release unit is equipped with buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes. If the robot is not connected to the controller, power must be supplied to the connector R1.MP according to the section *Supplying power to connector R1.MP on page 75*.	Buttons are shown in figure *Location of brake release unit on page 74*.
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.	

Continues on next page

	Action	Note
3	Release the holding brake on a particular robot axis by pressing the corresponding button on the internal brake release unit. The brake will function again as soon as the button is released.	

Supplying power to connector R1.MP

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

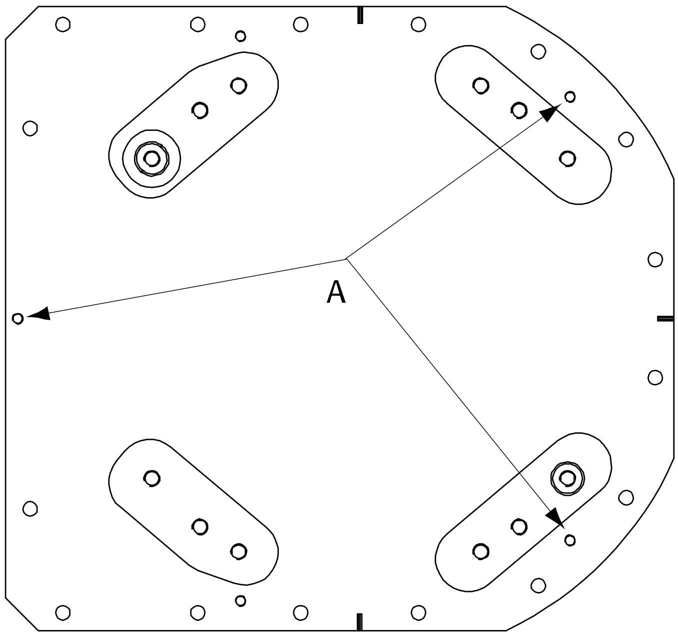
	Action	Note
1	 **DANGER** Incorrect connections, such as supplying power to the wrong pin, may cause all brakes to be released simultaneously!	
2	Supply 0V on pin 12 and 24V on pin 11.	 xx0600002937

2.5.5 Lifting the base plate

Required equipment

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

Hole configuration



xx0200000096

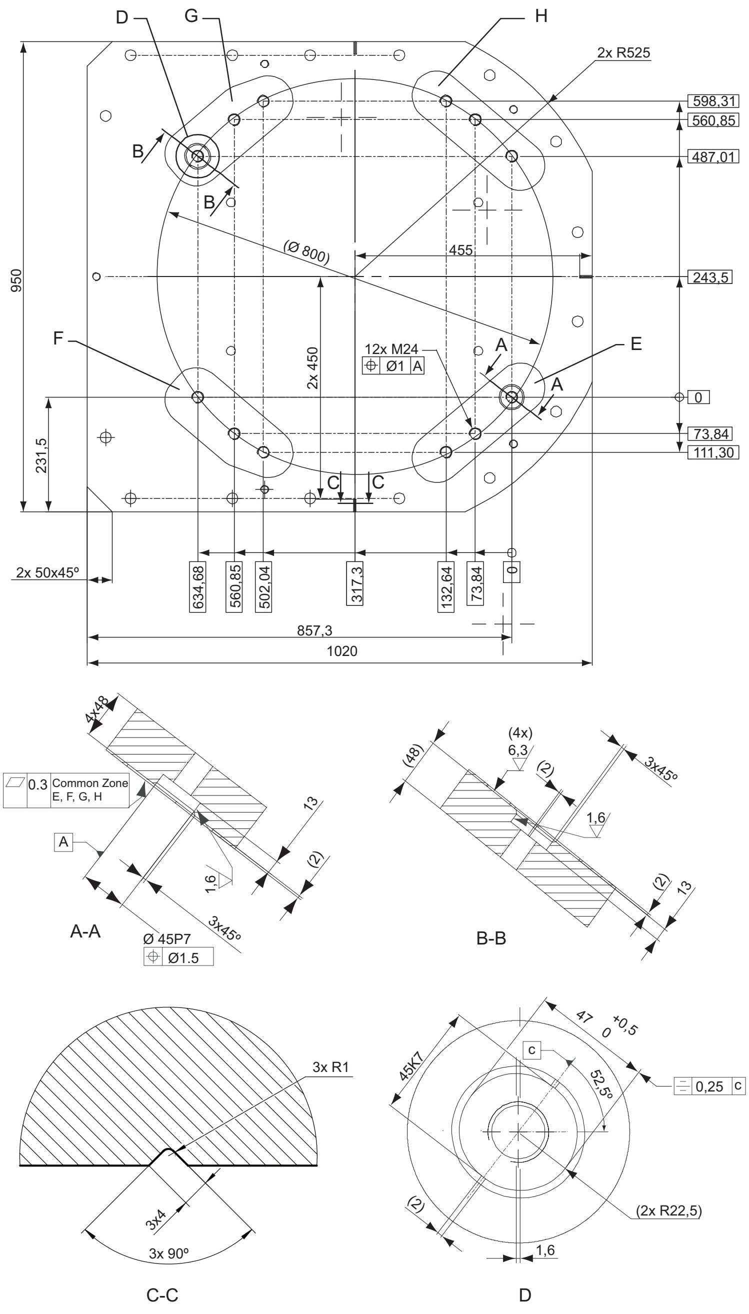
A	Attachment holes for lifting eyes (x3)

Lifting, base plate

	Action	Note
1	**CAUTION** The base plate weighs 353 kg. All lifting accessories used must be sized accordingly.	
2	Fit lifting eyes in specified holes.	Shown in figure *Hole configuration on page 76*.
3	Fit lifting slings to the eyes and to the lifting accessory. **CAUTION** Lift and move the base plate very slowly. If the base plate starts to swing it is a risk for injuries or damage.	

2.5.6 Securing the base plate

Base plate, dimensions



xx1000001053

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

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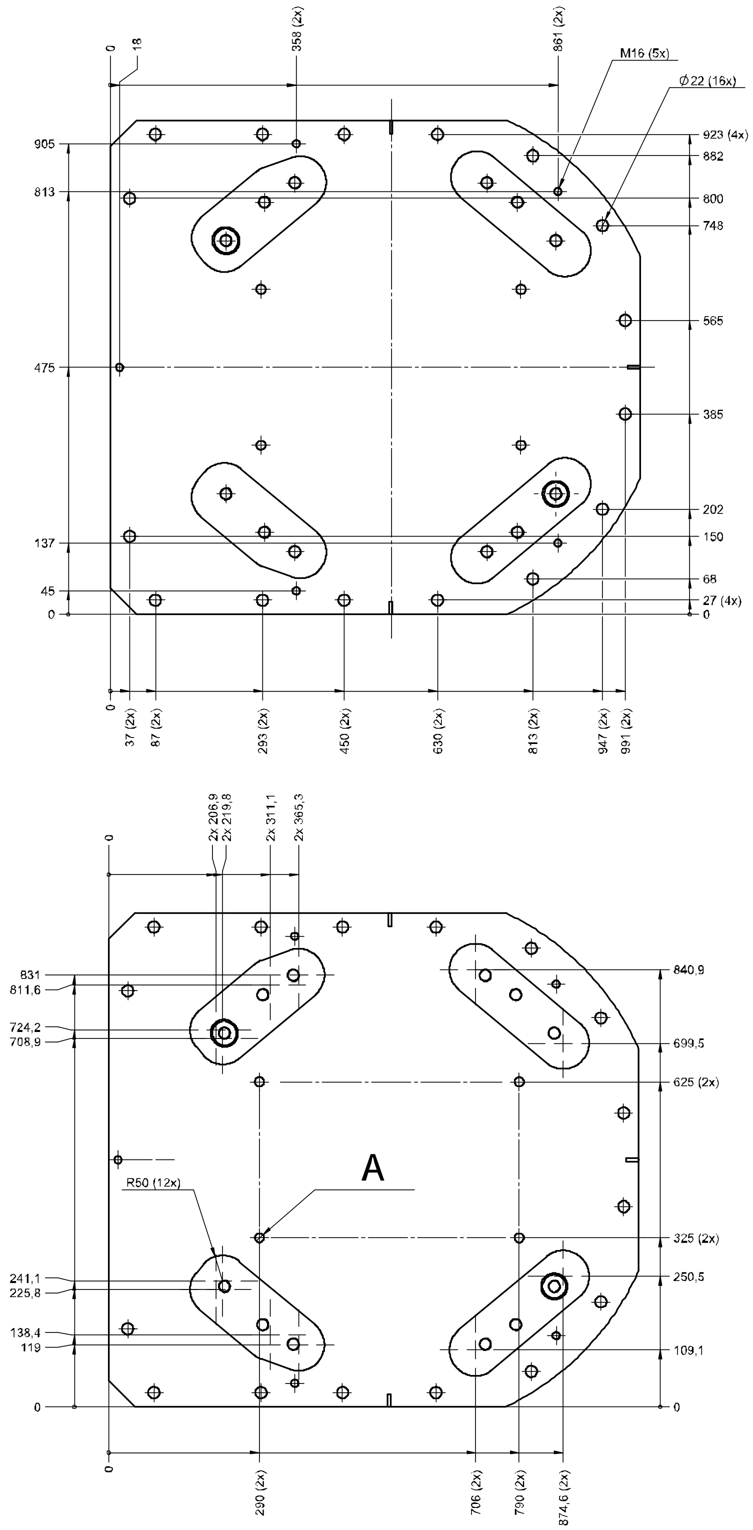
2.5.6 Securing the base plate

Continued



xx0400000715

A	Four holes for alternative clamping, 4x Ø18

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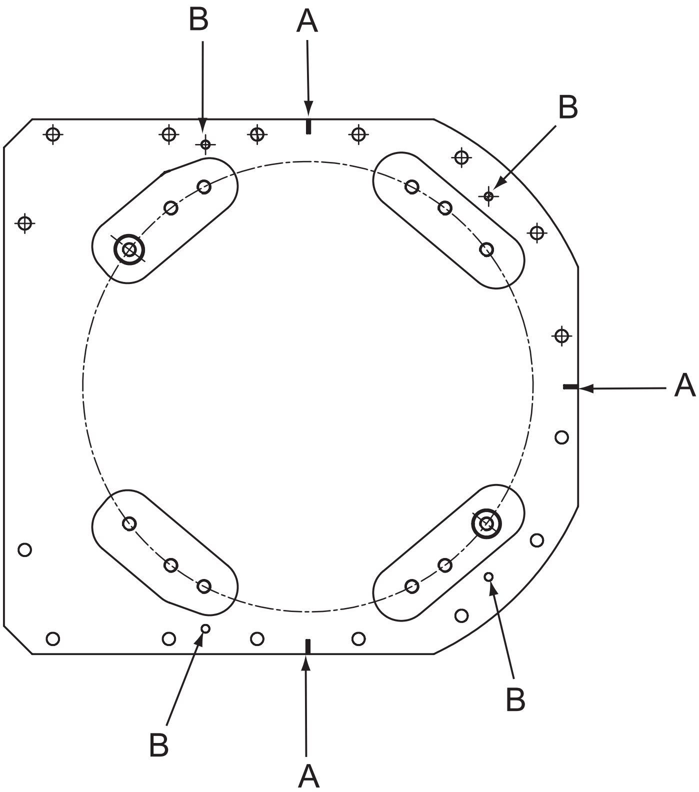
Base plate, orienting grooves and leveling bolts

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



xx1500000312

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

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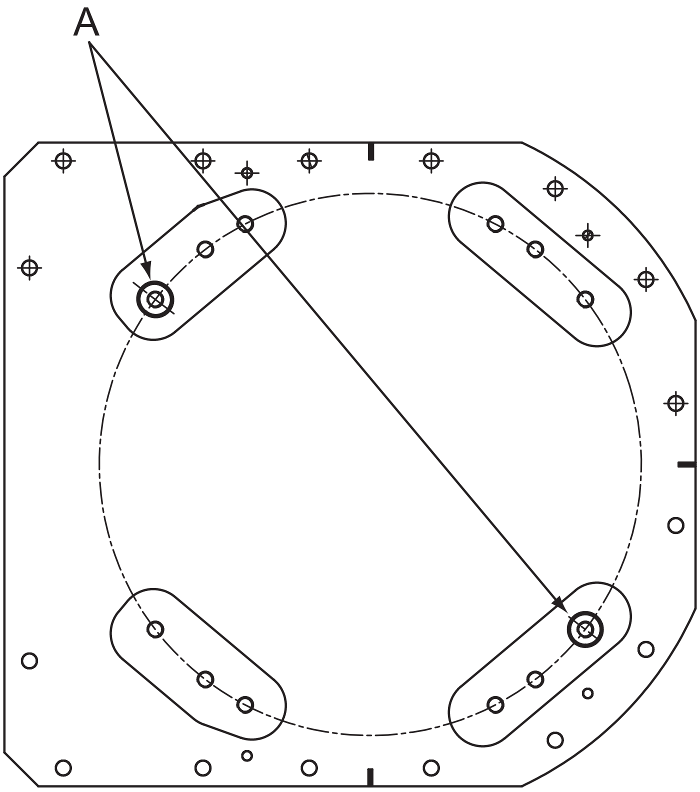
Base plate, guide sleeve holes

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



xx0300000045

A	Guide sleeve holes (2 pcs)

Required equipment

Equipment	Article number	Note
Base plate	3HAC12937-9	Includes • guide sleeves, 3HAC12937-3 • levelling screws, 9ADA120-79 • attachment screws and washers for securing the robot to the base plate.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Base plate

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

	Action	Note
1	Make sure the foundation is levelled.	

Continues on next page

	Action	Note
2	**CAUTION** The base plate weighs 353 kg! All lifting equipment used must be sized accordingly!	
3	Position base plate in relation to the robot work location using the grooves in the base plate.	Shown in figure *Base plate, orienting grooves and leveling bolts on page 79*.
4	Lift the base plate to its mounting position.	Detailed in section *Lifting the base plate on page 76*.
5	Use the base plate as a template and drill attachment holes as required by the selected bolt dimension.	Attachment holes: 16 pcs.
6	Fit the base plate and use the levelling bolts to level the base plate.	Shown in figure *Base plate, orienting grooves and leveling bolts on page 79*.
7	If required, fit strips of sheet metal underneath the base plate to fill any gaps.	
8	Secure the base plate to the foundation with screws and sleeves.	
9	Recheck the four contact surfaces on the base plate to make sure the base plate is levelled and flat. If it is not, use pieces of sheet metal or similar to bring the base plate to a levelled position.	Maximum allowed deviation all over the base plate, from one contact surface to the other: 0.3 mm.

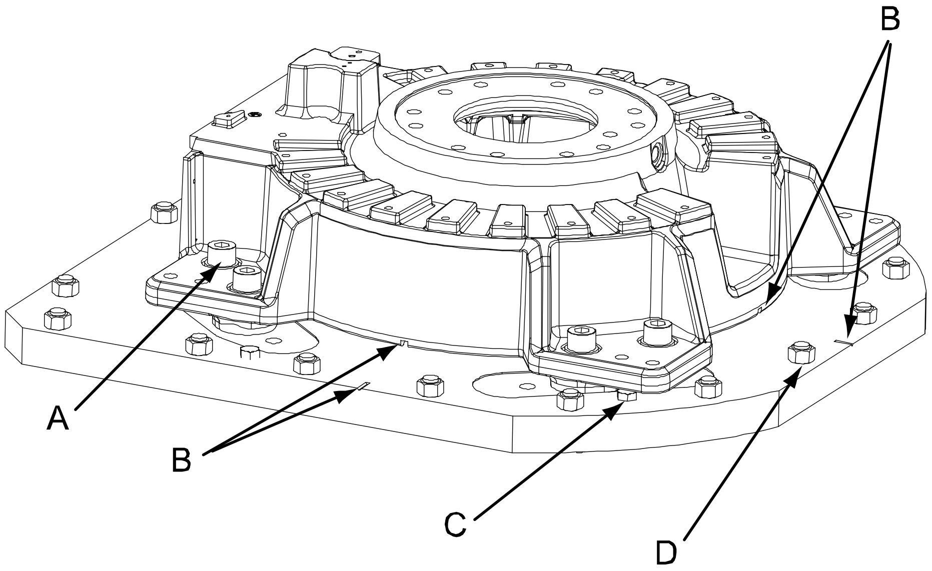
2.5.7 Orienting and securing the robot

General

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

Illustration, robot fitted to base plate

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



xx0600002933

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

Attachment screws

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

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

Continues on next page

Securing the robot

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

	Action	Note
1	Lift the robot.	See section *Lifting robot with roundslings on page 72*.
2	Move robot to the vicinity of its installation location.	
3	Fit two guide sleeves to the *guide sleeve holes* in the base plate.	Shown in figure *Base plate, guide sleeve holes on page 80*. **Note** One of the guide sleeve holes is elongated!
4	Guide the robot gently using two M24 screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the guide sleeves!
5	Fit the *bolts and washers* in the base attachment holes.	Specified in *Attachment screws on page 82*. Shown in figure *Illustration, robot fitted to base plate on page 82*. **Note** Lightly lubricate screws before assembly!
6	Tighten bolts in a criss-cross pattern to ensure that the base is not distorted.	

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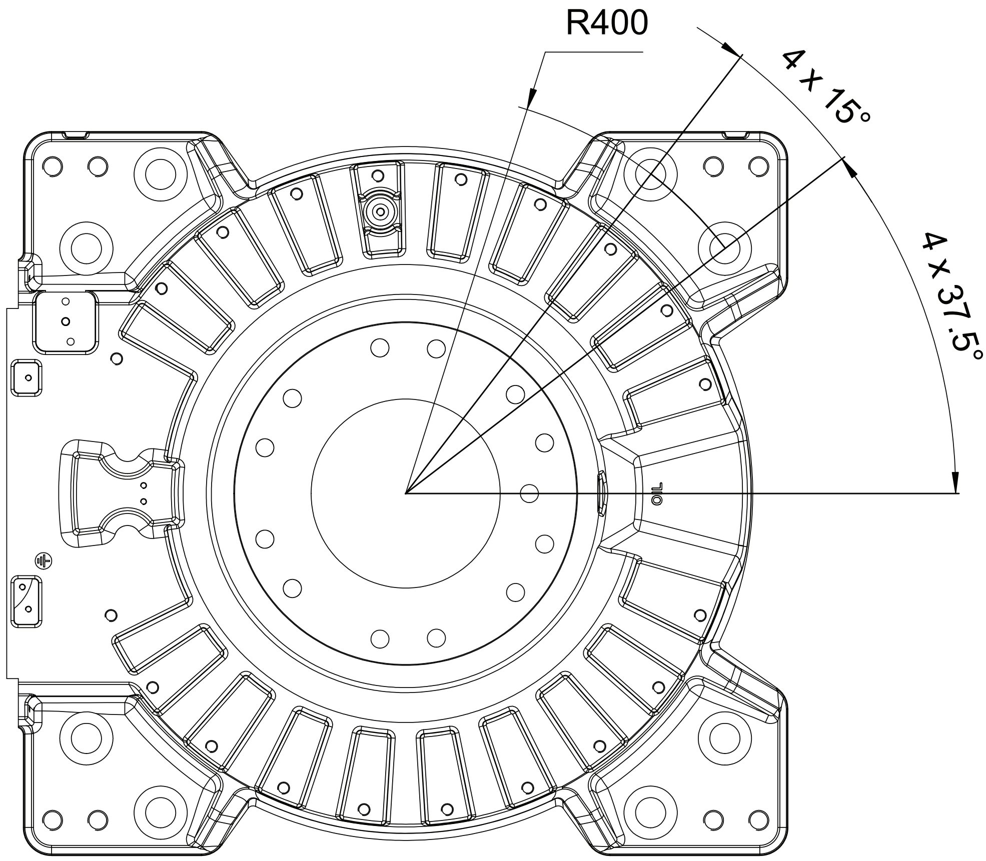
Hole configuration, base

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



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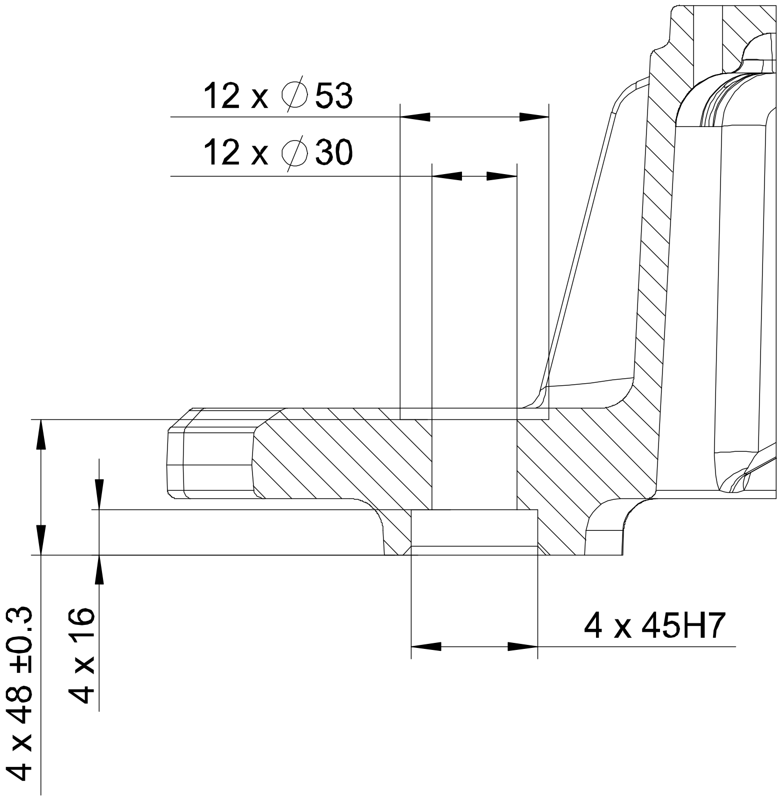
Cross section, guide sleeve hole

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



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2.5.8 Setting the system parameters for a suspended or tilted robot

General

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

Note

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

Note

The allowed mounting positions are described in the product specification for the robot. The requirements on the foundation are described in *Requirements, foundation on page 53*.

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 ±π/2 (±1.570796) if mounted on a wall.

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

Continues on next page

Gravity Alpha

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° x 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 (A°)	Gravity Beta
Floor mounted	0°	0.000000 (Default)
Tilted mounting	15°	0.261799
Suspended mounting	180°	3.141593

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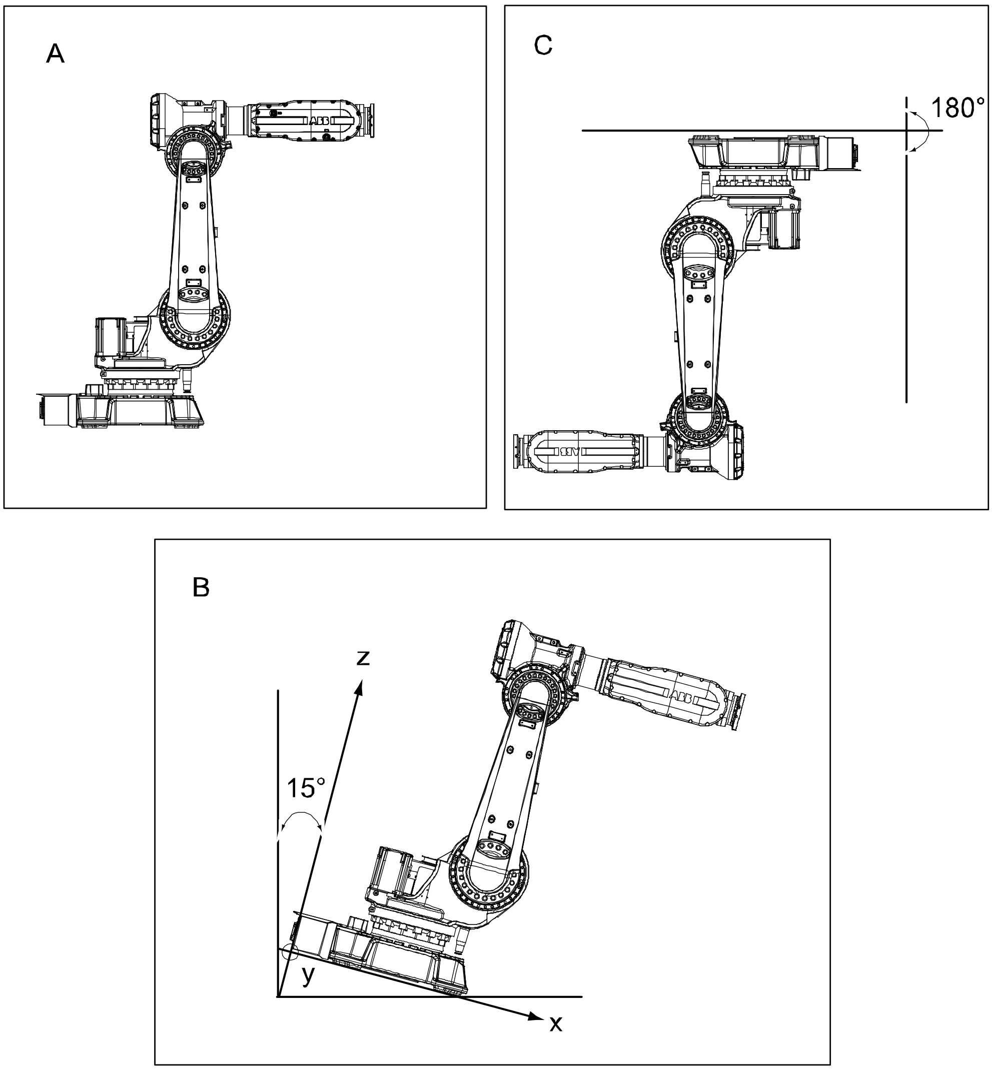
Examples of mounting angles tilted around the Y axis (*Gravity Beta*)



xx0600003144

A	Floor mounted
B	Tilted mounting, mounting angle 15°.
C	Suspended mounting, mounting angle 180°.

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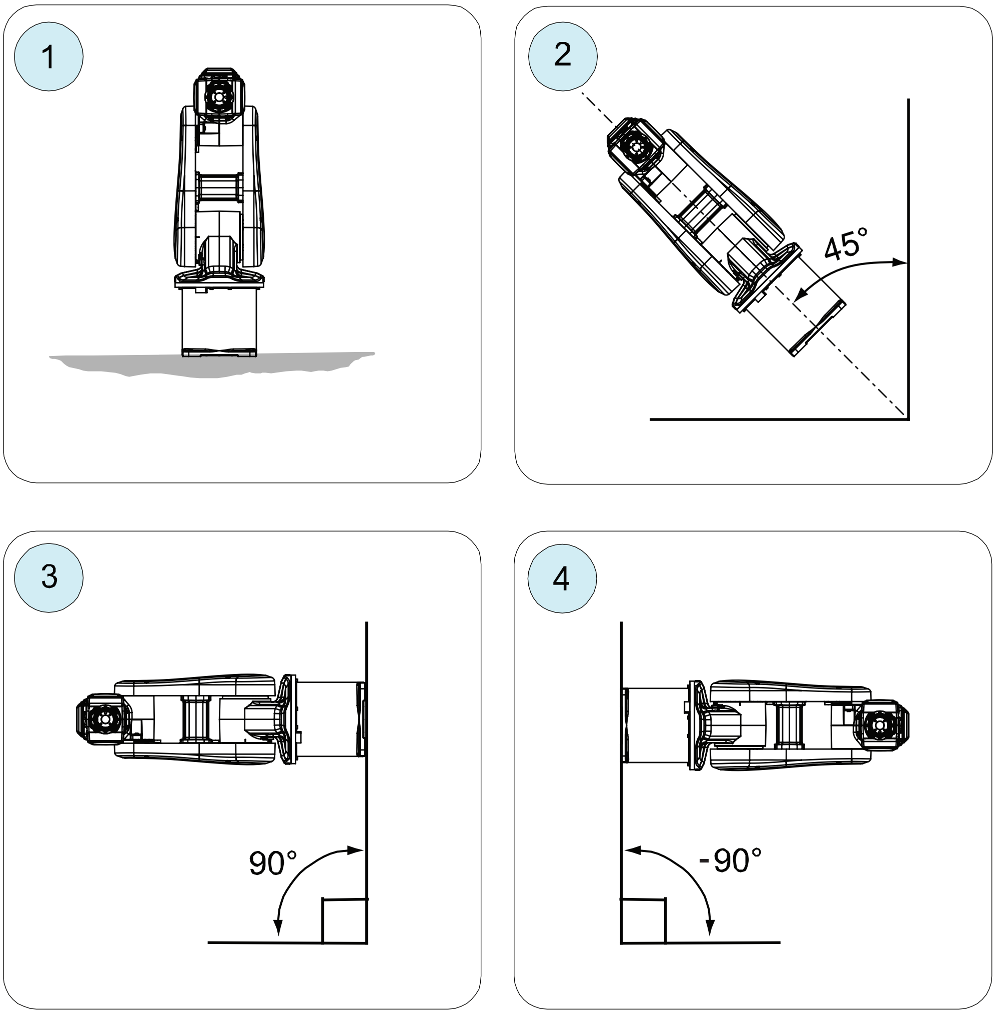
Examples of mounting angles tilted around the X axis (*Gravity Alpha*)

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*.

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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 87*.

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

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

2.5.9 Fitting equipment on robot

General

The robot features mounting holes for additional equipment.

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

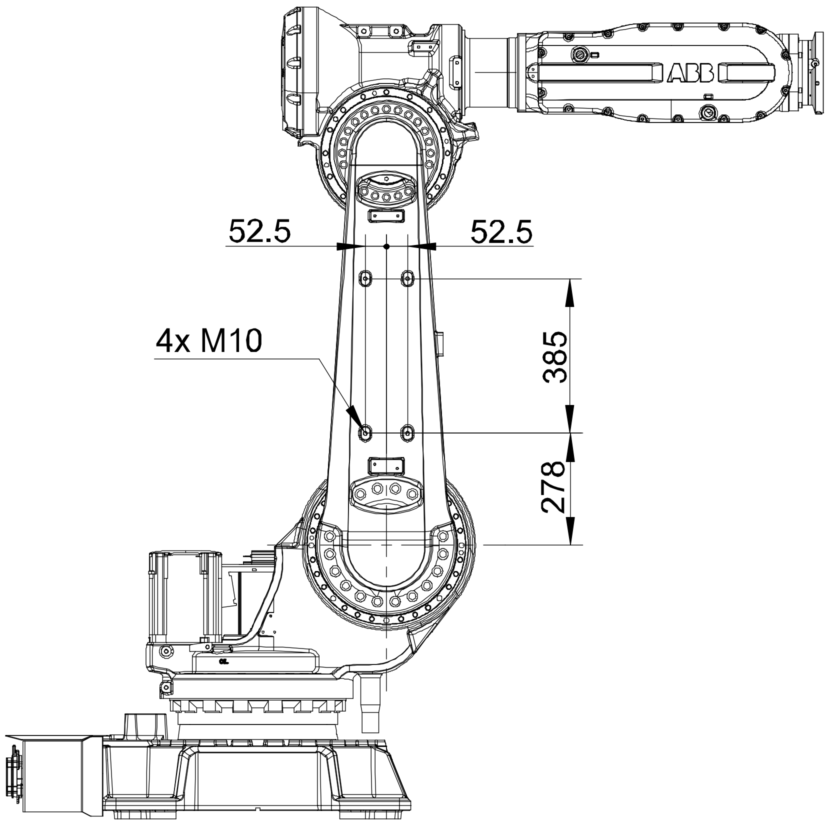
Note

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

Illustration, fitting of extra equipment on lower arm

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

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



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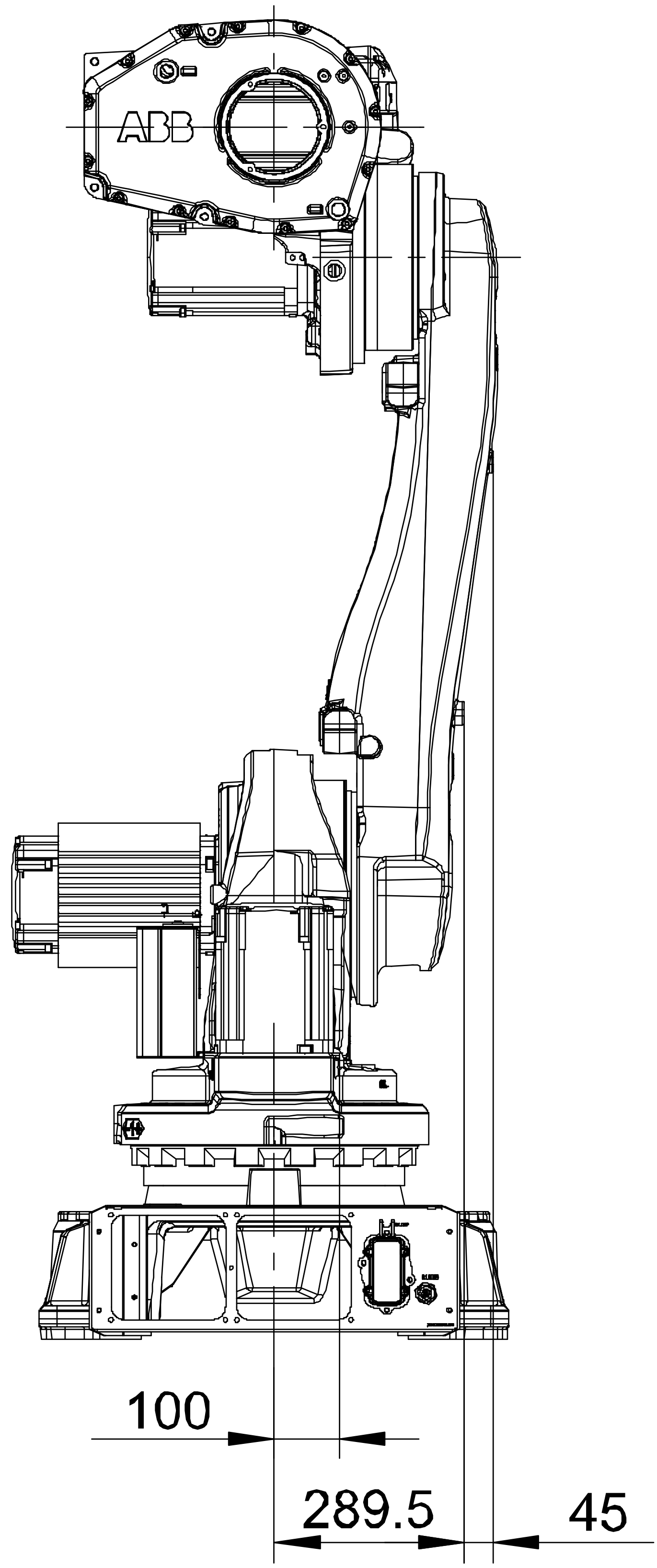

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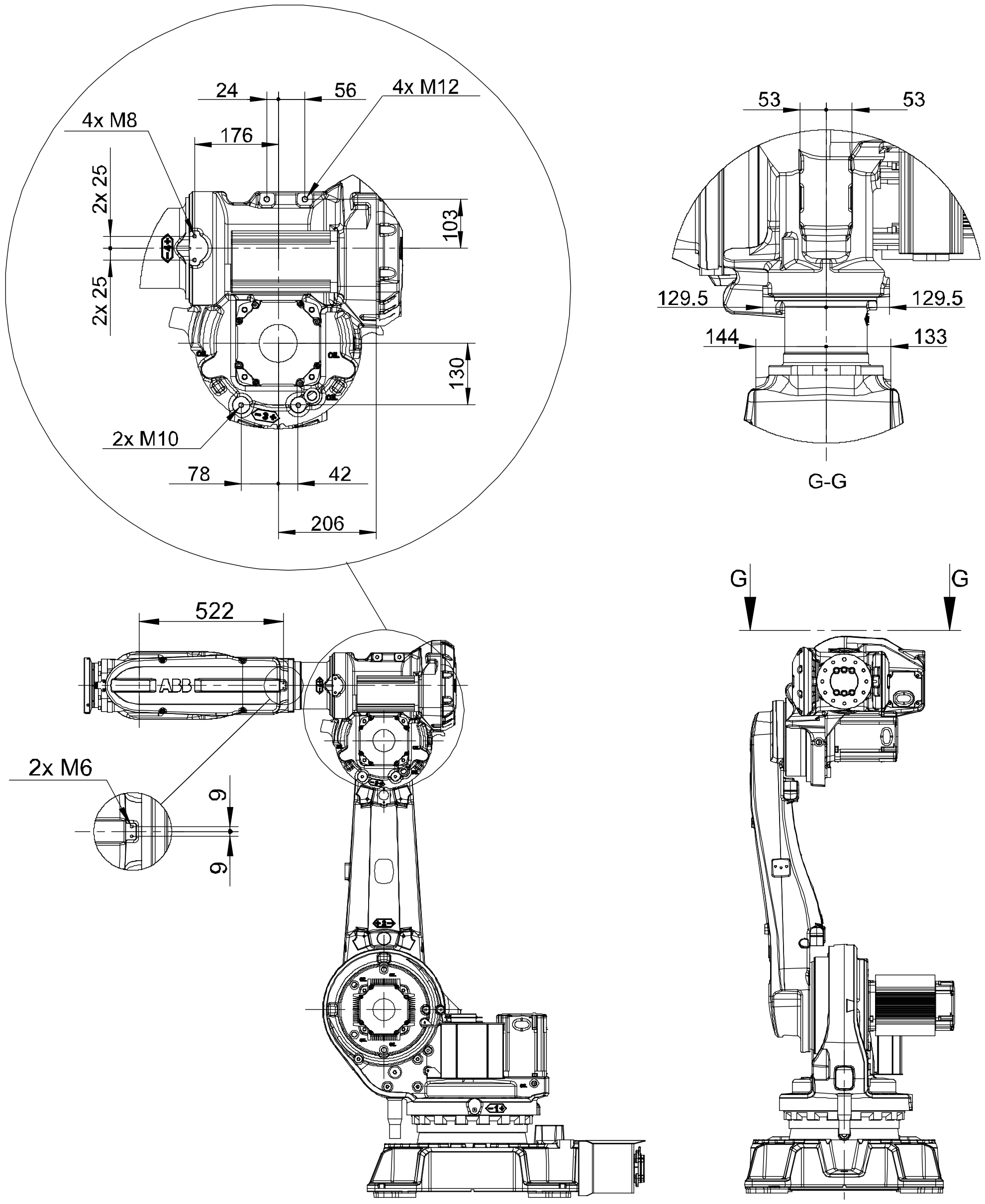
Illustration, fitting of extra equipment on upper arm

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



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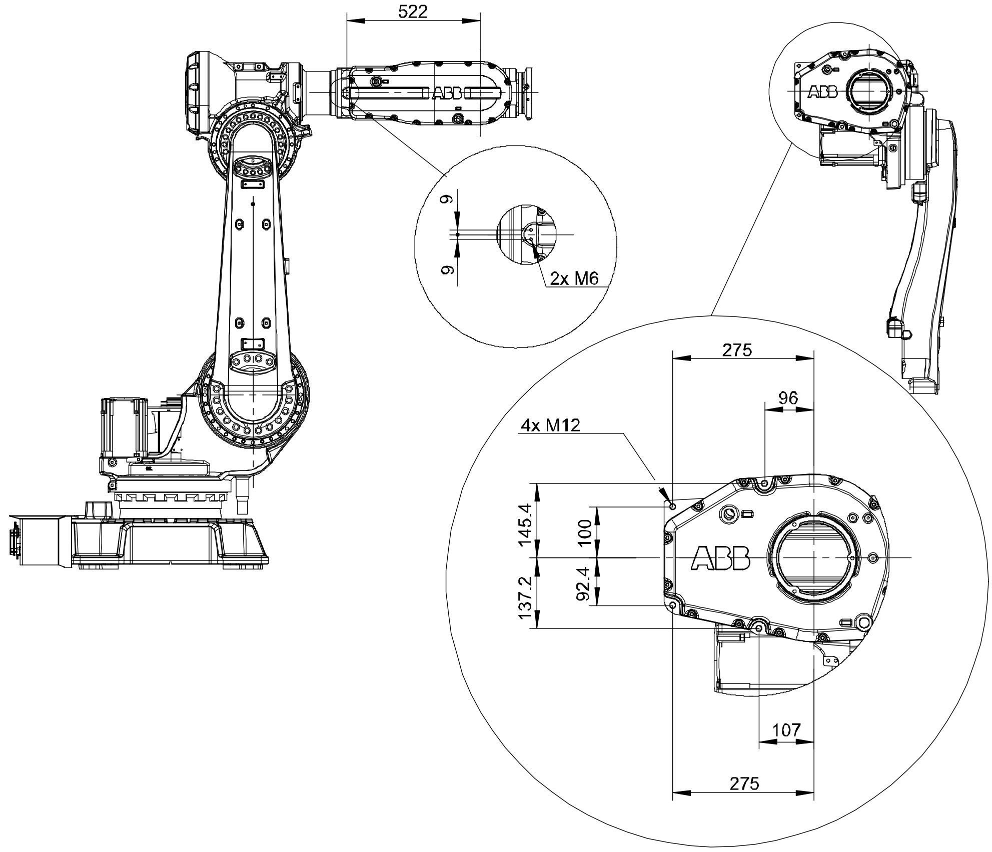

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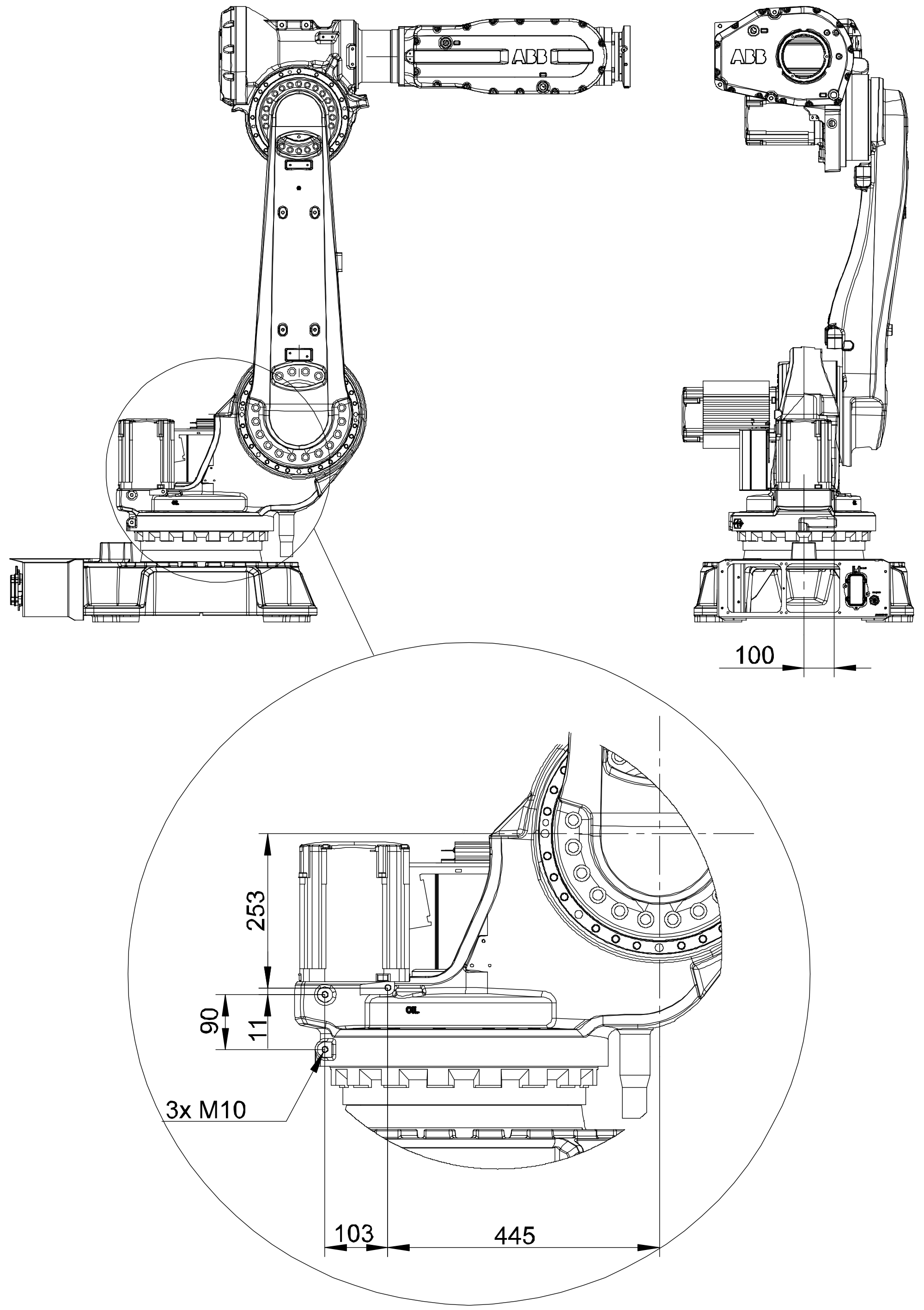
Illustration, fitting of extra equipment on frame

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



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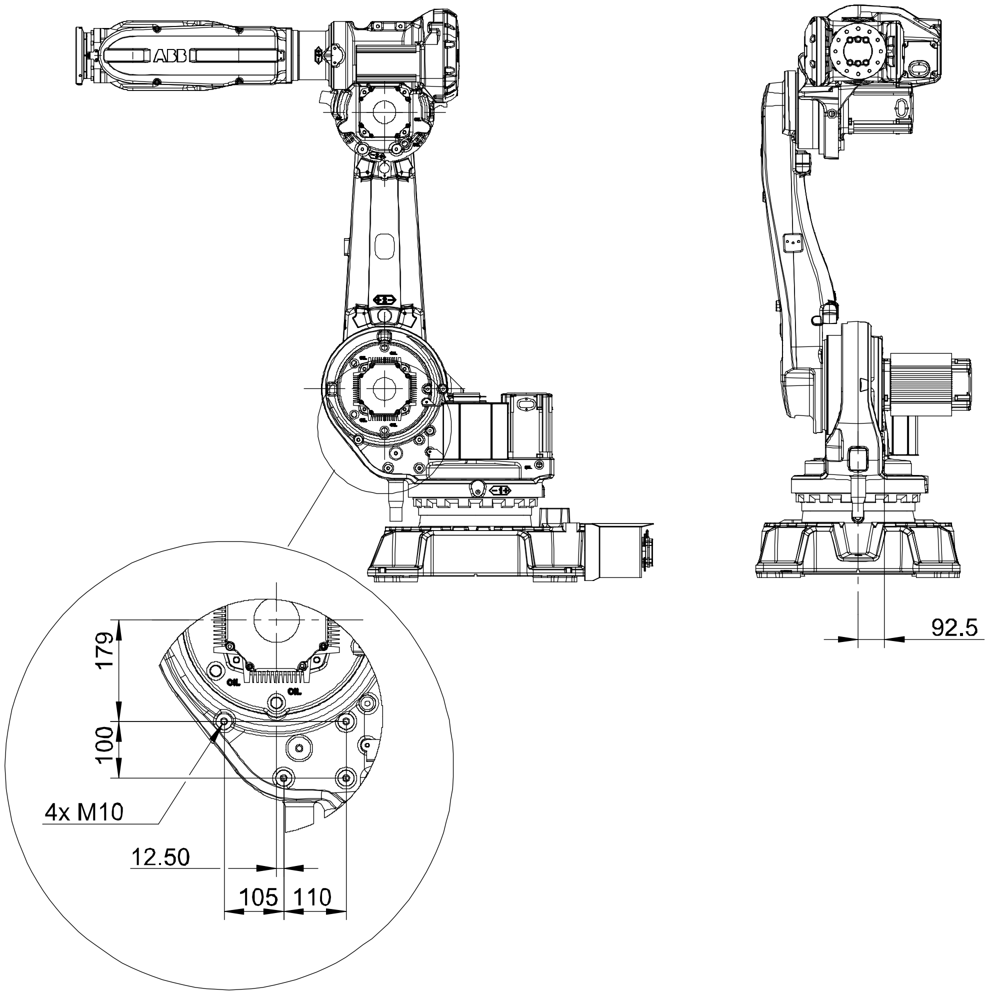

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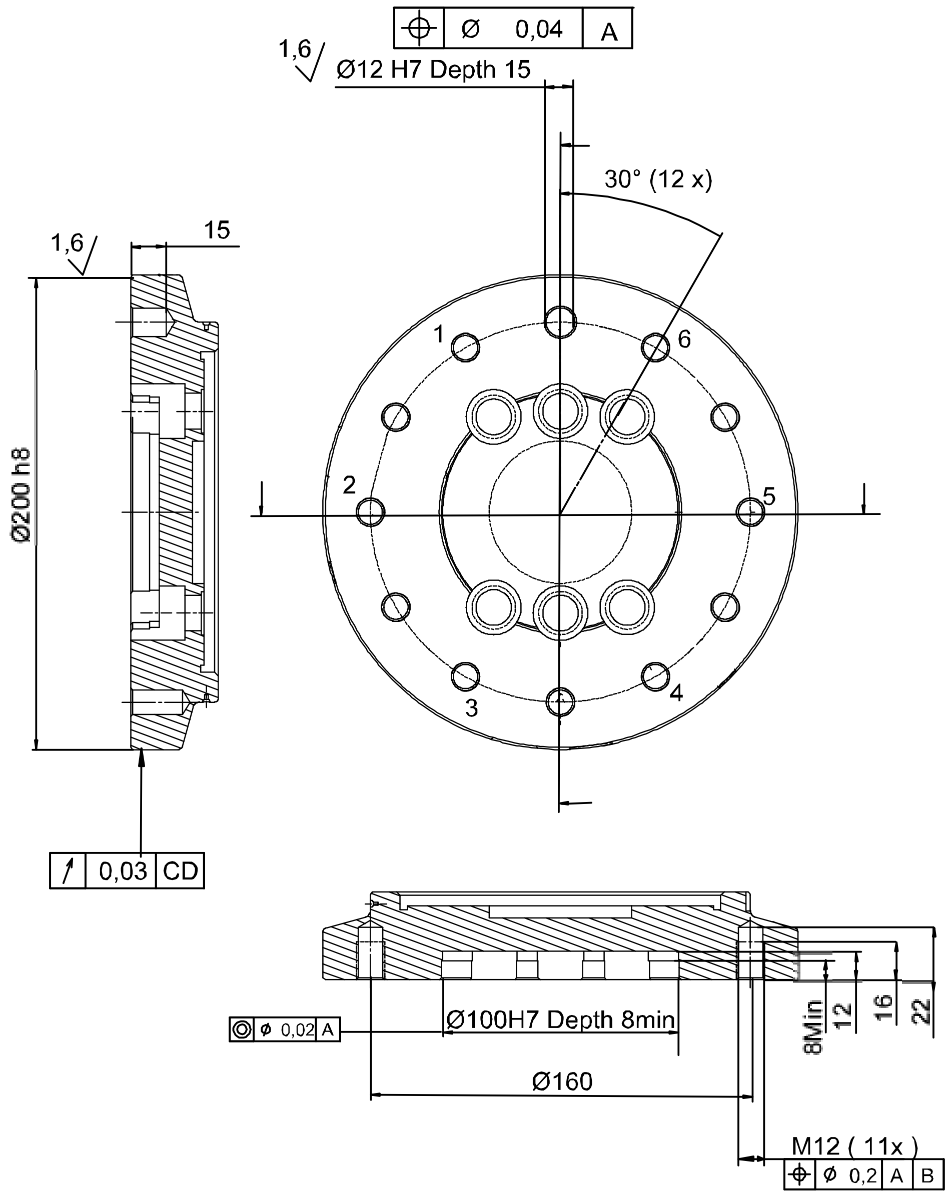
Illustration, fitting on turning disc

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



xx0200000397

-	Turning disk for robot version IRB6620 - 150/2.2. Use every other of the bolt holes for six attachment bolts, as numbered in the figure.
-	Turning disk type 1

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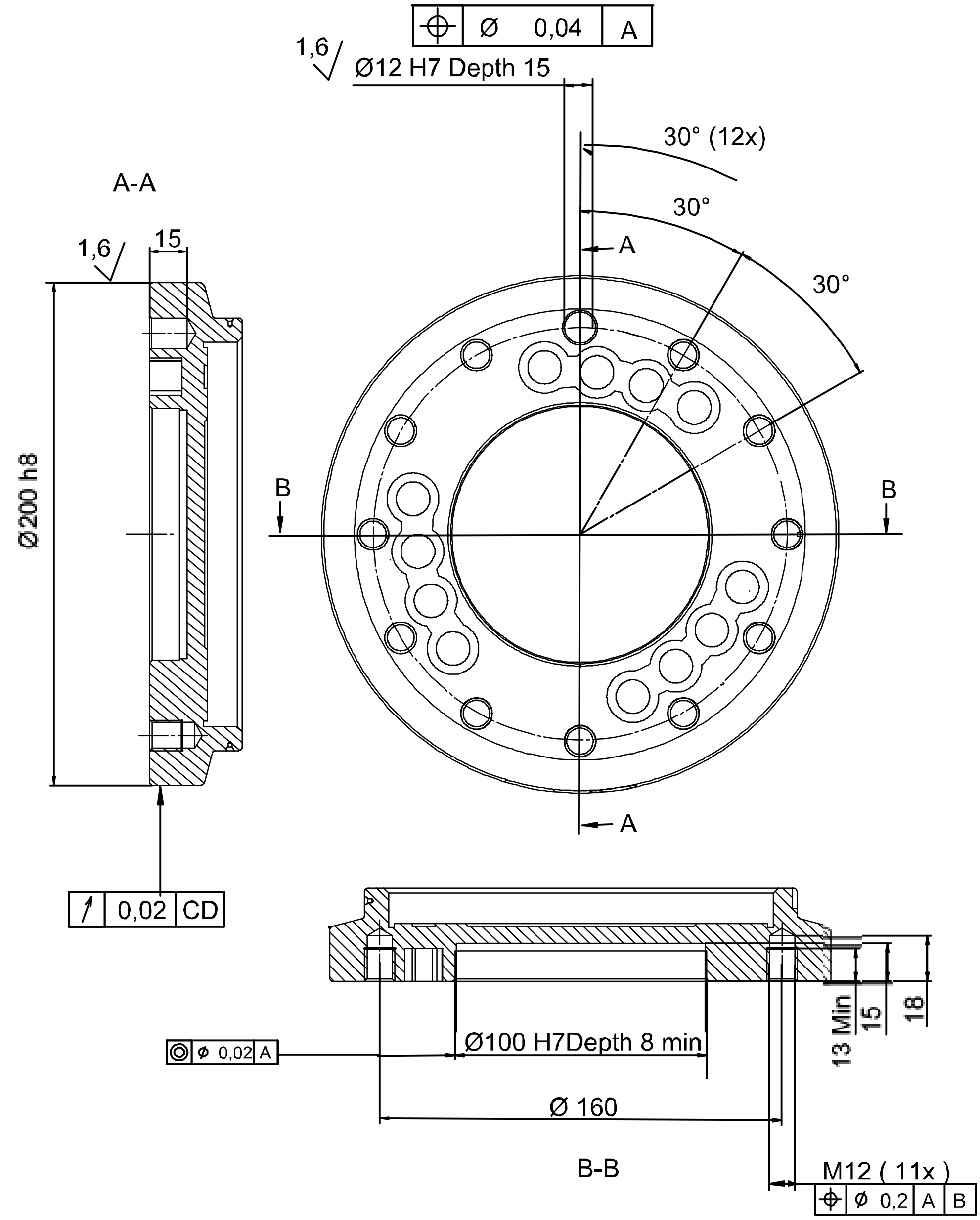


xx0200000197

-	Turning disk (type 2) for robot version IRB 6620 Foundry Plus.

Fastener quality

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

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

General

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

CAUTION

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

References

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

- *Operating manual - IRC5 with FlexPendant*

Stopping time and braking distances

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

2.5.11 Signal lamp (option)

Description

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

Installation

See the assembly instruction delivered with the signal lamp.

Function

The lamp is active in MOTORS ON mode.

Further information

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

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

Overview

The working range of axis 1 can be extended from the default range that is limited by mechanical stops. The working range can be extended to ±220°.

CAUTION

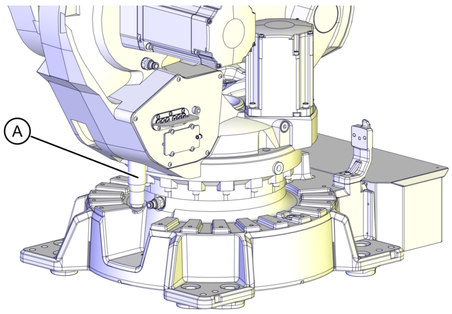
The option *Extended work range* enables an extension of the working range for axis 1, through a software configuration. With this option installed, the working range can exceed the range limited by the mechanical stop on axis 1. The working range shall be limited through the option SafeMove.

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

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

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

Extending the working range

	Action	Note/Illustration
1	Configure the safety setup and verify it by test.	
2	Remove the mechanical stop pin from axis 1 (A).	 xx2100001702
3	In RobotWare, redefine the working range limitations in the system parameters, topic *Motion*. The *Arm* parameters *Upper Joint Bound* and *Lower Joint Bound* can be changed to the values corresponding to the actual installation.	With the option *Extended working range*, the maximum value for the system parameters *Upper Joint Bound* and *Lower Joint Bound* is 3.84 respectively -3.84. The values are in radians, that is 3.84 radians = 220 degrees.

Related information

The system parameters are described in detail in the reference manual, see *References on page 10*.

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

2.6 Restricting the working range

2.6.1 Axes with restricted working range

General

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

The working range of the following axes may be restricted:

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

As a standard configuration, axis 1 is allowed to move ±170°.

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

Note

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

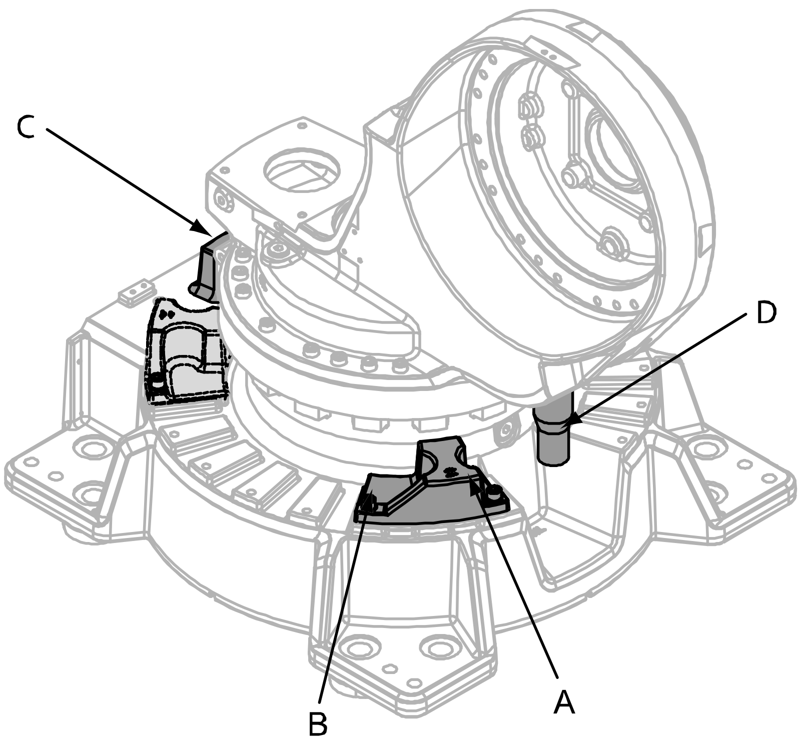
2.6.2 Mechanically restricting the working range of axis 1

General

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

Mechanical stops, axis 1

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



xx0600002938

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

Continues on next page

Required equipment

Equipment, etc.	Article number	Note
Movable mechanical stop set, axis 1 (+15°/-7.5°)	3HAC025204-003	Includes: • one stop (+15°/ -7.5°), 3HAC025366-001 • one stop (+7.5°/ -15°), 3HAC025367-001 • attachment screws and washers • document for movable mech.stop, 3HAC025204-002
Standard toolkit	-	
Technical reference manual - System parameters	-	Article number is specified in section *References on page 10*.

Installation, mechanical stops axis 1

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Fit the additional mechanical stop to the frame according to the figure *Mechanical stops, axis 1 on page 103*.	Tightening torque: 120 Nm.
3	Adjust the software working range limitations (system parameter configuration) to correspond to the mechanical limitations.	The system parameters that must be changed (*Upper joint bound* and *Lower joint bound*) are described in *Technical reference manual - System parameters*.
4	**WARNING** If the mechanical stop pin is deformed after a hard collision, it must be replaced! Deformed *movable stops* and/or *additional stops* as well as deformed *attachment screws* must also be replaced after a hard collision.	

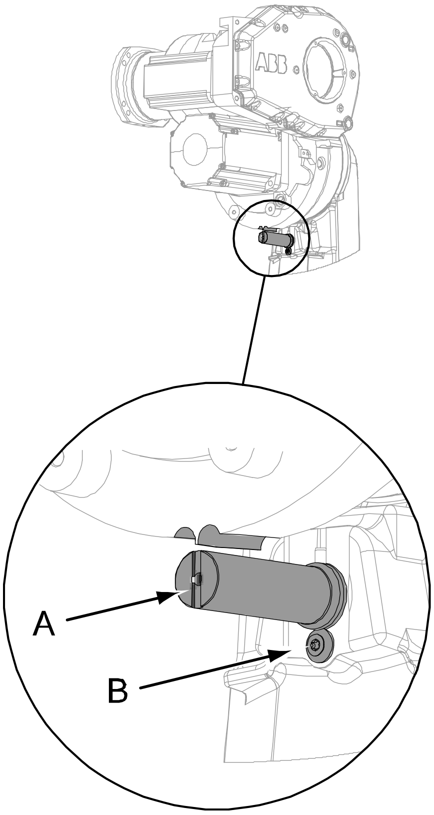
2.6.3 Mechanically restricting the working range of axis 3

General

The working range of axis 3 is limited by a fixed mechanical stop. This stop limits the backwards movement of the upper arm to -90°, which secures the robot arm from tipping over.

Mechanical stops, axis 3

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



xx0600002973

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

Required equipment

Equipment, etc.	Art. no.	Note
Mechanical stop set, axis 3	3HAC025290-003	Includes: • one mechanical stop pin, 3HAC025092-001. • attachment screw and washer. • document for Mech stop pin, 3HAC025409-001.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.

Continues on next page

Equipment, etc.	Art. no.	Note
Technical reference manual - System parameters	-	Art. no. is specified in section *References on page 10*.

Installation, mechanical stops axis 3

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Fit and tighten the mechanical stop, axis 3, on to the lower arm.	Tightening torque: 115 Nm. Shown in the figure *Mechanical stops, axis 3 on page 105*
3	**Note** The software working range limitations (system parameters) must be redefined to correspond to the changes in the mechanical limitations of the working range (+70°/ -90°).	The system parameters that must be changed (*Upper joint bound* and *Lower joint bound*) are described in *Technical reference manual - System parameters*.
4	**WARNING** If the *mechanical stop pin* is deformed after a hard collision, it must be replaced! Deformed *movable stops* and/or *additional stops* as well as deformed *attachment screws* must also be replaced after a hard collision.	

2.7 Foundry Plus Cable guard (option)

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

Introduction

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

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

2.8 Electrical connections

2.8.1 Robot cabling and connection points

Introduction

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

CAUTION

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

CAUTION

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

Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table *Robot cables on page 108*.
Customer cables (option)	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. The customer cables also handle databus communication. See the product manual for the controller, see document number in *References on page 10*.
External axes cables (option)	Handles power supply to and control of the external axes' motors as well as feedback from the servo system. See the *Application manual - Additional axes and stand alone controller (M2004)*, see document number in *References on page 10*.
DressPack cables (option)	Handles signals, process media and power feeding for customer use, regarding material handling or spot welding. See the *Product manual - DressPack/SpotPack IRB 6620*, see document number in *References on page 10*.

Robot cables

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

Cable sub-category	Description	Connection point, cabinet	Connection point, robot
Robot cable, power	Transfers drive power from the drive units in the control cabinet to the robot motors.	XS1	R1.MP

Continues on next page

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

Robot cable, power

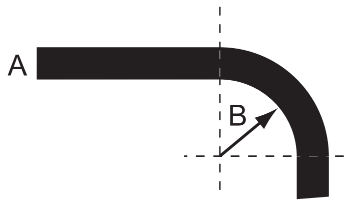
Cable	Art. no.
Robot cable, power: 7 m	3HAC026787-001
Robot cable, power: 15 m	3HAC026787-002
Robot cable, power: 22 m	3HAC026787-003
Robot cable, power: 30 m	3HAC026787-004

Robot cable, signals

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

Bending radius for static floor cables

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



xx1600002016

A	Diameter
B	Diameter x10

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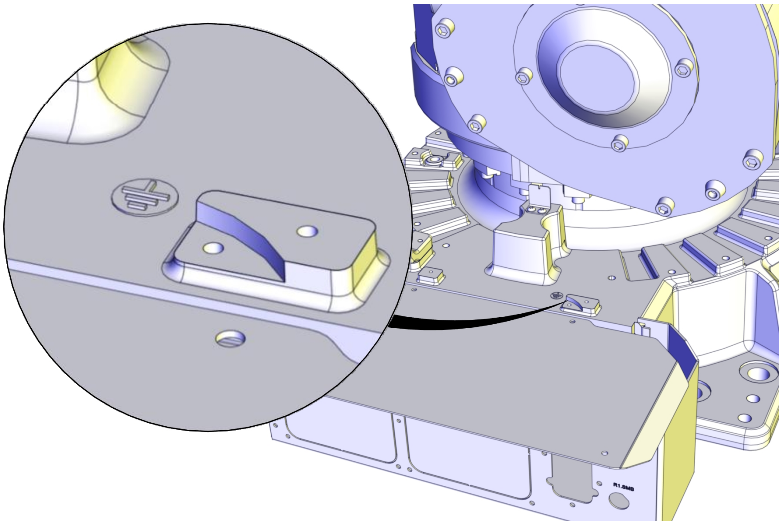
Grounding and bonding point on manipulator

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



xx1500001603

Note

How to ground DressPack/SpotPack cables is detailed in the *Product manual - DressPack/SpotPack IRB 6620*, see the document number in *References on page 10*.

2.9 Start of robot in cold environments

Introduction

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

Problems with starting the robot

Event message from Motion Supervision

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

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

Robot stopping with other event message

Use this procedure if the robot is not starting.

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

Adjusting the speed and acceleration during warm-up

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

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

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

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3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 6620.

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 19* before performing any service work.

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

Note

If the IRB 6620 is connected to power, always make sure that the IRB 6620 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Panel Mounted Controller*
- *Robot cabling and connection points on page 108*.

3.2 Maintenance schedule and expected component life

3.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 6620:

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

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

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

Overhaul

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

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

Contact your local ABB Customer Service to get more information.

3.2.2 Maintenance schedule

General

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

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

The inspection intervals *do not* specify the life of each component. Values for these are specified in the section *Expected component life on page 117*

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

- *Inspection activities on page 118*
- *Replacement/changing activities on page 147*
- *Cleaning activities on page 170*

Activities and intervals, standard equipment

The following table specifies the required maintenance activities and intervals.

Maintenance activity	Equipment	Interval
Cleaning	Robot	*Cleaning the IRB 6620 on page 170*
Inspection	Oil level in axis-1 gearbox	Every 12 months.
Inspection	Oil level in axis-2 gearbox	Every 12 months.
Inspection	Oil level in axis-3 gearbox	Every 12 months.
Inspection	Oil level in axis-4 gearbox	Every 12 months.
Inspection	Oil level in axis-5 gearbox	Every 12 months.
Inspection	Oil level in axis-6 gearbox	Every 12 months.
Inspection	Robot harness	Every 12 months[i].
Inspection	Information labels	Every 12 months.
Inspection	Dampers	Every 12 months.
Inspection	Mechanical stop	Every 12 months.
Change	Oil in axis-1 gearbox	First change when DTC [ii] reads: • 6,000 hours Second change when DTC[ii] reads: • 24,000 hours Following changes: • Every 24,000 hours.
Change	Oil in axis-2 gearbox	First change when DTC [ii] reads: • 6,000 hours Second change when DTC[ii] reads: • 24,000 hours Following changes: • Every 24,000 hours.

Continues on next page

Maintenance activity	Equipment	Interval
Change	Oil in axis-3 gearbox	First change when DTC*ii* reads: • 6,000 hours Second change when DTC*ii* reads: • 24,000 hours Following changes: • Every 24,000 hours.
Change	Oil in axis-4 gearbox	Every 24,000 hours.
Change	Oil in axis-5 gearbox	Every 24,000 hours.
Change	Oil in axis-6 gear	First change when DTC*ii* reads: • 6,000 hours Second change when DTC*ii* reads: • 24,000 hours Following changes: • Every 24,000 hours.
Overhaul	Robot	Every: • 40,000 hours .
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert [iii]
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert [iv]

i Replace when damage or cracks is detected or life limit is approaching that specified in section *Expected component life on page 117*.

ii DTC = Duty Time Counter. Shows the operational time of the robot.

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

See the replacement instruction for more details.

iv The battery low alert (38213 **Battery charge low**) is displayed when remaining backup capacity (robot powered off) is less than 2 months. The typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.

Activities and intervals, optional equipment

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

Maintenance activity	Equipment	Interval	Note
Inspection	Signal lamp	Every: 12 months	
Inspection	Mechanical stop axis 1 and 3	Every: 12 months	

3.2.3 Expected component life

General

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

Expected component life - protection type Standard

Component	Expected life	Note
Cable harness Normal usage [i]	40,000 hours [ii]	Not including: • Possible SpotPack harnesses • Optional upper arm harnesses
Cable harness Extreme usage [iii]	20,000 hours [ii]	Not including: • Possible SpotPack harnesses • Optional upper arm harnesses
Gearboxes [iv]	40,000 hours	

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

ii Severe chemical or thermal environments, or similar environments, can result in shortened life expectancy.

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

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

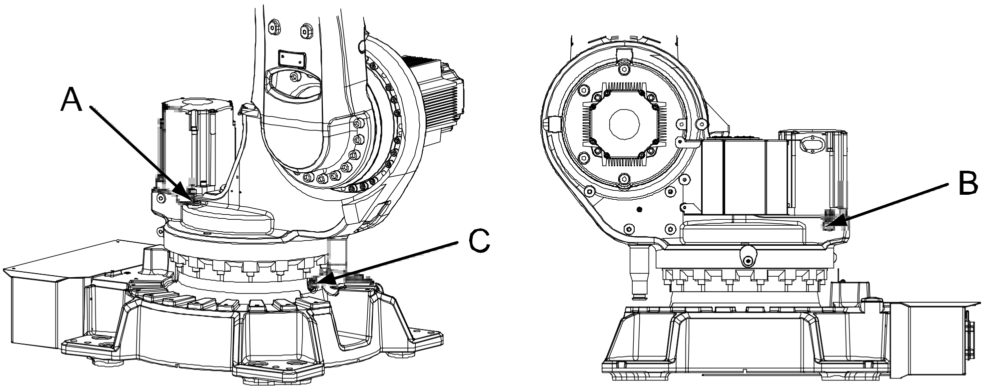
The SIS for an IRC5 system is described in the *Operating manual - Service Information System*.

3.3 Inspection activities

3.3.1 Inspecting the oil level in axis-1 gearbox

Location of gearbox

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



xx0600002958

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

Required equipment

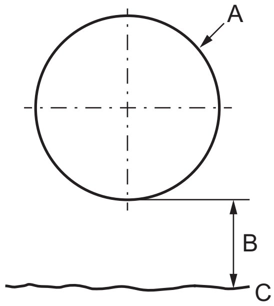
Equipment	Art. no.	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	**Note** Do not mix with other oils!
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Inspecting the oil level in axis-1 gearbox

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

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	

Continues on next page

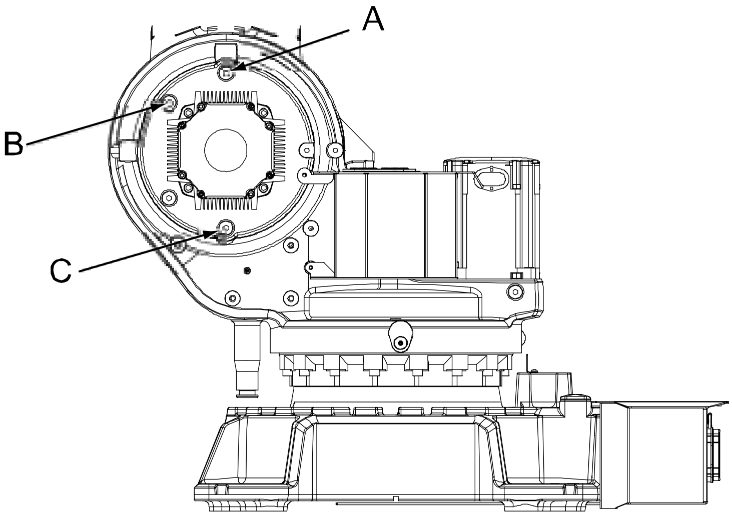
	Action	Note
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
3	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
4	Open the *oil plug, inspection*.	Shown in figure *Location of gearbox on page 118*.
5	Measure the oil level. Required oil level: max. 5 mm below the oil plug hole. Required oil level for tilted robots: 15-20 mm below the oil plug hole.	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
6	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in *Type of lubrication in gearboxes on page 147*. Further information about how to fill with oil is found in section *Changing oil, axis-1 gearbox on page 149*.
7	Refit the oil plug.	Tightening torque:24 Nm

3.3.2 Inspecting the oil level in axis-2 gearbox

Location of gearbox on floor mounted robot

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

The following figure shows the robot mounted on the floor.



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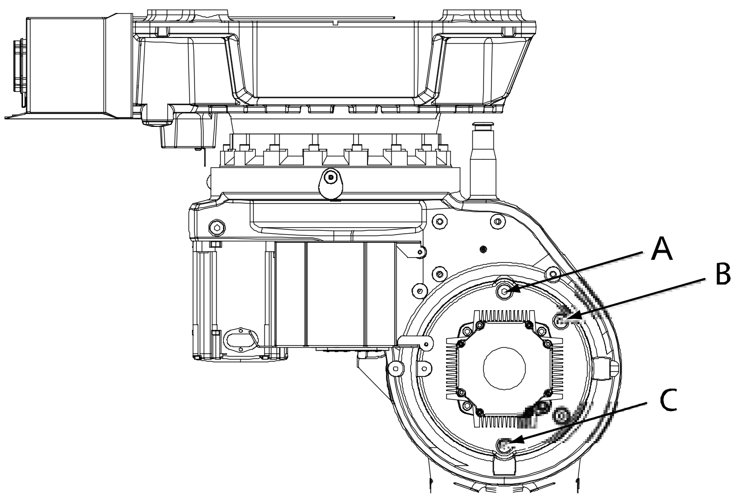
A	Oil plug, vent hole
B	Oil plug, filling and inspection
C	Oil plug, draining

Location of gearbox on suspended mounted robot

The following figure shows suspended mounted robot.

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



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

Required equipment

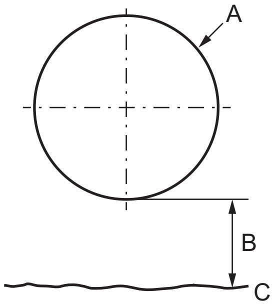
Equipment, etc.,	Art. no.	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	**Note!** Do not mix with other oils!
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Inspecting the oil level in axis-2 gearbox

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

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
4	Open the *oil plug, filling and inspection*.	Shown in the figure *Location of gearbox on floor mounted robot on page 120*.

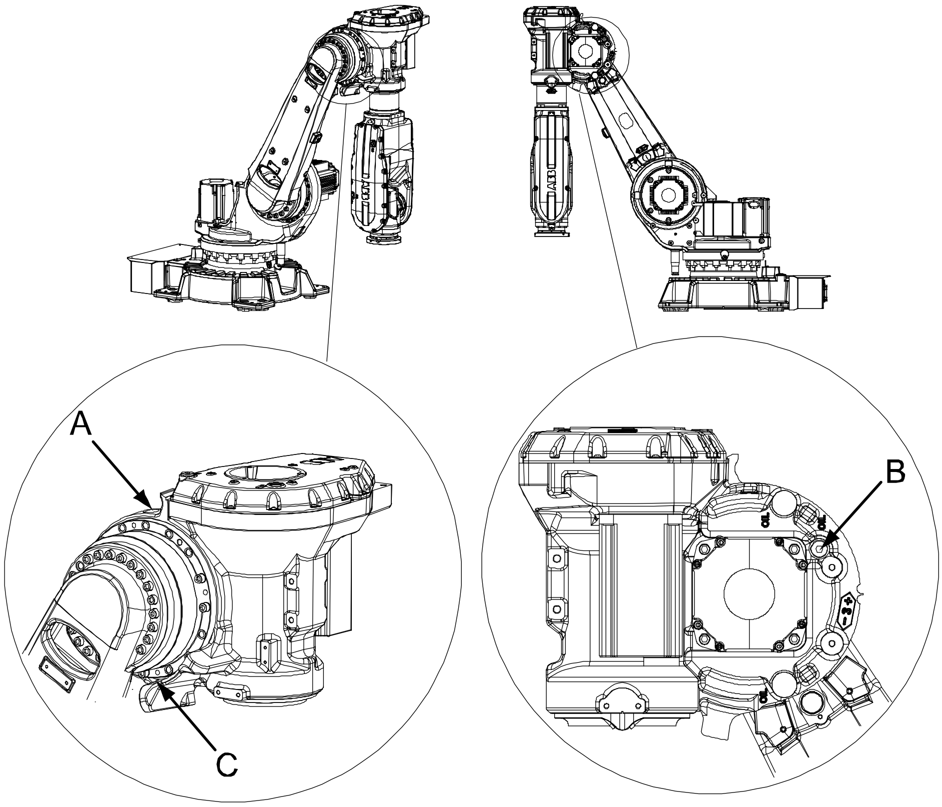
Continues on next page

	Action	Note
5	Measure the oil level. Required oil level: max. 5 mm below the inspection oil plug hole. Required oil level for tilted robots: 40-45 mm below the oil plug filling hole. Note! Not the oil plug inspection hole.	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
6	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*. Filling of oil is detailed further in the section *Filling, oil on page 153*.
7	Refit the oil plug.	Tightening torque: 24 Nm.

3.3.3 Inspecting the oil level in axis-3 gearbox

Location of gearbox

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



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

Required equipment

Equipment, etc.	Art. no.	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	**Note!** Do not mix with other oils!
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
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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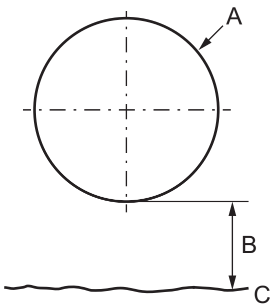
Inspecting the oil level in axis-3 gearbox

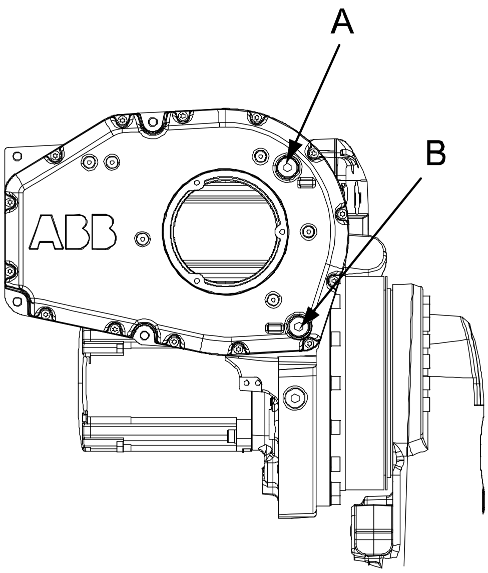
Use this procedure to inspect the oil level in the axis-3 gearbox.

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
2	Move the robot to a position according to the illustration in *Location of gearbox on page 123*.	Detailed in the section *Synchronization marks and synchronization position for axes on page 306*.
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the *oil plug, inspection*.	Shown in the figure *Location of gearbox on page 123*.
6	Measure the oil level. Required oil level: max. 5 mm below the inspection oil plug hole.	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
7	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*. Further information about how to fill the oil may be found in the section *Filling, oil on page 156*.
8	Refit the oil plug.	Tightening torque:24 Nm

3.3.4 Inspecting the oil level in axis-4 gearbox

Location of gearbox

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



xx0600002962

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

Required equipment

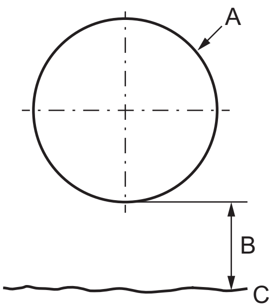
Equipment, etc.	Art. no.	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Inspecting the oil level in axis-4 gearbox

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

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	

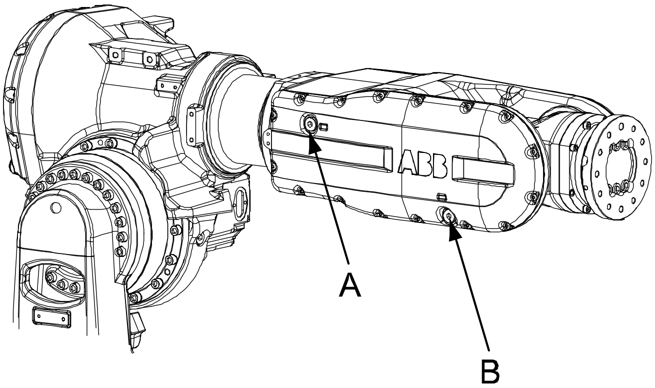
Continues on next page

	Action	Note
2	Move the robot to the calibration position.	This is detailed in section *Synchronization marks and synchronization position for axes on page 306*.
3	 **DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the *oil plug, filling and inspection*.	Shown in the figure *Location of gearbox on page 125*.
6	Measure the oil level. Required oil level: 0-10 mm	 xx1400002785 A Oil plug hole B Required oil level C Gearbox oil
7	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*. Further information about how to fill the oil may be found in the section *Filling, oil on page 159*.
8	Refit the oil plug.	Tightening torque:24 Nm

3.3.5 Inspecting the oil level in axis-5 gearbox

Location of gearbox

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



xx0600002963

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

Required equipment

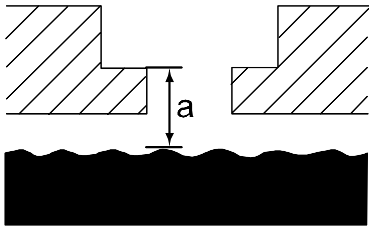
Equipment etc.	Art. no.	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Inspecting the oil level in axis-5 gearbox

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

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
2	Move the robot upper arm to a horizontal position.	
3	Turn the wrist unit in a way that both oil plugs are facing upwards.	

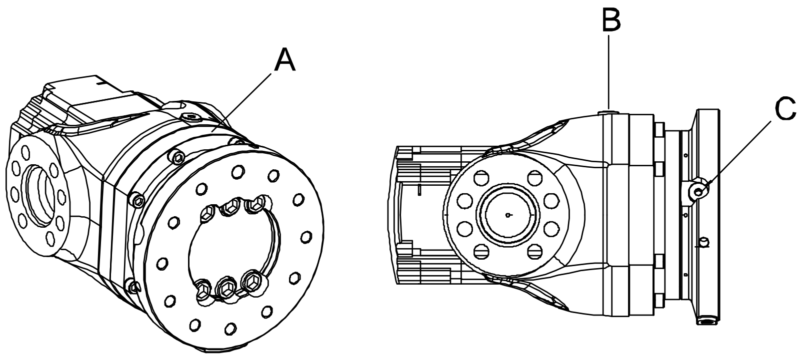
Continues on next page

	Action	Note
4	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
5	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
6	Open the *oil plug, filling and inspection*.	Shown in the figure *Location of gearbox on page 127*.
7	Measure the oil level. Required oil level to the upper edge of the filling and inspection oil plug hole (a): 10 mm	 xx0500002222
8	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*. Further information about how to fill the oil may be found in the section *Filling, oil, axis 5 on page 162*.
9	Refit the oil plug.	Tightening torque:24 Nm

3.3.6 Inspecting the oil level in axis-6 gearbox

Location of gearbox

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



xx0600002964

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

Required equipment

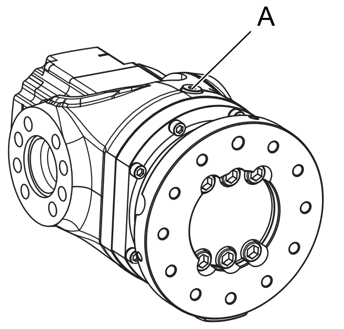
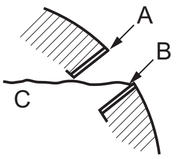
Equipment	Art. no.	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Inspecting the oil level in axis-6 gearbox

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

	Action	Note
1	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
2	Move axes 3 and 5 to a horizontal position, and make sure that the *oil plug, filling and inspection* is facing upwards.	

Continues on next page

	Action	Note
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Make sure that the oil temperature is +25°C ±10°C.	This is a precaution to reduce the temperature dependency of the measurement.
5	Open the *oil plug, filling and inspection*.	 xx1300000244
6	Turn axis 6 so that the *oil plug, draining* faces upwards.	
7	Open the *oil plug, draining*.	This is a precaution to avoid vacuum effects by allowing air to enter at the top of the gearbox. **Note** If equipment that covers the *oil plug, draining* is fitted on the robot so that the oil plug cannot be opened, then this step can be skipped.
8	Slowly turn axis 4, while adjusting axis 6 so that the oil plug, draining always faces upwards. Turn axis 4 until the axis-4 angle reads -45° to -55°.	
9	Inspect the oil level in the hole for the *oil plug, filling and inspection*. The oil should reach all the way up to the external edge of the thread for the *oil plug, filling and inspection*. **Note** If the *oil plug, draining* is not opened, then use a clean, narrow object, for example an oil stick or a cable tie, to gently poke the oil surface. This will avoid surface tension from stopping air to enter into the gearbox.	 xx1400002786 A Oil plug hole B Required oil level C Gearbox oil

Continues on next page

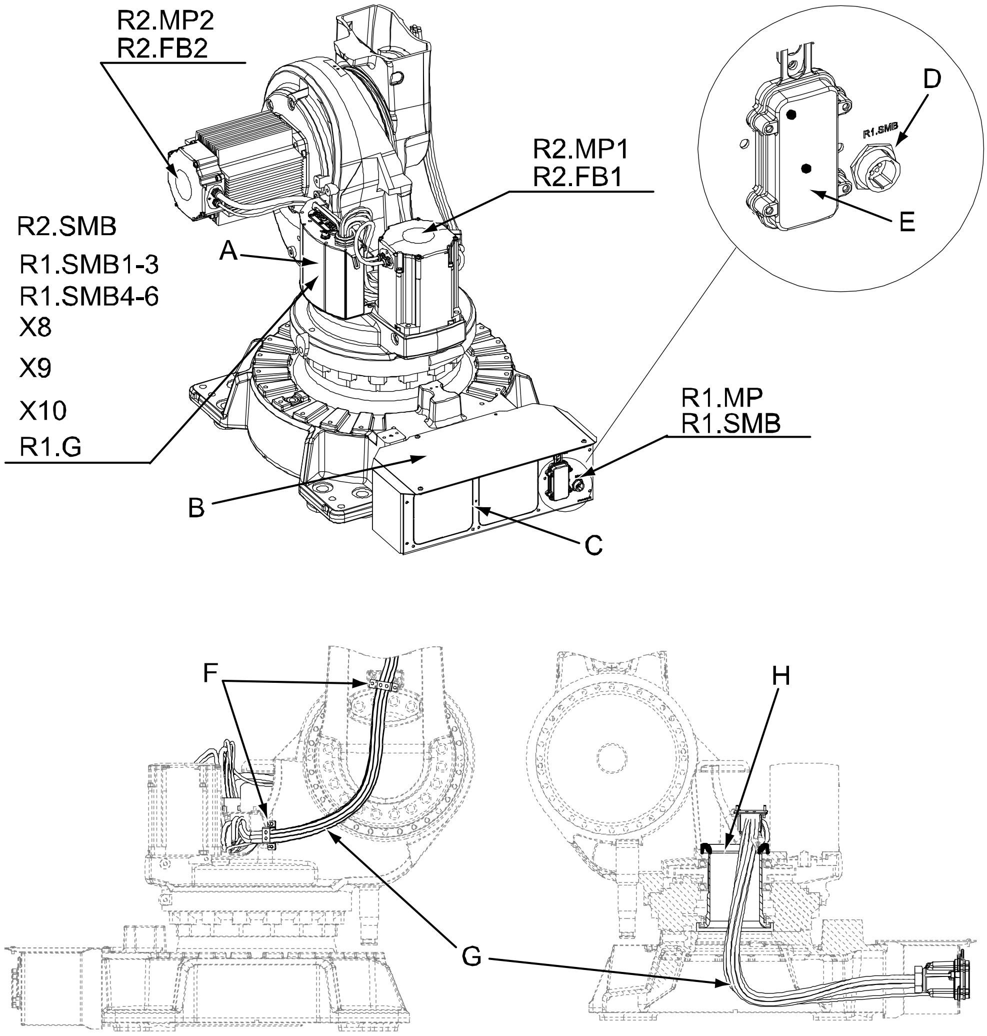
	Action	Note
10	Adjust the oil level, if required.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*. Further information about how to fill the oil may be found in the section .
11	Refit the oil plugs.	Tightening torque: 24 Nm.
12	**WARNING** Do not mix oil types! If wrong oil is refilled, the gearbox must be rinsed as detailed in *Technical reference manual - Lubrication in gearboxes*.	

3.3.7 Inspecting, cable harness

Location of cable harness, axes 1-6

The axes-1-6 cable harness is shown below.

The figure shows the lower routing of the cable harness.

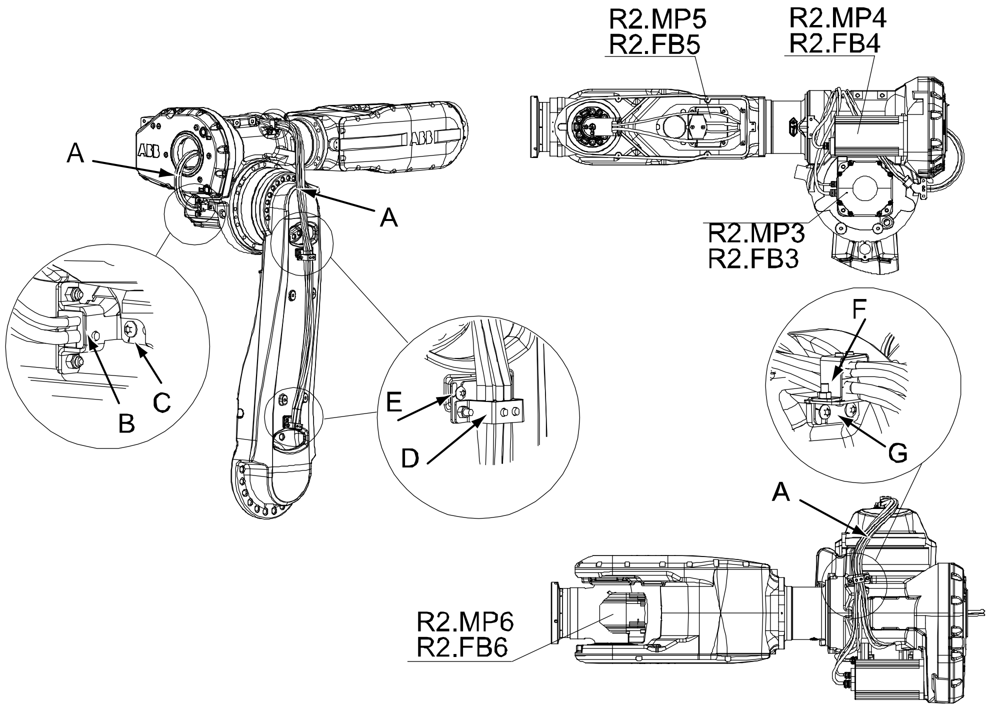


xx0600002970

A	SMB/BU box
B	Top cover, connection box
C	Connection plate, base
D	Connector R1.SMB
E	Connector R1.MP
F	Metal clamps
G	Cable harness
H	Cable guide (cut away view)

Continues on next page

The figure shows the upper routing of the cable harness.



xx0600003078

A	Cable harness
B	Metal clamp, at gearbox axis 3
C	Attachment screws, metal clamp at gearbox axis 3, M6x16 quality 8.8 (2 pcs)
D	Metal clamp, lower arm (2 pcs)
E	Attachment screws, metal clamp lower arm, M6x16 quality 8.8 (2+2 pcs)
F	Metal clamp, armhouse
G	Attachment screws, metal clamp armhouse, M6x16 quality 8.8 (2 pcs)

Required equipment

Visual inspection, no tools are needed.

Inspecting cable harness, axes 1-6

Use this procedure to inspect cable harness of axes 1-6.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

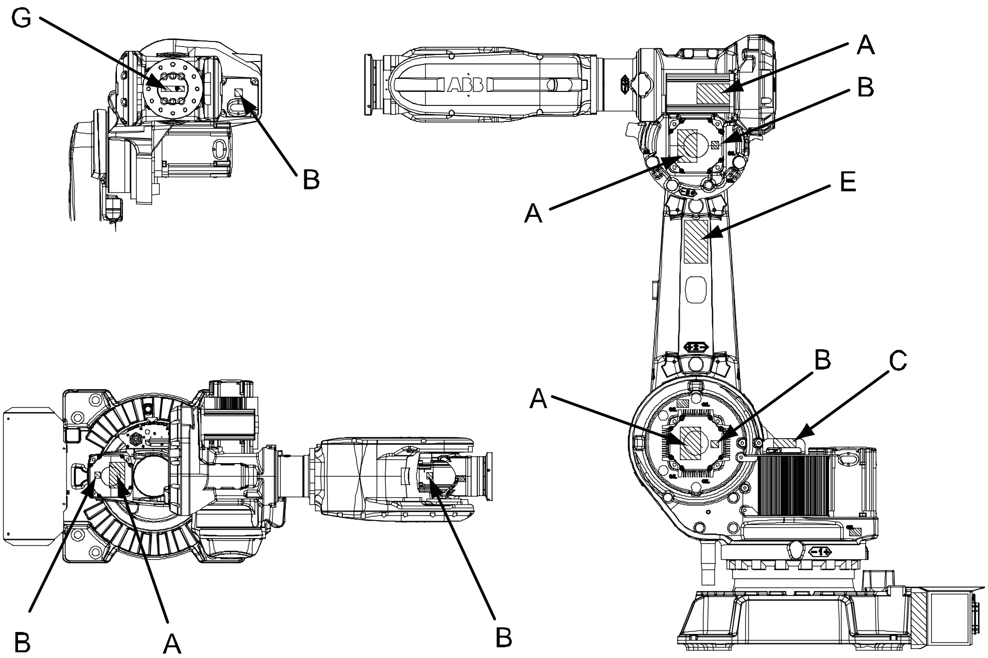
Continues on next page

	Action	Note
2	Make an overall inspection of the cable harness in order to detect wear and damage.	
3	Check the *connectors at the base*.	Shown in figure *Location of cable harness, axes 1-6 on page 132*
4	Check the cables.	Shown in figure *Location of cable harness, axes 1-6 on page 132*
5	Check the *metal clamps* on the robot.	Shown in figure *Location of cable harness, axes 1-6 on page 132*
6	Replace the cable harness if wear or damage is detected!	Detailed in section: *Replacement of cable harness, lower end (axes 1-2) on page 182* *Replacement of cable harness, upper end on page 189*

3.3.8 Inspecting the information labels

Location of labels

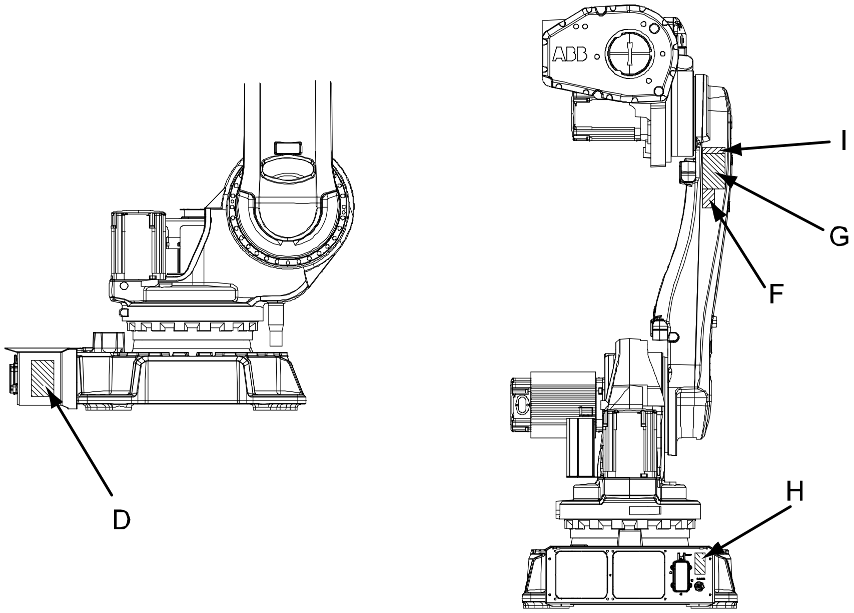
These figures show the location of the information labels to be inspected. The symbols are described in section *Safety symbols on manipulator labels on page 23*.



xx0600002980

A	Warning label concerning high temperature (4 pcs)
B	Warning sign, symbol of a flash (located on motor cover) (5 pcs)
C	Warning label concerning brake release
E	Instruction label concerning lifting
G	Serial no. from rating label

Continues on next page



xx0600002981

D	Warning label concerning risk of tipping
F	Label for calibration
G	Serial no. from rating label
H	UL-label
I	AbsAcc information sign

Required tools and equipment

Visual inspection, no tools are required.

Inspecting, labels

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Inspect the labels, located as shown in the figures.	
3	Replace any missing or damaged labels.	Article numbers for the labels and plate set is specified in *Spare part lists on page 349*.

3.3.9 Inspecting the axis-1 mechanical stop pin

WARNING

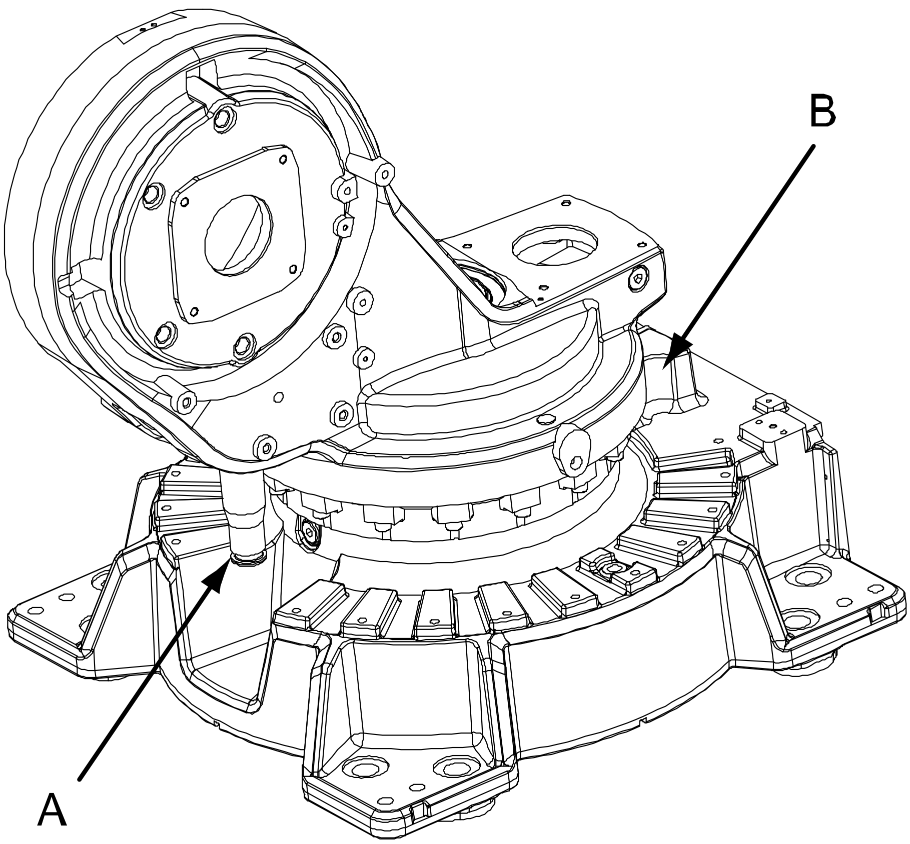
Mechanical stop pin can not be fitted onto robot if option 810-1 *Electronic Position Switch* is used.

WARNING

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

Location of mechanical stop pin

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



xx0600002972

A	Mechanical stop pin, axis 1
B	Fixed mechanical stop

Required equipment

Visual inspection, no tools are required.

Continues on next page

Inspecting, mechanical stop pin

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

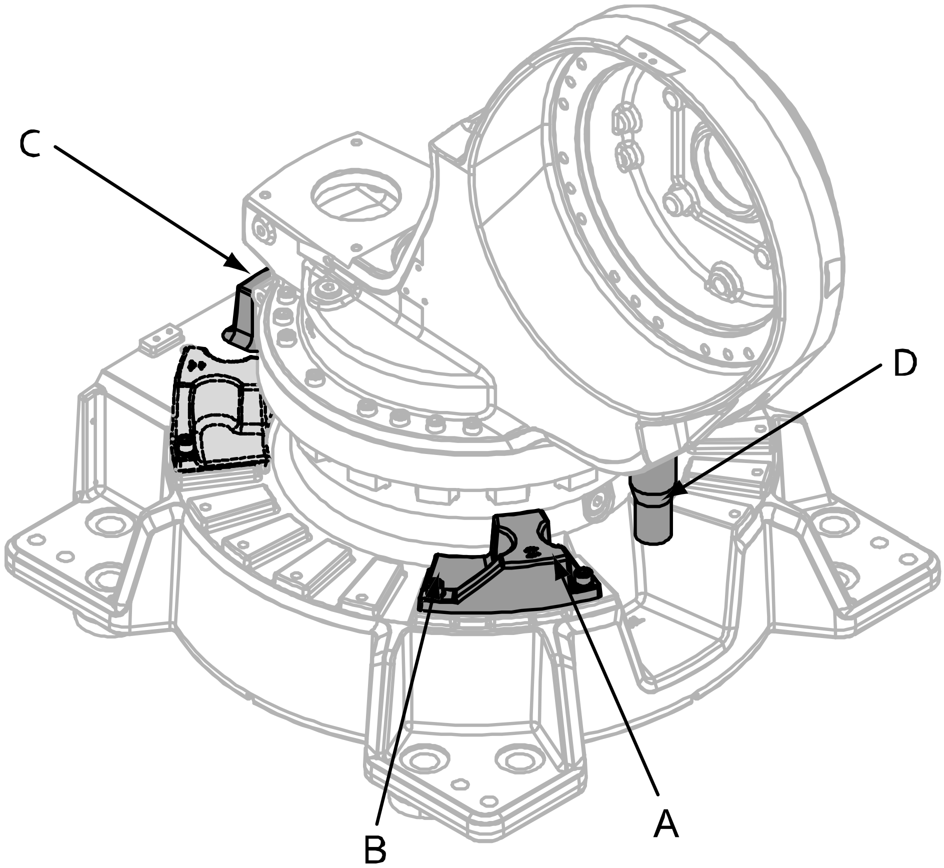
	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Inspect the axis-1 mechanical stop pin. If the mechanical stop pin is bent or damaged, it must be replaced. **Note** The expected life of gearboxes can be reduced after collision with the mechanical stop.	

3.3.10 Inspecting the additional mechanical stops

Location of mechanical stops

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

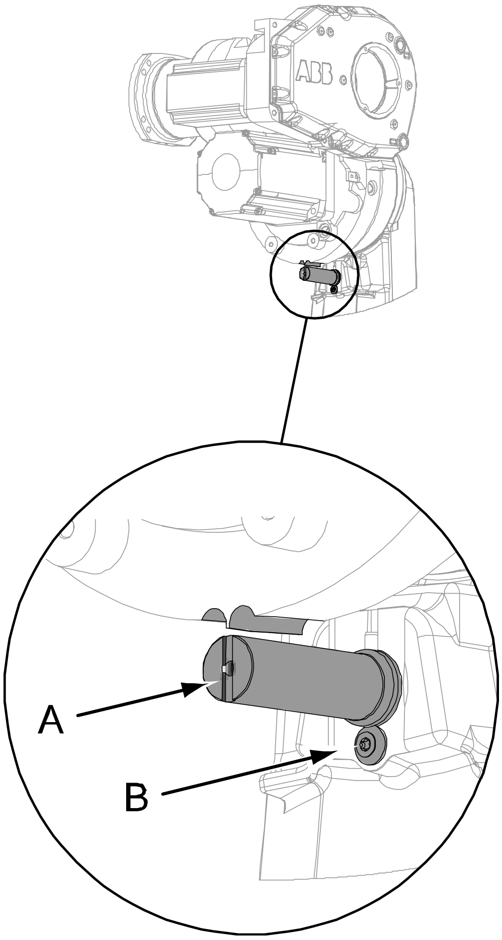
Additional mechanical stops are not provided for axis 2.



xx0600002938

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

Continues on next page



xx0600002973

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

Required equipment

Equipment etc.	Article number	Note
Mechanical stop set, axis 1	3HAC025204-003	Includes: • Stop +15°/-7.5° • Stop +7.5°/-15° • Attachment screws plus washers • Document for movable mechanical stop
Mechanical stop set, axis 3	3HAC025290-003	Includes: • Mechanical stop pin • Attachment screw and washer • Document for mechanical stop pin
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.

Continues on next page

Inspecting, mechanical stops

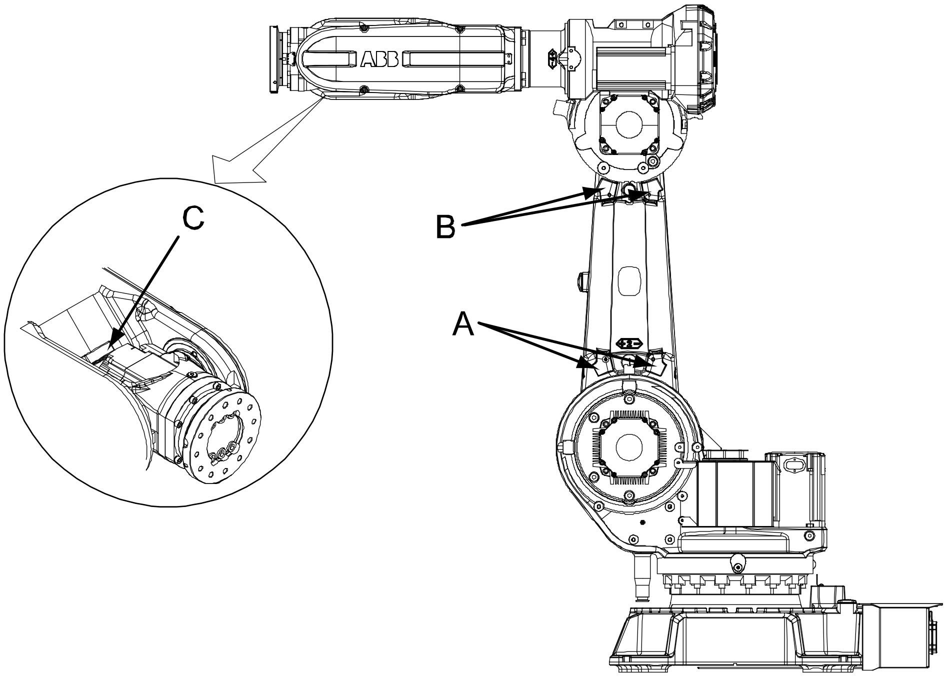
Use this procedure to inspect the additional mechanical stops.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Make sure no additional stops are damaged.	Shown in figure *Location of mechanical stops on page 139*.
3	Make sure the stops are properly attached. Correct tightening torque, additional mechanical stops: • Axis 1 = 120 Nm. • Axes 2 and 3 = 115 Nm	
4	If any damage is detected, the mechanical stops must be replaced. Correct attachment screws: • Axis 1: M12 x 40, quality 12.9. • Axis 3: M6 x 16	Article number is specified in *Required equipment on page 140*.

3.3.11 Inspecting the damper on axes 2-5

Location of dampers

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



xx0600002976

A	Damper axis 2
B	Damper axis 3
C	Damper axis 5

Required equipment

A damper must be replaced if damaged!

Equipment	Spare part/ art. no.	Note
Damper axes 2-3	3HAC12320-1	
Damper axis 5	3HAC024541-001	
Standard toolkit	3HAC15571-1	Content is defined in section *Standard tools on page 344*.

Continues on next page

Inspection, dampers

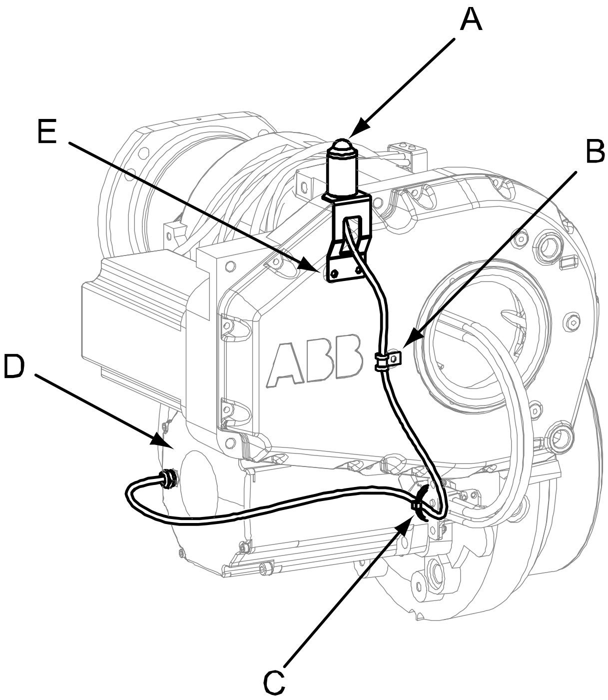
The procedure below details how to inspect the dampers, axes 2-5.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	Check all *dampers* for damage, and for cracks or existing impressions larger than 1 mm.	Shown in the figure *Location of dampers on page 142*.
3	Check attachment screws for deformation.	
4	If any damage is detected, the damper must be replaced with a new one!	Art. no. is specified in *Required equipment on page 142*.

3.3.12 Inspecting, signal lamp

Location of signal lamp

The signal lamp is located as shown in this figure.



xx0600003071

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

Required equipment

Equipment, etc.	Art. no.	Note
Signal lamp	3HAC10830-1	To be replaced in case of detected damage.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
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, signal lamp

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

	Action	Note
1	Check that signal lamp is lit when motors are put in operation ("MOTORS ON").	
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	If the lamp is not lit, trace the fault by: • Checking whether the *signal lamp* is broken. If so, replace it. • Checking cable connections. • Measuring the voltage in connectors motor axis 3 (=24V). • Checking the cabling. Replace cabling if a fault is detected.	Art. no. is specified in *Required equipment on page 144*.

3.3.13 Inspection of air hoses (Foundry Prime)

Required equipment

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

Procedure

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

	Action	Note
1	Apply compressed air to the air connector on robot base, and raise the pressure with the knob until the correct value is shown on the pressure gauge.	Recommended pressure: 0.2-0.3 bar
2	Close the cut off valve.	It should take at least 5 seconds for the pressure to reach 0 bar.
3	The time is < 5 seconds: • If the answer is **YES**: Localize the leakage by following the procedures below. • If the answer is **NO**: The system is OK. Remove the leak testing equipment.	
4	Pressurize by opening the cut off valve.	
5	Spray suspected leak areas with leak detection spray. **Note** Bubbles indicate a leak.	
6	When the leak is localized: correct the leak.	

3.4 Replacement/changing activities

3.4.1 Type of lubrication in gearboxes

Introduction

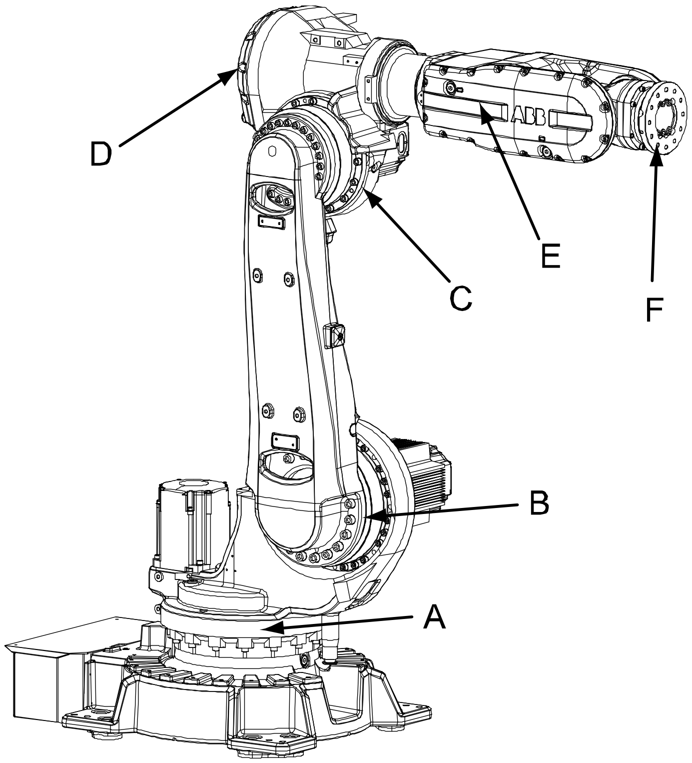
This section describes where to find information about the type of lubrication, article number and the amount of lubrication in the specific gearbox. It also describes the equipment needed when working with lubrication.

Type and amount of oil in gearboxes

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

Location of gearboxes

The figure shows the location of the gearboxes.



xx0600002977

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

Continues on next page

Equipment

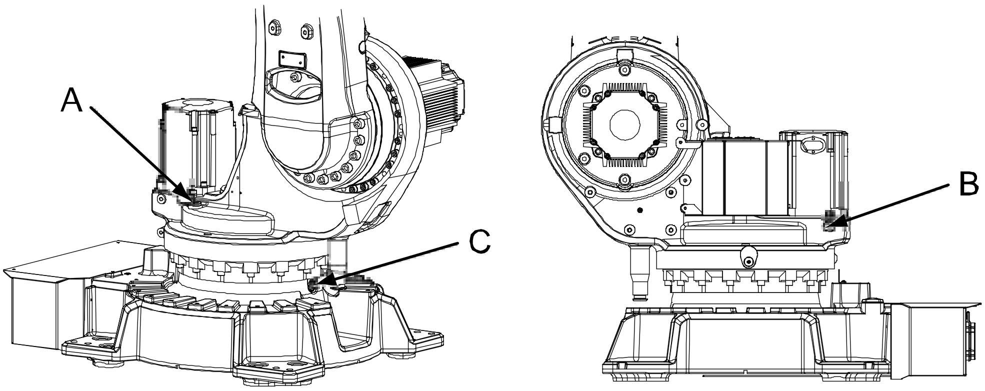
Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: • Orion OriCan article number 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	

3.4.2 Changing oil, axis-1 gearbox

Location of oil plugs

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

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



xx0600002958

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	See *Type and amount of oil in gearboxes on page 147*.	**Note** Do not mix with other oils!
Oil collecting vessel	-		Capacity: 8,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section *Special tools on page 345*.
Standard toolkit	-		Content is defined in section *Standard tools on page 344*.

Continues on next page

Draining oil, axis-1 gearbox

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

When using oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 149*.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	If the robot is suspended: lift down the robot from its inverted position and secure it on the floor.	
4	Collect drained oil in an oil vessel.	Vessel capacity is specified in *Required equipment on page 149*.
5	Remove *oil plug, filling* in order to drain oil quicker!	Shown in figure *Location of oil plugs on page 149*.
6	Open the oil plug for draining and drain the oil into a vessel. **CAUTION** Drain as much oil as possible.	**Note** Draining is time-consuming. Elapsed time depends on the temperature of the oil.
7	Refit the *oil plug, draining*.	

Filling oil, axis-1 gearbox

Use this procedure to fill gearbox axis 1 with oil.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the safeguarded space.	

Continues on next page

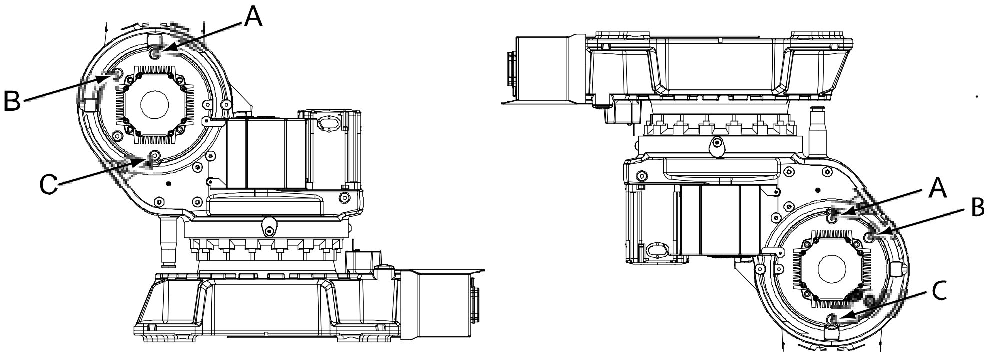
	Action	Note
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	Open the *oil plug, filling.*	Shown in figure *Location of oil plugs on page 149*.
4	Refill the gearbox with clean *lubricating oil.* The correct oil level is detailed in section *Inspecting the oil level in axis-1 gearbox on page 118*.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*.
5	**Note** Do not mix Kyodo Yushi TMO 150 with other oil types!	
6	Refit the oil plug, filling.	Tightening torque: 24 Nm.

3.4.3 Changing oil, axis-2 gearbox

Location of oil plugs

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

The figure shows both floor and suspended mounted robot. **Note** that the holes are used differently depending on how the robot is mounted!



xx0600002983

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	See *Type and amount of oil in gearboxes on page 147*.	**Note!** Do not mix with other oil types!
Oil collecting vessel	-		Capacity: 5,000 ml.
Oil exchange equipment	3HAC021745-001		Content is defined in section *Special tools on page 345*.
Standard toolkit	-		Content is defined in section *Standard tools on page 344*.

Continues on next page

Draining, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 152*.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	Remove the *oil plug, draining,* and drain the gearbox oil using a hose with nipple and an oil collecting vessel. **CAUTION** Drain as much oil as possible.	Shown in the figure *Location of oil plugs on page 152*. Vessel capacity is specified in *Required equipment on page 152*. **Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
4	Refit the oil plug.	Tightening torque: 24 Nm.

Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 152*.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	

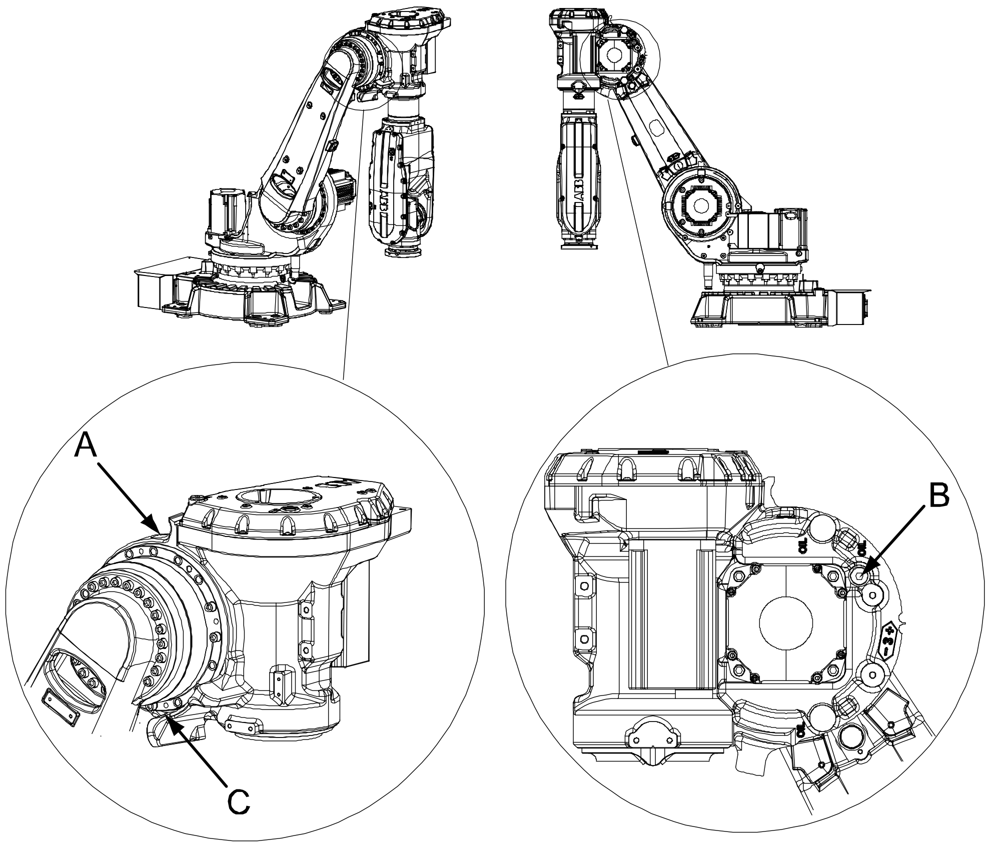
Continues on next page

	Action	Note
3	Remove the *oil plug for filling* and the *oil plug for inspection*.	Shown in the figure *Location of oil plugs on page 152*.
4	Refill the gearbox with clean *lubricating oil.* The correct oil level is detailed in section *Inspecting the oil level in axis-2 gearbox on page 120*.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*.
5	**Note** Don´t mix Kyodo Yushi TMO 150 with other oil types!	
6	Refit the oil plug.	Tightening torque: 24 Nm.

3.4.4 Changing oil, axis-3 gearbox

Location of gearbox

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



xx0600002961

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	See *Type and amount of oil in gear-boxes on page 147*.	**Note!** Do not mix with other oil types!
Oil exchange equipment	3HAC021745-001		Content is defined in section *Special tools on page 345*.
Oil collecting vessel	-		Capacity: 3,000 ml.
Standard toolkit	-		Content is defined in section *Standard tools on page 344*.

Continues on next page

Draining, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 155*.

	Action	Note
1	Move the upper arm of the robot to the position where the wrist is pointing towards the floor.	This is done in order to drain all oil from the gearbox axis 3.
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
4	Remove the *oil plug, filling*.	
5	Remove the *oil plug, draining,* and drain the gearbox oil using a hose with nipple and an oil collecting vessel. **CAUTION** Drain as much oil as possible.	Shown in the figure *Location of gearbox on page 155*. Vessel capacity is specified in *Required equipment on page 155*. **Note** Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
6	Refit the oil plug.	Tightening torque: 24 Nm.

Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 155*.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

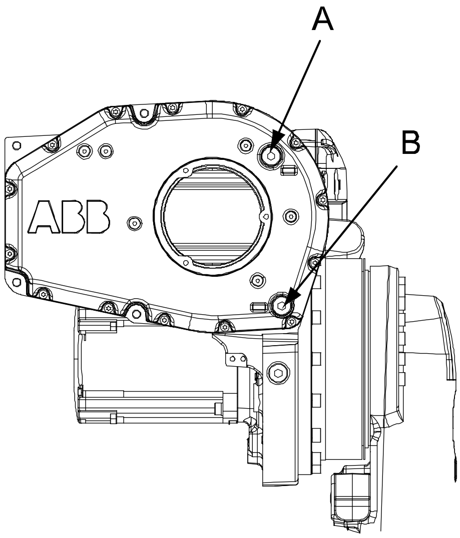
Continues on next page

	Action	Note
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	Remove the *oil plug, filling.*	Shown in the figure *Location of gearbox on page 155*.
4	Refill the gearbox with clean *lubricating oil.* The correct oil level is detailed in section *Inspecting the oil level in axis-3 gearbox on page 123*.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*.
5	**Note** Do not mix Kyodo Yushi TMO 150 with other oil types!	
6	Refit the oil plug.	Tightening torque: 24 Nm.

3.4.5 Changing oil, axis-4 gearbox

Location of gearbox

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



xx0600002962

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	See *Type and amount of oil in gear-boxes on page 147*.	
Oil exchange equipment	3HAC021745-001		Content is defined in section *Special tools on page 345*.
Oil collecting vessel	-		Capacity: 6,000 ml.
Standard toolkit	-		Content is defined in section *Standard tools on page 344*.

Draining, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 158*.

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

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
4	Remove the *oil plug, filling*.	
5	Drain the oil from the gearbox into a vessel by opening the *oil plug, draining.*	Shown in the figure *Location of gearbox on page 158*. Vessel capacity is specified in *Required equipment on page 158*.
6	Run the upper arm back to its calibration position (horizontal position).	This is detailed in section *Synchronization marks and synchronization position for axes on page 306*.
7	Refit the oil plug, draining.	Tightening torque: 24 Nm.

Filling, oil

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 158*.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	Refill the gearbox with clean *lubricating oil.* The correct oil level is detailed in section *Inspecting the oil level in axis-4 gearbox on page 125*.	Shown in the figure *Location of gearbox on page 158*. Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*.

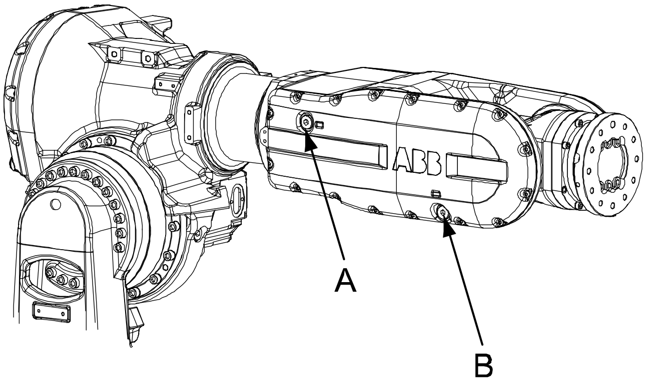
Continues on next page

	Action	Note
4	Refit the oil plug, filling.	Tightening torque: 24 Nm.

3.4.6 Changing oil, axis-5 gearbox

Location of gearbox

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



xx0600002963

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

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	See *Type and amount of oil in gearboxes on page 147*.	
Oil exchange equipment	3HAC021745-001		Content is defined in section *Special tools on page 345*.
Oil collecting vessel	-		Capacity: 4,000 ml.
Standard toolkit	-		Content is defined in section *Standard tools on page 344*.

Draining, oil, axis 5

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 161*.

	Action	Note
1	Move the robot to its calibration position.	This puts the oil plug draing in the right position.

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
4	Remove the *oil plug, filling*.	
5	Drain the oil from the gearbox by opening the *oil plug, draining.*	Shown in the figure *Location of gearbox on page 161*. Vessel capacity is specified in *Required equipment on page 161*.
6	Refit the oil plug, draining.	Tightening torque: 24 Nm.

Filling, oil, axis 5

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 161*.

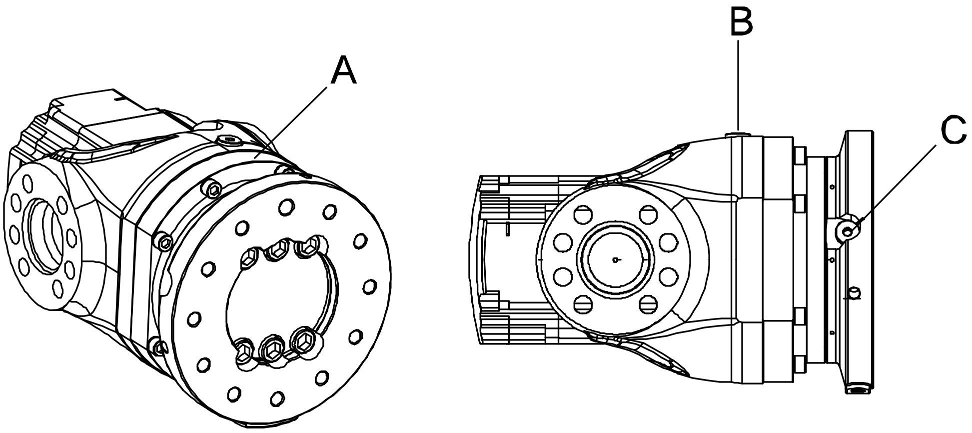
	Action	Note
1	Run axis 4 to a position where the oil plug, filling, is facing upwards.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Refill the gearbox with clean *lubricating oil.* The correct oil level is detailed in section *Inspecting the oil level in axis-5 gearbox on page 127*.	Shown in the figure *Location of gearbox on page 161*. Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*.
5	Refit the oil plug, filling.	Tightening torque: 24 Nm.

3.4.7 Changing oil, axis-6 gearbox

Location of gearbox

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

The figure shows gearbox axis 6 for IRB 6620 Foundry Plus.



xx0600002964

A	Gearbox axis 6
B	Oil plug, filling
C	Oil plug, draining

Required equipment

Equipment, etc.	Art. no.	Amount	Note
Lubricating oil	See *Type and amount of oil in gearboxes on page 147*.	See *Type and amount of oil in gearboxes on page 147*.	**Note** Do not mix with other oils!
Oil exchange equipment	3HAC021745-001		Content is defined in section *Special tools on page 345*.
Oil collecting vessel	-		Vessel capacity: 500 ml
Standard toolkit	-		Content is defined in section *Standard tools on page 344*.

Draining, oil, axis 6

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 163*.

	Action	Note
1	Run the robot to a position where the *oil plug, filling* of axis 6 gearbox is facing downwards.	Shown in the figure *Location of gearbox on page 163*.

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
4	Drain the oil from the gearbox into a vessel by removing the oil plug.	Vessel capacity is specified in *Required equipment on page 163*.
5	Refit the *oil plug, filling*.	Tightening torque: 24 Nm.

Filling, oil, axis 6

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

When using the oil exchange equipment, follow the instructions enclosed with the kit. Art. no. for the kit is specified in *Required equipment on page 163*.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	**WARNING** Handling gearbox oil involves several safety risks, see *Gearbox lubricants (oil or grease) on page 34*.	
3	Remove the *oil plug, filling.*	Shown in the figure *Location of gearbox on page 163*.
4	Refill the gearbox with clean *lubricating oil.* The correct oil level is detailed in section *Inspecting the oil level in axis-6 gearbox on page 129*.	Where to find type of oil and total amount is detailed in *Type and amount of oil in gearboxes on page 147*.
5	**Note** Do not mix Kyodo Yushi TMO 150 with other oil types!	Detailed in the section *Type of lubrication in gearboxes on page 147*.
6	Refit the oil plug.	Tightening torque: 24 Nm.

Continues on next page

	Action	Note
	Inspect the oil level.	Detailed in the section *Inspecting the oil level in axis-6 gearbox on page 129*.

3.4.8 Replacing the SMB battery

Note

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

For 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.

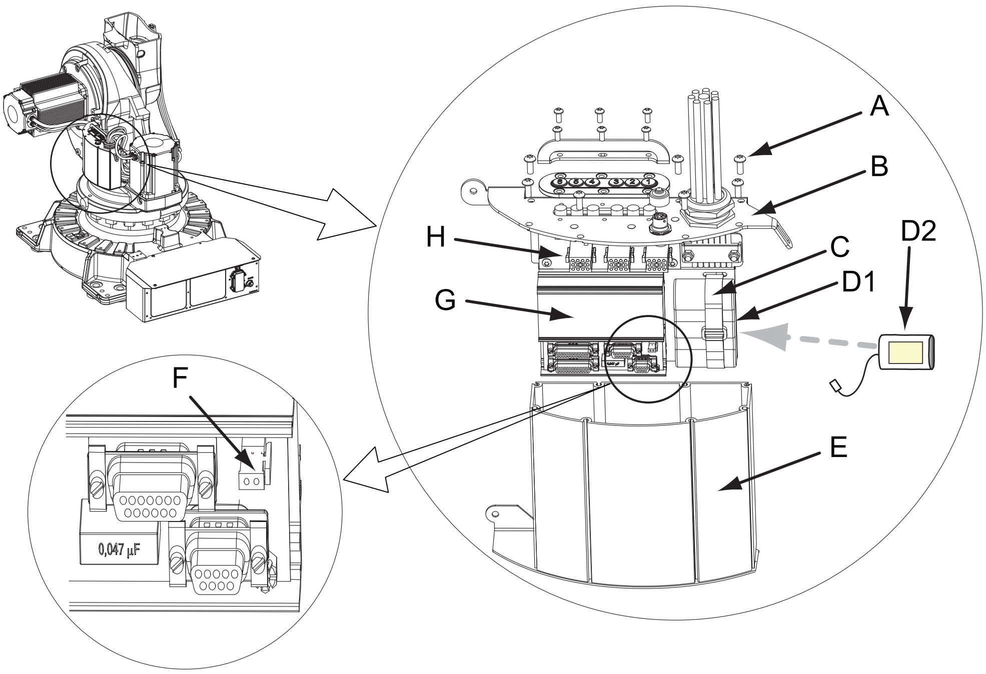
For an SMB board with 2-pole battery contact, the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See *Operating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

WARNING

See *Hazards related to batteries on page 35*.

Location of SMB battery

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



xx0600002982

A	Attachment screws
B	SMB/BU unit (complete)
C	Velcro strap

Continues on next page

D1	Battery pack (2-pole battery contact)
D2	Battery pack (3-pole battery contact)
E	SMB/BU box
F	Connection point, battery cable
G	SMB (Serial measurement board)
H	BU unit (Brake release unit)

Required equipment

Note

There are two variants of SMB units and batteries. One with 2-pole battery contact and one with 3-pole battery contact. 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.	Spare part no.	Note
Battery pack	For spare part no. see: • *Spare part lists on page 349*	Battery includes protection circuits. Only replace with a specified spare part or an ABB-approved equivalent.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Circuit diagram	-	See chapter *Circuit diagram on page 351*.

Removing, battery

Use this procedure to remove the SMB battery.

	Action	Note
1	Move the robot to its calibration position.	This is done in order to facilitate updating of the revolution counter.
2	**DANGER** Turn off all: • 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	 xx0200000023 **WARNING** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 60*	
4	Remove SMB/BU box by unscrewing the attachment screws. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
5	Lift the *SMB/BU unit* out of its box and disconnect the battery cable.	
6	Remove the velcro strap that holds the battery.	
7	Remove the *SMB battery.* Battery includes protection circuits. Only replace with a specified spare part or with an ABB- approved equivalent.	Shown in figure *Location of SMB battery on page 166*.

Refitting, battery

Use this procedure to refit the SMB battery.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	 xx0200000023 **WARNING** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 60*	

Continues on next page

	Action	Note
3	Reconnect the battery cable to the SMB battery pack and secure it with the *velcro strap*.	Art. no. is specified in *Required equipment on page 167*. Shown in figure *Location of SMB battery on page 166*.
4	Put the *SMB/BU unit* back into the box and secure it with its *attachment screws*.	Shown in figure *Location of SMB battery on page 166*.
5	Update the revolution counter.	Detailed in chapter Calibration - section *Updating revolution counters on page 309*.
6	**DANGER** Make sure all safety requirements are met when performing the first test run.	

3.5 Cleaning activities

3.5.1 Cleaning the IRB 6620

DANGER

Turn off all:

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

to the robot, before entering the safeguarded space.

General

To secure high uptime it is important that the IRB 6620 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Different cleaning methods are allowed depending on the type of protection of the IRB 6620.

Note

Always verify the protection type of the robot before cleaning.

Oil spills

Oil spills from gearboxes

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

1. Inspect that the oil level in the suspected gearbox is according to the recommendations, see *Inspection activities on page 118*.
2. Write down the oil level.
3. Inspect the oil level again after, for example, 6 months.
4. If the oil level is decreased then replace the gearbox.

Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

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

Continues on next page

Cleaning methods

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

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

[i] Perform according to section *Cleaning with water and steam on page 171*.

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/m^2 (7 bar) [I]
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum flow: 20 liters/min[I]

[I] Typical tap water pressure and flow

Instructions for steam or high pressure water cleaning

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2500 kN/m^2 (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.

[1] See *Cleaning methods on page 171* for exceptions.

[2] See *Cleaning methods on page 171* for exceptions.

Continues on next page

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

4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 6620. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.

WARNING

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

Report replaced units

Note

When replacing a part on the IRB 6620, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

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

Safety information

Make sure to read through the chapter *Safety on page 19* before commencing any service work.

Note

If the IRB 6620 is connected to power, always make sure that the IRB 6620 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

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

4.2 General procedures

4.2.1 Performing a leak-down test

When to perform a leak-down test

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

Required equipment

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

Performing a leak-down test

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

4.2.2 Mounting instructions for bearings

General

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

Equipment

Equipment, etc.	Article number	Note
Grease	3HAC042536-001	Shell Gadus S2 Used to grease the bearings, if not specified otherwise.

Assembly of all bearings

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

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

Assembly of tapered bearings

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

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

	Action	Note
1	Tension the bearing gradually until the recommended pre-tension is achieved. **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

Note

This instruction is not valid for solid oil bearings.

Continues on next page

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

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

Grease the different types of bearings as following description:

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

4.2.3 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

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

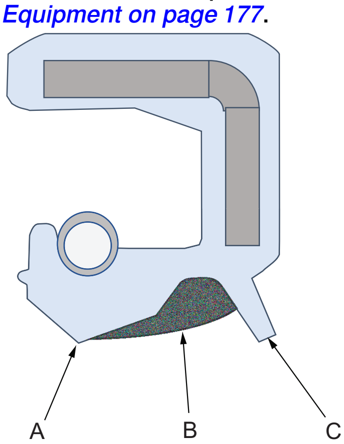
Rotating sealings

The procedure below describes how to fit rotating sealings.

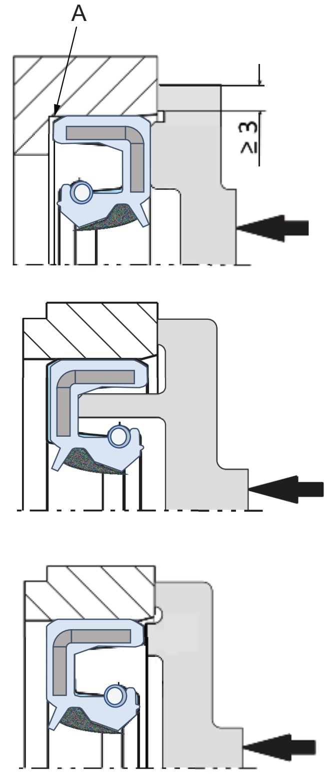
CAUTION

Please observe the following before commencing any assembly of sealings:

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

	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	
3	Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.) Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.	Article number is specified in *Equipment on page 177*.  xx2000000071 A Main lip B Grease C Dust lip

Continues on next page

	Action	Note
4	Mount the sealing correctly with a mounting tool. Never hammer directly on the sealing as this may result in leakage.	 xx2000000072 A Gap

Flange sealings and static sealings

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

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

O-rings

The following procedure describes how to fit o-rings.

	Action	Note
1	Ensure that the correct o-ring size is used.	
2	Check the o-ring for surface defects, burrs, shape accuracy, or deformation.	Defective o-rings, including damaged or deformed o-rings, may not be used.

Continues on next page

	Action	Note
3	Check the o-ring grooves. The grooves must be geometrically correct and should be free of pores and contamination.	
4	Lubricate the o-ring with grease.	
5	Tighten the screws evenly while assembling.	
6	Check that the o-ring is not squashed outside the o-ring groove.	

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

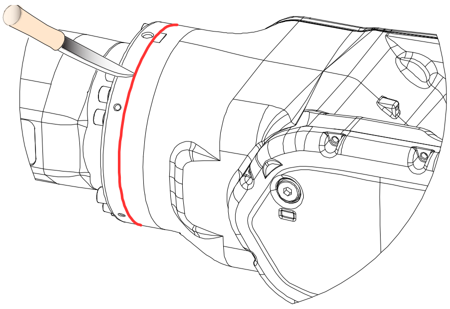
General

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

Required equipment

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

Removing

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

4.2.5 The brake release buttons may be jammed after service work

Description

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

DANGER

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

Elimination

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

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

4.3 Complete robot

4.3.1 Replacement of cable harness, lower end (axes 1-2)

General

The cable harness 1-6 is undivided.

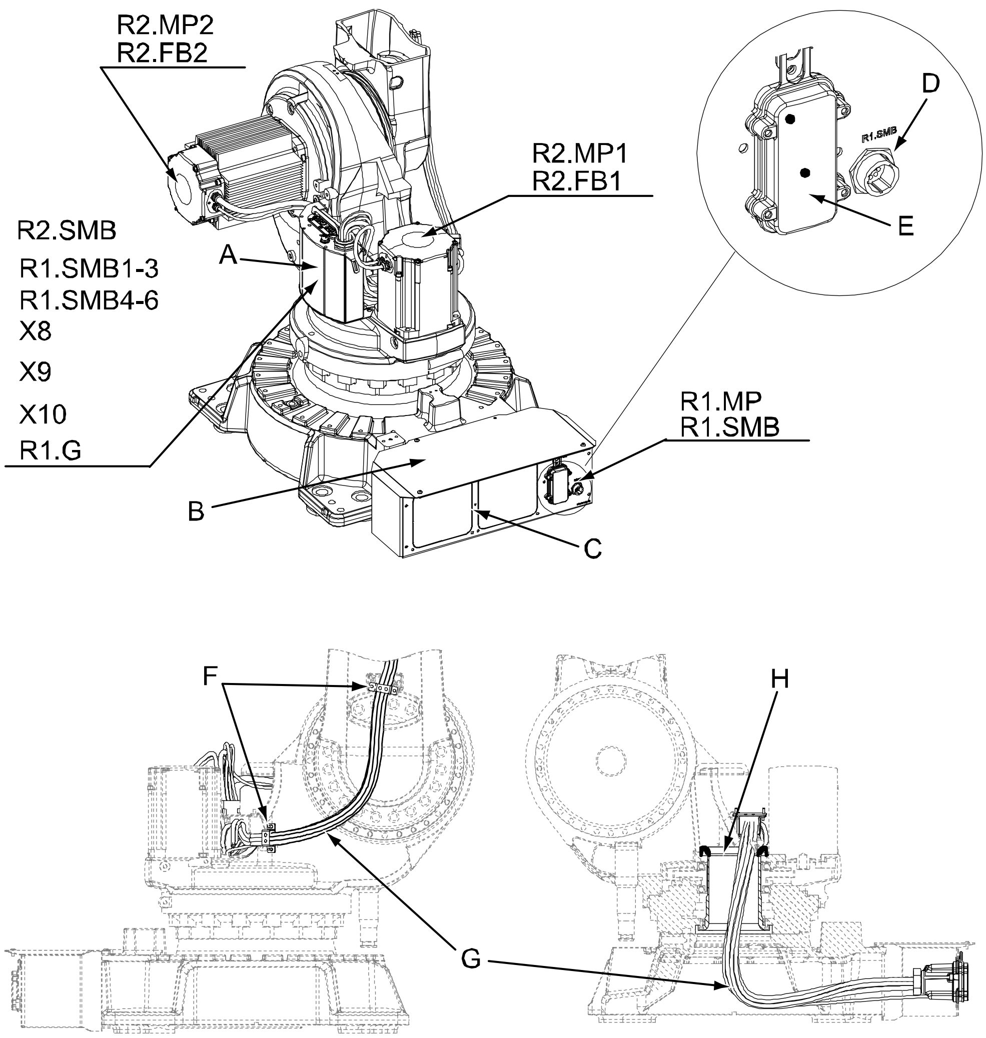
Replacement of the cable harness is detailed in two steps - lower end and upper end.

The procedure below details replacement of the lower end of the cable harness.

The procedure for replacing the upper end is detailed in the section *Replacement of cable harness, upper end on page 189*.

Location of cable harness, axes 1-2

The cable harness for axes 1-2 is run throughout the base and frame as shown in the figure below.



xx0600002970

A	SMB/BU unit

Continues on next page

B	Top cover, connection box
C	Connection plate, base
D	Connector R1.SMB
E	Connector R1.MP
F	Metal clamps
G	Cable harness
H	Cable guide (cut away view)

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Cable harness	See *Spare part lists on page 349*.		
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
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 351*.

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. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.

Continues on next page

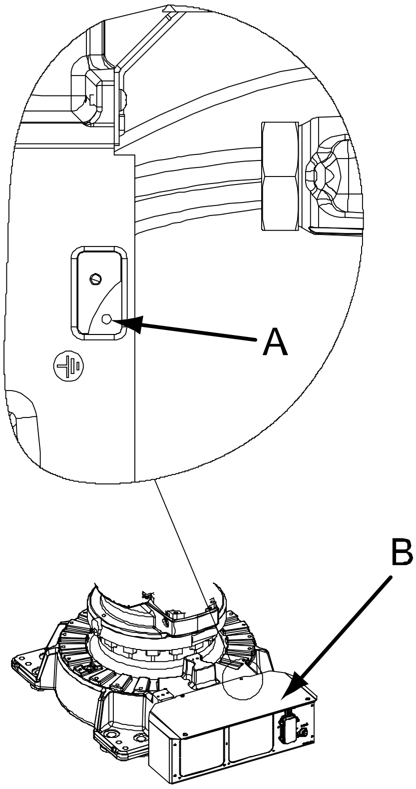
	Action	Note
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

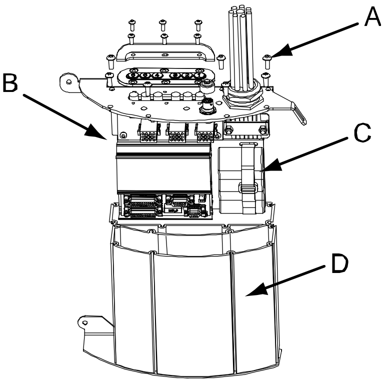
The procedure below details how to remove the cable harness, axes 1-2.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	In order to facilitate refitting of the cable harness, run the robot to the specified positions: • Axis 1: 0° • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° • Axis 5: +90° • Axis 6: no significance	
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove the *top cover, connection box* from the robot by removing its attachment screws.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.

Continues on next page

	Action	Note
5	Disconnect the earth cable.	 xx0600003028 • A: Earth (placed beneath the top cover) • B: Top cover, connection box
6	Disconnect connectors *R1.MP* and *R1.SMB* on the *connection plate, base*.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.
7	Disconnect all connectors at motors 1 *R2.MP1, R2.FB1* and 2 *R2.MP2, R2.FB2*.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.
8	Remove the *metal clamps* on the frame, securing the cable harness.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.

Continues on next page

	Action	Note
9	Remove the *attachment screws* holding the *SMB/BU unit* in its *box*. The cable between the battery and the SMB/BU unit may stay connected in order to avoid an update of the revolution counter. If the battery cable is disconnected, an update of the revolution counter is necessary!	 xx0600003026 • A: Attachment screws, M5x12 quality 8.8 (7 pcs) • B: SMB/BU unit • C: Battery unit • D: Box
10	Carefully lift the *SMB/BU unit* out of its *box*, while at the same time lifting the cables of the harness.	
11	Pull the *cable harness* and its *connectors* carefully up through the *cable guide* in the center of the frame.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.
12	Continue removal of the cable harness, axes 3-6.	Detailed in the section *Replacement of cable harness, upper end on page 189*.

Refitting

The procedure below details how to refit the cable harness axes 1-2.

	Action	Note
1	Push the *cable harness* axes 1-2 carefully down through the *cable guide* in the center of the frame.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.
2	Reconnect the connectors *R1.MP* and *R1.SMB* at the *connection plate, base*.	Tightening torque for R1.SMB: 10 Nm. Shown in the figure *Location of cable harness, axes 1-2 on page 182*.

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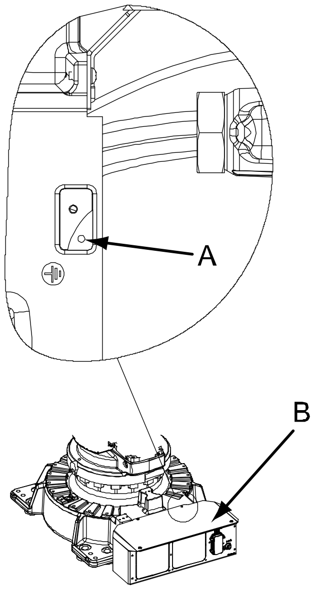
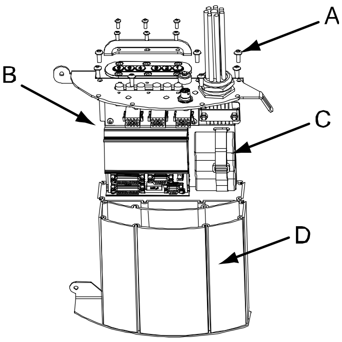
	Action	Note
3	Reconnect the earth cable.	 xx0600003028 • A: Earth (placed beneath the top cover) • B: Top cover, connection box
4	Put the *SMB/BU unit* carefully back into its *box* and refit its *attachment screws*.	 xx0600003026 • A : Attachment screws, M5x12 quality 8.8 (7 pcs) • B : SMB/BU unit • C : Battery unit • D : Box
5	Reconnect all connectors at motors 1 *R2.MP1, R2,FB1* and 2 *R2.MP2, R2.FB2*.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.
6	Refit the *metal clamps* on the frame, securing the cable harness.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.
7	Refit the *top cover, connection box*.	Shown in the figure *Location of cable harness, axes 1-2 on page 182*.

Continues on next page

	Action	Note
8	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
9	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.3.2 Replacement of cable harness, upper end

Introduction

The cable harness 1-6 is undivided.

Replacing the cable harness is described in two steps:

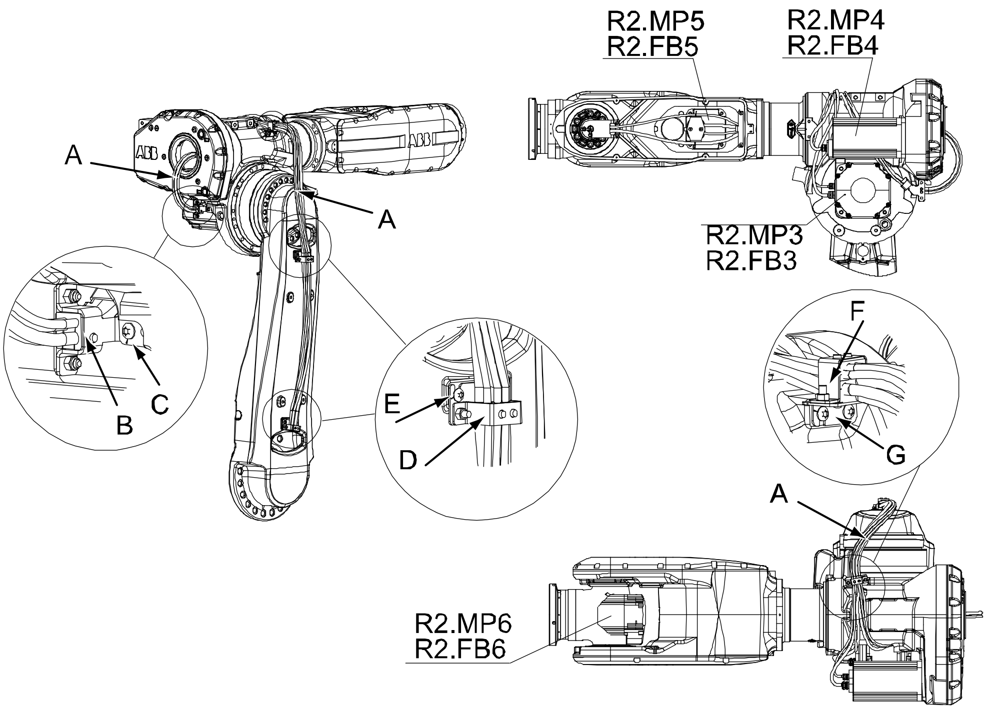
- lower end (axes 1-2)
- upper end (axes 3-6)

This procedure details how to replace the upper end.

For description of how to replace the lower end, see *Replacement of cable harness, lower end (axes 1-2) on page 182*.

Location of cable harness

The cable harness for the axes 3 to 6 runs throughout the lower and upper arm as shown in the figure below:



xx0600003078

A	Cable harness
B	Metal clamp, at gearbox axis 3
C	Attachment screws, metal clamp at gearbox axis 3, M6x16 quality 8.8 (2 pcs)
D	Metal clamp, lower arm (2 pcs)
E	Attachment screws, metal clamp lower arm, M6x16 quality 8.8 (2+2 pcs)
F	Metal clamp, armhouse
G	Attachment screws, metal clamp armhouse, M6x16 quality 8.8 (2 pcs)

Continues on next page

Required equipment

Equipment, etc.	Note
Cable harness axes 1-6	See *Spare part lists on page 349*.
Gasket	Motors axes 1-5 See *Spare part lists on page 349*.
Gasket	Motor axis 6. Recommended to be changed for Foundry Plus. See *Spare part lists on page 349*.
Retrofit set Foundry Plus, wrist	See *Spare part lists on page 349*.
Retrofit set Foundry Plus, upper arm axis 4	See *Spare part lists on page 349*.
Standard toolkit	Content is defined in section *Standard tools on page 344*.
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 351*.

Deciding calibration routine

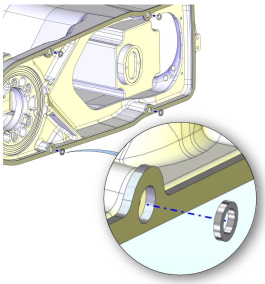
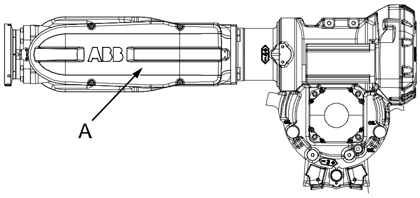
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removal

The procedure below details how to remove the cable harness.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	In order to facilitate refitting of the cable harness, run the robot to the specified positions: • Axis 1: 0° • Axis 2: 0° • Axis 3: 0° • Axis 4: 0° • Axis 5: +90° • Axis 6: no significance	
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Before starting the removal of cable harness axes 3-6, first remove cable harness axes 1-2.	Detailed in the section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
5	Remove the *cover, wrist unit* in order to reach the cable harness at axes 5 and 6. **Note** *Foundry Plus* Make sure not to lose the washers placed in the holes of the foundry gasket.  xx1400002580	 xx0600003024 • A : Cover, wrist unit

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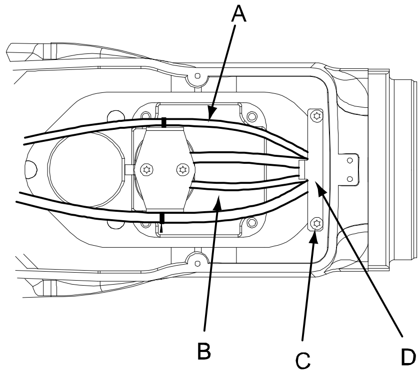
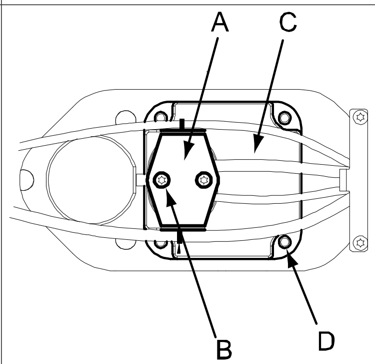
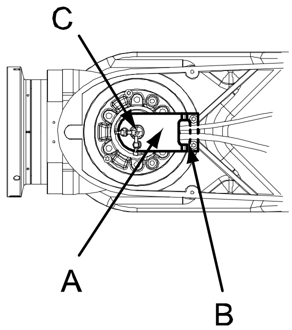
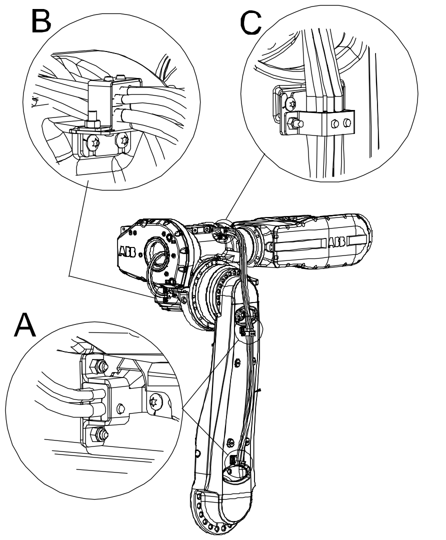
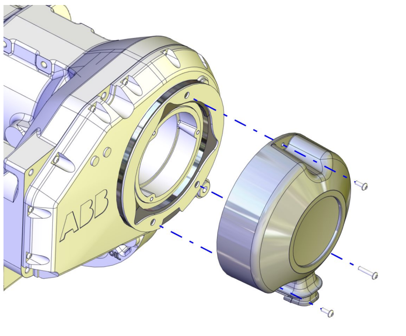
	Action	Note
6	Remove the *metal clamp* securing the *cable harness* at axis 5 by removing its *attachment screws*.	 xx0600003030 • A : Cable harness • B : Motor, axis 5 • C : Attachment screw, M6x16 8.8 (2 pcs) • D : Metal clamp
7	Remove the *cover* at motor axis 5 by removing its *attachment screws.* Also remove the *cover motor, axis 5* by removing its attachment screws and disconnect the motor cables *R2.MP5* and *R2.FB5*.	 xx0600003032 • A : Cover • B : Attachment screw M6X30 8.8 (2 pcs) • C : Cover motor, axis 5 • D : Attachment screws motor
8	Remove the *cable holder* in the wrist unit by unscrewing the three *attachment screws*. Two of the attachment screws (M6x16) are visibly located at the rear of the cable holder. The third screw (M4x12) is located at the bottom of the cable holder, securing the carrier.	 xx0600003034 • A : Cable holder • B : Attachment screws M6x16, 8.8 (2 pcs) • C : Attachment screw M4x12, 8-A2F (securing the carrier)

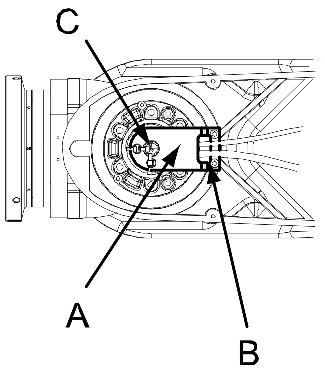
Continues on next page

	Action	Note
9	Remove the back cover motor, axis 6 by removing its attachment screws.	
10	Pull out the cabling *R2.MP6* and *R2.FB6* from motor axis 6 .	Shown in the figure *Location of cable harness on page 189*
11	Disconnect all connectors at motor axis 6 *R2.MP6* and *R2.FB6*.	Shown in the figure *Location of cable harness on page 189*
12	Remove the cover of motor axes 3 and 4 by removing its attachment screws.	
13	Disconnect all connectors at motor axes 3 *R2.MP3, R2.FB3* and 4 *R2.MP4, R2.FB.4*.	Shown in the figure *Location of cable harness on page 189*
14	Remove the *metal clamps*, two on the lower arm, one on gearbox axis 3 and one on the armhouse.	 xx0600003083 • A : Metal clamp, lower arm (2 pcs) • B : Metal clamp, gearbox axis 3 • C : Metal clamp, armhouse
15	*Foundry Plus* Remove the Foundry Plus arm house cover.	 xx1400002582
16	Use caution and pull out the cable harness of the upper arm.	
17	Tie the connectors into a bundle, to avoid damaging them during further removal.	

Continues on next page

Refitting

The procedure below details how to refit the cable harness.

	Action	Note
1	Begin by refitting the cable harness lower end (axes 1-2).	Detailed in the section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
2	Insert the cable harness gently from the rear into the upper arm.	Arrange the cable harness as shown in the figure *Location of cable harness on page 189*
3	Place the cabling to motor axis 6 correctly on the upper arm and pull the connectors carefully through the hole on top of the wrist unit to motor, axis 6.	Shown in the figure *Location of cable harness on page 189* We recommend changing the *gasket* on the cover for Foundry Plus robots.
4	Reconnect all connectors at motor axes 3 *(R2.MP3, R2.FB3)* and 4 *(R2.MP4, R2.FB4)*.	
5	Refit covers motor axes 3 and 4.	
6	Refit the cable holder wrist unit with the three attachment screws. Two of the attachment screws (M6x16) are visibly located at the rear of the cable holder. The third screw (M4x10) is located at the bottom of the cable holder, securing the carrier.	 xx0600003034 • A : Cable holder • B : Attachment screws M6x16, quality 8.8 (2 pcs) • C . Attachment screws M4x10, quality 8-A2F (securing the carrier)
7	Reconnect the motor cables axis 6 *R2.MP6* and *R2.FB6*.	Shown in the figure *Location of cable harness on page 189*
8	Refit cover motor, axis 6.	
9	Reconnect the motor cables axis 5 *R2.MP5* and *R2.FB5*.	Shown in the figure *Location of cable harness on page 189*

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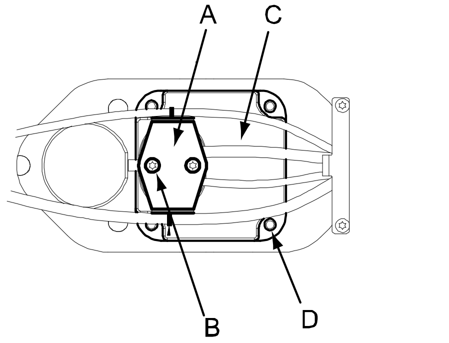
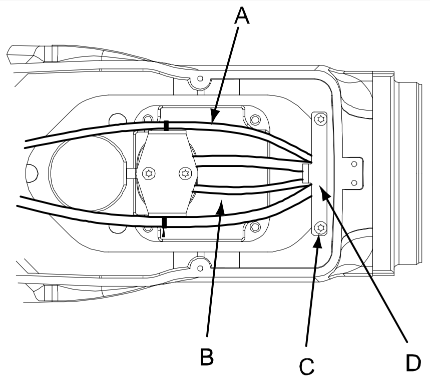
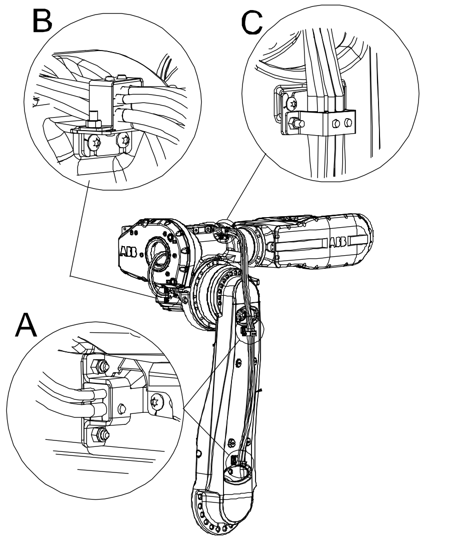
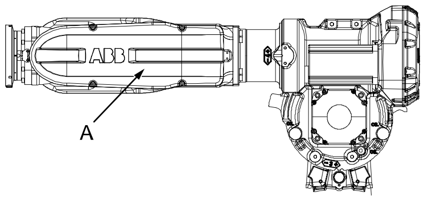
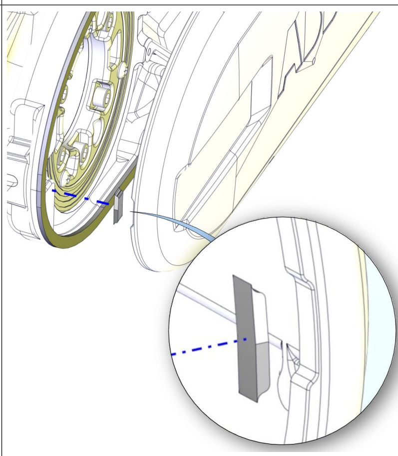
	Action	Note
10	Refit the *cover motor, axis 5 (C)* and *cover (A)*.	 xx0600003032 • A : Cover • B : Attachment screws M6x30, 8.8 (2 pcs) • C : Cover motor, axis 5 • D : Attachment screws
11	Refit the *metal clamp* securing the cable harness at axis 5.	 xx0600003030 • A : Cable harness • B : Motor, axis 5 • C : Attachment screws M6x16, 8.8 (2 pcs) • D : Metal clamp

Continues on next page

	Action	Note
12	Refit the four *metal clamps*, two on the lower arm, one on gearbox axis 3 and one on the armhouse.	 xx0600003083 • A : Metal clamp, lower arm (2 pcs) • B : Metal clamp, gearbox axis 3 • C : Metal clamp, armhouse
13	*Standard* Fit the wrist cover.	 xx0600003024 • A : Cover, wrist unit
14	*Foundry Plus* Make sure the wrist cover gasket and the small gasket fitted in the recess of the wrist cover are undamaged. Replace if damaged.	 xx1400002579

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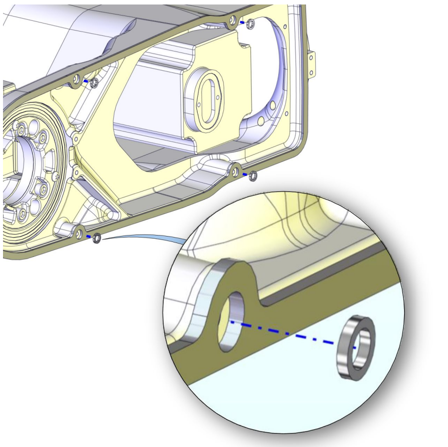
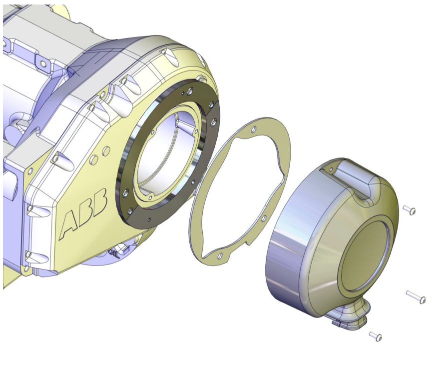
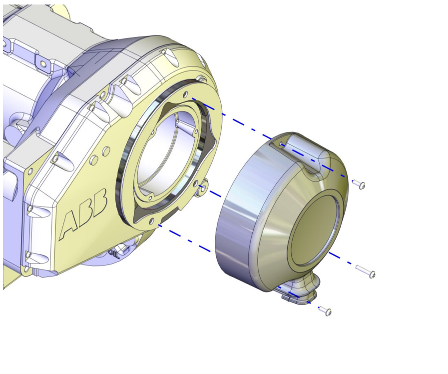
	Action	Note
15	*Foundry Plus* Make sure the washers are fitted in the gasket holes.	 xx1400002580
16	*Foundry Plus* Fit the wrist cover, Foundry Plus. Make sure the gasket stays undamaged after fitting. Replace if damaged.	
17	*Foundry Plus* Make sure the gasket on the adapter ring is undamaged. Replace if damaged.	 xx1400002581
18	*Foundry Plus* Fit the Foundry Plus cover on the adapter ring.	 xx1400002582
19	Make sure the gasket on the adapter ring is undamaged. Replace if damaged.	

Continues on next page

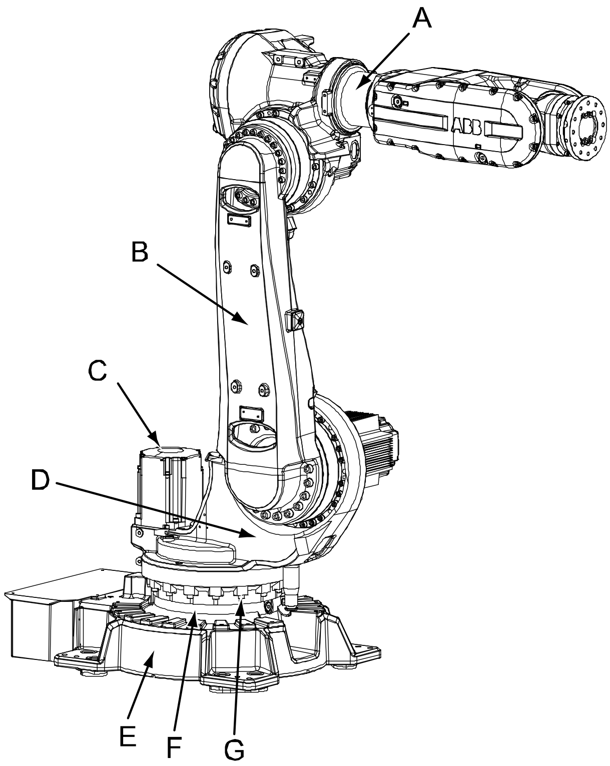
	Action	Note
20	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
21	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.3.3 Replacement of complete arm system

Location of arm system

The complete arm system is defined as the complete robot except for the base, motor and axis-1 gearbox axis 1. This is shown in the figure below.

A more detailed view of the component and its position may be found in *Spare part lists on page 349*.



xx0600003035

A	Upper arm
B	Lower arm
C	Motor, axis 1
D	Frame
E	Base
F	Gearbox, axis 1
G	Attachment screws base M12x80, quality 12.9 Gleitmo (16 pcs)

Required equipment

Equipment, etc.	Art. no.	Note
Lifting accessory, robot	3HAC026597-001	Instruction 3HAC026600-002 is enclosed!

Continues on next page

Equipment, etc.	Art. no.	Note
Guide pins M12 x 130	3HAC022637-001	Used to guide the complete arm system when lifting it. Always use the guide pins in pairs! In order to make the refitting easier, it is recommended to use two guide pins of different lengths.
Roundsling 1,5 m		Lifting capacity 1,000 kg
Roundslings	-	
Hoisting block	-	Used to adjust the length of the lifting chain.
Lifting chain	-	Used together with the hoisting block.
Isopropanol	-	Used for cleaning mounting surfaces.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Deciding calibration routine

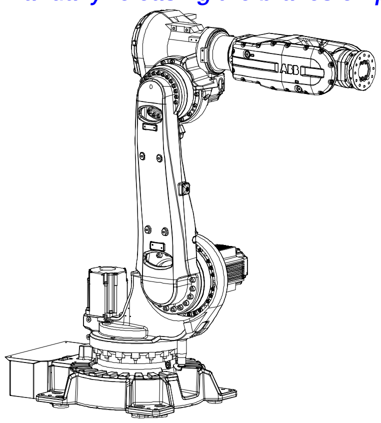
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

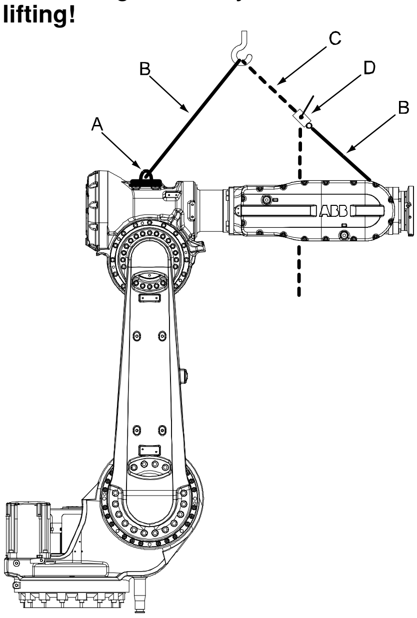
Continues on next page

Removal, arm system

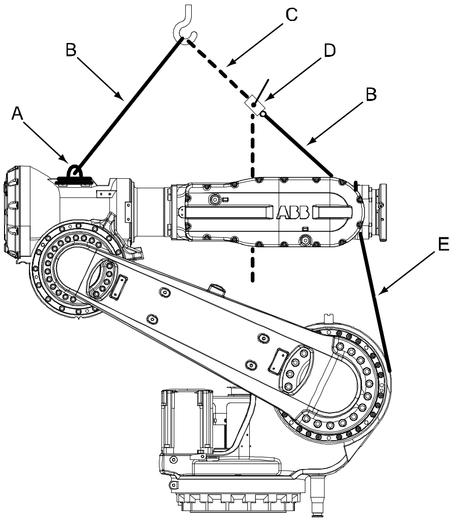
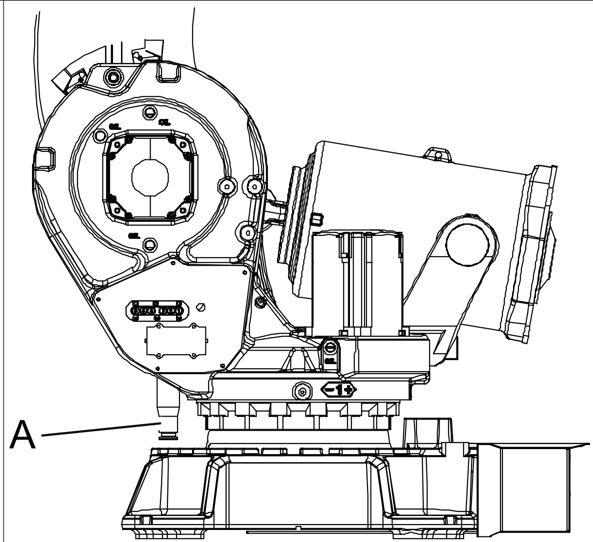
Use this procedure to lift and remove the complete arm system.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Run the robot to the position shown in the figure to the right.	Release the brakes if necessary, as detailed in section *Manually releasing the brakes on page 74*.  xx0600003125
3	Run the overhead crane to a position above the robot.	

Continues on next page

	Action	Note
4	Fit the *lifting accessory* and adjust it as detailed in the enclosed *instructions*. Also fit a *hoisting block* to the front, used to adjust the balance of the arm system in order to lift it completely level. **Note** There is an **alternate method** of lifting the complete armsystem described below.	Art. no. is specified in *Required equipment on page 199*. Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting accessory! **Read the instructions before lifting!**  xx0600003101 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
5	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
6	Drain the oil from gearbox axis 1.	Detailed in section *Changing oil, axis-1 gearbox on page 149*.
7	Disconnect the cabling in the rear of the robot base and remove the cable support plate inside the base.	
8	Pull the disconnected cabling up through the center of the axis-1 gearbox.	How to replace the cabling is detailed in *Replacement of cable harness, lower end (axes 1-2) on page 182*.
9	Remove the motor, axis 1.	Detailed in section *Replacement of motor, axis 1 on page 239*.

Continues on next page

	Action	Note
10	*Alternate method* of lifting: Fit the *lifting accessory* and a *roundsling* on the upper arm **and** a *roundsling* with a hoisting block, to the wrist unit. Also fit a separate *roundsling* between the wrist and the frame in order to eliminate any load through the brake on motor axis 3. The hoisting block is used to balance the upper arm. See the **lifting instructions**. **Note** The brake on axis 3 shall be released during the lift, until the roundsling between the wrist and the frame tranfers the load of the frame. See figure to the right!	Art. no. is specified in *Required equipment on page 199*. Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting accessory! **Follow the instructions before lifting!** Releasing the brakes is detailed in section *Manually releasing the brakes on page 74*.  xx0600003100 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block • E : Roundsling (used to transfer the load of the frame)
11	Remove the mechanical stop pin from the frame.	 xx1200000668 A Mechanical stop pin

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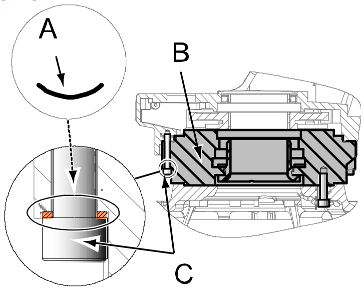
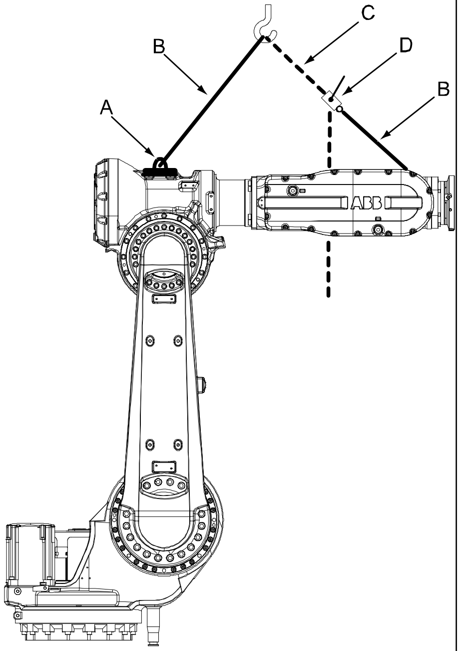
	Action	Note
12	Unfasten the arm system from the base by unscrewing its 16 *attachment screws.*	Shown in the figure *Location of arm system on page 199*.  xx0600003070 Parts: • A: Serrated lock washer • B: Gearbox axis 1 • C: Attachment screws M12x80
13	Fit two *guide pins* in two opposite screw holes.	Art. no. is specified in section *Required equipment on page 199*.
14	**CAUTION** The complete arm system weighs 590 kg! All lifting equipment used must be sized accordingly!	
15	Lift the arm system carefully and secure it in a safe area. Always move the robot at very low speeds, making sure it does not tip. Continue lifting even if the arm system turns out to be unbalanced despite earlier adjustments! The risk of damaging the interfaces is bigger if the load is lowered unbalanced!	Make sure all hooks and attachments stay in the correct position while lifting the arm system and that the lifting accessory does not wear against sharp edges.

Refitting, arm system

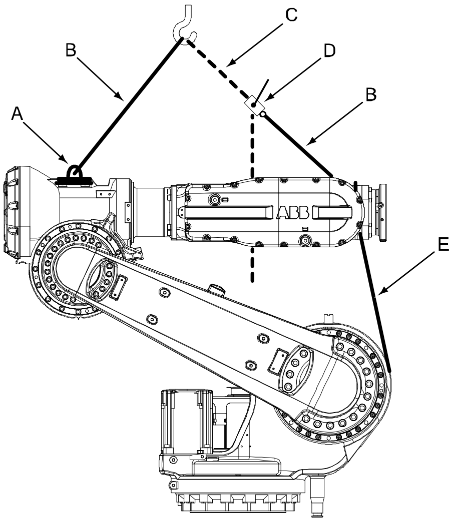
The procedure describes how to lift and refit the complete arm system.

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

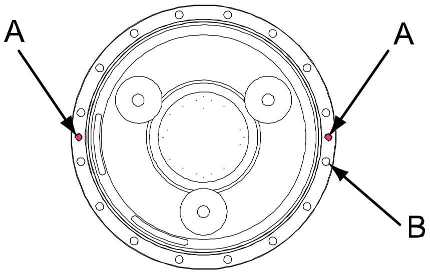
Continues on next page

	Action	Note
2	Fit the lifting accessory as detailed in the figure to the right. Also fit a *hoisting block* to the front. (Used to adjust the balance of the arm system in order to lift it completely level!) **Note** There is an **alternate method** of lifting the complete armsystem described below!	Art. no. is specified in *Required equipment on page 199*. Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting accessory! **Follow the instructions before lifting!** Releasing the brakes are detailed in section *Manually releasing the brakes on page 74*.  xx0600003101 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block

Continues on next page

	Action	Note
3	*Alternate method* of lifting: Fit the *lifting device* and a *roundsling* on the upper arm **and** a *roundsling* with a hoisting block, to the wrist unit. Also fit a separate *roundsling* between the wrist and the frame in order to eliminate any load through the brake on motor axis 3. The hoisting block is used to balance the upper arm. See the **lifting instructions.** **Note** The brake on axis 3 shall be released during the lift, until the roundsling between the wrist and the frame transfers the load of the frame. See figure to the right!	Art. no. is specified in *Required equipment on page 199*. Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting device! **Follow the instructions before lifting!** Releasing the brakes is detailed in section *Manually releasing the brakes on page 74*.  xx0600003100 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block • E : Roundsling (used to transfer the load of the frame)
4	**CAUTION** The complete arm system weighs 590 kg! All lifting equipment used must be sized accordingly!	
5	Lift the complete arm system and move it at very low speed, making sure it does not tip! Make sure the lift is done completely level. Adjust the length of the chains as detailed in enclosed instruction or with a hoisting block.	
6	Clean the mounting surfaces with isopropanol.	

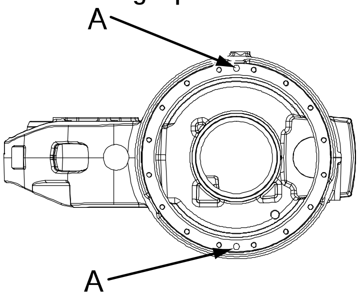
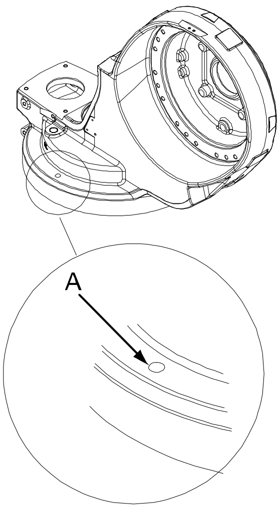
Continues on next page

	Action	Note
7	Fit two *guide pins* in the holes in the axis-1 gearbox, as shown in the figure to the right. If using guide pins of different lengths, fit the pin with maximal length of 130 mm on the right side of the gearbox (seen from behind). **Note** Lubricate the guide pins for easier fitting of the arm system.	Dimension is specified in *Required equipment on page 199*.  xx0600003095 The figure below shows the gearbox, axis 1. A Attachment holes for guide pins, M12 in gearbox axis 1. B Hole for attachment screw.
8	Lubricate the outer surface of the gearbox for easier mating of the gearbox and arm system.	

Continues on next page

4.3.3 Replacement of complete arm system

Continued

	Action	Note
9	Look through the empty mounting hole of motor 1 to assist in aligning the assembly during refitting of the arm system. Lower the arm system with guidance from the guide pins previously fitted to the axis-1 gearbox axis 1. Fit the guide pins in the corresponding holes in the frame as shown in the figure to the right. **Note** The refitting must be made completely level! Make sure the lifting accessory is adjusted prior to refitting of arm system.	This is a complex task to be performed with utmost care in order to avoid injury or damage! Use a crank to turn the gearbox in order to find the right position for the holes.  xx0600003094 • A : Holes in frame for guide pins, shown from below.  xx0600003093 • A : Holes in frame for guide pins, shown from above.
10	Remove the guide pins and secure the arm system to the base with its 16 *attachment screws and washers.*	Shown in the figure *Location of arm system on page 199*. M12 x 80, 12.9 quality gleitmo. Tightening torque: 105 Nm. Reused screws may be used, providing they are lubricated as detailed in section *Screw joints on page 340* before fitting.
11	Refit the *axis-1 motor*.	
12	Perform a *leak-down test* of the axis-1 gearbox.	Detailed in section *Performing a leak-down test on page 174*.
13	Refit the *cabling* in the base.	Detailed in section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
14	Refill the gearbox with lubricating oil.	Detailed in section *Changing oil, axis-1 gearbox on page 149*.

Continues on next page

	Action	Note
15	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
16	**DANGER** Make sure all safety requirements are met when performing the first test run.	

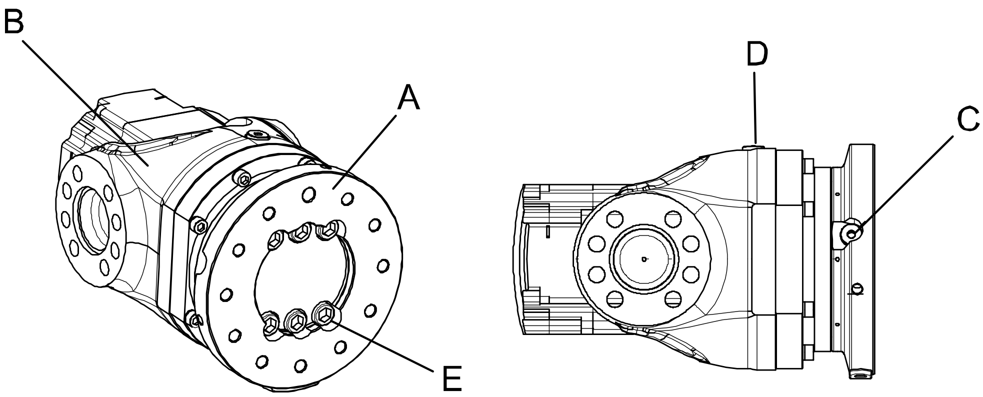
4.4 Upper and lower arm

4.4.1 Replacing the turning disk

Location of turning disk

The turning disk is located in the front of the wrist housing as shown in the figure below.

The figure shows the turning disk on an IRB 6620 Foundry Plus/IRB 6620LX.



xx0600003082

A	Turning disk
B	Wrist unit
C	Oil plug, draining
D	Oil plug, filling
E	Attachment screws, turning disk (6 pcs)

Required equipment

Equipment, etc.	Art. no.	Note
Turning disk	For spare part no. see: *Spare part lists on page 349*.	O-rings are not included!
O-ring Wrist, type 1	3HAB3772-65 (1pc) 21520431-20 (6 pcs)	Must be replaced when replacing the turning disk!
O-ring Wrist, type 2	3HAB3772-64 (1 pc) 3HAB3772-61 (12 pcs)	For IRB 6620 Foundry Plus. Must be replaced when replacing the turning disk!
Grease	3HAC042536-001	Shell Gadus S2 Used to lubricate the o-rings.
Flange sealant	3HAC034903-001	Loctite 574
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Continues on next page

Removing, turning disk

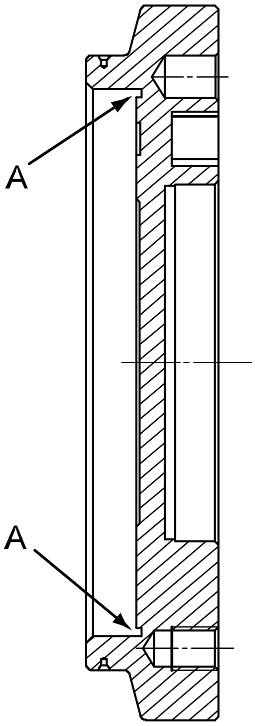
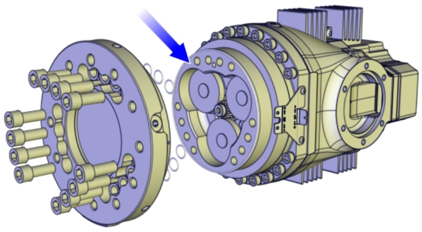
Use this procedure to remove the turning disk.

	Action	Note
1	Run the robot to a position where the *oil plug, draining* of axis 6 gearbox faces downwards.	Shown in the figure *Location of turning disk on page 210*.
2	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
3	Remove any equipment fitted to the turning disk.	
4	Drain the axis 6 gearbox.	See section • *Changing oil, axis-6 gearbox on page 163*
5	Remove the *attachment screws* that secure the turning disk.	Shown in the figure *Location of turning disk on page 210*.
6	Remove the *turning disk*.	
7	*Foundry Plus:* Remove old flange sealant residues and other contamination from the contact surfaces.	

Continues on next page

Refitting, turning disk

Use this procedure to refit the turning disk.

	Action	Note
1	Lubricate the *o-ring* of the turning disk with *grease* and fit it to the turning disk. Also fit the six o-rings, when refitting the attachment screws.	Art. no. is specified in *Required equipment on page 210*.  xx0200000218 • A: Sealing surface, o-ring
2	*Foundry Plus:* Apply Loctite 574 flange sealant on the contact surface.	 xx1400000995
3	Secure the turning disk with its *attachment screws*.	6 pcs M14 x 25, 12.9 quality. Tightening torque: 175 Nm Reused screws may be used, providing they are lubricated as detailed in section *Screw joints on page 340* before fitting.
4	Perform a *leak-down test* of the gearbox axis 6.	Detailed in the section *Performing a leak-down test on page 174*.
5	Refill the axis 6 gearbox with oil.	See section • *Changing oil, axis-6 gearbox on page 163*
6	Refit any equipment removed during disassembly to the turning disk.	

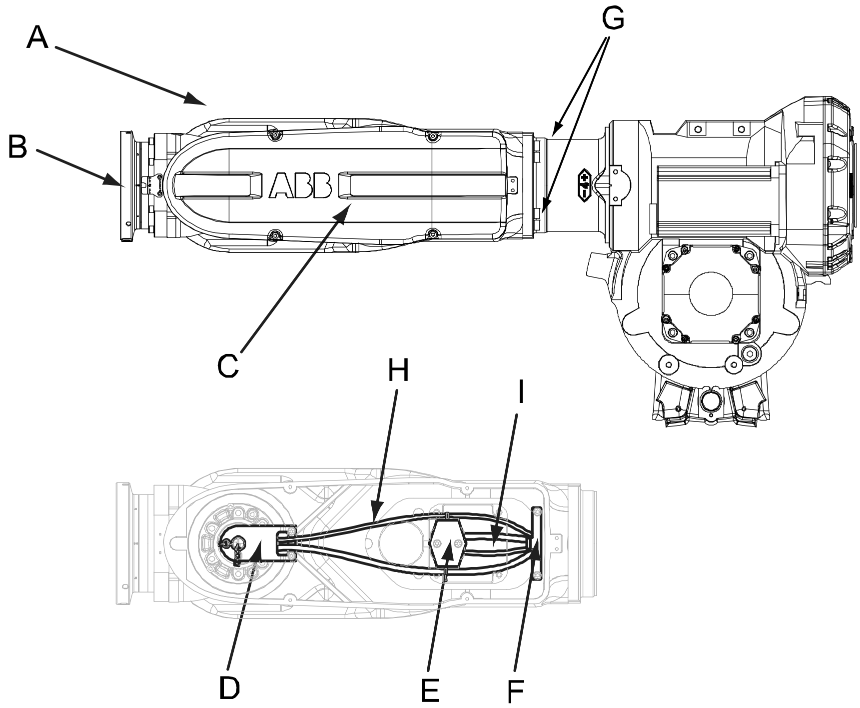
Continues on next page

	Action	Note
7	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.4.2 Replacement of wrist unit

Location of wrist unit

The wrist unit is located in the foremost part of the upper arm as shown in the figure below.



xx0600003055

A	Wrist unit
B	Turning disk
C	Cover, wrist unit
D	Cable holder
E	Cover, cable gland
F	Metal clamp
G	Wrist unit, attachment screws
H	Cable harness, axis 6
I	Cable harness, axis 5

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Wrist unit	See *Spare part lists on page 349*.		
Wrist unit, insulated	See *Spare part lists on page 349*.		
Retrofit set Foundry Plus, wrist	See *Spare part lists on page 349*.		

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Retrofit set Foundry Plus, upper arm axis 4	See *Spare part lists on page 349*.		
Roundsling		-	
Grease		3HAB 3537-1	Used to lubricate o-rings.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Deciding calibration routine

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

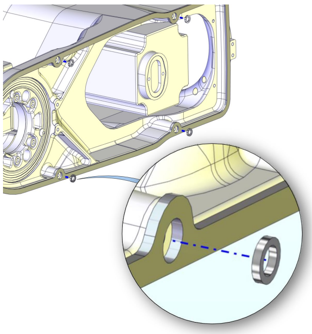
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

The procedure below details how to remove the wrist unit.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to a suitable position for removal of the wrist unit.	

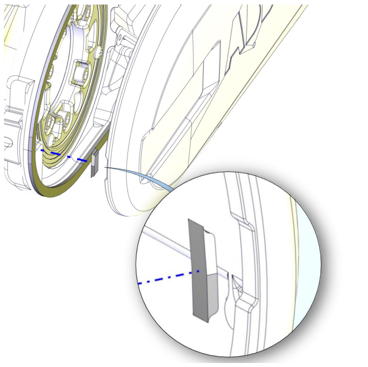
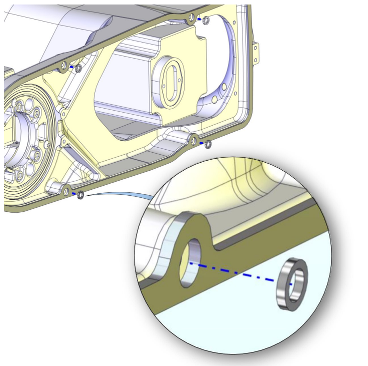
Continues on next page

	Action	Note
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove all equipment fitted to the *wrist unit*.	Shown in the figure in *Location of wrist unit on page 214*.
5	Remove the *cover, wrist unit* in order to reach the cable harness. **Note** *Foundry Plus* Make sure not to lose the washers placed in the holes of the Foundry Plus gasket.  xx1400002580	Shown in the figure *Location of wrist unit on page 214*.
6	Remove the cable harness, axes 5 and 6.	Detailed in section *Replacement of cable harness, upper end on page 189*.
7	**CAUTION** The complete wrist unit weighs 96 kg! All lifting equipment used must be sized accordingly!	
8	Secure the wrist unit with a roundsling in an overhead crane.	
9	Unscrew the eight *attachment screws* securing the wrist unit.	Shown in the figure *Location of wrist unit on page 214*.
10	Remove the wrist unit from the upper arm by moving it a little back and forth until it is lose.	**Note!** Do not damage the cylindrical pin in the process.

Refitting

	Action	Note
1	Secure the wrist unit with a roundsling in an overhead crane and lift it to its mounting position.	

Continues on next page

	Action	Note
2	**CAUTION** The complete wrist unit weighs 96 kg! All lifting equipment used must be sized accordingly!	
3	Put some *grease* on the surface of the fit.	
4	Check the cylindrical pin.	If the pin is damaged replace it.
5	Fit the wrist with its 8 attachment screws and washers.	M12x50 12.9 gleitmo (8 pcs) Tightening torque: 120 Nm
6	Refit the cable harness, axes 5 and 6.	Detailed in the section *Replacement of cable harness, upper end on page 189*.
7	*Standard* Fit the wrist cover.	Shown in the figure *Location of wrist unit on page 214*.
8	*Foundry Plus* Make sure the wrist cover gasket and the small gasket fitted in the recess of the wrist cover are undamaged. Replace if damaged.	 xx1400002579
9	*Foundry Plus* Make sure the washers are fitted in the gasket holes. Refit the wrist cover, Foundry Plus.	 xx1400002580
10	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.

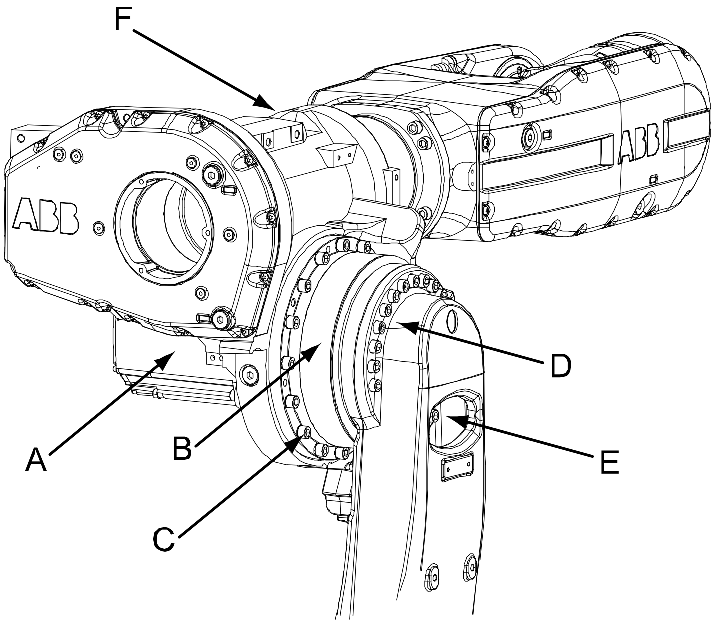
Continues on next page

	Action	Note
11	Refit any equipment previously removed from the wrist unit.	
12	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.4.3 Replacement of the upper arm

Location of the upper arm

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



xx0600003057

A	Motor, axis 3
B	Gearbox, axis 3
C	Attachment screws, M12x50 quality 12.9 Gleitmo (20 pcs)
D	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)
E	Hole in the lower arm
F	Upper arm

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Upper arm (Axes 3-4)	See *Spare part lists on page 349*.		
O-ring			Replace only if damaged.
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting chain		-	
Roundsling		-	
Guiding pins			Always use in pairs.
Hoisting block		-	
Grease		3HAC042536-001	Used to lubricate o-rings.

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Deciding calibration routine

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

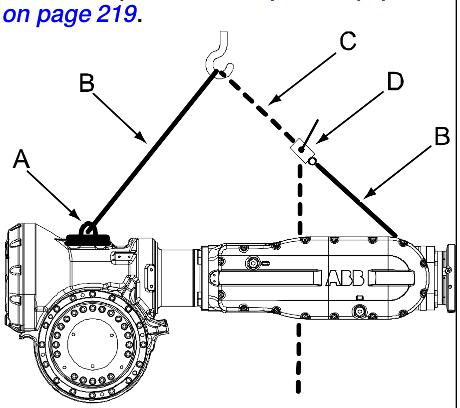
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

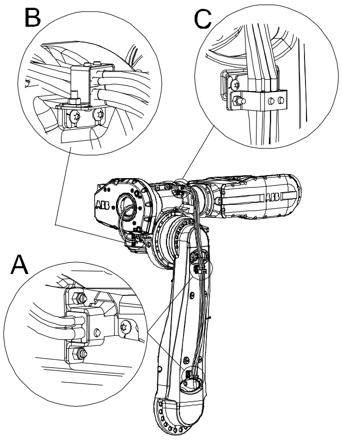
The procedure below details how to remove the upper arm.

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

Continues on next page

	Action	Note
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Drain the oil from gearbox axis 3.	Detailed in the section *Changing oil, axis-3 gearbox on page 155*.
4	Raise the upper arm to a position where it is parallel to the floor by releasing the brake of the axis 3 motor. In order to release the brake of the axis 3 motor, connect the 24 VDC power supply. **Note!** When releasing the brake, the position of the upper arm can change suddenly! Perform the procedure carefully!	Connect to connector R2.MP3: • + : pin 2 • -: pin 5
5	**CAUTION** The complete upper arm (incl. gearbox axis 3) weighs 282 kg without any additional equipment fitted! Use a suitable lifting device to avoid injury to personnel!	
6	Fit the *lifting tool* on the upper arm as detailed in the enclosed instructions. Also fit a *hoisting block* to the front which is used to adjust the balance of the upper arm in order to lift it completely level.	Art. no. is specified in *Required equipment on page 219*.  xx0600003102 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
7	Remove the cable harness, axes 3-6.	Detailed in the section *Replacement of cable harness, upper end on page 189*.

Continues on next page

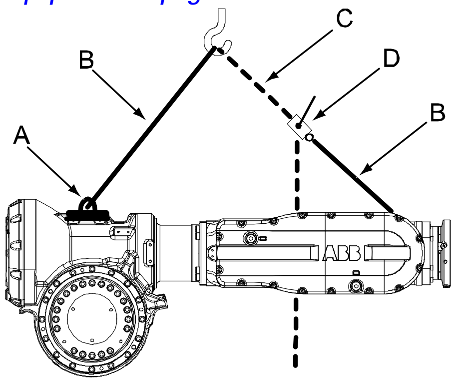
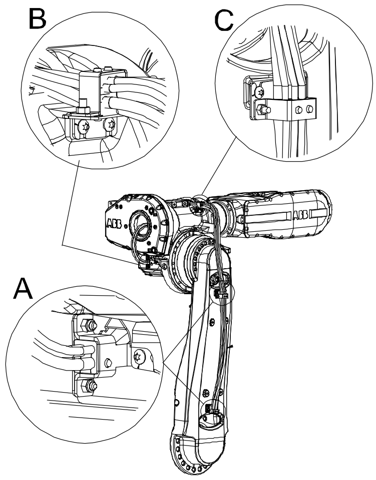
	Action	Note
8	Remove the three metal clamps securing the cable harness on the lower arm and armhouse.	 xx0600003083 • A: Metal clamp, lower arm (2 pcs) • B: Metal clamp, gearbox axis 3 • C: Metal clamp, armhouse
9	Remove motor, axis 3.	Detailed in the section *Replacement of motor, axis 3 on page 250*.
10	Remove the attachment screws securing the upper arm to the gearbox axis 3. **Note!** Do not forget to remove the four screws inside the hole in the lower arm.	Shown in the figure *Location of the upper arm on page 219*.
11	Remove the complete upper arm and put it on the floor. Let the upper arm lean on its side.	

Refitting

The procedure below details how to refit the upper arm.

	Action	Note
1	Make sure the o-ring is fitted to the gearbox. Lightly lubricate the o-ring with grease.	
2	**CAUTION** The complete upper arm (incl. gearbox axis 3) weighs 282 kg without any additional equipment fitted! Use a suitable lifting device to avoid injury to personnel!	

Continues on next page

	Action	Note
3	Fit the *lifting tool* on the upper arm as detailed in the enclosed instructions and lift it to its mounting position. Also fit a *hoisting block* to the front which is used to adjust the balance of the upper arm in order to lift it completely level.	Art. number is specified in *Required equipment on page 219*.  xx0600003102 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
4	Fit the guiding pins in gearbox axis 3.	
5	Refit the attachment screws securing the upper arm to the gearbox. **Note**! Do not forget the four screws inside the hole in the upper arm.	Shown in the figure *Location of the upper arm on page 219*.
6	Remove the guiding pins.	
7	Refit motor, axis 3.	Detailed in the section *Replacement of motor, axis 3 on page 250*.
8	Refit the metal clamps securing the cable harness on the lower arm and armhouse.	 xx0600003083 • A: Metal clamp, lower arm (2 pcs) • B: Metal clamp, gearbox axis 3 • C: Metal clamp, armhouse
9	Perform a leak-down test of the axis-3 gearbox.	Detailed in section *Performing a leak-down test on page 174*.
10	Refit the cable harness, axes 3-6.	Detailed in section *Replacement of cable harness, upper end on page 189*.

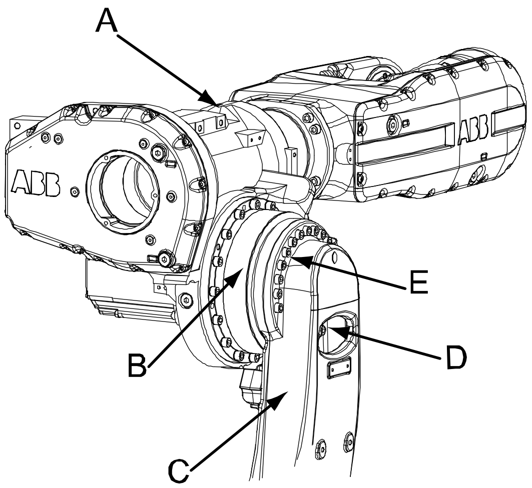
Continues on next page

	Action	Note
11	Fill gearbox, axis 3 with oil.	Detailed in section *Changing oil, axis-3 gearbox on page 155*.
12	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
13	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.4.4 Replacement of lower arm

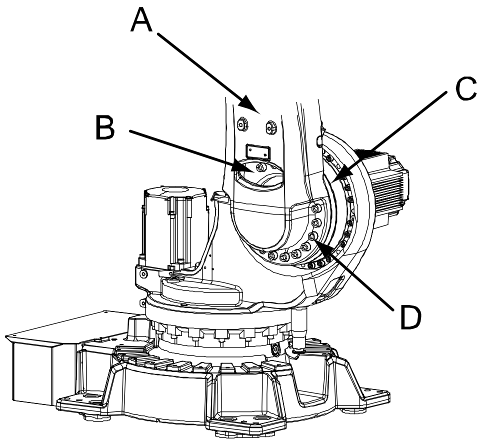
Location of lower arm

The location of the lower arm is shown in the figure below.



xx0600003058

A	Upper arm
B	Gearbox, axis 3
C	Lower arm
D	Hole in lower arm
E	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)



xx0600003059

A	Lower arm
B	Hole in lower arm
C	Gearbox, axis 2
D	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)

Continues on next page

Required equipment

Equipment, etc.	Spare part no.	Art no.	Note
Lower arm	See *Spare part lists on page 349*.		
Grease		3HAC042536-001	Used to lubricate o-rings.
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting chain		-	
Hoisting block		-	
Roundslings		-	
Guiding pins			Always use in pairs.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Deciding calibration routine

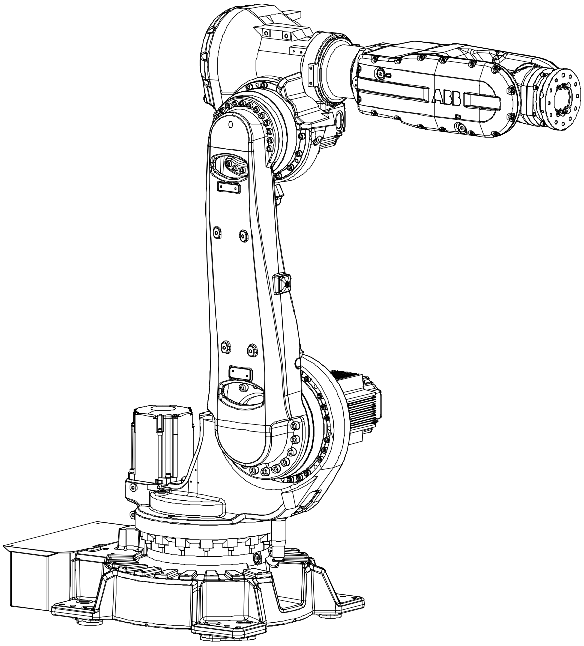
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removal

The procedure below details how to remove the lower arm.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to the position shown in the figure to the right.	 xx0600003125
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove the cable harness axes 3-6.	Detailed in the section *Replacement of cable harness, upper end on page 189*.
5	Let the cable harness hang loose, without it getting damaged in the proceeded removal procedure.	
6	Remove the upper arm.	Detailed in the section *Replacement of the upper arm on page 219*.
7	Secure the lower arm with a roundsling in an overhead crane.	

Continues on next page

	Action	Note
8	**CAUTION** The lower arm weighs 75 kg (gearboxes axes 2-3 excluded)!	
9	Remove the attachment screws and washers securing the lower arm to gearbox axis 2.	Shown in the figure *Location of lower arm on page 225*.
10	Remove the lower arm.	

Refitting

The procedure below details how to refit the lower arm.

	Action	Note
1	Secure the lower arm with a roundsling and lift it to its mounting position.	
2	**CAUTION** The lower arm weighs 75 kg (gearboxes axes 2-3 excluded)!	
3	Make sure the o-ring is fitted to the gearbox. Lightly lubricate the o-ring with grease.	
4	Fit guiding pins in two of the holes in gearbox axis 2.	
5	Lift the lower arm on to the guiding pins.	
6	Refit the attachment screws and washers securing the lower arm to gearbox axis 2.	Shown in the figure *Location of lower arm on page 225*. M16x50, quality 12.9 gleitmo (16 pcs). Tightening torque: 300 Nm.
7	Remove the guiding pins.	
8	Secure the upper arm with a roundsling and lift it to its mounting position.	
9	Refit the upper arm.	Detailed in the section *Replacement of the upper arm on page 219*.
10	Refit the cable harness axes 3-6.	Detailed in the section *Replacement of cable harness, upper end on page 189*.
11	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.

Continues on next page

	Action	Note
12	**DANGER** Make sure all safety requirements are met when performing the first test run.	

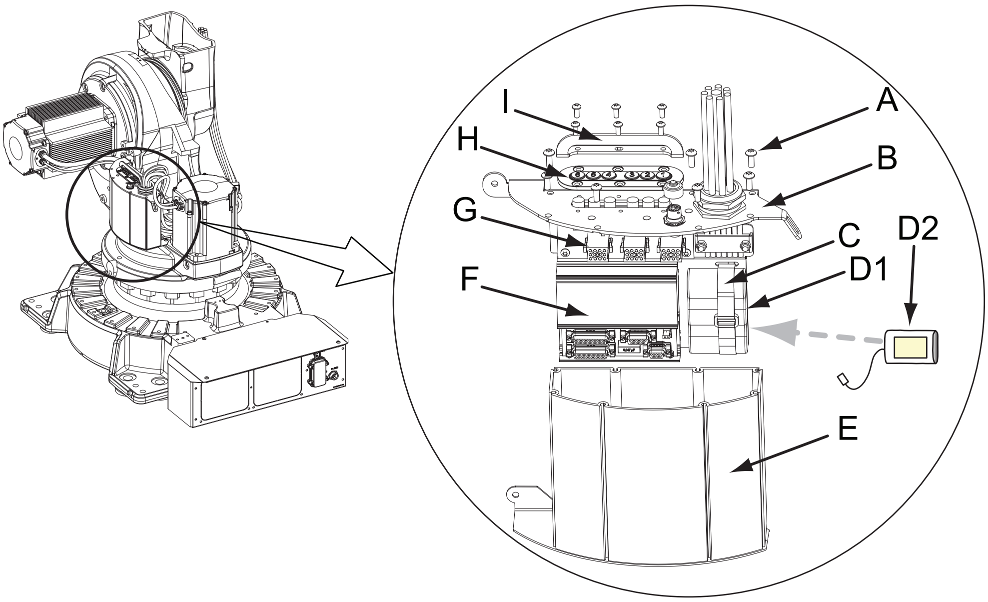
4.5 Frame and base

4.5.1 Replacement of SMB unit

Location of SMB unit

The SMB/BU unit (SMB = serial measurement board, BU = brake release unit) is located on the left-hand side of the frame as shown in the figure below.

The SMB unit and the BU unit are both located inside the SMB/BU box.



xx0600003052

A	Attachment screws (4 pcs)
B	SMB/BU unit
C	Velcro strap
D1	Battery pack (2-pole battery contact)
D2	Battery pack (3-pole battery contact)
E	SMB/BU box
F	Serial measurement unit (SMB), DSQC 633A
F	Serial measurement unit (SMB), RMU 101
G	Brake release unit (BU), DSQC 1050
H	Push button guard
I	Cover, push button guard
J	Gasket (Foundry Plus)

Continues on next page

Required equipment

> **Note**
>
> There are different variants of SMB units and batteries. The variant with the 3-pole battery contact has longer lifetime for the battery.
>
> It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

Equipment, etc.	Spare part no.	Art. no.	Note
Serial measurement unit (SMB)		*Spare part lists on page 349*.	
Standard toolkit		-	Content is defined in section *Special tools on page 345*.
Circuit diagram			See chapter *Circuit diagram on page 351*.

Removal, SMB unit

The procedure below details how to remove the SMB unit.

	Action	Note
1	Move the robot to the calibration position.	
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 60*.	
4	Unscrew the attachment screws of the SMB/BU unit and carefully lift it out of its box. **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	Shown in the figure *Location of SMB unit on page 230*.

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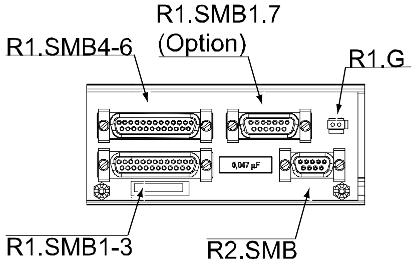
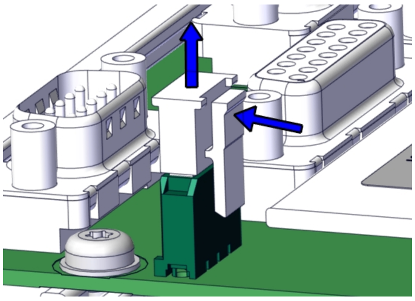
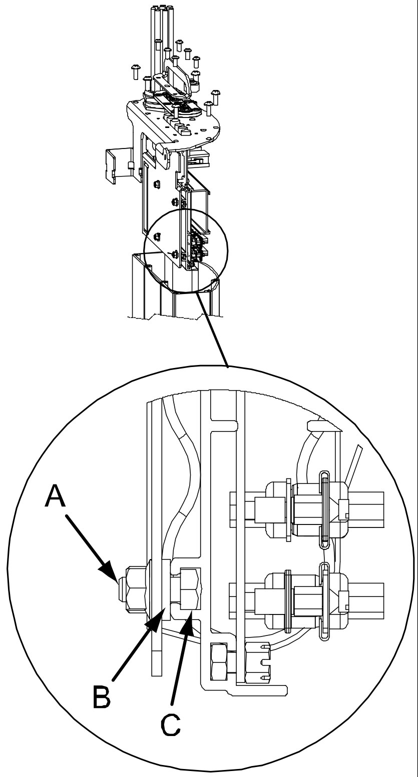
	Action	Note
5	Carefully disconnect the connectors from the SMB unit.	Connectors R1.SMB1-3, R1.SMB4-6 and R2.SMB  xx0600003054
6	Disconnect the battery cable by pressing down the upper lip of the R1.G connector to release the lock while pulling the connector upwards.	 xx1700000993
7	Unscrew the hexagon nuts securing the SMB unit just enough to pull the SMB unit out.	 xx0600003053 • A: Hexagon nut, M5 • B: Tooth lock washer, 6.4 fzb • C: Hexagon screw, M5x12 quality 8.8
8	Pull the SMB unit out carefully.	

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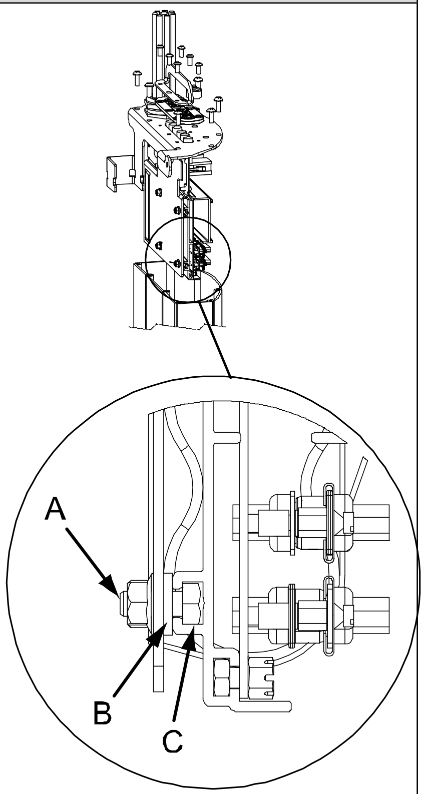
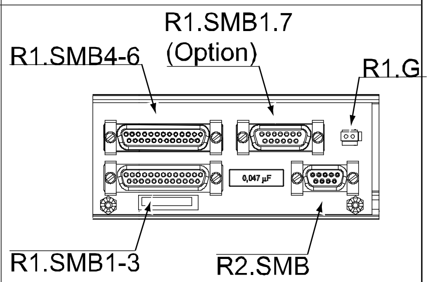
Refitting, SMB unit

The procedure below details how to refit the SMB unit.

	Action	Note
1	Push the SMB unit into its tracks and secure it with its hexagon nuts.	 xx0600003053 • A : Hexagon nut, M5 • B : Tooth lock washer, 6.4 fzb • C : Hexagon screw, M5x12 quality 8.8
2	Reconnect the connectors to the SMB unit. If cabling is used for 7th axis (option), refit the connector R2.FB7 to the SMB cover and tighten with 6 Nm.	 xx0600003054
3	Reconnect the battery cable. Make sure the lock on the battery cable connector R1.G snaps into place during refitting.	Connector R1.G
4	Put the SMB/BU unit back into its box and refit the attachment screws.	Shown in the figure *Location of SMB unit on page 230*.
5	Update the revolution counters!	Detailed in section *Updating revolution counters on page 309*.

Continues on next page

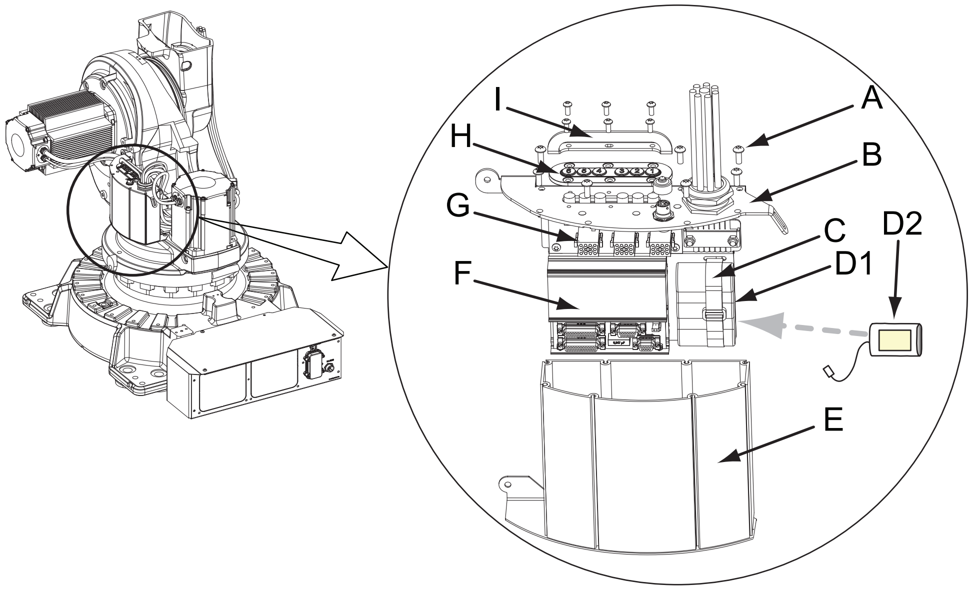
	Action	Note
6	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.5.2 Replacing the brake release board

Location of brake release board

The SMB/BU unit (SMB = serial measurement board, BU = brake release unit) is located on the left hand side of the frame as shown in the figure below.

The SMB unit and the BU unit are both located inside the SMB/BU box.



xx0600003052

A	Attachment screws (4 pcs)
B	SMB/BU unit
C	Velcro strap
D	Battery pack
E	SMB/BU box
F	Serial measurement unit (SMB), DSQC633
G	Brake release unit (BU), DSQC1050
H	Push button guard
I	Cover, push button guard
J	Gasket (Foundry Plus)

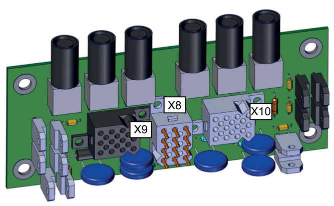
Required equipment

Equipment, etc.	Article number	Note
Brake release board including harness and bracket	3HAC066539-001	DSQC1050
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Continues on next page

Removing, brake release board

Use this procedure to remove the brake release board.

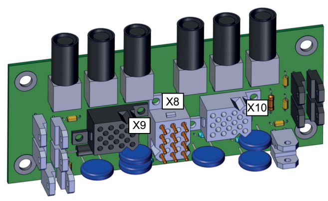
	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 60*.	
3	Remove the cover for the push button guard.	
4	Remove the push button guard from the SMB cover.	Shown in the figure *Location of brake release board on page 235*. The guard must be removed to ensure a correct refitting of the brake release board.
5	Take a picture or make notes of how the robot cabling is positioned in regard to the brake release board.	
6	Unscrew the attachment screws of the SMB/BU unit and carefully lift the unit out of its box. Let the battery stay connected, to avoid the need of synchronization of the robot! **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
7	Disconnect the connectors X8, X9 and X10 from the brake release board.	 xx1700000978 Location of the brake release unit is shown in the figure *Location of brake release board on page 235*.

Continues on next page

	Action	Note
8	Remove the brake release board from the bracket by removing the four attachment screws.	

Refitting, brake release board

Use this procedure to refit the brake release board.

	Action	Note
1	**ELECTROSTATIC DISCHARGE (ESD)** The unit is sensitive to ESD. Before handling the unit read the safety information in section *The unit is sensitive to ESD on page 60*.	
2	Connect the connectors X8, X9 and X10 to the brake release board. Be careful not to damage the sockets or pins. Make sure the connector and its locking arms are snapped down properly.	 xx1700000978
3	Fasten the *brake release board* on the bracket with the attachment screws. Make sure the board is positioned as straight as possible on the bracket! The push buttons can otherwise get jammed when the SMB cover is refitted.	Maximum tightening torque: 5 Nm. Shown in the figure *Location of brake release board on page 235*. Art. no. is specified in *Required equipment on page 235*.
4	Put the SMB/BU unit carefully back into its box and refit its attachment screws.	
5	Verify that the robot cabling is positioned correctly, according to previously taken picture/notes. **WARNING** Screened cables must not get in contact with the brake release board after installation. Eliminate all risks of contact between screened cables and the brake release board.	
6	**WARNING** Before continuing any service work, follow the safety procedure in *The brake release buttons may be jammed after service work on page 181*.	
7	Refit the *push button guard* to the SMB cover.	Shown in the figure *Location of brake release board on page 235*.
8	Refit the *cover, push button guard*.	

Continues on next page

	Action	Note
9	Press the push buttons 1 to 6, one at a time, to make sure that the buttons are moving freely and do not stay in a locked position.	
10	If the battery has been disconnected the revolution counter must be updated.	Detailed in the Calibration chapter - section *Updating revolution counters on page 309*.
11	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.6 Motors

4.6.1 Replacement of motor, axis 1

Note

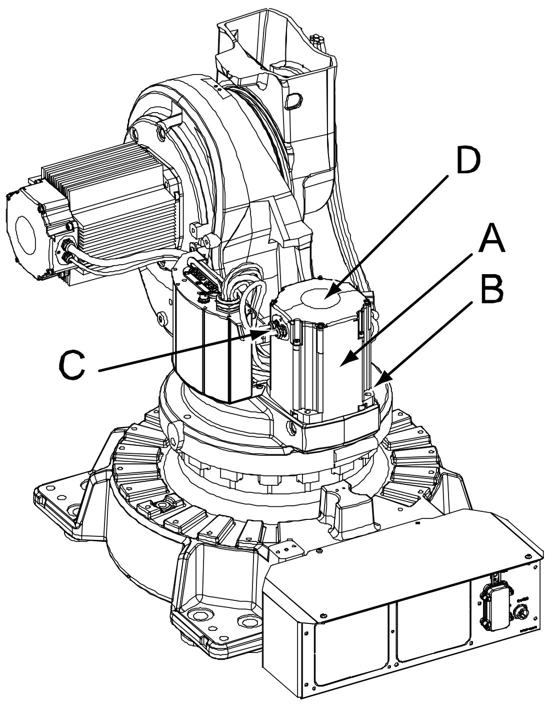
This procedure requires calibration of the robot.

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

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

Location of motor

The motor axis 1 is located as shown in the figure below.



xx0600003037

A	Motor, axis 1
B	Motor attachment screws and washers
C	Cable gland
D	Cover

Continues on next page

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion	See *Spare part lists on page 349*.		Includes • motor • pinion • o-ring 21522012-430.
O-ring	21522012-430		Must be replaced when reassemling the motor.
Mobilux EP 2	-	-	Used to lubricate the motor clutch.
Grease		3HAC042536-001	Used to lubricate the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!
Lifting tool, motor ax 1, 4, 5		3HAC14459-1	
Power supply		-	24 VDC, max. 1,5 A For releasing the brakes.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter *Circuit diagram on page 351*.

Continues on next page

Deciding calibration routine

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

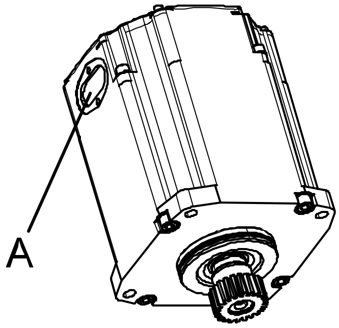
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor axis 1

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

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Remove the cover for connector access on top of the motor by unscrewing its four attachment screws.	Shown in the figure *Location of motor on page 239*.

Continues on next page

	Action	Note
4	Remove the cable gland cover at the cable exit by unscrewing its two attachment screws. **Note** Make sure the gasket is not damaged!	 xx0200000199 • A: Cable gland cover
5	Disconnect all connectors beneath the motor cover.	
6	Apply *lifting tool, motor axis 1, 4, 5* to the motor.	Art. no. is specified in *Required equipment on page 240*.
7	In order to release the brakes, connect the 24 VDC power supply.	Connect to connector R2.MP1 • +: pin 2 • -: pin 5
8	Remove the motor by unscrewing its four *attachment screws* and plain washers.	Shown in the figure *Location of motor on page 239*.
9	**CAUTION** The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
10	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
11	Remove the motor by gently lifting it straight up.	

Refitting, motor axis 1

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the *o-ring* on the circumference of the motor is seated properly. Lightly lubricate the o-ring with *grease.*	Art no. is specified in *Required equipment on page 240*.
3	**CAUTION** The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	

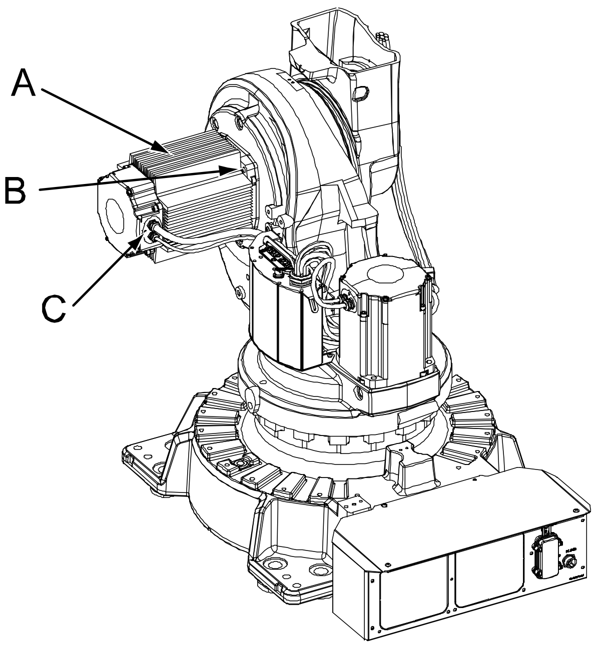
Continues on next page

	Action	Note
4	Apply the *lifting tool, motor axis 1, 4, 5* to the motor.	Art no. is specified in *Required equipment on page 240*.
5	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP1 • +: pin 2 • -: pin 5
6	Fit the motor, making sure the motor pinion is properly mated to gearbox of axis 1.	Make sure the motor is turned the correct way, that is connection of motorcable as shown in the figure *Location of motor on page 239*. Make sure the motor pinion does not get damaged!
7	Fit the clutch on the pinion on the motor.	
8	Secure the motor with its four attachment screws and plain washers.	M10 x 40, tightening torque: 50 Nm.
9	Disconnect the brake release voltage.	
10	Reconnect all connectors beneath the motor cover.	
11	Refit the cable gland cover at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed!
12	Refit the motor cover with its four attachment screws.	Make sure the cover is tightly sealed!
13	Recalibrate the robot!	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
14	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.6.2 Replacement of motor axis 2

Location of motor

The motor, axis 2, is located on the left-hand side of the robot as shown in the figure below.



xx0600003040

A	Motor, axis 2
B	Motor attachment holes (4 pcs)
C	Cable gland

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion	See *Spare part lists on page 349*.		Includes • motor • pinion • o-ring 2152 2012-430
O-ring	21522012-430		Must be replaced when reassembling motor!
Grease		3HAC042536-001	For lubricating the o-ring.
Removal tool, motor M12x		3HAC14973-1	Always use the removal tools in pairs!
Guide pins M10 x 150		3HAC15521-2	For guiding the motor. Guides are to be used in pairs!
Lifting tool, motor ax 2,3		3HAC026061-001	
Extension bar, 300 mm for bits 1/2"		3HAC12342-1	

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Rotation tool		3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24VDC power supply.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram			See chapter *Circuit diagram on page 351*.

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. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	

Continues on next page

	Action	Note
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor

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

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Secure the robot from collapsing once the motor axis 2 is removed, by following the procedure detailed below: • Move the lower arm as far back as possible. • *Release the brakes* on motor axis 2 which will enable the lower arm to rest on its mechanical stop . • The motor axis 2 can now be replaced without securing the robot in an overhead crane.	Releasing brakes are detailed in section *Manually releasing the brakes on page 74*.
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Drain the oil from gearbox, axis 2.	Detailed in the section *Changing oil, axis-2 gearbox on page 152*.
5	Remove the cover on top of the motor by unscrewing its four attachment screws.	

Continues on next page

	Action	Note
6	Remove the *cable gland cover* at the cable exit by unscrewing its two attachment screws.	Shown in the figure *Location of motor on page 244*. Make sure the gasket is not damaged!
7	Disconnect all connectors beneath the motor cover.	
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!	Use the lock screw to lock the lower arm, as detailed above!
9	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP2 • +: pin 2 • -: pin 5
10	Remove the motor by unscrewing its four attachment screws and plain washers.	
11	Fit the two *guide pins* in two of the *motor attachment holes.*	Art. no. is specified in *Required equipment on page 244*. Shown in the figure *Location of motor on page 244*.
12	If required, press the motor out of position by fitting the *removal tool, motor* to the remaining *motor attachment holes.*	Art. no. is specified in *Required equipment on page 244*. Shown in the figure *Location of motor on page 244*. Always use the removal tools in pairs!
13	Remove the removal tools and fit the *lifting tool, motor axis 2, 3, 4* to the motor.	Art. no. is specified in *Required equipment on page 244*.
14	**CAUTION** The motor weighs 38 kg! All lifting equipment used must be sized accordingly!	
15	Lift the motor to get the pinion away from the gear.	Make sure the motor pinion does not get damaged!
16	Remove the motor by gently lifting it straight out and place it on a secure surface. Disconnect the brake release voltage.	

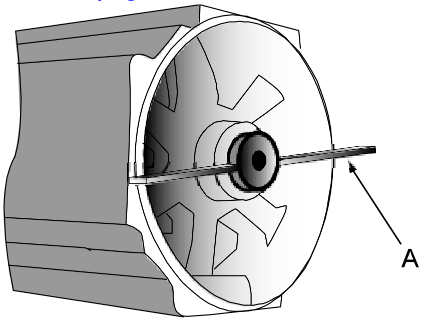
Continues on next page

Refitting, motor

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the *o-ring* on the circumference of the motor is seated properly. Lightly lubricate the o-ring with *grease.*	Art. no. is specified in *Required equipment on page 244*.
3	In order to release the brake, remove the cover on top of the motor and connect the 24 VDC power supply.	Connect to connector R2.MP2 • +: pin 2 • -: pin 5
4	Fit the *lifting tool, motor axis 2, 3, 4* to the motor.	Art. no. is specified in *Required equipment on page 244*.
5	Fit the two *guide pins* in the two lower *motor attachment holes.*	Art. no. is specified in *Required equipment on page 244*. Shown in the figure *Location of motor on page 244*.
6	**CAUTION** The motor weighs 38 kg! All lifting equipment used must be sized accordingly!	
7	Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear. Make sure that the motor is turned the right direction, that is the cables facing as shown in the figure *Location of motor on page 244*.	
8	Remove the lifting tool and allow the motor to rest on the guide pins.	

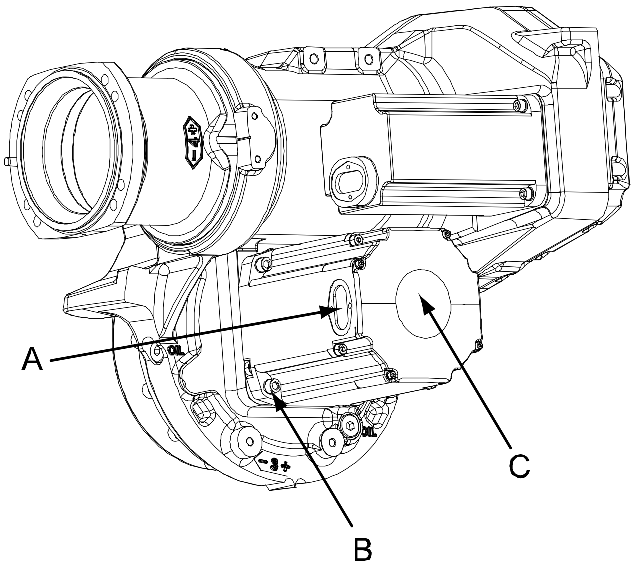
Continues on next page

	Action	Note
9	Use the *rotation tool* in order to rotate the motor pinion when mating it to the gear (see the figure to the right). Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox axis 2 and that it does not get damaged.	Art. no. is specified in *Required equipment on page 244*.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in the figure above. • A: Rotation tool
10	Remove the guide pins.	
11	Secure the motor with four attachment screws and plain washers.	M10 x 40, tightening torque: 50 Nm. Reused screws may be used, providing they are lubricated as detailed in section *Screw joints on page 340* before fitting.
12	Disconnect the brake release voltage.	
13	Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
14	Refit the *cable gland cover* at the cable exit with its two attachment screws.	Shown in the figure *Location of motor on page 244*.
15	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
16	Perform a leak down test.	Detailed in *Performing a leak-down test on page 174*.
17	Refill the gearbox with oil.	Detailed in the section *Changing oil, axis-2 gearbox on page 152*.
18	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
19	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.6.3 Replacement of motor, axis 3

Location of motor

The motor axis 3 is located on the left hand side of the robot as shown in the figure below.



xx0600003051

A	Cable gland cover, motor axis 3
B	Motor attachment holes (4 pcs)
C	Motor, axis 3

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor, axis 3	See *Spare part lists on page 349*.		Includes: • motor • pinion • o-ring 21522012-430
O-ring	21522012-430		Must be replaced when reassembling motor!
Grease		3HAC042536-001	For lubricating the o-ring.
Bolts M16x60 (for mechanical stop axis 3)		3HAB3409-86	
Guide pins M10 x 100		3HAC15521-1	For guiding the motor.
Guide pins M10 x 150		3HAC15521-2	For guiding the motor.
Rotation tool		3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24 VDC power supply.

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Power supply		-	24 VDC, max. 1.5 A For releasing the brakes.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram		3HAC025090-001	See chapter *Circuit diagram on page 351*.

Deciding calibration routine

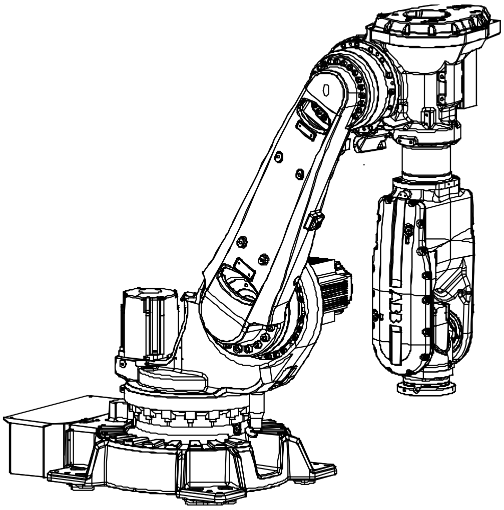
Decide which calibration routine to be used, based on the information in the table. Depending on which routine is chosen, action might be required prior to beginning the repair work of the robot, see the table.

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Continues on next page

Removal, motor

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

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to the position shown in the figure. This is done in order to drain all oil from the gearbox axis 3.	 xx0600003041
3	Drain the oil from gearbox axis 3.	Detailed in the section *Changing oil, axis-3 gearbox on page 155*.
4	Secure the robot from collapsing once the motor axis 3 is removed, by following the procedure detailed below: • Move the lower arm as far back as possible. • *Release the brakes* on motor axis 2 and let the lower arm rest on its mechanical stop. • Also *release the brakes* on motor axis 3 and let the upper arm rest on its mechanical stop. • The lower and upper arms now rests on their respective mechanical stops. The motor axis 3 can now be replaced without securing the armsystem in an overhead crane.	Detailed in the section *Manually releasing the brakes on page 74*.

Continues on next page

	Action	Note
5	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
6	Remove any equipment hindering access to motor axis 3.	
7	Remove the cover on top of the motor by unscrewing its four attachment screws.	
8	Remove the *cable gland cover* at the cable exit by unscrewing its two securing screws.	Shown in the figure *Location of motor on page 250*. Make sure the gasket is not damaged!
9	Disconnect all connectors beneath the motor cover.	
10	Unscrew the motors four *attachment screws and plain washers* .	Shown in the figure *Location of motor on page 250*.
11	Fit the two *guide pins* in two of the motor attachment screw holes.	Art. no. is specified in *Required equipment on page 250*.
12	Press the motor out of position by fitting *removal tool, motor* to the remaining motor attachment screw holes.	Art. no. is specified in *Required equipment on page 250*. Always use the removal tools in pairs!
13	Apply the *lifting tool, motor axis 2 ,3, 4* to the motor.	Art. no. is specified in *Required equipment on page 250*.
14	**CAUTION** The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
15	Lift the motor to get the pinion away from the gear.	
16	Remove the motor by gently lifting it straight out and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!

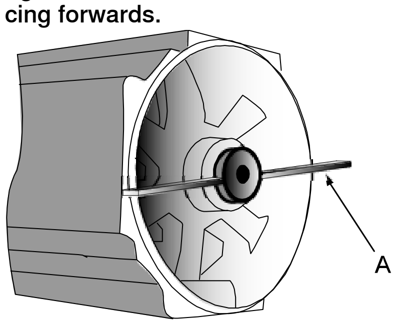
Continues on next page

Refitting, motor

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the *o-ring* on the circumference of the motor is seated properly. Lightly lubricate it with *grease*.	Art no. is specified in *Required equipment on page 250*.
3	Fit the *lifting tool, motor axis 2, 3, 4* to the motor.	Art no. is specified in *Required equipment on page 250*.
4	Fit the two *guide pins* in the two lower *motor attachment holes.*	Art no. is specified in *Required equipment on page 250*. Shown in the figure *Location of motor on page 250*
5	**CAUTION** The motor weighs 25 kg! All lifting equipment used must be sized accordingly!	
6	Lift the motor and guide it onto the guide pins, as close to the correct position as possible without pushing the motor pinion into the gear.	
7	Remove the lifting tool and allow the motor to stay on the guide pins.	
8	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP3 • +: pin 2 • -: pin 5

Continues on next page

	Action	Note
9	Use the *rotation tool* in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear of gearbox, axis 3.	Art no. is specified in *Required equipment on page 250*. Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above. • A: Rotation tool.
10	Remove the guide pins.	
11	Secure the motor with four attachment screws and plain washers.	4 pcs: M10 x 40, tightening torque: 50 Nm.
12	Disconnect the brake release voltage.	
13	Reconnect all connectors beneath the motor cover.	Connect in accordance with markings on connectors.
14	Refit the *cable gland cover* at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed! Shown in the figure *Location of motor on page 250*.
15	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
16	Remove the equipment used to unload the upper arm.	
17	Perform a leak-down test.	Detailed in the section *Performing a leak-down test on page 174*.
18	Refill the gearbox with oil.	Detailed in the section *Changing oil, axis-3 gearbox on page 155*.
19	Recalibrate the robot!	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.

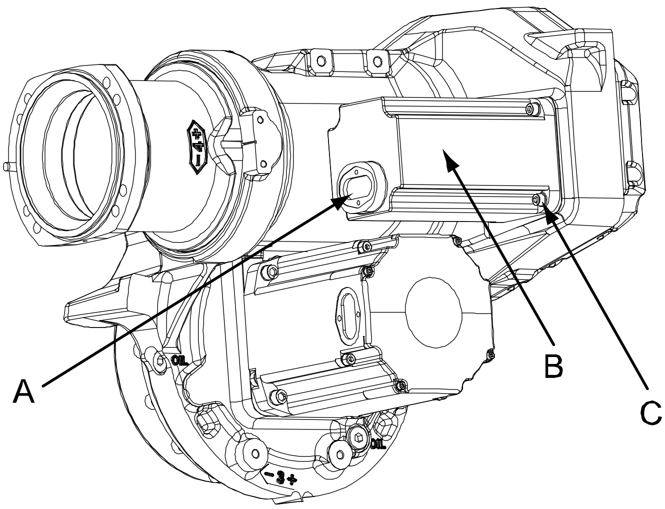
Continues on next page

	Action	Note
20	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.6.4 Replacement of motor, axis 4

Location of motor

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



xx0600003050

A	Cable gland cover, motor axis 4
B	Motor, axis 4
C	Motor attachment holes (4 pcs)

Required equipment

Equipment, etc.	Art. no.	Note
Motor including pinion	See spare part number in *Spare part lists on page 349*.	Includes: • motor • pinion • o-ring 21522012-430
O-ring	21522012-430	Must be replaced when reassembling motor!
Grease	3HAC042536-001	Used to lubricate the o-ring.
Loctite 574, Flange sealant	12340011-116	Option Foundry Plus
Guide pins M8 x 100	3HAC15520-1	For guiding the motor.
Guide pins M8 x 150	3HAC15520-2	For guiding the motor.
Rotation tool	3HAC17105-1	Used to rotate the motor pinion when mating it to the gear when brakes are released with 24 VDC power supply.
Power supply	-	24 VDC, max. 1,5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.

Continues on next page

Equipment, etc.	Art. no.	Note
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.
Circuit diagram	3HAC024090-001	See chapter *Circuit diagram on page 351*.

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. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor axis 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.	

Continues on next page

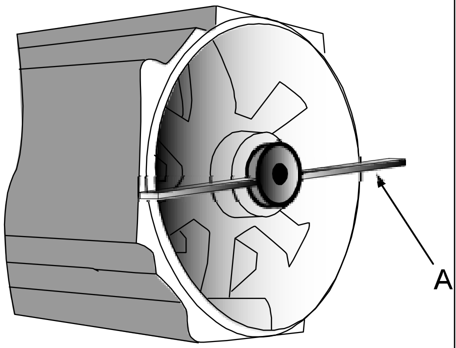
	Action	Note
2	Move the robot to a position where the upper arm is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time. Any other position of the upper arm requires a draining of oil from the gearbox for axis 4.	Draining of oil is described in section *Draining, oil on page 158*.
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove the *cable gland cover* at the cable exit of the motor by unscrewing its two attachment screws.	Shown in the figure *Location of motor on page 257*. Make sure the gasket is not damaged!
5	Remove the cover on top of the motor by unscrewing its four attachment screws.	
6	Disconnect all connectors beneath the motor cover.	
7	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R2.MP4 • +: pin 2 • -: pin 5
8	Unscrew the motors four *attachment screws and plain washers.*	Shown in the figure *Location of motor on page 257*.
9	Fit the two *guide pins* in two of the motor attachment screw holes.	
10	If required, press the motor out of position by fitting *removal tool, motor* to the motor attachment screw holes.	Art. no. is specified in *Required equipment on page 257*. Always use the removal tools in pairs!
11	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	
12	Remove the motor by gently lifting it straight out.	Make sure the motor pinion is not damaged!

Refitting, motor axis 4

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

Continues on next page

	Action	Note
2	Make sure the *o-ring* on the circumference of the motor is seated properly. Lightly lubricate the o-ring with *grease.*	Art. no. is specified in *Required equipment on page 257*.
3	In order to release the brakes, connect the 24 VDC power supply.	Connect to connector R2.MP4: • +: pin 2 • -: pin 5
4	Fit the two *guide pins* in two of the *motor attachment holes.*	Art. no. is specified in *Required equipment on page 257*. Shown in the figure *Location of motor on page 257*.
5	Fit the motor with guidance of the pins, making sure the motor pinion is properly mated to the gear of gearbox 4.	Make sure the motor pinion does not get damaged!
6	Use the *rotation tool* in order to rotate the motor pinion when mating it to the gear! Fit the motor, making sure the motor pinion is properly mated to the gear, axis 4.	Art. no. is specified in *Required equipment on page 257*. Make sure the motor pinion does not get damaged! Make sure the motor is turned the right direction, that is the cables facing forwards.  xx0200000165 The rotation tool is used beneath the motor cover, directly on the motor shaft as shown in figure above. • A: Rotation tool.
7	Remove the guide pins.	
8	Secure the motor with four attachment screws and plain washers.	4 pcs: M8 x 25, tightening torque: 24 Nm.
9	Disconnect the brake release voltage.	
10	Reconnect all connectors beneath the motor cover.	
11	Refit the cover on top of the motor with its four attachment screws.	Make sure the cover is tightly sealed!
12	Refit the *cable gland cover* at the cable exit with its two attachment screws.	Shown in the figure *Location of motor on page 257*.
13	Perform a leak-down test if the gearbox has been drained.	Detailed in the section *Performing a leak-down test on page 174*.
14	Refill the gearbox with oil if drained.	

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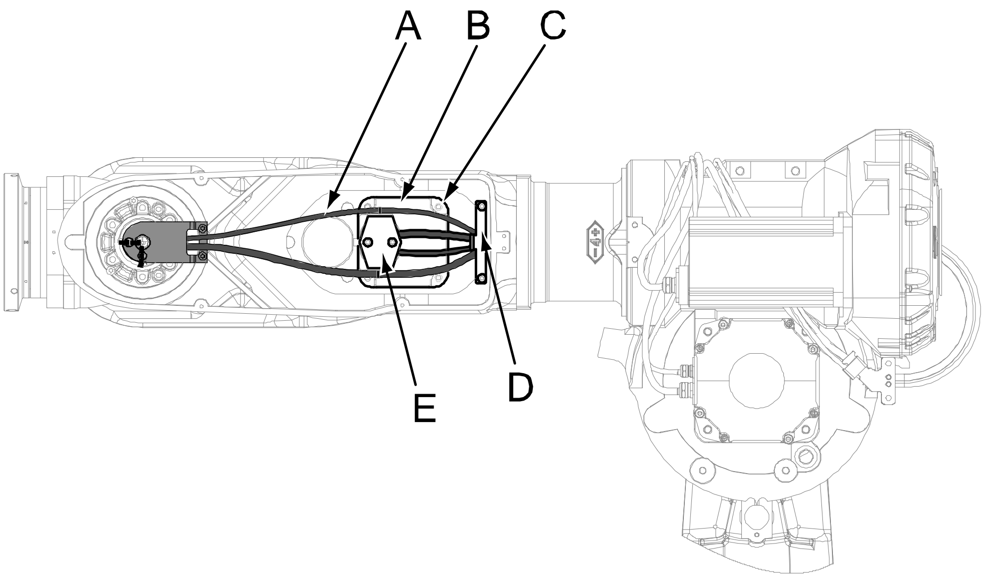
	Action	Note
15	Recalibrate the robot!	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
16	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.6.5 Replacement of motor, axis 5 , IRB 6620/6620LX

Location of motor

The motor axis 5 is located inside the upper arm tube, but attached to the wrist unit, as shown in the figure below.

A more detailed view of the component and its position may be found in *Spare part lists on page 349*.



xx0600003049

A	Cable harness
B	Motor, axis 5
C	Attachment screws (4 pcs)
D	Metal clamp
E	Cover, cable gland

Required equipment

Equipment, etc.	Art. no.	Note
Motor	For spare part number, see *Spare part lists on page 349*.	
Retrofit set Foundry Plus, wrist	For spare part number, see *Spare part lists on page 349*.	
Retrofit set Foundry Plus, upper arm axis 4	For spare part number, see *Spare part lists on page 349*.	
O-ring	21522012-430	Must be replaced when reassembling motor!
Grease	3HAC042536-001	For lubricating the o-ring.
Loctite 574, Flange sealant	12340011-116	Option Foundry Plus

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Equipment, etc.	Art. no.	Note
Removal tool, motor M10x	3HAC14972-1	Always use the removal tools in pairs!
Extension bar 300 mm for bits 1/2"	3HAC12342-1	
Guide pins M8 x 100	3HAC15520-1	For guiding the motor.
Guide pins M8 x 150	3HAC15520-2	For guiding the motor.
Power supply	-	24 VDC, 1.5 A For releasing the brakes.
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
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 351*.

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. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

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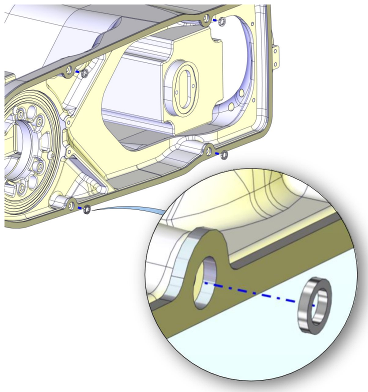
Removal, motor, axis 5

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

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to a position where the upper arm is parallel to the floor and the side of the wrist unit, where motor axis 5 is placed, is facing up.	
3	 **DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove the cover on the wrist unit by removing its attachment screws.  **Note** Make sure not to lose the washers placed in the holes of the foundry gasket.	 xx1400002580
5	Remove the *metal clamp* securing the cable harness.	Shown in the figure in section *Location of motor on page 262*.
6	Remove the *cable gland cover* at the cable exit by unscrewing its two attachment screws.	Shown in the figure in section *Location of motor on page 262*.
7	Remove the cover on top of the motor by unscrewing its four attachment screws.	
8	Disconnect all connectors beneath the motor cover and remove the cable of the axis-5 motor.	
9	Pull the *cable harness* out of the upper arm a little, far enough to make room for removal of the motor.	Shown in the figure in the section *Location of motor on page 262*.
10	In order to release the brake, connect the 24 VDC power supply.	Connect to: - connector R2.MP5 (in the motor): • + : pin 2 • -: pin 5
11	Remove the motor by unscrewing its four attachment screws and plain washers.	
12	Fit the two *guide pins* in two of the motor attachment screw holes.	Art. no. is specified in *Required equipment on page 262*.

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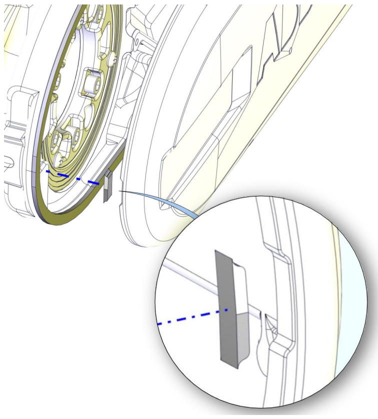
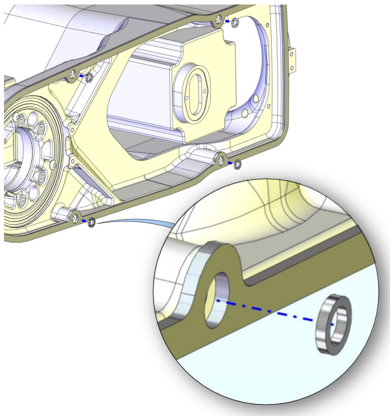
	Action	Note
13	If required, press the motor out of position by fitting *removal tool, motor, M10* to the motor attachment screw holes.	Art. no. is specified in *Required equipment on page 262*. Always use the removal tools in pairs and diagonally!
14	Lift the motor to get the pinion away from the gear and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!
15	Remove the motor by gently lifting it straight out.	Keep track of the shims between the motor flange and the wrist housing.

Refitting, motor, axis 5

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

	Action	Note
1	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
2	Make sure the *o-ring* on the circumference of the motor is seated properly. Lightly lubricate the *o-ring* with *grease.*	Art. no. is specified in *Required equipment on page 262*.
3	In order to release the brake, connect the 24 VDC power supply.	Connect to: - connector R2.MP5 (in the motor): • + : pin 2 • -: pin 5
4	Fit the two *guide pins* in two of the motor attachment holes.	Art. no. is specified in *Required equipment on page 262*.
5	Fit the motor, with guidance from the pins, making sure the motor pinion is properly mated to the gear of axis 5.	Make sure the motor pinion does not get damaged!
6	Secure the motor with four attachment screws and plain washers.	4 pcs: M8 x 25; tightening torque: 24 Nm.
7	Disconnect the brake release voltage.	
8	Refit the cable of the axis-5 motor and reconnect all connectors beneath the motor cover.	
9	Refit the cover on top of the motor with its four attachment screws.	
10	Refit the cable gland cover at the cable exit with its two attachment screws.	Make sure the cover is tightly sealed!
11	Refit the *metal clamp* securing the cable harness.	Shown in the figure in the section *Location of motor on page 262*.
12	Perform a leak-down test.	Detailed in the section *Performing a leak-down test on page 174*.
13	*Standard* Refit the cover of the wrist unit with its attachment screws.	

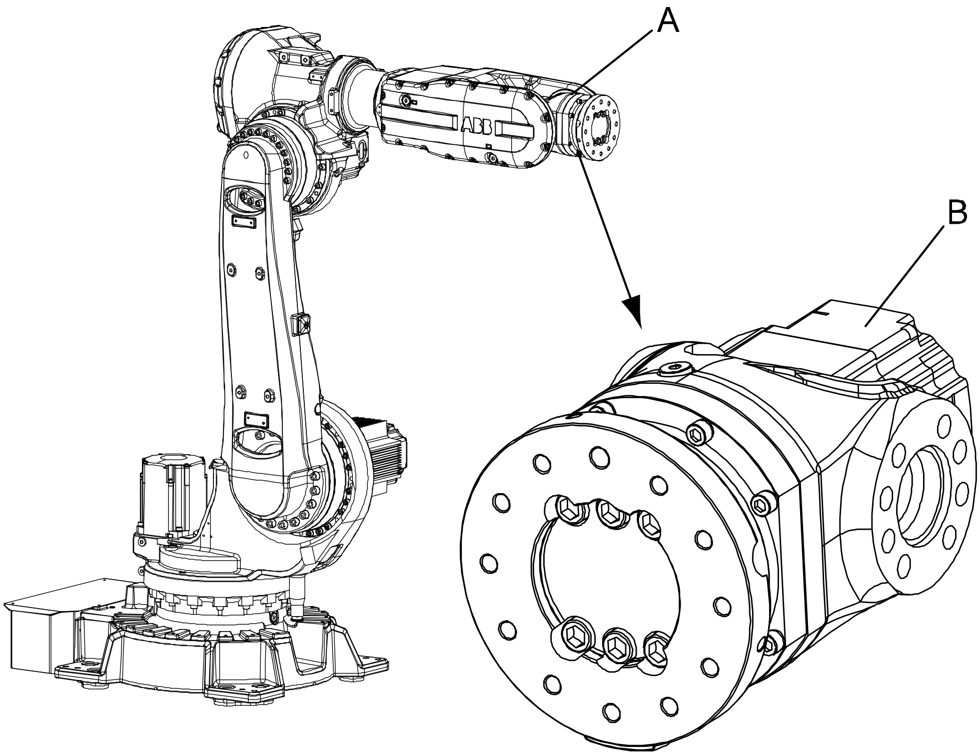
Continues on next page

	Action	Note
14	*Foundry Plus* Make sure that the gasket is undamaged. Also the small gasket fitted in the cover recess. Replace if damaged.	 xx1400002579
15	*Foundry Plus* Make sure the washers are fitted in the gasket holes. Refit the *cover, wrist unit* Foundry Plus.	 xx1400002580
16	Refill the gear with oil.	Detailed in the section *Changing oil, axis-5 gearbox on page 161*.
17	Re-calibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
18	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.6.6 Replacement of motor, axis 6

Location of motor

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



xx0600003039

A	Wrist unit
B	Motor, axis 6

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Motor including pinion Motor including pinion (Foundry Plus)	See spare part number in *Spare part lists on page 349*.		Includes: • motor • pinion • o-ring 21522012-430
Motor including pinion (insulated)	See spare part number in *Spare part lists on page 349*.		Includes: • motor • pinion • o-ring 21522012-430
O-ring	21522012-430		Must be replaced when reassembling motor!
Gasket	3HAC048560-001		Must be replaced when replacing motor
Gasket, cover	3HAC033489-001		Must be replaced when opening cover.

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Removal tool, motor M10x		3HAC14972-1	Always use the removal tools in pairs!
Extension bar 300 mm for bits 1/2"		3HAC12342-1	
Guide pins M8 x 100		3HAC15520-1	For guiding the motor.
Guide pins M8 x 150		3HAC15520-2	For guiding the motor.
Power supply		-	24 VDC, 1.5 A For releasing the brakes.
Grease		3HAC042536-001	For lubricating the o-ring.
Loctite 574, Flange sealant		12340011-116	Option Foundry Plus
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.
Calibration Pendulum toolkit		3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration		3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.
Circuit diagram		-	See chapter *Circuit diagram on page 351*.

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. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	

Continues on next page

	Action	Note
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, motor

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

Note

Robots with protection type Foundry Plus or Foundry Prime require special repair routines to maintain the tightness level, in addition to the procedure below, described in *Replacement of the motor axis 6 (Foundry Plus) on page 272*.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to a position where the motor in axis 6 is pointed straight up. This position enables the motor to be replaced without draining the gear oil, which in turn saves time.	
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Remove the rear motor cover by unscrewing the five attachment screws.	
5	Disconnect all connectors beneath the cover.	
6	Connect the 24 VDC power supply to release the brakes.	Connect to connector R3.MP6 • +: pin 2 • -: pin 5

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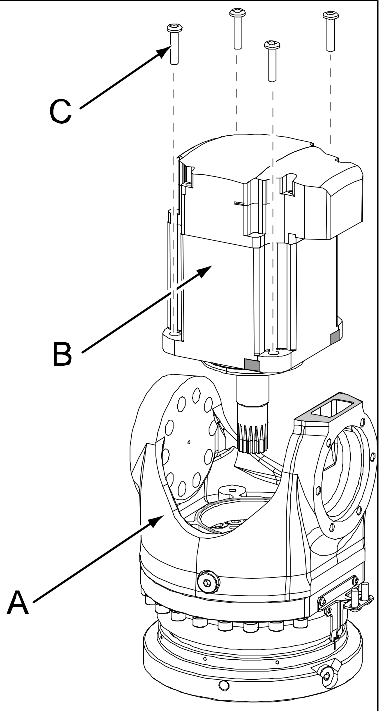
	Action	Note
7	Remove the motor by unscrewing its four attachment screws and plain washers.	 xx0600003038 • A: Tilthouse • B: Motor, axis 6 • C: Attachment screws (4 pcs)
8	If required, press the motor out of position by fitting *removal tool, motor* to the motor attachment screw holes.	Art. no. is specified in *Required equipment on page 267*. Always use the removal tools in pairs!
9	Lift the motor carefully to get the pinion away from the gear and disconnect the brake release voltage.	Make sure the motor pinion is not damaged!
10	Remove the motor by gently lifting it straight out.	

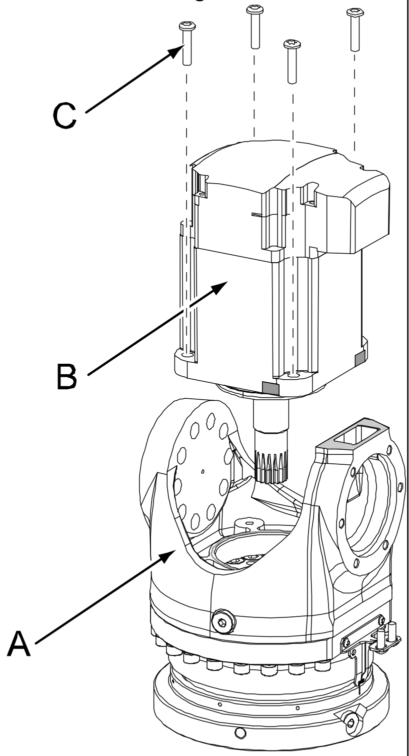
Refitting, motor

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

> **Note**
>
> Robots with protection type Foundry Plus or Foundry Prime require special repair routines to maintain the tightness level, in addition to the procedure below, described in *Replacement of the motor axis 6 (Foundry Plus) on page 272*.

	Action	Note
1	Make sure the *o-ring* on the circumference of the motor is seated properly. Lightly lubricate the o-ring with *grease.*	Art. no. is specified in *Required equipment on page 267*.
2	In order to release the brake, connect the 24 VDC power supply.	Connect to connector R3.MP6 • +: pin 2 • -: pin 5

Continues on next page

	Action	Note
3	Fit the two *guide pins* in two of the motor attachment holes.	Art. no. is specified in *Required equipment on page 267*.
4	Fit the motor, with guidance from the pins, making sure the motor pinion is properly mated to the gear of gearbox, axis 6.	Make sure the pinion on the motor shaft is not damaged!  xx0600003038 • A: Tilthouse • B: Motor, axis 6 • C: Attachment screws
5	Remove the guide pins.	
6	Secure the motor with its four attachment screws and plain washers.	4 pcs: M8 x 25, tightening torque: 24 Nm.
7	Disconnect the brake release voltage.	
8	Reconnect all connectors beneath the motor cover.	
9	Refit the cover on top of the motor with its five attachment screws.	Make sure the cover is tightly sealed!
10	Re-calibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.

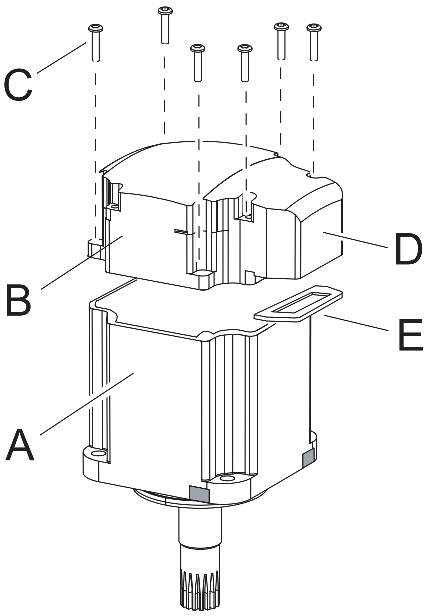
Continues on next page

	Action	Note
11	**DANGER** Make sure all safety requirements are met when performing the first test run.	

Replacement of the motor axis 6 (Foundry Plus)

Robots with protection type Foundry Plus require special repair routines to maintain the tightness level.

The repair must be done according to the previous repair procedure with the following additions.

	Action	Note
1	**DANGER** Turn off all: • 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	Remove the rear motor cover by unscrewing the five attachment screws.	 xx1500002524 • A: Motor unit • B: Connection box • C: Attachment screw (5 pcs) • D: Rear motor cover • E: Gasket
3	Continue to remove the motor unit, according to step 6 and forwards in *Removal, motor on page 269*.	

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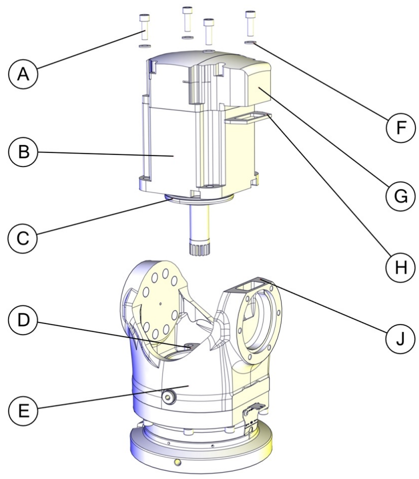
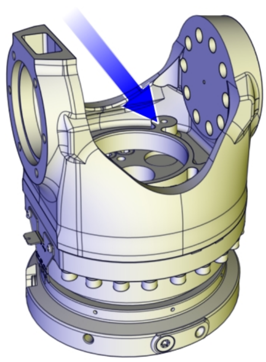
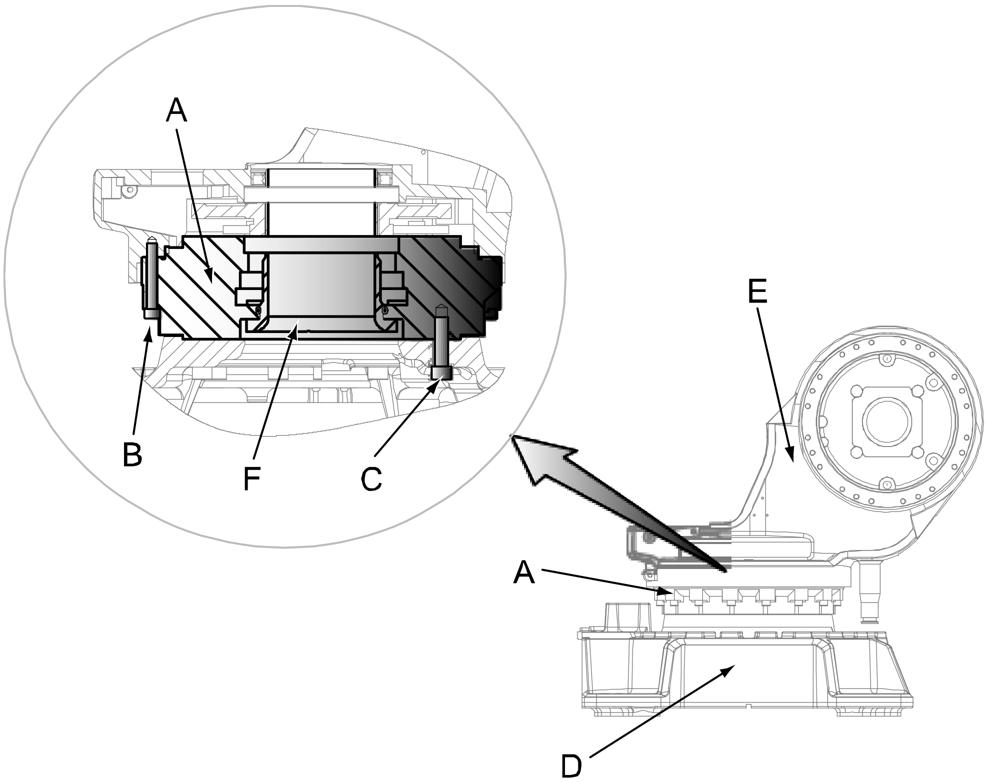
	Action	Note
4	**Note** Keep the old *rear motor cover* with the air nipple.	
5	Remove the protection strip on the *gasket* and mount it on the *motor*.	 xx1500002425 • A: Attachment screw (4pcs) Mercasol 3106 • B: Motor unit • C: O-ring • D: Sikaflex in screw recesses • E: Tilt house • F: Washer • G: Rear motor cover • H: Sealing • J: Loctite 574
6	Apply Mercasol 3106 on the *motor end cover*.	
7	Apply Loctite 574 flange sealant on the contact surface.	 xx1400000992
8	Apply grease on the *o-ring* on the *motor*.	
9	Continue to refit the new motor according to section, *Refitting, motor on page 270*.	

4.7 Gearboxes

4.7.1 Replacement gearbox axis 1

Location of gearbox axis 1



xx0600003068

A	Gearbox, axis 1 RV 320C-191.35
B	Attachment screw, M12x80 quality 12.9 gleitmo (16 pcs)
C	Attachment screw, M16x60 quality 12.9 gleitmo (12 pcs)
D	Base
E	Frame
F	Protection pipe axis 1
G	O-ring

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Gearbox, axis 1	See *Spare part lists on page 349*.		Includes: • gearbox • o-ring
O-ring	3HAB3772-93		Replace only when damaged. 380.6x3.53
O-ring (3 pcs)	3HAB3772-97		23x3.6

Continues on next page

Equipment, etc.	Spare part no.	Art. no.	Note
Support, base and gear axis 1		3HAC15535-1	Consists of 4 pcs.
Guide pins (M16x300)		3HAC13120-5	Always use guiding pins in pairs.
Guide pins (M16x250)		3HAC13120-4	Always use guiding pins in pairs
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting tool		3HAC15556-1	Used to lift gearbox axis 1 and frame.
Lifting eye (2 pcs)		3HAC025333-005	Used together with lifting tool 3HAC15556-1.
Grease		3HAC042536-001	For lubricating o-rings.
Standard tools		-	Content is defined in section *Standard tools on page 344*.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.			These procedures include references to the tools required.

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

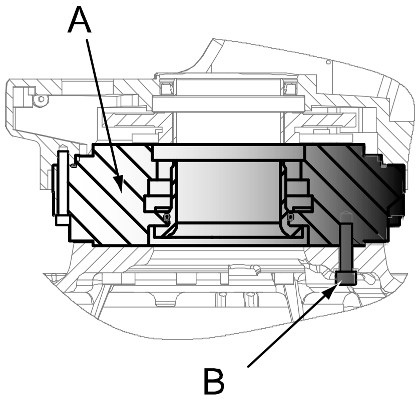
Continues on next page

Removal

The procedure below details how to remove the gearbox axis 1.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Remove motor, axis 1.	Detailed in section *Replacement of motor, axis 1 on page 239*.
4	Remove the cable harness, axes 1-2. Secure the cable harness to the robot in a safe way, that it will not be damaged in the continued removal procedure.	Detailed in section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
5	Run an overhead crane to a position above the robot.	
6	**CAUTION** The complete arm system weighs 590 kg! All lifting equipment used must be sized accordingly!	
7	Lift the robot (without the base) and put it safely on its side on the floor.	
8	Remove the robot´s attachments screws in order to unfasten the base from the foundation.	Detailed in section *Orienting and securing the robot on page 82*.
9	Fit two *lifting eyes* on each side of the gearbox and secure it with a roundsling.	Art. no. is specified in *Required equipment on page 274*.
10	Attach the *lifting tool* to the gearbox.	Art. no. is specified in *Required equipment on page 274*.
11	**CAUTION** The complete gearbox unit and base weighs 241 kg together! (Base: 133 kg, gearbox unit: 108 kg.) All lifting equipment used must be sized accordingly!	
12	Lift the robot base with gearbox axis 1, to allow fitting the *support, base and gear axis 1* on each side of the base.	Art. no. is specified in *Required equipment on page 274*.

Continues on next page

	Action	Note
13	Fit the support, base and gear axis 1. Make sure the base remains in a stable position before performing any work underneath the base!	
14	Unscrew the 12 attachment screws and washers securing the gearbox to the base.	 xx0600003069 • A: Gearbox, axis 1 • B: Attachment screw, M16x60
15	**CAUTION** The gearbox weighs 108 kg! All lifting equipment used must be sized accordingly!	
16	Remove the gearbox.	

Refitting

The procedure below details how to remove the gearbox axis 1.

	Action	Note
1	If the base not already is resting on the *support base and gear, axis 1*, this should be done first.	Mounting of the *support base and gear, axis 1* is detailed in section *Removal on page 276*.

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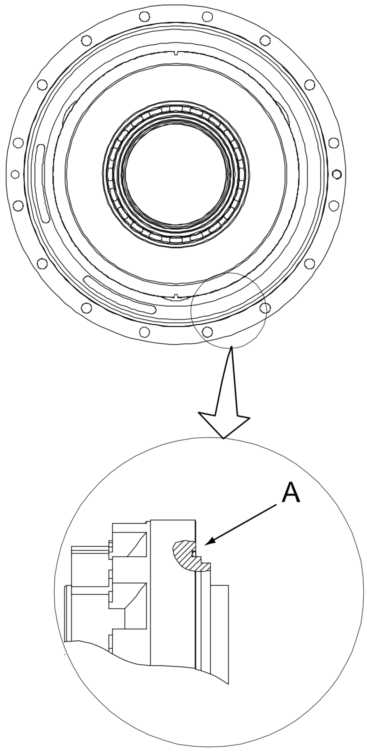
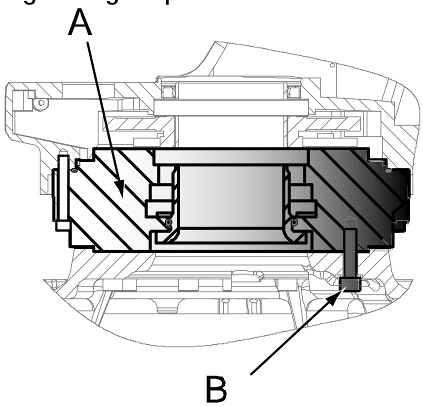
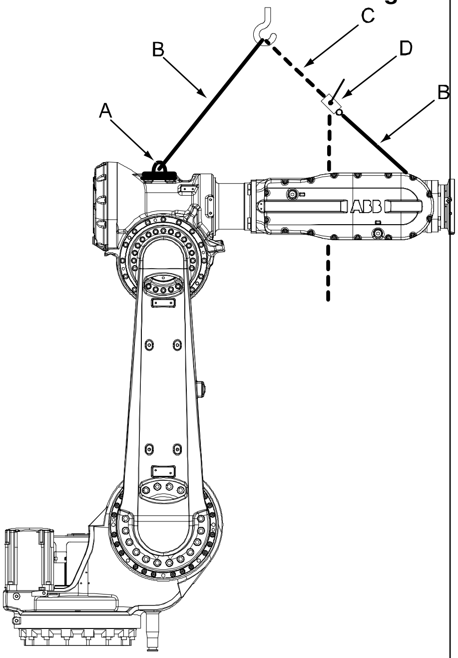
	Action	Note
2	Make sure the *o-ring* is fitted to the gearbox as shown in the figure to the right. Lightly lubricate the o-ring with grease.	Art. no. is specified in *Required equipment on page 274*.  xx0600003126 • A : O-ring (Gearbox shown from the side)
3	Fit the three o-rings (23x3.6).	Use some grease to attach them.
4	Refit the *protection pipe axis 1* in the center of gearbox 1 with its attachment screws.	Shown in the figure *Location of gearbox axis 1 on page 274*.
5	Fit two *lifting eyes* on each side of the gearbox and secure it with a roundsling.	Art. no. is specified in *Required equipment on page 274*.
6	Fit two guide pins in two of the attachment holes, parallel to each other.	
7	**CAUTION** The gearbox weighs 108 kg! All lifting equipment used must be sized accordingly!	
8	Lift the gearbox on to the guide pins and lower it carefully to its mounting position.	

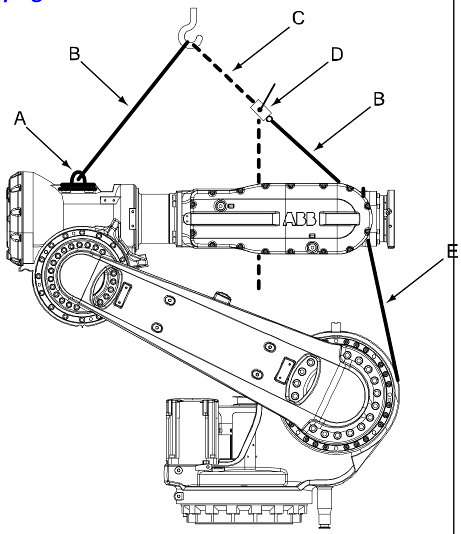
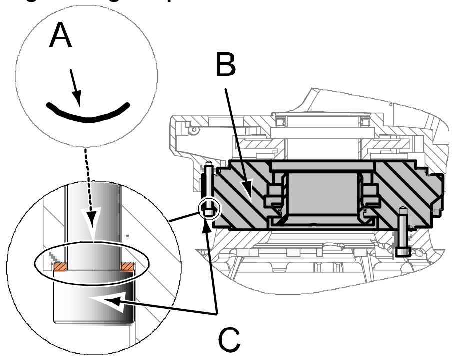
Continues on next page

	Action	Note
9	Refit the gearbox to the base with its attachment screws and washers.	Shown in the figure *Location of gearbox axis 1 on page 274*. M16x60 quality 12.9 (12 pcs) Tightening torque: 300 Nm.  xx0600003069 • A: Gearbox, axis 1 • B: Attachment screw, M16x60
10	**CAUTION** The complete gearbox unit and base weighs 241 kg together! (Base: 133 kg, gearbox unit: 108 kg.) All lifting equipment used must be sized accordingly!	
11	Lift the robot base and gearbox 1 to allow removing the support, base and gear.	
12	Secure the base to the mounting site.	Detailed in section *Orienting and securing the robot on page 82*.
13	**CAUTION** The complete arm system weighs 590 kg! All lifting equipment used must be sized accordingly!	

Continues on next page

	Action	Note
14	Fit the *lifting tool* and adjust as detailed in the enclosed instructions. Also fit a hoisting block to the front, used to adjust the balance of the armsystem in order to lift it completely level. **Note** There is an **alternate method** of lifting the complete armsystem, described below.	Art. no. is specified in *Required equipment on page 274*. Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting tool. **Read the instructions before lifting!**  xx0600003101 • A : Lifting tool • B : Roundsling • C : Lifting sling • D : Hoisting block

Continues on next page

	Action	Note
15	**Alternate method** of lifting: Fit the **lifting tool** and a roundsling on the upper arm and a roundsling with a hoisting block, to the wrist unit. Also fit a separate roundsling between the wrist and the frame in order to eliminate any load through the brake on motor axis 3. The hoisting block is used to balance the upper arm. **Note** The brake on axis 3 shall be released during the lift, until the roundsling between the wrist and the frame transfers the load of the frame!	Art. no. is specified in *Required equipment on page 274*. Make sure the lift is done completely level! How to adjust the lift is described in the enclosed instruction to the lifting tool. *Read the instructions before lifting!* Releasing the brakes is detailed in section *Manually releasing the brakes on page 74*.  xx0600003100 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block • E : Roundsling (used to transfer the load of the frame)
16	Refit the robot to the base with its attachment screws and serrated lock washers. **Note** The orientation of the serrated lock washer must be fitted as is shown in the figure to the right!	Shown in the figure *Location of gearbox axis 1 on page 274*. M12x80 quality 12.9 (16 pcs) Tightening torque: 105 Nm.  xx0600003070 • A: Serrated lock washer • B: Gearbox, axis 1 • C: Attachment screw, M12x80

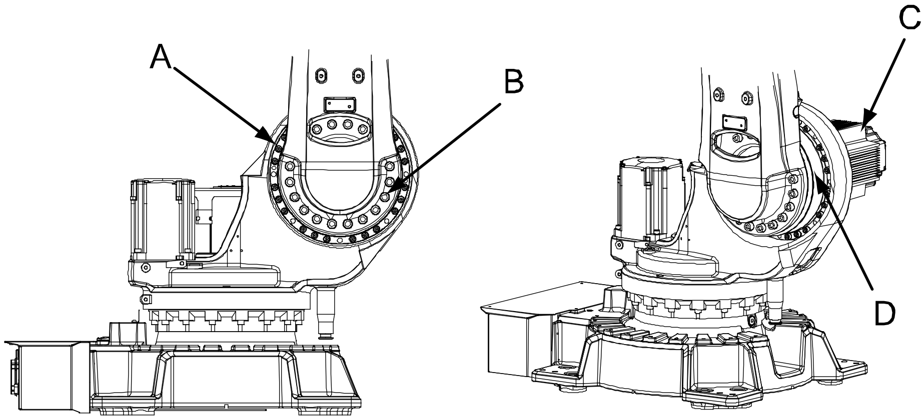
Continues on next page

	Action	Note
17	Refit the cable harness, axes 1-2.	Detailed in section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
18	Refit motor, axis 1.	Detailed in section *Replacement of motor, axis 1 on page 239*.
19	Fill oil in gearbox axis 1.	Detailed in section *Changing oil, axis-1 gearbox on page 149*.
20	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
21	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.7.2 Replacement gearbox axis 2

Location of gearbox axis 2

The gearbox axis 2 is located in the lower arm rotational center.



xx0600003056

A	Attachment screws, M12x60 quality 12.9 Gleitmo (24 pcs)
B	Attachment screws, M16x50 quality 12.9 Gleitmo (16 pcs)
C	Motor, axis 2
D	Gearbox, axis 2

Required equipment

Equipment, etc	Spare part no.	Art. no.	Note
Gearbox, axis 2	See Spare parts		Includes: • gearbox • o-ring
O-ring (339.3x5.7)	3HAB3772-91		
Grease		3HAC042536-001	For lubricating o-rings.
Lifting tool		3HAC026597-001	Instruction 3HAC026600-002 is enclosed.
Lifting tool		3HAC025214-001	For lifting gearbox
Roundsling		-	
Guide pins (M12x250)		3HAC13056-4	Always use in pairs.
Guide pins (M12x200)		3HAC13056-3	Always use in pairs.
Crank		3HAC020999-001	Used to turn the gear in correct position.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.

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.

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. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

The procedure below details how to remove gearbox axis 2.

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

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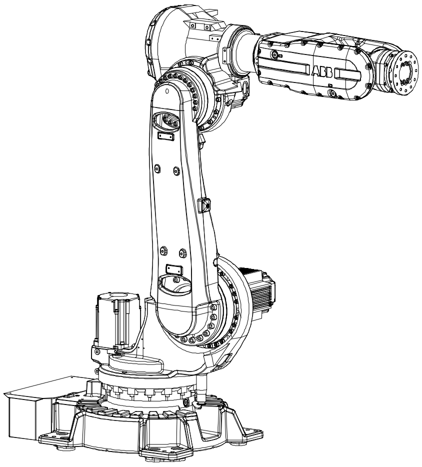
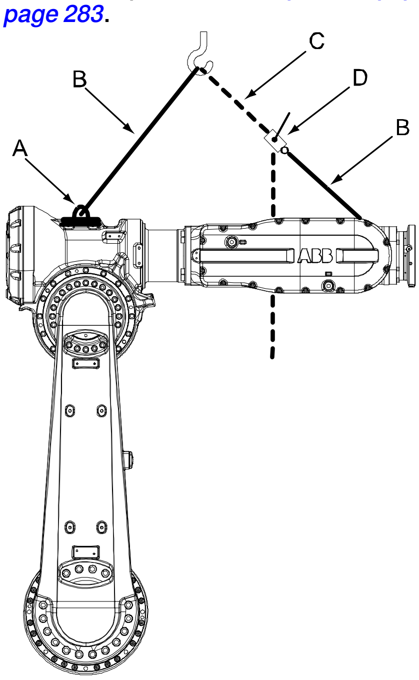
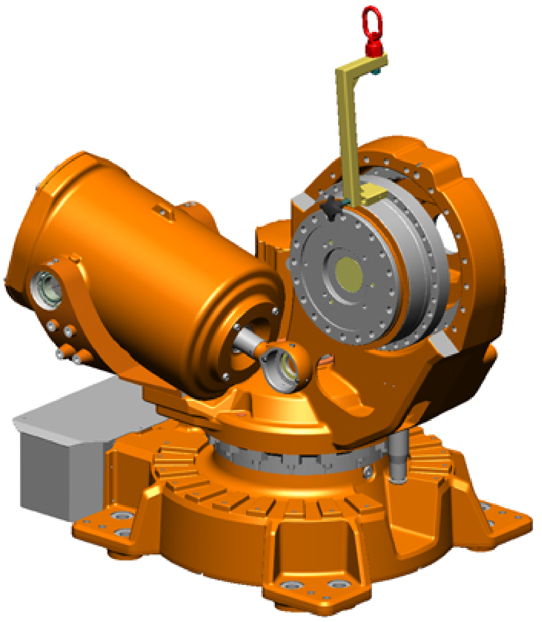
	Action	Note
2	Jog the robot to the position shown in the figure to the right.	 xx0600003125
3	**CAUTION** The upper and lower arms (incl. gearboxes axes 2 and 3) weighs 455 kg. All lifting equipment used must be sized accordingly!	
4	Fit the *lifting tool* on the upper arm and secure the robot in an overhead crane.	Art. no. is specified in *Required equipment on page 283*.  xx0600003099 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
5	Drain the oil from gearbox axis 2.	Detailed in the section *Changing oil, axis-2 gearbox on page 152*.

Continues on next page

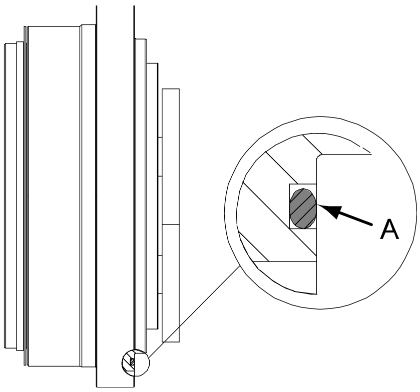
	Action	Note
6	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
7	Remove the cable harness, axes 1-3.	Detailed in the section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
8	Let the removed part of the cable harness hang loose and take care not to damage it during the removal process.	
9	Remove the attachment screws M16x50 (16 pcs) that secure the lower arm to gearbox axis 2.	Shown in the figure *Location of gearbox axis 2 on page 283*.
10	Remove the upper and lower arms and put them down on the floor.	
11	Remove motor axis 2.	Detailed in the section *Replacement of motor axis 2 on page 244*.
12	Remove two attachment screws (M12x60) parallel to each other.	
13	Fit two guide pins in the holes, parallel to each other.	
14	**CAUTION** The gearbox weighs 98 kg! All lifting equipment used must be sized accordingly!	

Continues on next page

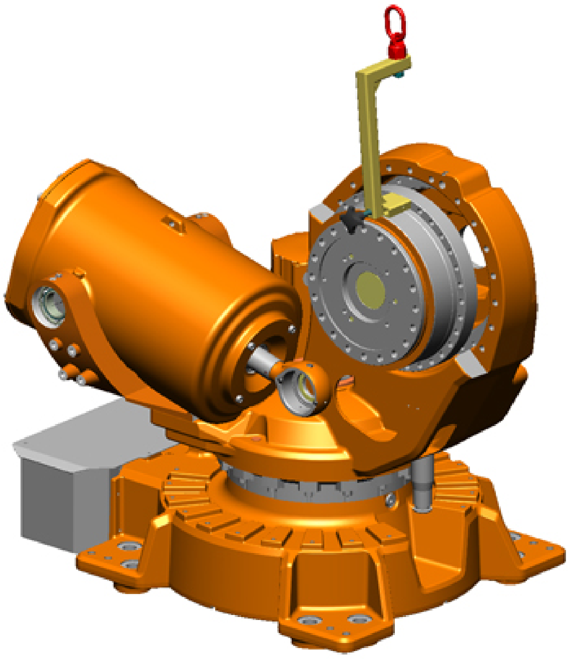
	Action	Note
15	Fit the *lifting tool* for lifting the gearbox in the uppermost hole and secure it with a roundsling.	Art. no. is specified in *Required equipment on page 283*.  xx0900000114 The figure shows IRB6640.
16	Remove the attachment screws M12x60 (24 pcs) securing the gearbox to the frame.	Shown in the figure *Location of gearbox axis 2 on page 283*.
17	Remove the gearbox and put it in a place where it will not/cannot be damaged.	
18	Wipe away residual oil and paint.	

Refitting

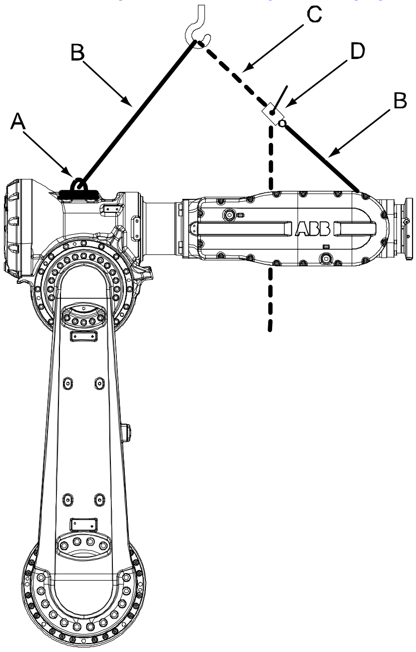
The procedure below details how to refit gearbox axis 2.

	Action	Note
1	Make sure the o-ring is fitted to the gearbox. Lightly lubricate it with grease.	 xx0600003128 • A : O-ring 3HAB3772-91

Continues on next page

	Action	Note
2	**CAUTION** The gearbox weighs 98 kg! All lifting equipment used must be sized accordingly!	
3	Fit the *lifting tool* for lifting the gearbox in the uppermost hole of the gearbox and secure it with a roundsling.	Art. no. is specified in *Required equipment on page 283*.  xx0900000114 The figure shows IRB6640.
4	Fit two guide pins in two of the attachment holes, parallel to each other.	
5	Lift the gearbox on to the guide pins and push it in mounting position.	
6	Refit the gearbox with its attachment screws.	M12x60 (24 pcs) Tightening torque: 120 Nm.
7	**CAUTION** The upper and lower arms (incl. gearboxes axes 2 and 3) weighs 455 kg. All lifting equipment used must be sized accordingly!	

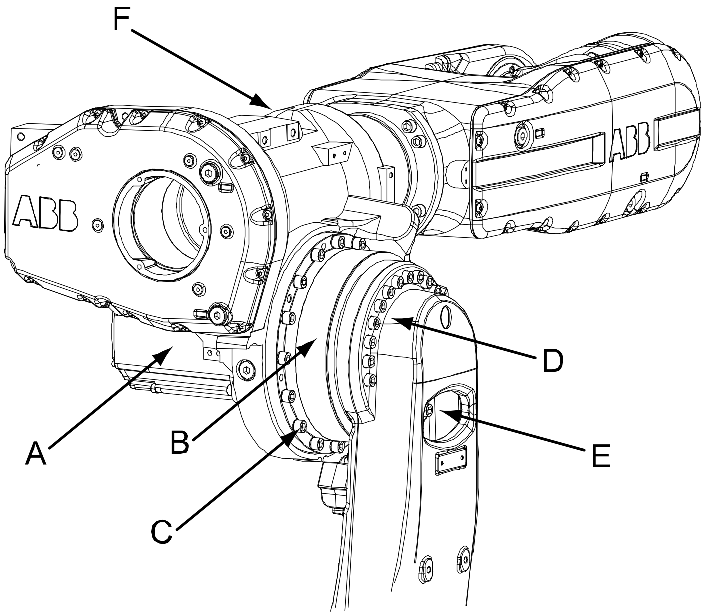
Continues on next page

	Action	Note
8	Fit the *lifting tool* on the upper arm and secure the robot in an overhead crane and lift it carefully up to its mounting position.	Art. no. is specified in *Required equipment on page 283*.  xx0600003099 • A : Lifting tool • B : Roundsling • C : Lifting chain • D : Hoisting block
9	Use a crank in the gearbox in order to find the holes for the attachment screws.	
10	Refit the lower arm to the gearbox axis 2 with its attachment screws.	M16x50 (16 pcs) Tightening torque: 300 Nm.
11	Refit motor axis 2.	Detailed in the section *Replacement of motor axis 2 on page 244*.
12	Refit the cable harness, axes 1-3.	Detailed in the section *Replacement of cable harness, lower end (axes 1-2) on page 182*.
13	Fill the gearbox axis 2 with oil.	Detailed in the section *Changing oil, axis-2 gearbox on page 152*.
14	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
15	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.7.3 Replacement of gearbox axis 3

Location of gearbox axis 3

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



xx0600003057

A	Motor, axis 3
B	Gearbox, axis 3
C	Attachment screws, M12x50 quality 12.9 gleitmo (20 pcs)
D	Attachment screws, M16x50 quality 12.9 gleitmo (16 pcs)
E	Hole in lower arm

Required equipment

Equipment, etc.	Spare part no.	Art. no.	Note
Gearbox, axis 3	See *Spare part lists on page 349*.		Includes: • gearbox • o-ring
O-ring		3HAB3772-92	Replace only if damaged.
Grease		3HAC042536-001	Used to lubricate the o-ring.
Lifting tool		3HAC026597-001	Instructions 3HAC 026600-002 is enclosed.
Lifting tool		3HAC025214-001	For lifting gearbox.
Standard toolkit		-	Content is defined in section *Standard tools on page 344*.

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.

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.

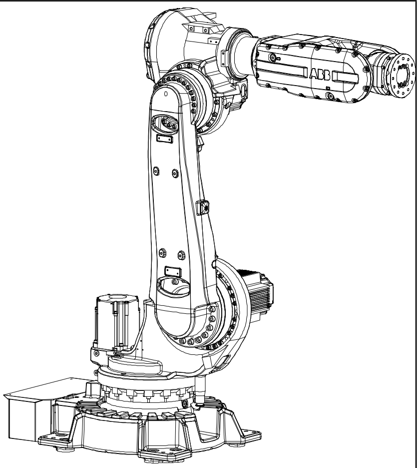
	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal

The procedure below details how to remove gearbox axis 3.

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

Continues on next page

	Action	Note
2	Move the robot to the position shown in the figure to the right.	 xx0600003125
3	**DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
4	Drain the oil from gearbox axis 3.	Detailed in the section *Changing oil, axis-3 gearbox on page 155*.
5	Remove the upper arm.	Detailed in the section *Replacement of the upper arm on page 219*.
6	While the upper arm is resting on its side on the floor, fit the *lifting tool* in the uppermost hole of the gearbox.	Art. no. is specified in *Required equipment on page 290*.
7	**CAUTION** The gearbox weighs 51 kg! All lifting equipment used must be sized accordingly!	
8	Secure the gearbox with a roundsling in an overhead crane.	
9	Remove the *attachment screws* securing the gearbox to the upper arm.	Shown in the figure *Location of gearbox axis 3 on page 290*.
10	Remove the gearbox and put it in a safe place.	

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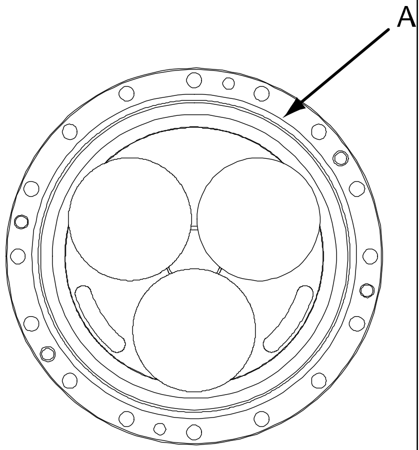
Refitting

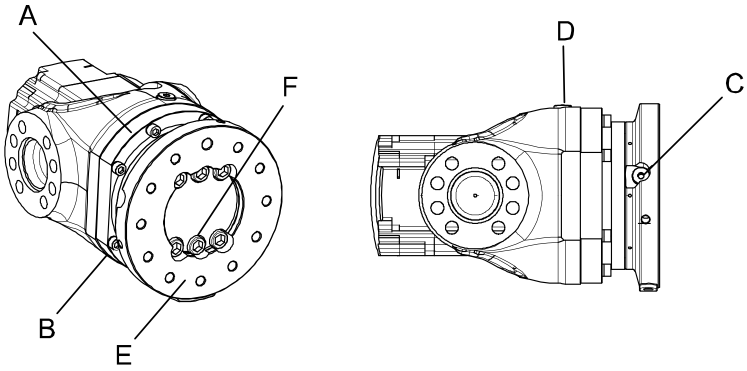
The procedure below details how to refit gearbox axis 3.

	Action	Note
1	Make sure the o-ring is fitted to the gearbox. Lightly lubricate the o-ring with grease.	 xx0600003127 • A : O-ring 3HAB 3772-92
2	**CAUTION** The gearbox weighs 51 kg! All lifting equipment used must be sized accordingly!	
3	Fit a *lifting tool* in the uppermost hole of the gearbox and secure it with a roundsling.	Art. no. is specified in *Required equipment on page 290*.
4	Fit two guide pins in two of the attachment holes, parallel to each other.	
5	Lift the gearbox on to the guide pins and push it to its mounting position.	
6	Refit the gearbox, while the upper arm is resting on its side on the floor.	
7	Refit the *upper arm*.	Detailed in the section *Replacement of the upper arm on page 219*.
8	Fill the *gearbox axis 3* with oil.	Detailed in the section *Changing oil, axis-3 gearbox on page 155*.
9	Recalibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
10	**DANGER** Make sure all safety requirements are met when performing the first test run.	

4.7.4 Replacement of gearbox, axis 6

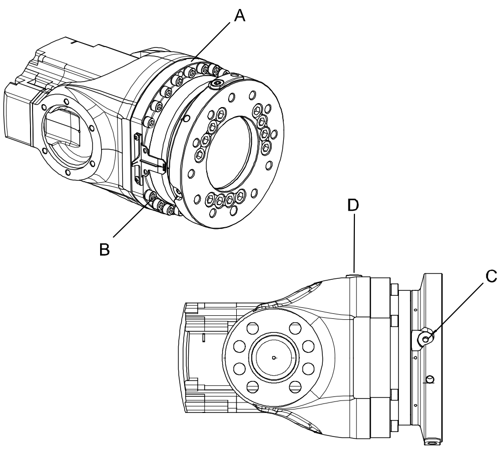
Location of gearbox

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



xx0600003085

A	Gearbox, axis 6 (IRB 6620)
B	Attachment screws, gearbox
C	Oil plug, draining
D	Oil plug, filling
E	Turning disk
F	Attachment screws, turning disk



xx0200000219

A	Gearbox, axis 6 (IRB 6620 Foundry Plus)
B	Attachment screws and washers
C	Oil plug, draining
D	Oil plug, filling

Continues on next page

Required equipment

Equipment, etc.	Article number	Note
Gearbox	For spare part number, see *Spare part lists on page 349*.	Includes o-ring
O-ring	3HAB3772-58	Must be replaced when reassembling gearbox.
O-ring	3HAB3772-57	For type 2 of the gearbox. 164.7x3.53 Must be replaced when reassembling gearbox.
O-ring	3HAB3772-64	For type 2 of the gearbox. 150.0x2.0 Must be replaced when reassembling gearbox.
O-ring	3HAB3772-61	For type 2 of the gearbox. 12 pcs, 13.1x1.6 Must be replaced when reassembling gearbox.
Grease	3HAC042536-001	For lubricating the o-ring.
Flange sealant	12340011-116	Loctite 574
Standard toolkit	-	Content is defined in section *Standard tools on page 344*.
Calibration Pendulum toolkit	3HAC15716-1	Complete kit that also includes operating manual. Required if Calibration Pendulum is the valid calibration method for the robot.
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Continues on next page

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in *Reference calibration routine on page 314*. Read more about reference calibration for Pendulum Calibration in *Operating manual - Calibration Pendulum*.
	If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.	

Removal, gearbox

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

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 **DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	
3	Drain the oil from gearbox, axis 6.	Detailed in the section *Changing oil, axis-6 gearbox on page 163*.
4	Remove the *turning disc*.	Detailed in the section *Removing, turning disk on page 211*.
5	Remove the gearbox by unscrewing its *attachment screws*.	Shown in the figure *Location of gearbox on page 294*.

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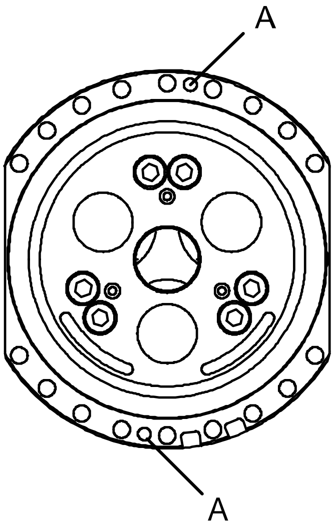
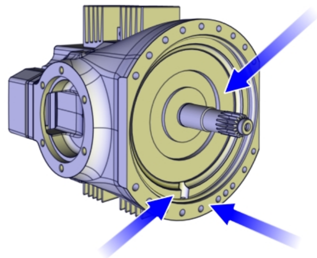
	Action	Note
6	If required, apply M8 screws to the holes shown in the figure beside to press the gearbox out.	 xx0200000220 • A: M8 holes for pressing out the gearbox
	Foundry Plus: Remove old Loctite 574 flange sealant residues and other contamination from the contact surfaces.	 xx1400001123
7	Remove the gearbox axis 6 by lifting it out carefully.	Be careful not to damage the motor pinion!

Refitting, gearbox

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

	Action	Note
1	 **DANGER** Turn off all: • electric power supply to the robot • hydraulic pressure supply to the robot • air pressure supply to the robot Before entering the robot working area.	

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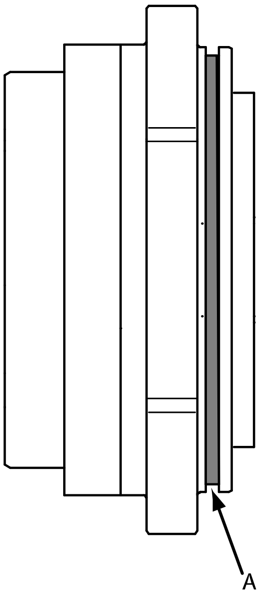
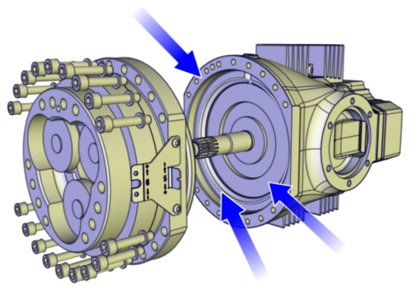
	Action	Note
2	Make sure the *o-ring* is fitted to the rear of the gearbox. Lubricate the o-ring with *grease.*	Article number is specified in *Required equipment on page 295*.  xx0200000221 • A: O-ring, gearbox axis 6
3	Release the holding brake of motor axis 6.	Detailed in the section *Manually releasing the brakes on page 74*.
4	*Foundry Plus:* Apply Loctite 574 flange sealant on the contact surface.	 xx1400001122
5	Insert the *gearbox, axis 6* into the wrist unit.	Article number is specified in *Required equipment on page 295*. Shown in the figure *Location of gearbox on page 294*. Make sure the gears of the gearbox mate with the gears of the motor!
6	Secure the gearbox with the *attachment screws and washers.*	Shown in the figure *Location of gearbox on page 294*. 8 pcs or 18 pcs (depending on wrist version): M8 x 40, 12.9 quality Gleitmo, Tightening torque: 30 Nm. Reused screws may be used, providing they are lubricated as detailed in section *Screw joints on page 340* before fitting.
7	Refit the *turning disc*.	Detailed in the section *Refitting, turning disk on page 212*.

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	Action	Note
8	Perform a *leak-down test*.	Detailed in the section *Performing a leak-down test on page 174*.
9	Refill the gearbox with oil.	Detailed in the section *Changing oil, axis-6 gearbox on page 163*.
10	Re-calibrate the robot.	Pendulum Calibration is described in *Operating manual - Calibration Pendulum*, enclosed with the calibration tools. Axis Calibration is described in *Calibrating with Axis Calibration method on page 313*. General calibration information is included in section *Calibration on page 301*.
11	**DANGER** Make sure all safety requirements are met when performing the first test run.	

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5 Calibration

5.1 Introduction to calibration

5.1.1 Introduction and calibration terminology

Calibration information

This chapter includes general information about the recommended calibration methods and also the detailed procedures for updating the revolution counters, checking the calibration position etc.

Detailed instructions of how to perform Axis Calibration are given on the FlexPendant during the calibration procedure. To prepare calibration with Axis Calibration method, see *Calibrating with Axis Calibration method on page 313*.

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

Calibration terminology

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

5.1.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned at calibration position. Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot. For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.	Axis Calibration or Calibration Pendulum [i] Levelmeter calibration (alternative method)
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the SMB (serial measurement board) in the robot. 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. A robot calibrated with Absolute accuracy has a sticker next to the identification plate of the robot. To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.  xx0400001197	CalibWare

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Type of calibration	Description	Calibration method
Optimization	Optimization of TCP reorientation performance. The purpose is to improve reorientation accuracy for continuous processes like welding and gluing. Wrist optimization will update standard calibration data for axes 4 and 5.	Wrist Optimization

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

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

If no data is found related to standard calibration, Calibration Pendulum is used as default.

Brief description of calibration methods

Calibration Pendulum method

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

Two different routines are available for the Calibration Pendulum method:

- Calibration Pendulum II
- Reference calibration

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

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 6620 and is the most accurate method for the standard calibration. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

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

An introduction to the calibration method is given in this manual, see *Calibrating with Axis Calibration method on page 313*.

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

Wrist Optimization method

Wrist Optimization is a method for improving reorientation accuracy for continuous processes like welding and gluing and is a complement to the standard calibration method.

The following routines are available for the Wrist Optimization method:

- Wrist Optimization

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

Levelmeter calibration - alternative method

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

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

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

CalibWare - Absolute Accuracy calibration

The CalibWare tool guides through the calibration process and calculates new compensation parameters. This is further detailed in the *Application manual - CalibWare Field*.

If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

References

Article numbers for the calibration tools are listed in the section *Special tools on page 345*.

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

5.1.3 When to calibrate

When to calibrate

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

The resolver values are changed

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

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See *Updating revolution counters on page 309*. 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 re-calibrated for new resolver values.

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

Robot is not floor mounted

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

5.2 Synchronization marks and axis movement directions

5.2.1 Synchronization marks and synchronization position for axes

Introduction

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

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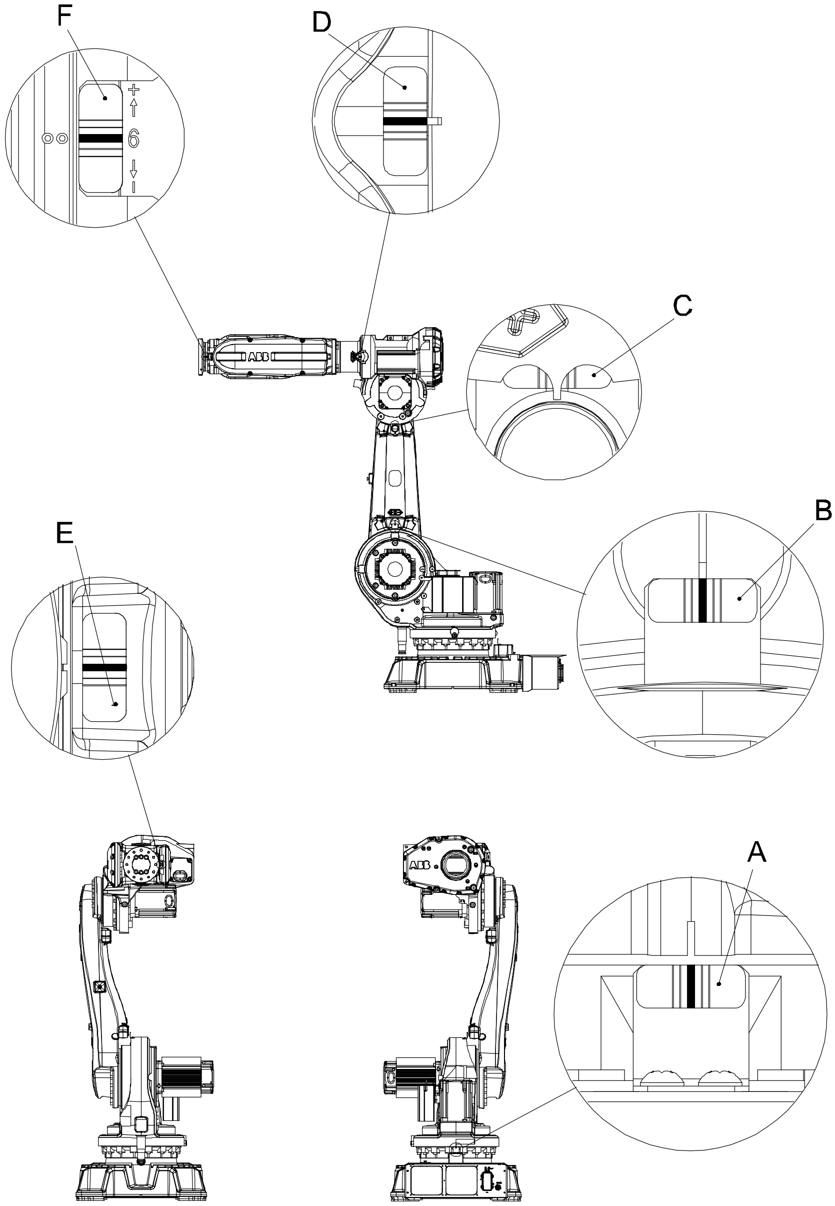
Synchronization marks, IRB 6620



xx0600003096

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

5.2.2 Calibration movement directions for all axes

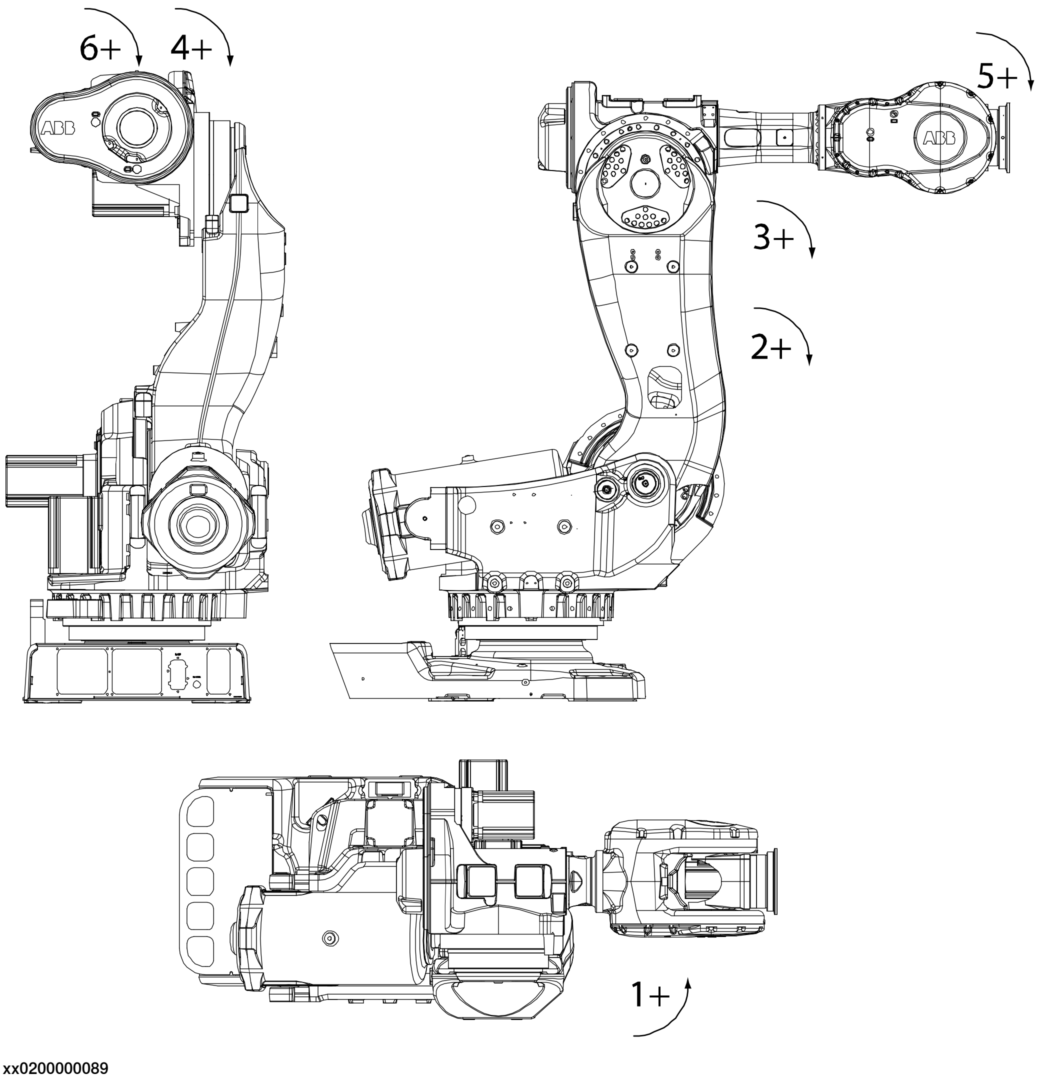
Overview

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

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

Manual movement directions, 6 axes

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



xx0200000089

5.3 Updating revolution counters

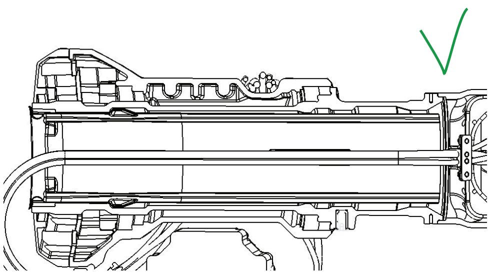
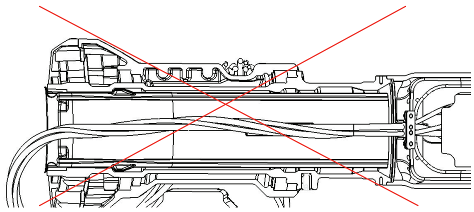
Introduction

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

Mandatory check of cable harness prior to revolution counter update or calibration

Before updating the revolution counter or performing calibration, the status of the cable harness in the tubular shaft must be checked. There is a possibility that axis 4 has been rotated more than ±360° and therefor is positioned incorrectly (at wrong turn), causing the cable harness inside the tubular shaft to be twisted, which can damage the cabling.

Check the cable harness using a flashlight into the tubular shaft. Check that the cable harness is not twisted inside the tubular shaft.

Cabling is straight = axis 4 is positioned at correct turn	Cabling is twisted = axis 4 is positioned at wrong turn (rotated more than ±360°)
 xx1900001265	 xx1900001266

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. **CAUTION** Check the position of axis 4 before continuing, see *Mandatory check of cable harness prior to revolution counter update or calibration on page 309*.	See *Synchronization marks and synchronization position for axes on page 306*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 310*.

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.

Continues on next page

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.

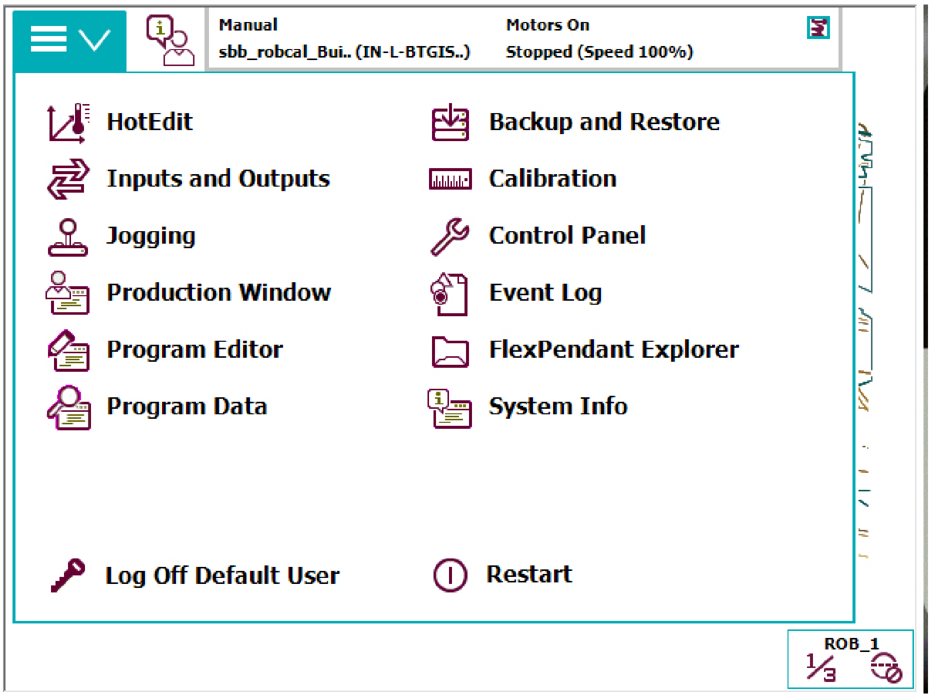
If one of the following mentioned axes are rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration position will be lost due to non-integer gear ratio. This affects the following manipulators:

Manipulator variant	Axis 4	Axis 6
IRB 6620	Yes	No

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

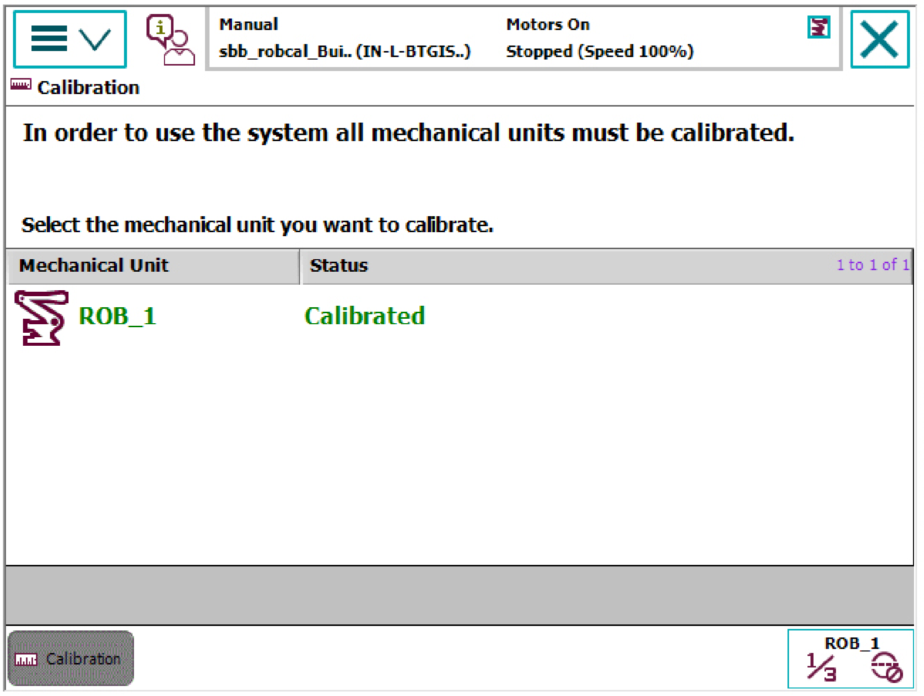
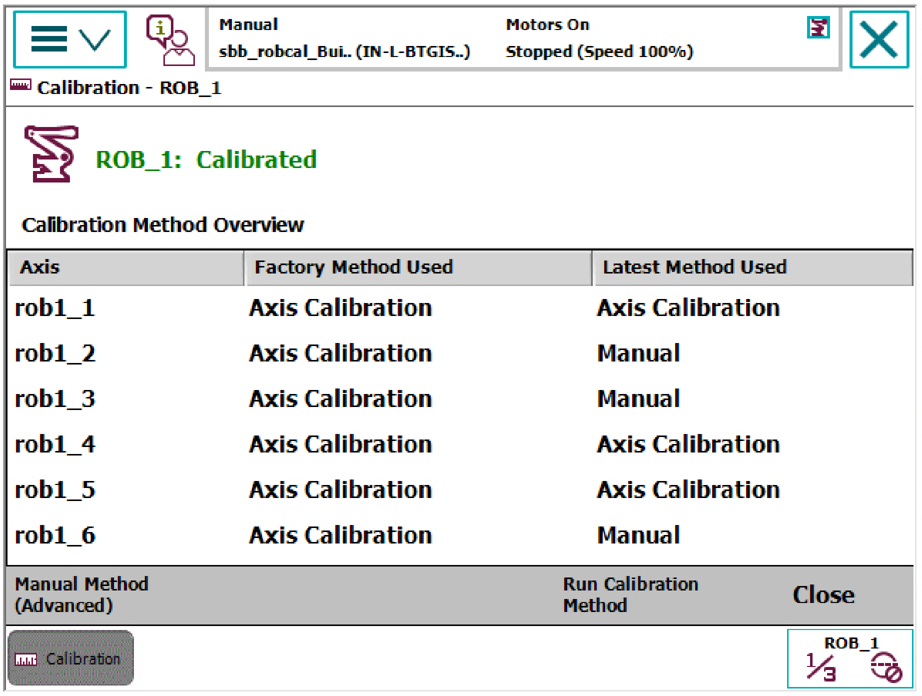
Step 2 - Updating the revolution counter with the FlexPendant

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

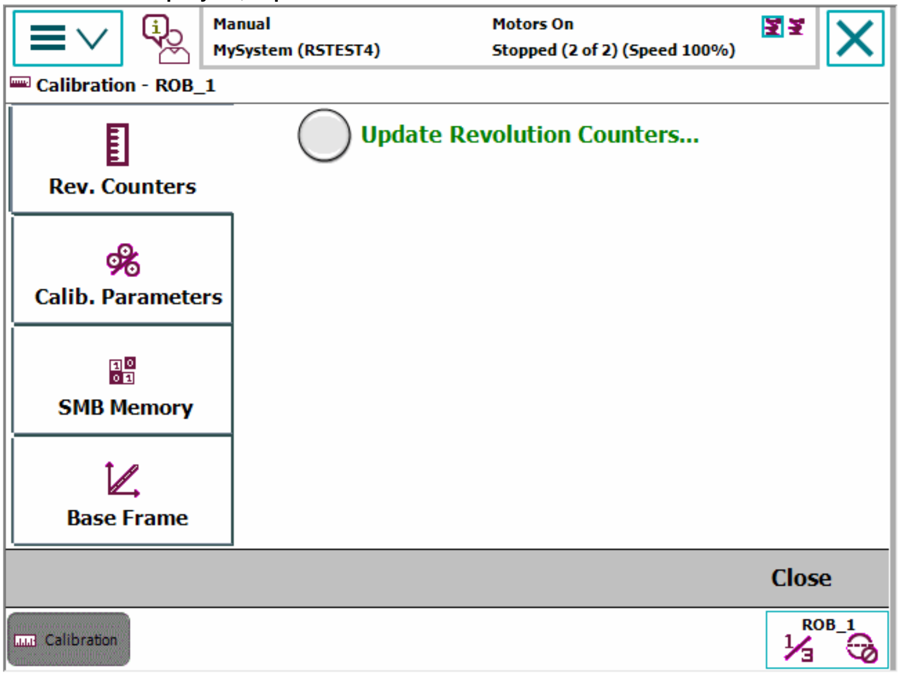
<table>
<tr><th></th><th>Action</th></tr>
<tr><td>1</td><td>On the ABB menu, tap Calibration.


xx1500000942</td></tr>
</table>

Continues on next page

	Action
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.  xx1500000943
3	**This step is valid for RobotWare 6.02 and later.** Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration. Tap **Manual Method (Advanced)**.  xx1500000944

Continues on next page

	Action
4	A screen is displayed, tap **Rev. Counters**.  en0400000771
5	Tap **Update Revolution Counters...**. A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: • Tap **Yes** to update the revolution counters. • Tap **No** to cancel updating the revolution counters. Tapping **Yes** displays the axis selection window.
6	Select the axis to have its revolution counter updated by: • Ticking in the box to the left • Tapping **Select all** to update all axes. Then tap **Update**.
7	A dialog box is displayed, warning that the updating operation cannot be undone: • Tap **Update** to proceed with updating the revolution counters. • Tap **Cancel** to cancel updating the revolution counters. Tapping **Update** updates the selected revolution counters and removes the tick from the list of axes.
8	**CAUTION** If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See *Checking the synchronization position on page 331*.

5.4 Calibrating with Axis Calibration method

5.4.1 Description of Axis Calibration

Instructions for Axis Calibration procedure given on the FlexPendant

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

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

Overview of the Axis Calibration procedure

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

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

The Axis Calibration procedure described roughly:

1. A removable calibration tool is inserted by the operator into a calibration bushing on the axis chosen for calibration, according to instructions on the FlexPendant.

   WARNING

   Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.

   WARNING

   The calibration tool must be fully inserted into the calibration bushing, until the steel spring ring snaps into place.

2. During the calibration procedure, RobotWare moves the robot axis chosen for calibration so that the calibration tools get into contact. RobotWare records values of the axis position and repeats the coming-in-contact procedure several times to get an exact value of the axis position.

   WARNING

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

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

Continues on next page

Routines in the calibration procedure

The following routines are available in the Axis Calibration procedure, given at the beginning of the procedure on the FlexPendant.

Fine calibration routine

Choose this routine to calibrate the robot when there are no tools, process cabling or equipment fitted to the robot.

Reference calibration routine

Choose this routine to create reference values and to calibrate the robot when the robot is dressed with tools, process cabling or other equipment.

Also choose this routine if the robot is suspended.

> **Note**
>
> When calibrating the robot with the reference calibration routine, the robot must be dressed with the same tools, process cabling and any other equipment as when the reference values were created.

If calibrating the robot with reference calibration there must be reference values created before repair is made to the robot, if values are not already available. Creating new values requires possibility to move the robot. The reference values contain positions of all axes, torque of axes and technical data about the tool installed. A benefit with reference calibration is that the current state of the robot is stored and not the state when the robot left the ABB factory. The reference value will be named according to tool name, date etc.

Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.

When reference calibration is performed, the robot is restored to the status given by the reference values.

Update revolution counters

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

Validation

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

System containing SafeMove/EPS

SafeMove/EPS

SafeMove will lose its synchronization to the controller if a new calibration is done. New calibration values have to be downloaded to SafeMove, and a new SafeMove/EPS calibration has to be done. Make sure that the user rights admit to change the safety settings and to synchronize SafeMove/EPS.

Continues on next page

Position of robot axes

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

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

Requirements for axis positioning during calibration

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

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

How to calibrate a suspended robot

The IRB 6620 is fine calibrated floor standing in factory, prior to shipping.

To calibrate a suspended robot, reference calibration must be used. Reference values for a suspended robot must be created with the robot mounted at its working position, not standing on a floor.

To calibrate a suspended robot with the fine calibration routine, the robot must first be taken down and then be mounted standing on the floor.

5.4.2 Calibration tools for Axis Calibration

Calibration tool set

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.

The calibration tool will eventually break from fatigue after longer period of use and then needs to be replaced. There is no risk for bad calibrations as long as the calibration tool is in one piece.

WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

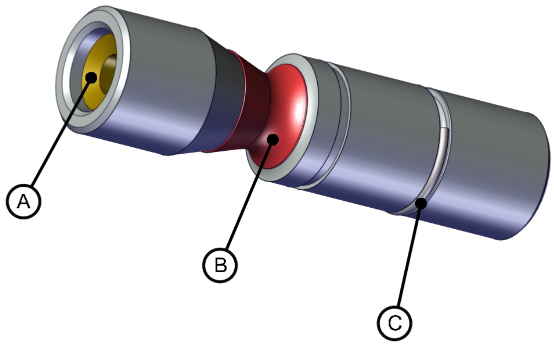
Examining the calibration tool

Check prior to usage

Before using the calibration tool, make sure that the tube insert, the plastic protection and the steel spring ring are present.

WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

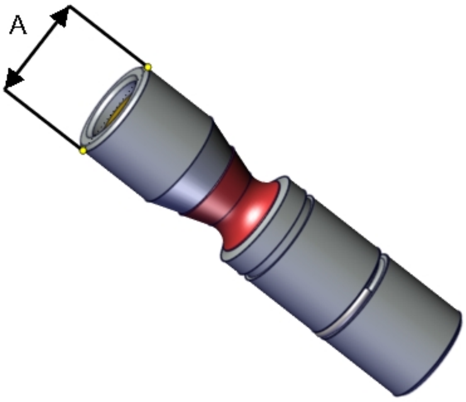
A	Tube insert
B	Plastic protection
C	Steel spring ring

Continues on next page

Periodic check of the calibration tool

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within Ø12g4 mm, Ø8g4 mm or Ø6g5 mm (depending on calibration tool size).
- Straightness within 0.005 mm.



xx1500000951

A	Outer diameter

Identifying the calibrating tools

It is possible to make the calibration tool identifiable with, for example, an RFID chip. The procedure of how to install an RFID chip is described below.

Note

The tool identifier is NOT delivered from ABB, it is a customized solution.

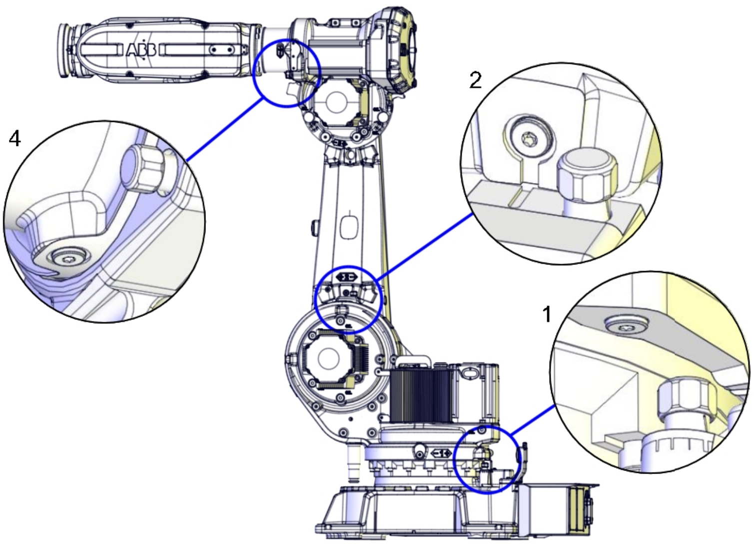
	Action	Note
1	It is possible to use any RFID solution, with the correct dimensions. ABB has verifed function on some suppliers fulfilling the requirements of NFC compatible devices (13.56 Mhz) according to ISO 14443 or ISO 15693. **Note** The maximum dimensions on the RFID chip must not exceed Ø7.9 mm x 8.0 mm, Ø5.9 mm x 8.0 mm or Ø3.9 mm x 8.0 mm (depending on calibration tool size).	
2	There is a cavity on one end of the calibration tool in which the RFID chip can be installed. Install the RFID chip according to supplier instructions. Install the chip in flush with the tool end.	

5.4.3 Installation locations for the calibration tools

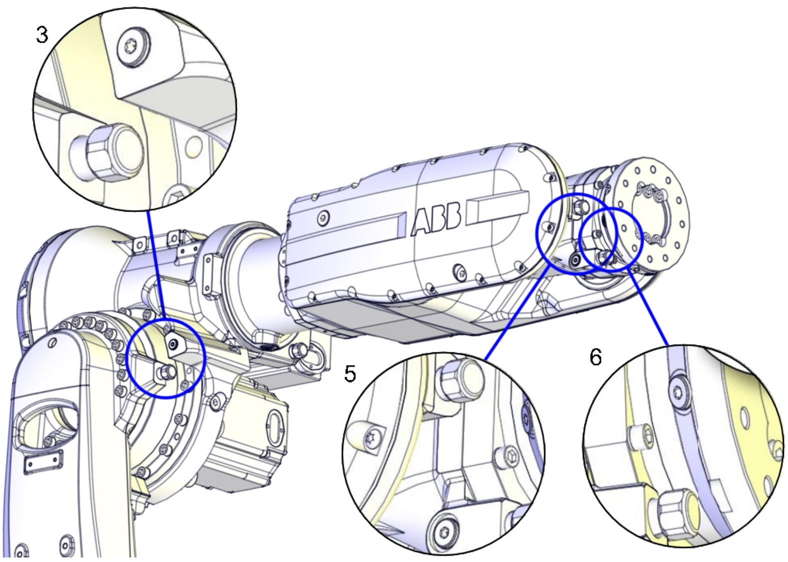
Location of fixed calibration items

This section shows how the robot is equipped with items for installation of calibration tools for Axis Calibration (fixed calibration pins and/or bushings). Installed calibration tools are not shown.

A fixed calibration pin and a bushing for the movable calibration tool are located on each axis as follows.



xx1600000001



xx1600000011

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Spare parts

When calibration is not being performed, a protective cover and an o-ring should always be installed on the fixed calibration pin as well as a protective plug, included a sealing, in the bushing. Replace damaged parts with new.

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

5.4.4 Axis Calibration - Running the calibration procedure

Required tools

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.

WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration holes may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC056806-001	Contains replacement calibration pin covers and protective plugs for the bushing.

Overview of the calibration procedure on the FlexPendant

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

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

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

1. Choose calibration routine. The routines are described in *Routines in the calibration procedure on page 314*.
2. Choose which axis/axes to calibrate.
3. The robot moves to synchronization position.
4. Validate the synchronization marks.
5. The robot moves to preparation position.
6. Remove the protective cover from the fixed pin and the protection plug from the bushing, if any, and install the calibration tool.

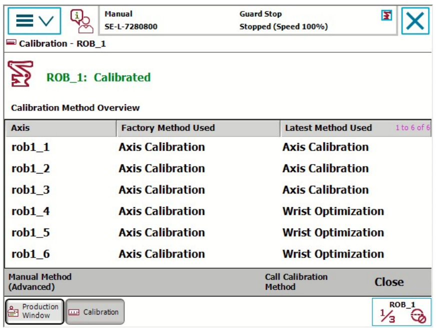
Continues on next page

7. The robot performs a measurement sequence by rotating the axis back and forth.
8. Remove the calibration tool and reinstall the protective cover on the fixed pin and the protection plug in the bushing, if any.
9. The robot moves to verify that the calibration tool is removed.
10. Choose whether to save the calibration data or not.

Calibration of the robot is not finished until the calibration data is saved, as last step of the calibration procedure.

Preparation prior to calibration

The calibration procedure is described in the FlexPendant while conducting it.

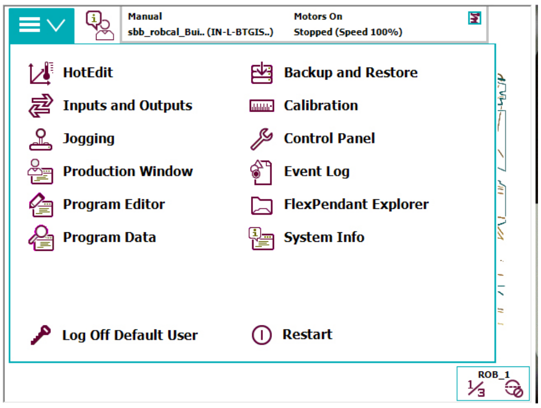
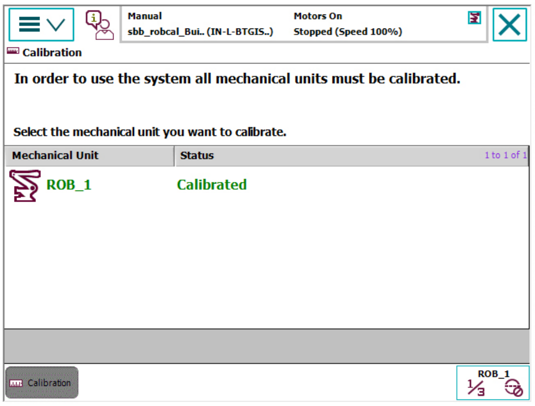
<table>
<tr><th></th><th>Action</th><th>Note</th></tr>
<tr><td>1</td><td>DANGER
While conducting the calibration, the robot needs to be connected to power.
Make sure that the robot's working area is empty, as the robot can make unpredictable movements.</td><td></td></tr>
<tr><td>2</td><td>Wipe the calibration tool clean.
Note
The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.</td><td>Use a clean cloth.</td></tr>
<tr><td>3</td><td>Check if the standard calibration data for axes 4 or 5 are updated with wrist optimization.
This is shown in the Calibration Method Overview window on the FlexPendant.


xx2000000509</td><td>If the data is optimized, the calibration routine Wrist Optimization must be re-run after standard calibration.
See Calibrating with Wrist Optimization method on page 328.</td></tr>
</table>

Continues on next page

Starting the calibration procedure

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

	Action	Note
1	On the **ABB** menu, tap **Calibration**.  xx1500000942	
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.  xx1500000943	

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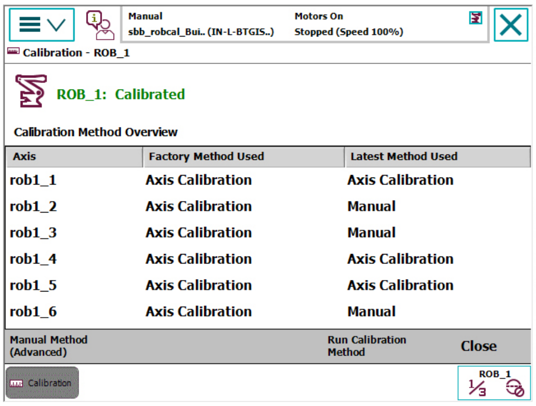
<table>
<tr><th></th><th>Action</th><th>Note</th></tr>
<tr><td>3</td><td>Calibration method used at factory for each axis is shown, as well as calibration method used for the robot during last field calibration.

Tap Run Calibration Method. The software will automatically call for the procedure for the valid calibration method.



xx1500000944</td><td>The FlexPendant will give all information needed to proceed with Axis Calibration.</td></tr>
<tr><td>4</td><td>Follow the instructions given on the FlexPendant.</td><td>A brief overview of the sequence that will be run on the FlexPendant is given in Overview of the calibration procedure on the FlexPendant on page 320.</td></tr>
</table>

Restarting an interrupted calibration procedure

If the Axis Calibration procedure is interrupted before the calibration is finished, the RobotWare program needs to be started again. Use this procedure to take required action.

Situation	Action
The three-position enabling device on the FlexPendant has been released during robot movement.	Press and hold the three-position enabling device and press **Play**.
The RobotWare program is terminated with **PP to Main**.	Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See *Starting the calibration procedure on page 322*. If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in *Calibration movement directions for all axes on page 308*

Axis Calibration with SafeMove option

To be able to run Axis Calibration, SafeMove needs to be unsynchronized. The Axis Calibration routine recognizes if the robot is equipped with SafeMove and will force SafeMove to unsynchronize automatically.

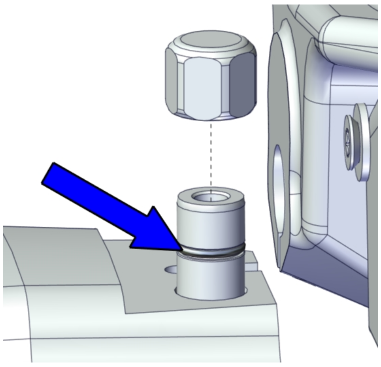
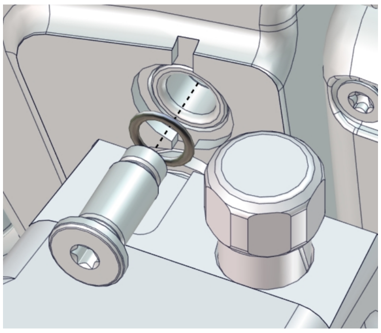
Continues on next page

However, SafeMove may generate other warning messages anytime during the Axis Calibration routine. When a warning message is displayed, tap **Acknowledge** to confirm the unsynchronized state and continue Axis Calibration procedure.

CAUTION

SafeMove must be synchronized after the calibration is completed.

After calibration

	Action	Note
1	Check the o-ring on the fixed calibration pin. Replace if damaged or missing.	 xx1600002102 Protection cover and plug set: 3HAC056806-001.
2	Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	
3	Reinstall the protective plug and sealing in the bushing on each axis, directly after the axis has been calibrated. Ensure that the sealing is not damaged. Replace the plug and the sealing with new spare part, if missing or damaged.	 xx1500000952 Protection cover and plug set: 3HAC056806-001.
4	If the standard calibration data for axes 4, 5 or 6 should be updated with wrist optimization, run the calibration routine **Wrist Optimization**.	See *Calibrating with Wrist Optimization method on page 328*.

5.4.5 Reference calibration

Brief introduction to Reference Calibration

Reference calibration is a faster method compared to Fine calibration, as it refers to a previously made calibration.

1. Create a backup of the current robot system.
2. Check that the active calibration offset values corresponds to the values on the silver label (on the lower arm or the base).
3. Jog the manipulator so that all axes are in zero position (ex use `MoveAbsJ` instruction). Check that all axis scales are aligned with calibration marks.
4. If the scales differ from calibration marks it might depend on wrong turns of the revolution counters. Make a marker line on the corresponding axis to be able to validate the result of the calibration. If more than one motor revolutions are wrong, the calibration will fail.
5. Use a verification position. This is especially recommended if all axes were not aligned with the synchronization marks (step 3). Reuse an existing position that is suitable and accurate so it can be used to validate the repair. Use a position where a deviation in axis calibration gives a big deviation in positioning. Note! Check the position after each repair in one axis.
6. Use Reference calibration to save reference values for all axes that is to be replaced. Make sure that the values are saved in RobotStudio or FTP program. The files are located in "Active system folder name/HOME/RefCalibFiles".
7. Perform the repair.
8. Make sure that the tooling and process equipment are the same as when creating the reference. Use Reference calibration to update the system with new calibration offset value for the repaired axis.
9. Check the position against the verification position (step 5).
10. Proceed with the repair of the next axis, if necessary, and repeat (step 8-9) for every axis.
11. (For system containing SafeMove or EPS) Download new calibration values to SafeMove. Use Visual SafeMove in RobotStudio.
12. (For system containing SafeMove or EPS) Synchronize SafeMove to activate SafeMove.
13. Perform test run.
14. Update the label for resolver values with new calibration values.

Manual tuning of calibration offset

Manual tuning of calibration offset is normally not needed, but can be useful in some situations. The requirement to do manual tuning is that there is a known accurate position, that worked accurately before the repair (step 5, see *Brief introduction to Reference Calibration on page 325*).

Example "Adjust axis 4":

1. Create a backup.

Continues on next page

2 Run the manipulator to the verification position. (The manipulator position is now deviating from the verification position.)
3 Read and note current axis 4 value in degrees (example: 96.3 degrees).
4 Manually jog, only axis 4, so that the manipulator is correctly positioned to the verification position.
5 Read and note current axis 4 value in degrees (example: 94.2 degrees).
6 Move the manipulator to its calibration position.
7 Calculate the angle difference (ie 96.3-94.2=2.1 degrees).
8 Manually jog axis 4 the calculated angle difference (-2.1). NOTE! The direction +/- shall be the same direction as the direction used when axis 4 was manually jogged to coincide with the verification process. In the example -2.1 degrees.
9 Make a new manual fine calibration of axis 4 with axis in -2.1 degrees position.
10 Check again against the verification position.
11 Repeat the manual tuning if needed.
12 Create a new reference if the intention is to use the reference in the future.

5.5 Calibrating with Calibration Pendulum method

Where to find information for Calibration Pendulum

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

5.6 Calibrating with Wrist Optimization method

When to run Wrist Optimization

Wrist Optimization routine is run to improve TCP reorientation performance.

Calibrating the robot with standard calibration method overwrites the optimized positions of axes 4, 5. Re-run the **Wrist Optimization** routine after standard calibration to re-achieve the optimized positions of the wrist axes.

Overview of the calibration procedure on the FlexPendant

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

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

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

1. Choose calibration routine Wrist Optimization.
2. Modify targets for 4-point tool frame definition, in Wrist Optimization routine.

   > **Tip**
   >
   > Select positions with large reorientations around the TCP. For best results, make sure that axis 4 and 5 have large movements.

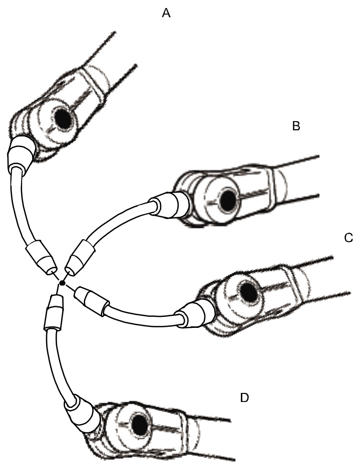
   a. Jog the robot to an appropriate position, A, for the first approach point.

      Use small increments to accurately position the tool tip as close to the reference point as possible.

   b. Tap **Modify Position** to define the point.

   c. Repeat for each approach point to be defined, positions B, C, and D.

      Jog away from the fixed world point to achieve the best result. Just changing the tool orientation will not give as good a result.



en0400000906

3. Improved calibration data to the wrist axes is identified and presented.
4. Optimized positions for the wrist axes are presented.

Continues on next page

5. The robot moves to the optimized positions for the wrist axes and automatically overwrites previous calibration data.

   WARNING

   Robot moves automatically when pressing **Calibrate**.

6. Wrist optimization is finished.
7. Redefine / verify TCP for all tools.

5.7 Verifying the calibration

Introduction

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

Verifying the calibration

Use this procedure to verify the calibration result.

	Action	Note
1	Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See *Checking the synchronization position on page 331*.
2	Adjust the *synchronization marks* when the calibration is done, if necessary.	This is detailed in section *Synchronization marks and synchronization position for axes on page 306*.
3	Write down the values on a new label and stick it on top of the calibration label. The label is located on the lower arm.	

5.8 Checking the synchronization position

Introduction

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

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

Using a `MoveAbsJ` instruction

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:
	`MoveAbsJ [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\NoEOffs, v1000, fine, tool0`	

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 306* and *Updating revolution counters on page 309*.

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 306* and *Updating revolution counters on page 309*.

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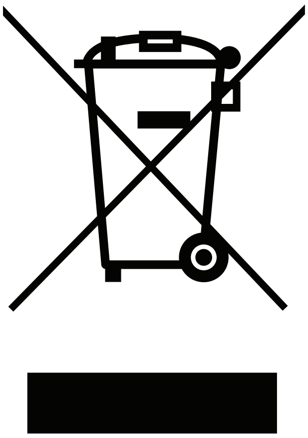
6 Decommissioning

6.1 Environmental information

Symbol

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



xx1800000058

Hazardous material

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

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

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

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.

Continues on next page

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.

6.2 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. 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.

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7 Reference information

7.1 Applicable standards

Note

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

General

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

Normative standards as referred to from ISO 10218-1

Standard	Description
ISO 9283:1998	Manipulating industrial robots - Performance criteria and related test methods
ISO 10218-2	Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration
ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
ISO 13850	Safety of machinery - Emergency stop - Principles for design
IEC 60204-1:2005	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
IEC 62061:2005	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems

Region specific standards and regulations

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

Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments

Continues on next page

Standard	Description
IEC 61000-6-4 (option 129-1)	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
ISO 13732-1:2006	Ergonomics of the thermal environment - Part 1
IEC 60974-1:2012[i]	Arc welding equipment - Part 1: Welding power sources
IEC 60974-10:2014[i]	Arc welding equipment - Part 10: EMC requirements
ISO 14644-1:2015[ii]	Classification of air cleanliness
IEC 60529:1989 + A2:2013	Degrees of protection provided by enclosures (IP code)

i Only valid for arc welding robots. Replaces IEC 61000-6-4 for arc welding robots.
ii Only robots with protection Clean Room.

7.2 Unit conversion

Converter table

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

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

7.3 Screw joints

General

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

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

UNBRAKO screws

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

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

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. 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)	3HAC042472-001

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard torques** are specified in the following tables. Any **special torques** are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct tightening torque* for each type of screw joint.
- Only use *correctly calibrated* torque keys.

Continues on next page

- 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.*

Note

A 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.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670
M24	680	960	1150

Lubricated screws (Molycote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molycote 1000, Gleitmo 603 or equivalent* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M8	28	35

Continues on next page

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M10	55	70
M12	96	120
M16	235	280
M20	460	550
M24	790	950

i Lubricated with Molycote 1000, Gleitmo 603 or equivalent

Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one* or *both* connectors are made of *brass*.

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque Nm - Nominal	Tightening torque Nm - Min.	Tightening torque Nm - Max.
1/8	12	8	15
1/4	15	10	20
3/8	20	15	25
1/2	40	30	50
3/4	70	55	90

7.4 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 arm weighs 25 kg. All lifting accessories used must be sized accordingly.	

7.5 Standard tools

General

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

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

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

Contents, standard toolkit

Qty	Tool	Rem.
1	Ring-open-end spanner 8-19 mm	
1	Socket head cap 5-17 mm	
1	Torx socket no: 20-60	
1	Box spanner set	
1	Torque wrench 10-100 Nm	
1	Torque wrench 75-400 Nm	
1	Ratchet head for torque wrench 1/2	
2	Hexagon-headed screw M10x100	
1	Hex bit socket head cap no. 14 socket 40 mm L=100 mm	
1	Hex bit socket head cap no. 14 socket 40 mm L=20 mm	To be shortened to 12 mm
1	Hex bit socket head cap no. 6 socket 40 mm L=145 mm	
1	Hex bit socket head cap no. 6 socket 40mm bit L=220 mm	

7.6 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 344*, and of special tools, listed directly in the instructions and also gathered in this section.

Calibration equipment, Calibration Pendulum

The following table specifies the calibration equipment needed when calibrating the robot with the Calibration Pendulum method.

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

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

If no data is found related to standard calibration, Calibration Pendulum is used as default.

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

Calibration equipment, Axis Calibration

The following table specifies the calibration equipment needed when calibrating the robot with the Axis Calibration method.

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

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

If no data is found related to standard calibration, Calibration Pendulum is used as default.

Description	Art. no.	Note
Calibration tool box, Axis Calibration	3HAC055412-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot.

Basic tools

The following table specifies the tools in the basic toolkit that are used for the current robot model. This toolkit is necessary primarily when removing and refitting the motors.

The tools are also listed directly in the instructions.

Description	Qty	Art. no.
Extension 300mm for bits 1/2"	1	3HAC12342-1
Guide pins M8 x 100	2	3HAC15520-1
Guide pins M8 x 150	2	3HAC15520-2

Continues on next page

Description	Qty	Art. no.
Guide pins M10 x 100	2	3HAC15521-1
Guide pins M10 x 150	2	3HAC15521-2
Lifting tool, motor ax 1	1	3HAC14459-1
Lifting tool, motor ax 2, 3	1	3HAC026061-001
Removal tool, motor M10x	2	3HAC14972-1 Fits motors, axes 6.
Removal tool, motor M12x		Fits motors axes 1, 2 and 3.
Rotation tool	1	3HAC17105-1
	1	3HAC12342-1
Standard toolkit (content described in section *Standard tools on page 344*)	1	-

Lifting tool

The following table specifies the lifting tools required during several of the service procedures. The tools may be ordered separately and are also specified directly in concerned instructions in the product manual.

Description	Qty	Art. no.
Lifting tool		3HAC026597-001
Hoisting block		
Lifting chain (used together with the hoisting block)		
Support, base and gear axis 1		3HAC15535-1
Lifting tool, gearbox axis 1		3HAC15556-1
Lifting eye (used together with lifting tool 3HAC 15556-1)		3HAC025333-005
Lifting tool, gearbox		3HAC025214-001
Guide pins, M12x130		3HAC022637-001
Guide pins, M16x		
Lifting eye, M16		3HAC14457-1
Lifting eye, M20		
Crank		

7.7 Lifting accessories and lifting instructions

General

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

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

The instructions delivered with the lifting accessories should be stored for later reference.

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8 Spare part lists

8.1 Spare part lists and illustrations

Location

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

Tip

All documents can be found via myABB Business Portal, www.abb.com/myABB.

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9 Circuit diagram

9.1 Circuit diagrams

Overview

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

See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
Circuit diagram - IRC5	*3HAC024480-011*
Circuit diagram - IRC5 Compact	*3HAC049406-003*
Circuit diagram - IRC5 Panel Mounted Controller	*3HAC026871-020*
Circuit diagram - Euromap 67, design 14	*3HAC024120-005*
Circuit diagram - Spot welding cabinet	*3HAC057185-001*

Robots

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 120	*3HAC031408-003*
Circuit diagram - IRB 140 type C	*3HAC6816-3*
Circuit diagram - IRB 260	*3HAC025611-001*
Circuit diagram - IRB 360	*3HAC028647-009*
Circuit diagram - IRB 460	*3HAC036446-005*
Circuit diagram - IRB 660	*3HAC025691-001*
Circuit diagram - IRB 760	*3HAC025691-001*
Circuit diagram - IRB 1200	*3HAC046307-003*
Circuit diagram - IRB 1410	*3HAC2800-3*
Circuit diagram - IRB 1600/1660	*3HAC021351-003*
Circuit diagram - IRB 1520	*3HAC039498-007*
Circuit diagram - IRB 2400	*3HAC6670-3*
Circuit diagram - IRB 2600	*3HAC029570-007*
Circuit diagram - IRB 4400/4450S	*3HAC9821-1*
Circuit diagram - IRB 4600	*3HAC029038-003*
Circuit diagram - IRB 6620	*3HAC025090-001*
Circuit diagram - IRB 6620 / IRB 6620LX	*3HAC025090-001*
Circuit diagram - IRB 6640	*3HAC025744-001*
Circuit diagram - IRB 6650S	*3HAC13347-1* *3HAC025744-001*

Continues on next page

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 6660	*3HAC025744-001* *3HAC029940-001*
Circuit diagram - IRB 6700 / IRB 6790	*3HAC043446-005*
Circuit diagram - IRB 7600	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 14000	*3HAC050778-003*
Circuit diagram - IRB 910SC	*3HAC056159-002*

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