



Product manual

IRB 4600 Foundry Prime

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**Product manual
IRB 4600 Foundry Prime - 60/2.05
IRC5**

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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.

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

Usage

This manual should be used during:

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

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

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

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

Organization of chapters

The manual is organized in the following chapters:

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

Continues on next page

Overview of this manual

Continued

Chapter	Contents
Reference information	Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards etc.
Spare part / part list	Complete spare part list and complete list of robot components, shown in exploded views.
Exploded views	Detailed illustrations of the robot with reference numbers to the part list.
Circuit diagram	Reference to the circuit diagram for the robot.

References

Reference	Document ID
<i>Product manual - IRB 4600</i>	3HAC033453-001
<i>Product manual, spare parts - IRB 4600</i>	3HAC049108-001
<i>Product specification - IRB 4600</i>	3HAC032885-001
<i>Circuit diagram - IRB 4600</i>	3HAC029038-003
<i>Operating manual - General safety information</i> ⁱ	3HAC031045-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC 639.	3HAC021313-001
<i>Product manual - IRC5</i> IRC5 with main computer DSQC1000.	3HAC047136-001
<i>Operating manual - Emergency safety information</i>	3HAC027098-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - Trouble shooting IRC5</i>	3HAC020738-001
<i>Operating manual - Calibration Pendulum</i>	3HAC16578-1
<i>Operating manual - Service Information System</i>	3HAC050944-001
<i>Technical reference manual - Lubrication in gearboxes</i>	3HAC042927-001
<i>Technical reference manual - System parameters</i>	3HAC050948-001
<i>Application manual - Additional axes and stand alone controller</i>	3HAC051016-001
<i>Application manual - Electronic Position Switches</i>	3HAC050996-001
<i>Application manual - CalibWare Field 5.0</i>	3HAC030421-001
List of approved cleaners and detergents for Foundry Prime robots	Contact ABB local sales organization

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

Revisions

Revision	Description
-	First edition
A	The following updates have been made in this revision: <ul style="list-style-type: none">• A new SMB unit and battery is introduced, with longer battery lifetime.• Updated the list of approved detergents, see Approved cleaners and detergents on page 197.

Continues on next page

Revision	Description
B	<p>The following updates have been made in this revision:</p> <ul style="list-style-type: none"> • Several more spare part numbers are corrected throughout the spare part chapter. • The list of approved cleaners and detergents is updated more frequently than the manual is updated, therefore the information is removed from the manual and instead referenced. See Approved cleaners and detergents on page 197.
C	<p>The following updates have been made in this revision:</p> <ul style="list-style-type: none"> • Added information about risks when scrapping a decommissioned robot, see Scrapping of robot on page 381.
D	<p>The following updates have been made in this revision:</p> <ul style="list-style-type: none"> • Illustration changes in Dimension, mounting surface and guide bushing on page 85. • Term "Guide sleeves" changed to "Guide bushings", see Dimension, mounting surface and guide bushing on page 85. • A new WARNING! is added in the section about motor replacement, informing not to mix different motor types. • Minor corrections.
E	<p>The following updates have been made in this revision:</p> <ul style="list-style-type: none"> • Note added in Fitting equipment on robot. • Foundry Prime: Seal armhouse cover with Sikaflex (several updates)
F	<p>The following updates have been made in this revision:</p> <ul style="list-style-type: none"> • Turning disc fixture is removed from special tools for Levelmeter calibration. • New illustrations for foundry prime air connections in manipulator base, maintenance and repair chapter.
G	<p>Published in release R16.2. The following updates are made in this revision:</p> <ul style="list-style-type: none"> • Corrections due to updates in SAP terminology. • New dimensional drawing of the turning disk added to Fitting equipment on wrist and mounting flange on page 92. • New standard calibration method is introduced (Axis Calibration). See Calibration on page 351. • Information about grounding point added. See Robot cabling and connection points on page 106. • The spare part lists are removed from this manual. Valid spare part lists are published in Product manual, spare parts - IRB 4600. • The maintenance schedule is revised, activities not valid for IRB 4600 were incorrectly added to the schedule previously. Faulty activities are removed.
H	<p>Published in release R17.1. The following updates are made in this revision:</p> <ul style="list-style-type: none"> • Drying time for Mercasol added. • Changed the tightening torque of the oil plug located on axis-1 gearbox. • Added information regarding tightening of protective calibration plugs after calibration. Risk of damage on sealing washer if tightened too hard.

Product documentation, IRC5

Categories for user documentation from ABB Robotics

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

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

Product manuals

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

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

Technical reference manuals

The technical reference manuals describe reference information for robotics products.

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

Continues on next page

Application manuals

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

An application manual generally contains information about:

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

Operating manuals

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

The group of manuals includes (among others):

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

How to read the product manual

Reading the procedures

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

References to figures

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

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

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

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

References to required equipment

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

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

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

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

Safety information

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

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

Illustrations

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

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

Important information about robots with protection type Foundry Prime

Introduction

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

Warranty claims

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

Robot models available with the protection type Foundry Prime

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

Robot variant
IRB 4600 Foundry Prime

Pressurized components

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

For more information, see [Pressurized components on page 60](#).

Cleaning

Special procedures are needed when cleaning the Foundry Prime robot. See section [Cleaning the IRB 4600 Foundry Prime on page 195](#).

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1 Safety

1.1 Introduction to safety information

Overview

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

- General safety aspects, important to attend to before performing any service work on the robot. These are applicable for all service work and are found in [General safety information on page 18](#).
- Safety signals and symbols shown in the manual and on the robot, warning for different types of dangers, are found in [Safety signals and symbols on page 40](#).
- Specific safety information, pointed out in the procedures. How to avoid and eliminate the danger is either described directly in the procedure, or in specific instructions in the section [Safety related instructions on page 48](#).

1 Safety

1.2.1 Introduction to general safety information

1.2 General safety information

1.2.1 Introduction to general safety information

Definitions

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

Sections

The general safety information is divided into the following sections.

Section	Examples of content
<i>Safety in the manipulator system on page 19</i>	This section describes the following: <ul style="list-style-type: none">• safety, service• limitation of liability• related information
<i>Protective stop and emergency stop on page 21</i>	This section describes protective stop and emergency stop.
<i>Safety risks on page 22</i>	This section lists dangers relevant when working with the product. The dangers are split into different categories. <ul style="list-style-type: none">• safety risks during installation or service• risks associated with live electrical parts
<i>Safety actions on page 32</i>	This section describes actions which may be taken to remedy or avoid dangers. <ul style="list-style-type: none">• fire extinguishing• safe use of the teach pendant or jogging device

1.2.2 Safety in the manipulator system

Validity and responsibility

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

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

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

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

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

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

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

Connection of external safety devices

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

Limitation of liability

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

Related information

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

Continues on next page

1 Safety

1.2.2 Safety in the manipulator system

Continued

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

1.2.3 Protective stop and emergency stop

Overview

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

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

1.2.4 Safety risks

1.2.4.1 Safety risks during installation and service work on robots

Overview

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

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

General risks during installation and service

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

Spare parts and special equipment

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

Personal protective equipment

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

Nation/region specific regulations

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

Non-voltage related risks

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

Continues on next page

1.2.4.1 Safety risks during installation and service work on robots

Continued

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

To be observed by the supplier of the complete system

When integrating the robot with external devices and machines:

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

Complete robot

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

Continues on next page

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

Continued

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

Cabling

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

Gearboxes and motors

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

1.2.4.2 CAUTION - Hot parts may cause burns!

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

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

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

Elimination

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

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

1 Safety

1.2.4.3 Safety risks related to tools/work pieces

1.2.4.3 Safety risks related to tools/work pieces

Safe handling

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

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

Safe design

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

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



CAUTION

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

1.2.4.4 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.



Note

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

Residual energy

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

Safe design

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

1 Safety

1.2.4.5 Safety risks with pressure relief valve

Introduction

The pressure relief valve must be kept clean and open, for it to be able to function properly.

Safety risks

The pressure relief valve is a vital part preventing too much air pressure being built up inside the robot. If too much air pressure has been built up, there is a risk of personal injury and mechanical damage.

1.2.4.6 Safety risks during operational disturbances**General**

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

Qualified personnel

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

Extraordinary risks

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

1 Safety

1.2.4.7 Risks associated with live electric parts

1.2.4.7 Risks associated with live electric parts

Voltage related risks, general

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

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

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

All work must be performed:

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

Voltage related risks, IRC5 controller

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

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

Continues on next page

Voltage related risks, robot

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

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

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

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

1 Safety

1.2.5.1 Safety fence dimensions

1.2.5 Safety actions

1.2.5.1 Safety fence dimensions

General

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

Dimensioning

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

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

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

1.2.5.2 Fire extinguishing



Note

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

1 Safety

1.2.5.3 Emergency release of the robot arm

1.2.5.3 Emergency release of the robot arm

Description

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

How to release the brakes is detailed in the section:

- [*Manually releasing the brakes on page 81.*](#)

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

Increased injury

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



DANGER

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

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

1.2.5.4 Brake testing

When to test

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

How to test

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

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

1 Safety

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



Note

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

1.2.5.6 Safe use of the jogging device

Three-position enabling device

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

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



Note

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

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

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

Hold-to-run function

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

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

1 Safety

1.2.5.7 Work inside the working range of the robot



WARNING

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

- The operating mode selector on the controller must be in the manual mode position to render the three-position enabling device operational and to block operation from a computer link or remote control panel.
- The maximum speed of the robot is limited to 250 mm/s when the operating mode selector is in the position *Manual mode with reduced speed*. This should be the normal position when entering the working space.
The position *Manual mode with full speed (100%)* may only be used by trained personnel who are aware of the risks that this entails. *Manual mode with full speed (100%)* is not available in USA or Canada.
- Pay attention to the rotating axes of the robot. Keep away from axes to not get entangled with hair or clothing. Also, be aware of any danger that may be caused by rotating tools or other devices mounted on the robot or inside the cell.
- Test the motor brake on each axis, according to the section [Brake testing on page 35](#).
- To prevent anyone else from taking control of the robot, always put a safety lock on the cell door and bring the three-position enabling device with you when entering the working space.



WARNING

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

1.2.5.8 Signal lamp (optional)

Description

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

Function

The lamp is active in MOTORS ON mode.

Further information

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

1 Safety

1.3.1 Safety signals in the manual

1.3 Safety signals and symbols

1.3.1 Safety signals in the manual

Introduction to safety signals

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

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

Danger levels

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

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

Continues on next page

1.3.1 Safety signals in the manual

Continued

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

1 Safety

1.3.2 Safety symbols on product labels

1.3.2 Safety symbols on product labels

Introduction to labels

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

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



Note

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

Types of labels

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

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 42](#).

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

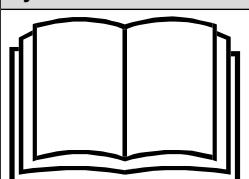
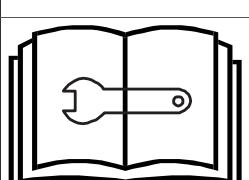
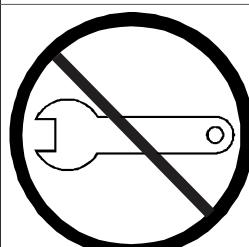
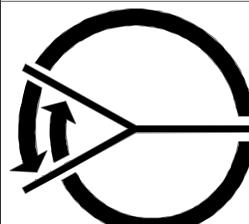
Symbols on safety labels

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

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1.3.2 Safety symbols on product labels

Continued

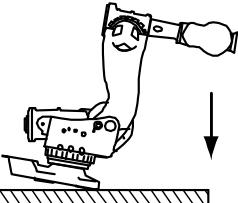
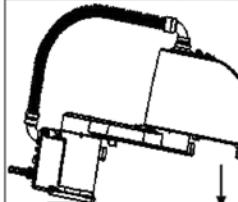
Symbol	Description
 xx0900000813	See user documentation Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none"> • No text: <i>Product manual</i>. • EPS: <i>Application manual - Electronic Position Switches</i>.
 xx0900000816	Before disassemble,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

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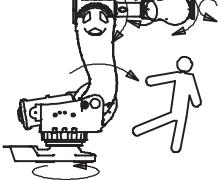
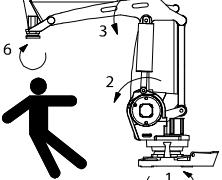
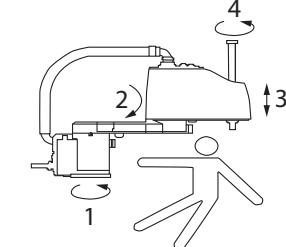
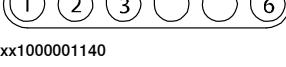
1 Safety

1.3.2 Safety symbols on product labels

Continued

Symbol	Description
 xx0900000810	Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened.
  3HAC 057068-001 xx1500002402	
  xx0900000817	Crush Risk of crush injuries.
 xx0900000818	Heat Risk of heat that can cause burns.

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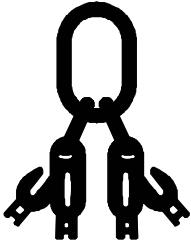
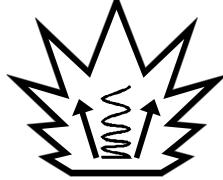
Symbol	Description
 xx0900000819	Moving robot The robot can move unexpectedly.
 xx1000001141	
 xx1500002616	
 xx0900000820	Brake release buttons
 xx1000001140	
 xx0900000821	Lifting bolt

Continues on next page

1 Safety

1.3.2 Safety symbols on product labels

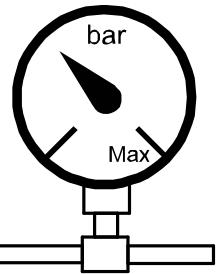
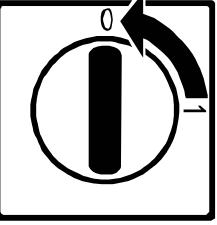
Continued

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

Continues on next page

1.3.2 Safety symbols on product labels

Continued

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

1 Safety

1.4.1 DANGER - Moving robots are potentially lethal!

1.4 Safety related instructions

1.4.1 DANGER - Moving robots are potentially lethal!

Description

Any moving robot is a potentially lethal machine.

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

Elimination

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

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

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

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

Elimination

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

**DANGER**

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

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

Collision risks**CAUTION**

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

Mechanical stops will not always stop the movements of the robot completely.

1 Safety

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

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

Description

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



DANGER

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

Elimination

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

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

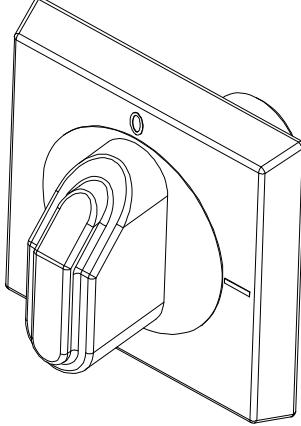
1.4.4 DANGER - Make sure that the main power has been switched off!

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

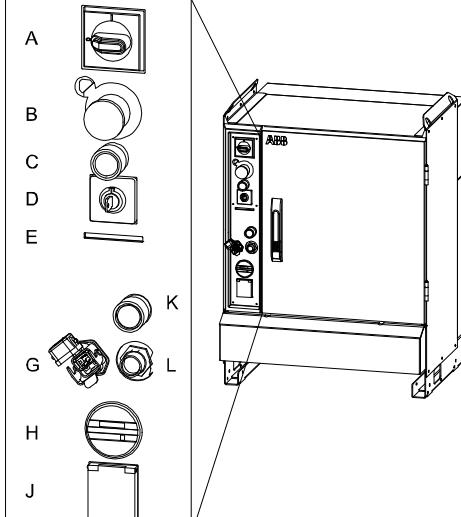
Description

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

Elimination, IRC5 Panel Mounted Controller

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

Elimination, IRC5 Single Cabinet Controller

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

Continues on next page

1 Safety

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

Continued

Elimination, IRC5 Dual Cabinet Controller

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

1.4.5 WARNING - The unit is sensitive to ESD!

1.4.5 WARNING - The unit is sensitive to ESD!**Description**

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

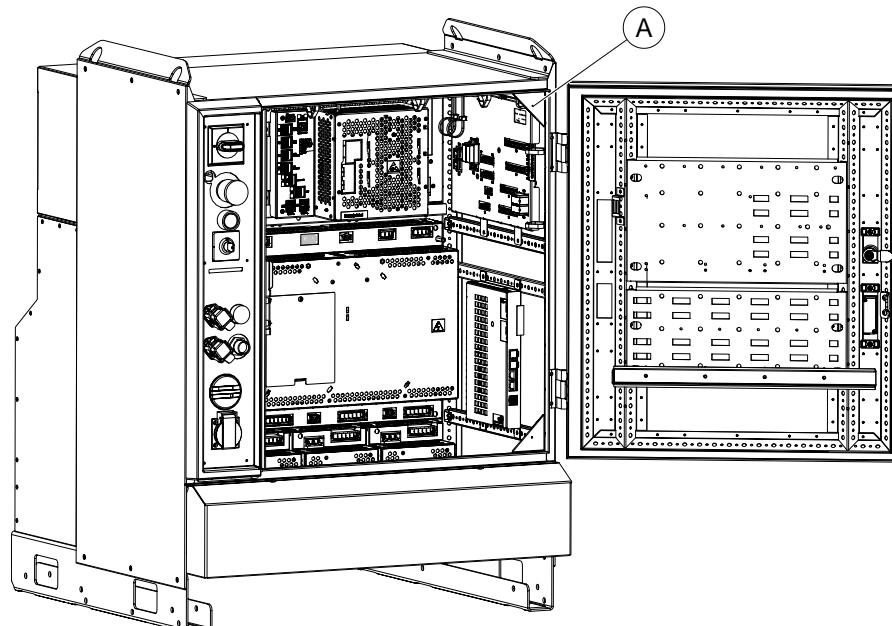
Elimination

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

Location of wrist strap button

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

IRC5



xx1300000856

A	Wrist strap button
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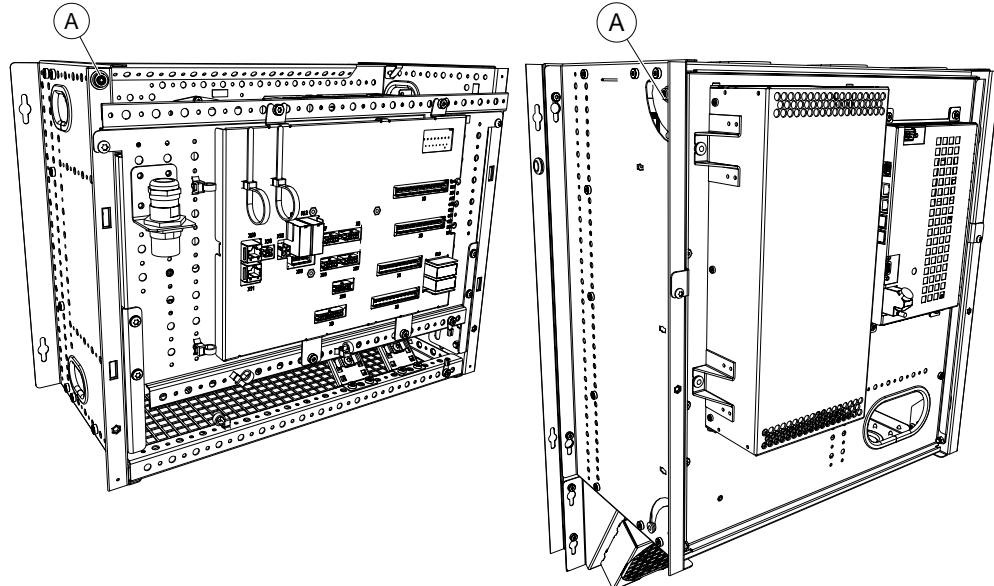
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1 Safety

1.4.5 WARNING - The unit is sensitive to ESD!

Continued

Panel Mounted Controller



xx1300001960

A	Wrist strap button
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1.4.6 WARNING - Safety risks during handling of batteries

Description

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

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



Note

Appropriate disposal regulations must be observed.

Elimination

	Action	Note
1	Do not short circuit, recharge, puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion.	Operating temperatures are listed in Pre-installation procedure on page 64 .
2	Use safety glasses when handling the batteries.	
3	In the event of leakage, wear gloves and chemical apron.	
4	In the event of fire, use self-contained breathing apparatus.	

1 Safety

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

Description

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



Note

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



Note

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



Note

Appropriate disposal regulations must be observed.



Note

Take special care when handling hot lubricants.

Warnings and elimination

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

Continues on next page

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

Continued

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

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2 Installation and commissioning

2.1 Introduction

General

This chapter contains assembly instructions and information for installing the IRB 4600 Foundry Prime at the working site.

More detailed technical data can be found in the *Product specification* for the IRB 4600 Foundry Prime, such as:

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

Safety information

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

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



Note

If the IRB 4600 Foundry Prime is connected to power, always make sure that the robot is connected to *protective earth* before starting any installation work!

For more information see:

- *Product manual - IRC5*

2 Installation and commissioning

2.2 Installation and operational requirements for Foundry Prime robots

Introduction

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

Fluids in the vicinity of the robot

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

Activity to lubricate gearbox cavities and gears

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

Pressurized components

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

At the installation of the Foundry Prime robot a pressure sensor and pressure relief valve (not included) must be installed in the air supply system to monitor the supply of air pressure in order to secure a correct pressure. See [Pressurizing equipment on page 61](#) for equipment specifications.



Note

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



WARNING

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

Continues on next page



WARNING

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



Note

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

Air quality for pressurizing of robot

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

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

Pressurizing equipment

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

Example of products:

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

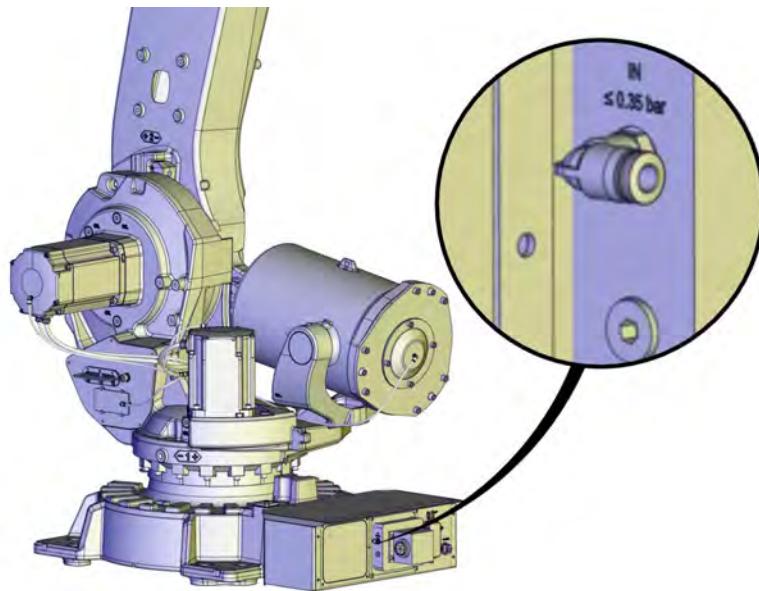
Continues on next page

2 Installation and commissioning

2.2 Installation and operational requirements for Foundry Prime robots

Continued

Connect air hose to over pressure unit



xx1700000565

Precautionary measures



Note

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

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



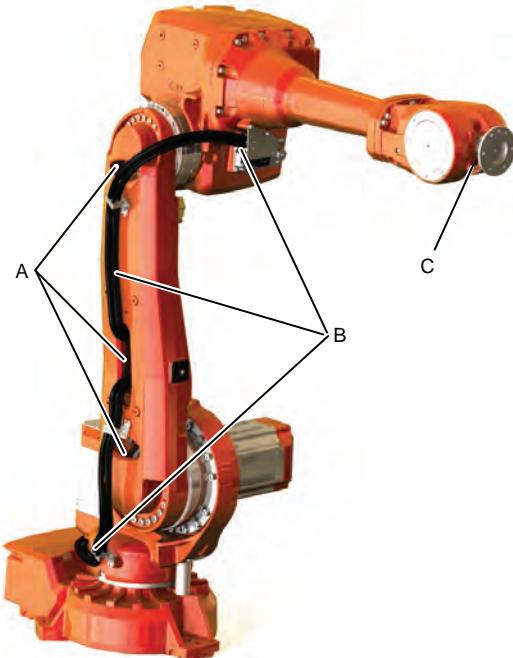
Note

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

Continues on next page

Sensitive points IRB 4600

Illustration shows points that are particularly sensitive to water spray.



xx0800000462

A	Inside lower arm
B	Cable package
C	Wrist

Shut-down periods

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

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

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

2 Installation and commissioning

2.3.1 Pre-installation procedure

2.3 Unpacking

2.3.1 Pre-installation procedure

Introduction

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

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage.  Note Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used is suitable to handle the weight of the robot as specified in: Weight, robot on page 64
6	If the robot is not installed directly, it must be stored as described in: Storage conditions, robot on page 66
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: Operating conditions, robot on page 66
8	Before taking the robot to its installation site, make sure that the site conforms to: <ul style="list-style-type: none">• Loads on foundation, robot on page 65• Protection classes, robot on page 67• Requirements, foundation on page 66
9	Before moving the robot, please observe the stability of the robot: Risk of tipping/stability on page 72
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: On-site installation on page 73
11	Install required equipment, if any. <ul style="list-style-type: none">• Installation of signal lamp (option) on page 96

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 4600 Foundry Prime	440 kg

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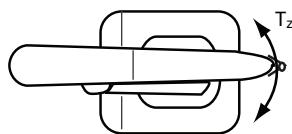
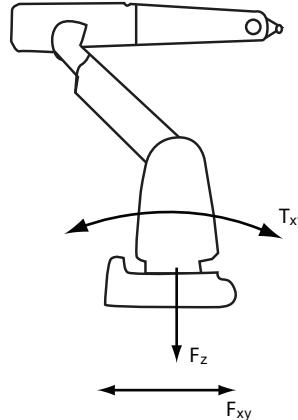
Note

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

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

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



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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!

Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$\pm 3950 \text{ N}$	$\pm 7800 \text{ N}$
Force z	$4350 \pm 1700 \text{ N}$	$4350 \pm 5500 \text{ N}$
Torque xy	$\pm 6350 \text{ Nm}$	$\pm 13000 \text{ Nm}$
Torque z	$\pm 1650 \text{ Nm}$	$\pm 3000 \text{ Nm}$

Continues on next page

2 Installation and commissioning

2.3.1 Pre-installation procedure

Continued

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	$\pm 3950\text{N}$	$\pm 7800\text{ N}$
Force z	$-4350 \pm 1700\text{N}$	$-4350 \pm 5500\text{ N}$
Torque xy	$\pm 6350\text{ Nm}$	$\pm 13000\text{ Nm}$
Torque z	$\pm 1650\text{ Nm}$	$\pm 3000\text{ Nm}$

Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.5 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy.
Maximum tilt	15°	
Minimum resonance frequency	22 Hz	

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	+5°C
Maximum ambient temperature	+45°C
Maximum ambient humidity	100% at constant temperature (gaseous only)

Continues on next page

Protection classes, robot

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

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

2 Installation and commissioning

2.3.2 Surface inspection before start-up - Foundry Prime

2.3.2 Surface inspection before start-up - Foundry Prime

Foundry Prime coating

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

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

Pre-installation procedure/ Operation conditions, robot

Parameter	Value
Minimum ambient temperature	+5 °C
Maximum ambient temperature	+45 °C
Maximum ambient humidity	100% at constant temperature (gaseous only)

Protect attachment bolts and washers at the base

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

2.3.3 Working range and type of motion

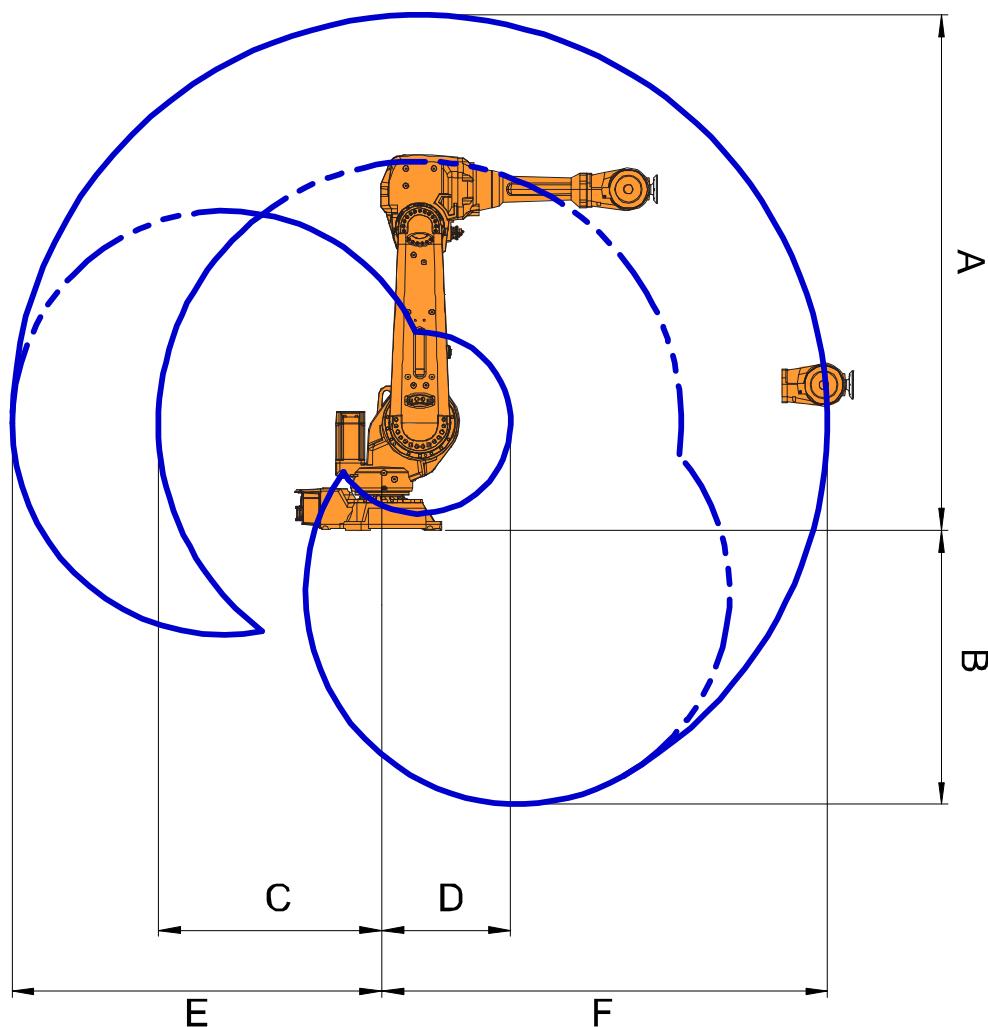
Working range

The figures show the working ranges of the robot variants mounted in different ways.

The extreme positions of the robot arm are specified at the wrist center (dimensions in mm).

Working range, floor mounted

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



xx0800000267

Variant	Pos. A	Pos. B	Pos. C	Pos. D	Pos. E	Pos. F
IRB 4600 - 60/2.05	2371 mm	1260 mm	1028 mm	593 mm	1701 mm	2051 mm

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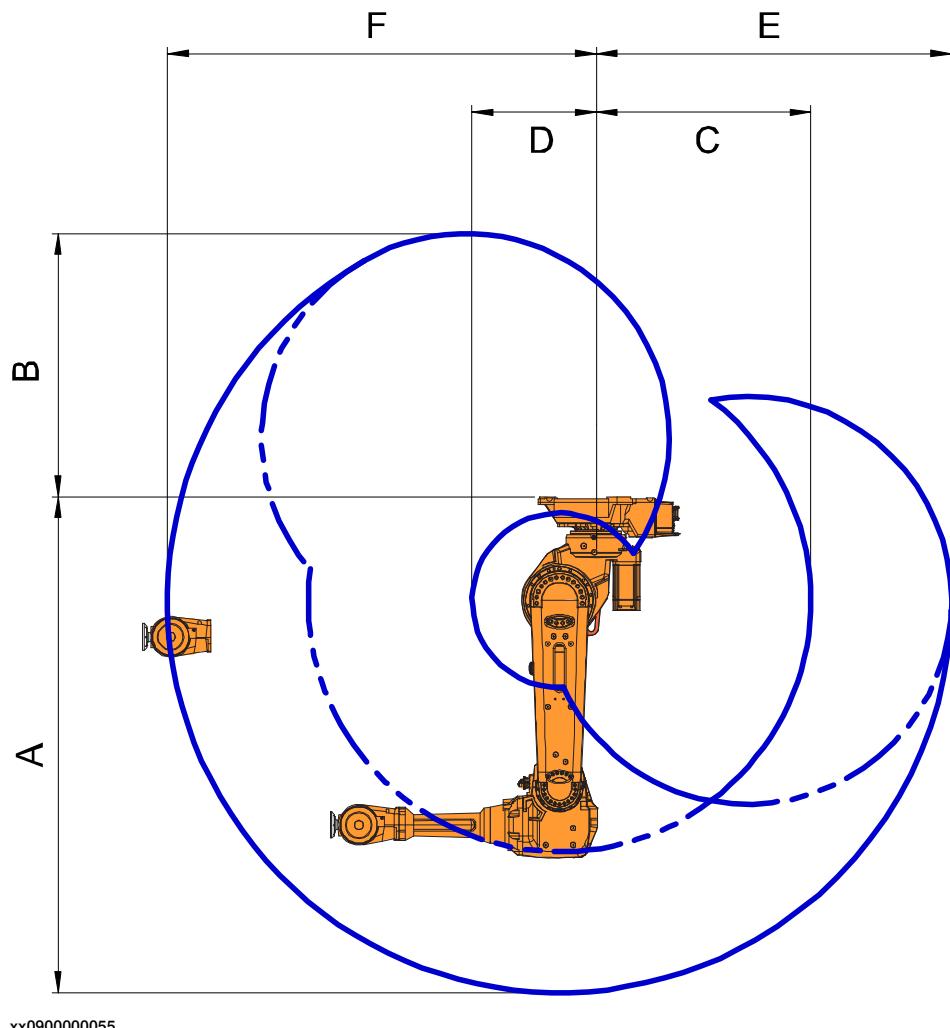
2 Installation and commissioning

2.3.3 Working range and type of motion

Continued

Working range, suspended mounted

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

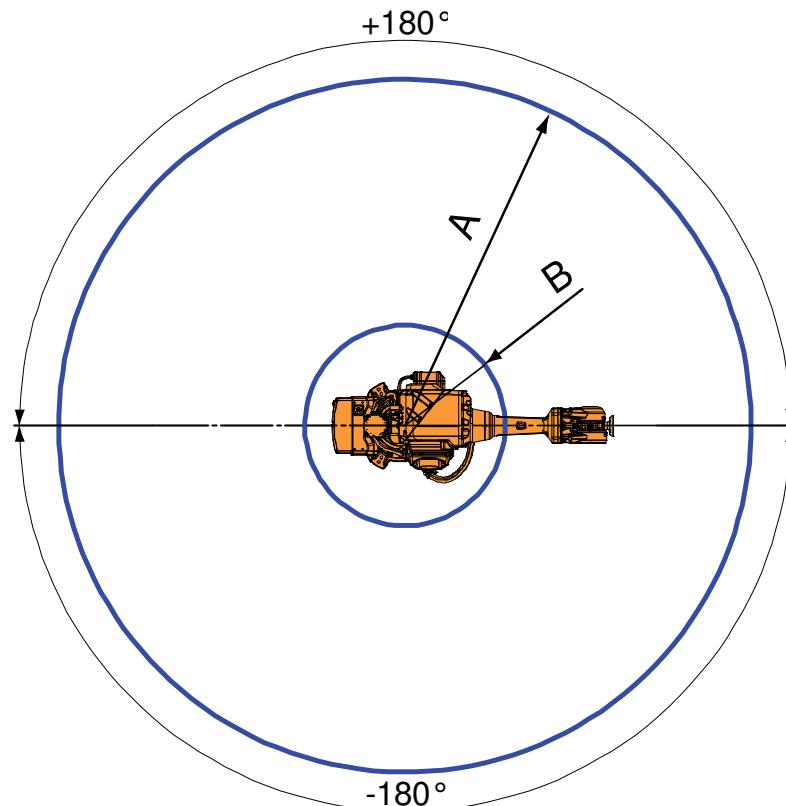


Variant	Pos. A	Pos. B	Pos. C	Pos. D	Pos. E	Pos. F
IRB 4600 - 60/2.05	2371 mm	1260 mm	1028 mm	593 mm	1701 mm	2051 mm

Continues on next page

Turning radius

The turning radius of the robot that is floor or suspended mounted is shown in the figure.



xx0800000268

Variant	Pos. A	Pos. B
IRB 4600 - 60/2.05	R2051	R593

Robot motion, IRB 4600-60/2.05

The table specifies the types and ranges of motion in every axes.

Location of motion	Type of motion	Range of movement
Axis 1	Rotation motion	$\pm 180^\circ$
Axis 2	Arm motion	$+150^\circ / -90^\circ$
Axis 3	Arm motion	$+75^\circ / -180^\circ$
Axis 4	Wrist motion	$\pm 400^\circ$
Axis 5	Bend motion	$+120^\circ / -125^\circ$
Axis 6	Turn motion	$\pm 400^\circ$

2 Installation and commissioning

2.3.4 Risk of tipping/stability

2.3.4 Risk of tipping/stability

Risk of tipping

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

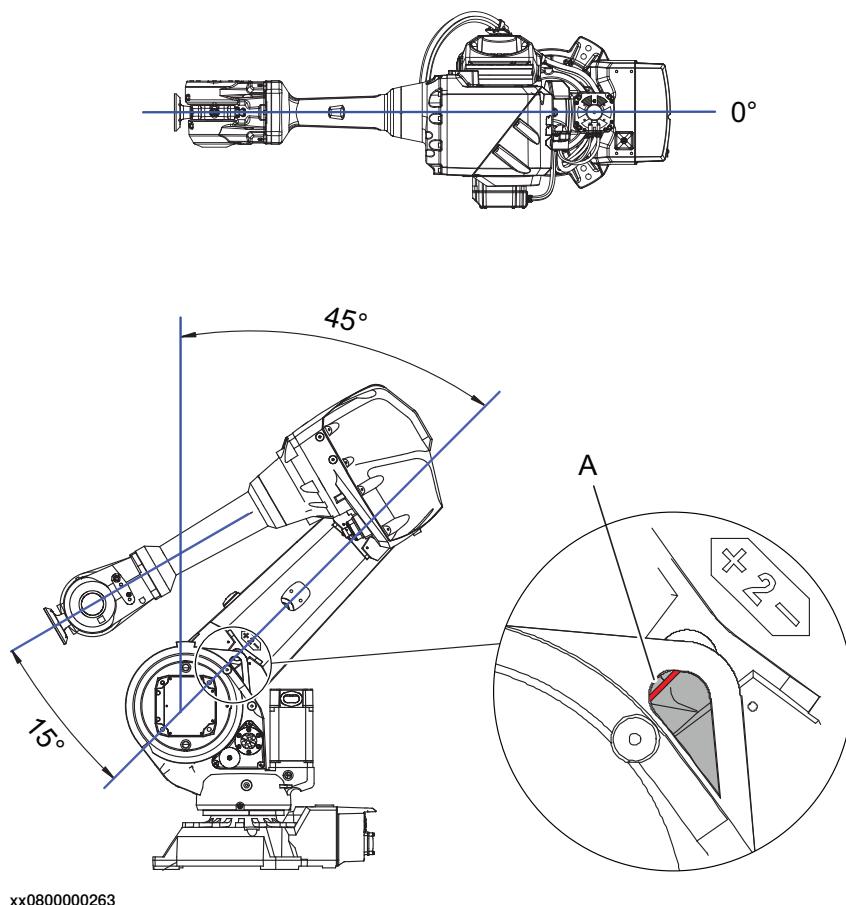
The shipping position is the most stable position.

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

Shipping and transportation position

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

The position of the calibration mark (A) in the figure is approximate and is used as aiming aid.



WARNING

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

2.4 On-site installation

2.4.1 Lifting robot with roundslings

Introduction

When lifting the robot use roundslings and an overhead crane.

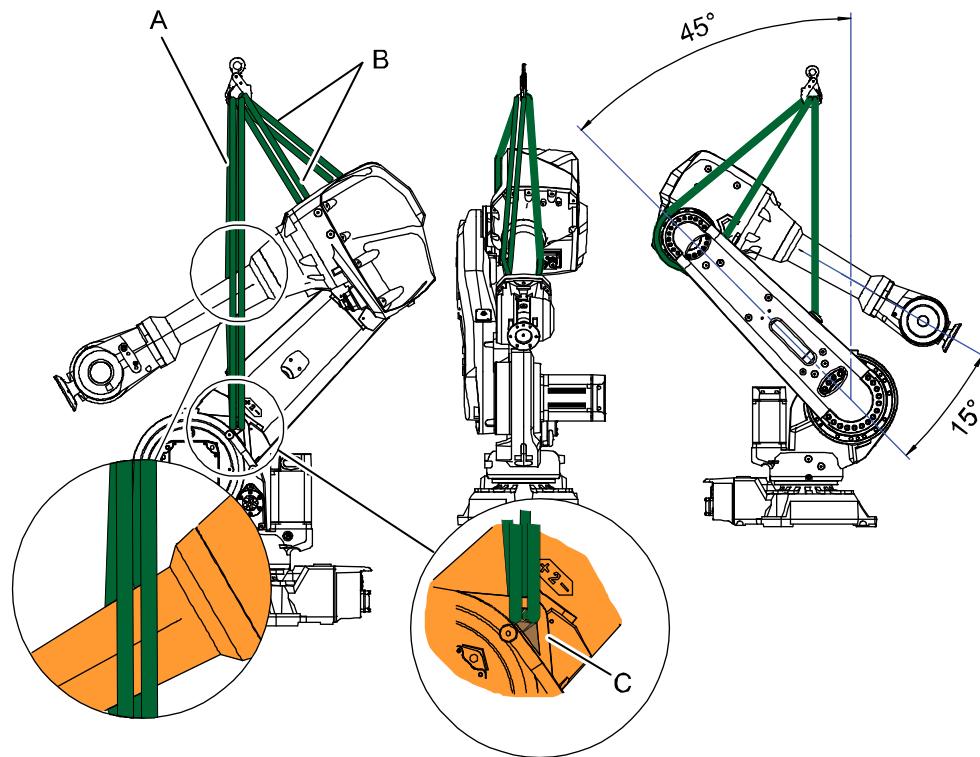
How to lift *suspended mounted robot* is described in the lifting instruction delivered with the turning tool art. no. 3HAC034766-001. See [Lifting and turning a suspended mounted robot on page 76](#).

Required equipment

Equipment	Note
Overhead crane	Lifting capacity 1 000 kg (Max load at 90°)
Roundslings (2 pcs)	<ul style="list-style-type: none"> Lifting capacity/roundslings: 1 000 kg Length: 2 m

Lifting

Attach the roundslings as shown in the figure.



xx0800000262

A	Roundsling put folded in U-shape through the lifting lug
B	Roundsling put folded in U-shape around gearbox axis 3
C	Lifting lug

Continues on next page

2 Installation and commissioning

2.4.1 Lifting robot with roundslings

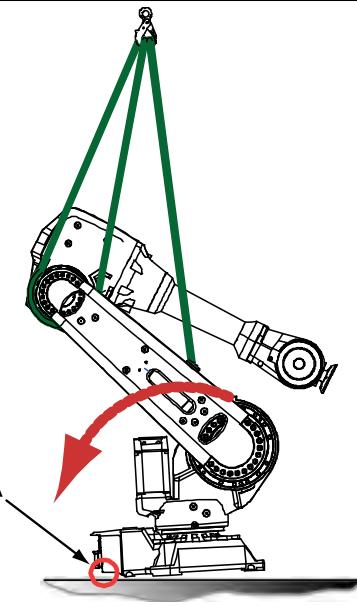
Continued

Lifting instructions

Use this procedure to lift the robot in a safe way.

	Action	Note
1	 CAUTION The IRB 4600 Foundry Prime robot weighs 440 kg. All lifting accessories used must be sized accordingly!	
2	 CAUTION Attempting to lift the robot in any other position than that recommended may result in the robot tipping over and causing severe damage or injury!	
3	 WARNING Personnel must not, under any circumstances, be present under the suspended load!	
4	Move the robot to its most stable position.	Detailed in section: <ul style="list-style-type: none">• Risk of tipping/stability on page 72
5	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
6	Attach <i>roundsling A</i> to the lifting lug on the frame, and put folded in a U-shape on either side of the upper arm.	See the figure in: <ul style="list-style-type: none">• Lifting on page 73
7	Attach <i>roundsling B</i> at axis 3 gearbox by running it folded in a U-shape around the gearbox.	See the figure in: <ul style="list-style-type: none">• Lifting on page 73
8	Make sure the roundslings do not rub against any sharp edges.	

Continues on next page

Action	Note
<p>9 When the robot is lifted the roundslings will adjust themselves.</p> <p>! CAUTION</p> <p>When lifting, the robot will tilt slightly backwards! Be careful not to damage the <i>connection box</i> at the base of the robot!</p>	 <p>xx0800000291</p> <ul style="list-style-type: none"> A: Area where the connection box can be damaged while lifting.
10 Lift the robot with an overhead crane.	<p>Lifting capacity:</p> <ul style="list-style-type: none"> See Required equipment on page 73

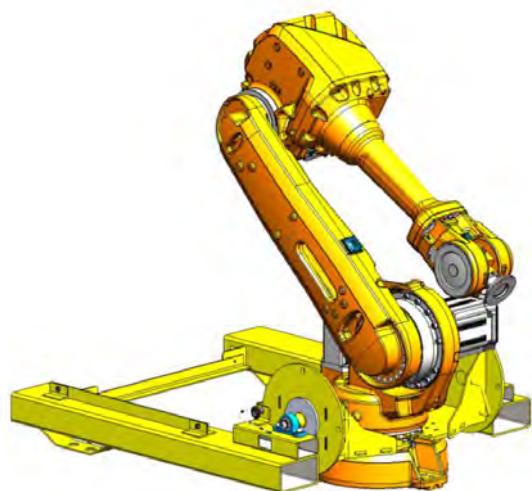
2 Installation and commissioning

2.4.2 Lifting and turning a suspended mounted robot

Introduction

How to lift and turn the robot to a suspended position using the turning accessory is described in the lifting instruction delivered with the turning accessory. Article numbers for the accessory and the instruction is specified in [Special tools on page 392](#). Any additional equipment required is specified in the instruction for the lifting accessory. Contact ABB for more information.

Illustration



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2.4.3 Setting the system parameters for a suspended or tilted robot

General

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



Note

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



Note

The allowed mounting positions are described in the product specification for the robot. The requirements on the foundation are described in [Requirements, foundation on page 66](#).

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 tilted (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).

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

2 Installation and commissioning

2.4.3 Setting the system parameters for a suspended or tilted robot

Continued

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.

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

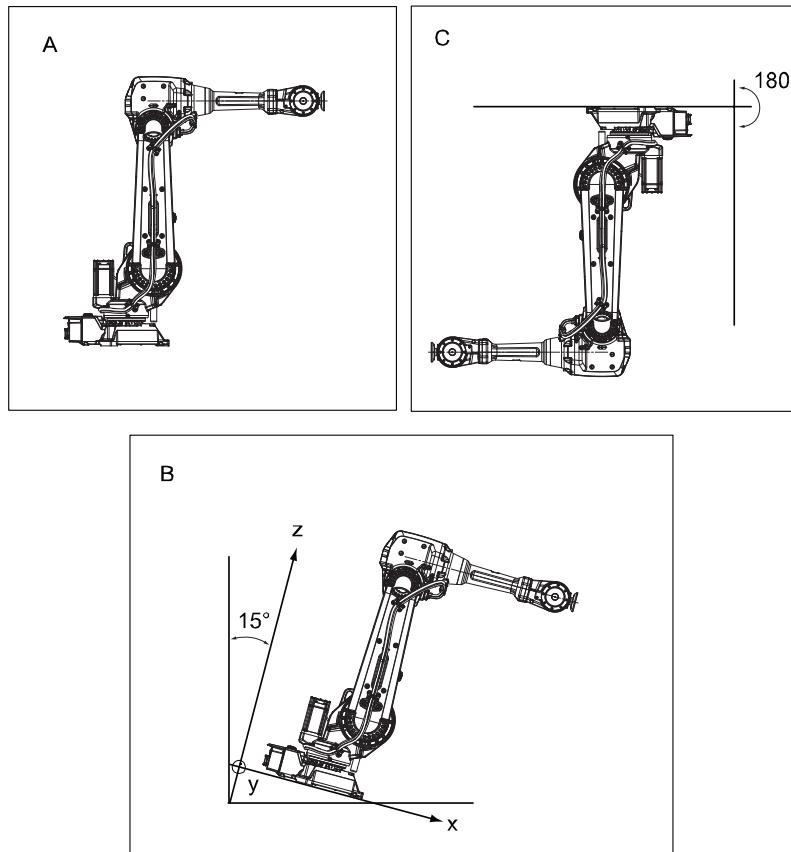
Example of position	Mounting angle (A°)	Gravity Beta
Floor mounted	0°	0.000000 (Default)
Suspended mounting	180°	3.141593

Continues on next page

2.4.3 Setting the system parameters for a suspended or tilted robot

Continued

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



xx1700000267

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

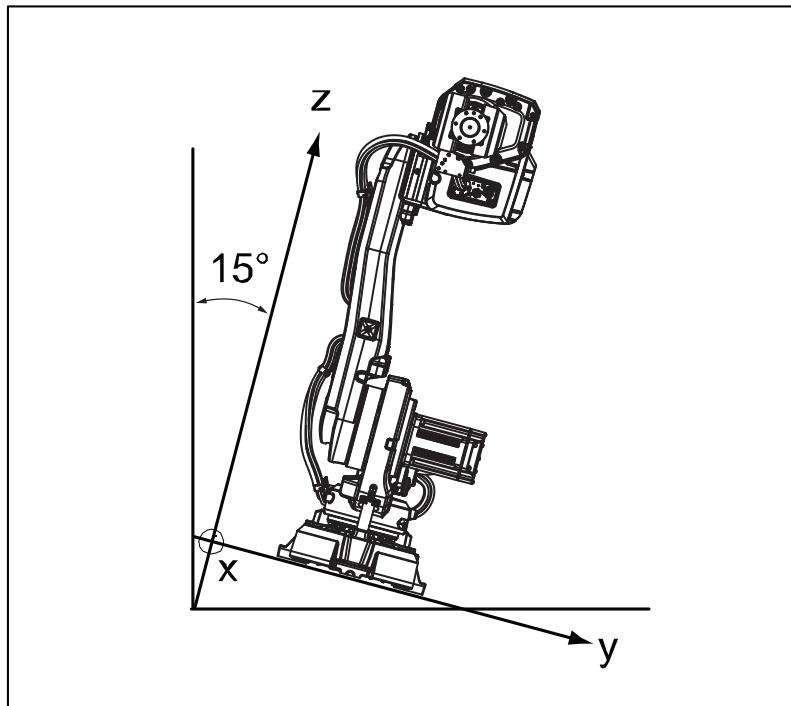
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2 Installation and commissioning

2.4.3 Setting the system parameters for a suspended or tilted robot

Continued

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



xx1700000268

-	Tilted mounting, mounting angle 15°.
Note	For suspended robots (180°), it is recommended to use <i>Gravity Beta</i> instead of <i>Gravity Alpha</i> .

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 78](#).

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

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

2.4.4 Manually releasing the brakes

General

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

This can be done in one of three ways:

- using the push-button when the robot is connected to the controller.
- using the push-button on the robot with an external power supply.
- using an external voltage supply directly on the respective brake.



DANGER

When releasing the holding brakes with push-buttons, the robot must be properly attached!



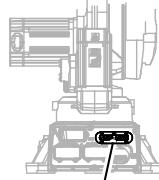
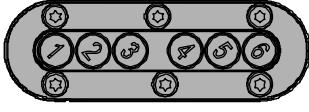
DANGER

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

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

Using the push-button when the robot is connected to the controller

This procedure details how to release the holding brakes with push-buttons, when the robot is connected to the controller.

	Action	Note
1	The internal brake release unit is located at the base of the robot.	  xx0800000272
2	The brake release unit is equipped with six buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes.	
3	Release the holding brake on a particular axis by pressing the corresponding button on the push-button unit and keeping it depressed.	
4	The brake will function again as soon as the button is released.	

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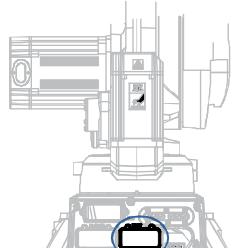
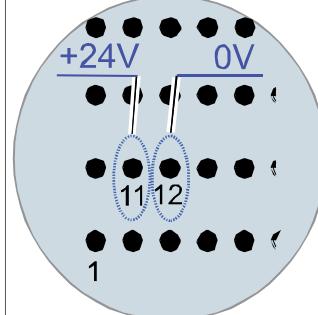
2 Installation and commissioning

2.4.4 Manually releasing the brakes

Continued

Using the push-button on the robot with an external power supply

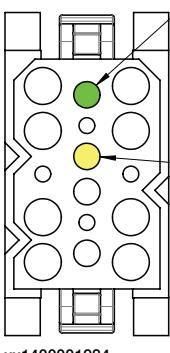
This procedure details how to release the holding brakes with the push-buttons, when the robot is not connected to the controller.

Action	Note
1 Connect an external 24VDC power supply to the connector R1.MP on the robot base.  Note Be careful not to interchange the 24V and 0V pins! If they are mixed up, damage can be caused to the brake release unit and the system board!  WARNING Incorrect connections can cause all brakes to be released simultaneously!	  xx0800000269 Connect to connector R1.MP: <ul style="list-style-type: none">• 0V to pin 12• +24V to pin 11 The brake release unit is equipped with six buttons for controlling the axes brakes. The buttons are numbered according to the numbers of the axes. See the previous figure.
2 Release the holding brake on a particular axis by pressing the corresponding button on the push-button unit and keeping it depressed.	
3 The brake will function again as soon as the button is released.	

Continues on next page

Using an external voltage supply directly on the respective brake

This procedure details how to release the holding brake of a specific axis by supplying external voltage directly on the brake.

	Action	Note
1	<p>Every axis has a holding brake built into the axis motor. This holding brake may be released by connecting 24VDC power supply directly to one of the connectors in the motor.</p> <p>DANGER</p> <p>When power is connected directly to the brake cable, the brake will be released immediately when the power is switched on. This may cause some unexpected robot movements!</p>	<p>Make the connection to the current motor according to the Circuit Diagram. See chapter Circuit diagram on page 399.</p>
2	<p>Connect an external 24 VDC power supply to the motor, according to the figures.</p> <p>Note</p> <p>Be careful not to interchange the 24V and 0V pins! If they are mixed up, damage can be caused to the integrated quenching circuits.</p> <p>WARNING</p> <p>Incorrect connections can cause all brakes to be released simultaneously!</p>	<p>Axes 1, 2 and 3: Pos 2: +24 V Pos 5: 0 V</p>  <p>xx1400001984</p>

2 Installation and commissioning

2.4.5 Orienting and securing the robot

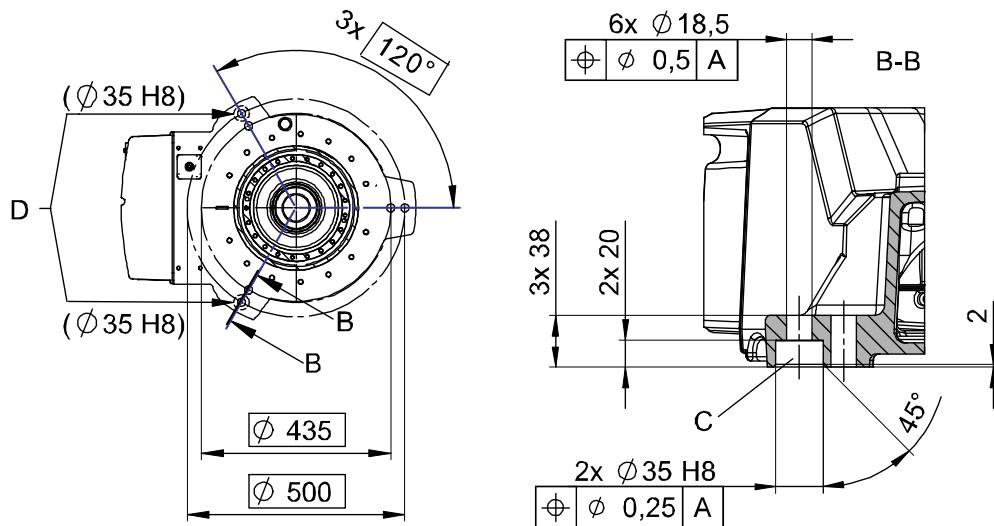
2.4.5 Orienting and securing the robot

Introduction

This section describes how to orient and secure the robot to the foundation or base plate in order to run the robot safely. The requirements made on the foundation are shown in sections [Loads on foundation, robot on page 65](#) and [Requirements, foundation on page 66](#).

Hole configuration, base

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



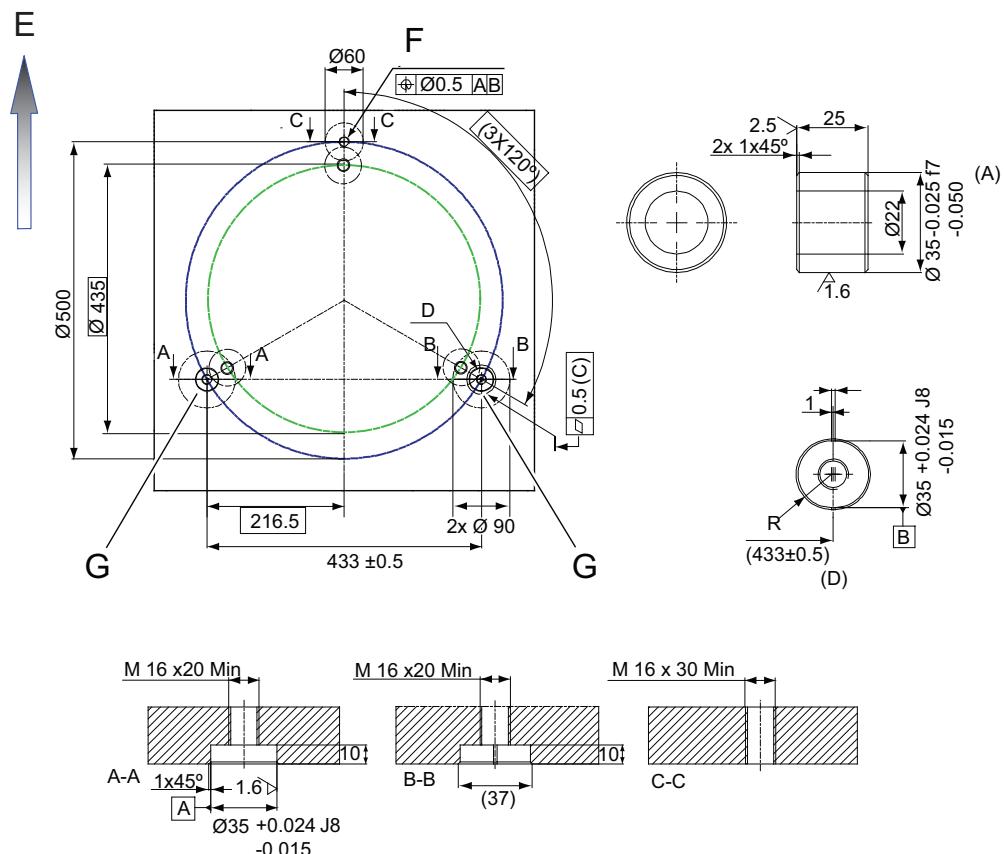
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C	Hole for guide bushing
D	Rear bolt holes

Continues on next page

Dimension, mounting surface and guide bushing

The figure shows the dimension of the mounting surface and guide bushings.



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(C)	3x common zone
E	Position of the front of the robot
F	4xM16, depth 30 minimum
G	Guide bushings (2 pcs)

Specification, attachment screws

The table specifies the type of securing screws and washers to be used to secure the robot to the foundation or base plate.

Securing parts/Facts	Dimension	Note
Securing screws, oiled	M16 x 60 (installation directly on foundation) M16 x 70/80 (installation on foundation or base plate, using guide bushings) Quality 8.8	6 pcs 200 Nm
Washers	17 x 30 x 3	6 pcs

Continues on next page

2 Installation and commissioning

2.4.5 Orienting and securing the robot

Continued

Securing parts/Facts	Dimension	Note
Guide bushings		<p>Article number: 21510024-169, 2 pcs. Added to the rear bolt holes, to allow the same robot to be re-mounted without program adjustments.</p>  <p>xx1200000885</p>
Level surface requirements	 xx0300000251	

Orienting and securing the robot

Use this procedure to orient and secure the robot.

Action	Note
1 Make sure the installation site for the robot conforms to the specifications in section Pre-installation procedure on page 64 .	
2 Prepare the installation site with attachment holes.	Hole configuration of the base is shown in the figure in: <ul style="list-style-type: none">• Hole configuration, base on page 84
3  CAUTION The IRB 4600 Foundry Prime robot weighs 440 kg. All lifting accessories used must be sized accordingly!	
4  CAUTION When the robot is put down after being lifted or transported, there is a risk of it tipping, if not properly secured.	
5 Lift the robot to its installation site.	How to lift the robot is described in section: <ul style="list-style-type: none">• Lifting robot with roundslings on page 73
6 Fit two <i>guide bushings</i> to the <i>rear bolts</i> in the base.	
7 Guide the robot gently, using the attachment screws while lowering it into its mounting position.	Make sure the robot base is correctly fitted onto the guide sleeves.

Continues on next page

	Action	Note
8	Fit the <i>securing screws and washers</i> in the attachment holes of the base.	
9	Tighten the bolts in a criss-cross pattern to ensure that the base is not distorted.	

Securing robot on a mounting plate

When bolting a mounting plate or frame to a concrete floor, follow the general instructions for expansion-shell bolts.

Screw joints must be able to withstand the stress loads defined in section [Loads on foundation, robot on page 65](#).

2 Installation and commissioning

2.4.6 Fitting equipment on robot

2.4.6 Fitting equipment on robot

Introduction

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.

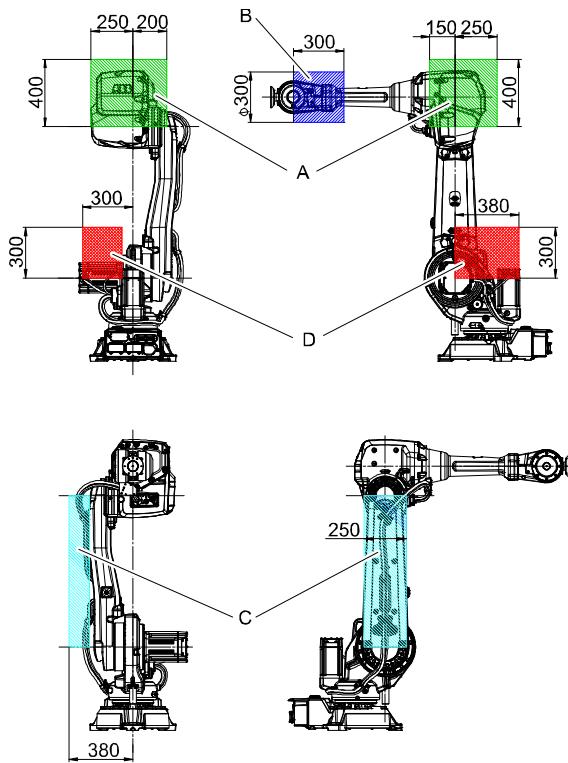


Note

Never drill a hole in the robot without first consulting ABB!

Fitting equipment on robot - Load areas

The shaded area indicates the permitted positions (center of gravity) for any extra equipment fitted in the holes intended for this purpose.



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Variant	Max load A	Max load B	Max load C	Max load A+C	Max load D
IRB 4600-60/2.05	15 kg	5 kg ⁱ	15 kg	15 kg	35 kg

ⁱ Payload + B = Max 60 kg

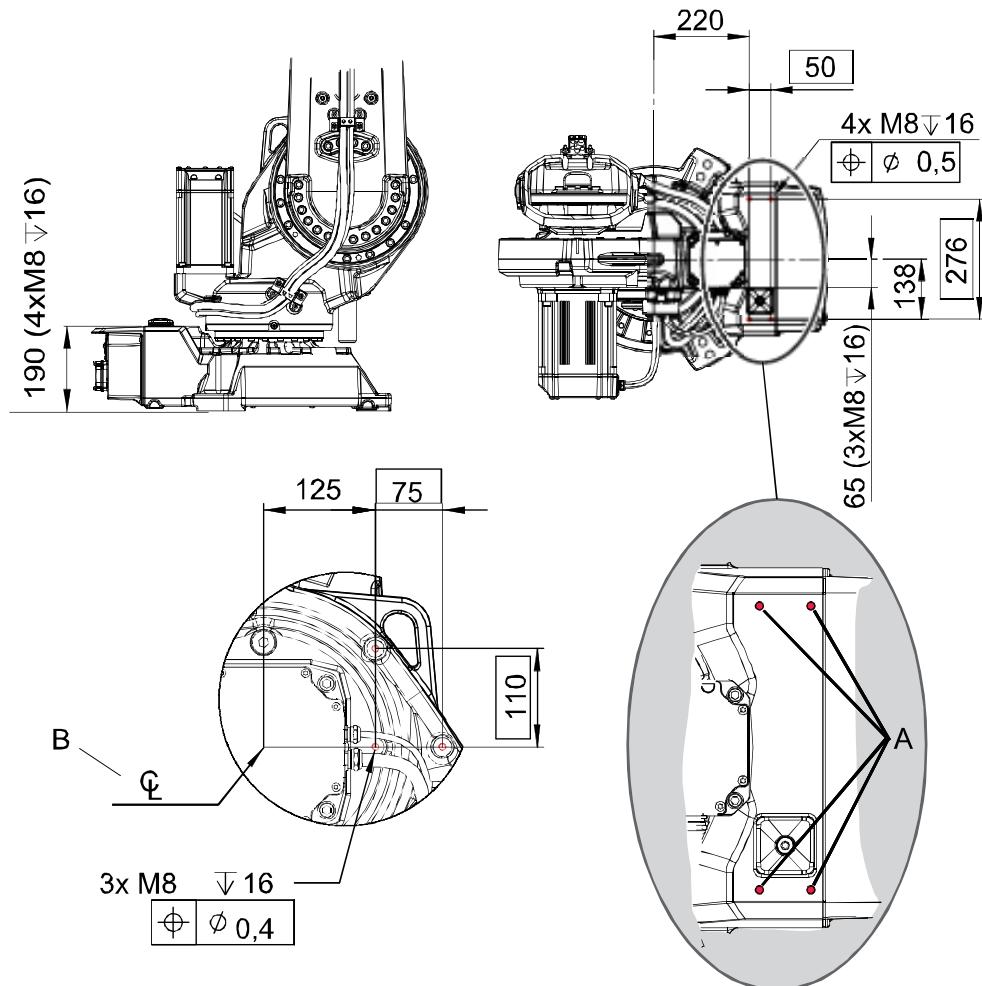
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**Note**

Maximum loads must never be exceeded!

Fitting equipment on base and frame

The illustrations show the fitting holes available for fitting extra equipment on the base and frame of the robot.



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A	Attachment holes on base
B	Center axis 2

Continues on next page

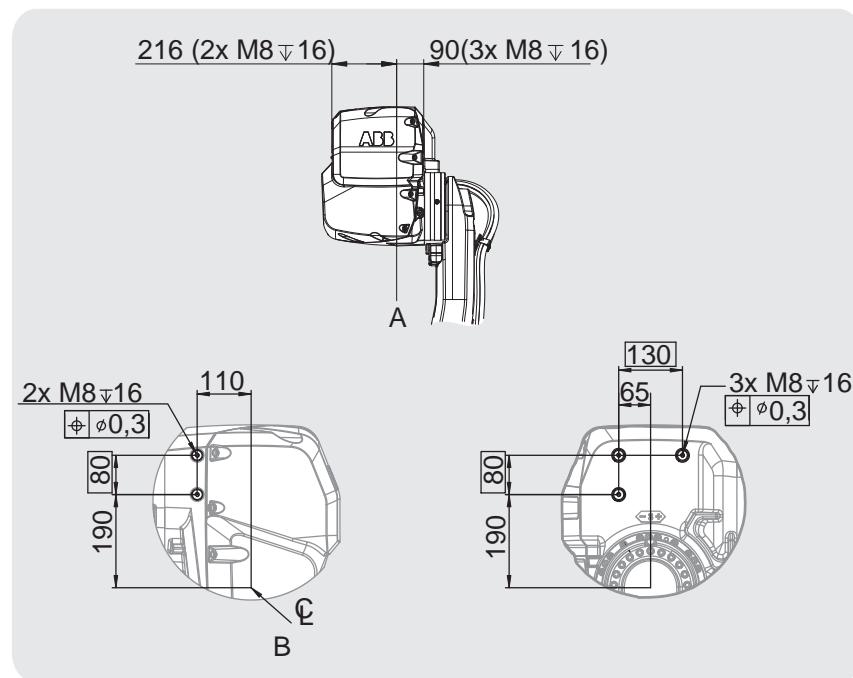
2 Installation and commissioning

2.4.6 Fitting equipment on robot

Continued

Fitting equipment on lower and upper arm

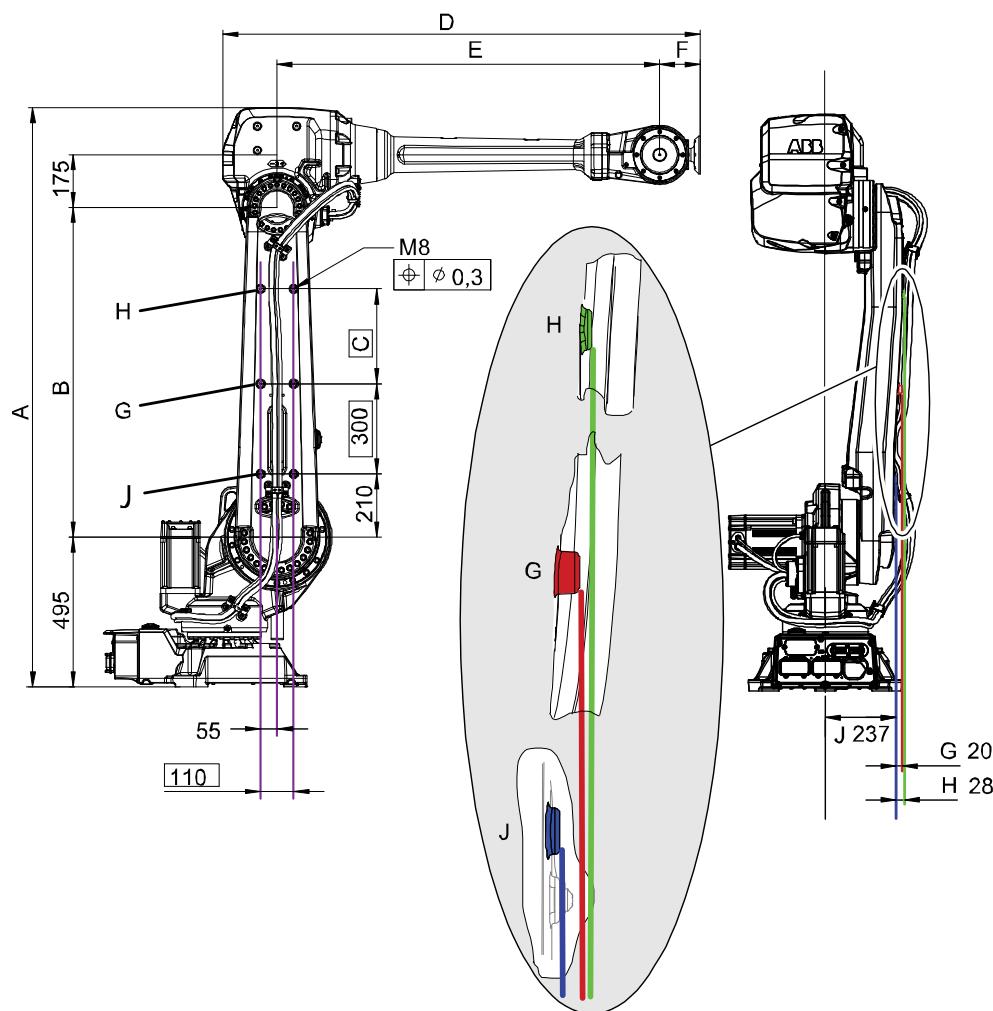
The illustrations show the fitting holes available for fitting extra equipment on the lower and upper arm of the robot.



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A	Center axis 4
B	Center axis 3

Continues on next page



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Variant	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)
60/2.05	1727	900	See note i	1276	960	135	20	See note i	237

i Position H and measurement C is only applicable to IRB 4600 - 40/2.55 and IRB 4600 - 20/2.50.
Position H and measurement C is only applicable to IRB 4600 - 40/2.55 and IRB 4600 - 20/2.50.

Variant	Attachment screws
60/2.05	4x M8, through



Note

On delivery, all of the extra fitting holes are covered with coated set screws.
Remove these to fit extra equipment. Seal with Mercasol.



Note

If extra equipment is removed, cover up equipment holes with coated set screws.
Seal with Mercasol.

Continues on next page

2 Installation and commissioning

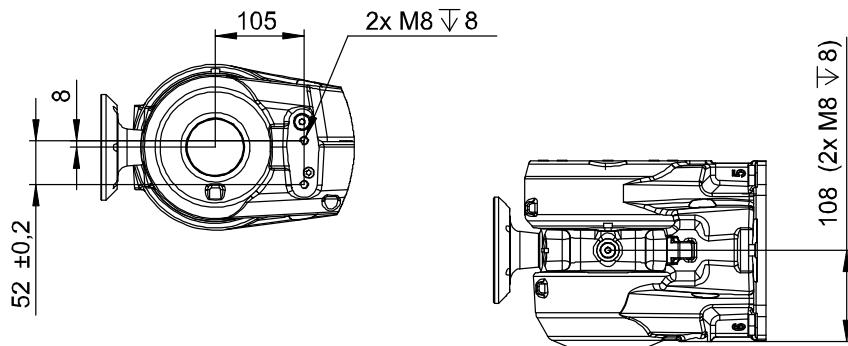
2.4.6 Fitting equipment on robot

Continued

Fitting equipment on wrist and mounting flange

Extra equipment on wrist, robot versions IRB 4600 -60/2.05

The illustration shows the fitting holes available for fitting extra equipment on the wrist of the robot.

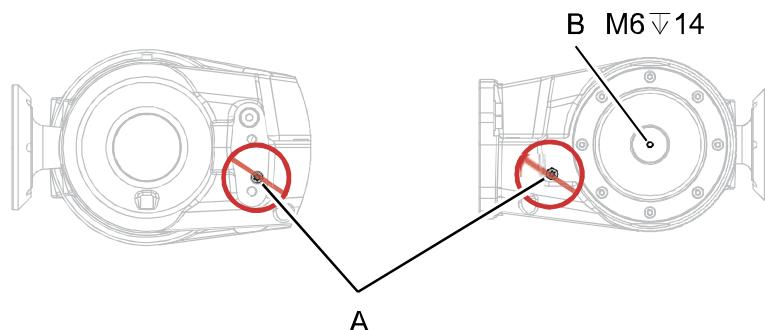


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Note

Do not remove screws indicated in the illustration below!



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A	Screws not to be removed! Do not use these holes for fitting equipment on the wrist!
B	Screw hole intended for swivel fitting.

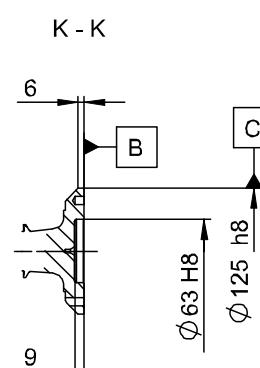
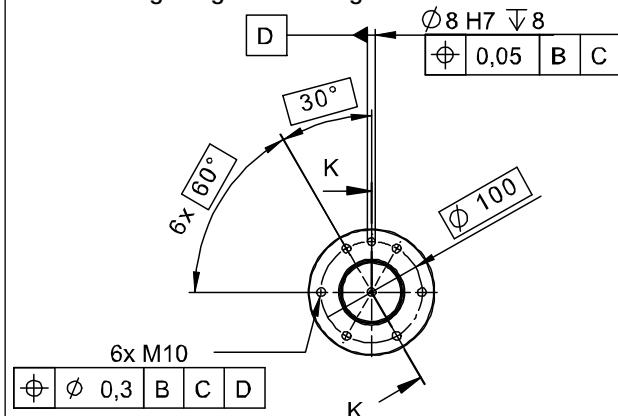
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Extra equipment on mounting flange, robot versions IRB 4600 -60/2.05

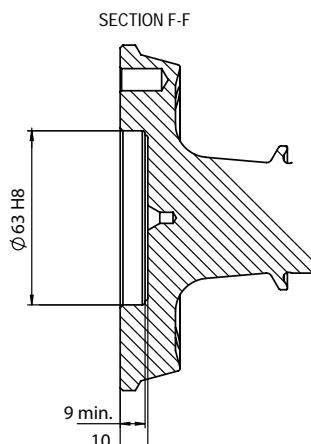
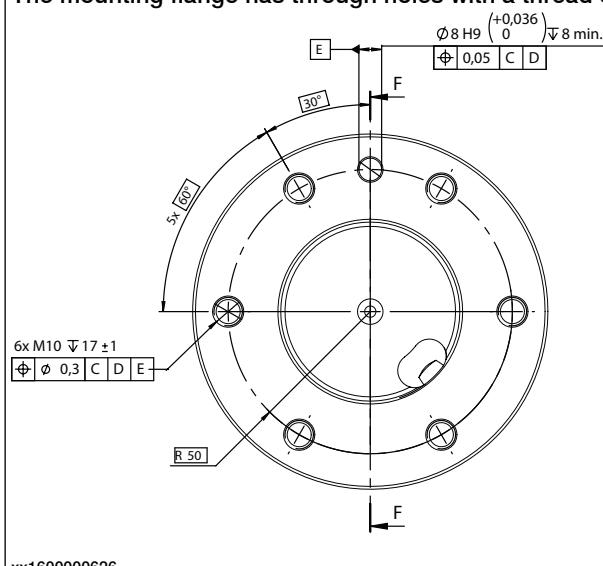
The illustration shows the mechanical interface for the mounting flange.

There are two versions of the mounting flange, differences are shown in the figures.

The mounting flange has through holes with a thread all the way through.



The mounting flange has through holes with a thread only part way through the hole.



Note

Use attachment screws M10, quality 12.9 and 15 mm *used* thread length.

2 Installation and commissioning

2.4.7 Surface inspection before start-up - Foundry Prime

2.4.7 Surface inspection before start-up - Foundry Prime

Foundry Prime coating

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

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

Pre-installation procedure/ Operation conditions, robot

Parameter	Value
Minimum ambient temperature	+5 °C
Maximum ambient temperature	+45 °C
Maximum ambient humidity	100% at constant temperature (gaseous only)

Protect attachment bolts and washers at the base

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

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

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

General

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



CAUTION

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

References

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

- *Operating manual - IRC5 with FlexPendant*

Stopping time and braking distances

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

2 Installation and commissioning

2.4.9 Installation of signal lamp (option)

Signal lamp

See the assembly instruction delivered with the signal lamp.

2.5 Restricting the working range

2.5.1 Axes with restricted working range

General

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

The working range of the following axes may be restricted:

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

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



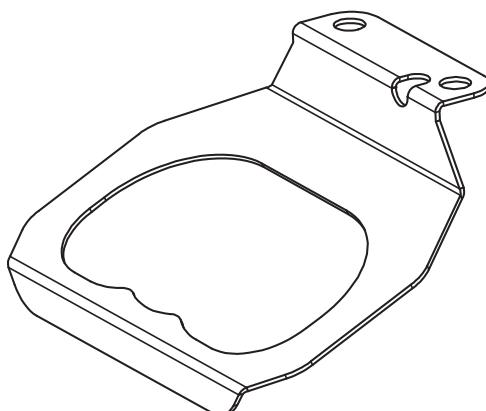
Note

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



WARNING

Remove the mechanical stop bracket if the robots full working range is from a mechanical stop to another mechanical stop. Otherwise the mechanical stop pin will be worn out.



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2 Installation and commissioning

2.5.2 Mechanically restricting the working range of axis 1

Mechanically restricting the working range

The information in this section is valid both for the floor and the suspended mounted robot.

The working range of axis 1 is limited by fixed mechanical stops. The working range can be reduced further by adding movable mechanical stops.

The mechanical turning range can be limited between $\pm 129^\circ$ to $\pm 16.5^\circ$ in steps of 22.5° from synchronization position.



Note

The software working range limitations must be adjusted to correspond to the changes in the mechanical limitations of the working range. The system parameters that must be changed (*Upper joint bound* and *Lower joint bound*) are described in *Technical reference manual - System parameters*.

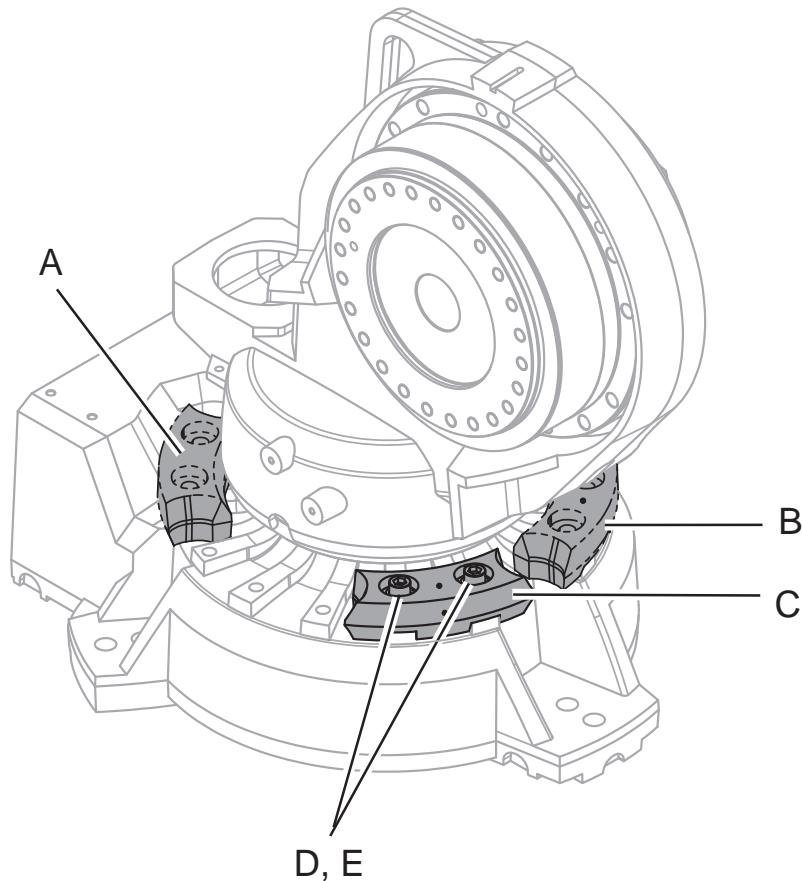
Required equipment

Equipment, etc.	Art. no.	Note
Mechanical stop, axis 1	See Spare part lists on page 397 .	Includes two additional stop lugs, attachment screws, washers and instruction
Attachment screw	See Spare part lists on page 397 .	2 pcs/stop lug Hex socket head cap screw M12x40, quality 8.8-A3F
Washer	See Spare part lists on page 397 .	2 pcs/lug 13x24x2.5
Standard toolkit		Content is defined in section Standard tools on page 391 .
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

Additional stops

The additional stops are fitted as shown in the figure.



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A	Movable mechanical stop. Limited to -129°
B	Movable mechanical stop. Limited to +16.5°
C	Movable mechanical stop. Limited to -16.5°
D	Attachment screws
E	Washers

Fitting, mechanical stop axis 1

How to fit the additional mechanical stop to the base is described in the procedure.

Mounting instructions are also supplied with the kit.

	Action	Note
1	Determine the position of the stop lugs.	See the figure Additional stops on page 99 for guidance.
2	Fit the stop lugs firmly with attachment screws and washers according to the figure Additional stops on page 99 .	Specified in Required equipment on page 98 . Tightening torque: 82 Nm

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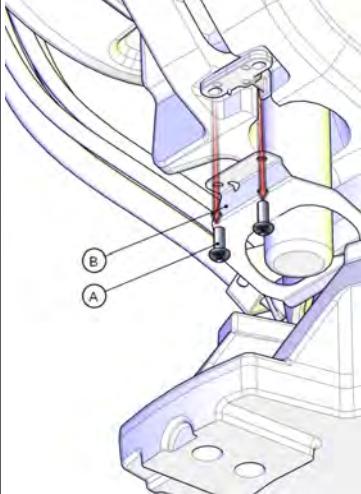
2 Installation and commissioning

2.5.2 Mechanically restricting the working range of axis 1

Continued

Preparing the robot for working range $\pm 180^\circ$

This procedure describes how to prepare the robot for working range $\pm 180^\circ$.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2 Remove the two screws holding the mechanical stop and the bracket.	 xx110000091 A Attachment screw B Bracket, stop axis 1
3 Remove the bracket.	
4 Refit the attachment screws.	
5 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

2.6 Installing options

2.6.1 Installing an expansion container



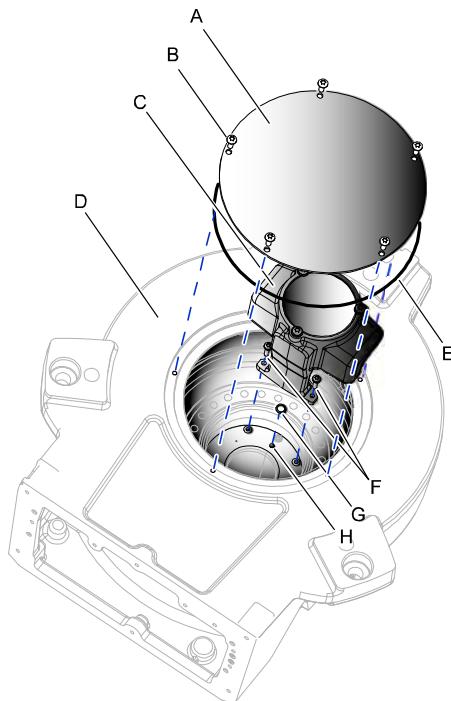
Note

This section is not applicable to type C. Expansion container is not needed on this type.

Introduction to the expansion container

The expansion container is needed on suspended robots to make sure that the amount of oil in gearbox axis 1 covers all important parts. Robots ordered as suspended robots have the expansion container installed on delivery.

Expansion container



xx1000000318

A	Cover
B	Attachment screw M6x16, quality 8.8-A2F (5 pcs)
C	Oil expansion container with cover
D	Base
E	O-ring D220x5
F	Attachment screw M5x20, quality 8.8-A2F and washer (2+2 pcs)
G	O-ring D1=9.5 D2=1.6
H	Oil plug (to be removed)

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2 Installation and commissioning

2.6.1 Installing an expansion container

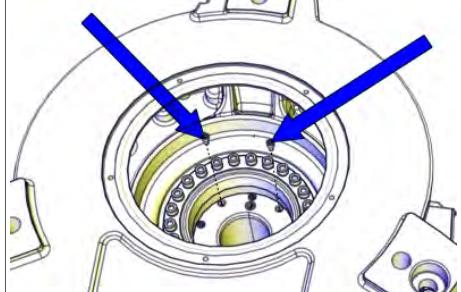
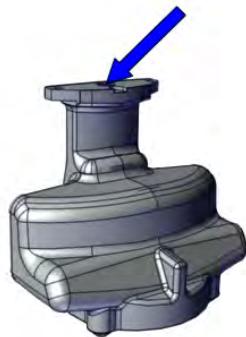
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Required equipment

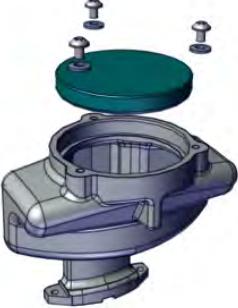
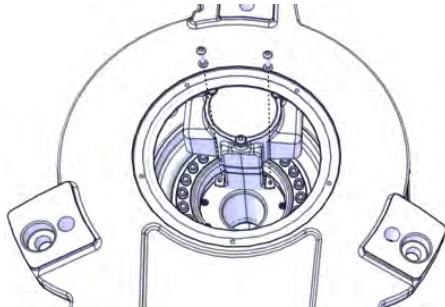
Equipment	Note
Expansion container	Kit including oil.
Lifting accessory	3HAC034766-001
Lifting instruction	Included with the lifting accessory.
Grease	-
O-ring for base cover	Replace if damaged.

Installing an expansion container

Use this procedure to install the expansion container.

Action	Information
1 Lift the robot using the lifting accessory and place it in suspended position with the base free for installation work.	See <i>Lifting and turning a suspended mounted robot on page 76</i> .
2 Remove the cover and the o-ring from the base.	
3 Remove the two existing attachment screws.	 xx1500001958 The screws must be replaced with longer screws.
4 Remove the oil plug from the base.	
5 Apply some grease on the small o-ring and place it in the recess on the expansion container.	
6 Fit a plastic plug in the oil drain hole.	 xx1500001956

Continues on next page

Action	Information
7 Fill oil in expansion container, and press down the <i>VK-cover</i> . Secure with three screws and washers.	 xx1500001957
8 Place the <i>expansion container</i> in the base and place it so the drain holes match.	
9 Secure the expansion container with the <i>attachment screws</i> and <i>washers</i> .	 xx1500001959 Tightening torque 6 Nm.
10 Check the <i>o-ring</i> used on the cover. Replace it if damaged.	
11 Refit the <i>cover</i> on the base with its <i>attachment screws</i> .	
12 Turn the robot so it is not suspended.	
13 Turn the robot to suspended position.	
14 Inspect the oil level.	See procedure for suspended robot, Inspecting oil level, axis 1 gearbox on page 123 .

2 Installation and commissioning

2.7.1 Start of robot in hot environments

2.7 Robot in hot environments

2.7.1 Start of robot in hot environments

Introduction

This procedure describes how to start the robot in a hot environment. This procedure must be performed the first time the robot is started in a hot environment or if it has not been used for some time in a hot environment.

There is a possibility that some overpressure has been built up in the system. This overpressure must be released before starting up the robot.

Releasing overpressure in gearboxes

Use this procedure before the start of the robot in a hot environment to release potential overpressure being built up in gearboxes.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	 CAUTION Before approaching the potentially hot robot component, observe the safety information in section CAUTION - Hot parts may cause burns! on page 25 .	
3	 Note Before opening the oil plug, make certain that the oil plug is above the oil level. Place the robot accordingly.	
4	 Note Open the oil plug filling <i>very carefully!</i> Open the oil plug just enough for the overpressure to be released.	 Tip Hold a cloth or some paper over the oil plug while opening it to prevent surplus oil causing burns or other injuries.
5	Let the overpressure leave the gearbox.	
6	Refit the oil plug.	
7	Continue releasing the overpressure on all gearboxes.	

2.8 Robot in cold environments

2.8.1 Start of robot in cold environments

Introduction

This procedure describes how to start the robot in a cold environment.

Starting in cold environment

Use this procedure to start the robot in a cold environment if it is not starting the normal way:

	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.	

If still not starting...

If the robot is still not starting after turning off motion supervision, use this procedure:

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

Adjusting the speed

Depending on how cold the environment is and the program being used, the ramping up of speed has to be adjusted. The table shows examples of how to adjust the speed:

Work cycles	AccSet	Speed/velocity
3 Work cycles	20.20	100
5 Work cycles	40.40	400
5 Work cycles	60.60	600
5 Work cycles	100.100	1000
More than 5 Work cycles	100.100	Max.

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

2 Installation and commissioning

2.9.1 Robot cabling and connection points

2.9 Electrical connections

2.9.1 Robot cabling and connection points

Introduction

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

Main cable categories

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

Cable category	Description
Robot cables	Handles power supply to and control of the robot's motors as well as feedback from the serial measurement board. Specified in the table Robot cables on page 106 .
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 <i>Application manual - Additional axes and stand alone controller (M2004)</i> , see document number in References on page 10 .

Robot cables

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

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

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

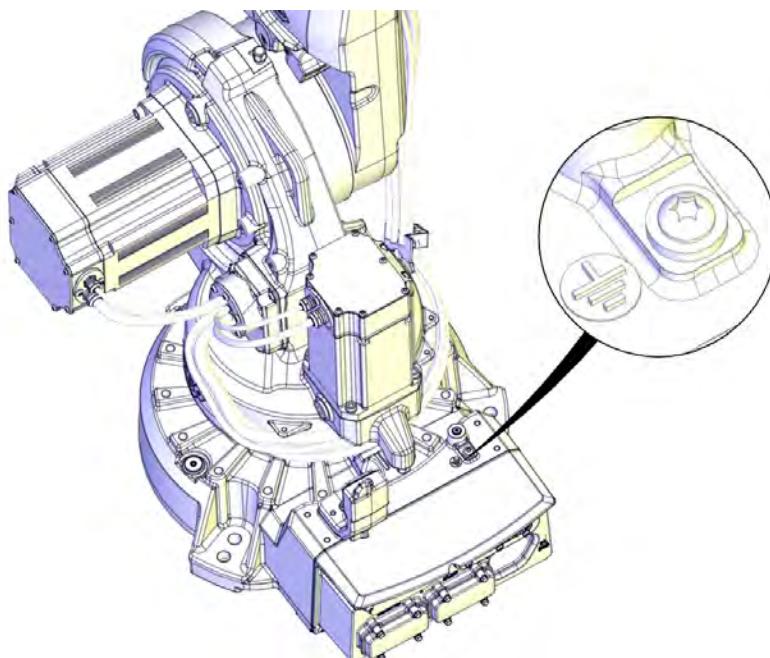
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Robot cable, signals

Cable	Art. no.
Robot cable signal, shielded: 7 m	3HAC2493-1
Robot cable signal, shielded: 15 m	3HAC2530-1
Robot cable signal, shielded: 22 m	3HAC2540-1
Robot cable signal, shielded: 30 m	3HAC2566-1

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.



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2 Installation and commissioning

2.9.2 Customer connection on robot

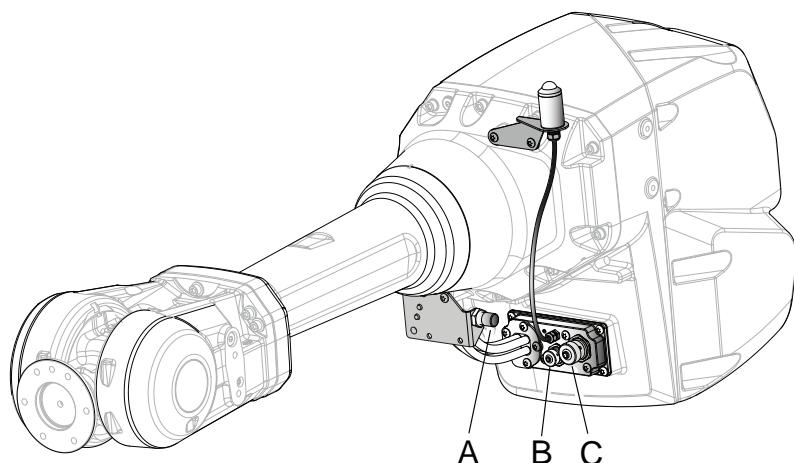
2.9.2 Customer connection on robot

Location of customer connection

For the connection of extra equipment to the robot, cables and air hose are integrated into the robot's cabling, and there is one UTOW71210SH06 and one UTOW71626SH06 connector on the front part of the upper arm.

The customer connections are located on the robot as shown in the figure.

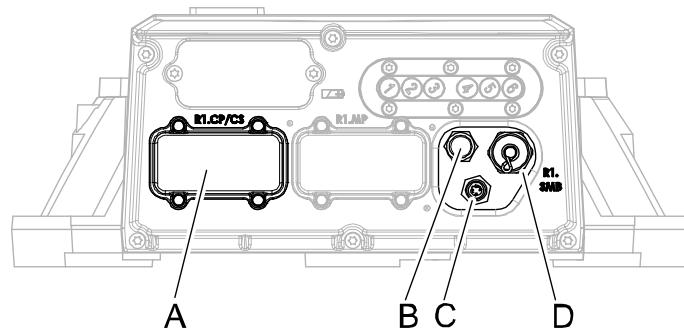
Customer connection upper arm.



xx0800000289

A	Air M16x1.5 (24° cone sealing)
B	R2.CP
C	R2.CS

Customer connections base



xx0800000288

A	R1.CP/CS
B	Air M16x1.5
C	R1.CBUS
D	R1.SMB

Continues on next page

Extra equipment connections

Connections to the:

- air hose (3/8") is located on the front part of the upper arm and at the base.
Max. 8 bar. Inner hose diameter: 9.5 mm.
- signal cabling (option) is located on the front of the upper arm.

Number of signals, customer connections R1.CP/CS:

- 23 (50V, 0.5A)
- 9 (300V, 2A). 8 are double crimped in R1.CP/CS and one is only accessible in the robot base.
- 2 DeviceNet or Profibus R1.CP/CS
- One protective ground

Number of signals, customer connections R1.CBUS:

- 4 EtherNet R1.CBUS

Connection sets

To connect power and signal conductors to the robot base/upper arm connectors, the following parts are recommended.

Connection set	Connector	Art. no.	Content
PROC1 on base	R1.CP/CS	3HAC16667-1	<ul style="list-style-type: none">• Sockets for cable area of 0.14-2.5 mm²• Hood foundry• Hinged frame, hood• Multicontact-module, female
Connector set on base	R1.CP/CS	3HAC033181-001	<ul style="list-style-type: none">• Hose coupling• M12 connector, male
R2.CP/R2.CS	R2.CP/R2.CS	3HAC025396-001	<ul style="list-style-type: none">• Pins for cable area 0.21 - 0.93 mm²• Bottle shaped shrinking hose• Angle shaped shrinking hose

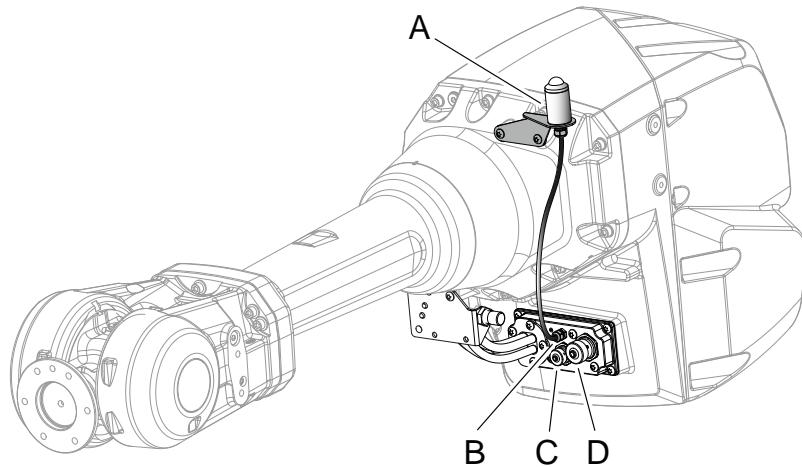
2 Installation and commissioning

2.9.3 Customer connections on upper arm

2.9.3 Customer connections on upper arm

Customer connections on upper arm

The figure shows the customer connections on the upper arm, including the optional signal lamp that can be fitted to the armhouse.



xx0800000290

A	Signal lamp
B	R3.H1 +, R3.H2 -
C	R2.CP
D	R2.CS

Power supply connections on upper arm

Signal name	Customer Terminal Controller	Customer Contact on Upper arm, R2	Customer Contact on robot base (cable between robot and controller not supplied)
CPA	XP6.1	R2.CP.A	R1.CP/CS.d1
CPB	XP6.2	R2.CP.B	R1.CP/CS.d6
CPC	XP6.3	R2.CP.C	R1.CP/CS.d3
CPD	XP6.4	R2.CP.D	R1.CP/CS.d4
CPE	XP6.1	R2.CP.E	R1.CP/CS.d1
CPF	XP6.2	R2.CP.F	R1.CP/CS.d6
CPG		R2.CP.G (Earth)	
CPH	-	R2.CP.H	R1.CP/CS.d7
CPJ	XP6.3	R2.CP.J	R1.CP/CS.d3
CPK	XP6.4	R2.CP.K	R1.CP/CS.d4

Continues on next page

Signal connection on upper arm

Signal name	Customer Terminal Controller	Customer Contact on Upper arm, R2	Customer Contact on robot base (cable between robot and controller not supplied)
CSA	XP5.1.1	R2.CS.A	R1.CP/CS.b1
CSB	XP5.1.2	R2.CS.B	R1.CP/CS.b2
CSC	XP5.2.1	R2.CS.C	R1.CP/CS.b3
CSD	XP5.2.2	R2.CS.D	R1.CP/CS.b4
CSE	XP5.2.3	R2.CS.E	R1.CP/CS.b5
CSF	XP5.2.4	R2.CS.F	R1.CP/CS.b6
CSG	XP5.1.9	R2.CS.G	R1.CP/CS.b7
CSH	XP5.1.10	R2.CS.H	R1.CP/CS.b8
CSJ	XP5.1.11	R2.CS.J	R1.CP/CS.b9
CSK	XP5.1.12	R2.CS.K	R1.CP/CS.b10
CSL	XP5.1.3	R2.CS.L	R1.CP/CS.b11
CSM	XP5.1.4	R2.CS.M	R1.CP/CS.b12
CSN	XP5.1.5	R2.CS.N	R1.CP/CS.b13
CSP	XP5.1.6	R2.CS.P	R1.CP/CS.b14
CSR	XP5.3.1	R2.CS.R	R1.CP/CS.b15
CSS	XP5.3.2	R2.CS.S	R1.CP/CS.b16
CST	XP5.3.3	R2.CS.T	R1.CP/CS.b18
CSU	XP5.3.4	R2.CS.U	R1.CP/CS.b19
CSV	XP5.3.5	R2.CS.V	R1.CP/CS.b20
CSW	XP5.3.6	R2.CS.W	R1.CP/CS.b21
CSX	XP5.2.9	R2.CS.X	R1.CP/CS.b22
CSY	XP5.2.10	R2.CS.Y	R1.CP/CS.b23
CSZ	XP5.2.11	R2.CS.Z	R1.CP/CS.b24

2 Installation and commissioning

2.10.1 Installation of IRB 4600 Foundry Prime in a water jet application

2.10 Additional installation (Foundry Prime)

2.10.1 Installation of IRB 4600 Foundry Prime in a water jet application

General

Robots delivered with the Foundry Prime protection are specially designed to work in water jet cleaning cells with 100% humidity and alkaline detergent. To ensure that the protection offers the best reliability, some measures are needed during installation of the robot according to the procedures below.



Note

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

Commissioning

- Never switch off the overpressure in motors and serial measurement compartment during cooling down of robot after it has been switched off.
- When turning off a cleaning cell we recommend that the humid air inside a cell is ventilated out, to avoid that the humid air is sucked into e.g. gearboxes due to the raised vacuum when cooled down.

Environmental conditions

Humidity	100%
Washing detergent with pH	<9.0
Washing detergent must contain rust inhibitor and be approved by ABB.	
Cleaning bath temperature	<60°C, used in a typical waterjet cleaning application at suitable speed.

Air specification for pressurizing of robot

The air must be dry and clean, such as instrument air. Following table details the air specification.

Dew point	<+2°C at 6 bar
Solid particle size	<5 microns
Oil content	<1 ppm (1 mg/m3)
Pressure to robot	0.2 - 0.3 bar



WARNING

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

Continues on next page



WARNING

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



Note

To secure sufficient air pressure, it is recommended to use a pressure sensor.

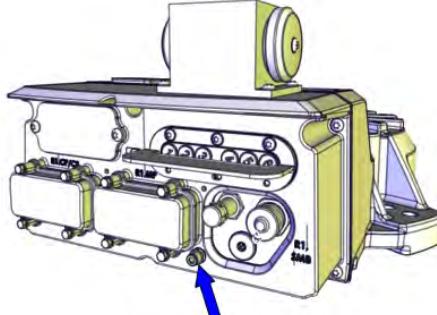
Pressurize the motors and serial measurement board cavity

The robots are prepared with hoses to the motors and the serial measurement board cavity to enable pressurizing of them.



WARNING

The robot must be pressurized also when it is switch off, to avoid that the humid environmental air is sucked into the motors when cooling down.

	Action	Note/Illustration
1	Connect a compressed air hose to air connector on robot base, see illustration.	 xx1500002398 Dimension: G1/8, d=6mm
2	Protect the screws on the Harting connectors on the robot base from corrosion with Mer-casol.	Do this when the controller cables are connected.
3	Pressurize the robot.	See Air specification for pressurizing of robot on page 112 for correct pressure.
4	Inspect the air system.	See Inspection of air hoses (Foundry Prime) on page 156 .

Protecting from high pressure water



WARNING

No part of the robot are allowed to be exposed to direct high pressure jet of water. The sealings between the moving parts on the wrist must not be exposed to direct or rebounding high-pressure jet of water.

Continues on next page

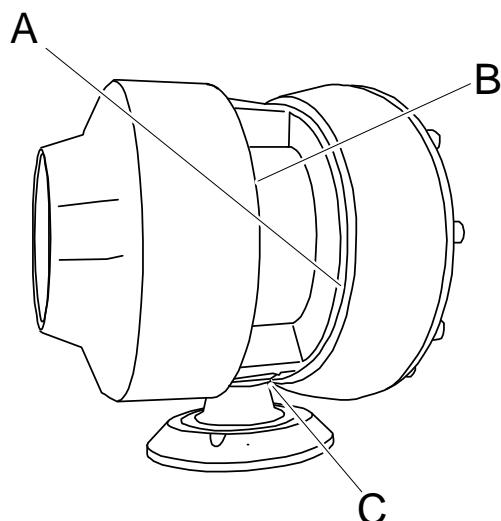
2 Installation and commissioning

2.10.1 Installation of IRB 4600 Foundry Prime in a water jet application

Continued

Protecting the wrist joints

The sealings between the moving parts on the wrist must not be exposed to direct high-pressure water. We recommend that the gripper include a shield that prevents direct water flush on the sealing surfaces of the wrist. The sealings are pointed out in the illustration below.



xx0600003108

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

Protecting the wrist flange from corrosion

The mounting surface on the wrist flange is protected with grease. The joint between the wrist flange and the tool and the screw holes on the wrist flange must be protected.

Action	Note/Illustration
1 After mounting the tool, clean the following surfaces from grease: <ul style="list-style-type: none">• the visible surface (not painted)• the rear end of the screw holes and end of screws.	<p>A line drawing of a robotic wrist assembly. Two points are labeled: A points to the rear end of the screw holes and the end of the screws; B points to the unpainted surface of the mounting flange.</p> <p>xx0600003109</p> <p>A screw holes and screws B unpainted surface</p>
2 Protect these surfaces with Mercasol.	

Continues on next page

2 Installation and commissioning

2.10.1 Installation of IRB 4600 Foundry Prime in a water jet application

Continued

	Action	Note/Illustration
3	Before running the robot in a water jet cleaning cell: <ul style="list-style-type: none">• perform a inspection of the pressure in motors and SMB cavity.	<i>Inspection of air hoses (Foundry Prime) on page 156</i>

2 Installation and commissioning

2.10.2 Commissioning (Foundry Prime)

General

The following should be taken in consideration when running a robot in a water jet application cell:



CAUTION

Never switch off the overpressure in motors and serial measurement compartment during cooling down of robot after it has been switched off.



Note

To reduce the risk for corrosion due to condensation in gearboxes, it is required that the robot is running with high speed on each axes at least on one occasion each hour. This is to lubricate the gearbox cavities.



Note

When turning off a cleaning cell we recommend that the humid air is ventilated out from the cell, to avoid that the humid air is sucked into gearboxes for example, due to the raised vacuum when cooled down.

3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 4600 Foundry Prime.

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

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

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

Safety information

Observe all safety information before conducting any service work!

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



Note

If the IRB 4600 Foundry Prime is connected to power, always make sure that the IRB 4600 Foundry Prime is connected to protective earth before starting any maintenance work!

For more information see:

- *Product manual - IRC5*

3 Maintenance

3.2 Introduction for Foundry Prime robots

3.2 Introduction for Foundry Prime robots

Introduction

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

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

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

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

Specific maintenance activities and intervals for Foundry Prime

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

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

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

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

Activity to lubricate gearbox cavities and gears

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

Non-predictable situations

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



Note

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

Warranty claims

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

3.3 Maintenance schedule

3.3.1 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 4600 Foundry Prime:

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

3 Maintenance

3.3.2 Maintenance schedule

3.3.2 Maintenance schedule

General

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

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

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

Values for these are specified in the section [Expected component life on page 122](#)



Note

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

Activities and intervals, Foundry Prime

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

Maintenance activity	Equipment	Interval
Inspection	Oil level in axis-1 gearbox	Every: <ul style="list-style-type: none">• 6 months
Inspection	Oil level in axis-2 gearbox	Every: <ul style="list-style-type: none">• 6 months
Inspection	Oil level in axis-3 gearbox	Every: <ul style="list-style-type: none">• 6 months
Inspection	Oil level in axis-4 gearbox	Every: <ul style="list-style-type: none">• 6 months
Inspection	Oil level in axis-5 gearbox	Every: <ul style="list-style-type: none">• 6 months
Inspection	Oil level in axis-6 gearbox	Every: <ul style="list-style-type: none">• 6 months
Inspection	Surface treatment	Every: <ul style="list-style-type: none">• 6 months ⁱ
Inspection	Cable harness (Including rubber blocks and straps)	Every: <ul style="list-style-type: none">• 6 months If required ⁱⁱ
Replacement	Cable harness	If required ⁱⁱ
Inspection	Air hoses	Every: <ul style="list-style-type: none">• 6 months
Inspection	Information labels	Every: <ul style="list-style-type: none">• 12 months
Inspection	Dampers	Every: <ul style="list-style-type: none">• 12 months
Inspection	Mechanical stop, axis 1	Every: <ul style="list-style-type: none">• 12 months

Continues on next page

3.3.2 Maintenance schedule

Continued

Maintenance activity	Equipment	Interval
Analysis	Oil gearbox axis 6	Every: • 3,000 hours or 6 months, whichever occurs first ⁱⁱⁱ
Changing ^{iv}	Oil in axis-1 gearbox	Every: • 6,000 hours
Changing ^{iv}	Oil in axis-2 gearbox	Every: • 6,000 hours
Changing ^{iv}	Oil in axis-3 gearbox	Every: • 6,000 hours
Changing ^{iv}	Oil in axis-4 gearbox	Every: • 12,000 hours
Changing ^{iv}	Oil in axis-5 gearbox	Every: • 12,000 hours
Changing ^{iv}	Oil in axis-6 gearbox	Every: • 3,000 hours or 6 months, whichever occurs first ^v
Replacement	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	36 months or battery low alert ^{vi}
Replacement	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	Battery low alert ^{vii}
Overhaul	Robot	40,000 hours
Overhaul	Axis-6 gearbox	Every: • 24 months

ⁱ Damage to painted surfaces must be repaired as soon as possible to avoid corrosion.ⁱⁱ The warranty does not apply to effects or wear caused by environmental factors.ⁱⁱⁱ Analyse the water content in oil in gearbox axis 6 first time after 3,000 hours or 6 months. If the working conditions changes, analyse again after 3,000 hours or 6 months.^{iv} Before changing oil, always check the oil level. Always analyze the water content in the exchanged oil, according to [Analysing the water content in gearbox oil on page 194](#), to determine the condition of each gearbox.

If the water content in oil is more than 3%, analyze the new oil within 2 months. Repeatedly high water content in oil indicates wear of radial sealing in the gearbox.

^v If the robot is working in cleaning cells that are not emptied when the robot is switched off, the oil may be replaced more frequently.^{vi} 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.

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

3 Maintenance

3.3.3 Expected component life

3.3.3 Expected component life

General

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



Note

For expected component life of Foundry Prime robots see [Expected component life - protection type Foundry Prime on page 122](#).

Expected component life - protection type Standard

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

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.

^{iv} Depending on application, the lifetime can vary. The Service Information System (SIS), integrated in the robot software, can be used as a guidance for planning service of gearbox for the individual robot. This applies to gearboxes on axes 1, 2 and 3. The lifetime of gearbox axes 4, 5 and 6 is not calculated by SIS (See the *Operating manual - Service Information System*) In 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 gearboxes. Contact the local *ABB Robotics Service team* for more information.

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

Expected component life - protection type Foundry Prime

The demanding nature of using Foundry Prime robots in a washing application, can shorten the life of the robot's components compared to that of standard robots in a typical robotic application. See [Expected component life - protection type Standard on page 122](#) for standard robots. Depending on the actual washing application, the life of an individual robot can vary or being reduced.

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

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

3.4 Inspection activities

3.4.1 Inspecting oil level, axis 1 gearbox

Mounting position of the robot

If the robot is floor mounted, follow the procedures in [Inspecting the gearbox oil level in a floor mounted robot on page 124](#).

If the robot is suspended, follow the procedures in [Inspecting the gearbox oil level in a suspended robot on page 126](#).

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 158 .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

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3 Maintenance

3.4.1 Inspecting oil level, axis 1 gearbox

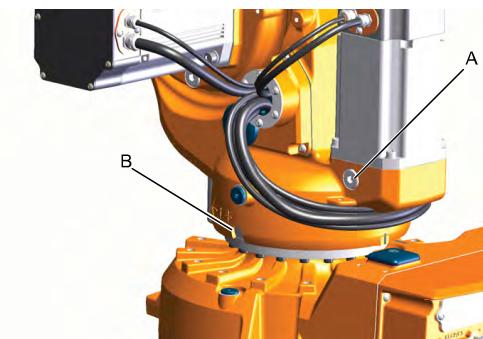
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Inspecting the gearbox oil level in a floor mounted robot

Location of oil plugs (floor mounted)

The axis 1 gearbox is located between the frame and base of the robot. The oil plug for inspection is shown in the figure.

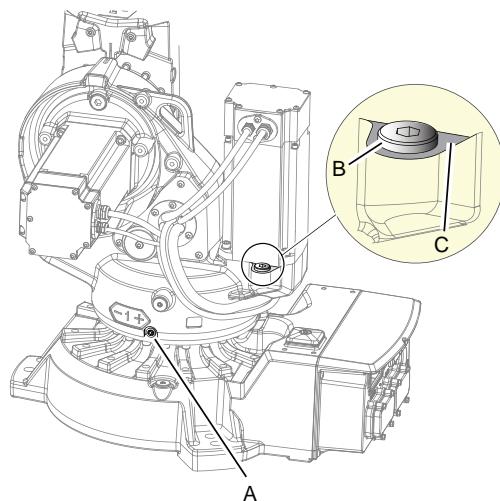
Old design:



xx0800000304

A	Oil plug, inspection
B	Oil plug, gearbox

Current design:



xx1000000669

A	Oil plug draining, on gearbox
B	Oil plug filling, on surface for motor flange
C	Surface for motor flange

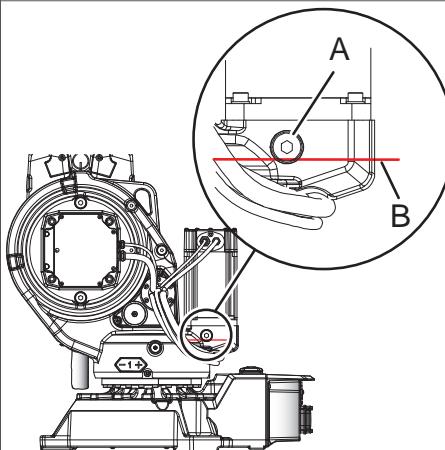
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3.4.1 Inspecting oil level, axis 1 gearbox

Continued

Inspecting oil level, axis-1 gearbox (floor mounted)

Use this procedure to inspect the oil level in the axis-1 gearbox, when the robot is floor mounted.

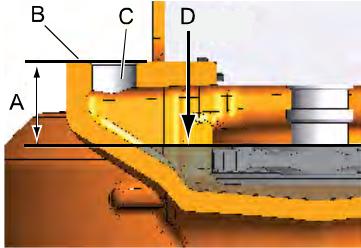
Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
2  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
3  CAUTION The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4 Open the <i>oil plug, inspection.</i>	See Location of oil plugs (floor mounted) on page 124 .
5 Old design: Measure the oil level by looking into the hole of the oil plug inspection. Required oil level: <ul style="list-style-type: none"> • 0 -5 mm, up to the lower edge of the oil plug hole of the oil plug inspection. 	 xx1200000859 Parts: A Oil plug inspection B Approximate oil level

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3 Maintenance

3.4.1 Inspecting oil level, axis 1 gearbox

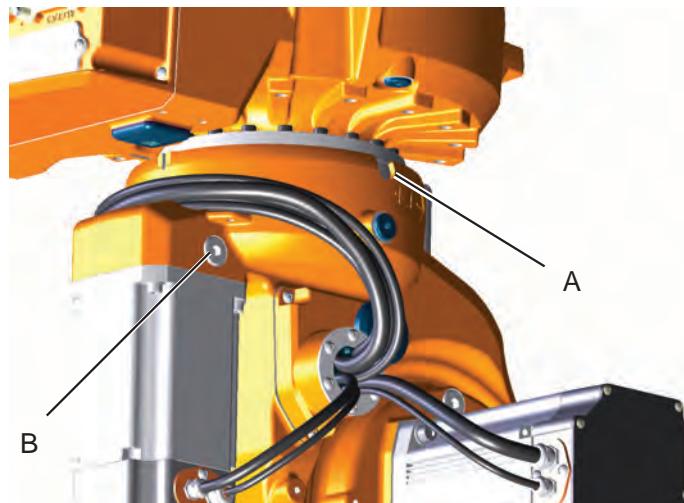
Continued

Action	Note
6 Current design: Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none"> • 35 ± 3 mm below the surface for the motor flange. The oil level shall only just start to be observed when looking through the oil filling hole. See figure!	 xx1000000824 Parts: <ul style="list-style-type: none"> • A: 35 ± 3 mm • B: Surface for motor flange • C: Filling hole • D: Oil level
7 Add oil if required.	How to fill oil is described in section: <ul style="list-style-type: none"> • Changing the oil, axis 1 gearbox on floor mounted robots on page 160
8 Refit the oil plug, inspection.	Tightening torque: <ul style="list-style-type: none"> • 24 Nm
9 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

Inspecting the gearbox oil level in a suspended robot

Location of oil plugs (suspended)

Old design:



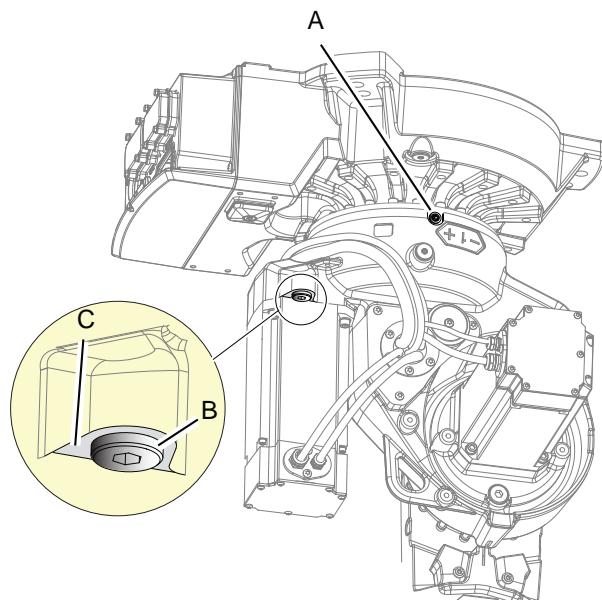
A	Oil plug, filling
B	Oil plug, draining

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3.4.1 Inspecting oil level, axis 1 gearbox

Continued

Current design:



xx1000001436

A	Filling oil plug, on gearbox
B	Draining oil plug, on surface for motor flange
C	Surface for motor flange

Inspecting oil level, axis-1 gearbox (suspended robot)

Use this procedure to inspect the oil level in the axis-1 gearbox, when the robot is suspended.



Note

If the axis-1 gearbox is filled with an amount of oil suited for an inverted position, the oil level can only be inspected in the inverted position! If the robot was taken down to stand on the floor, the oil level would be above the oil plug hole, which would result in oil leakage if the plug would be opened while robot stands on the floor!

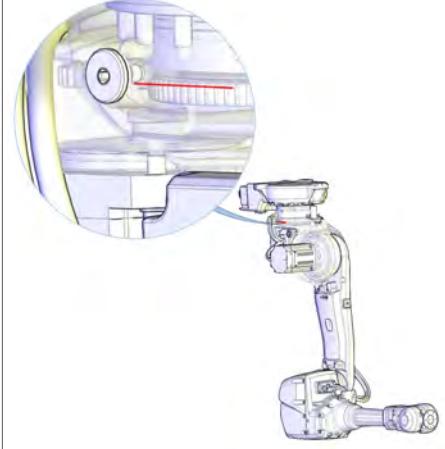
Action	Note
<p>1</p> <p> WARNING</p> <p>Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56.</p>	

Continues on next page

3 Maintenance

3.4.1 Inspecting oil level, axis 1 gearbox

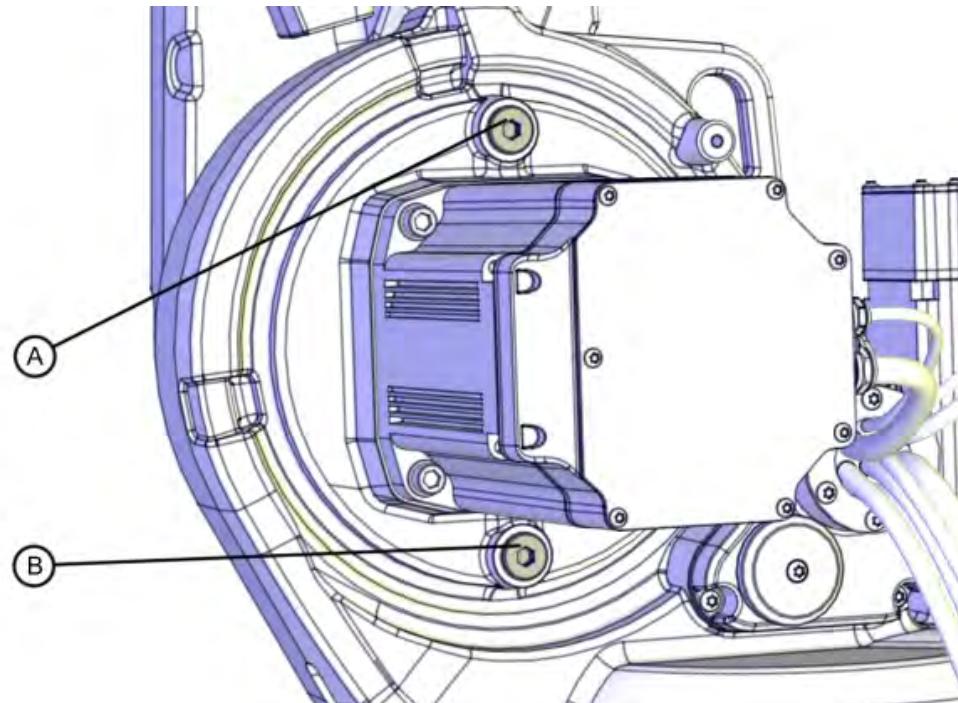
Continued

Action	Note
<p>2  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
<p>3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.</p>	
<p>4 Open the <i>oil plug inspection</i> on the axis 1 gearbox.</p>	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of oil plugs (floor mounted) on page 124
<p>5 Required oil level:<ul style="list-style-type: none"> • up to the lower edge of the oil plug hole. </p> <p> Note The oil plugs on gearbox axis 1 are now on top.</p>	 <p>xx1100000008</p>
<p>6 Add oil if required.</p>	<p>How to fill oil is described in section:</p> <ul style="list-style-type: none"> • Changing the oil, axis 1 gearbox on floor mounted robots on page 160
<p>7 Refit the oil plug.</p> <p> Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.</p>	<p>Tightening torque:</p> <ul style="list-style-type: none"> • 3-8 Nm
<p>8 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205.</p>	

3.4.2 Inspecting the oil level, axis 2 gearbox

Location of axis 2 gearbox

The axis 2 gearbox is located in the lower arm rotational center, underneath the motor attachment. The oil plugs are shown in the figure.



xx0800000305

A	Oil plug, filling
B	Oil plug, draining (Quick connect fitting)

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubrication oil	See section Type of lubrication in gearboxes on page 158 .
Oil plug (Quick connect fitting)	For article number see Spare part lists on page 397 .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol

Continues on next page

3 Maintenance

3.4.2 Inspecting the oil level, axis 2 gearbox

Continued

Equipment	Art. no.	Note
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Inspecting oil level, axis 2 gearbox

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

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
3	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
5	Open the correct <i>oil plug</i> depending on how the robot is fitted: <ul style="list-style-type: none">• Floor mounted: <i>oil plug, filling</i>• Suspended: <i>oil plug, draining (Quick connect fitting)</i>  Note Always open the oil plug on top, depending how the robot is fitted!	See the figure in: <ul style="list-style-type: none">• Location of axis 2 gearbox on page 129

Continues on next page

3.4.2 Inspecting the oil level, axis 2 gearbox

Continued

Action	Note
6 Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none">• 42 mm ± 5 mm below the lower edge of the oil plug hole.	
7 Add oil if required.	How to fill oil is described in section <ul style="list-style-type: none">• Changing the oil, axis-2 gearbox on page 171
8 Refit the oil plug, filling.  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: <ul style="list-style-type: none">• 24 Nm
9 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

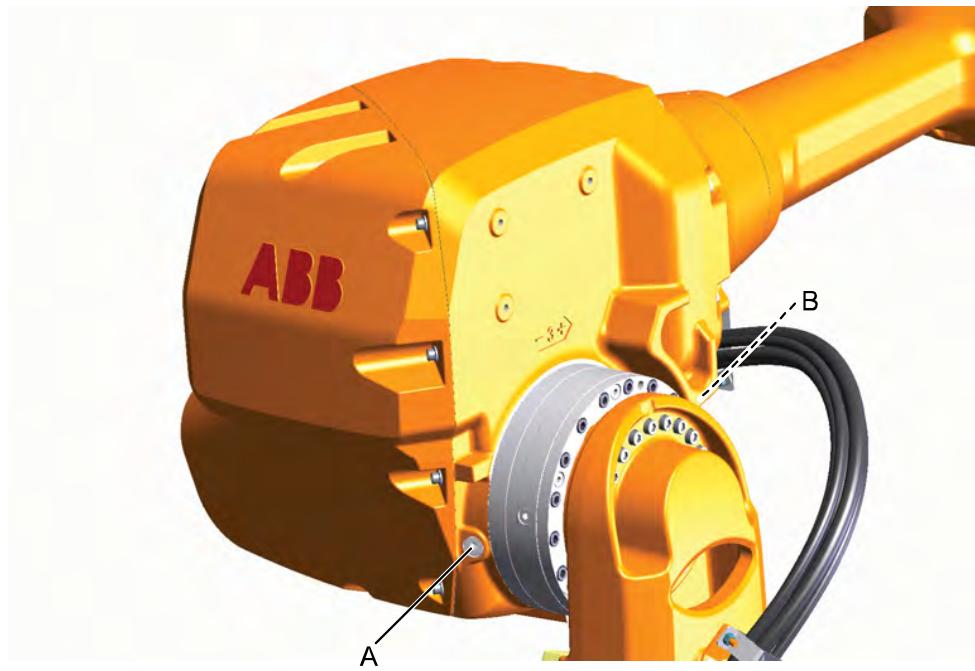
3 Maintenance

3.4.3 Inspecting the oil level, axis 3 gearbox

3.4.3 Inspecting the oil level, axis 3 gearbox

Location of axis 3 gearbox

The axis 3 gearbox is located in the upper arm rotational center, underneath the motor attachment. The oil plug for inspection is shown in the figure.



xx0800000306

A	Oil plug, armhouse
B	Oil plug, gearbox (not visible in this figure)

Required equipment

Equipment	Note
Lubrication oil	See section Type of lubrication in gearboxes on page 158 .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Continues on next page

Inspecting the oil level, axis 3 gearbox

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

	Action	Note
1	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
2	Move the robot to where the upper arm is placed in a +30° position.	
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
6	Open the <i>oil plug, armhouse</i> .	See the figure in: <ul style="list-style-type: none"> • Location of axis 3 gearbox on page 132
7	Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none"> • oil in the gearbox shall be just below the edge of the oil plug hole. 	
8	Add oil if required.	How to fill oil is described in section: <ul style="list-style-type: none"> • Changing the oil, axis-3 gearbox on page 175
9	Refit the oil plug.	Tightening torque: <ul style="list-style-type: none"> • in armhouse: 10 Nm • in gearbox: 3 Nm

Continues on next page

3 Maintenance

3.4.3 Inspecting the oil level, axis 3 gearbox

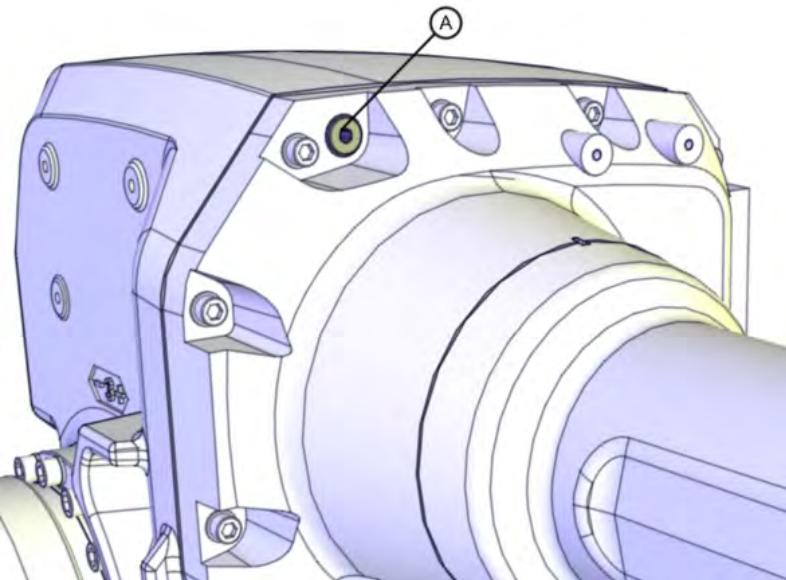
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Action	Note
10 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3.4.4 Inspecting the oil level, axis 4 gearbox

3.4.4 Inspecting the oil level, axis 4 gearbox**Location of axis 4 gearbox**

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



xx080000307

A	Oil plug, for filling and draining
---	------------------------------------

Required equipment

Equipment	Note
Lubrication oil	See section Type of lubrication in gearboxes on page 158 .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Continues on next page

3 Maintenance

3.4.4 Inspecting the oil level, axis 4 gearbox

Continued

Inspecting the oil level, axis 4 gearbox

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

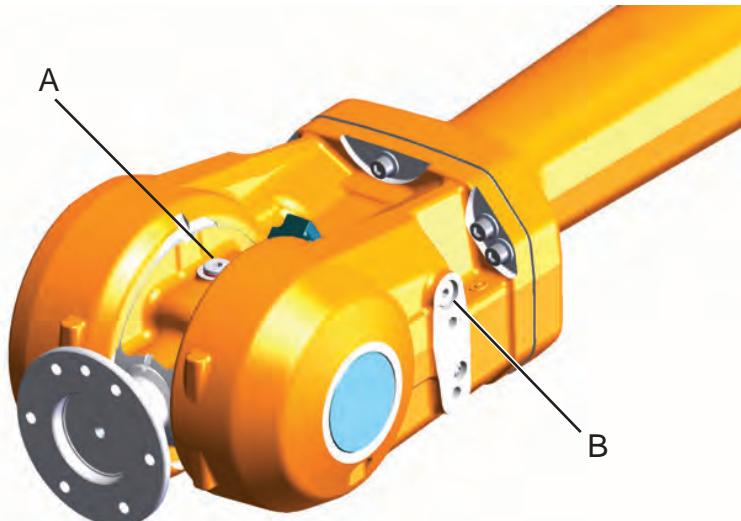
Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
2 Move the robot to where the upper arm points straight up and the oil plug hole is on top of the axis 4 gearbox.	
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
4  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
6 Open the <i>oil plug</i> .	See the figure in: <ul style="list-style-type: none">• Location of axis 4 gearbox on page 135
7 Measure the oil level at the oil plug hole. Required oil level: <ul style="list-style-type: none">• 35 ± 5 mm below the oil plug flange.	
8 Add oil if required.	How to fill oil is described in section: <ul style="list-style-type: none">• Changing the oil, axis-4 gearbox on page 181
9 Refit the oil plug, filling.	Tightening torque: <ul style="list-style-type: none">• 10 Nm
10 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3.4.5 Inspecting oil level, gearbox axes 5 - 6

Location of gearbox, axes 5-6

The gearbox axes 5-6 is located in the wrist unit. The oil plug is shown in the figure.

The figure shows IRB 4600 -60/2.05



xx0800000308

A	Oil plug, tilthouse
B	Oil plug, wrist (also used as air inlet when draining from oil plug A)

Required equipment

Equipment	Note
Lubrication oil	See section Type of lubrication in gearboxes on page 158 .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Continues on next page

3 Maintenance

3.4.5 Inspecting oil level, gearbox axes 5 - 6

Continued

Inspecting oil level, gearbox axes 5-6 - wrist 60 kg

Use this procedure to inspect the oil level in gearbox axes 5-6.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
2 Move the robot to where the upper arm is placed in its calibration position.	
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
4  CAUTION The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
6 Open the <i>oil plug, wrist</i> .	See the figure in: <ul style="list-style-type: none">• Location of gearbox, axes 5-6 on page 137
7 Required oil level: <ul style="list-style-type: none">• 3 ±3 mm below the edge of the oil plug hole.	 Note Open the <i>oil plug, tilthouse</i> when inspecting. This will level up oil in axes 5 and 6. See the figure in: <ul style="list-style-type: none">• Inspecting oil level, gearbox axes 5 - 6 on page 137
8 Add <i>oil</i> if required.	How to fill oil is described in section: <ul style="list-style-type: none">• Changing oil, axes-5 and -6 gearboxes on page 185
9 Refit the oil plugs.	Tightening torque: <ul style="list-style-type: none">• 10 Nm

Continues on next page

3.4.5 Inspecting oil level, gearbox axes 5 - 6

Continued

Action	Note
10 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

Inspecting oil level, gearbox axes 5-6 alternative method - wrist 60 kg

Use this procedure to inspect the oil level in gearbox axes 5-6 as an alternative method.

Action	Note
1  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
2 Move the robot to where the upper arm is placed in its calibration position.	
3 Move the upper arm (axis 3) to a horizontal position, then rotate (axis 4) +90°.	This will put the <i>oil plug, wrist</i> on top. See the figure in: <ul style="list-style-type: none">• Location of gearbox, axes 5-6 on page 137  Note In this position it is not possible to open the <i>oil plug, tilthouse</i> , in order to level up oil in axes 5 and 6!
4  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
5  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
6  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	

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3 Maintenance

3.4.5 Inspecting oil level, gearbox axes 5 - 6

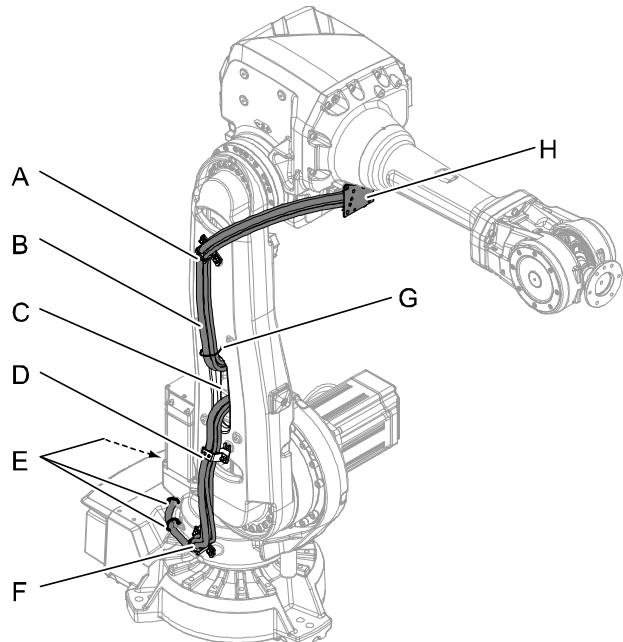
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	Action	Note
7	Open the <i>oil plug, wrist</i> .	See the figure in: <ul style="list-style-type: none">• <i>Location of gearbox, axes 5-6 on page 137</i>
8	Required oil level: <ul style="list-style-type: none">• 63 ±3 mm below the edge of the oil plug hole.	
9	Add oil if required.	How to fill oil is described in section: <ul style="list-style-type: none">• <i>Changing oil, axes-5 and -6 gearboxes on page 185</i>
10	Refit <i>oil plug, wrist</i> .	Tightening torque: <ul style="list-style-type: none">• 10 Nm
11	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See <i>Replacing parts on the robot on page 205</i> .	

3.4.6 Inspecting the cable harness

Location of cable harness

The figure shows the location of the cable harness.



xx0900000012

A	Bracket, lower arm
B	Cable harness
C	Hole in lower arm
D	Bracket, lower arm
E	Cable straps steel (One not visible here)
F	Bracket, frame
G	Cable strap plastic, lower arm
H	Bracket, armhouse

Required equipment

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .
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 399 .

Continues on next page

3 Maintenance

3.4.6 Inspecting the cable harness

Continued

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Inspecting the cable harness

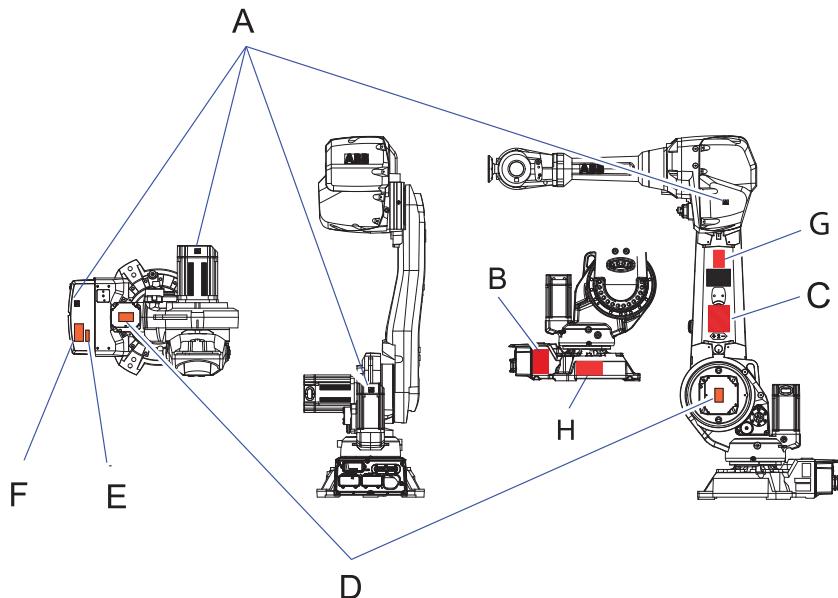
Use this procedure to inspect the cable harness. The inspection points are shown in the figure [Location of cable harness on page 141](#)

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Make an overall visual inspection of the cable harness in order to detect wear or damage.	
3	Check the <i>connectors at the base</i> .	
4	Check the <i>connectors at the armhouse</i> .	
5	Check all <i>brackets and straps</i> are properly attached to the robot.	
6	Replace the cable harness if wear, cracks or damage is detected.	How to replace the cable harness is described in Repair on page 199 .
7	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3.4.7 Inspecting information labels

Location of information labels

The figure shows the location of the information labels to be inspected.



xx1000000197

A	Warning - Symbol of flash (4 pcs)
B	Warning - Risk of tipping
C	Label - Lifting instruction
D	Warning - "High temperature" (2 pcs)
E	Label - Max. air pressure
F	Warning - Brake release unit
G	Label - Calibration
H	Label - Suspended robot

Required equipment

Equipment	Spare part number	Note
Labels	For spare part number of a specific label see Spare part lists on page 397 .	Labels are sold separately.

Continues on next page

3 Maintenance

3.4.7 Inspecting information labels

Continued

Inspecting labels

Use this procedure to inspect the labels on the robot.

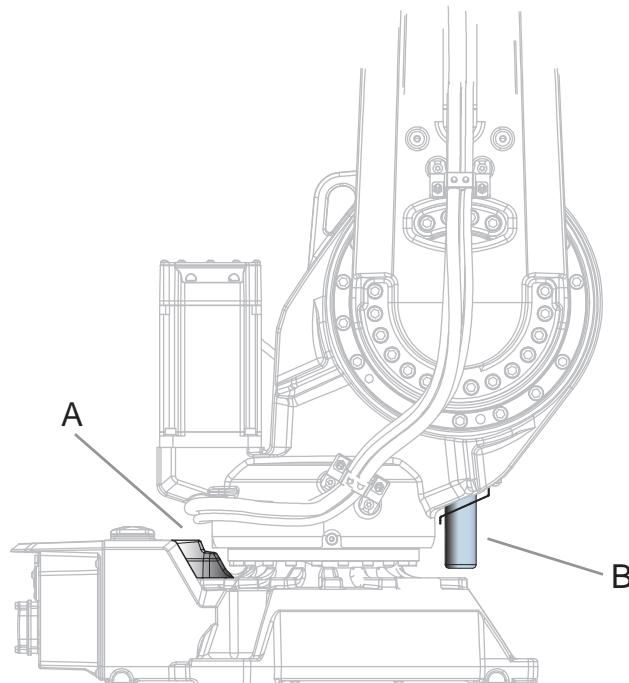
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Check all labels.	See the figure in Location of information labels on page 143 .
3	Replace any missing or damaged labels.	

3.4.8 Inspecting the mechanical stop pin, axis 1

3.4.8 Inspecting the mechanical stop pin, axis 1

Location of mechanical stop pin, axis 1

The mechanical stop pin is located on the frame as shown in the figure.



xx0800000298

A	Fixed stop
B	Mechanical stop pin, axis 1

Required equipment

Equipment	Art. no.	Note
Mechanical stop pin axis 1	See Spare part lists on page 397 .	
Standard toolkit		Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		

Continues on next page

3 Maintenance

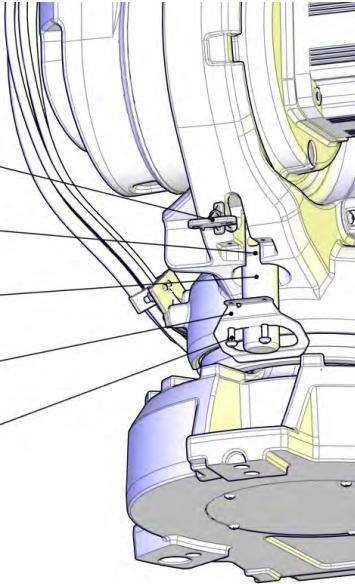
3.4.8 Inspecting the mechanical stop pin, axis 1

Continued

Equipment	Art. no.	Note
Foundry Prime touch up kit	3HAC035355-001	

Inspection of mechanical stop pin, axis 1

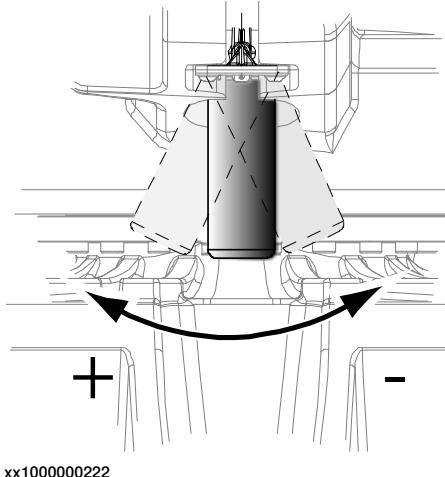
Use this procedure to inspect the mechanical stop pin, axis 1.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Regularly check that the <i>mechanical stop pin</i> is not bent or damaged in any other way.	See the figure in: <ul style="list-style-type: none">• Location of mechanical stop pin, axis 1 on page 145
3	 Note If the mechanical stop pin has been deformed or damaged, it must be replaced.	How to replace the stop pin is described in section Replacing stop pin axis 1 on page 302 .
4	Check that the mechanical stop pin is properly attached.	 xx0800000045 Parts: <ul style="list-style-type: none">A Attachment screwsB BracketC O-ring (2 pcs)D BracketE Stop pin

Continues on next page

3.4.8 Inspecting the mechanical stop pin, axis 1

Continued

Action	Note
5 Check that the <i>mechanical stop pin</i> can move freely in both directions and the <i>bracket</i> works as it is supposed to.	
6 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

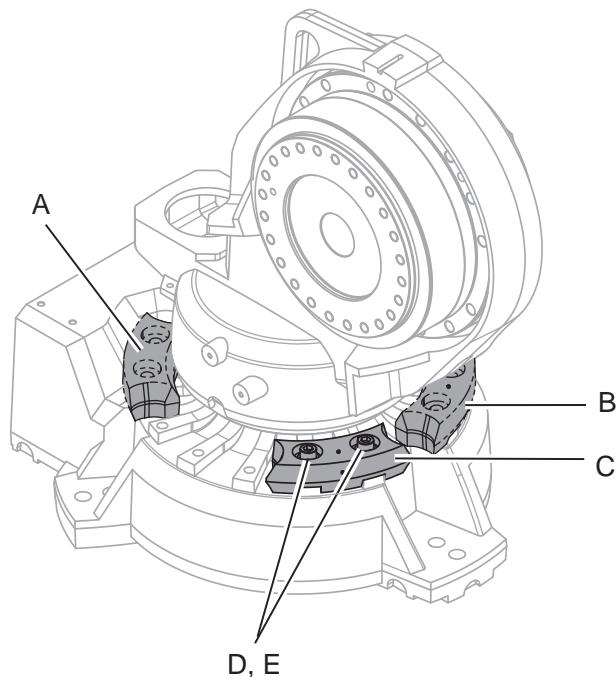
3 Maintenance

3.4.9 Inspecting additional mechanical stops

3.4.9 Inspecting additional mechanical stops

Location of additional mechanical stops

The figure shows the location of the additional stops.



xx0800000273

A	Movable mechanical stop. Limited to -129°
B	Movable mechanical stop. Limited to +16.5°
C	Movable mechanical stop. Limited to -16.5°
D	Attachment screws
E	Washers

Required equipment

Equipment etc.	Note
Mechanical stop set, axis 1	Includes: <ul style="list-style-type: none">StopAttachment screws plus washersDocument for movable mechanical stop For spare part no. see chapter Spare Parts.
Standard toolkit	Content is defined in section Standard tools on page 391 .
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

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Inspecting additional mechanical stops

Use this procedure to inspect the additional mechanical stops on axis 1.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Check the <i>additional mechanical stops</i> on axis 1 for damage.	See the figure in: <ul style="list-style-type: none"> • Location of additional mechanical stops on page 148
3	Make sure the stops are properly attached.	Tightening torque: <ul style="list-style-type: none"> • 82 Nm
4	If any damage on stops or attachment screws etc. is detected, the <i>mechanical stops</i> must be replaced!	Attachment screws: <ul style="list-style-type: none"> • M12x40, quality 8.8-A3F • 2 pcs/stop lug
5	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

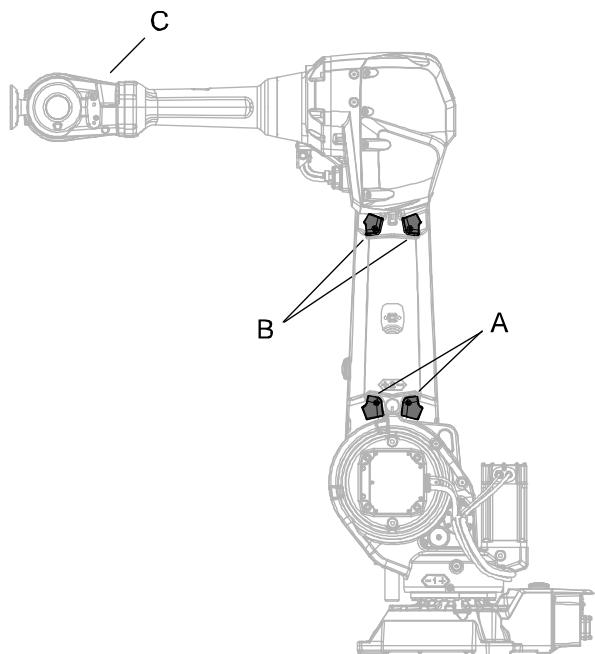
3 Maintenance

3.4.10 Inspecting dampers

3.4.10 Inspecting dampers

Location of dampers

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



xx0800000297

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

Required equipment

Equipment	Spare part no.	Note
Damper	See Spare part lists on page 397 .	
Standard toolkit	-	Content is defined in section Standard tools on page 391 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

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Inspecting dampers

Use this procedure to inspect the dampers.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Check all dampers for damage or cracks.	See the figure in: • Location of dampers on page 150
3	Check all dampers for existing impressions larger than 2-3 mm.	
4	Check attachment screws for deformation.	
5	If any damage is detected the damper must be replaced.	
6	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

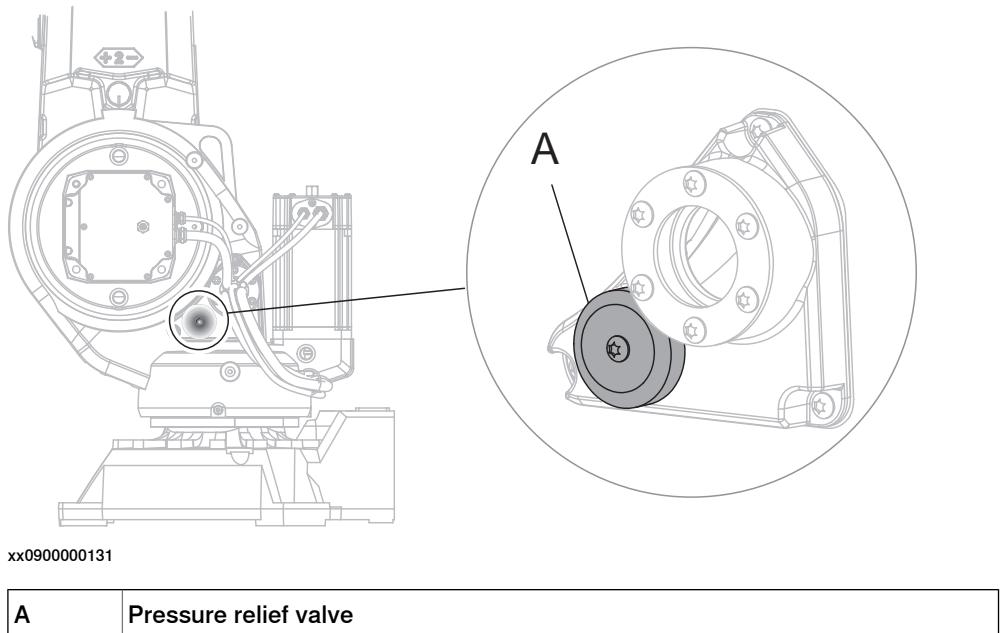
3 Maintenance

3.4.11 Inspecting the pressure relief valve

3.4.11 Inspecting the pressure relief valve

Location of the pressure relief valve

The figure shows the location of the pressure relief valve.



Required equipment

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

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Inspecting pressure relief valve

Use this procedure to inspect the pressure relief valve.

Action	Note
<p>1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
<p>2  DANGER It is important to keep the pressure relief valve open and clean. If the air pressure is stopped up, too much pressure can be built up which can be hazardous.</p>	
<p>3 Check if the <i>pressure relief valve</i> is not contaminated or covered with litter.</p>	See the figure in: <ul style="list-style-type: none"> • Location of the pressure relief valve on page 152
<p>4 Clean if necessary.</p>	 Note Use a cloth or a brush!
<p>5 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205.</p>	

3 Maintenance

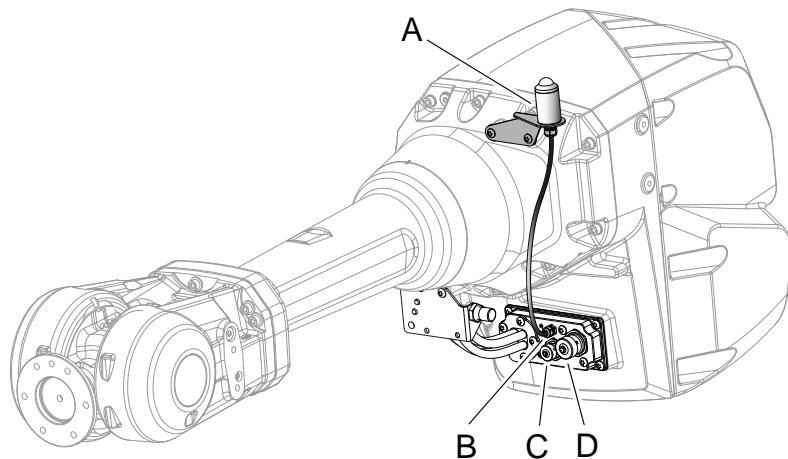
3.4.12 Inspecting Signal lamp (option)

3.4.12 Inspecting Signal lamp (option)

Location of signal lamp

Signal lamp is an option.

Located as shown in the figure.



xx0800000290

A	Signal lamp
B	R3.H1 +, R3.H2 -
C	R2.CP
D	R2.CS

Required equipment

Equipment	Note
Signal lamp	For spare parts no. see Spare parts - <i>Spare parts options in Product manual, spare parts - IRB 2600</i> .
Standard toolkit	Content is defined in section <i>Standard tools on page 391</i> .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

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Inspecting signal lamp

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

**Note**

If the signal lamp is damaged, it shall be replaced!

	Action	Note
1	Check that the signal lamp is lit when motors are put in operation ("MOTORS ON").	
2	If the signal lamp is not lit, continue tracing the fault with the steps below.	
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Check whether the signal lamp is broken. If so, replace.	
5	Check the cable connections.	
6	Measure the voltage in connectors, motor axis 3.	24V
7	Check the cabling. If a fault is detected, replace.	
8	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3 Maintenance

3.4.13 Inspection of air hoses (Foundry Prime)

3.4.13 Inspection of air hoses (Foundry Prime)

General

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

Required equipment

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

Procedure

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

Action	Note
1 Apply compressed air to the air connector on robot base, and raise the pressure with the knob until the correct value is shown on the pressure gauge.	<p>Recommended pressure: 0.2-0.3 bar</p> <p>xx1500002399</p> <ul style="list-style-type: none">A: Air connection robotB: Pressure gaugeC: Cut off valveD: Air connection
2 Close the cut off valve.	It should take at least 5 seconds for the pressure to reach 0 bar.
3 The time is < 5 seconds: <ul style="list-style-type: none">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 <i>leak detection spray</i> . Bubbles indicate a leak.	
6 When the leak is localized: correct the leak.	

3.4.14 Inspection of surface treatment (Foundry Prime)**3.4.14 Inspection of surface treatment (Foundry Prime)****Introduction to inspection of surface treatment**

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

Required equipment

Equipment, etc.	Note
Touch up paint Foundry Prime 2, grey	

Additional equipment - Foundry Prime

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

Inspection and repair of surface treatment

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

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

3 Maintenance

3.5.1 Type of lubrication in gearboxes

3.5 Replacement activities

3.5.1 Type of lubrication in gearboxes

Introduction

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



CAUTION

Always read the specific instructions for Foundy Prime robots before doing any repair work, see [Replacing parts on the robot on page 205](#).

Type and amount of oil in gearboxes

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

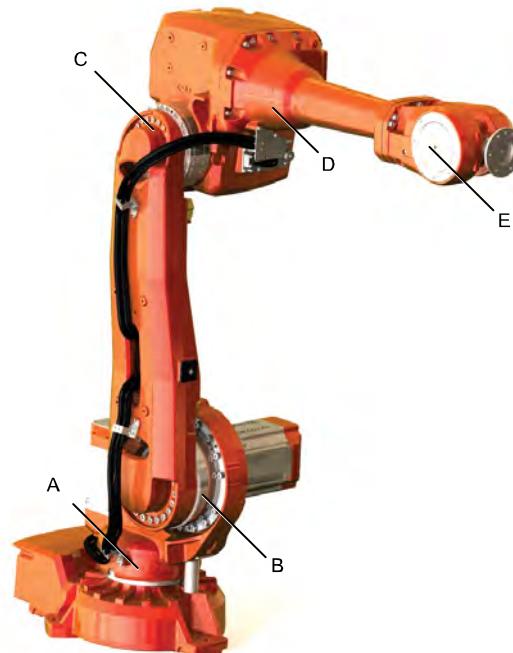
Before starting any inspection, maintenance, or changing activities of lubrication, **always** contact the local ABB Service organization for more information.

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

Continues on next page

Location of gearboxes

The figure shows the location of the gearboxes.



xx0800000311

A	Axis-1 gearbox
B	Axis-2 gearbox
C	Axis-3 gearbox
D	Axis-4 gearbox
E	Axis-5 and -6 gearbox

Equipment

Equipment	Note
Oil dispenser	Includes pump with outlet pipe. Use the suggested dispenser or a similar one: <ul style="list-style-type: none">Orion OriCan article number 22590 (pneumatic)
Nipple for quick connect fitting, with o-ring	Used on the axis-2 gearbox.
Expansion container, gearbox axis 1	Used when the robot is fitted in a suspended position.

3 Maintenance

3.5.2 Changing the oil, axis 1 gearbox on floor mounted robots

3.5.2 Changing the oil, axis 1 gearbox on floor mounted robots

Floor mounted or suspended robot

Depending on whether the robot is floor mounted or suspended, the method of changing the oil differs.

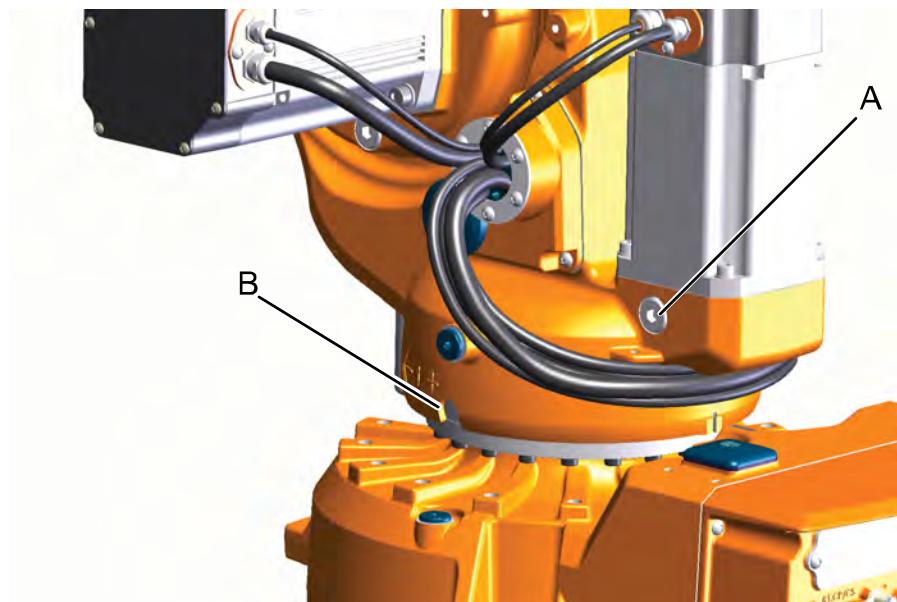
This section describes how to change the axis-1 gearbox oil in a floor mounted robot. If the robot is suspended, see [Changing the oil, axis-1 gearbox on suspended robots on page 165](#).

Location of oil plugs

The axis 1 gearbox is located between the frame and base of the robot.

The oil plugs are shown in the figure.

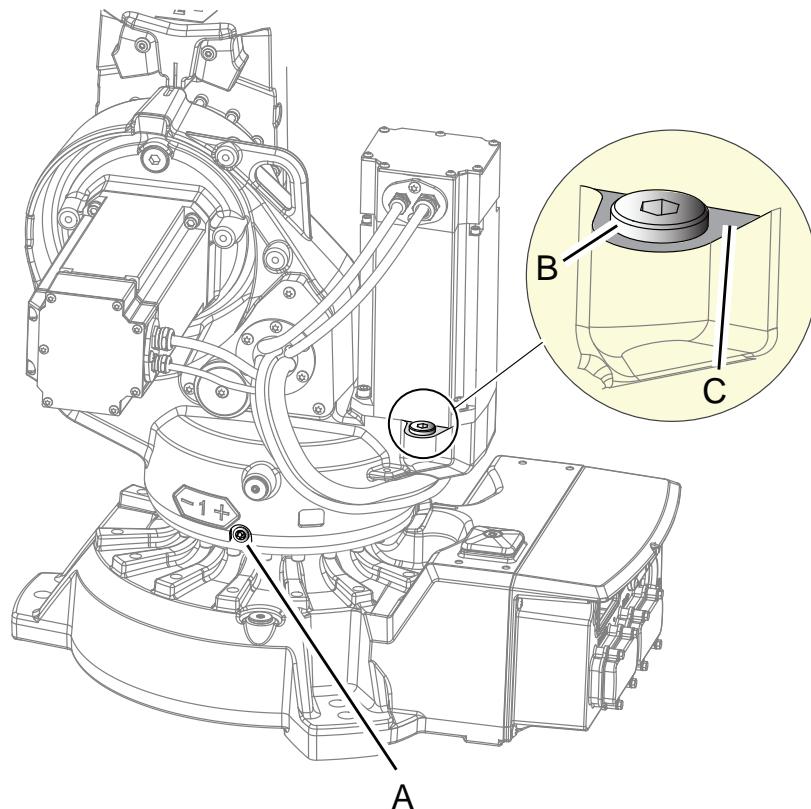
Old design:



xx0800000304

A	Oil plug, filling
B	Oil plug, draining

Continues on next page

Current design:

xx1000000669

A	Oil draining plug gearbox 1
B	Oil filling plug for gearbox 1
C	Surface for motor flange

**Note**

Use correct oil plugs for filling and draining depending on which position the robot is mounted:

Floor mounted:

- Draining = Oil plug on gearbox.
- Filling = Oil plug on surface for motor flange.

Mounted in suspended position:

- Draining and filling = Oil plug on surface for motor flange.

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubricating oil	See section Type of lubrication in gearboxes on page 158 .

Continues on next page

3 Maintenance

3.5.2 Changing the oil, axis 1 gearbox on floor mounted robots

Continued

Equipment	Note
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	One example of oil dispenser can be found in section: <ul style="list-style-type: none">• Type of lubrication in gearboxes on page 158
Standard toolkit	Content is defined in section Standard tools on page 391 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Draining, axis 1 gearbox

Use this procedure to drain the gearbox of oil.

The oil must be sucked out from the gearbox. It is recommended to use a pneumatic oil dispenser to drain oil from the gearbox.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
3	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Put an <i>oil collecting vessel</i> as close as possible to the draining hole of the gearbox.	The capacity of the vessel must be sufficient to take the complete amount of oil.

Continues on next page

3.5.2 Changing the oil, axis 1 gearbox on floor mounted robots

Continued

Action	Note
5 Replace <i>oil plug draining</i> quickly with a nipple (M10x1.5) where a draining hose is fitted.	See the figure in: • Location of oil plugs on page 160  Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
6 Connect the <i>oil dispenser</i> .	One example can be found in section: • Type of lubrication in gearboxes on page 158
7 Open the <i>oil plug filling</i> .  WARNING If the oil plug filling is not open when the oil dispenser is working, there is a risk of damaging vital parts in the gearbox!	See the figure in: • Location of oil plugs on page 160
8 Start sucking the oil out from the gearbox with the oil ejector equipment.	
9  WARNING Used oil is hazardous material and must be disposed of in a safe way. See section Decommissioning on page 379 for more information.	
10  Note There will be some oil left in the gearbox after draining.	
11 Refit the <i>oil plugs</i> .  Note Before refitting the oil plug in the gearbox, always replace the oil plug gasket with a new gasket. If not there is a risk of leakage.	See the figure in: • Location of oil plugs on page 160 Tightening torque: • <i>Oil plug filling</i> : 24 Nm • <i>Oil plug draining</i> : Other design than Type C: 3-8 Nm Type C: 24 Nm
12 If the robots paint coat is damaged during the procedure, paint touchup is needed.	See Inspection and repair of surface treatment on page 157

Continues on next page

3 Maintenance

3.5.2 Changing the oil, axis 1 gearbox on floor mounted robots

Continued

Filling oil, axis 1 gearbox

Use this procedure to fill the gearbox with oil.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4 Open the <i>oil plug, filling</i> .	See the figure in; <ul style="list-style-type: none">• Location of oil plugs on page 160
5 Refill the gearbox with <i>lubrication oil</i> .  Note The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 158 .
6 Inspect the oil level.	How to inspect the oil level is described in section: <ul style="list-style-type: none">• Inspecting oil level, axis 1 gearbox on page 123
7 Refit the <i>oil plug</i> .	Tightening torque: <ul style="list-style-type: none">• <i>Oil plug filling:</i> 24 Nm
8 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3.5.3 Changing the oil, axis-1 gearbox on suspended robots

Floor mounted or suspended robot

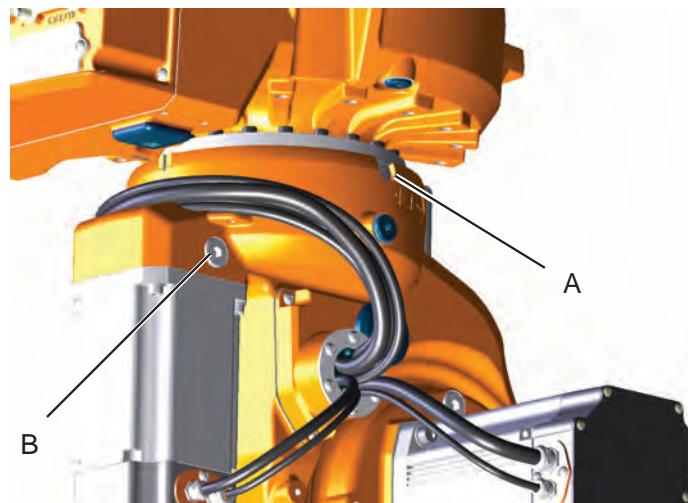
Depending on whether the robot is floor mounted or suspended, the method of changing the oil is different.

How to change oil if the robot is floor mounted, see [Changing the oil, axis 1 gearbox on floor mounted robots on page 160](#).

Location of oil plugs

The axis-1 gearbox is located between the frame and base of the robot. The oil plugs are shown in the figures.

Other design than Type C:



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

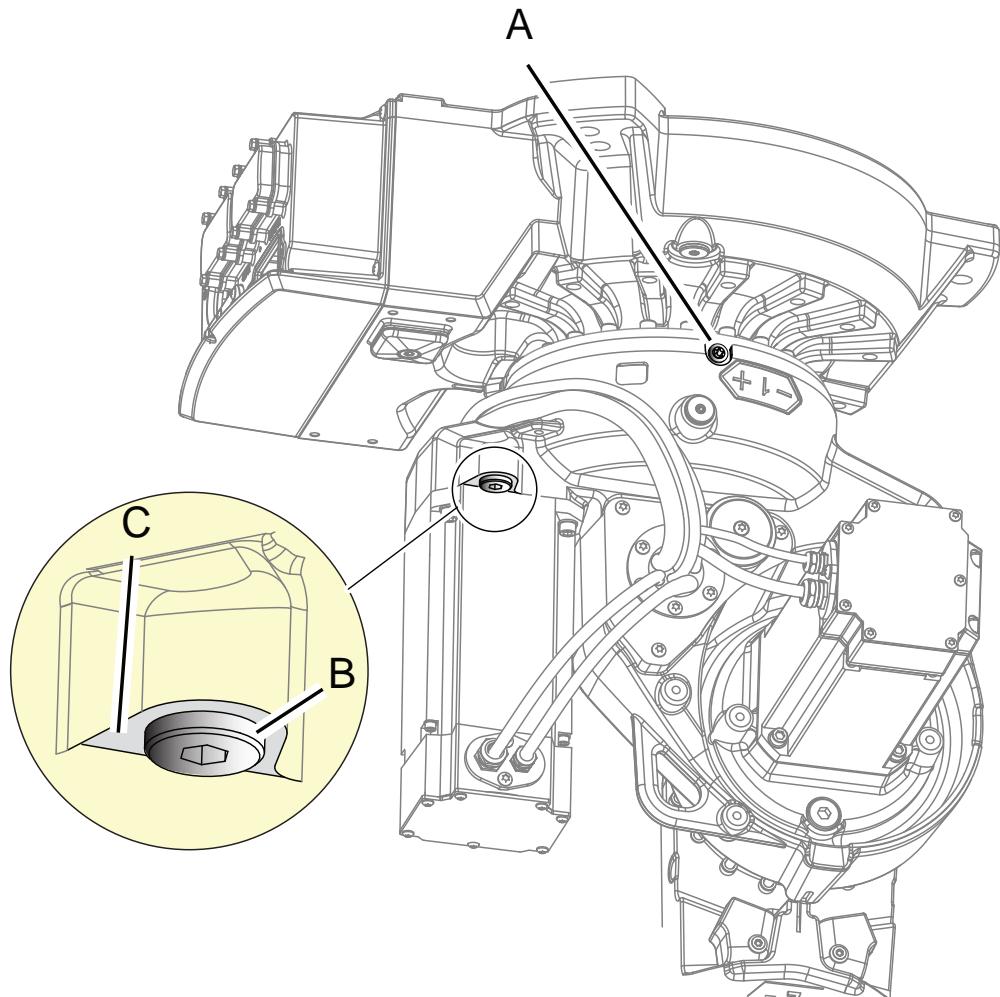
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3 Maintenance

3.5.3 Changing the oil, axis-1 gearbox on suspended robots

Continued

Type C:



xx1000001436

A	Oil plug, venting
B	Oil plug, draining and filling
C	Motor flange

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubricating oil	See section Type of lubrication in gearboxes on page 158
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	One example of oil dispenser can be found in section: <ul style="list-style-type: none">• Type of lubrication in gearboxes on page 158
Oil change equipment	See section Special tools on page 392

Continues on next page

Equipment	Note
Hose	Used with the oil dispenser
Standard toolkit	Content is defined in section Standard tools on page 391 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Draining, axis-1 gearbox

Use this procedure to drain the gearbox of oil.

**Tip**

In order to save time, a pneumatic oil dispenser can be used to suck out the oil from the gearbox. Follow the instructions below!

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
3	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Connect the <i>oil dispenser</i> to the <i>oil plug for draining</i> .	See Required equipment on page 166 . See Location of oil plugs on page 165 .

Continues on next page

3 Maintenance

3.5.3 Changing the oil, axis-1 gearbox on suspended robots

Continued

	Action	Note
5	Put the end of the hose in an <i>oil collecting vessel</i> .	The capacity of the vessel must be sufficient to take the complete amount of oil.
6	Open the end plug of the hose.	
7	Open the <i>oil plug, venting</i> .	See Location of oil plugs on page 165 .
8	Using a low air pressure, start sucking the oil out from the gearbox with the oil change equipment.	
9	 WARNING Used oil is hazardous material and must be disposed of in a safe way. See section Decommissioning on page 379 for more information.	
10	Let the oil drain until the gearbox is empty.  Note There will be some oil left in the gearbox after draining. Measure the volume of the drained oil in the vessel.	 Tip Make a note how much oil was drained. The same amount shall later be refilled.
11	Remove the hose and clean it.	
12	If the robots paint coat is damaged during the procedure, paint touchup is needed.	See Inspection and repair of surface treatment on page 157

Filling oil, axis-1 gearbox

Use this procedure to fill the gearbox with oil.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	

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3.5.3 Changing the oil, axis-1 gearbox on suspended robots

Continued

Action	Note
3  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4 Verify that the hose of the oil change equipment is clean and then fit the quick connection to the <i>oil plug for filling</i> .	See Location of oil plugs on page 165 .
5 Open the <i>oil plug for venting</i> .	See Location of oil plugs on page 165 .
6 Prepare oil change equipment with the same amount of <i>lubrication oil</i> that was drained.  Note The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 158 .
7 Inspect the oil level.	How to inspect the oil level is described in section: <ul style="list-style-type: none">• Inspecting oil level, axis 1 gearbox on page 123
8 Disconnect the oil change equipment and put on the protective hood on the oil plug.	
9 Refit the <i>oil plug for venting</i> .  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: <ul style="list-style-type: none">• 3-8 Nm
10 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

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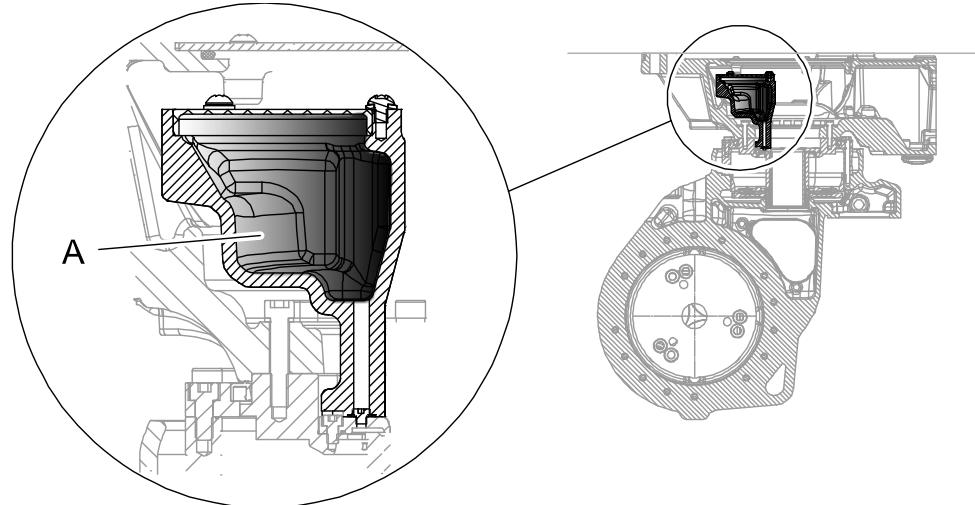
3 Maintenance

3.5.3 Changing the oil, axis-1 gearbox on suspended robots

Continued

Expansion container axis-1 gearbox, suspended mounted robots

When the robot is fitted in a suspended mounted position, an expansion container for oil must be fitted on gearbox axis 1.



xx0900000129

A	Expansion container
---	---------------------



Note

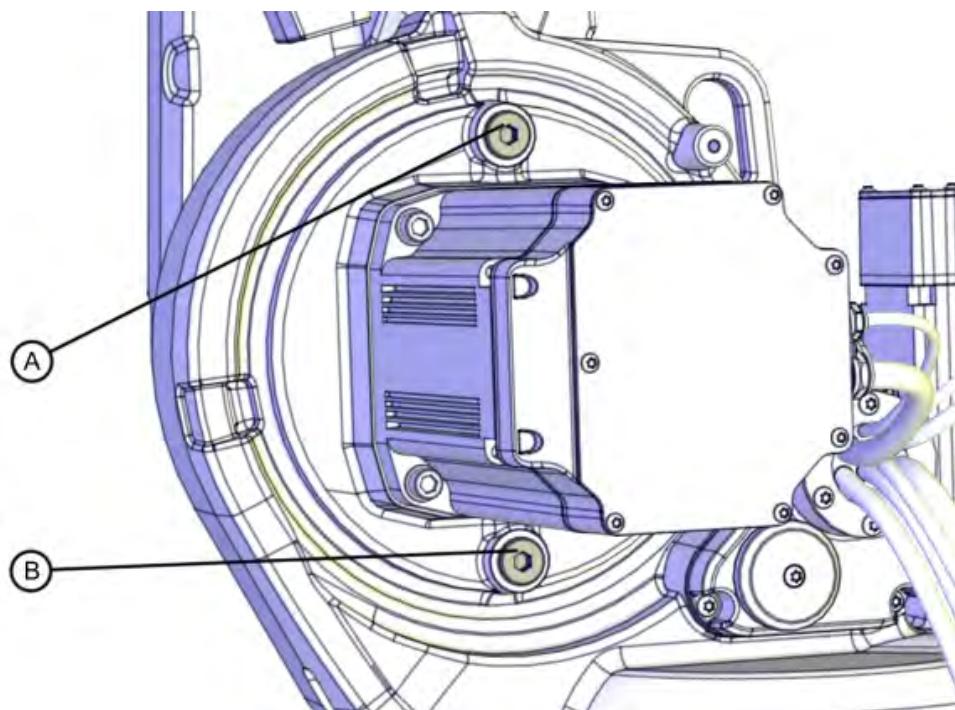
The expansion container is installed on delivery on the robot if ordered as option suspended/inverted mounted. If a floor mounted robot shall be fitted in a suspended mounted position, an expansion container must be installed. See [Installing an expansion container on page 101](#).

3.5.4 Changing the oil, axis-2 gearbox

Location of oil plugs

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

Oil plugs are shown in the figure.



xx0800000305

A	Oil plug, filling (draining when suspended mounted)
B	Oil plug, draining (filling when suspended mounted) (Quick connect fitting)

Required equipment

Equipment	Note
Oil plug sealing washer, gearbox	3HAC029646-001
Lubricating oil	Information about the oil is found in <i>Technical reference manual - Lubrication in gearboxes</i> . See Type and amount of oil in gearboxes on page 158 .
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Nipple (TEMA IF 3820 S06)	To be fitted on a hose, and then used for draining connected to the <i>quick connect fitting</i> . See Location of oil plugs on page 171 .
Standard toolkit	Content is defined in section Standard tools on page 391 .

Continues on next page

3 Maintenance

3.5.4 Changing the oil, axis-2 gearbox

Continued

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Draining, axis-2 gearbox

Use this procedure to drain the gearbox of oil.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
3	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Either <ul style="list-style-type: none">• connect a nipple to the <i>quick connect fitting</i> in the hole for drainingor• remove the <i>quick connect fitting</i>.	See the figure in: <ul style="list-style-type: none">• Location of oil plugs on page 171
5	Open the <i>oil plug, filling</i> .	See the figure in: <ul style="list-style-type: none">• Location of oil plugs on page 171  Note Drainage will be quicker if the oil plug, filling is removed.

Continues on next page

Action	Note
6 Drain the gearbox oil using an <i>oil collecting vessel</i> .	 Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
7  WARNING Used oil is hazardous material and must be disposed of in a safe way. See section Decommissioning on page 379 for more information.	
8  Note There will be some oil left in the gearbox after draining.	
9 Refit <i>oil plug</i> .  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: • 24 Nm

Filling oil, axis-2 gearbox

Use this procedure to fill the gearbox with oil.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	

Continues on next page

3 Maintenance

3.5.4 Changing the oil, axis-2 gearbox

Continued

	Action	Note
3	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Open <i>oil plug, filling</i> .	See the figure in: • Location of oil plugs on page 171
5	Refill the gearbox with <i>lubrication oil</i> .  Note The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 158 .
6	Inspect the oil level.	How to inspect the oil level is described in section: • Inspecting the oil level, axis 2 gearbox on page 129
7	Refit <i>oil plug</i> .  Note Before refitting the oil plug in the gearbox, always replace the oil plug sealing washer with a new one. If not there is a risk of leakage.	Tightening torque: • 24 Nm
8	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3.5.5 Changing the oil, axis-3 gearbox

Location of oil plugs

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

Oil plugs are shown in the figure.



xx0800000306

A	Oil plug, armhouse
B	Oil plug, gearbox (not visible in this figure)

Required equipment

Equipment	Note
Lubricating oil	Information about the oil is found in <i>Technical reference manual - Lubrication in gearboxes</i> . See Type and amount of oil in gearboxes on page 158 .
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Oil dispenser	One example of oil dispenser can be found in section: <ul style="list-style-type: none"> Type of lubrication in gearboxes on page 158
Funnel	 xx1200000862

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3 Maintenance

3.5.5 Changing the oil, axis-3 gearbox

Continued

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .

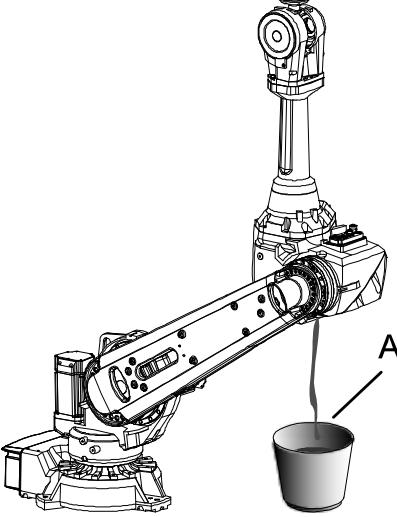
Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Draining, axis-3 gearbox

Use this procedure to drain the gearbox of oil.

There is an alternative method to drain the gearbox. See [Draining - alternative method on page 177](#).

Action	Note
1 Move the robot to an upright position as shown in the figure.	 xx0800000327 • A: Oil collecting vessel
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	

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Action	Note
3  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
4  CAUTION The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5 Open the <i>oil plug, armhouse</i>	See the figure in: • Location of oil plugs on page 175
6 Open the <i>oil plug, gearbox</i> and use it as a ventilation hole.	See the figure in: • Location of oil plugs on page 175
7 Drain the gearbox oil using an <i>oil collecting vessel</i> .	 Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
8  WARNING Used oil is hazardous material and must be disposed of in a proper way. See section Decommissioning for more information.	
9 Refit oil plugs.	Tightening torque: • in armhouse: 10 Nm • in gearbox: 3 Nm

Draining - alternative method

Use this procedure to drain the oil from the gearbox, as an alternative method.

If this method is used, oil must be sucked out of the gearbox using an oil dispenser.

Action	Note
1 Move the upper arm of the robot to a position where the <i>oil plug, gearbox</i> is pointing at the floor.	See the figure in: • Location of oil plugs on page 175
2  DANGER Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

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3 Maintenance

3.5.5 Changing the oil, axis-3 gearbox

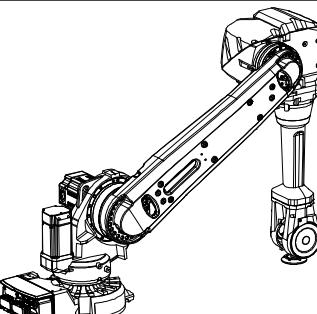
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	Action	Note
3	 CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
4	Use an <i>oil dispenser</i> fitted to the <i>oil plug, gearbox</i> to drain the oil.	An example of oil dispenser is detailed in section: <ul style="list-style-type: none"> • Type of lubrication in gearboxes on page 158 See the figure in: <ul style="list-style-type: none"> • Location of oil plugs on page 175
5	Replace the <i>oil plug, gearbox</i> with a nipple where a draining hose is fitted.	See the figure in: <ul style="list-style-type: none"> • Location of oil plugs on page 175
6	Connect the <i>oil dispenser</i> .	One example can be found in section: <ul style="list-style-type: none"> • Type of lubrication in gearboxes on page 158
7	Open the <i>oil plug, armhouse</i> now pointing upwards and use it as a ventilation hole.	See the figure in: <ul style="list-style-type: none"> • Location of oil plugs on page 175  WARNING The oil plug, gearbox must be open when the oil dispenser equipment is used! Otherwise sealings and other parts will be damaged.
8	Start sucking the oil out from the gearbox with the oil ejector equipment.	For capacity of the vessel see section: <ul style="list-style-type: none"> • Type of lubrication in gearboxes on page 158
9	 WARNING Used oil is hazardous material and must be disposed of in a proper way. See section <i>Decommissioning</i> for more information.	
10	 Note There will be some oil left in the gearbox after draining!	
11	Refit the <i>oilplugs</i> .	See the figure in: <ul style="list-style-type: none"> • Location of oil plugs on page 175 Tightening torque: <ul style="list-style-type: none"> • in armhouse: 10 Nm • in gearbox: 3 Nm

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Filling oil, axis-3 gearbox

Use this procedure to fill the gearbox with oil.

Action	Note
1 Move the upper arm to a position where the wrist is pointing towards the floor as shown in the figure.	 xx0800000329
2  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
3  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
4  CAUTION The gearbox can contain an excess of pressure that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5 Open the <i>oil plug, armhouse</i> .	See the figure in: <ul style="list-style-type: none">• Location of oil plugs on page 175
6 Refill the gearbox with <i>lubricating oil</i> .  Tip Use a funnel.  Note The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 158 .

Continues on next page

3 Maintenance

3.5.5 Changing the oil, axis-3 gearbox

Continued

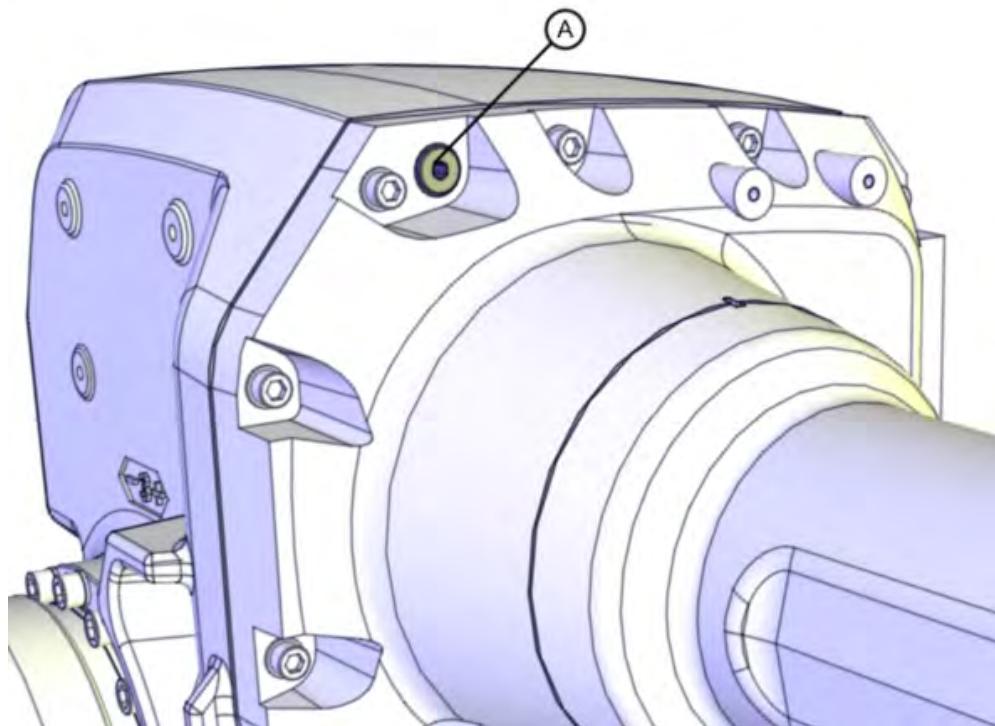
	Action	Note
7	Inspect the <i>oil level</i> .	How to inspect oil is described in section: <ul style="list-style-type: none">• <i>Inspecting the oil level, axis 3 gearbox on page 132</i>
8	Refit the <i>oil plug</i> .	Tightening torque: <ul style="list-style-type: none">• in armhouse: 10 Nm• in gearbox: 3 Nm
9	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See <i>Replacing parts on the robot on page 205</i> .	

3.5.6 Changing the oil, axis-4 gearbox

Location of oil plugs

The axis-4 gearbox is located in the front of the upper armhouse.

The oil plug is shown in the figure.



xx0800000307

A	Oil plug, for filling and draining
---	------------------------------------

Required equipment

Equipment	Note
Lubricating oil	Where to find information of the <i>type of oil</i> , <i>article number</i> and the <i>amount</i> in the gearbox, see section Type of lubrication in gearboxes on page 158
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Plastic hose	Used for venting the gearbox during draining. A suitable hose would be a hose normally used for compressed air. Length: minimum 300 mm. Diameter: 5 mm.
Funnel	 xx1200000862

Continues on next page

3 Maintenance

3.5.6 Changing the oil, axis-4 gearbox

Continued

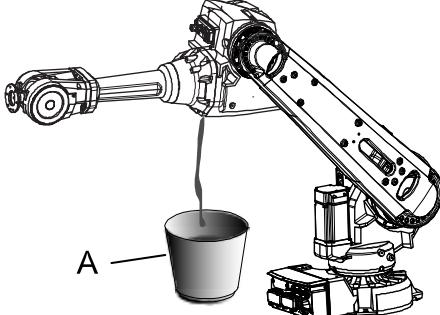
Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Draining oil

Use this procedure to drain oil from the gearbox.

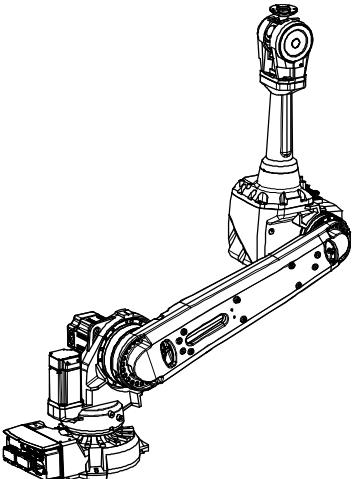
	Action	Note
1	Move the robot to the position shown in the figure.	 xx0800000328 • A: Oil collecting vessel
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
3	 WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	

Continues on next page

Action	Note
4  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	
5 Open <i>oil plug, draining.</i>	See the figure in: • Location of oil plugs on page 181
6 Drain the gearbox oil using an <i>oil collecting vessel.</i>  Tip Insert a compressed air hose approximately 100 mm into the gearbox, to vent the gearbox. This speeds up the draining significantly.	 Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.
7  WARNING Used oil is hazardous material and must be disposed of in a safe way. See section De-commissioning on page 379 for more information.	
8 Refit the oil plug.	Tightening torque: 10 Nm.

Filling oil

Use this procedure to fill oil in the gearbox.

Action	Note
1 Move the upper arm to the position shown in the figure.	 xx0800000330

Continues on next page

3 Maintenance

3.5.6 Changing the oil, axis-4 gearbox

Continued

Action	Note
<p>2  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
<p>3  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56.</p>	
<p>4  CAUTION The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.</p>	
<p>5 Open the <i>oil plug, filling.</i></p>	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of oil plugs on page 181
<p>6 Refill the gearbox with <i>lubricating oil.</i></p> <p> Tip Use a funnel.</p> <p> Note The amount of oil to be filled depends on the amount previously being drained.</p>	<p>Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 158.</p>
<p>7 Refit the <i>oil plug.</i></p>	<p>Tightening torque: 10 Nm.</p>
<p>8 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205.</p>	

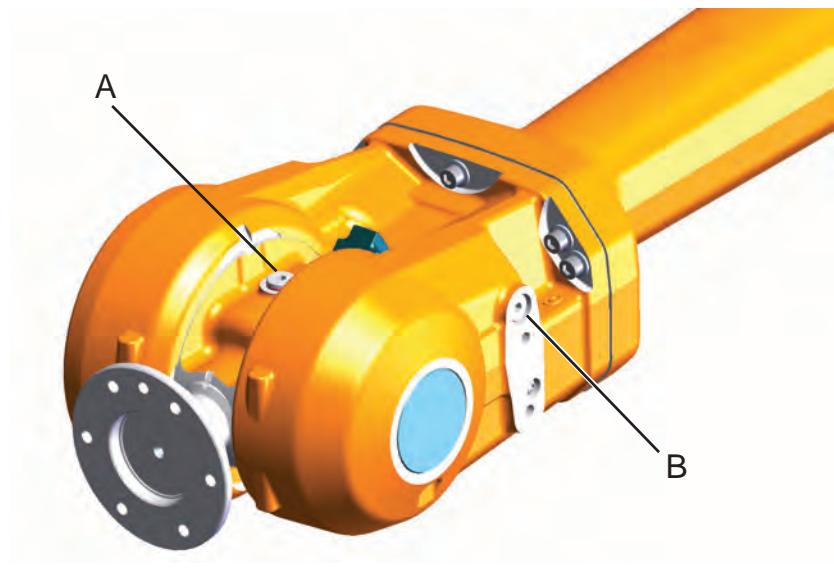
3.5.7 Changing oil, axes-5 and -6 gearboxes

Location of oil plugs

The axes-5 and -6 gearboxes are located in the wrist unit.

The oil plug is shown in the figure.

The figure shows wrist variant 60 kg



xx0800000308

A	Oil plug, tilthouse
B	Oil plug, wrist unit (also used as air inlet when draining from oil plug A)



Note

The gearboxes for axes-5 and -6 are the same.

Required equipment

Equipment	Note
Lubrication oil	Where to find information of the <i>type of oil, article number</i> and the <i>amount</i> in the gearbox, see section: Type of lubrication in gearboxes on page 158
Oil collecting vessel	The capacity of the vessel must be sufficient to take the complete amount of oil.
Standard toolkit	Content is defined in section Standard tools on page 391 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	

Continues on next page

3 Maintenance

3.5.7 Changing oil, axes-5 and -6 gearboxes

Continued

Equipment	Art. no.	Note
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Draining axes-5 and -6 gearbox - wrist 60 kg

Use this procedure to drain oil from the gearbox.



CAUTION

The gearbox can contain an *excess of pressure* that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.

	Action	Note
1	Move the <i>upper arm</i> to a position where it points downwards.	
2	Move axis 5 to a position where the <i>oil plug, tilthouse</i> points downwards.	The turning disk shall be in a horizontal position.
3	DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
4	WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
5	Put an <i>oil collecting vessel</i> under the wrist in order to collect drained oil.	The capacity of the vessel must be sufficient to take the complete amount of oil.
6	Open the <i>oil plug, tilthouse</i> .	See the figure in: <ul style="list-style-type: none">• Location of oil plugs on page 185
7	Open the oil plug, wrist (air inlet). This is done for the ventilation of the gearbox and to facilitate draining.	See the figure in: <ul style="list-style-type: none">• Location of oil plugs on page 185
8	Drain the gearbox.	Note Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.

Continues on next page

Action	Note
9  WARNING Used oil is hazardous material and must be disposed of in a safe way. See section De-commissioning on page 379 for more information.	

Filling oil axes-5 and -6 gearbox - wrist 60 kg

Use this procedure to fill oil in the gearbox.

 CAUTION	
The gearbox can contain an <i>excess of pressure</i> that can be hazardous. Open the oil plug carefully in order to let out the excess pressure.	

Action	Note
1 Move the upper arm to a position where the <i>oil plug, wrist</i> points upwards.	See the figure in: • Location of oil plugs on page 185
2 Move axis-5 to a position where the <i>oil plug, tilthouse</i> points upwards.	See the figure in: • Location of oil plugs on page 185
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
4  WARNING Handling gearbox oil involves several safety risks. Before proceeding, please read the safety information in the section WARNING - Safety risks during work with gearbox lubricants (oil or grease) on page 56 .	
5 Open <i>oil plug, wrist</i> .	See the figure in: • Location of oil plugs on page 185
6 Open <i>oil plug, tilthouse</i> .	See the figure in: • Location of oil plugs on page 185
7 Refill oil using <i>oil plug, wrist</i> .  Note There will be some oil left in the gearbox after draining.	There will be oil left in the gearbox after draining. Therefore the amount of oil filled will be less than the total amount. When filling oil in a wrist (60 kg) begin by only filling 1.500 ml. Check oil level. If needed add more oil.

Continues on next page

3 Maintenance

3.5.7 Changing oil, axes-5 and -6 gearboxes

Continued

	Action	Note
8	Refill the gearbox with <i>lubrication oil</i> .  Note The amount of oil to be filled depends on the amount previously being drained.	Where to find type of oil and total amount is detailed in Type and amount of oil in gearboxes on page 158 .
9	Inspect the <i>oil level</i> .	How to inspect the oil level is described in section: <ul style="list-style-type: none">• Inspecting oil level, gearbox axes 5 - 6 on page 137
10	Refit both oil plugs.	Tightening torque: <ul style="list-style-type: none">• 10 Nm
11	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

3.5.8 Replacing 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 instructions for batteries, [WARNING - Safety risks during handling of batteries on page 55](#).

Continues on next page

3 Maintenance

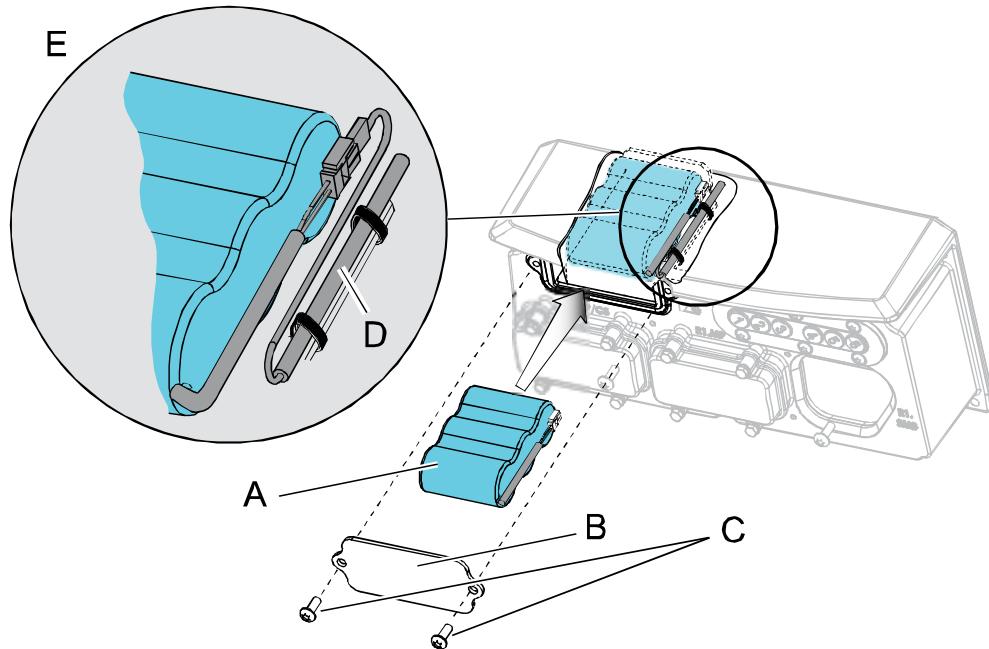
3.5.8 Replacing SMB battery

Continued

Location of SMB battery

The SMB battery is located at the base of the robot, as shown in the figure.

DSQC 633A

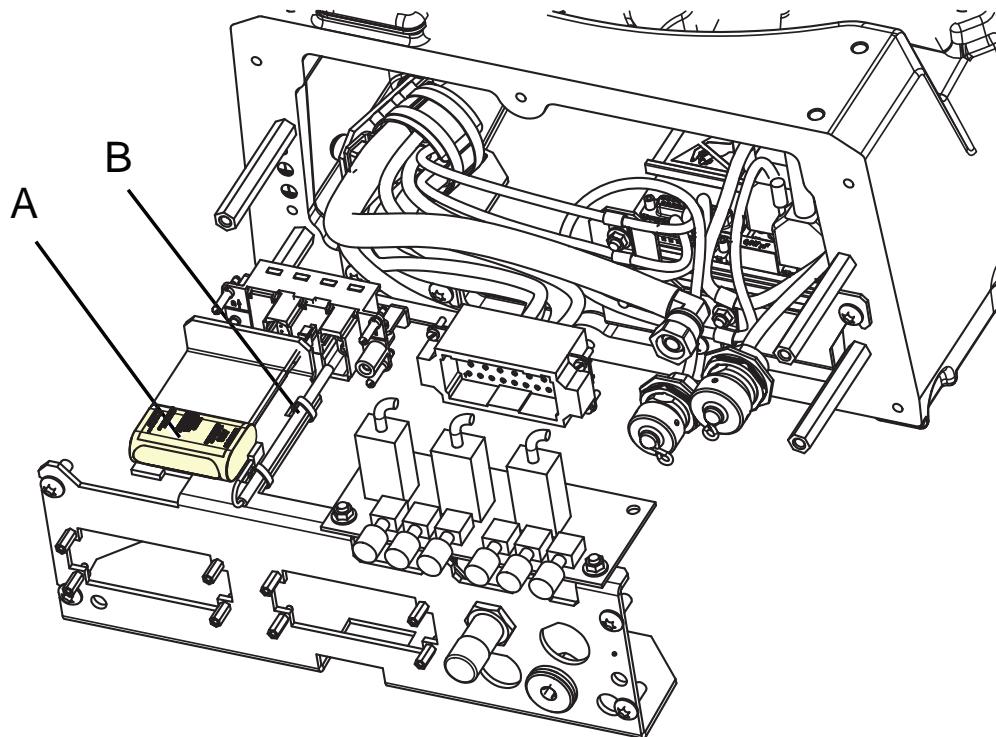


xx0800000322

A	SMB battery (2-pole battery contact)
B	Battery cover
C	Attachment screws
D	SMB battery cable
E	How to arrange the battery cable

Continues on next page

RMU 101



xx1300000339

A	SMB battery (3-pole battery contact)
B	Battery cover

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	Note
SMB battery pack	Battery includes protection circuits. Replace it only with given spare part no. or an ABB approved equivalent. See Spare part lists on page 397 .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Circuit diagram	See chapter Circuit diagram on page 399 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol

Continues on next page

3 Maintenance

3.5.8 Replacing SMB battery

Continued

Equipment	Art. no.	Note
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Removing SMB 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 the updating of the revolution counter.
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
3	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 53	
4	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
5	Remove the <i>SMB battery cover</i> .	See the figure in Location of SMB battery on page 190 .
6	Pull out the <i>SMB battery</i> .	See the figure in Location of SMB battery on page 190 .
7	Disconnect the <i>battery cable</i> and remove the battery.	See the figure in Location of SMB battery on page 190 .
8	How to dispose of the used SMB battery, see chapter Decommissioning on page 379 .	

Continues on next page

Refitting SMB battery

Use this procedure to refit the SMB battery.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	 ELECTROSTATIC DISCHARGE (ESD) The unit is sensitive to ESD. Before handling the unit please read the safety information in the section WARNING - The unit is sensitive to ESD! on page 53	
3	Reconnect the <i>battery cable</i> to the <i>SMB battery</i> .	See the figure in Location of SMB battery on page 190 .
4	Put the battery unit into its recess while arranging the SMB cables as shown in the figure.	See the figure in Location of SMB battery on page 190 .
5	Secure the <i>SMB cover</i> with its <i>attachment screws</i> .	See the figure in Location of SMB battery on page 190 .
6	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
7	Update the revolution counter.	Detailed in Updating revolution counters on page 358 .
8	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

3 Maintenance

3.6.1 Analysing the water content in gearbox oil

3.6 Analysis activities

3.6.1 Analysing the water content in gearbox oil

Analysis of the water content

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

Effect on gearbox replacement

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

	If:	Then....
1	<p>More than 3% water in oil:</p> <ul style="list-style-type: none">With more than 3% water content there is a risk for corrosion in the gearbox and reduced viscosity in the oil.	<p>Replacement of gearbox required every two years</p> <p>xx0600003155</p> <ul style="list-style-type: none">A: Water content in gearbox oilB: Months or hours in operationC: Replacement of gearbox
2	Less than 3% water in oil.	<p>Normal replacement interval is required for the gearbox.</p> <p>See Analysing the water content in gearbox oil on page 194.</p> <ul style="list-style-type: none">Activities and intervals, Foundry Prime on page 120 <p>xx0600003156</p> <ul style="list-style-type: none">A: Water content in gearbox oilB: Months or hours in operation

3.7 Cleaning activities

3.7.1 Cleaning the IRB 4600 Foundry Prime



WARNING

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

General

To secure high uptime it is important that the IRB 4600 Foundry Prime is cleaned regularly. The frequency of cleaning depends on the environment in which the manipulator works.

Different cleaning methods are allowed depending on the type of protection of the IRB 4600 Foundry Prime.



Note

Always verify the protection type of the robot before cleaning.

Oil spills

Oil spills from gearboxes

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

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

Oil spills discolors painted surfaces

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



Note

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

Dos and don'ts!

This section specifies some special considerations when cleaning the robot.

Always!

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

Continues on next page

3 Maintenance

3.7.1 Cleaning the IRB 4600 Foundry Prime

Continued

Never!

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

Cleaning methods

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

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Foundry Prime	Yes	Yes. With cleaning detergent approved by ABB, spirit or isopropyl alcohol. See Approved cleaners and detergents on page 197 .	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. If cleaning detergents are used they must be approved by ABB for Foundry Prime robots. See Approved cleaners and detergents on page 197 .

ⁱ Perform according to section [Cleaning with water and steam on page 196](#).

Cleaning with water and steam

Instructions for rinsing with water

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

The following list defines the prerequisites:

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

¹ Typical tap water pressure and flow

Instructions for steam or high pressure water cleaning

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2500 kN/m² (25 bar)
- Fan jet nozzle should be used, min. 45° spread

¹ See [Cleaning methods on page 196](#) for exceptions.

² See [Cleaning methods on page 196](#) for exceptions.

Continues on next page

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

Additional cleaning instructions for Foundry Prime robots

Washing detergents

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



Note

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

Approved cleaners and detergents

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

Temperature of cleaning bath

- Maximum temperature <60°C.
- Ambient temperature must not be higher than +45 °C.



Note

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

Washing without detergent

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

Cables

Movable cables need to be able to move freely:

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

Continues on next page

3 Maintenance

3.7.1 Cleaning the IRB 4600 Foundry Prime

Continued

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

4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes all repair activities recommended for the IRB 4600 Foundry Prime and any external unit.

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



WARNING

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

Required equipment

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

The details of equipment are also available in different lists in the chapter [Reference information on page 383](#).

Safety information

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



Note

If the IRB 4600 Foundry Prime is connected to power, always make sure that the IRB 4600 Foundry Prime is connected to earth before starting any repair work.

For more information see:

- *Product manual - IRC5*

4 Repair

4.2.1 Performing a leak-down test

4.2 General procedures

4.2.1 Performing a leak-down test

When to perform a leak-down test

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

Required equipment

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

Performing a leak-down test

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

4.2.2 Mounting instructions for bearings

General

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

Equipment

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

Assembly of all bearings

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

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

Assembly of tapered bearings

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

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

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

Greasing of bearings

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

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

Continues on next page

4 Repair

4.2.2 Mounting instructions for bearings

Continued

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

Grease the different types of bearings as following description:

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

4.2.3 Mounting instructions for seals

General

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

Equipment

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

Rotating seals

The procedure below describes how to fit rotating seals.



CAUTION

Please observe the following before commencing any assembly of seals:

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

Action	Note
1 Check the seal to ensure that: <ul style="list-style-type: none"> • The seal is of the correct type (provided with cutting edge). • There is no damage to the sealing edge (feel with a fingernail). 	
2 Inspect the sealing surface before mounting. If scratches or damage are found, the seal must be replaced since it may result in future leakage.	
3 Lubricate the seal with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the seal.) Fill 2/3 of the space between the dust tongue and sealing lip with grease. The rubber coated external diameter must also be greased, unless otherwise specified.	Article number is specified in Equipment on page 203 .
4 Mount the seal correctly with a mounting tool. Never hammer directly on the seal as this may result in leakage.	

Continues on next page

4 Repair

4.2.3 Mounting instructions for seals

Continued

Flange seals and static seals

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

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

O-rings

The following procedure describes how to fit o-rings.

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

4.2.4 Replacing parts on the robot

General

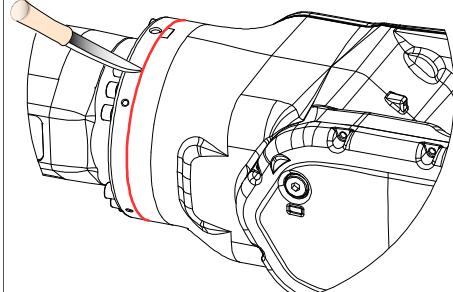
Follow the procedures in this section whenever breaking the surface paint of the robot during replacement of parts.

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

Required equipment

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

Removing

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

Refitting

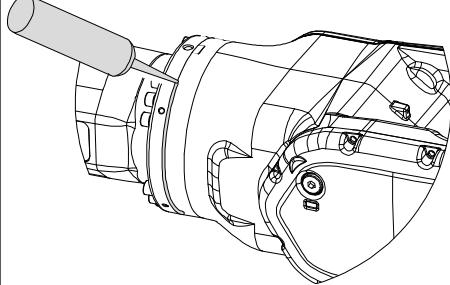
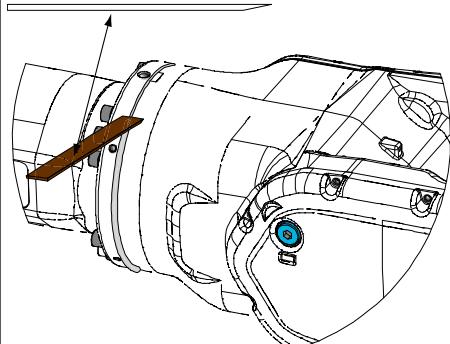
	Action	Description
1	Before the parts are refitted, clean the joint so that it is free from oil and grease.	Use ethanol on a lint free cloth.
2	Place the tooling pin in hot water.	

Continues on next page

4 Repair

4.2.4 Replacing parts on the robot

Continued

Action	Description
3 Seal all refitted joints with Sikaflex 521FC.	 xx0900000122
4 Use the tooling pin to even out the surface of the Sikaflex seal.	 xx0900000125
5 Wait 15 minutes.	Sikaflex 521FC skin dry time (15 minutes).
6 Use Touch up paint Foundry Prime 2, grey to paint the joint.	3HAC035355-001
<p> Note</p> <p>Always read the instruction in the product data sheet in the paint repair kit for Foundry Prime.</p>	
7 Apply Mercasol on all screw heads and set screws after tightening.	

4.3 Complete robot

4.3.1 Removing the complete cable harness

Introduction

This procedure describes how to remove the complete cable harness.

How to refit the cable harness is described in section [Refitting the complete cable harness on page 220](#).

The removal procedure is presented in the order the work is recommended to be performed. Therefore the order is different in the two procedures removal and refitting of the cable harness. Cross references will make it easy to find what is needed to know as the work continues.

The section *Removing the complete cable harness* consists of the following parts presented in the order the work is recommended to be performed:

- Removal in the *base* [Removing cable harness in base on page 210](#)
- Removal in the *frame* [Removing cable harness in frame on page 215](#)
- Removal in *lower arm* and *armhouse* [Removing cable harness in lower arm and armhouse on page 217](#).

How to replace the SMB unit, brake release unit and motors can be found in:

- SMB unit [Removing the SMB unit on page 250](#)
- Brake release unit [Removing the brake release board on page 255](#)
- Motors [Removing motors on page 306](#)

Continues on next page

4 Repair

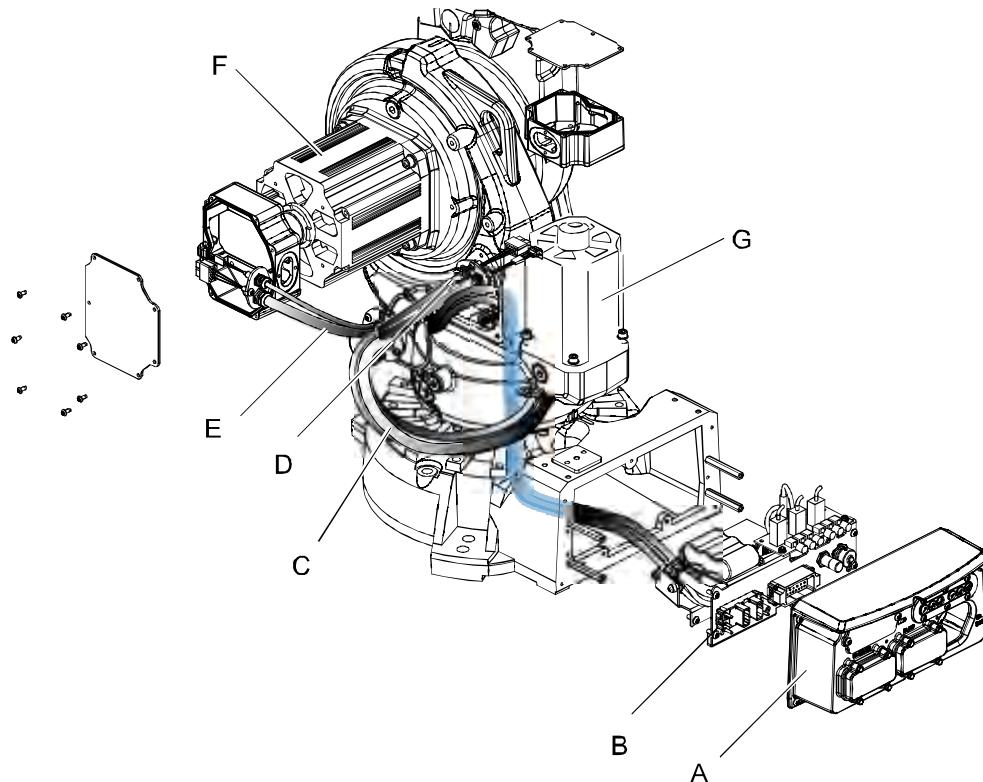
4.3.1 Removing the complete cable harness

Continued

Location of the cable harness

The location of the cable harness in the base, frame and lower arm is shown in the figures.

Cable harness, base and frame.



xx0900000009

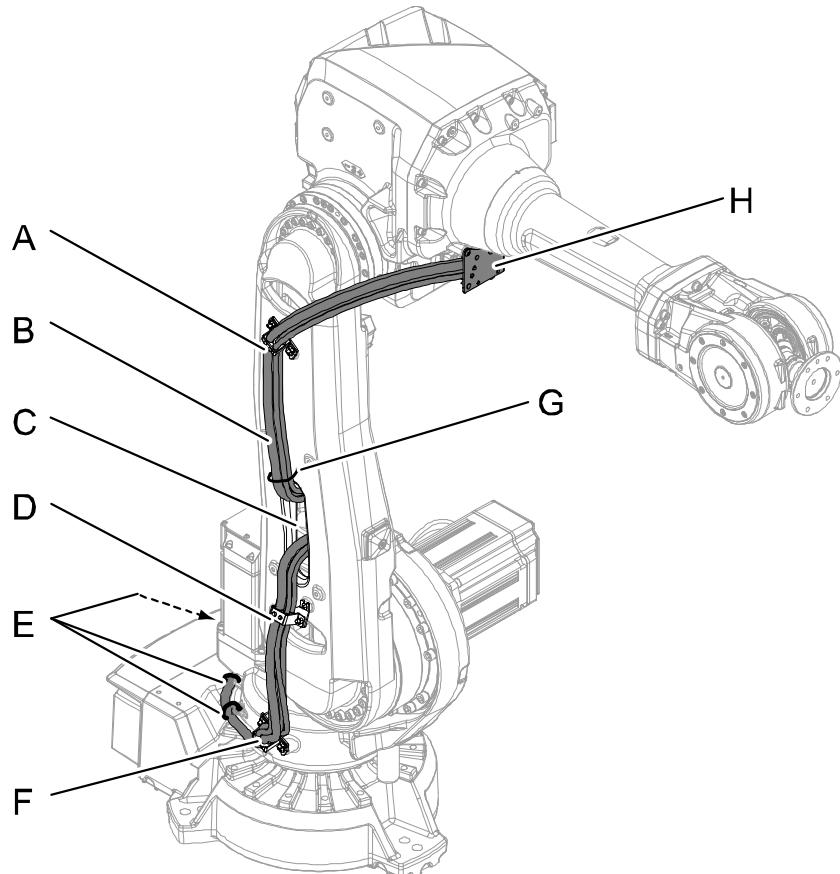
A	Cover base
B	Bracket
C	Cable harness
D	Axis-1 motor cable
E	Axis-2 motor cable
F	Axis-2 motor
G	Axis-1 motor

Continues on next page

4.3.1 Removing the complete cable harness

Continued

Cable harness, lower arm.



xx0900000012

A	Bracket, lower arm
B	Cable harness
C	Hole in lower arm
D	Bracket, lower arm
E	Cable straps, one not visible here (steel)
F	Bracket, frame
G	Cable strap, lower arm (plastic)
H	Bracket, armhouse

Required equipment

Equipment	Note
Deep well hexagon socket	Width 30 mm
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Continues on next page

4 Repair

4.3.1 Removing the complete cable harness

Continued

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . 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.	

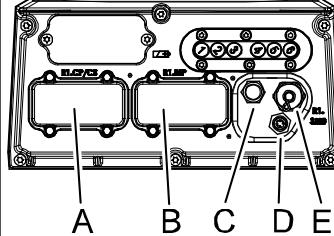
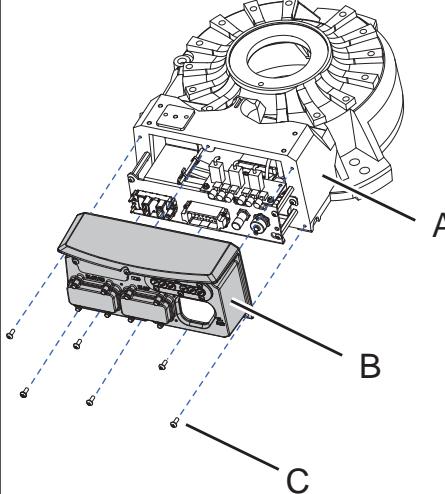
Removing cable harness in base

Use this procedure to remove the cable harness in the base.

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

Continues on next page

4.3.1 Removing the complete cable harness Continued

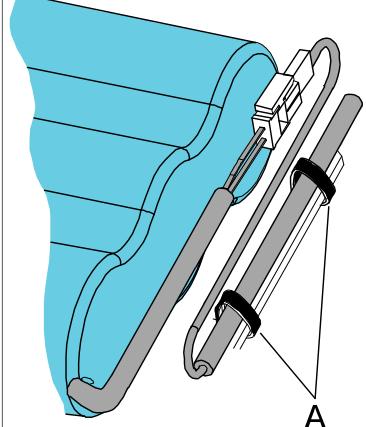
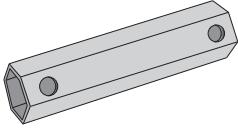
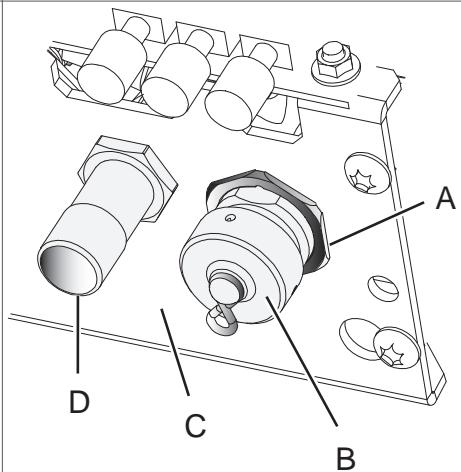
Action	Note
<p>2  DANGER Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
<p>3 Disconnect the following connectors on the <i>base cover</i>:</p> <ul style="list-style-type: none"> • R1.CP/CS • R1.MP • R1.CBUS (if used) <p> Tip Do not remove the <i>R1.SMB-connector</i> and <i>air hose connector</i> at this stage. It will be easier to remove these two when the cover base has been removed.</p>	 xx0900000014 Parts: <ul style="list-style-type: none"> • A: R1.CP/CS • B: R1.MP • C: Air hose connector • D: Position of R1.CBUS (if used) • E: R1.SMB
<p>4  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205</p>	
<p>5 Remove the <i>cover base</i>.</p>	 xx0800000456 A Base B Cover base C Attachment screws

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4 Repair

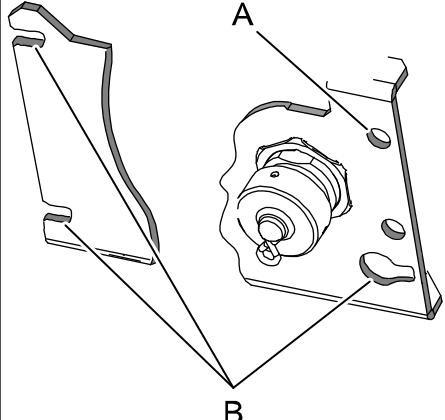
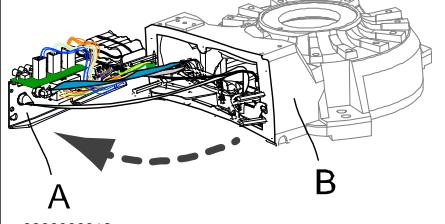
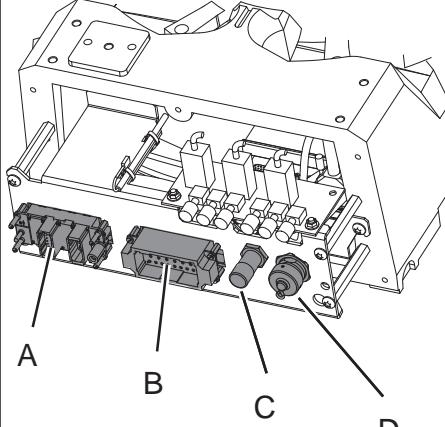
4.3.1 Removing the complete cable harness

Continued

Action	Note
6 Disconnect connectors on the brake release unit: <ul style="list-style-type: none">• X8• X9• X10	
7 Cut the <i>cable straps</i> securing the battery cable.	 xx090000099 <p>Parts:</p> <ul style="list-style-type: none"> • A: Cable straps (2 pcs)
8 Disconnect the battery cable.	
9 Unscrew the thin nut securing the R1.SMB connector on the outside of the bracket.	<p> Tip</p> <p>Use a deep well hexagon socket, width 30 mm (like the ones used for spark plugs, or similar).</p>  xx1200000888  xx1200000889 <p>A Thin nut, width 30 mm B R1.SMB C Bracket D Air connector</p>
10 Unscrew the nut for the air connection on the inside of the bracket.	

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4.3.1 Removing the complete cable harness Continued

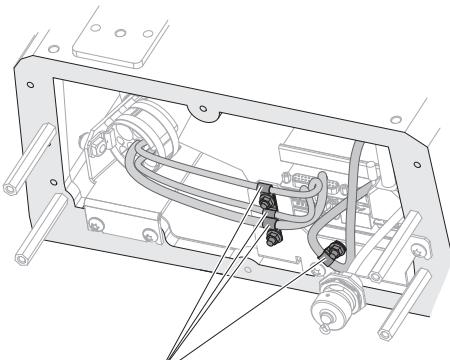
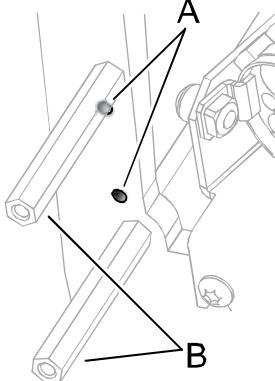
Action	Note
11 Remove the screw that secures the bracket and unscrew the three other screws a little just enough to be able to slide the bracket sideways.	 <p>xx0900000100</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Screw to be removed B: Screws to be unscrewed (3 pcs)
12 Remove the <i>bracket</i> by sliding it off the remaining three attachment screws and put it at a 90° angle from the base. Putting the bracket at a 90° angle facilitates the disconnecting of cables from the bracket.	 <p>xx090000013</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Bracket at a 90° angle B: Base
13 Remove connectors and air hose connector completely from the <i>bracket</i> : <ul style="list-style-type: none"> R1.CP/CS R1.MP R1.SMB Air hose connector R1.CBUS (if used) 	 <p>xx1200000890</p> <p> A R1.CP/CS B R1.MP C Air hose connector D R1.SMB </p>
14 Remove the <i>SMB unit</i> from its attachment screws. Leave the screws in the base.	<p>How to remove the <i>SMB unit</i> is described in section:</p> <ul style="list-style-type: none"> Removing the SMB unit on page 250

Continues on next page

4 Repair

4.3.1 Removing the complete cable harness

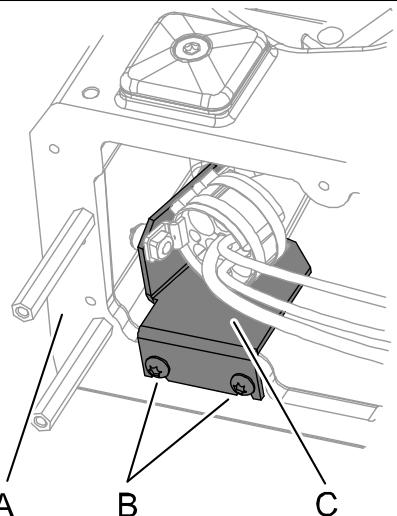
Continued

Action	Note
15 Disconnect connectors on the SMB unit: <ul style="list-style-type: none"> • R1.SMB1-2 • R1.SMB2-6 • R2.SMB 	
16 Disconnect the <i>screen connections</i> of: <ul style="list-style-type: none"> • R1.SMB1-2 • R1.SMB2-6 	 <p>xx0900000035</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Screen connection (4 pcs)
17 Disconnect the <i>earth cables</i> .	 <p>xx0900000015</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Earth • B: Distance screws

Continues on next page

4.3.1 Removing the complete cable harness

Continued

Action	Note
18 Remove the <i>bracket</i> securing the cable package inside the base on the left side, by following these steps: <ul style="list-style-type: none"> • Unscrew the attachment screws just enough to be able to remove the bracket. • Lift the bracket off the screws. 	 xx0900000018 <p>Parts:</p> <ul style="list-style-type: none"> • A: Base • B: Attachment screws • C: Bracket
19 Continue removal of the cable package from the frame.	How to remove the cable package from the frame is described in section <ul style="list-style-type: none"> • Removing cable harness in frame on page 215

Removing cable harness in frame

Use this procedure to remove the cable harness in the frame.



Tip

Before starting this procedure, first remove the cable harness in the base. See [Removing the complete cable harness on page 207](#).

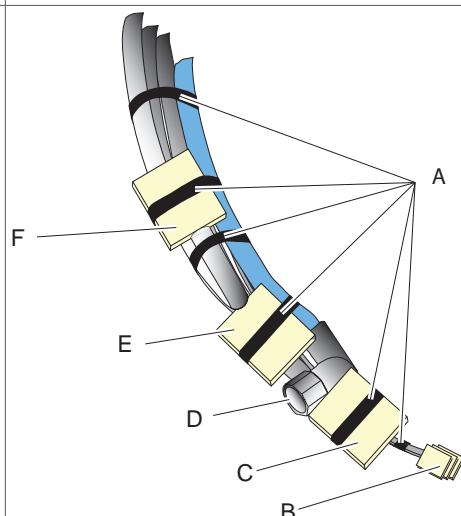
Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2 Disconnect the <i>motor cables</i> on the axis-1 and axis-2 motors.	How to remove the motor cables is described in section: <ul style="list-style-type: none"> • Removing motors on page 306

Continues on next page

4 Repair

4.3.1 Removing the complete cable harness

Continued

Action	Note
3  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
4 Remove the <i>bracket</i> securing the cable package to the frame.	See the figure in: <ul style="list-style-type: none">Location of the cable harness on page 208
5 Cut the <i>cable straps</i> securing the cable harness to the frame and lower arm.	See the figure in: <ul style="list-style-type: none">Location of the cable harness on page 208
6 Prepare the end of the cable package in the base with tape as shown in the figure.  Tip In order to protect the connectors from getting residual grease on the cable harness, put some plastic over them prior to pushing it through the hole in the frame.	 xx1200000886 <ul style="list-style-type: none"> A Tape B Connectors to SMB unit and Brake release unit C R1.CP/CS D Air hose E R1.MP F R1.SMB (Connector bent and taped upwards)
7 Pull out the cable package through the hole in the frame.  Note Use caution when performing this procedure in order not to damage cables or other components!	
8 Continue the removal of the cable package from the lower arm and armhouse.	How to remove the cable package from the lower arm and armhouse is described in section: <ul style="list-style-type: none">Removing cable harness in lower arm and armhouse on page 217

Continues on next page

Removing cable harness in lower arm and armhouse

Use this procedure to remove the cable harness in the lower arm and armhouse.

**Tip**

Before starting this procedure, first remove the cable harness in the base [Removing the complete cable harness on page 207](#) and frame [Removing the complete cable harness on page 207](#).

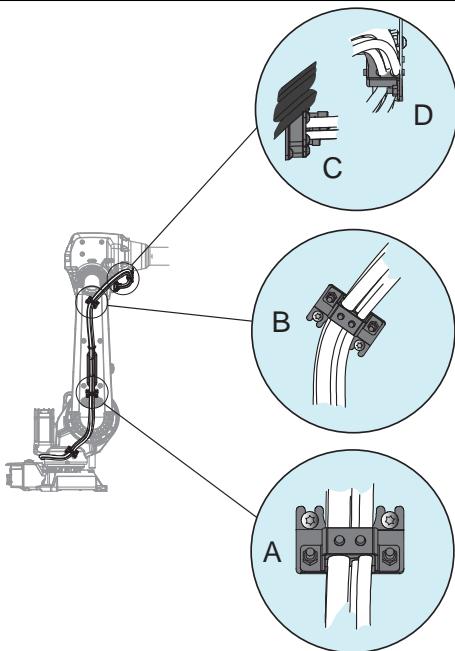
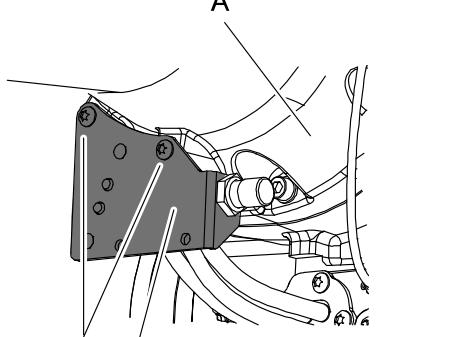
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Cut the <i>cable strap</i> on the lower arm.	See the figure in: <ul style="list-style-type: none"> • Location of the cable harness on page 208 (Cable harness, lower arm)
3	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	

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4 Repair

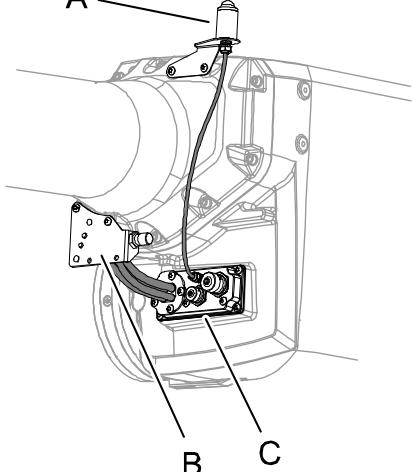
4.3.1 Removing the complete cable harness

Continued

Action	Note
4 Remove the <i>brackets</i> on the lower arm.	 <p>xx0900000020</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Bracket, lower arm • B: Bracket, lower arm • C: Bracket, armhouse • D: Cable bracket
5 Remove the <i>bracket</i> on the armhouse.	 <p>xx0800000335</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Tubular shaft unit • B: Attachment screws • C: Bracket, armhouse

Continues on next page

4.3.1 Removing the complete cable harness
Continued

Action	Note
6 Remove the <i>cable cover</i> on the armhouse.	 <p>xx0800000338</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Signal lamp • B: Bracket • C: Cable cover, armhouse
7 Remove signal lamp if used.	
8 Continue the removal of the cable package by disconnecting the motor cables of the axis-3, axis-4, axis-5 and axis-6 motors.	<p>How to remove the <i>motor cables</i> from the <i>axis-3, axis-4, axis-5 and axis-6 motors</i> see section:</p> <ul style="list-style-type: none"> • Removing motors on page 306

4.3.2 Refitting the complete cable harness

Introduction

This procedure describes how to refit the complete cable harness.

How to remove the cable harness is described in [Removing the complete cable harness on page 207](#).

The refitting procedure is presented in the order the work is recommended to be performed.

Therefore the order is different in the two procedures removal and refitting of the cable harness. Cross references will make it easy to find what is needed to know as the work continues.

The section *Refitting the complete cable harness* consists of the following parts presented in the order the work is recommended to be performed:

- Refitting in the frame [Refitting the cable harness in the frame on page 223](#)
- Refitting in the base [Refitting the cable harness in the base on page 227](#)
- Refitting in the lower arm and armhouse [Refitting the cable harness in the lower arm and armhouse on page 233](#).

How to refit the SMB unit, brake release unit and motors can be found in:

- SMB unit [Refitting the SMB unit on page 252](#)
- Brake release unit [Refitting the brake release board on page 256](#)
- Motors [Refitting motors on page 315](#)

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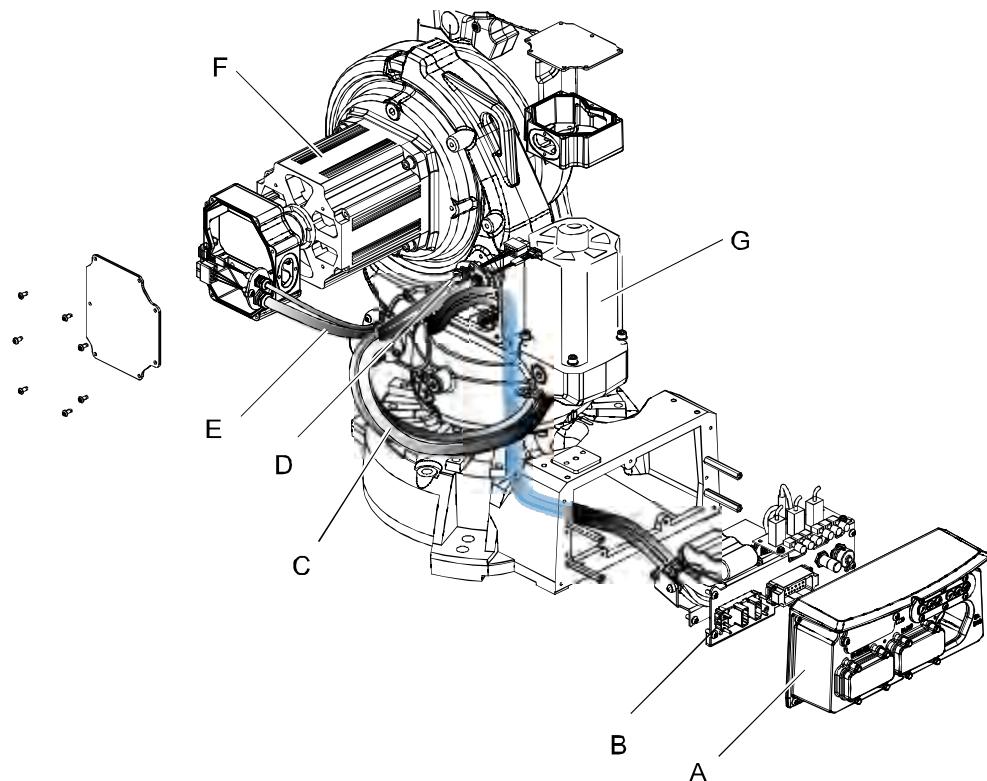
4.3.2 Refitting the complete cable harness

Continued

Location of the cable harness

The location of the cable harness in the base, frame and lower arm is shown in the figures.

Cable harness, base and frame.



xx0900000009

A	Cover base
B	Bracket
C	Cable harness
D	Axis-1 motor cable
E	Axis-2 motor cable
F	Axis-2 motor
G	Axis-1 motor

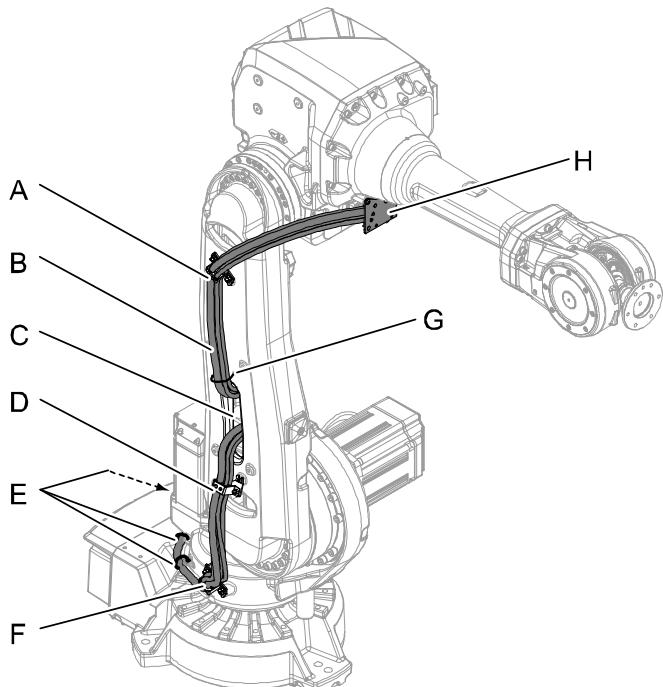
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4 Repair

4.3.2 Refitting the complete cable harness

Continued

Cable harness, lower arm.



xx0900000012

A	Bracket, lower arm
B	Cable harness
C	Hole in lower arm
D	Bracket, lower arm
E	Cable straps, one not visible here (steel)
F	Bracket, frame
G	Cable strap, lower arm (plastic)
H	Bracket, armhouse

Required equipment

Equipment	Note
Deep well hexagon socket	Width 30 mm
Standard toolkit	Content is defined in section Standard tools on page 391 .
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.
Cable grease	Shell Alvania WR2

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol

Continues on next page

4.3.2 Refitting the complete cable harness

Continued

Equipment	Art. no.	Note
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Refitting the cable harness in the frame

Use this procedure to refit the cable harness in the frame.

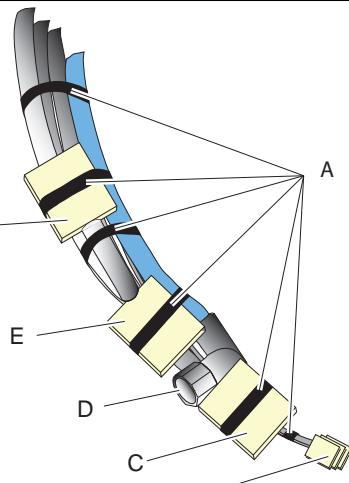
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3	Apply cable grease on these surfaces: <ul style="list-style-type: none"> • cable guide inside the hole • the part of the cable harness that runs through the cable guide. 	Cable grease is specified in: <ul style="list-style-type: none"> • Required equipment on page 222
4	 Note Two alternative methods to insert the cable package in frame and base are presented below. Chose one of the methods.	

Continues on next page

4 Repair

4.3.2 Refitting the complete cable harness

Continued

Action	Note
<p>5 <i>Use this procedure when replacing the old cable harness:</i></p> <p>Method 1, step 1:</p> <p>Prepare the end of the cable package in the base with tape as shown in the figure.</p> <p> Tip</p> <p>In order to protect the connectors from getting residual grease on the cable harness, put some plastic over them prior to pushing it through the hole in the frame.</p>	 <p>xx1200000886</p> <p>A Tape B Connectors to SMB unit and Brake release unit C R1.CP/CS D Air hose E R1.MP F R1.SMB (Connector bent and taped upwards)</p>
<p>6 <i>Use this procedure when replacing the old cable harness:</i></p> <p>Method 1, step 2:</p> <p>Push the cable package carefully in through the base and up through the hole in the frame.</p> <p> Note</p> <p>Use caution when performing this procedure in order not to damage cables or other components!</p>	

Continues on next page

4.3.2 Refitting the complete cable harness

Continued

Action	Note
<p>7 <i>Use this procedure when replacing the old cable harness:</i></p> <p>Method 2:</p> <p>Push the cable harness carefully into the hole in the frame and out of the hole in the base.</p> <p>Perform the procedure in the following order:</p> <ul style="list-style-type: none"> • R1.MP • R1.CP/CS • R1.SMB1-2 and R1.SMB3-6 • Air hose. <p> Note</p> <p>Use caution when performing this procedure in order not to damage cables or other components!</p> <p> Tip</p> <p>In order to protect the connectors from getting residual grease on the cable harness, put some plastic over them prior to pushing it through the hole in the frame.</p>	
<p>8 <i>Use this procedure when fitting a new cable harness:</i></p> <p>Without removing the plastic around cables and hose, push the cable harness through the hole in the frame.</p> <p> Note</p> <p>Use caution when performing this procedure in order not to damage cables or other components!</p>	 Note Check that cables and air hose are placed as shown in the figure above.

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4 Repair

4.3.2 Refitting the complete cable harness

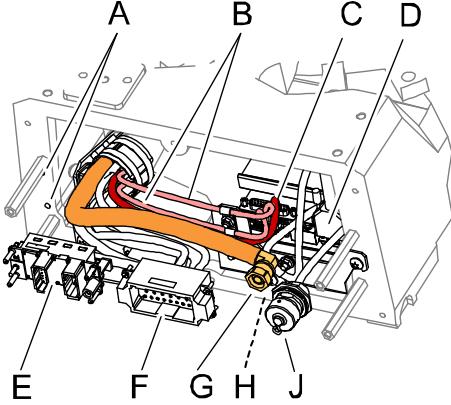
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Action	Note
9	<p>Note</p> <p>It is vital that the position of the air hose is correct, as shown in the figure!</p> <p>xx0900000096</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Cables • B: Air hose • C: Hole in frame • D: Cable guide • E: Position of the front of the robot
10	<p>Secure the cover to the frame with its attachment screws.</p> <p>xx0900000016</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Frame • B: Hole in frame • C: Cover
11	<p>Connect the axis-1 and axis-2 motor cables.</p> <p>How to refit the motor cables is described in section:</p> <ul style="list-style-type: none"> • Refitting motors on page 315

Continues on next page

4.3.2 Refitting the complete cable harness

Continued

Action	Note
12 Sort out the different cables the way they later will be fit on the bracket in the base.	 xx0900000017 <p>Connections:</p> <ul style="list-style-type: none"> A: Earth cables B: R1.SMB1-2 C: R1.SMB3-6 D: R2.SMB E: R1.CP/CS F: R1.MP G: Air hose H: Position of R1.CBUS (if used) J: R1.SMB
13 Continue the refitting of the cable harness in the base.	How to refit the cable harness in the base is described in section: <ul style="list-style-type: none"> <i>Refitting the cable harness in the base on page 227</i>

Refitting the cable harness in the base

Use this procedure to refit the cable harness in the base.



Tip

Before starting this procedure, first refit the cable harness in the frame. See:

- Refitting the complete cable harness on page 220*

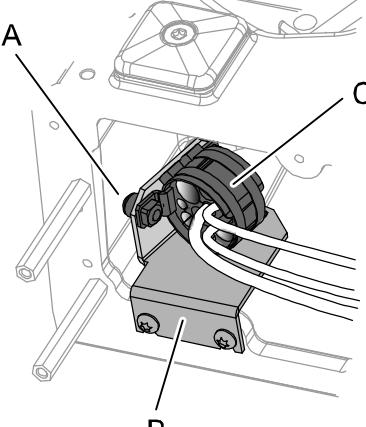
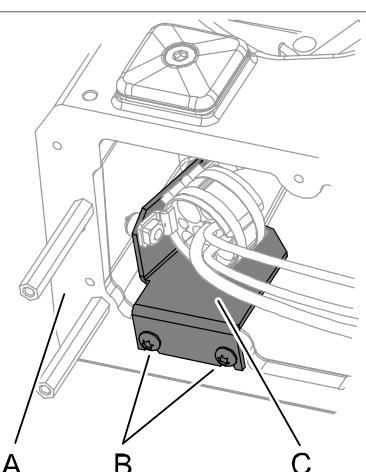
Action	Note
 DANGER Turn off all: <ul style="list-style-type: none"> electric power supply hydraulic pressure supply to the robot, before entering the robot working area.	

Continues on next page

4 Repair

4.3.2 Refitting the complete cable harness

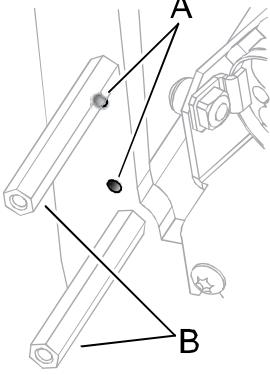
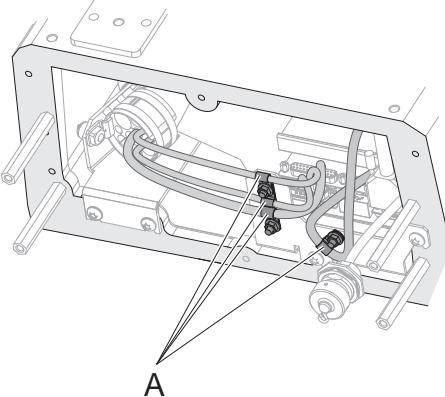
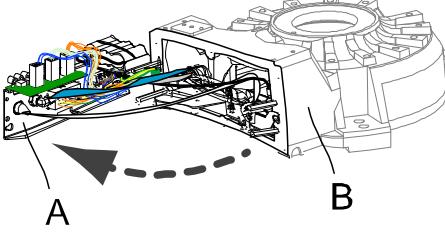
Continued

Action	Note
2 Attach the <i>cable harness</i> to the bracket.	 <p>xx0900000098</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Attachment screw and nut • B: Bracket • C: Cable harness
3 Secure the <i>bracket</i> on its <i>attachment screws</i> in the <i>base</i> .	<p> Tip</p> <p>Perform this in the following order:</p> <ul style="list-style-type: none"> • Put the <i>attachment screws</i> in the holes but do not tighten them yet (if they have been removed earlier). • Place the <i>bracket</i> on the attachment screws. • Secure the bracket with its attachment screws.  <p>xx0900000018</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Base • B: Attachment screws (2 pcs) • C: Bracket

Continues on next page

4.3.2 Refitting the complete cable harness

Continued

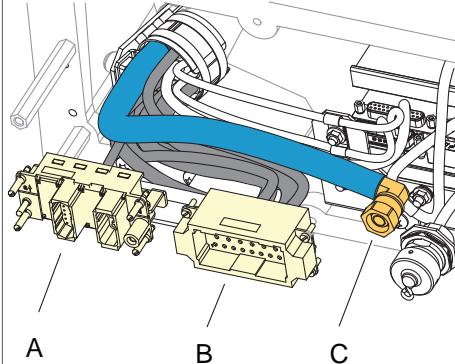
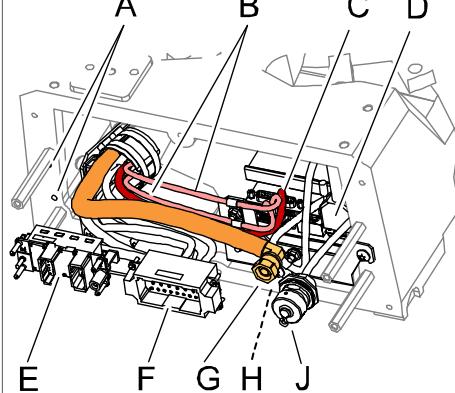
Action	Note
4 Refit the <i>earth cables</i> .	 <p>xx0900000015</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Earth B: Distance screws
5 Connect the contacts on the SMB unit: <ul style="list-style-type: none"> R1.SMB1-2 R1.SMB3-6 R2.SMB 	
6 Refit the SMB unit.	<p>How to refit the SMB unit is described in section: Refitting the SMB unit on page 252</p>
7 Refit the cables with the <i>screen connections</i> .	 <p>xx0900000035</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Screen connections (4 pcs)
8 <p> Tip</p> <p>When refitting connectors on the bracket, put it at a 90° angle.</p>	 <p>xx0900000013</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Bracket B: Base

Continues on next page

4 Repair

4.3.2 Refitting the complete cable harness

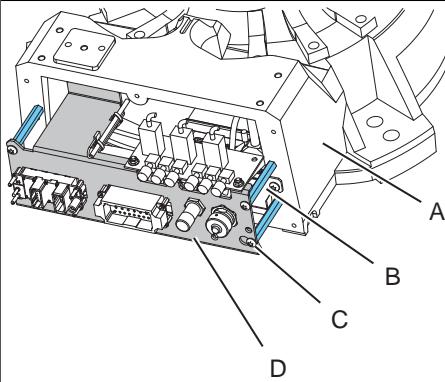
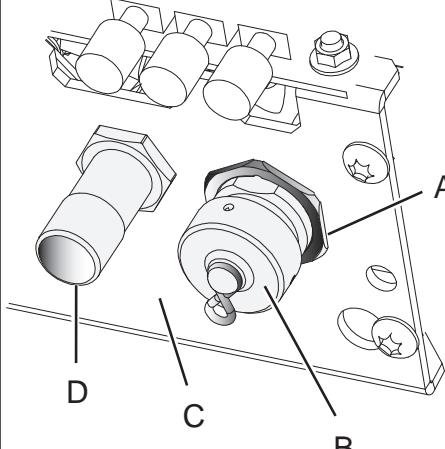
Continued

Action	Note
9 Before refitting the connectors on the bracket, arrange cables and connectors as shown in the figure.	 <p>xx1200000857</p> <p>A R1.CP/CS B R1.MP C Air hose</p>
10 Refit the <i>connectors</i> and <i>air hose</i> on the bracket: <ul style="list-style-type: none"> • R1.CP/CS • R1.CBUS (if used) • R1.MP <p> Tip</p> <p>Do not refit the <i>R1.SMB-connector</i> and <i>air hose</i> at this stage. It will be easier to refit these two when the bracket has been fitted to the distance screws.</p>	 <p>xx0900000017</p> <p>Connectors:</p> <ul style="list-style-type: none"> • A: Earth cables • B: R1.SMB1-2 • C: R1.SMB3-6 • D: R2.SMB • E: R1.CP/CS • F: R1.MP • G: Air hose • H: Position of R1.CBUS (if used) • J: R1.SMB

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4.3.2 Refitting the complete cable harness

Continued

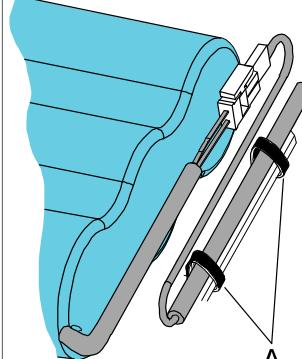
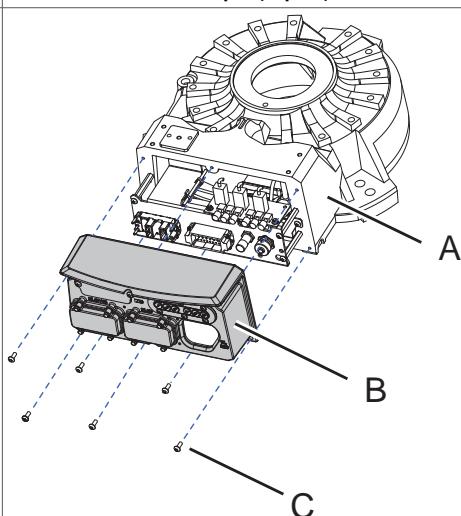
Action	Note
11 Secure the bracket on the distance screws.	 <p>xx1200000887</p> <p>A Base B Distance screw C Attachment screw D Bracket</p>
12 Reconnect connectors on the brake release unit: <ul style="list-style-type: none">• X8• X9• X10	
13 Refit the <i>R1.SMB</i> -connector on the bracket.  Tip Use a deep well hexagon socket, width 30 mm (like the ones used for spark plugs, or similar).	 <p>xx1200000889</p> <p>A Thin nut, width 30 mm B R1.SMB C Bracket D Air connector</p>
14 Refit the <i>air hose connector</i> on the bracket.  Note Check that there is no leakage from the air hose.	
15 Reconnect the battery cable.	

Continues on next page

4 Repair

4.3.2 Refitting the complete cable harness

Continued

Action	Note
16 Secure the battery cable with <i>cable straps</i> .	 xx0900000099 <ul style="list-style-type: none"> Parts: <ul style="list-style-type: none"> • A: Cable straps (2 pcs)
17 Use caution when pushing the <i>base cover</i> into position while at the same time checking that no cables are damaged.	 xx08000000456 <ul style="list-style-type: none"> Parts: <ul style="list-style-type: none"> • A: Base • B: Base cover • C: Attachment screws (6 pcs)
18 Secure the <i>base cover</i> with its attachment screws.	
19 Refit the <i>bracket</i> on the frame.	See the figure in: <ul style="list-style-type: none"> • Location of the cable harness on page 221
20 Refit the <i>cable straps</i> securing the cable harness to the frame.	See the figure in: <ul style="list-style-type: none"> • Location of the cable harness on page 221
21 Continue the refitting of the cable package on lower arm and armhouse.	How to refit the cable harness on the <i>lower arm and armhouse</i> is described in section: <ul style="list-style-type: none"> • Refitting the cable harness in the lower arm and armhouse on page 233

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4.3.2 Refitting the complete cable harness

Continued

Refitting the cable harness in the lower arm and armhouse

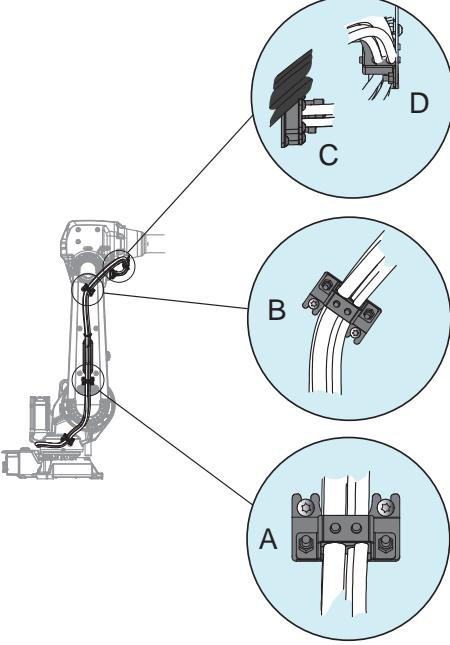
Use this procedure to refit the cable harness in the *lower arm* and *armhouse*.



Tip

Before starting this procedure, first refit the cable harness in the *frame* and *base*.
See:

- [Refitting the complete cable harness on page 220](#)
- [Refitting the complete cable harness on page 220](#)

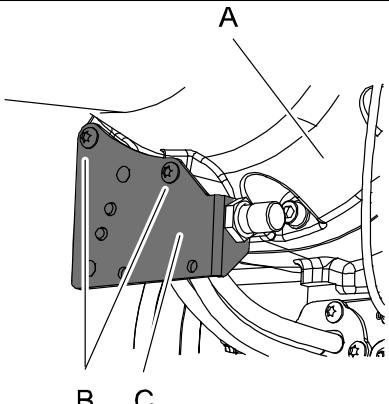
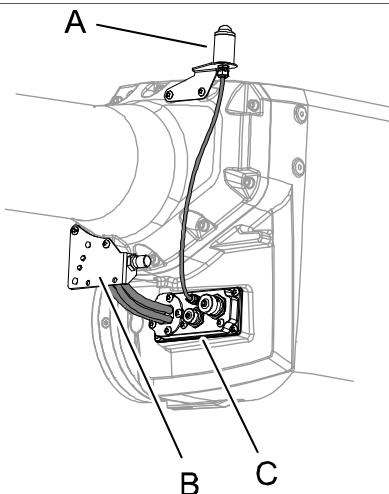
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Secure the <i>brackets</i> on the lower arm.	 <p>xx0900000020</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Bracket, lower arm • B: Bracket, lower arm • C: Bracket, armhouse • D: Cable bracket
3	Refit the <i>cable straps</i> securing the cable harness to the lower arm.	See the figure in: <ul style="list-style-type: none"> • Location of the cable harness on page 221 (Cable harness, lower arm)
4	Push the cable harness carefully into the armhouse.	

Continues on next page

4 Repair

4.3.2 Refitting the complete cable harness

Continued

Action	Note
5 Secure the <i>bracket, armhouse</i> with its attachment screws.	 <p>xx0800000335</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Tubular shaft unit • B: Attachment screws • C: Bracket, armhouse
6 Secure the <i>bracket</i> to the armhouse with its attachment screws.	 <p>xx0800000338</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Signal lamp • B: Bracket, armhouse • C: Cable bracket
7 Reconnect the axis-3, axis-4, axis-5 and axis-6 <i>motor cables</i> .	How to connect the axis-3, axis-4, axis-5 and axis-6 motor cables, see: <ul style="list-style-type: none"> • Refitting motors on page 315
8 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

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4.3.2 Refitting the complete cable harness

Continued

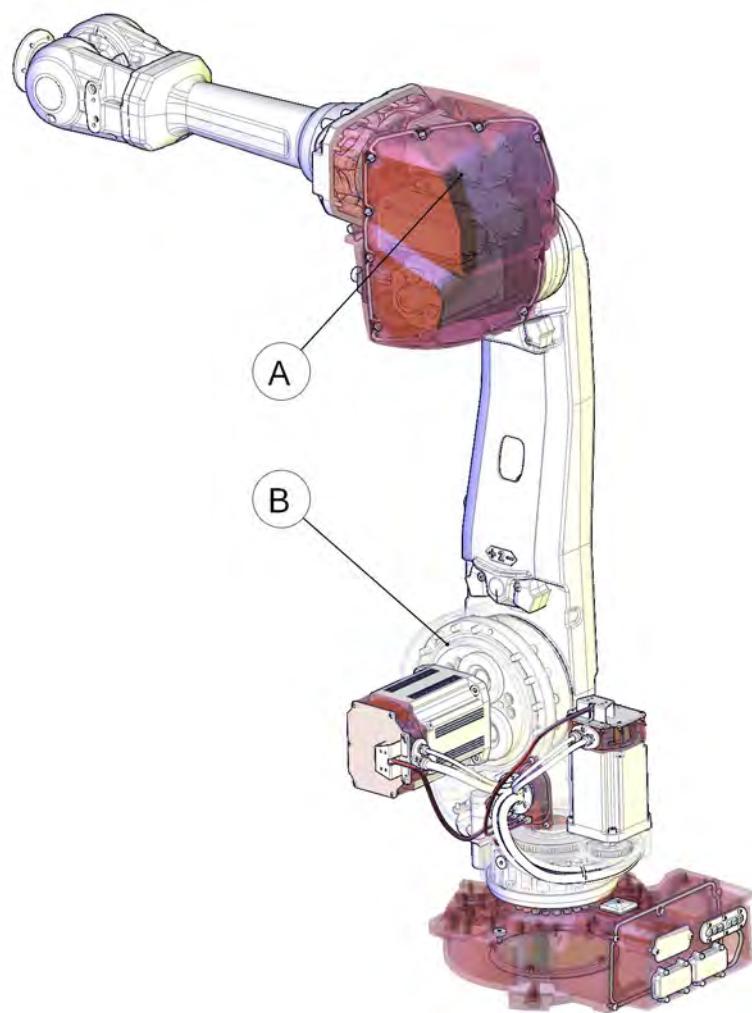
Action	Note
9 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
10  WARNING The cover on the armhouse must be fitted when the robot is running. It is a vital part for the stability of the robot.	
11  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

4 Repair

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Function

The pressure inside the areas A and B are 0.2 - 0.3 bar.



xx1100000047

Required equipment

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .
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.
Loctite 577	12691907-1
Rust preventive	3HAC026621-001

Continues on next page

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

Equipment	Note
Brush	-

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

**Note**

Make sure that the special Foundry Prime painting of the robot is not broke during testing, installation or repair work. Use touch up kit available for Foundry Prime art. no. 3HAC035355-001 to repair the damage paint coat see section [Replacing parts on the robot on page 205](#).

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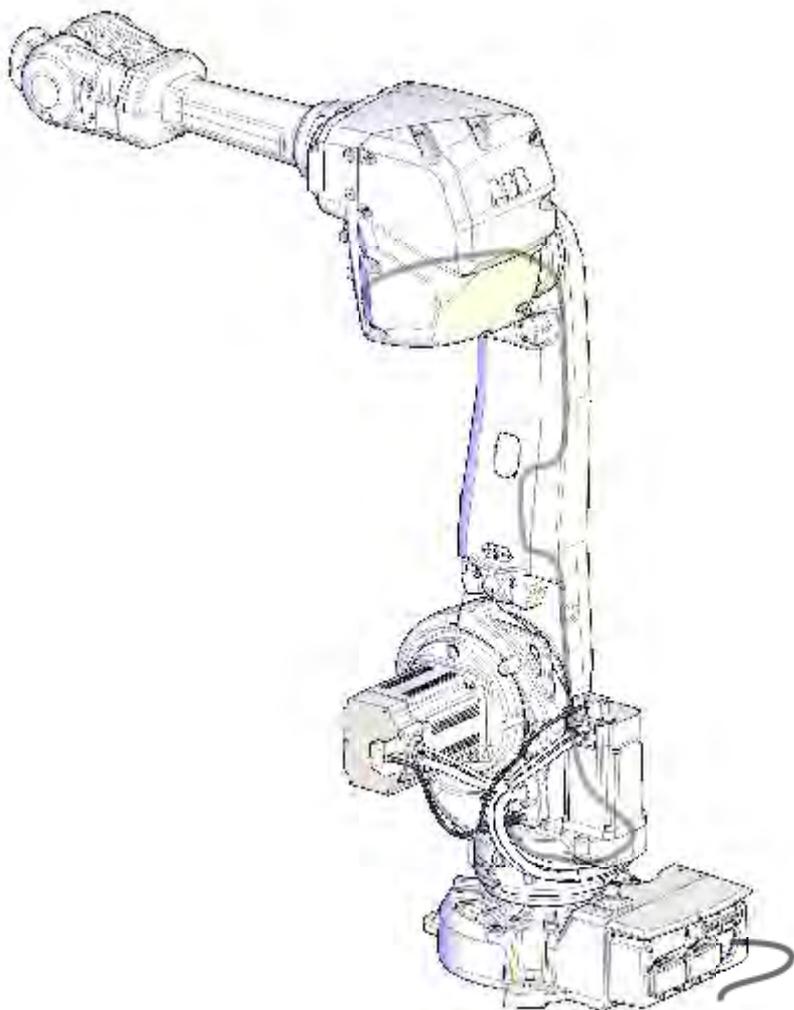
4 Repair

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

Replacing air hoses and nipples

The illustration show the routing of the pressure hoses on a IRB 4600 Foundry Prime robot.

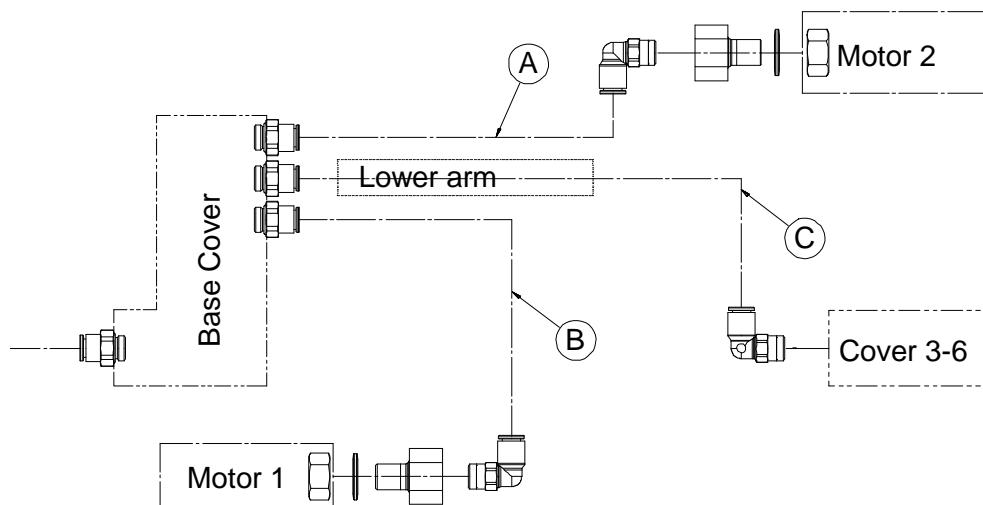


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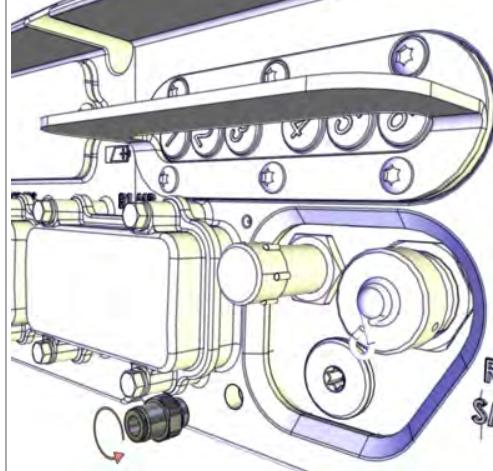
4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued



xx1100000051

A	Pneumatic hose - Foundry Prime 360 mm
B	Pneumatic hose - Foundry Prime 410 mm
C	Pneumatic hose - Foundry Prime 2500 mm

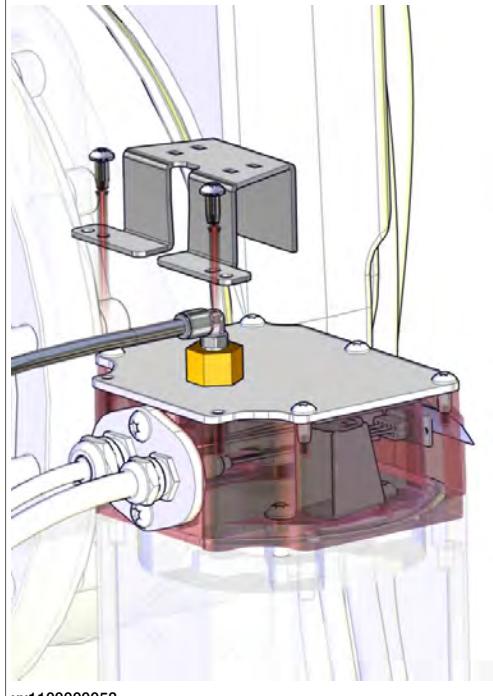
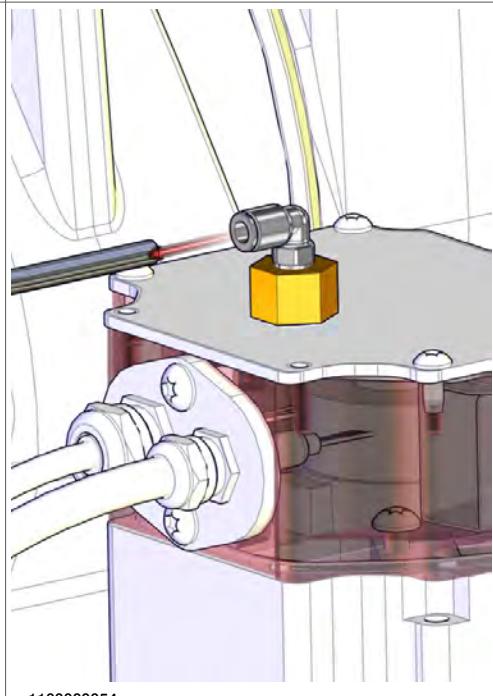
	Action	Information
1	 DANGER Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator. Also read the safety sections: <ul style="list-style-type: none"> • <i>Safety risks related to pneumatic/hydraulic systems on page 27</i> • <i>Risks associated with live electric parts on page 30</i> • <i>Safety risks during installation and service work on robots on page 22</i> 	
2	Remove hose, and remove the straight fitting from the manipulator base.	 xx1500002400

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4 Repair

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

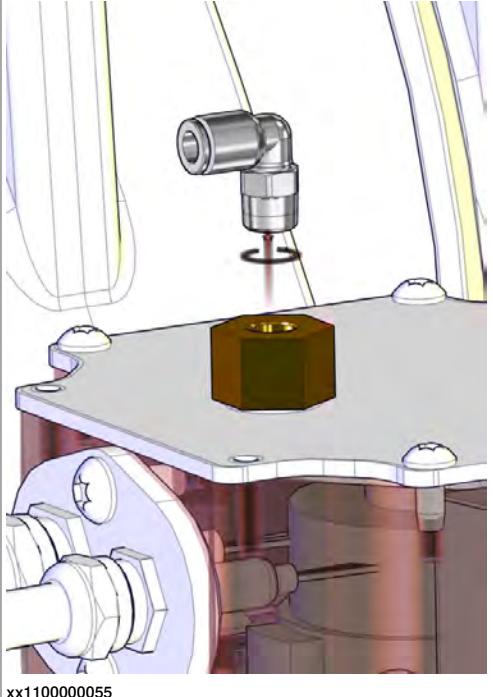
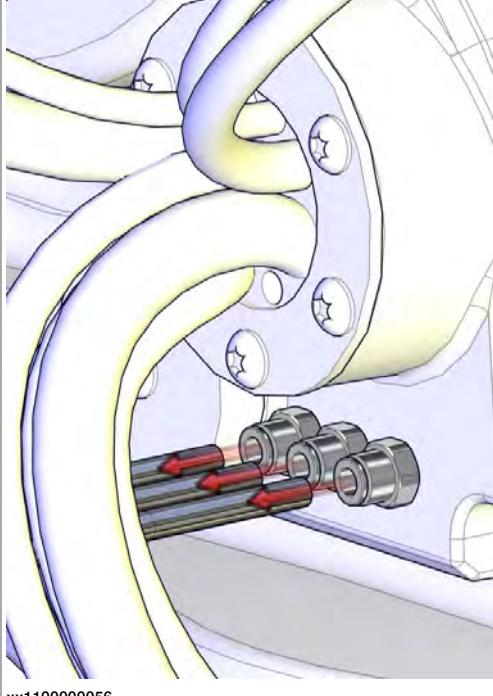
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Action	Information
3 Remove the hose protection from motor 1 and 2. Use standard tools.	 xx1100000053
4 Remove the hoses from the elbow fittings. No tools needed.	 xx1100000054

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4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

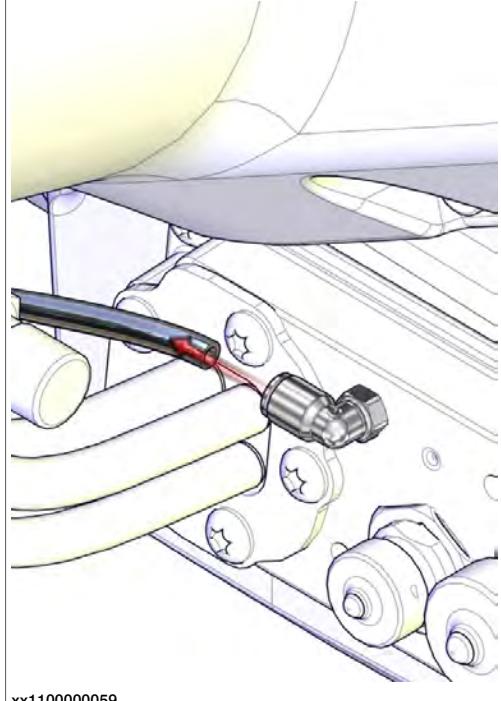
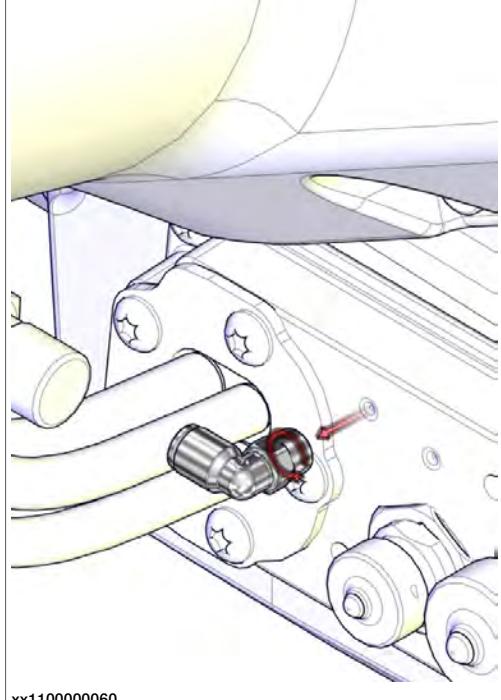
	Action	Information
5	Remove the elbow fittings. Use standard tools	 xx1100000055
6	Remove hoses from the straight fittings on the cover at the frame. No tools needed.	 xx1100000056
7	Remove the straight fittings on the cover at the frame. Use standard tools.	

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4 Repair

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

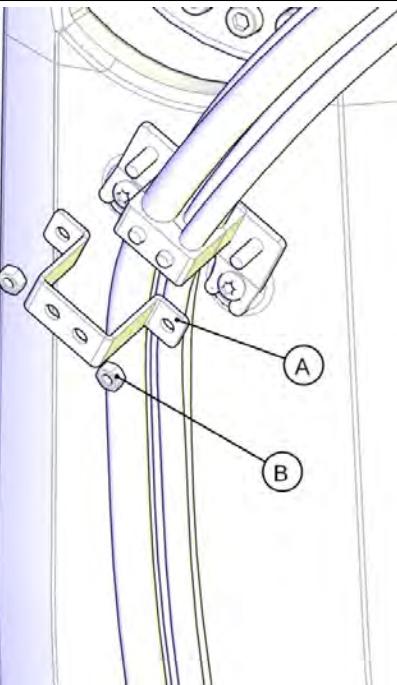
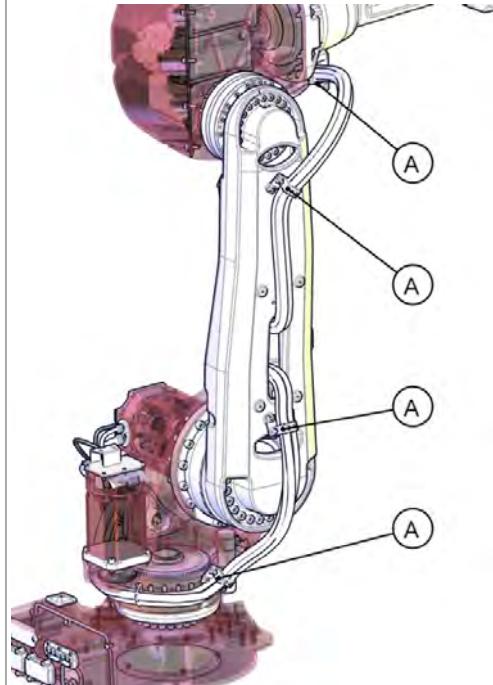
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	Action	Information
8	Remove the Pneumatic hose - Foundry Prime 2500 mm from the upper elbow fitting.	 xx1100000059
9	Remove the upper elbow fitting.	 xx1100000060

Continues on next page

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

Action	Information
10 Remove the nuts (B) on all the hose clamps (A). Use standard tools.  Note It is important to maintain the position of the hoses and the hose clamps. Use a cable strap to secure the position of the rubber blocks.	 xx1100000058
11 Remove all hose clamps (A) from the lower arm.	 xx1100000057
12 Remove the Pneumatic hose - Foundry Prime 2500 mm from the upper arm.	

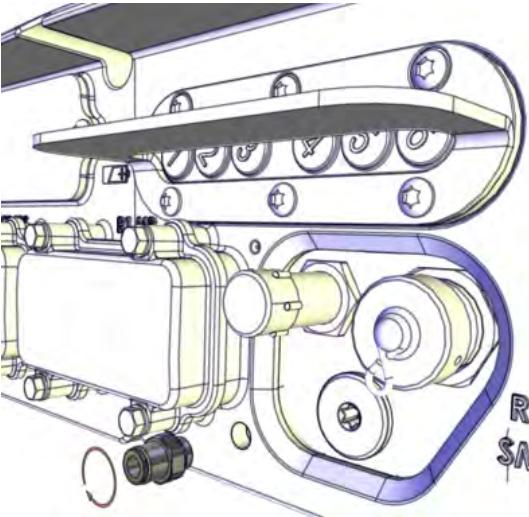
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4 Repair

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

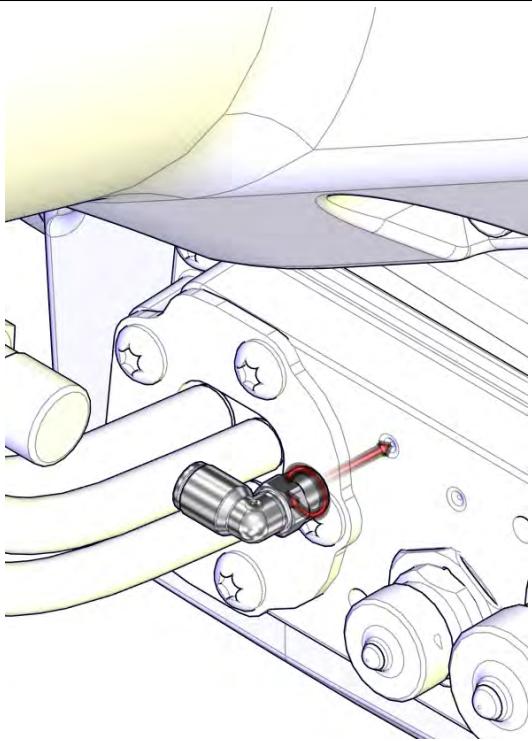
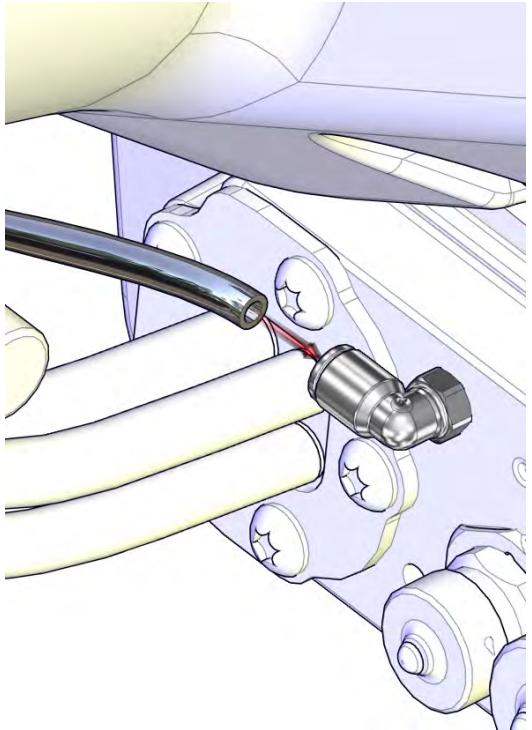
Refitting air hoses and nipples

	Action	Information
1	 Note Apply rust preventive around all dismantled covers and attachment screws with a brush.	
2	 Note Always apply rust preventive (Mericasol) on covers, attachment plates and screws after refitting these components.	
3	Refit the straight fitting on the manipulator base. Apply Loctite 577 on the thread. Use standard tools.	 xx1500002401

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4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

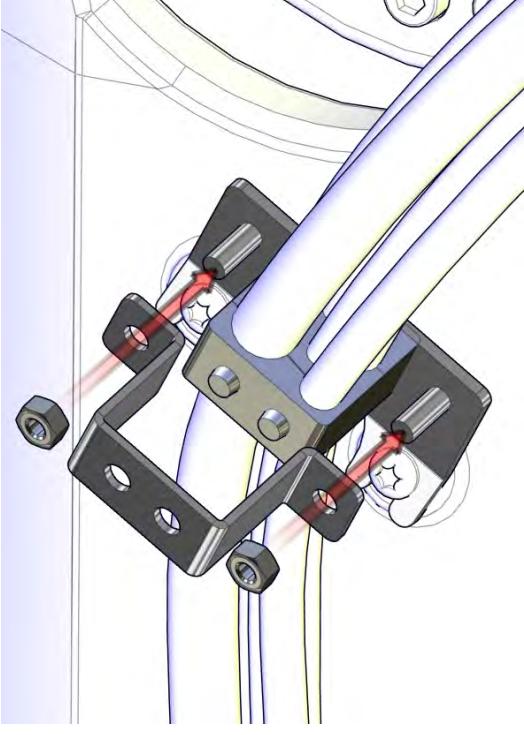
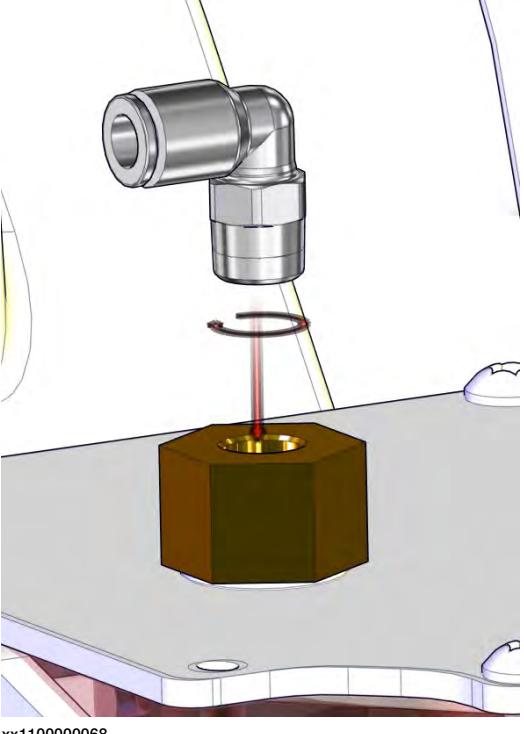
Action	Information
4 Refit the upper elbow fitting. Apply Loctite 577 on the thread. Use standard tools.	 xx1100000061
5 Refit the upper hose in the elbow-fitting.	 xx1100000062

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4 Repair

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

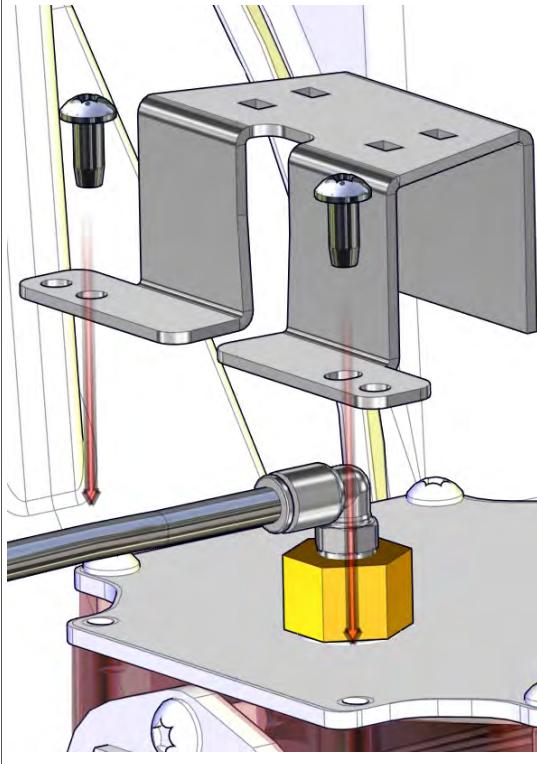
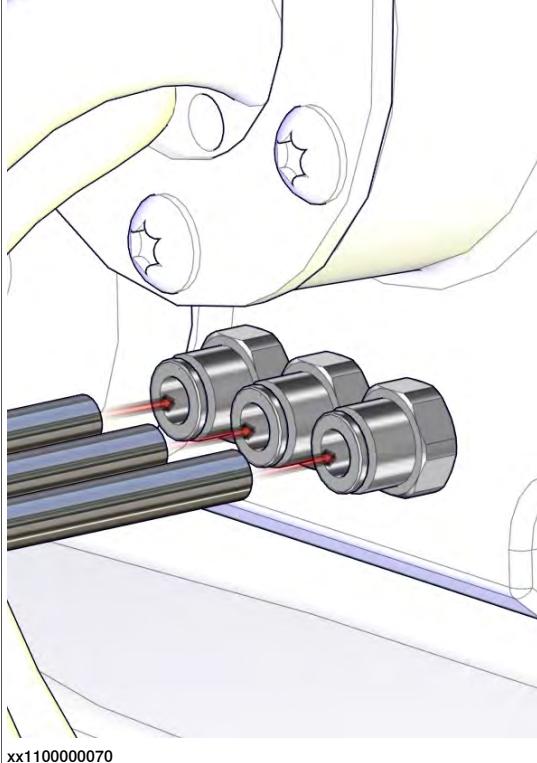
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	Action	Information
6	<p>Refit all hose clamps</p> <p>CAUTION</p> <p>The position of the hoses and the hose clamps is essential. Changed position can cause wear on the hoses.</p>	 xx1100000066
7	<p>Refit the elbow fittings on the motors. Apply Loctite 577 on the thread. Use standard tools.</p>	 xx1100000068
8	Refit the hose on the elbow fitting.	

Continues on next page

4.3.3 Replacement of air nipples and hoses (Foundry Prime)

Continued

	Action	Information
9	Refit the hose protection on motor 1 and 2. Use standard tools.	 xx1100000069
10	Refit the straight fittings on the cover at the frame. Apply Loctite 577 on the thread. Use standard tools.	
11	Refit the hoses on the straight fittings on the cover at the frame.	 xx1100000070

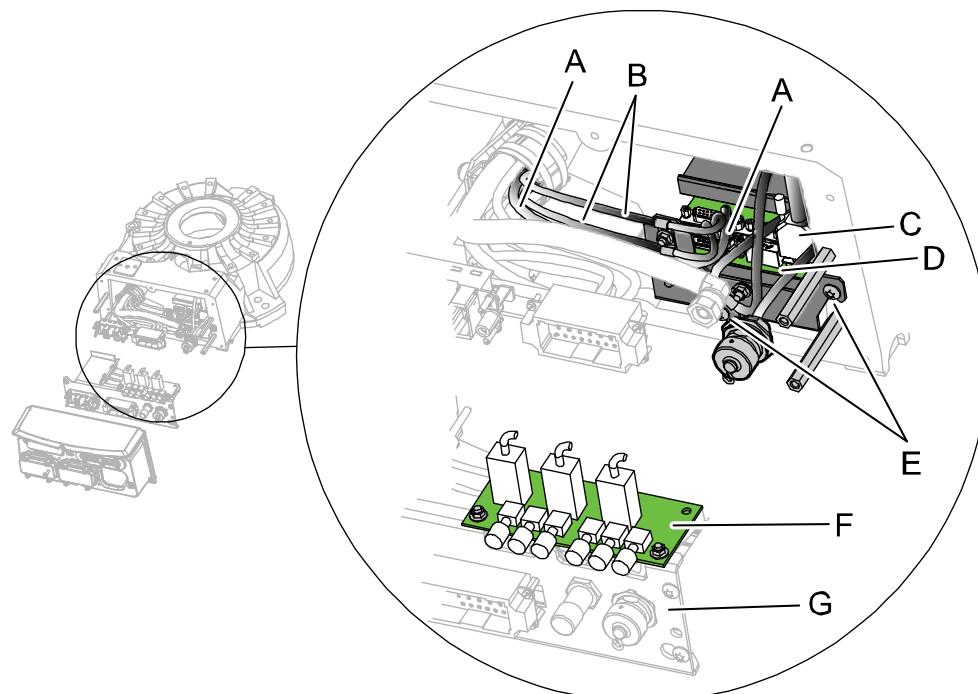
4 Repair

4.3.4 Replacing SMB unit

4.3.4 Replacing SMB unit

Location of SMB unit

The SMB unit (SMB = Serial measurement board) is located in the base below the brake release unit, as shown in the figure.



xx0800000466

A	R1.SMB3-6
B	R1.SMB1-2
C	R2.SMB
D	SMB unit
E	Attachment screws M6x16 quality 8.8-A2F (2 pcs)
F	Brake release unit
G	Bracket

Required equipment



Note

There are different variants of SMB units and batteries. The variant with the 3-pole battery contact (RMU) 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	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .

Continues on next page

Equipment	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.
SMB unit	For spare part no. see chapter Spare parts, section: • Spare part lists on page 397

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

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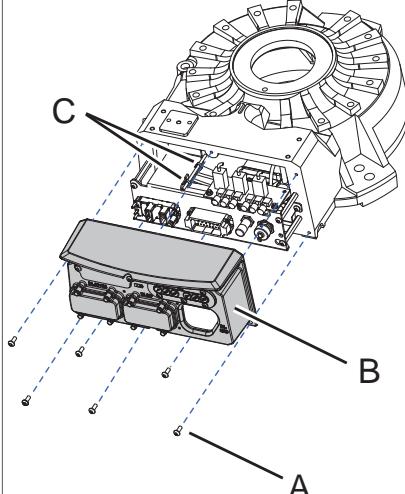
4 Repair

4.3.4 Replacing SMB unit

Continued

Removing the SMB unit

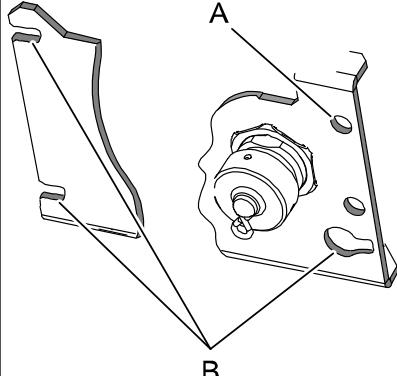
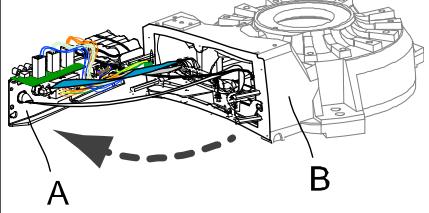
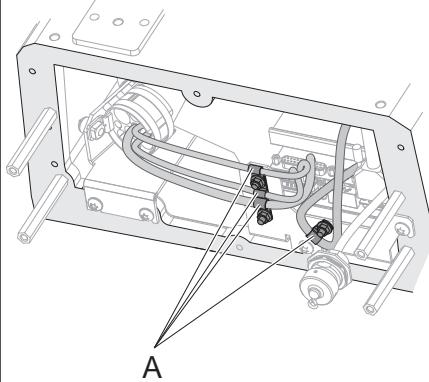
Use this procedure to remove the SMB unit.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
3	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
4	Remove the <i>base cover</i> .	 <p>xx0900000103</p> <p>Parts:</p> <ul style="list-style-type: none">• A: Attachment screws (6 pcs)• B: Base cover• C: Cable straps, securing the battery cable (2 pcs)
5	Cut the <i>cable straps</i> securing the battery cable.	

Continues on next page

4.3.4 Replacing SMB unit

Continued

Action	Note
6 Remove the screw that secures the bracket and unscrew the three other screws a little just enough to be able to slide the bracket sideways.	 Note <p>It is not needed to remove these three screws.</p>  xx0900000100 Parts: <ul style="list-style-type: none"> A: Screw to be removed B: Screws to be unscrewed a little (3 pcs)
7 Remove the <i>bracket</i> by sliding it off the remaining three attachment screws and put it at a 90° angle from the base. Putting the bracket at a 90° angle facilitates the disconnecting of cables from the bracket.	 Note <p>Use caution when performing this procedure order not to damage cables or other components!</p>  xx0900000013 Parts: <ul style="list-style-type: none"> A: Bracket at a 90° angle B: Base
8 Disconnect cable clamps.	 xx0900000035 Parts: <ul style="list-style-type: none"> A: Cable clamps
9 Unscrew the <i>attachment screws</i> securing the SMB unit just enough to be able to remove the SMB unit.	See the figure in: <ul style="list-style-type: none"> Location of SMB unit on page 248
10 Remove the SMB unit.	

Continues on next page

4 Repair

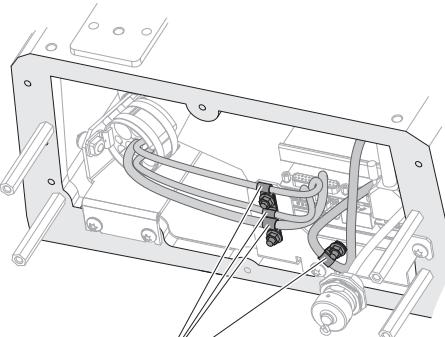
4.3.4 Replacing SMB unit

Continued

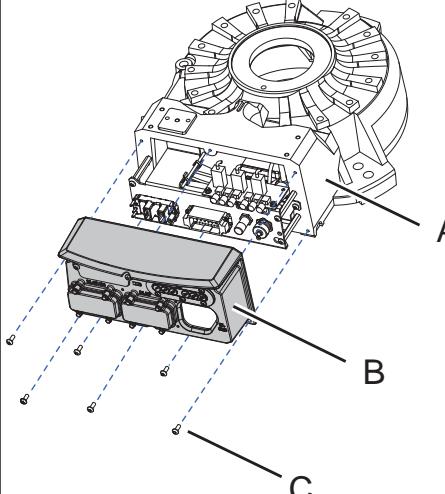
	Action	Note
11	Disconnect contacts on the SMB unit: <ul style="list-style-type: none">• R1.SMB1-2• R1.SMB3-6• R2.SMB• Battery cable	See the figure in: <ul style="list-style-type: none">• Location of SMB unit on page 248

Refitting the SMB unit

Use this procedure to refit the SMB unit.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3	Reconnect contacts on the SMB unit: <ul style="list-style-type: none">• R1.SMB1-2• R1.SMB3-6• R2.SMB• Battery cable	See the figure in: <ul style="list-style-type: none">• Location of SMB unit on page 248
4	Place the SMB unit on its <i>attachment screws</i> .	See the figure in: <ul style="list-style-type: none">• Location of SMB unit on page 248
5	Secure the SMB unit with its attachment screws.	
6	Refit the <i>cable clamps</i> .	 <p>xx0900000035 Parts:<ul style="list-style-type: none">• A: Cable clamps</p>

Continues on next page

Action	Note
7 Put back the cable harness in the base and refit the bracket on the distance screws.	See the figure in: • Location of SMB unit on page 248
<p> Note</p> <p>Use caution when performing this procedure order not to damage cables or other components!</p>	
8 Secure the battery cable with cable straps.	
9 Use caution when pushing the <i>base cover</i> into position while at the same time checking that no cables are damaged.	 xx0800000456 <p>Parts:</p> <ul style="list-style-type: none"> • A: Attachment screws (6 pcs) • B: Base cover • C: Base
10 Refit the <i>base cover</i> .	
11 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
12 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
13  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

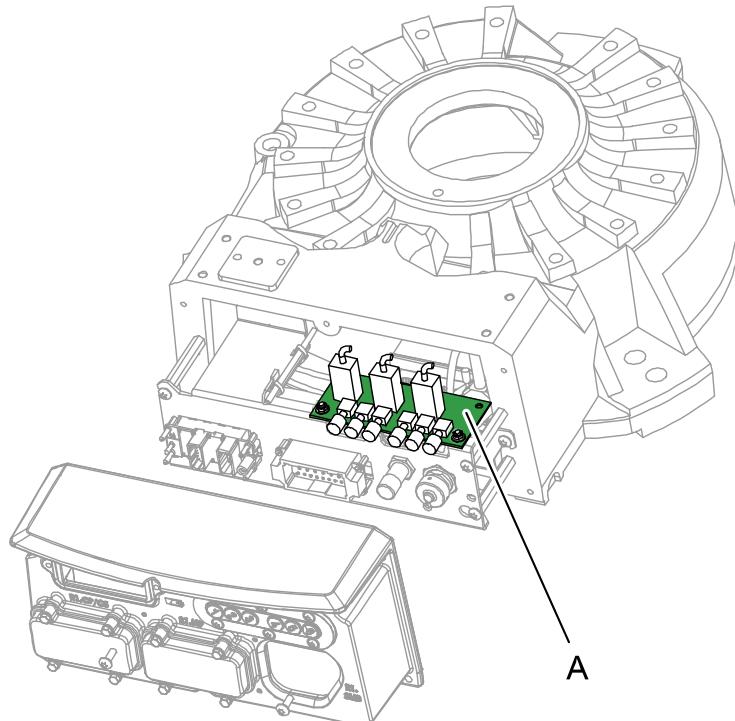
4 Repair

4.3.5 Replacing the brake release board

4.3.5 Replacing the brake release board

Location of brake release board

The brake release board is located as shown in the figure.

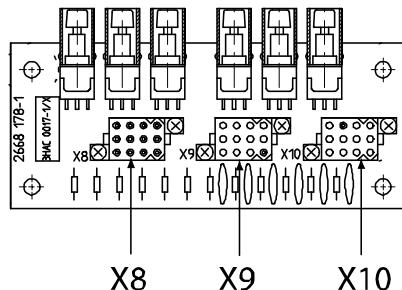


xx0900000101

A Brake release board

Connectors on push-button board

The connectors X8, X9 and X10 are placed on the push-button board as shown in the figure below.



xx0300000201

Required equipment

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .

Continues on next page

Equipment	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.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Removing the brake release board

Use this procedure to remove the brake release board.

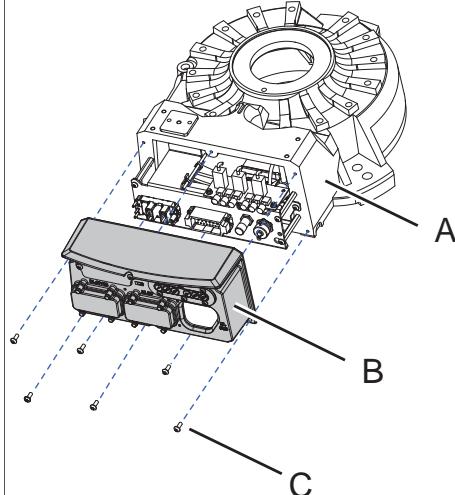
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	

Continues on next page

4 Repair

4.3.5 Replacing the brake release board

Continued

Action	Note
3 Remove the <i>base cover</i> .	 xx0800000456 Parts: <ul style="list-style-type: none"> A Base B Base cover C Attachment screws M6x16 quality 8.8-A2F (6 pcs)
4 Disconnect connectors X8, X9 and X10 from the brake release board.	See the figure in: <ul style="list-style-type: none"> • Connectors on push-button board on page 254
5 Remove the <i>nuts</i> securing the brake release board.	See the figure in: <ul style="list-style-type: none"> • Location of brake release board on page 254
6 Remove the brake release board.	

Refitting the brake release board

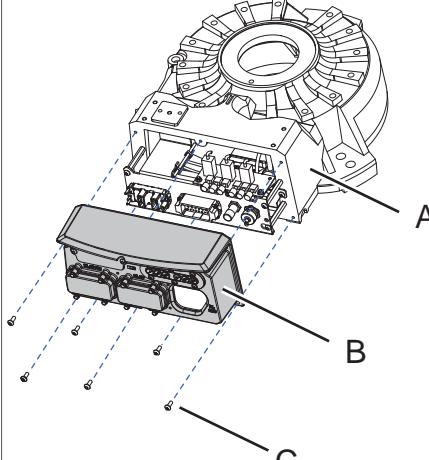
Use this procedure to refit the brake release board.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3 Secure the brake release board to the <i>bracket</i> with its <i>nuts with flange</i> .	See the figure in: <ul style="list-style-type: none"> • Location of brake release board on page 254
4 Reconnect connectors X8, X9 and X10 to the brake release board.	See the figure in: <ul style="list-style-type: none"> • Connectors on push-button board on page 254

Continues on next page

4.3.5 Replacing the brake release board

Continued

Action	Note
5 Use caution when pushing the <i>base cover</i> into position while at the same time checking that no cables are damaged.	 <p>xx0800000456</p> <p>Parts:</p> <ul style="list-style-type: none"> A Base B Base cover C Attachment screws M6x16 quality 8.8-A2F (6 pcs)
6 Secure the <i>base cover</i> with its <i>attachment screws</i> .	
7 Check that the <i>brake release buttons</i> not are jammed.	<p>How to check and fix the brake release buttons if jammed, is described in section:</p> <ul style="list-style-type: none"> • <i>WARNING - The brake release buttons may be jammed after service work on page 50</i>
8 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See <i>Replacing parts on the robot on page 205</i> .	
9  WARNING Before continuing any service work, please observe the safety information in section <i>WARNING - The brake release buttons may be jammed after service work on page 50!</i>	
10  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section <i>DANGER - First test run may cause injury or damage! on page 49</i> .	

4 Repair

4.3.6 Replacing the base

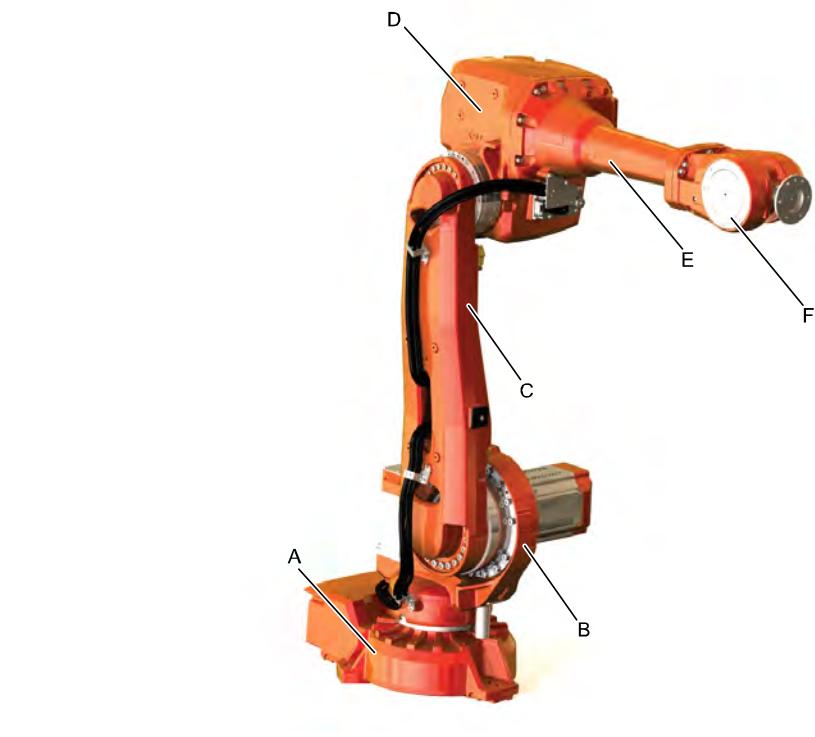
4.3.6 Replacing the base

Location of base and complete arm system

The complete arm system is defined as:

- complete upper arm (includes: wrist unit, tubular shaft unit and armhouse)
- lower arm
- frame.

The location of the base and the complete arm system is shown in the figure.



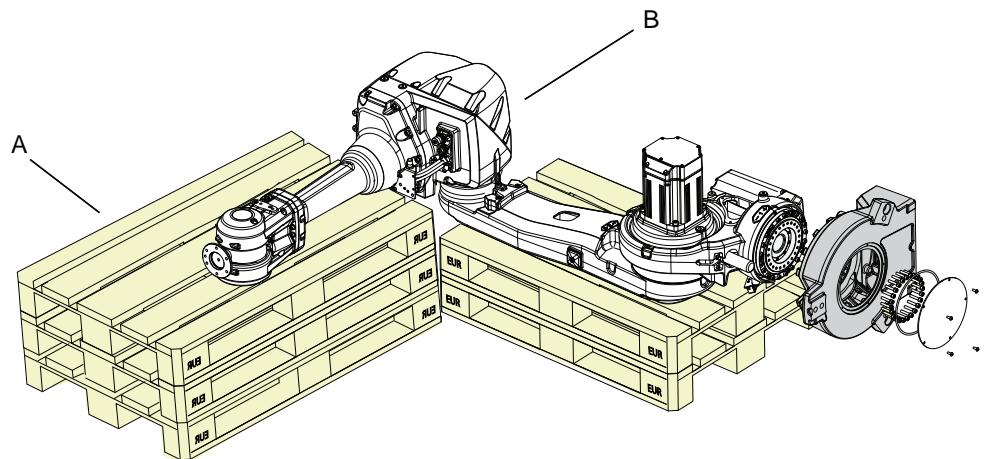
xx0800000345

A	Base
B	Frame
C	Lower arm
D	Armhouse (part of Upper arm complete)
E	Tubular shaft unit (part of Upper arm complete)
F	Wrist unit (part of Upper arm complete)

Continues on next page

Position of robot when replacing base from complete arm system

During the removal and refitting of the base from the complete arm system, the following method is recommended. How to perform the method is detailed in the procedures below. The position of the robot on loading pallets is shown in the figure.



xx0800000352

A	Loading pallets
B	Robot

Required equipment

Equipment	Note
Roundslings	3 pcs. Lengths: 2 m (2 pcs), 1.5 m (1 pc). Lifting capacity: 1 000 kg.
Crowbar	Small
Guide pins	
Standard toolkit	Content is defined in section Standard tools on page 391 .
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.
Loctite 7063	For cleaning.
Loctite 574	For sealing.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Continues on next page

4 Repair

4.3.6 Replacing the base

Continued

Deciding calibration routine

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

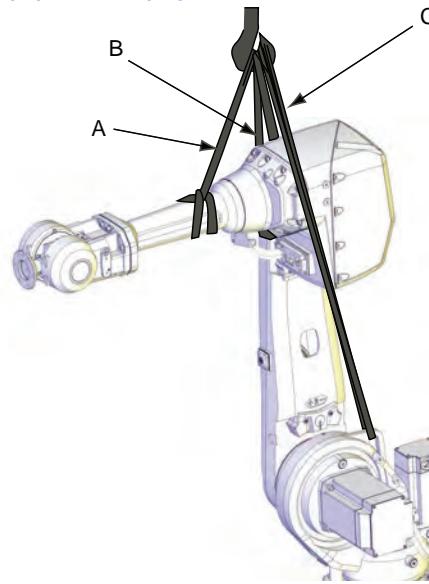
Action	Note
1 Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . 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.	

Removing the base

Use this procedure to remove the base from the arm system.

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.	 xx0800000336
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	

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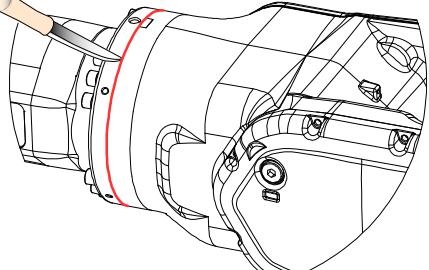
	Action	Note
4	 CAUTION <p>Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205</p>	
5	 Note <p>Draining is time-consuming. Elapsed time varies depending on the temperature of the oil.</p>	How to drain oil is detailed in section <ul style="list-style-type: none"> Changing the oil, axis 1 gearbox on floor mounted robots on page 160
6	 Tip <p>Wrap up the cabling against the frame to keep it undamaged during the remaining work.</p>	How to remove the cable harness in base and frame is detailed in sections: <ul style="list-style-type: none"> Removing cable harness in base on page 210 Removing cable harness in frame on page 215 Removing cable harness in lower arm and armhouse on page 217
7	Secure the robot with <i>roundslings</i> in an overhead crane.	Dimensions are specified in Required equipment on page 259 .  <p>xx1100000582</p> <p>A Roundsling 1.5 m B Roundsling 2 m C Roundsling 2 m</p>

Continues on next page

4 Repair

4.3.6 Replacing the base

Continued

Action	Note
8  CAUTION The IRB 4600 Foundry Prime robot weighs 440 kg. All lifting accessories used must be sized accordingly!	
9  Tip Put the robot on its side on a couple of loading pallets put on top of each other in order to create a more comfortable working situation.	See the figure in: • <i>Position of robot when replacing base from complete arm system on page 259</i>
10  DANGER Do not remove either <i>motor axis 2 or 3</i> at this stage! This will make the upper and lower arms move in a dangerous way and can cause serious personal injury or mechanical damage to the robot.	
11 Remove the bolts securing the robot to the foundation and carefully put it on the <i>loading pallets</i> as shown in the figure.	See the figure in: • <i>Position of robot when replacing base from complete arm system on page 259</i>  WARNING It is important to secure the robot properly on the loading pallet. Small movements can make the robot alter its position, which can cause personal injury or mechanical damage.
12 Foundry Prime robots: Cut the paint with a knife in the joint between the motor and the structure in order to avoid that the paint cracks.	The figure shows the principal method.  xx0900000121

Continues on next page

4.3.6 Replacing the base

Continued

Action	Note
13 Remove the <i>cover plate</i> at the bottom of the base.	 xx0800000357 <p>Parts:</p> <ul style="list-style-type: none"> • A: Gearbox axis 1 • B: Base • C: Attachment screws M8x40 quality Steel 12.9 Gleitmo and washers (24+24 pcs) • D: O-ring D220x5 • E: Cover plate • F: Attachment screws M6x16 quality 8.8-A2F (5 pcs)
14 CAUTION The robot base weighs 85 kg. All lifting accessories used must be sized accordingly!	
15 Secure the <i>base</i> of the robot with round-slings in an overhead crane or similar.	
16 Remove the <i>attachment screws</i> that secure the base to the axis 1 gearbox.	Shown in previous figure.
	<p>Note</p> <p>The attachment screws on Type C are different from the ones on Other design than type C!</p>
17 Remove the base carefully.	<p>Tip</p> <p>A small crowbar will probably be needed to carefully remove the base.</p> xx1200000891

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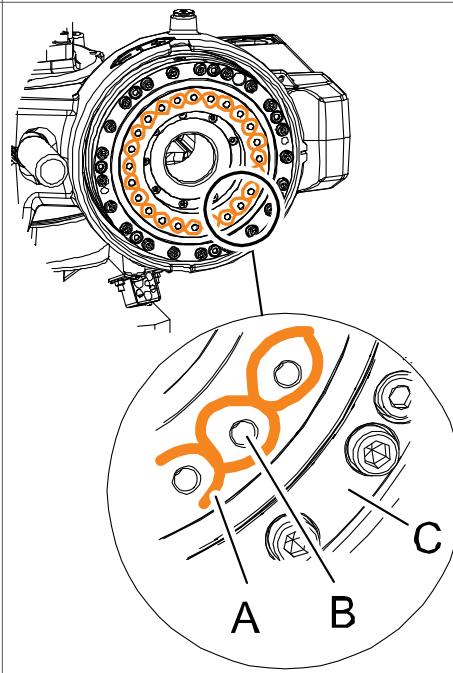
4 Repair

4.3.6 Replacing the base

Continued

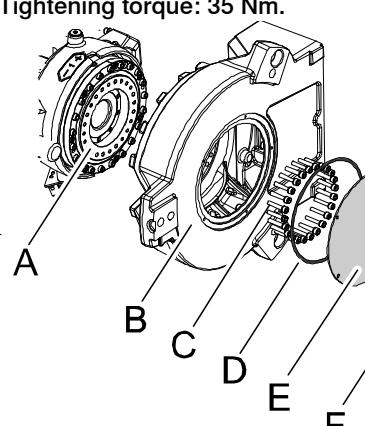
Refitting the base

Use this procedure to refit the base to the complete arm system.

Action	Note
<p>1</p> <p> DANGER</p> <p>Turn off all:</p> <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply <p>to the robot, before entering the robot working area.</p>	
2	Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205
3	 Tip Use Loctite 7063 (or similar) for cleaning.
4	Apply <i>Loctite 574</i> around the <i>screwholes</i> on gearbox axis 1 as shown in the figure.  xx0800000353 Parts <ul style="list-style-type: none">• A: Loctite 574• B: Screwhole in gearbox axis 1• C: Gearbox axis 1
5	<p> CAUTION</p> <p>The robot base weighs 85 kg. All lifting accessories used must be sized accordingly!</p>

Continues on next page

4.3.6 Replacing the base
Continued

Action	Note
6 Secure the <i>base</i> with a roundsling in an overhead crane or similar and lift it to the mounting site.	
7 Apply guide pins in opposite holes in the axis-1 gearbox.	
8 Refit the base with its <i>attachment screws</i> and <i>washers</i> .	<p>Tightening torque: 35 Nm.</p>  <p>xx0800000357</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Gearbox axis 1 B: Base C: Attachment screws M8x40 quality Steel 12.9 Gleitmo and washers (24+24 pcs) D: O-ring D220x5 E: Cover plate F: Attachment screws M6x16 quality 8.8-A2F (5 pcs)
9 Apply some grease to the <i>o-ring</i> and refit the <i>o-ring</i> between the cover and base.	
10 Refit the <i>cover plate</i> at the bottom of the base with its attachment screws.	
11  CAUTION The IRB 4600 Foundry Prime robot weighs 440 kg. All lifting accessories used must be sized accordingly!	
12 Lift the robot from the loading pallets, using caution and refit it to the foundation.	
13 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

Continues on next page

4 Repair

4.3.6 Replacing the base

Continued

	Action	Note
14	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
15	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

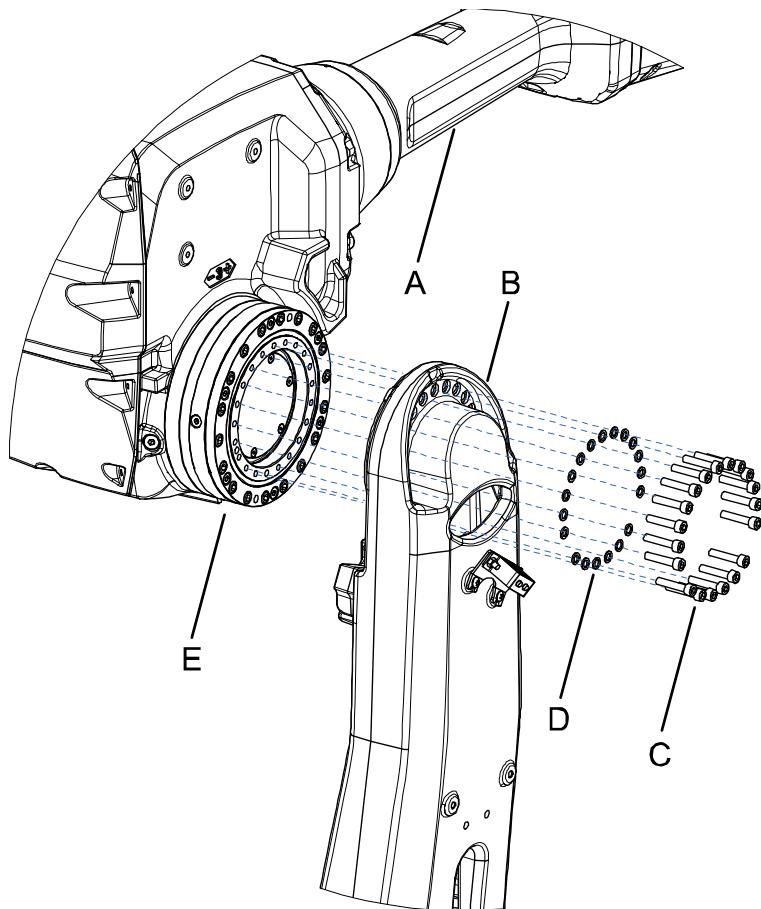
4.4.1 Replacing the complete upper arm

4.4 Upper arm

4.4.1 Replacing the complete upper arm

Location of the complete upper arm

The complete upper arm is located as shown in the figure.



xx0800000337

A	Upper arm
B	Lower arm
C	Attachment screws M8x40 quality steel 12.9 Gleitmo (19 pcs)
D	Washers quality steel 8.4x13x1.5 (19 pcs)
E	Axis-2 gearbox

Required equipment

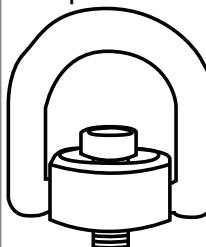
Equipment	Note
Armhouse	For spare parts no. see Spare parts - <i>Upper arm (2.05/2.50/2.55)</i> in <i>Product manual, spare parts - IRB 2600</i> .

Continues on next page

4 Repair

4.4.1 Replacing the complete upper arm

Continued

Equipment	Note
Tubular shaft unit	For spare parts no. see Spare parts - <i>Upper arm (2.05/2.50/2.55)</i> in <i>Product manual, spare parts - IRB 2600</i> .
Rotating lifting point	2 pcs. Dimension: M8. Example: Gunnebo RLP GrabiQ M8-10.  xx1100000564
Washer	Required if the screw in the rotating lifting point bottoms. Inner diameter: 12 mm. Outer diameter: min. 23 mm. Thickness: enough to prevent the screw in the rotating lifting point to bottom.
Roundslings	3 pcs. Length: 1.5 m. Lifting capacity: 500 kg.
Screws	2 pcs. Used to prevent the roundsling at the wrist from sliding. Dimension: <ul style="list-style-type: none">• M8, Length: 70 mm. Quality: 8.8. (IRB 4600 - 60/2.05)
Guide pins	M8 (2 pcs)
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Continues on next page

4.4.1 Replacing the complete upper arm

*Continued***Deciding calibration routine**

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum .
	<p>If the robot is to be calibrated with fine calibration: Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removing the complete upper arm

Use this procedure to remove the complete upper arm. This procedure can be done without draining the axis 3 gearbox.

	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. The robot must be floor mounted and the upper arm must be horizontally positioned.	 xx0800000336

Continues on next page

4 Repair

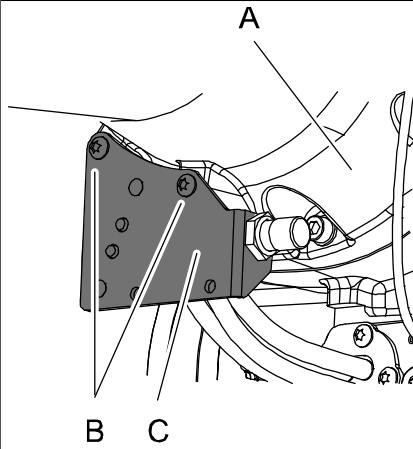
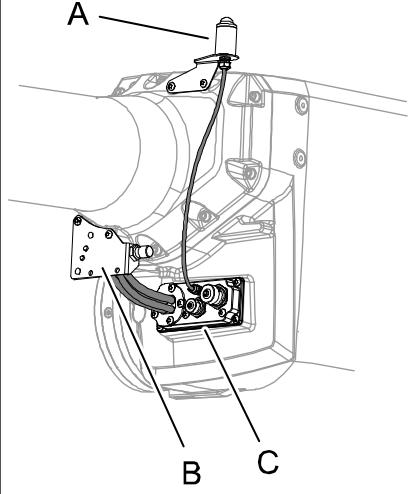
4.4.1 Replacing the complete upper arm

Continued

Action	Note
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
4  CAUTION The robot upper arm weighs 140 kg. All lifting accessories used must be sized accordingly!	
5 Attach the lifting accessories to the upper arm.	See <i>Attaching the lifting accessories to the upper arm on page 272</i> .
6 Unload the weight of the upper arm by stretching the roundslings.  Tip Turn on the power temporarily and release the brakes of axis 3 to rest the weight onto the roundslings.	
7  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
8  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <i>Replacing parts on the robot on page 205</i>	
9 Disconnect all <i>motor cables</i> from motors axes 3, 4, 5 and 6.	How to disconnect cables from motors is detailed in sections: <ul style="list-style-type: none">• <i>Removing motors on page 306</i>

Continues on next page

4.4.1 Replacing the complete upper arm
Continued

Action	Note
10 Remove the <i>bracket</i> fitted on the tubular shaft unit.	 <p>A B C xx0800000335</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Tubular shaft unit • B: Attachment screws M6x16 quality 8.8-A2F (2 pcs) • C: Bracket
11 Remove the <i>signal lamp</i> , if used.	
12 Remove the <i>cable bracket</i> on the armhouse.	 <p>A B C xx0800000338</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Signal lamp • B: Bracket • C: Cable bracket
13 Using caution, pull the cable package out of the hole where the cable bracket was fitted.	
14 Stop the air from the Foundry Prime air hose. Insert a screw in the hose and a lock it with a hose clamp.	

Continues on next page

4 Repair

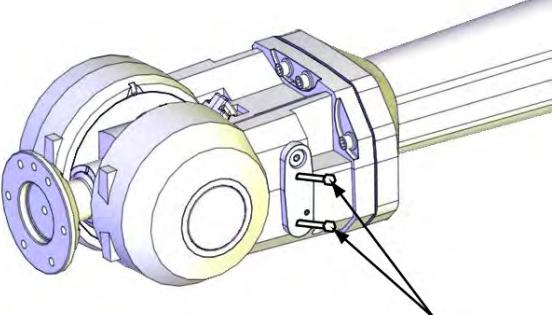
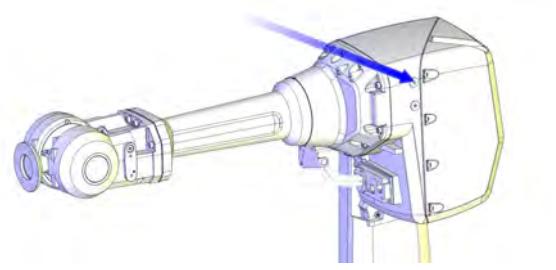
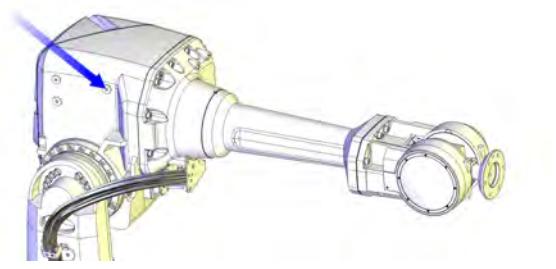
4.4.1 Replacing the complete upper arm

Continued

Action	Note
15 Remove the <i>attachment screws</i> securing the upper arm to the lower arm.	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of the complete upper arm on page 267  <p>Note</p> <p>Do not remove the attachment screws securing the gearbox axis 3 to the arm-house!</p>
16 Remove the complete upper arm.	

Attaching the lifting accessories to the upper arm

Attaching the lifting accessories

Action	Note
1 Fit two <i>screws</i> in the wrist unit. The purpose of these screws is to prevent the roundsling from sliding.	<p>Dimension is specified in Required equipment on page 267.</p>  <p>xx1100000568</p>
2 Fit two <i>rotating lifting points</i> to the attachment holes in the arm house, see the figure. Secure the lifting point tightly against the arm house, but at the same time making sure that the screw does not bottom. Use an extra <i>washer</i> if the screw does bottom. Tightening torque: 30 Nm.	<p>Dimension is specified in Required equipment on page 267.</p>  <p>xx1100000565</p>  <p>xx1100000566</p>

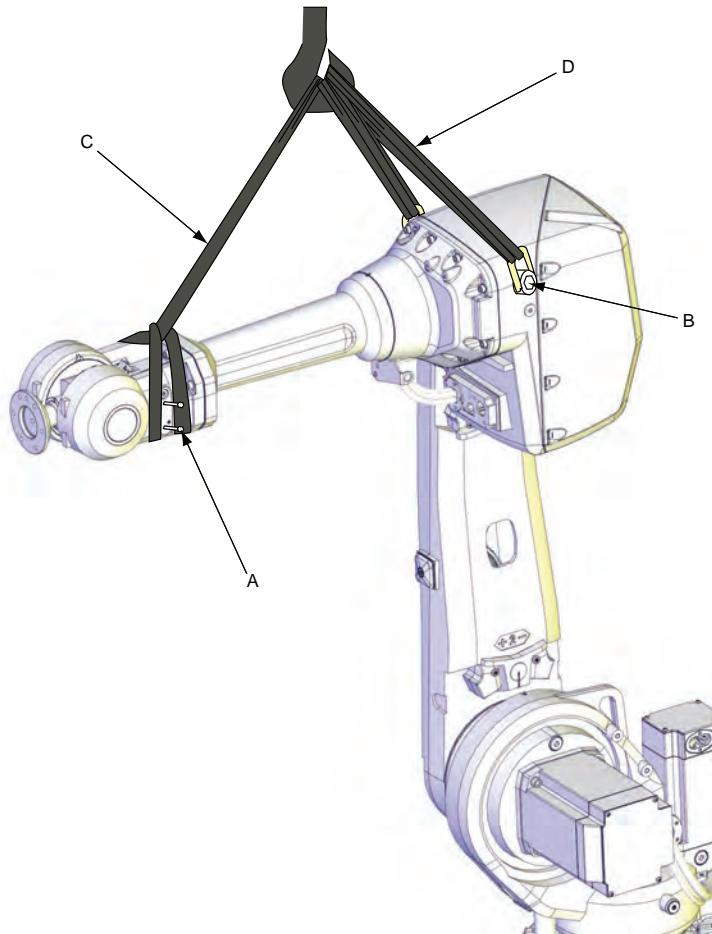
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4.4.1 Replacing the complete upper arm

Continued

	Action	Note
3	Run a <i>roundsling</i> through each rotating lifting point and fasten both ends at the lifting hook.	Dimension is specified in Required equipment on page 267 . See figure Attaching the roundslings to the upper arm on page 273 .
4	Make a loop of the third <i>roundsling</i> , running it around the wrist unit. Run the roundsling on both sides of the screws and fasten the free end of the roundsling to the lifting hook.	Dimension is specified in Required equipment on page 267 . See figure Attaching the roundslings to the upper arm on page 273 .

Attaching the roundslings to the upper arm



xx1100000567

A	Screws to prevent the roundsling from sliding, 2 pcs
B	Rotating lifting point, 2 pcs
C	Roundsling around wrist unit Length: 1.5 m.
D	Roundsling attached to arm house, 2 pcs Length: 1.5 m.

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4 Repair

4.4.1 Replacing the complete upper arm

Continued

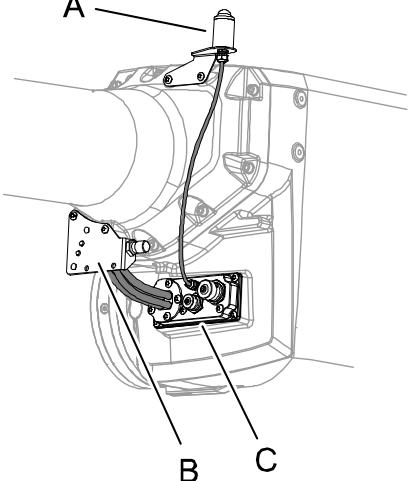
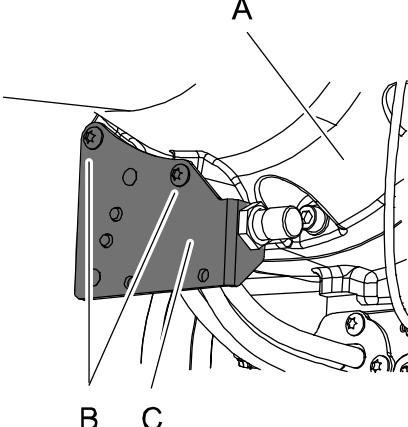
Refitting the complete upper arm

Use this procedure to refit the complete upper arm.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3	 Note Do not remove the attachment screws securing the gearbox axis 3 to the armhouse!	
4	 CAUTION The robot upper arm weighs 140 kg. All lifting accessories used must be sized accordingly!	
5	Clean all assembly surfaces.	
6	Attach the lifting accessories to the upper arm.	See Attaching the lifting accessories to the upper arm on page 272 .
7	Fit <i>guide pins</i> to the upper arm.	Specified in Required equipment on page 267 .
8	Lift the upper arm to the robot using an overhead crane.	
9	Release the brakes of the axis 3 motor.	
10	Refit the upper arm to the lower arm with its <i>attachment screws</i> .  Note Use new attachment screws! It may be necessary to turn the gear by rotating the motor pinion with a <i>rotation tool, motor</i> beneath the motor cover.	See the figure in: <ul style="list-style-type: none">• Location of the complete upper arm on page 267 Tightening torque : <ul style="list-style-type: none">• 35 Nm

Continues on next page

4.4.1 Replacing the complete upper arm
Continued

Action	Note
11 Using caution, push the cable package through the hole where the cable bracket will be fitted.	 <p>xx0800000338</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Signal lamp B: Bracket C: Cable bracket
12 Refit the air hose to the elbow fitting.	
13 Refit the <i>cable bracket</i> with its attachment screws.	
14 Reconnect all <i>motor cables</i> .	How to connect motor cables is detailed in sections: <ul style="list-style-type: none"> Refitting motors on page 315
15 Refit the <i>bracket</i> on the <i>tubular shaft unit</i> .	 <p>xx0800000335</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Tubular shaft unit B: Attachment screws M6x16 quality 8.8-A2F (2 pcs) C: Bracket
16 Refit the <i>signal lamp</i> , if used.	

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4 Repair

4.4.1 Replacing the complete upper arm

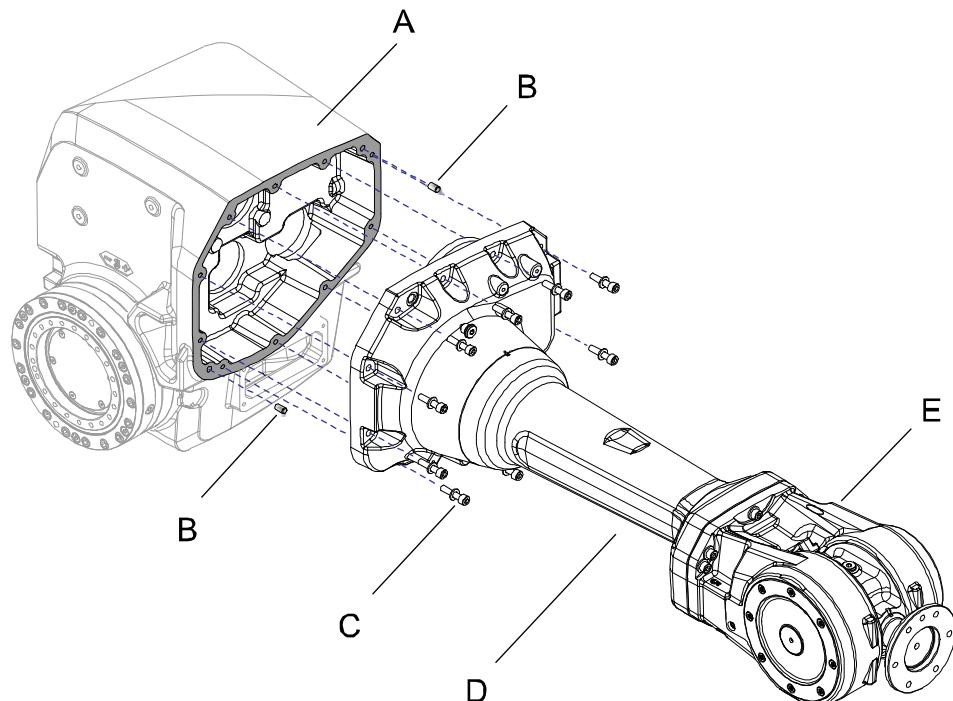
Continued

	Action	Note
17	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
18	Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
19	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

4.4.2 Replacing complete tubular shaft unit

Location of tubular shaft unit

The tubular shaft unit is located as shown in the figure.



xx0800000334

A	Armhouse
B	Parallel pin, hardened 8x16 m6 (2 pcs)
C	Attachment screws M8x35 quality 8.8-A2F and washers (10 + 10 pcs)
D	Tubular shaft unit
E	Wrist unit

Required equipment

Equipment	Note
Tubular shaft unit	For spare parts no. see Spare parts - <i>Upper arm (2.05/2.50/2.55)</i> in <i>Product manual, spare parts - IRB 2600</i> .
Guide pins	2 pcs. Dimension: M8.
Cleaning agent	Isopropanol
Sealing liquid	Loctite 574
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Continues on next page

4 Repair

4.4.2 Replacing complete tubular shaft unit

Continued

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . 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.	

Removing complete tubular shaft unit

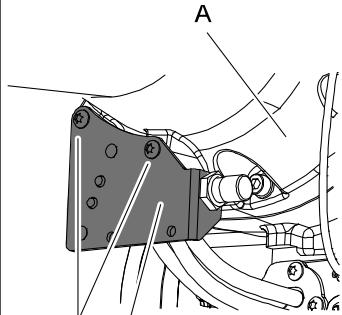
Use this procedure to remove the complete tubular shaft unit.

	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Drain oil from gearbox axis 4.	How to drain the oil from the gearbox is described in section: <ul style="list-style-type: none">• Changing the oil, axis-4 gearbox on page 181

Continues on next page

4.4.2 Replacing complete tubular shaft unit

Continued

Action	Note
3 Move the robot to the position shown in the figure.	 xx0800000336
4  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
5  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
6 Remove the bracket securing the cable package to the tubular shaft unit by removing its attachment screws.	 xx0800000335 <p>Parts:</p> <ul style="list-style-type: none"> • A: Tubular shaft unit • B: Attachment screws M6x16 quality 8.8-A2F (2 pcs) • C: Bracket
7 Place the cable package in a way that it will not be damaged in the continued removal procedure.	
8 Remove motors axes 4, 5 and 6.	How to remove motors is described in section: <ul style="list-style-type: none"> • Removing motors on page 306

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4 Repair

4.4.2 Replacing complete tubular shaft unit

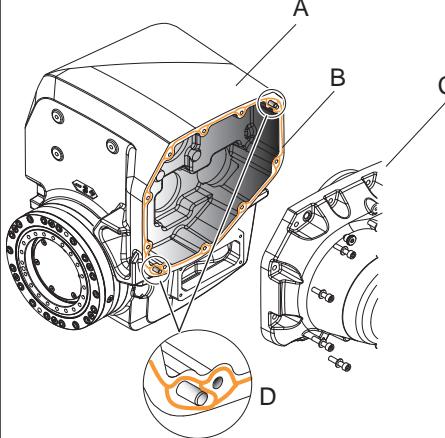
Continued

	Action	Note
9	 Tip If only the tubular shaft unit shall be replaced, it is a good idea to remove the <i>wrist unit</i> at this stage.	How to remove the wrist unit is detailed in section: <ul style="list-style-type: none">• Removal of wrist unit on page 285
10	 CAUTION The robot arm tube weighs 65 kg. All lifting accessories used must be sized accordingly!	
11	CAUTION Secure the <i>tubular shaft unit</i> with round-slings in an overhead crane. Prevent the slings from sliding! For example a small plate can be fitted to the lower attachment hole for the cable bracket (removed in a previous step). The plate should be fitted so it points downwards and functions as a mechanical stop for the roundsling. At the other end of the tubular shaft unit, a shackle can be fitted if the wrist unit is removed.	
12	Remove the <i>attachment screws</i> that secure the tubular shaft unit.	See the figure in: <ul style="list-style-type: none">• Location of tubular shaft unit on page 277
13	CAUTION Do not damage the gears when removing the tubular shaft unit. CAUTION Remaining oil will drain out from the gearbox cavity when the tubular shaft is lifted out.	 Note There are two parallel pins guiding the tubular shaft unit into its place. See figure in Replacing complete tubular shaft unit on page 277 .

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Refitting complete tubular shaft unit

Use this procedure to refit the tubular shaft unit.

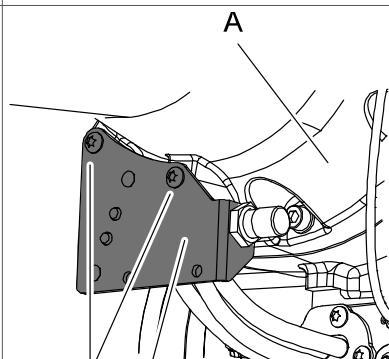
Action	Note
<p>1  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3 Remove residues of old Loctite and other contaminations from the assembly surfaces. Remove any painting from the assembly surfaces, with a knife.	
4 Apply sealing liquid (Loctite 574) on the surface between the tubular shaft unit and the armhouse. Make sure to apply the sealing liquid in circles around each of the attachment holes.	 xx0800000457 Parts: A Armhouse B Surface where Loctite 574 shall be applied C Tubular shaft unit D Cylindrical pin (2 pcs)
5  CAUTION The robot arm tube weighs 65 kg. All lifting accessories used must be sized accordingly!	

Continues on next page

4 Repair

4.4.2 Replacing complete tubular shaft unit

Continued

Action	Note
6 Secure the tubular shaft unit with a round-sling in an overhead crane. ! CAUTION Prevent the slings from sliding! For example a small plate can be fitted to the lower attachment hole for the cable bracket (removed in a previous step). The plate should be fitted so it points downwards and functions as a mechanical stop for the roundsling. At the other end of the tubular shaft unit, a shackle can be fitted if the wrist unit is removed.	
7 Fit <i>guide pins</i> in the upper arm house.	Specified in Required equipment on page 277 .
8 Refit the tubular shaft unit, using caution. ! CAUTION Do not damage the gears when refitting the tubular shaft unit.	Note There are two parallel pins guiding the tubular shaft unit into its place.
9 Secure the tubular shaft unit with its <i>attachment screws</i> .	See the figure in: <ul style="list-style-type: none">Location of tubular shaft unit on page 277 Tightening torque: 22 Nm
10 Refit <i>motors axes 4, 5 and 6</i> .	How to refit motors is described in section: <ul style="list-style-type: none">Refitting motors on page 315
11 Perform a leak-down test.	See Performing a leak-down test on page 200 .
12 Refit the <i>bracket</i> securing the cable package to the tubular shaft unit, with its <i>attachment screws</i> .	 Parts: <ul style="list-style-type: none"> A: Tubular shaft unit B: Attachment screws M6x16 quality 8.8-A2F (2 pcs) C: Bracket

Continues on next page

4.4.2 Replacing complete tubular shaft unit

Continued

Action	Note
13 If the <i>wrist unit</i> has been removed from the tubular shaft unit, refit it now.	How to refit the wrist unit is detailed in section: • Refitting of wrist unit on page 286
14 Refill gearbox axis 4 with oil.	How to refill oil in gearbox is described in section: • Changing the oil, axis-4 gearbox on page 181
15 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
16 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
17  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

4 Repair

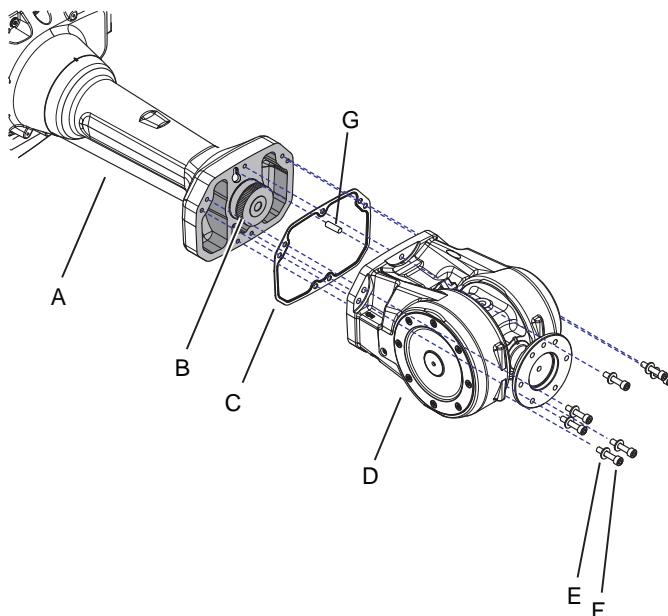
4.4.3 Replacing wrist unit

4.4.3 Replacing wrist unit

Location of wrist unit

The wrist unit is located in the upper arm as shown in the figures.

IRB 4600 -60/2.05



xx0800000333

A	Upper arm
B	Gear
C	O-ring sealing plate
D	Wrist unit
E	Spring washer, conical 8.4x18x2, quality steel-mZn12c (7 pcs)
F	Attachment screw M8x40, quality steel 12.9 Gleitmo (7 pcs)
G	Guide pin (only available for robots that are calibrated with Axis Calibration)

Required equipment

Equipment	Note
Wrist unit	For spare parts no. see Spare parts - <i>Upper arm (2.05/2.50/2.55)</i> in <i>Product manual, spare parts - IRB 2600</i> .
O-ring	For spare parts no. see Spare parts - <i>Upper arm (2.05/2.50/2.55)</i> in <i>Product manual, spare parts - IRB 2600</i> .
Measuring tool	For adjusting the play.
Standard toolkit	Content is defined in section <i>Standard tools</i> on page 391 .

Continues on next page

Equipment	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.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
	<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removal of wrist unit

Use this procedure to remove the wrist unit.

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

Continues on next page

4 Repair

4.4.3 Replacing wrist unit

Continued

Action	Note
<p>2  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
3 Drain oil from gearbox axes 5-6.	How to drain the oil from gearbox axes 5-6 is described in section: <ul style="list-style-type: none"> • Changing oil, axes-5 and -6 gearboxes on page 185
<p>4  CAUTION The robot wrist unit weighs 25 kg (IRB 4600 - 60/2.05, - 45/2.05, -40/2.55) and 15 kg (IRB 4600 - 20/2.50). All lifting accessories used must be sized accordingly!</p>	
5 Secure the wrist unit with a roundsling in an overhead crane or similar.	
<p>6  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205</p>	
<p>7 Remove the <i>attachment screws</i> and carefully remove the wrist unit.  CAUTION Do not damage gears!</p>	See the figure in: <ul style="list-style-type: none"> • Location of wrist unit on page 284

Refitting of wrist unit

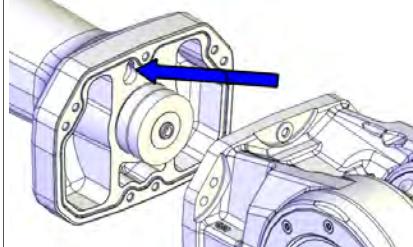
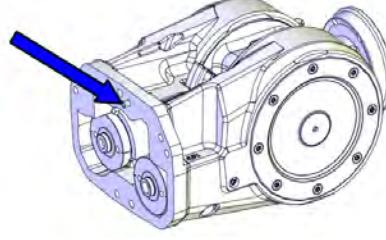
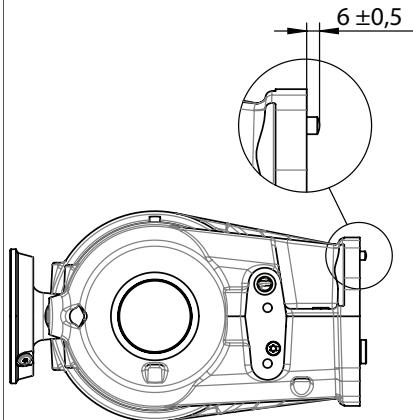
Use this procedure to refit the wrist unit.

Action	Note
<p>1  DANGER Turn off all:<ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.</p>	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	

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4.4.3 Replacing wrist unit

Continued

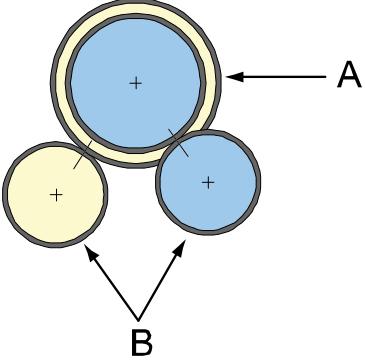
Action	Note
3 Check if there is a parallel pin hole in the upper arm tube. The hole is available on robots that are calibrated with the Axis Calibration method.	 xx1600000690
4 If there is a hole, fit the parallel pin into the corresponding hole in the wrist (enclosed with the new wrist spare part).  Note If the parallel pin is not installed on a robot calibrated with Axis Calibration, the calibration result will be affected negatively.	 xx1600000689 Verify that the parallel pin sticks out from the wrist according to the measurement given below. IRB 4600 -60/2.05  xx1600000702
5 Clean all assembly surfaces. Remove any painting from the assembly surfaces, with a knife.	

Continues on next page

4 Repair

4.4.3 Replacing wrist unit

Continued

Action	Note
6 Check the <i>o-ring</i> . Replace if damaged.	See the figure in: • Location of wrist unit on page 284
7 Prepare the refitting of the wrist by inserting the attachment screws and washers in the upper arm tube.	
8  CAUTION The robot wrist unit weighs 25 kg (IRB 4600 - 60/2.05, - 45/2.05, -40/2.55) and 15 kg (IRB 4600 - 20/2.50). All lifting accessories used must be sized accordingly!	
9 Carefully put the <i>wrist unit</i> in its place on the <i>upper arm</i> .  CAUTION Do not damage gears!  CAUTION Make sure that the <i>o-ring</i> stays in place on the <i>wrist unit</i> !	
10 Adjust the play of the wrist by following these steps: <ul style="list-style-type: none">• Fit the <i>measuring tool</i> at the rear of the motor.• Push the wrist as shown in the figure to locate the smallest play in the same way as for adjustment of motors for axes 4, 5 and 6. See Refitting motors on page 315.	 xx1000000223 Parts: <ul style="list-style-type: none">• A: Gears on drive shaft unit, axes 5-6• B: Gears on the wrist
11 Secure the wrist unit with its <i>attachment screws</i> and <i>washers</i> .	See the figure in • Location of wrist unit on page 284 Tightening torque: 35 Nm.
12 Measure the play by moving axes 5 and 6 with the measuring tool.	How to measure the play is described in sections: <ul style="list-style-type: none">• Measuring the play, axis 5 on page 290• Measuring the play, axis 6 on page 292
13 Perform a leak-down test.	See Performing a leak-down test on page 200 .

Continues on next page

4.4.3 Replacing wrist unit
Continued

Action	Note
14 Refill oil in gearbox axes 5-6.	How to fill oil in gearbox axes 5-6 is described in section: <ul style="list-style-type: none"> • Changing oil, axes-5 and -6 gearboxes on page 185
15 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
16 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
17  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

4 Repair

4.4.4 Measuring the play, axis 5

General

After reassembly due to repair work or any other reason, the play in axis 5 and 6 must be checked to ensure the repetition accuracy of the robot positioning. The procedure for axis 5 is detailed below.

Required equipment

Equipment, etc.	Art. no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 391 .
Measuring tool, play (IRB 4600 -60/2.05)	3HAB1611-6	
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Measurement, axis 5

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



Note

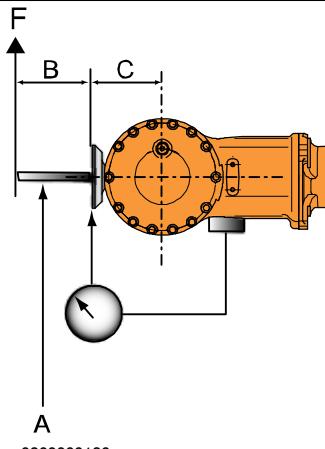
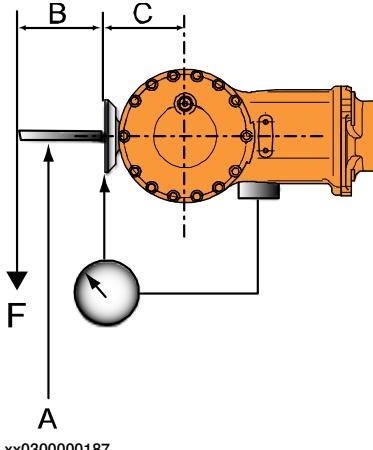
The measuring tool and measuring values differ depending on robot version!

	Action	Information
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Move the robot to calibration position and turn the axis 4 90°.	
3	Fit the <i>measuring tool, play</i> to the turning disk.	Art. no. is specified in Required equipment on page 290 .

Continues on next page

4.4.4 Measuring the play, axis 5

Continued

	Action	Information
4	<p>Apply load F in one direction, as shown in the figure to the right.</p> <p>Note Different load and distances for the different robot versions, as specified to the right!</p>	 <p>xx0300000186</p> <p>Values for IRB 4600 - 60/2.05</p> <ul style="list-style-type: none"> • A: Measuring tool, play • B: 100 mm • C: 135 mm • F: 90N
5	Remove the load and set the dial indicator to zero.	
6	Apply load F in the opposite direction, as shown in the figure to the right.	 <p>xx0300000187</p> <p>Values for IRB 4600 -60/2.05</p> <ul style="list-style-type: none"> • A: Measuring tool, play • B: 135 mm • C: 100 mm • F: 90N
7	Remove the load and measure the play by reading the dial indicator.	The maximum play allowed at the given distance from the center of axis 5 is, for robot version: <ul style="list-style-type: none"> • IRB 4600 -60/2.05

4 Repair

4.4.5 Measuring the play, axis 6

4.4.5 Measuring the play, axis 6

General

After reassembly due to repair work or any other reason, the play in axis 5 and 6 must be checked to ensure the repetition accuracy of the robot positioning. The procedure for axis 6 is detailed below.

Required equipment

Equipment	Art. no.	Note
Standard toolkit	-	Content is defined in section Standard tools on page 391 .
Measuring tool, play (IRB 4600 -60/2.05	3HAB1611-6	
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Measurement, axis 6

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



Note

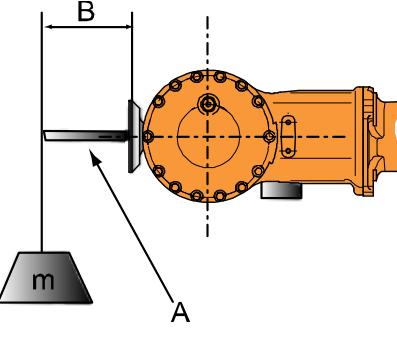
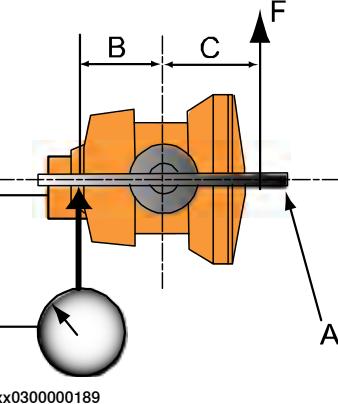
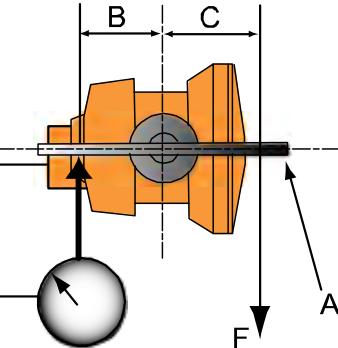
The measuring tool and measuring values differ depending on robot version!

	Action	Information
1	 DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2	Fit the <i>measuring tool, play</i> to the turning disk.	Art. no. is specified in Required equipment on page 292 .

Continues on next page

4.4.5 Measuring the play, axis 6

Continued

	Action	Information
3	Attach a weight (m) at a distance (B) from the wrist flange, in order to avoid the effects of play on axis 5.  Note Different weight and distance for the different robot versions, as specified to the right!	 xx0300000188 Values for robot versions IRB 4600 -60/2.05 <ul style="list-style-type: none"> • A: Measuring tool, play • B: 100 mm • m: 20 kg
4	Apply load F in one direction.  Note Different load and distances for the different robot versions, as specified to the right!	 xx0300000189 Values for robot versions IRB 4600 -60/2.05 <ul style="list-style-type: none"> • A: Measuring tool, play • B: 100 mm • C: 100 mm • F: 50N
5	Remove the load and set the dial indicator to zero.	
6	Apply load F in the opposite direction, as shown in the figure to the right.	 xx0300000190 Values for robot versions IRB 4600 -60/2.05 <ul style="list-style-type: none"> • A: Measuring tool, play • B: 100 mm • C: 150 mm • F: 50N

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4 Repair

4.4.5 Measuring the play, axis 6

Continued

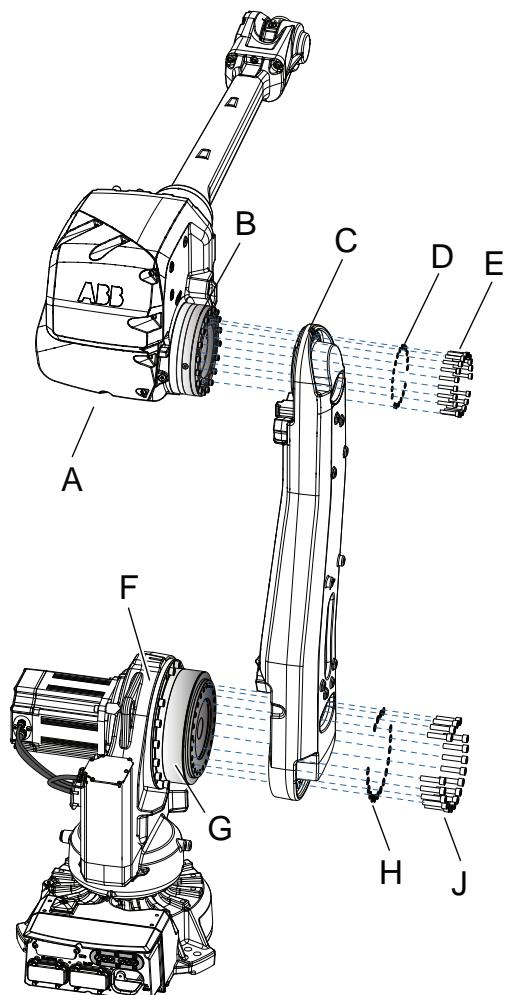
	Action	Information
7	Remove the load and measure the play by reading the dial indicator.	The maximum play allowed at the given distance (B) from the center of axis 6 is, for robot version: <ul style="list-style-type: none">• IRB 4600 -60/2.05

4.5 Lower arm

4.5.1 Replacing the lower arm

Location of lower arm

The lower arm is located as shown in the figure.



xx0800000360

A	Upper arm
B	Axis-3 gearbox
C	Lower arm
D	Washer (19 pcs)
E	Attachment screws M8x40 quality Steel 12.9 Gleitmo (19 pcs)
F	Frame
G	Axis-2 gearbox
H	Washer (18 pcs)
J	Attachment screws M12x50 quality Steel 12.9 Gleitmo (18 pcs)

Continues on next page

4 Repair

4.5.1 Replacing the lower arm

Continued

Required equipment

Equipment	Note
Lower arm	For spare parts no. see Spare parts - <i>Lower arm and motors</i> in <i>Product manual, spare parts - IRB 2600</i> .
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . 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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Removing the lower arm

Use this procedure to remove the lower arm.

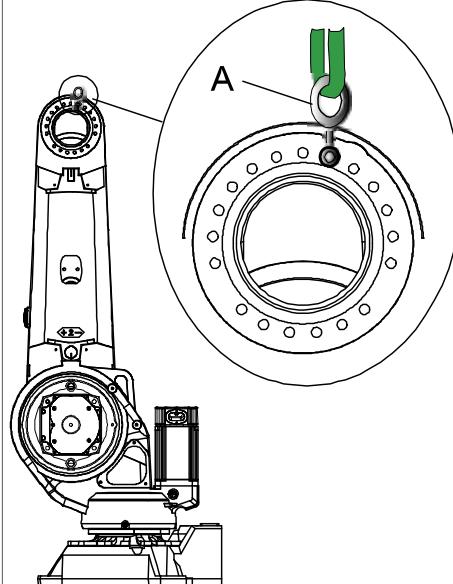
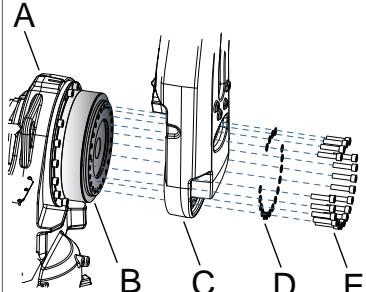
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to the position shown in the figure.	 xx0800000336
3	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Remove the <i>cable package</i> from all axes except in the base.	How to remove the cable package in frame, lower arm and armhouse is described in sections: <ul style="list-style-type: none"> • Removing cable harness in frame on page 215 • Removing cable harness in lower arm and armhouse on page 217 • Replacement of air nipples and hoses (Foundry Prime) on page 236
5	Secure the upper arm with a roundsling in an overhead crane.	
6	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
7	Remove the <i>complete upper arm</i> and put it on a loading pallet.	How to remove the complete upper arm is described in section: <ul style="list-style-type: none"> • Removing the complete upper arm on page 269

Continues on next page

4 Repair

4.5.1 Replacing the lower arm

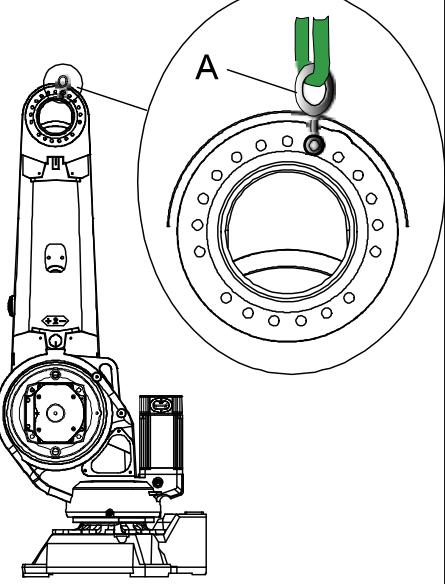
Continued

Action	Note
8  CAUTION The robot lower arm weighs 65 kg. All lifting accessories used must be sized accordingly!	
9 Fit a <i>lifting lug</i> in one of the upper holes in the lower arm, for the attachment screws.	 xx0800000379 Parts: • A: Lifting lug
10 Remove the <i>attachment screws</i> securing the lower arm to gearbox axis 2.	 xx0800000377 Parts: • A: Frame • B: Gearbox axis 2 • C: Lower arm • D: Washer (17 pcs) • E: Attachment screws M12x50 quality steel Gleitmo 12.9 (17 pcs)
11 Remove the lower arm.	

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Refitting the lower arm

Use this procedure to refit the lower arm.

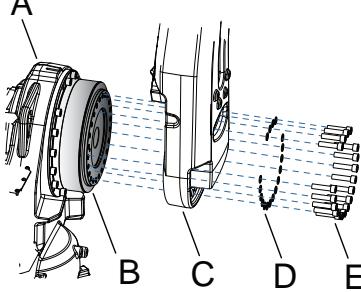
	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3	 CAUTION The robot lower arm weighs 65 kg. All lifting accessories used must be sized accordingly!	
4	Fit a <i>lifting lug</i> in one of the upper holes in the lower arm, for the attachment screws.	 xx0800000379 Parts: <ul style="list-style-type: none"> • A: Lifting lug
5	Secure the lower arm with a roundsling in an overhead crane and lift it to the robot.	

Continues on next page

4 Repair

4.5.1 Replacing the lower arm

Continued

Action	Note
6 Refit the <i>attachment screws</i> securing the lower arm to gearbox axis 2.	 <p>xx0800000377</p> <p>Tightening torque:</p> <ul style="list-style-type: none"> • 110 Nm <p>Parts:</p> <ul style="list-style-type: none"> • A: Frame • B: Gearbox axis 2 • C: Lower arm • D: Washer (17 pcs) • E: Attachment screws M12x50 quality steel Gleitmo 12.9 (17 pcs)
7 Secure the complete upper arm with round-slings in an overhead crane and lift it to the robot.	
8 Refit the <i>complete upper arm</i> .	How to refit the complete upper arm is described in section: <ul style="list-style-type: none"> • Refitting the complete upper arm on page 274
9 Refit the <i>cable package</i> .	How to refit the cable package in frame, lower arm and armhouse is described in sections: <ul style="list-style-type: none"> • Refitting the cable harness in the frame on page 223 • Refitting the cable harness in the lower arm and armhouse on page 233 • Replacement of air nipples and hoses (Foundry Prime) on page 236
10 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
11 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .

Continues on next page

	Action	Note
12	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49.	

4 Repair

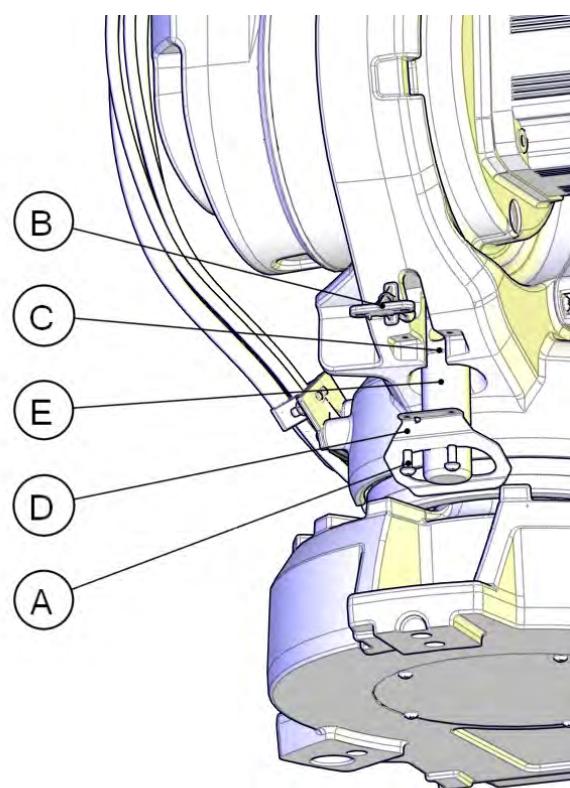
4.6.1 Replacing stop pin axis 1

4.6 Frame and base

4.6.1 Replacing stop pin axis 1

Location of stop pin axis 1

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



xx0800000045

A	Attachment screws M6x16 quality 8.8-A2F (2 pcs)
B	Bracket
C	O-ring (2 pcs)
D	Bracket
E	Stop pin

Required equipment

Equipment	Note
Stop pin	For spare parts no. see Spare parts - <i>Frame and base</i> in <i>Product manual, spare parts - IRB 2600</i> .
Standard toolkit	Content is defined in section Standard tools on page 391 .

Continues on next page

4.6.1 Replacing stop pin axis 1

Continued

Equipment	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.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Removing the stop pin, axis 1

Use this procedure to remove the stop pin axis 1.

	Action	Note
1	 DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
2	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
3	Remove the attachment screws securing the bracket and stop pin.	See the figure in <ul style="list-style-type: none"> • Location of stop pin axis 1 on page 302
4	Remove the bracket and stop pin.	See the figure in <ul style="list-style-type: none"> • Location of stop pin axis 1 on page 302

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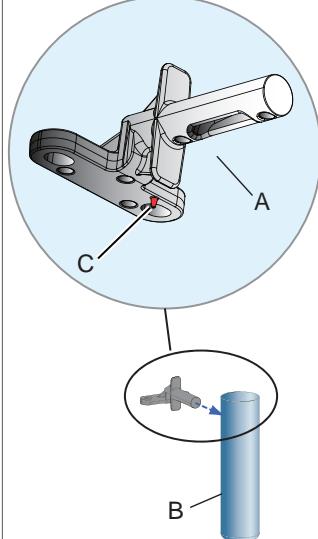
4 Repair

4.6.1 Replacing stop pin axis 1

Continued

Refitting the stop pin, axis 1

Use this procedure to refit the stop pin axis 1.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3 Fit the two <i>o-rings</i> on the stop pin.	See the figure in <ul style="list-style-type: none">• Location of stop pin axis 1 on page 302
4 Fit the <i>stop pin</i> on the <i>bracket</i> .  Note The small spike on the bracket shall be pointing downwards for correct fitting of the stop pin!	 xx0800000453 Parts: <ul style="list-style-type: none">• A: Bracket• B: Stop pin• C: Small spike
5 Secure the stop pin on the frame with its <i>attachment screws</i> .	See the figure in <ul style="list-style-type: none">• Location of stop pin axis 1 on page 302
6 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	

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4.6.1 Replacing stop pin axis 1

Continued

	Action	Note
7	 DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49.	

4 Repair

4.7.1 Removing motors

4.7 Motors

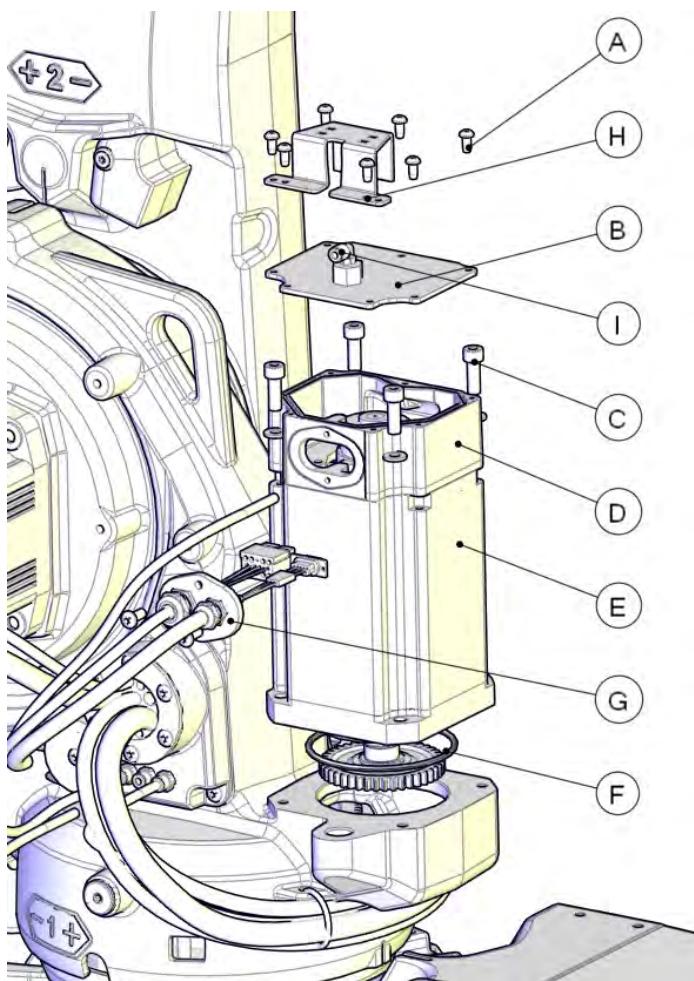
4.7.1 Removing motors

Introduction

This procedure describes how to remove motors on all axes of the robot.

Location of axis-1 and axis-2 motors (Foundry Prime)

The figure shows axis-1 motor on IRB 4600 Foundry Prime.



xx1100000083

A	Attachment screws M5x16, quality Steel 8-A2F (7 pcs)
B	Motor cover
C	Attachment screws, motor axis 1 (4 pcs) + washers Tightening torques and attachment screws on page 319 .
D	Connection box
E	Axis-1 motor
F	O-ring
G	Cable gland cover

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4.7.1 Removing motors

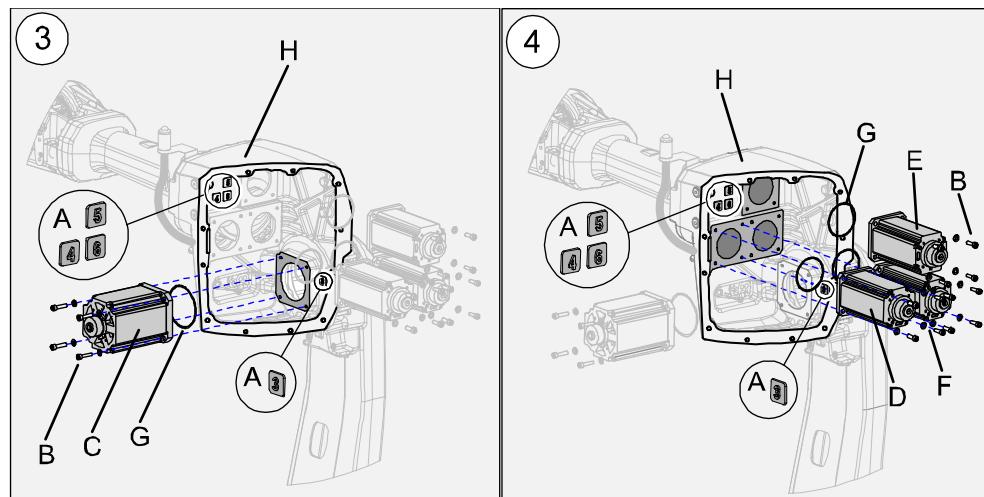
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H	Hose protection
I	Elbow nipple

Location of axis-3, axis-4, axis-5 and axis-6 motors

The axis-3, axis-4, axis-5 and axis-6 motors are located as shown in the figures.

Motors: (3) = Axis-3 motor. (4) = Axis-4, axis-5 and axis-6 motors.



xx0900000303

A	Markings inside armhouse, identifying the position of each motor
B	Attachment screws, axis-3 motor (4 pcs) + washers. See Tightening torques and attachment screws on page 319
B	Attachment screws, axis-4, axis-5 and axis-6 motors (3x4 pcs) + washers. Tightening torques and attachment screws on page 319
C	Axis-3 motor
D	Axis-4 motor
E	Axis-5 motor
F	Axis-6 motor
G	O-ring (axis-4, axis-5 and axis-6)
H	Armhouse

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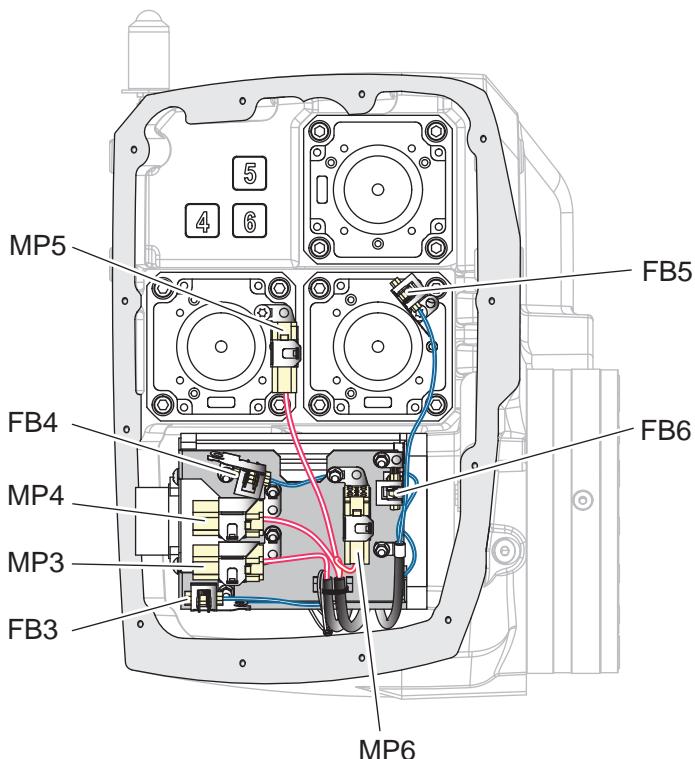
4 Repair

4.7.1 Removing motors

Continued

Connectors, axis-3 and axis-4 motors

The figure shows the connectors of motors axes 3-6.



xx0900000410

Required equipment

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Weights

The motors for the different axes weighs according to the table:

Motor	Weight in kg
Axis-1 motor	13 kg

Continues on next page

Motor	Weight in kg
Axis-2 motor	25 kg
Axis-3 motor	13 kg
Axis-4 motor	8 kg
Axis-5 motor	8 kg
Axis-6 motor	8 kg

**CAUTION**

All lifting equipment must be sized accordingly!

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
	<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

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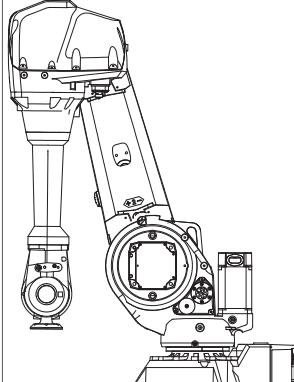
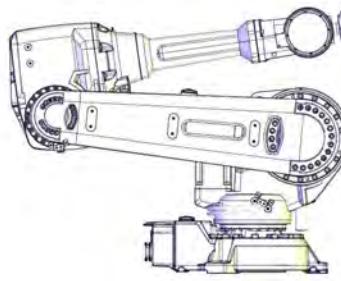
4 Repair

4.7.1 Removing motors

Continued

Position of robot

Use this procedure to place the robot in the position recommended in order to facilitate replacement of motors.

Action	Information
Axis-1, axis-4, axis-5 and axis-6 motor <ul style="list-style-type: none">Move the robot to a position where the wrist is pointing to the floor, as shown in the figure. This will make it possible to remove the motors without draining the oil from the gearbox.	 xx0800000388
Axis-2 motor <ul style="list-style-type: none">Move the robot to a position where the lower arm rests firmly on the damper of axes 2 and 3. Release the brake of axis 2 to be sure that the lower arm rests in the end position.	 xx1100000548
Axis-3 motor <ul style="list-style-type: none">Move axis-2 to 0° and axis-3 to maximal +. Release the brake of axis-3 to be sure that the upper arm is completely vertical and rests against the damper of axis-2 and axis-3.	

Draining gearbox

Use this procedure to drain gearboxes, if needed.



Note

Draining of gearbox is only needed when removing the axes 2 and 3 motors.

	Action	Note
1	Axis-1 motor: <ul style="list-style-type: none">Draining of gearbox is not needed.	-
2	Axis-2 motor: <ul style="list-style-type: none">The gearbox has to be drained before removing the motor.	How to drain the gearbox is described in section: <ul style="list-style-type: none">Changing the oil, axis-2 gearbox on page 171

Continues on next page

	Action	Note
3	Axis-3 motor: • The gearbox has to be drained before removing the motor.	How to drain the gearbox is described in section: • Changing the oil, axis-3 gearbox on page 175
4	Axis-4, axis-5 and axis-6 motors: • Draining of gearbox oil is not needed if robot is positioned as recommended.	-

Removing motors

Use this procedure to remove the axis-1, axis-2, axis-3, axis-4, axis-5 and axis-6 motors.



Note

The procedure contains information how to remove motors on all axes of the robot. Some steps are only applicable to a certain motor. Follow the steps carefully in order not to miss vital information!

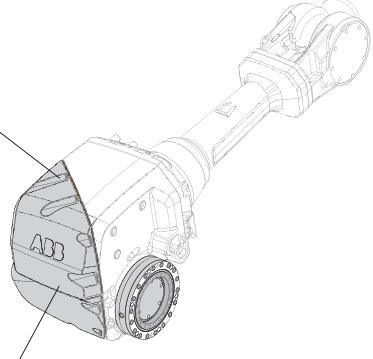
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Move the robot to the recommended position for the motor that shall be removed.	See Removing motors on page 306 . • Position of robot on page 310
3	 DANGER Turn off all: • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
4	Check if the gearbox needs to be drained.	See Removing motors on page 306 . • Draining gearbox on page 310
5	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	

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4 Repair

4.7.1 Removing motors

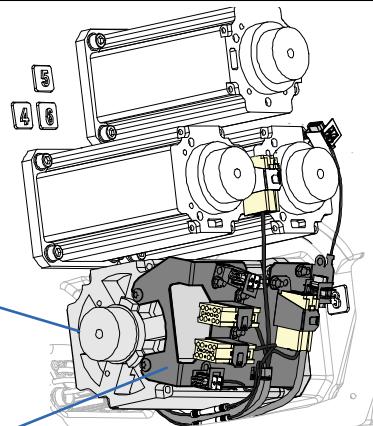
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Action	Note
<p>6 Only applicable to axis-3, axis-4, axis-5 and axis-6 motors! Remove the cover in the back of the arm house.</p> <p> WARNING</p> <p>The robot must never be run without the cover in the armhouse fitted! It is a vital supporting part of the robot.</p>	 <p>xx0800000389</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Cover • B: Attachment screws (10 pcs) + washers.
<p>7 Only applicable to axis-1 and axis-2 motors! Remove the motor cover.</p>	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of axis-1 and axis-2 motors (Foundry Prime) on page 306
<p>8 Only applicable to axis-1 and axis-2 motors! Remove the cable gland cover.</p>	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of axis-1 and axis-2 motors (Foundry Prime) on page 306
<p>9 Only applicable to axis-1 and axis-2 motors! Remove the connection box.</p> <p> Note</p> <p>Only needed if the motor shall be replaced with a new one.</p>	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of axis-1 and axis-2 motors (Foundry Prime) on page 306
<p>10 Disconnect the <i>motor cables</i>.</p>	<p> Note</p> <p>When removing the axis-3 motor, the cables of the axis-4, axis-5 and axis-6 motors must be disconnected too. This must be done in order to be able to remove the bracket on top of the axis-3 motor.</p>

Continues on next page

4.7.1 Removing motors

Continued

Action	Note
11 Only applicable to axis-3 motor! Remove the bracket from the axis-3 motor.	 <p>A B xx0800000390</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Axis-3 motor B: Bracket
12 In order to release the brakes of the motor to be removed, connect the 24 VDC power supply to the motor. Only applicable to motors axes 2 and 3! Release the brake of axis 2 until the lower arm firmly rests on the damper.	<p>Connectors:</p> <ul style="list-style-type: none"> Axis-1 motor: R2.MP1 Axis-2 motor: R2.MP2 Axis-3 motor: R2.MP3 Axis-4 motor: R2.MP4 Axis-5 motor: R2.MP5 Axis-6 motor: R2.MP6 <p>Connect to pins:</p> <ul style="list-style-type: none"> + : pin 2 - : pin 5 <p> CAUTION</p> <p>The connections for the motor brakes (24 VDC connection) are phase dependent. If the connection on the pins is switched, it can cause severe damage to vital parts.</p>
13  Note Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
14 Remove the attachment screws securing the motor. If needed use a 300 mm extension for bits 1/2" (Motor axis 1).	See the figure in: <ul style="list-style-type: none"> Location of axis-1 and axis-2 motors (Foundry Prime) on page 306
15 If required, press the motor out of position by fitting two screws in the threaded holes in the motor flange.	 Note Always use removal tools in pairs diagonal to each other.

Continues on next page

4 Repair

4.7.1 Removing motors

Continued

	Action	Note
16	Remove the motor!	 CAUTION Lift the motor gently in order not to damage pinion or gears.
17	Only applicable to motor axis 1! Cover the hole if replacement of motor axis 1 is not immediate, in order to avoid contamination.	See the figure in: <ul style="list-style-type: none">Location of axis-1 and axis-2 motors (Foundry Prime) on page 306
18	Only applicable to motors axes 4, 5 and 6! Check that the o-ring also is removed. It might stay in the armhouse when the motor is removed.	See the figure in: <ul style="list-style-type: none">Location of axis-1 and axis-2 motors (Foundry Prime) on page 306

4.7.2 Refitting motors

Introduction

This procedure describes how to refit motors on all axes of the robot.

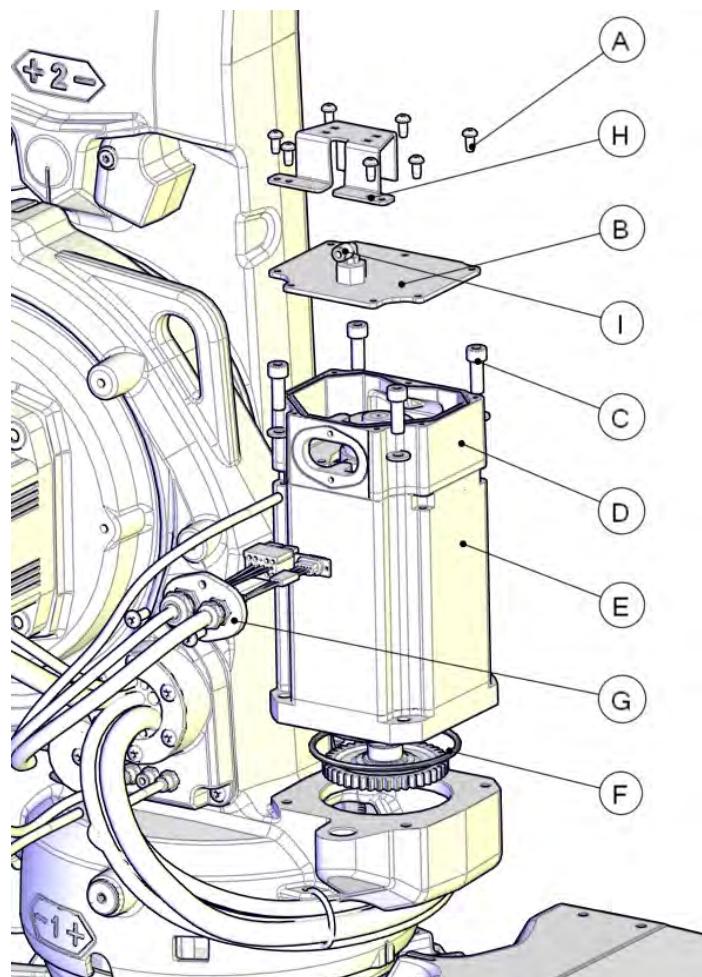


WARNING

When a motor is replaced, make sure to use the correct type of new motor. Motors of different types may not be compatible. See the *Spare parts manual* delivered as a separate document on the documentation DVD.

Location of axis-1 and axis-2 motors, (Foundry Prime)

The figure shows motor axis1 on IRB 4600 Foundry Prime.



xx1100000083

A	Attachment screws M5x16, quality Steel 8-A2F (7 pcs)
B	Motor cover
C	Attachment screws, motor axis 1 (4 pcs) + washers Tightening torques and attachment screws on page 319 .
D	Connection box

Continues on next page

4 Repair

4.7.2 Refitting motors

Continued

E	Motor, axis 1
F	O-ring
G	Cable gland cover
H	Hose protection
I	Elbow nipple

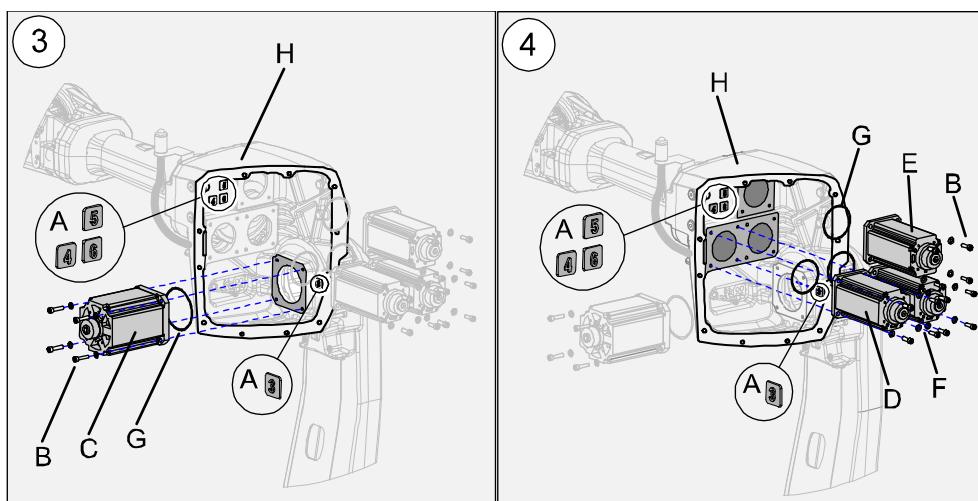
Location of axis-3, axis-4, axis-5 and axis-6 motors

The axis-3, axis-4, axis-5 and axis-6 motors are located as shown in the figures.

Motors:

(3) = Axis-3 motor

(4) = Axis-4, axis-5 and axis-6 motors



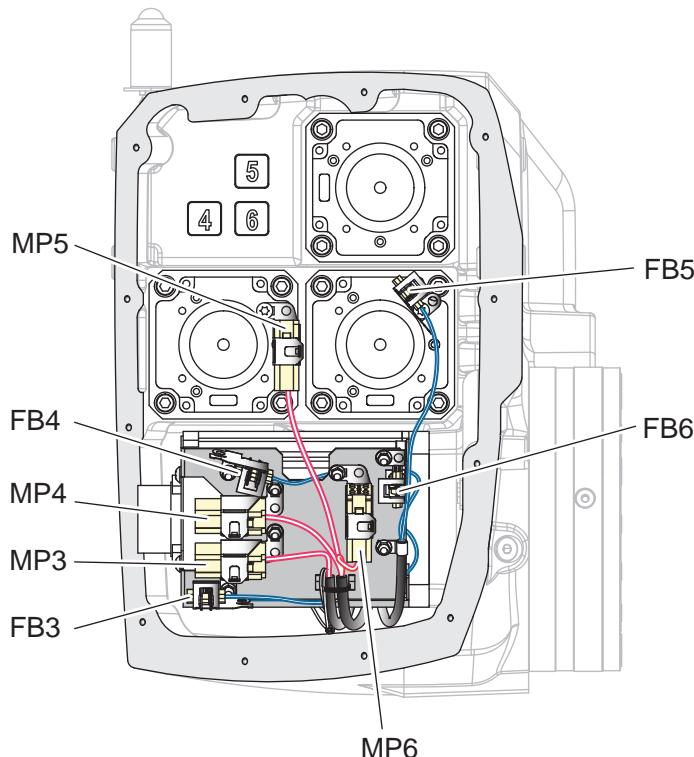
xx0900000303

A	Markings inside armhouse, identifying the position of each motor
B	Attachment screws, axis-3 motor, (4 pcs) + washers. See Tightening torques and attachment screws on page 319
B	Attachment screws, axis-4, axis-5 and axis-6 motors, (3x4 pcs) + washers. See Tightening torques and attachment screws on page 319
C	Axis-3 motor
D	Axis-4 motor
E	Axis-5 motor
F	Axis-6 motor
G	O-ring (axis-4, axis-5 and axis-6)
H	Armhouse

Continues on next page

Connectors, axis-3 and axis-4 motors

The figure shows the connectors of the axis-3 and axis-4 motors.



xx0900000410

Required equipment

Equipment	Note
Standard toolkit	Content is defined in section Standard tools on page 391 .
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.
Lifting tool, axis-2	For art. no. see Reference information .
Lifting tool, axis-3	For art. no. see Reference information .
Motors	For spare part no. see Spare part lists on page 397 .

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Continues on next page

4 Repair

4.7.2 Refitting motors

Continued

Weights

The motors for the different axes weighs according to the table:

Motor	Weight in kg
Axis-1 motor	13 kg
Axis-2 motor	25 kg
Axis-3 motor	13 kg
Axis-4 motor	8 kg
Axis-5 motor	8 kg
Axis-6 motor	8 kg

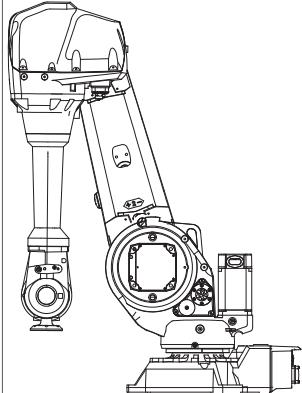
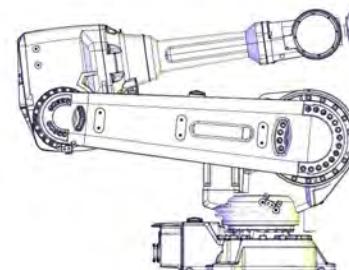


CAUTION

All lifting equipment must be sized accordingly!

Position of robot

Use this procedure to place the robot in the position recommended in order to facilitate replacement of motors.

Action	Information
Axis-1, axis-4, axis-5 and axis-6 motors <ul style="list-style-type: none">Move the robot to a position where the wrist is pointing to the floor, as shown in the figure. This will make it possible to remove the motors without draining the oil from the gearbox.	 xx0800000388
Axis-2 motor <ul style="list-style-type: none">Move the robot to a position where the lower arm rests firmly on the axis-3 damper. Release the axis-2 brake to be sure that the lower arm rests in the end position.	 xx1100000548
Axis-3 motor <ul style="list-style-type: none">Move axis-2 to 0° and axis-3 to maximal +. Release the axis-3 brake to be sure that the upper arm is completely vertical and rests against the damper.	

Continues on next page

Filling oil in gearbox

Use this procedure to fill oil in gearbox, if needed.

**Note**

Filling oil in the gearbox is only needed when refitting motors axes 2 and 3.

	Action	Note
1	Axis-1 motor: • Filling gearbox oil not needed.	-
2	Axis-2 motor: • Refill oil in gearbox after refitting.	How to fill oil in gearbox is described in section: • Changing the oil, axis-2 gearbox on page 171
3	Axis-3 motor: • Refill oil in gearbox after refitting.	How to fill oil in gearbox is described in section: • Changing the oil, axis-3 gearbox on page 175
4	Axis-4, axis-5 and axis-6 motors: • Filling gearbox oil not needed.	-

Tightening torques and attachment screws

The table shows the tightening torques for all motors.

Motor	Attachment screw	Quality	Tightening torque
Motor, axis 1	M8x25	8.8-A2F	22 Nm
Motor, axis 2	<i>Screwlengths depending on flange thickness on page 319</i>	8.8-A2F	35 Nm
Motor, axis 3	<i>Screwlengths depending on flange thickness on page 319</i>	8.8-A2F	22 Nm
Motor, axis 4	M8x25	8.8-A2F	22 Nm
Motor, axis 5	M8x25	8.8-A2F	22 Nm
Motor, axis 6	M8x25	8.8-A2F	22 Nm

Screwlengths depending on flange thickness

Screwlengths can vary depending on when the robot is delivered. The different screwlengths depends on the different flange thickness of motors. Make sure to use the correct screwlength! See table:

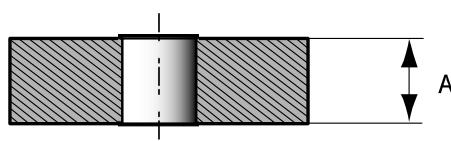
Motor axis 2		Motor axis 3	
Flange thickness	Attachment screws	Flange thickness	Attachment screws
18.5 mm	M10x40	15 mm	M8x35
16 mm	M10x35	13 mm	M8x30

Continues on next page

4 Repair

4.7.2 Refitting motors

Continued

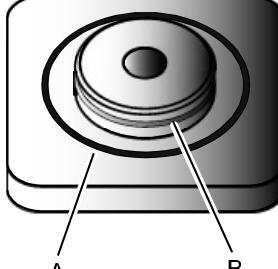


xx0900000443

A	Flange thickness
---	------------------

Preparations before the refitting of motors

Use this procedure to make necessary preparations before refitting motors.

Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2 Grind the paint on the surface carefully to get a smooth surface.	
3 Clean the surface from contamination such as oil and dirt. Remove any painting from the assembly surfaces, with a knife.	
4 Make sure that the motor and the pinion are not damaged or scratched.	
5 Lightly lubricate the o-ring with <i>grease</i> .	
6 Make sure the <i>o-ring</i> on the flange of the motor is seated properly.	 <p>xx0900000082</p> <p>Parts:</p> <ul style="list-style-type: none">• A: Correct position of o-ring• B: Incorrect position of o-ring ! <p>Replace with a new o-ring if damaged!</p>

Continues on next page

Action	Note
7 In order to release the brakes, connect the 24 VDC power supply.	<p>Connectors:</p> <ul style="list-style-type: none"> • Motor axis 1: R2.MP1 • Motor axis 2: R2.MP2 • Motor axis 3: R2.MP3 • Motor axis 4: R2.MP4 • Motor axis 5: R2.MP5 • Motor axis 6: R2.MP6 <p>Connect to pins:</p> <ul style="list-style-type: none"> • + : pin 2 • - : pin 5 <p> CAUTION</p> <p>The connections for the motor brakes (24 VDC connection) are phase dependent. If the connection on the pins is switched, it can cause severe damage to vital parts.</p>

Refitting motors

Use this procedure to refit motors axes 1, 2, 3, 4, 5 and 6.

 Note
The procedure contains information how to refit motors on all axes of the robot. Some steps are only applicable to a certain motor. Follow the steps carefully in order not to miss vital information!

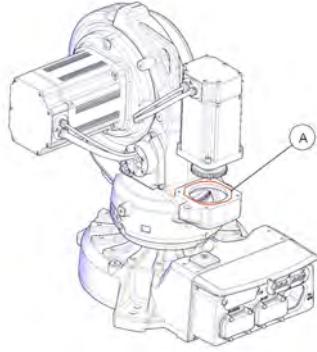
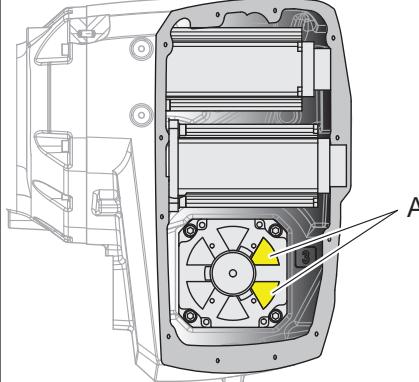
Action	Information
1  Note Before starting the refitting of the motor, first make the necessary preparations!	See Refitting motors on page 315 . • Preparations before the refitting of motors on page 320
2  Note Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
3 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	

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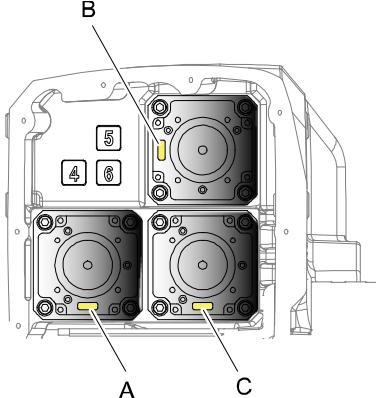
4 Repair

4.7.2 Refitting motors

Continued

Action	Information
4 Apply Loctite 574 on the surface as shown (A) in the figure.	 xx1100000549
5 Place the motor carefully in the gearbox.	
6 Fit the motor, making sure the motor pinion is properly mated to the gear in the gearbox.	Make sure that: <ul style="list-style-type: none"> the motor is turned the correct way the pinion or gear of the motor does not get damaged!
7 Applicable to motor axis 3! Make sure that the wire exit holes of motor axis 3 are in the correct position. See illustration!	 xx0900000300 <p>Parts:</p> <ul style="list-style-type: none"> A: Wire exit holes, motor axis 3

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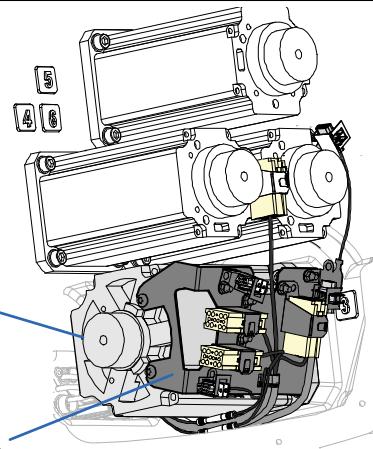
Action	Information
8 Applicable to motors axes 4, 5 and 6! Make sure that the wire exit hole of the motor is in the correct position.	 xx0900000062 Parts: <ul style="list-style-type: none"> A: Wire exit hole, motor axis 4 B: Wire exit hole, motor axis 5 C: Wire exit hole, motor axis 6
9 Only applicable to motors axes 4, 5 and 6! Fit the attachment screws for the motor and fasten them slightly. The motor must be able to move parallel to the gear during the adjustment of the play.	
10 Only applicable to motors axes 4, 5 and 6! Adjust the play of the motor.	See Adjusting the play of axis 4, 5 and 6 motors on page 326 .
11 Secure the motor with its attachment screws and washers.  Note Apply the correct tightening torque!	Tightening torque and attachment screws are specified in the table: <ul style="list-style-type: none"> Tightening torques and attachment screws on page 319
12 Disconnect the brake release voltage.	
13 Only applicable to motors axes 1 and 2! Refit the connection box (if it has been removed).  Note Make sure that the o-ring is in place!	See the figure in: <ul style="list-style-type: none"> Location of axis-1 and axis-2 motors, (Foundry Prime) on page 315

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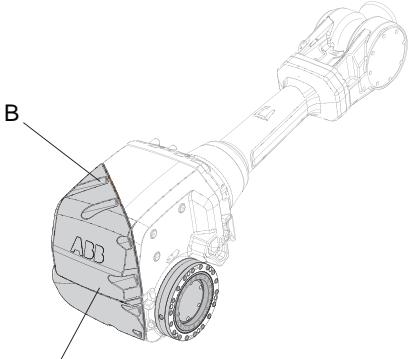
4 Repair

4.7.2 Refitting motors

Continued

	Action	Information
14	Applicable to motor axis 3! Refit the bracket on motor axis 3.	 xx0800000390 <p>Parts:</p> <ul style="list-style-type: none"> A: Motor axis 3 B: Bracket
15	Reconnect the motor cables.	
16	Applicable to motor axes 1 and 2! Refit the <i>cable gland</i> and <i>motor covers</i> . Make sure that the <i>o-ring</i> is in place!	See the figure in: <ul style="list-style-type: none"> Location of axis-1 and axis-2 motors, (Foundry Prime) on page 315 <p> Note</p> <p>Make sure that the cover is tightly sealed!</p>
17	Applicable to motors axis 2! Refill gearbox oil.	How to fill oil in the gearbox is described in sections: <ul style="list-style-type: none"> Changing the oil, axis-2 gearbox on page 171 Changing the oil, axis-3 gearbox on page 175
18	Applicable to motors axes 3, 4, 5 and 6! Make sure that the gasket on the cover on the armhouse is intact.	If the gasket is damaged, it need to be replaced.

Continues on next page

	Action	Information
19	<p>Applicable to motors axes 3, 4, 5 and 6! Refit the cover in the back of the armhouse with its attachment screws and washers.</p> <p> WARNING</p> <p>The cover on the armhouse must be fitted when the robot is running. It is a vital part for the stability of the robot.</p>	<p>Make sure that the cover is tightly sealed.</p>  <p>xx0800000389</p> <p>Parts:</p> <ul style="list-style-type: none"> • A: Cover • B: Attachment screws M6x25, quality 8.8-A2F (10 pcs) <p>Tightening torque:</p> <ul style="list-style-type: none"> • 14 Nm
20	Make sure that the armhouse cover is tightly fitted. If there is a gap between the cover and the robot, seal with Sikaflex 521 FC.	
21	Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
22	Recalibrate the robot.	<p>Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i>, enclosed with the calibration tools.</p> <p>Axis Calibration is described in Calibrating with Axis Calibration method on page 362.</p> <p>General calibration information is included in section Calibration on page 351.</p>
23	<p> DANGER</p> <p>Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49.</p>	

4 Repair

4.7.3 Adjusting the play of axis 4, 5 and 6 motors

4.7.3 Adjusting the play of axis 4, 5 and 6 motors

Required equipment

Equipment	Note
Measuring tool	For adjusting the play.
Standard toolkit	Content is defined in section <i>Standard tools on page 391</i> .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Adjusting the play of axis 4, 5 and 6 motors

Action	Note
1 Fit the measuring tool at the rear of the motor.	
2 Adjust the play on the motor by starting with a big play and then gradually finding the smallest play. Use swift movements in order to avoid noticing the magnetic field which causes the gears to stick together. Follow the instructions for current motor: Motor axis 4: 1 Turn the motor shaft six turns and find the smallest play within this range. Axis 5 motor: 1 Turn the outgoing shaft for axis 4 in intervals of 90° for one full turn and find the smallest play for the axis 5 motor within this range. 2 Turn the axis 5 motor one full turn at a time for a total of five turns and find the smallest play within this range. Axis 6 motor: 1 Turn the outgoing shaft for axis 4 in intervals of 90° for one full turn and find the smallest play for the axis 6 motor within this area. 2 Turn the axis 5 motor one full turn at a time for a total of five turns and find the smallest play for axis 6 within this range. 3 Turn the axis 6 motor one full turn at a time for a total of three turns and find the smallest play for axis 6 within this range.	
3 Push or tap the motor in radial direction so that the play becomes minimal within one motor turn, without the gear "chewing".	

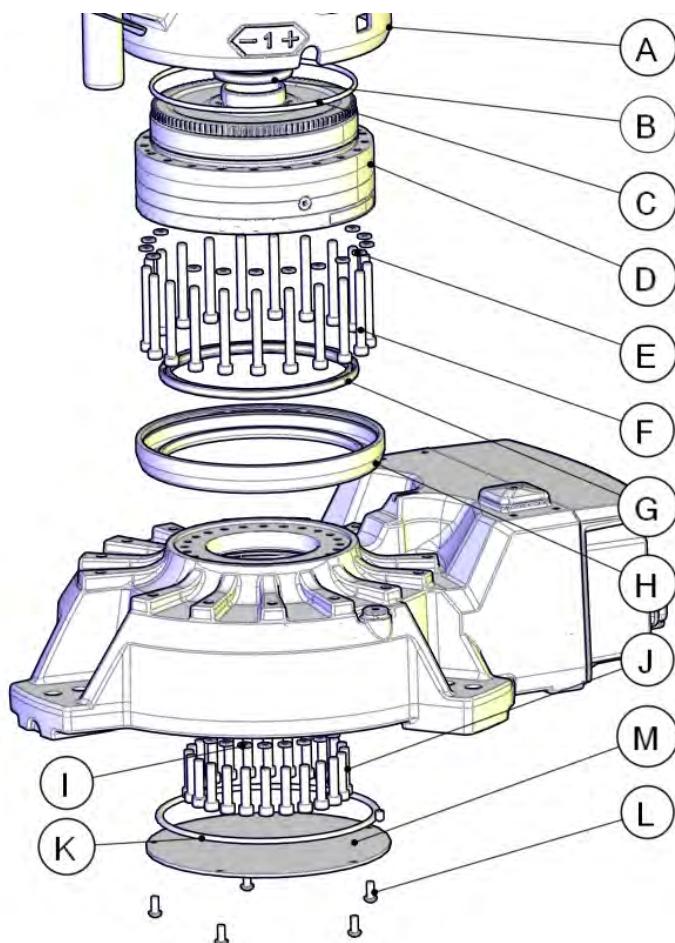
4.8 Gearboxes

4.8.1 Replacing gearbox axis 1

Location of gearbox

The gearbox is located as shown in the figure.

This exploded view only shows the principle of the assembly. The actual replacing is recommended to be done with the robot resting on its side. See illustration in section *Replacing the base: Position of robot when replacing base from complete arm system on page 259*.



xx1100000007

A	Frame
B	Radial sealing
C	O-ring
D	Gearbox axis 1
E	Washer (21 pcs)
F	Attachment screws M8x80 quality Steel 12.9 Gleitmo (21 pcs)

Continues on next page

4 Repair

4.8.1 Replacing gearbox axis 1

Continued

G	Radial sealing
H	Sealing ring
I	Washer
J	Attachment screws
K	O-ring
L	Attachment screws
M	Cover

Required equipment

Equipment	Note
Gearbox	See Spare part lists on page 397 .
Guide pins	M8 (2 pcs) Used to guide the gearbox during removal/re-fitting.
Standard toolkit	Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.	These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

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

Continues on next page

4.8.1 Replacing gearbox axis 1

Continued

Action	Note
<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

Removing gearbox axis 1

Use this procedure to remove the gearbox.

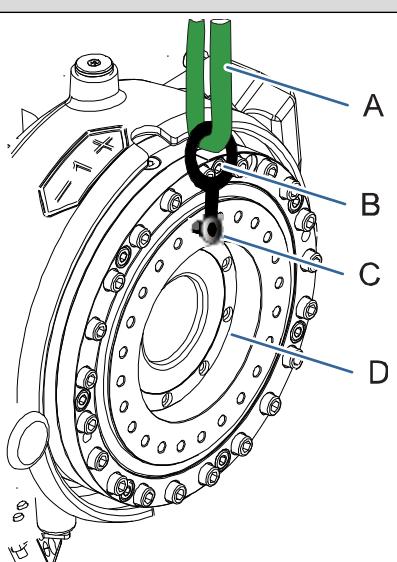
Action	Note
1 Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2 Drain the oil from the gearbox.	How to drain the oil from the gearbox is described in section: <ul style="list-style-type: none">• Changing the oil, axis 1 gearbox on floor mounted robots on page 160
3 Move the robot to the calibration position.	
4  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
5  CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	
6 Remove the axis 1 motor.	See Removing motors on page 306 .
7 In order to reach gearbox axis 1, it is necessary first to remove the base from the complete arm system.	How to remove the base from the complete arm system is described in section: <ul style="list-style-type: none">• Removing the base on page 260

Continues on next page

4 Repair

4.8.1 Replacing gearbox axis 1

Continued

Action	Note
8 Fit a <i>lifting lug</i> in the <i>uppermost hole</i> for the attachment screws securing the base, as shown in the figure.	 <p>xx0800000440</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Roundsling B: Lifting lug C: Uppermost attachment hole for securing the base D: Gearbox axis 1
9  CAUTION The gearbox weighs 27 kg. All lifting accessories used must be sized accordingly!	
10 Secure the gearbox in an overhead crane or similar.	
11 Remove the <i>attachment screws</i> securing the gearbox.	See the figure in: • Location of gearbox on page 327
12 Insert guide pins in two, diagonally located, attachment holes in the gearbox.	Always use guide pins in pairs!
13  Note Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
14  Note There will be some excess oil running out of the gearbox when it is removed. Put some absorbent material to catch the oil.	

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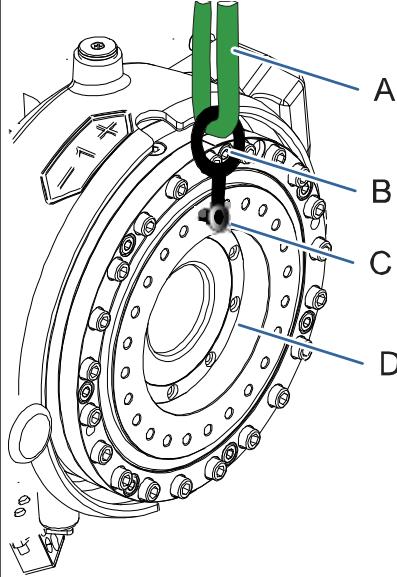
4.8.1 Replacing gearbox axis 1

Continued

Action	Note
15 Using caution slide the gearbox out onto the guide pins and lift it away. If necessary use removal tools to remove the gearbox.	 Note Always use removal tools in pairs diagonal to each other.

Refitting gearbox axis 1

Use this procedure to refit the gearbox.

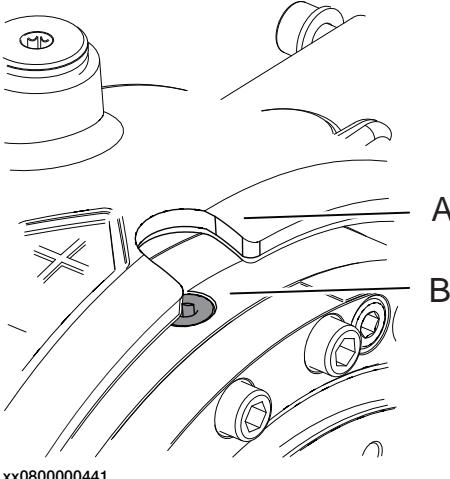
Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3 Fit a lifting lug in the <i>uppermost hole</i> for the attachment screws securing the base, as shown in the figure.	 xx0800000440 Parts: <ul style="list-style-type: none"> • A: Roundsling • B: Lifting lug • C: Uppermost attachment hole for securing the base • D: Gearbox axis 1

Continues on next page

4 Repair

4.8.1 Replacing gearbox axis 1

Continued

Action	Note
4  Note Check, when fitting the lifting lug, that both oil plugs will be placed in the correct position after the gearbox is fitted as shown in the figure. The oil plugs shall be placed in the <i>openings</i> in the frame.	 Parts: <ul style="list-style-type: none">• A: Opening for oil plug in frame• B: Oil plug
5 Apply grease on the <i>o-ring</i> .	See the figure in: <ul style="list-style-type: none">• Location of gearbox on page 327 Replace <i>o-ring</i> if damaged.
6 Clean all assembly surfaces. Remove any painting from the assembly surfaces, with a knife.	
7 Fit guide pins into two of the holes for the attachment screws.	Always use guide pins in pairs!
8  Note Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
9  CAUTION The gearbox weighs 27 kg. All lifting accessories used must be sized accordingly!	
10 Lift the gearbox onto the guide pins and slide it into position, using caution.	Double check that the oil plugs are in the correct position.
11 Secure the gearbox with its attachment screws.	See the figure in: <ul style="list-style-type: none">• Location of gearbox on page 327 Tightening torque: <ul style="list-style-type: none">• 35 Nm
12 Refit the base on the <i>complete arm system</i> .	How to refit the base on the complete arm system is described in section: <ul style="list-style-type: none">• Refitting the base on page 264

Continues on next page

4.8.1 Replacing gearbox axis 1

Continued

Action	Note
13 Refit the cable harness in the base, the frame and the lower arm.	See Replacing gearbox axis 1 on page 327 . <ul style="list-style-type: none"> • Refitting the cable harness in the base on page 227 • Refitting the cable harness in the frame on page 223 • Refitting the cable harness in the lower arm and armhouse on page 233
14 Refill oil in the gearbox.	How to fill oil in gearbox is described in section: <ul style="list-style-type: none"> • Changing the oil, axis 1 gearbox on floor mounted robots on page 160
15 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
16 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 362 . General calibration information is included in section Calibration on page 351 .
17  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

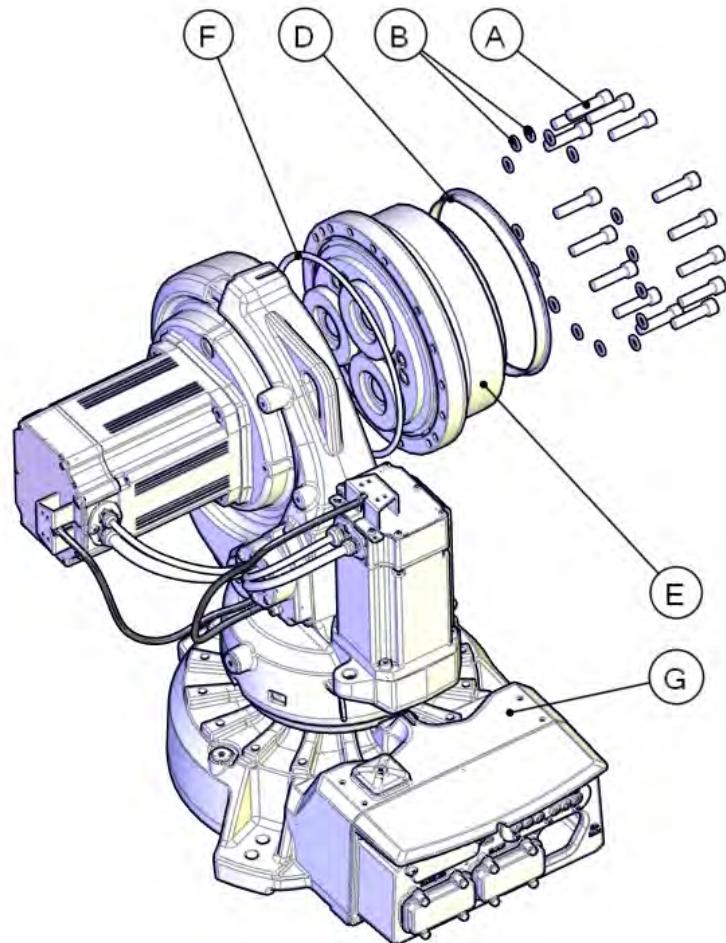
4 Repair

4.8.2 Replacing gearbox axis 2

4.8.2 Replacing gearbox axis 2

Location of gearbox axis 2

The gearbox is located as shown in the figure.



xx1100000006

A	Attachment screws M12x50 quality Steel 12.9 Gleitmo (15 pcs)
B	Washers (15 pcs)
D	Sleeve (delivered with gearbox)
E	Gearbox axis 2
F	O-ring
G	Frame

Continues on next page

Required equipment

Equipment	Article number	Note
Rotation tool	3HAB7887-1	
Lifting accessories	-	Roundslings.
Standard toolkit		Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	<p>Decide which calibration routine to use for calibrating the robot.</p> <ul style="list-style-type: none"> • Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot. • Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot. 	
	<p>If the robot is to be calibrated with reference calibration:</p> <p>Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot.</p> <p>If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.</p>	<p>Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.</p> <p>Creating new values requires possibility to move the robot.</p> <p>Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363.</p> <p>Read more about reference calibration for Pendulum Calibration in Operating manual - Calibration Pendulum.</p>
	<p>If the robot is to be calibrated with fine calibration:</p> <p>Remove all external cable packages (DressPack) and tools from the robot.</p>	

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4 Repair

4.8.2 Replacing gearbox axis 2

Continued

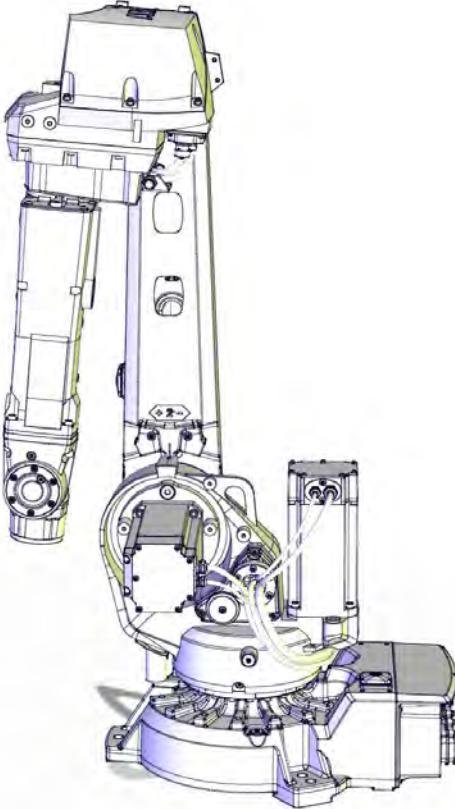
Removing gearbox axis 2

Use this procedure to remove the gearbox.



WARNING

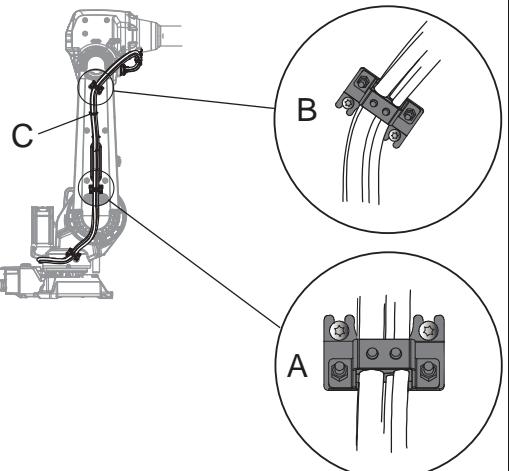
The procedure details how to replace the gearbox without removing the cable harness, only by loosening it. This means that the upper and lower arm will be separated from the frame but still be connected to the frame through the cabling. Be careful not to damage the cables!

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. Upper arm should rest on the axis-3 damper.	The figure shows IRB 2600 but the position of the robot is correct.  xx1200000068
3  DANGER Turn off all: <ul style="list-style-type: none">• electric power supply• hydraulic pressure supply to the robot, before entering the robot working area.	

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4.8.2 Replacing gearbox axis 2

Continued

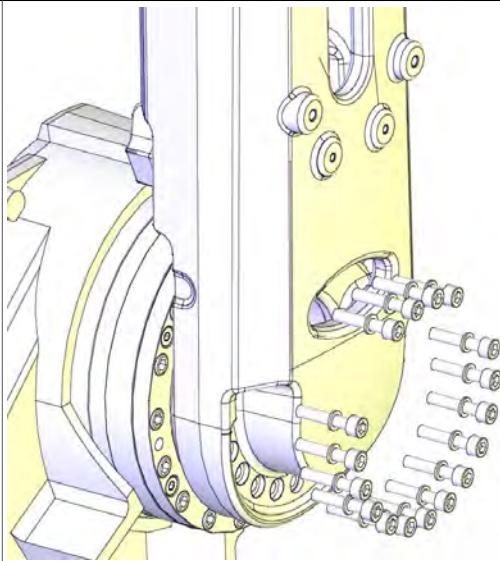
	Action	Note
4	Drain the gearbox.	How to drain the gearbox is described in section: <ul style="list-style-type: none"> • <i>Changing the oil, axis-2 gearbox on page 171</i>
5	 CAUTION <p>Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See <i>Replacing parts on the robot on page 205</i></p>	
6	Loosen the cabling from the lower arm by removing two cable brackets and a cable strap.	 xx1100000946 A Cable bracket B Cable bracket C Cable strap
7	Attach a roundsling around the upper arm house.	
8	Unload the weight of the lower and upper arm package by stretching the roundslings with the overhead crane. Turn on the power temporarily and release the brakes of axis 2 to rest the weight onto the roundslings.	
9	 DANGER <p>Turn off all:</p> <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply <p>to the robot, before entering the robot working area.</p>	

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4 Repair

4.8.2 Replacing gearbox axis 2

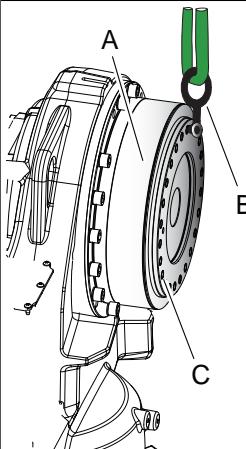
Continued

Action	Note
10 Remove the <i>attachment screws and washers</i> that secure the lower arm to the axis 2 gearbox.	 xx1200000085
11 Remove the lower and upper arm package from the frame.  WARNING The cable harness is still installed on the robot! Make sure not to damage the cables or the cable brackets on the robot.	
12  CAUTION The gearbox weighs 51 kg. All lifting accessories used must be sized accordingly!	

Continues on next page

4.8.2 Replacing gearbox axis 2

Continued

Action	Note
13 Fit a <i>lifting lug</i> in the uppermost hole for the attachment screws that secure the lower arm to the gearbox.	 xx0800000445 <p>Parts:</p> <ul style="list-style-type: none"> • A: Gearbox axis 2 • B: Lifting lug • C: Holes for attachment screws securing the lower arm to gearbox axis 2
14 Secure the gearbox with a roundsling in an overhead crane or similar.	
15 Remove the <i>attachment screws and washers</i> that secure the gearbox to the frame.	See the figure in: • Location of gearbox axis 2 on page 334
16 Fit guide pins to help guiding the gearbox out from the frame.	
17 If necessary, use removal tools to remove the gearbox.	 Note Always use removal tools in pairs diagonal to each other.
18 Remove the gearbox.  CAUTION Use caution in order not to damage gearbox or pinion!	

Refitting gearbox axis 2

Use this procedure to refit the gearbox.

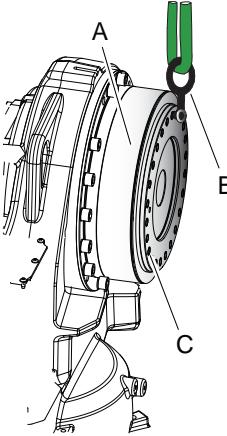
Action	Note
1  DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	

Continues on next page

4 Repair

4.8.2 Replacing gearbox axis 2

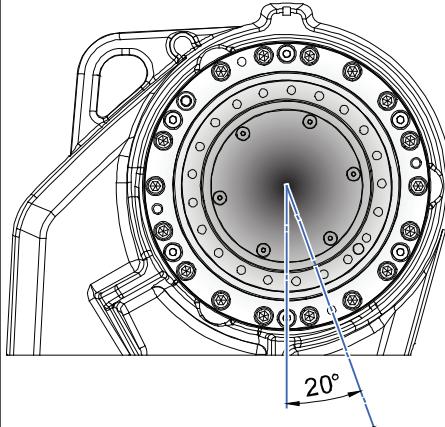
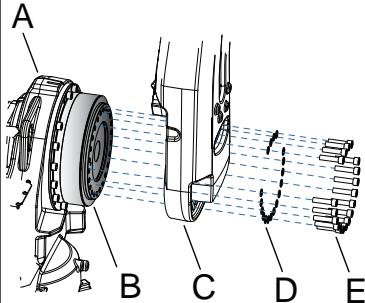
Continued

Action	Note
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3  CAUTION The gearbox weighs 51 kg. All lifting accessories used must be sized accordingly!	
4 Fit a lifting lug in the uppermost hole for the attachment screws securing the lower arm to the gearbox.	 xx0800000445 Parts: <ul style="list-style-type: none"> A: Gearbox axis 2 B: Lifting lug C: Holes for attachment screws securing the lower arm to gearbox axis 2.
5 Clean all assembly surfaces. Remove any painting from the assembly surfaces, with a knife.	
6 Apply some grease on the o-ring before fitting.	See the figure in: <ul style="list-style-type: none"> Location of gearbox axis 2 on page 334
7 Fit two guide pins in opposite holes in the frame.	
8 Secure the gearbox with a roundsling in an overhead crane or similar.	
9 Release the brakes of the axis 2 motor.	

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4.8.2 Replacing gearbox axis 2

Continued

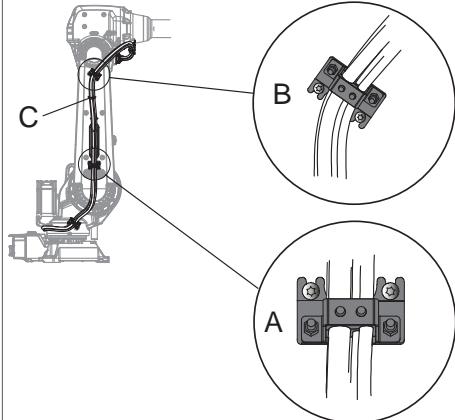
Action	Note
10 Lift the gearbox onto the guide pins and slide it into position while rotating the motor pinion to find the mating position. Use a <i>rotation tool</i> .	<p>Article number is specified in Required equipment on page 335.</p>  <p>xx1000000307</p> <p>Parts:</p> <ul style="list-style-type: none"> A: Position of oil plug on gearbox
11 Secure the gearbox with its <i>attachment screws and washers</i> .	<p>See screw dimension in the figure in:</p> <ul style="list-style-type: none"> Location of gearbox axis 2 on page 334 <p>Tightening torque: 110 Nm</p>
12 Perform a leak-down test.	<p>See Performing a leak-down test on page 200.</p>
13 Fit the guide pins to the gearbox.	
14 Lift the upper and lower arms into mounting position and guide them in place with the guide pins. It might be necessary to rotate the motor pinion with the rotating tool to find the mating position.	
15 Refit the <i>attachment screws</i> that secure the lower arm to the axis 2 gearbox.	 <p>xx0800000377</p> <p>Tightening torque:</p> <ul style="list-style-type: none"> 110 Nm <p>Parts:</p> <ul style="list-style-type: none"> A: Frame B: Gearbox axis 2 C: Lower arm D: Washer (18 pcs) E: Attachment screws M12x50 quality 12.9 steel Gleitmo (18 pcs)

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4 Repair

4.8.2 Replacing gearbox axis 2

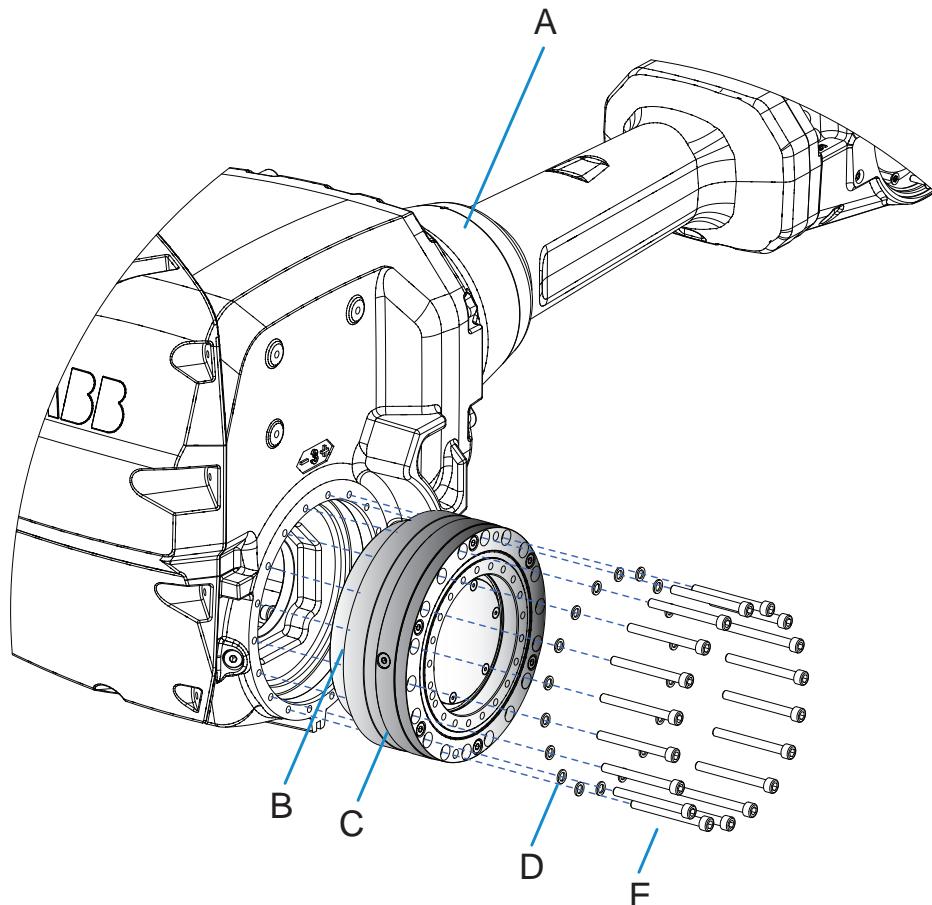
Continued

Action	Note
16 Refit the cable brackets and cable strap to the lower arm.	 xx1100000946 <ul style="list-style-type: none"> A Cable bracket B Cable bracket C Cable strap
17 Refill the gearbox with <i>lubrication oil</i> .	How to fill the gearbox with oil is described in section: <ul style="list-style-type: none"> • Changing the oil, axis-2 gearbox on page 171
18 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
19 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
20  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

4.8.3 Replacing gearbox axis 3

Location of gearbox axis 3

The gearbox is located as shown in the figure.



xx0800000398

A	Upper arm
B	O-ring
C	Axis-3 gearbox
D	Washers (18 pcs)
E	Attachment screws M8x80 quality Steel 12.9 Gleitmo (18 pcs)

Required equipment

Equipment	Art. no.	Note
Gearbox		See Spare part lists on page 397 .
Guide pins		M8 (2 pcs) Used to guide the gearbox and the upper arm during removal/refitting.
Rotation tool	3HAB7887-1	

Continues on next page

4 Repair

4.8.3 Replacing gearbox axis 3

Continued

Equipment	Art. no.	Note
Standard toolkit		Content is defined in section Standard tools on page 391 .
Other tools and procedures may be required. See references to these procedures in the step-by-step instructions below.		These procedures include references to the tools required.

Additional equipment - Foundry Prime

Equipment	Art. no.	Note
Rust preventive	3HAC034903-001	Mercasol
Sikaflex 521FC	3HAC026759-001	
Loctite 574	12340011-116	
Brush		
Foundry Prime touch up kit	3HAC035355-001	

Deciding calibration routine

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

	Action	Note
1	Decide which calibration routine to use for calibrating the robot. <ul style="list-style-type: none">• Reference calibration. External cable packages (DressPack) and tools can stay fitted on the robot.• Fine calibration. All external cable packages (DressPack) and tools must be removed from the robot.	
	If the robot is to be calibrated with reference calibration: Find previous reference values for the axis or create new reference values. These values are to be used after the repair procedure is completed, for calibration of the robot. If no previous reference values exist, and no new reference values can be created, then reference calibration is not possible.	Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values. Creating new values requires possibility to move the robot. Read more about reference calibration for Axis Calibration in Reference calibration routine on page 363 . 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

Removing gearbox axis 3

Use this procedure to remove the gearbox.

**WARNING**

The procedure details how to replace the gearbox without removing the cable harness. This means that the upper and lower arm will be separated but still be connected to each other through the cabling. Be careful not to damage the cables!

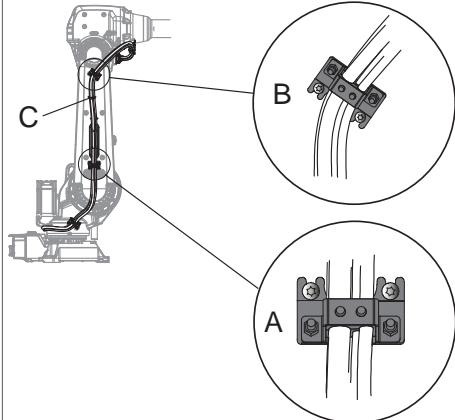
	Action	Note
1	Decide which calibration routine to use, and take actions accordingly prior to beginning the repair procedure.	
2	Drain the gearbox.	How to drain the gearbox is described in section: <ul style="list-style-type: none"> • Changing the oil, axis-3 gearbox on page 175
3	Move the robot to the position shown in the figure.	 xx0800000336
4	DANGER Turn off all: <ul style="list-style-type: none"> • electric power supply • hydraulic pressure supply to the robot, before entering the robot working area.	
5	CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of a Clean Room or Foundry Prime robot! See Replacing parts on the robot on page 205	

Continues on next page

4 Repair

4.8.3 Replacing gearbox axis 3

Continued

Action	Note
6 Unscrew the attachment screws securing the cable harness to the lower arm by the two cable brackets and a cable strap.	 <p>xx1100000946</p> <p>A Cable bracket B Cable bracket C Cable strap</p>
7 Loosen the cabling from the lower arm by unhooking the two cable brackets.	<p>! CAUTION</p> <p>The cable harness is still mounted in other parts of the robot. Make sure not to damage the cable harness or any cable brackets in the continued removal.</p>
8 Attach the lifting accessories to the upper arm.	See Attaching the lifting accessories to the upper arm on page 272
9 Connect the 24 VDC power supply to the axis-3 motor and release the brakes.	
10 Releasing the brakes of the axis-3 motor unloads the weight of the upper arm by stretching the roundslings.	
11 Remove the attachment screws that secure the upper arm to the lower arm.	<p>See the figure in:</p> <ul style="list-style-type: none"> • Location of the complete upper arm on page 267 <p>Note</p> <p>Do not remove the attachment screws securing the gearbox axis 3 to the armhouse!</p>
12 ! CAUTION	<p>The robot upper arm weighs 140 kg. All lifting accessories used must be sized accordingly!</p>

Continues on next page

	Action	Note
13	<p>Remove the upper arm from the lower arm and leave it hanging in the air.</p> <p> CAUTION</p> <p>When the upper arm no longer is attached to the robot, the armhouse has a tendency to drop down a little. In order to prevent this is to rise the front end of the upper arm a little before removing the attachment screws securing the upper arm.</p>	 WARNING <p>The cable harness is still installed on the robot! Make sure not to damage the cable harness or the cable brackets on the robot.</p>
14	<p> CAUTION</p> <p>The gearbox weighs 23 kg. All lifting accessories used must be sized accordingly!</p>	
15	Remove two attachment screws diagonally located and insert guide pins.	Always use guide pins in pairs!
16	Remove the remaining attachment screws that secures the gearbox.	See the figure in: • <i>Location of gearbox axis 3 on page 343</i>
17	<p> Note</p> <p>There will be some surplus oil in the gearbox. Place some absorbant cloth or similar under the gearbox.</p>	
18	<p>Slide the gearbox carefully out onto the guide pins and lift it away. If necessary, use a pair of screws to push out the gearbox.</p> <p> CAUTION</p> <p>Remaining oil will drain out from the gearbox cavity when the gearbox is lifted out.</p>	<p> Note</p> <p>Always use removal tools in pairs diagonal to each other.</p>

Refitting the gearbox axis 3

Use this procedure to refit the gearbox.

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

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4 Repair

4.8.3 Replacing gearbox axis 3

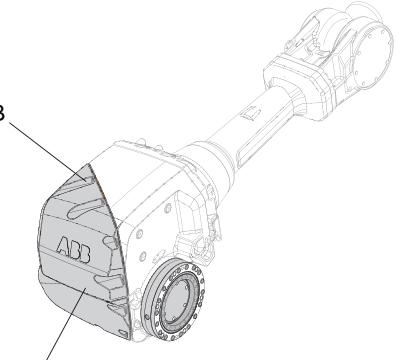
Continued

Action	Note
2 Clean Room and Foundry Prime robots: clean the joints that have been opened. See Replacing parts on the robot on page 205	
3  CAUTION The gearbox weighs 23 kg. All lifting accessories used must be sized accordingly!	
4 Clean all assembly surfaces. Remove any painting or other contamination from the assembly surfaces, with a knife.	
5 Apply some grease on the o-ring before fitting it to the gearbox.	See the figure in: • Location of gearbox axis 3 on page 343
6 Fit two guide pins in two opposite screw holes in the upper arm.	Always use guide pins in pairs!
7 Remove the arm house cover.	
8 Attach the rotation tool on the axis-3 motor.	
9 Release the brakes of the axis 3 motor.	
10 Lift the gearbox onto the guide pins.	
11  Note Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used!	
12 Slide the gearbox into position while rotating the motor pinion to find the mating position. Use a <i>rotation tool</i> .  Tip Two persons are required for this step since the upper arm is hanging freely in the air. One person needs to hold the upper arm still while the other fits the gearbox into the upper arm.	Article number for the rotation tool is specified in Required equipment on page 343 .
13 Rotate the motor pinion and slide the gearbox into position.	
14 Secure the gearbox with its <i>attachment screws and washers</i> .	See the figure in: • Location of gearbox axis 3 on page 343 Tightening torque: 35 Nm.
15 Remove the guide pins and replace them with the remaining attachment screws.	
16 Perform a leak-down test.	See Performing a leak-down test on page 200 .

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4.8.3 Replacing gearbox axis 3

Continued

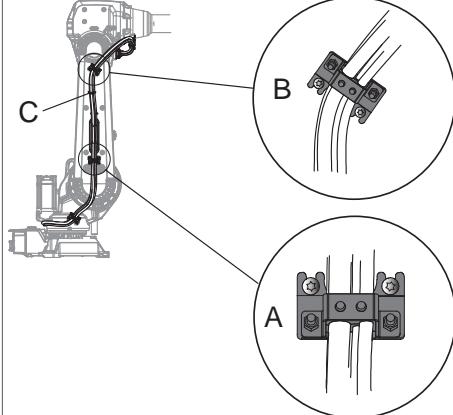
	Action	Note
17	Fit guide pins in the upper arm.	Specified in Required equipment on page 343 .
18	Move the upper arm to its mounting position. (With the brakes of the axis 3 motor still released.)	
19	Refit the upper arm to the lower arm with its attachment screws.	See the figure in: <ul style="list-style-type: none"> Location of the complete upper arm on page 267 Tightening torque: <ul style="list-style-type: none"> 35 Nm
20	Remove the guide pins and replace with the remaining attachment screws.	
21	Remove the 24 VDC power supply.	
22	Refit the upper armhouse cover with its attachment screws and washers.  WARNING The cover on the armhouse must be fitted when the robot is running. It is a vital part for the stability of the robot.	Tightening torque: 14 Nm. Make sure that the cover is tightly sealed.  A B xx0800000389 Parts: <ul style="list-style-type: none"> A: Cover B: Attachment screws M6x25, quality 8.8-A2F (10 pcs)
23	Make sure that the armhouse cover is tightly fitted. If there is a gap between the cover and the robot, seal with Sikaflex 521 FC.	

Continues on next page

4 Repair

4.8.3 Replacing gearbox axis 3

Continued

Action	Note
24 Refit the two cable brackets and a cable strap to the lower arm.	 xx1100000946 <ul style="list-style-type: none"> A Cable bracket B Cable bracket C Cable strap
25 Refill the gearbox with <i>lubrication oil</i> .	How to fill the gearbox with oil is described in section: <ul style="list-style-type: none"> • Changing the oil, axis-3 gearbox on page 175
26 Clean Room and Foundry Prime robots: seal and paint the joints that have been opened. Also repair possible damages of the special Foundry Prime paint coat of the robot. See Replacing parts on the robot on page 205 .	
27 Recalibrate the robot.	Pendulum Calibration is described in <i>Operating manual - Calibration Pendulum</i> , enclosed with the calibration tools. Axis Calibration is described in Calibrating with Axis Calibration method on page 362 . General calibration information is included in section Calibration on page 351 .
28  DANGER Make sure all safety requirements are met when performing the first test run. These are further detailed in the section DANGER - First test run may cause injury or damage! on page 49 .	

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 362](#).

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

Calibration terminology

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

5 Calibration

5.1.2 Calibration methods

5.1.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	<p>The calibrated robot is positioned at calibration position.</p> <p>Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot.</p> <p>For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.</p>	Axis Calibration or Calibration Pendulum ⁱ
Absolute accuracy calibration (optional)	<p>Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for:</p> <ul style="list-style-type: none">Mechanical tolerances in the robot structureDeflection due to load <p>Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot.</p> <p>Absolute accuracy calibration data is found on the SMB (serial measurement board) in the robot.</p> <p>For robots with RobotWare 5.05 or older, the absolute accuracy calibration data is delivered in a file, absacc.cfg, supplied with the robot at delivery. The file replaces the calib.cfg file and identifies motor positions as well as absolute accuracy compensation parameters.</p> <p>A robot calibrated with absolute accuracy has a sticker next to the identification plate of the robot.</p> <p>To regain 100% absolute accuracy performance, the robot must be recalibrated for absolute accuracy!</p>  <p>ABSOLUTE ACCURACY</p> <p>xx0400001197</p>	CalibWare

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

Continues on next page

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 4600 Foundry Prime 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 362](#).

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.

CalibWare - Absolute Accuracy calibration

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

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

References

Article numbers for the calibration tools are listed in the section [Special tools on page 392](#).

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

5 Calibration

5.1.3 When to calibrate

5.1.3 When to calibrate

When to calibrate

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

The resolver values are changed

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

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See [Updating revolution counters on page 358](#). This will occur when:

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

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

The robot is rebuilt

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

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

5.2 Synchronization marks and axis movement directions

5.2 Synchronization marks and axis movement directions

5.2.1 Synchronization marks and synchronization position for axes

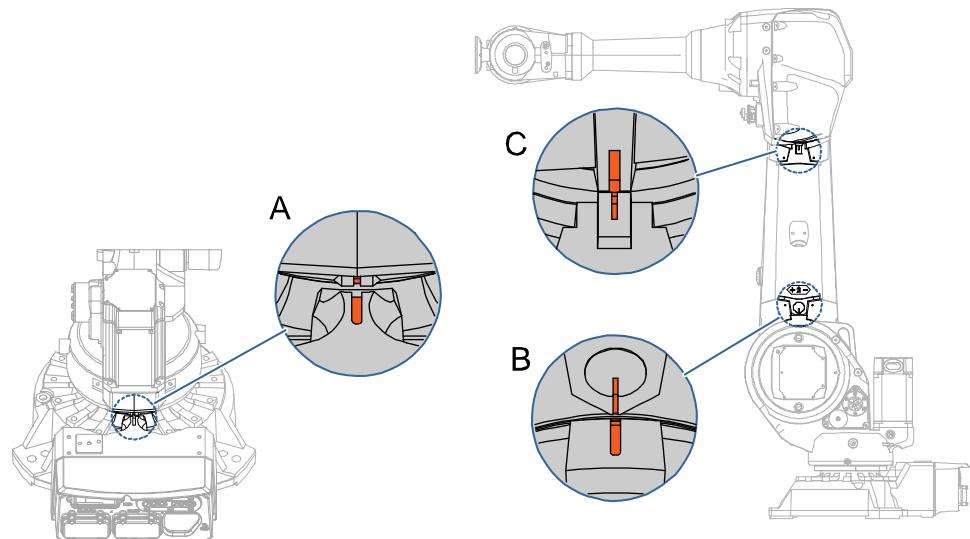
Introduction

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

Synchronization marks, IRB 4600

The figures show the positions of the synchronization marks for all robot variants.

IRB 4600 - 60/2.05



xx0800000312

A	Synchronization mark, axis 1
B	Synchronization mark, axis 2
C	Synchronization mark, axis 3

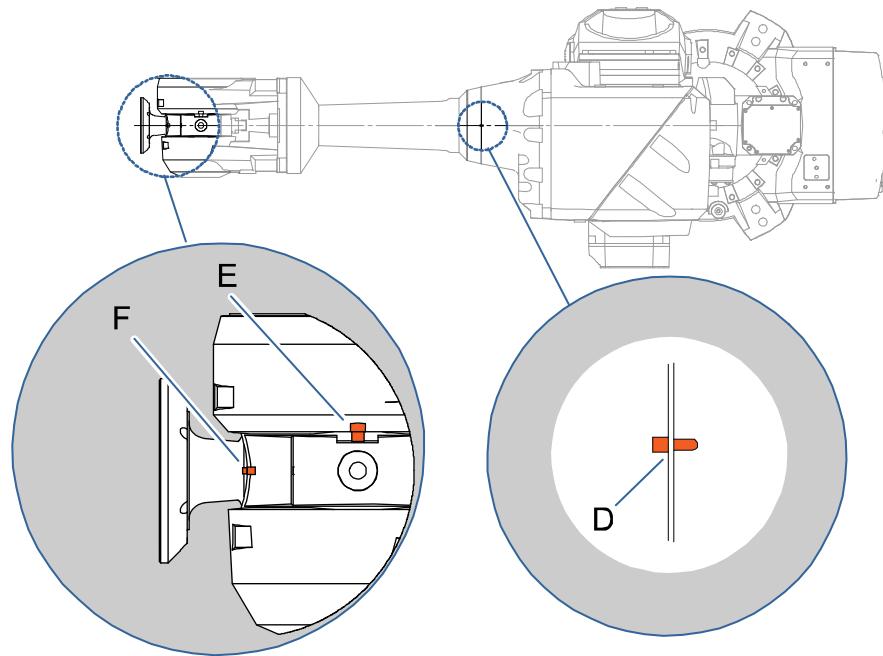
Continues on next page

5 Calibration

5.2.1 Synchronization marks and synchronization position for axes

Continued

IRB 4600 - 60/2.05



xx0800000313

D	Synchronization mark, axis 4
E	Synchronization mark, axis 5
F	Synchronization mark, axis 6

5.2.2 Calibration movement directions for all axes

5.2.2 Calibration movement directions for all axes

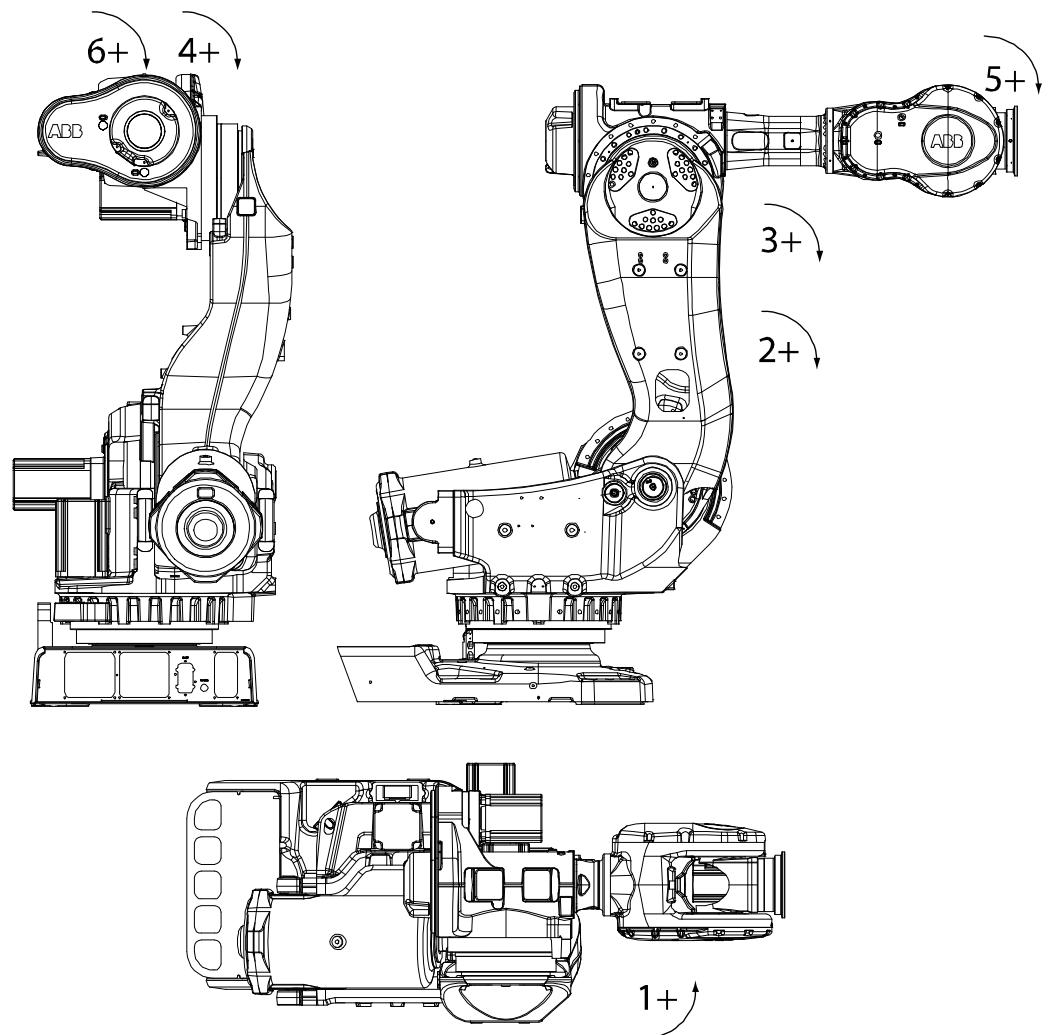
Overview

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 Calibration

5.3 Updating revolution counters

5.3 Updating revolution counters

Introduction

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

Step 1 - Manually running the manipulator to the synchronization position

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

Action	Note
1 Select axis-by-axis motion mode.	
2 Jog the manipulator to align the synchronization marks.	See Synchronization marks and synchronization position for axes on page 355 .
3 When all axes are positioned, update the revolution counter.	Step 2 - Updating the revolution counter with the FlexPendant on page 359 .

Correct calibration position of axis 4 and 6

When jogging the manipulator to synchronization position, it is extremely important to make sure that axes 4 and 6 of the following mentioned manipulators are positioned correctly. The axes can be calibrated at the wrong turn, resulting in an incorrect manipulator calibration.

Make sure the axes are positioned according to the correct calibration values, not only according to the synchronization marks. The correct values are found on a label, located either on the lower arm, underneath the flange plate on the base or on the frame.

At delivery the manipulator is in the correct position, do NOT rotate axis 4 or 6 at power up before the revolution counters are updated.

If one of the following mentioned axes are rotated one or more turns from its calibration position before updating the revolution counter, the correct calibration position will be lost due to non-integer gear ratio. This affects the following manipulators:

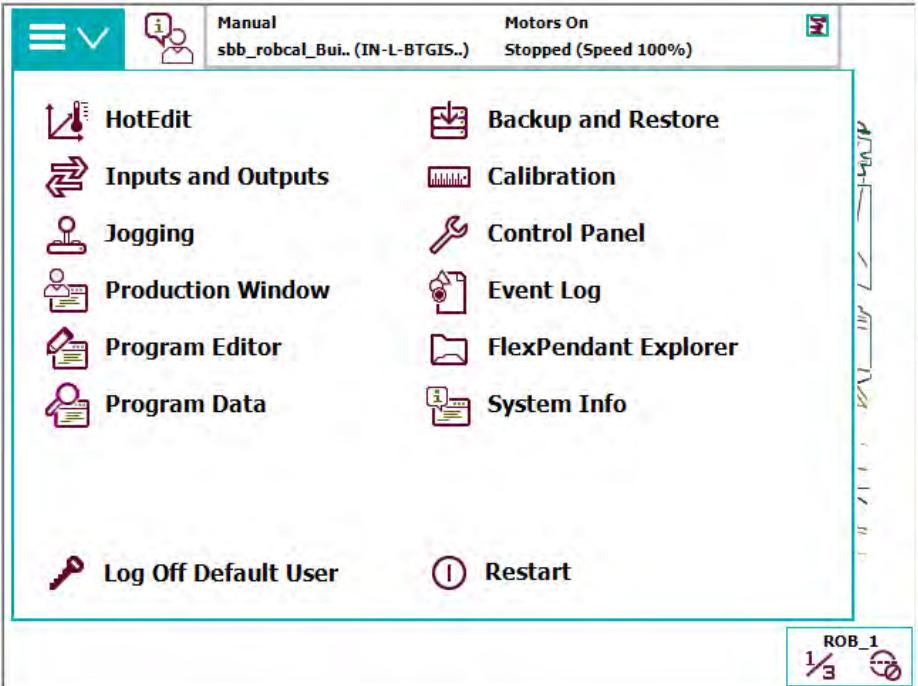
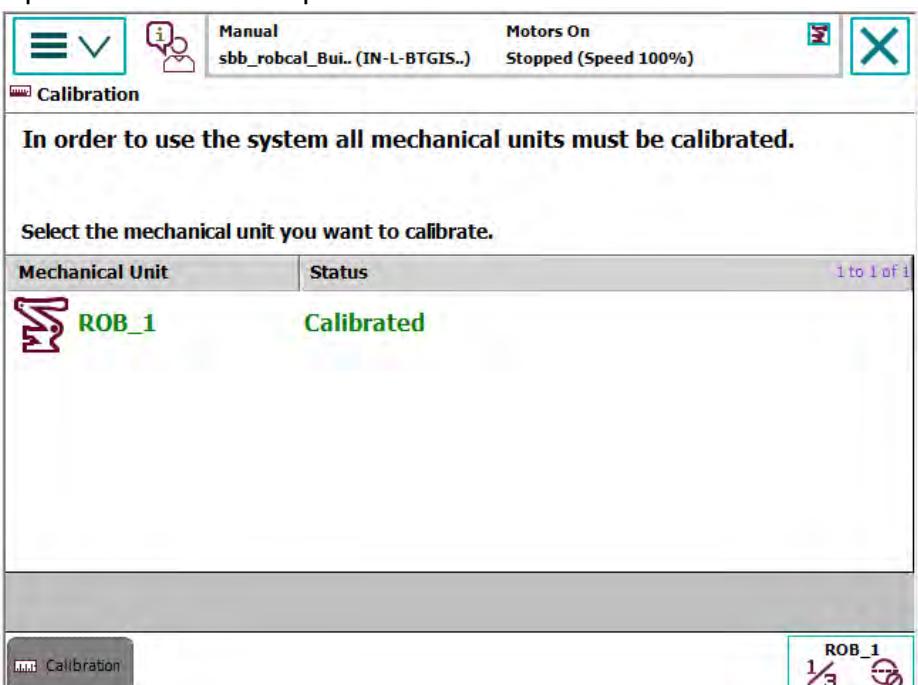
Manipulator variant	Axis 4	Axis 6
IRB 4600	No	No

If the synchronization marks seem to be wrong (even if the motor calibration data is correct), try to rotate the axis one turn, update the revolution counter and check the synchronization marks again (try both directions, if needed).

Continues on next page

Step 2 - Updating the revolution counter with the FlexPendant

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

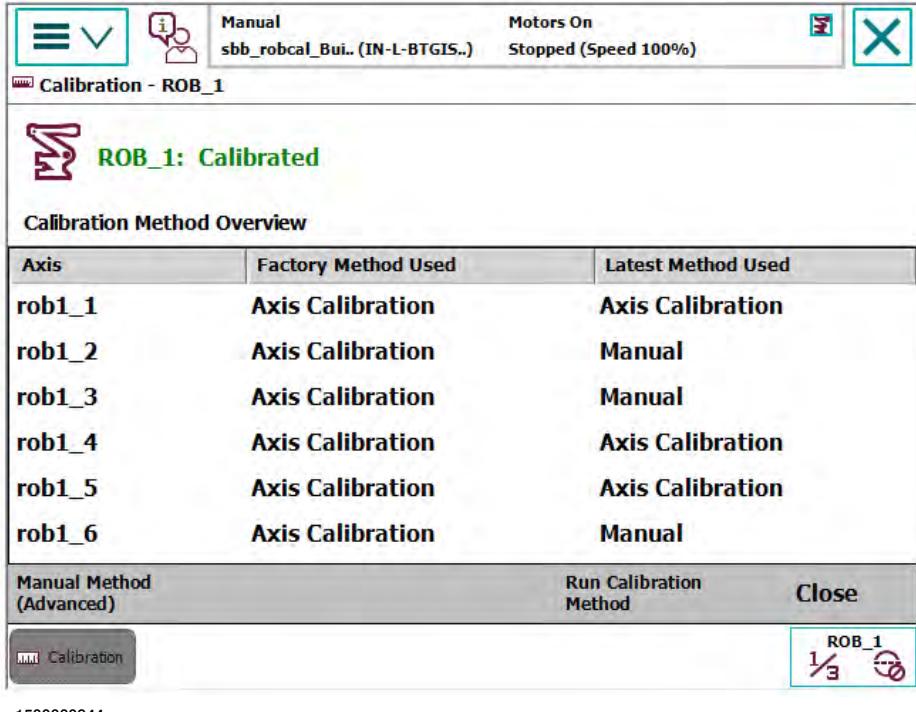
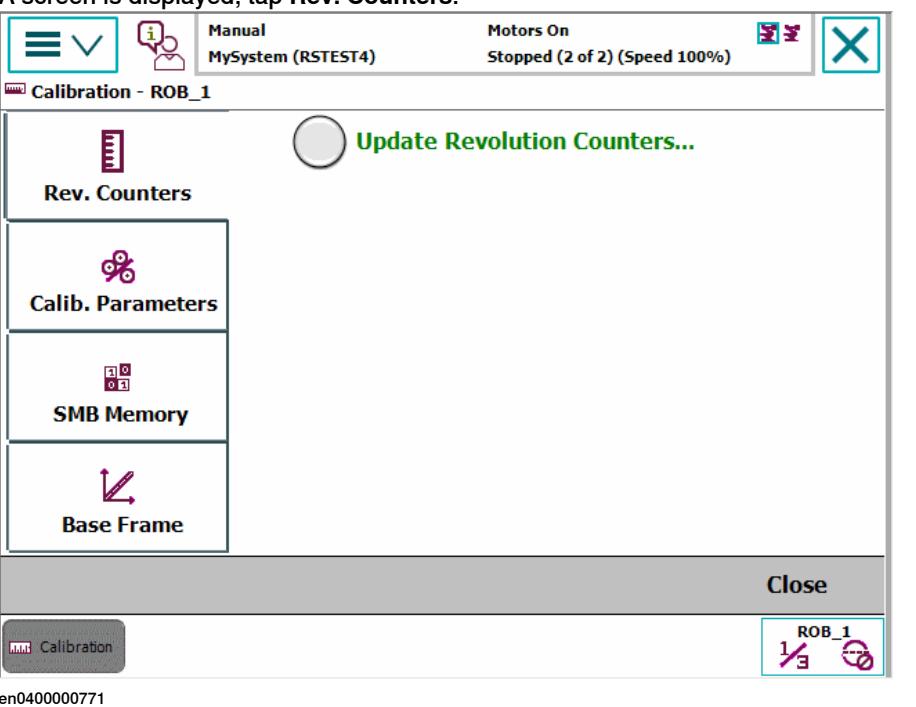
Action
<p>1 On the ABB menu, tap Calibration.</p>  <p>The screenshot shows the ABB menu interface. At the top, it says 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below the menu bar is a list of icons and text labels. The 'Calibration' icon (a wrench) is highlighted with a red box. Other options include 'HotEdit', 'Backup and Restore', 'Inputs and Outputs', 'Control Panel', 'Jogging', 'Event Log', 'Production Window', 'FlexPendant Explorer', 'Program Editor', 'System Info', 'Program Data', 'Log Off Default User', and 'Restart'. At the bottom left is the text 'xx1500000942' and at the bottom right is a status bar with 'ROB_1 1/3' and a battery icon.</p>
<p>2 All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p>  <p>The screenshot shows the 'Calibration' screen. At the top, it says 'Manual sbb_robcal_Bui.. (IN-L-BTGIS..)' and 'Motors On Stopped (Speed 100%)'. Below the title, a message reads 'In order to use the system all mechanical units must be calibrated.' A sub-section titled 'Select the mechanical unit you want to calibrate.' shows a table with one row. The table has two columns: 'Mechanical Unit' and 'Status'. The 'Mechanical Unit' column shows an icon of a robotic arm and the text 'ROB_1'. The 'Status' column shows the text 'Calibrated' in green. At the bottom left is the text 'xx1500000943' and at the bottom right is a status bar with 'ROB_1 1/3' and a battery icon.</p>

Continues on next page

5 Calibration

5.3 Updating revolution counters

Continued

Action																						
3	<p>This step is valid for RobotWare 6.02 and later.</p> <p>Calibration method used at factory for each axis is shown, as well as calibration method used during last field calibration.</p> <p>Tap Manual Method (Advanced).</p>  <table border="1"><thead><tr><th>Axis</th><th>Factory Method Used</th><th>Latest Method Used</th></tr></thead><tbody><tr><td>rob1_1</td><td>Axis Calibration</td><td>Axis Calibration</td></tr><tr><td>rob1_2</td><td>Axis Calibration</td><td>Manual</td></tr><tr><td>rob1_3</td><td>Axis Calibration</td><td>Manual</td></tr><tr><td>rob1_4</td><td>Axis Calibration</td><td>Axis Calibration</td></tr><tr><td>rob1_5</td><td>Axis Calibration</td><td>Axis Calibration</td></tr><tr><td>rob1_6</td><td>Axis Calibration</td><td>Manual</td></tr></tbody></table> <p>Manual Method (Advanced) Run Calibration Method Close</p> <p>Calibration xx1500000944</p> <p>ROB_1 1/3</p>	Axis	Factory Method Used	Latest Method Used	rob1_1	Axis Calibration	Axis Calibration	rob1_2	Axis Calibration	Manual	rob1_3	Axis Calibration	Manual	rob1_4	Axis Calibration	Axis Calibration	rob1_5	Axis Calibration	Axis Calibration	rob1_6	Axis Calibration	Manual
Axis	Factory Method Used	Latest Method Used																				
rob1_1	Axis Calibration	Axis Calibration																				
rob1_2	Axis Calibration	Manual																				
rob1_3	Axis Calibration	Manual																				
rob1_4	Axis Calibration	Axis Calibration																				
rob1_5	Axis Calibration	Axis Calibration																				
rob1_6	Axis Calibration	Manual																				
4	<p>A screen is displayed, tap Rev. Counters.</p>  <p>Rev. Counters</p> <p>Calib. Parameters</p> <p>SMB Memory</p> <p>Base Frame</p> <p>Update Revolution Counters...</p> <p>Close</p> <p>Calibration en0400000771</p> <p>ROB_1 1/3</p>																					

Continues on next page

	Action
5	<p>Tap Update Revolution Counters.... A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions:</p> <ul style="list-style-type: none"> • Tap Yes to update the revolution counters. • Tap No to cancel updating the revolution counters. <p>Tapping Yes displays the axis selection window.</p>
6	<p>Select the axis to have its revolution counter updated by:</p> <ul style="list-style-type: none"> • Ticking in the box to the left • Tapping Select all to update all axes. <p>Then tap Update.</p>
7	<p>A dialog box is displayed, warning that the updating operation cannot be undone:</p> <ul style="list-style-type: none"> • Tap Update to proceed with updating the revolution counters. • Tap Cancel to cancel updating the revolution counters. <p>Tapping Update updates the selected revolution counters and removes the tick from the list of axes.</p>
8	<p> CAUTION</p> <p>If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury!</p> <p>Check the synchronization position very carefully after each update. See Checking the synchronization position on page 377.</p>

5 Calibration

5.4.1 Description of Axis Calibration

5.4 Calibrating with Axis Calibration method

5.4.1 Description of Axis Calibration

Instructions for Axis Calibration procedure given on the FlexPendant

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

This manual contains a brief description of the method, additional information to the information given on the FlexPendant, article number for the tools and images of where to fit the calibration tools on the robot.

Overview of the Axis Calibration procedure

The Axis Calibration procedure applies to all axes, and is performed on one axis at the time. The robot axes are both manually and automatically moved into position, as instructed on the FlexPendant.

A fixed calibration pin/bushing is installed on each robot axis at delivery.

The Axis Calibration procedure described roughly:

- A removable calibration tool is inserted by the operator into a calibration bushing on the axis chosen for calibration, according to instructions on the FlexPendant.



WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.



WARNING

The calibration tool must be fully inserted into the calibration bushing, until the steel spring ring snaps into place.

- During the calibration procedure, RobotWare moves the robot axis chosen for calibration so that the calibration tools get into contact. RobotWare records values of the axis position and repeats the coming-in-contact procedure several times to get an exact value of the axis position.



WARNING

Risk of pinching! The contact force for large robots can be up to 150 kg. Keep a safe distance to the robot.

- The axis position is stored in RobotWare with an active choice from the operator.

Continues on next page

Routines in the calibration procedure

The following routines are available in the Axis Calibration procedure, given at the beginning of the procedure on the FlexPendant.

Fine calibration routine

Choose this routine to calibrate the robot when there are no tools, process cabling or equipment fitted to the robot.

Reference calibration routine

Choose this routine to create reference values and to calibrate the robot when the robot is dressed with tools, process cabling or other equipment.

Also choose this routine if the robot is suspended.

If calibrating the robot with reference calibration there must be reference values created before repair is made to the robot, if values are not already available.

Creating new values requires possibility to move the robot. The reference values contain positions of all axes, torque of axes and technical data about the tool installed. The reference value is unique for the current setup of the robot and will be named according to tool name, date etc.

Follow the instructions given in the reference calibration routine on the FlexPendant to create reference values.

When reference calibration is performed, the robot is restored to the status given by the reference values.

Update revolution counters

Choose this routine to make a rough calibration of each manipulator axis by updating the revolution counter for each axis, using the FlexPendant.

Validation

In the mentioned routines, it is also possible to validate the calibration data.

Position of robot axes

The axis chosen for calibration is automatically run by the calibration program to its calibration position during the calibration procedure.

In order for the axis to be able to be moved to calibration position, or in order for getting proper access to the calibration bushing, other axes might need to be jogged to positions different from 0 degrees. Information about which axes are allowed to be jogged will be given on the FlexPendant. These axes are marked with **Unrestricted** in the FlexPendant window.

How to calibrate a suspended robot

The IRB 4600 Foundry Prime is 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 Calibration

5.4.2 Calibration tools for Axis Calibration

5.4.2 Calibration tools for Axis Calibration

Calibration tool set

The calibration tools used for Axis Calibration are designed to meet requirements for calibration performance, durability and safety in case of accidental damage.



WARNING

Calibrating the robot with Axis Calibration requires special calibration tools from ABB. Using other pins in the calibration bushings may cause severe damage to the robot and/or personnel.

Equipment, etc.	Article number	Note
Calibration tool box, Axis Calibration	3HAC058080-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. Contains a removal tool for removing special protection plugs on the turning disk.

Examining the calibration tool

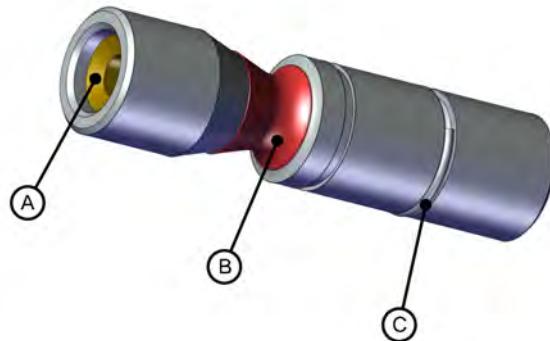
Check prior to usage

Before using the calibration tool, make sure that the tube insert, the plastic protection and the steel spring ring are present.



WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

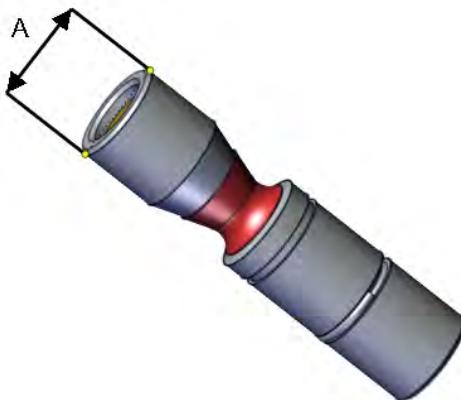
A	Tube insert
B	Plastic protection
C	Steel spring ring

Continues on next page

Periodic check of the calibration tool

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within $\varnothing 12g4$ mm, $\varnothing 8g4$ mm or $\varnothing 6g5$ mm (depending on calibration tool size).
- Straightness within 0.005 mm.



xx1500000951

A	Outer diameter
---	----------------

5 Calibration

5.4.3 Installation locations for the calibration tools

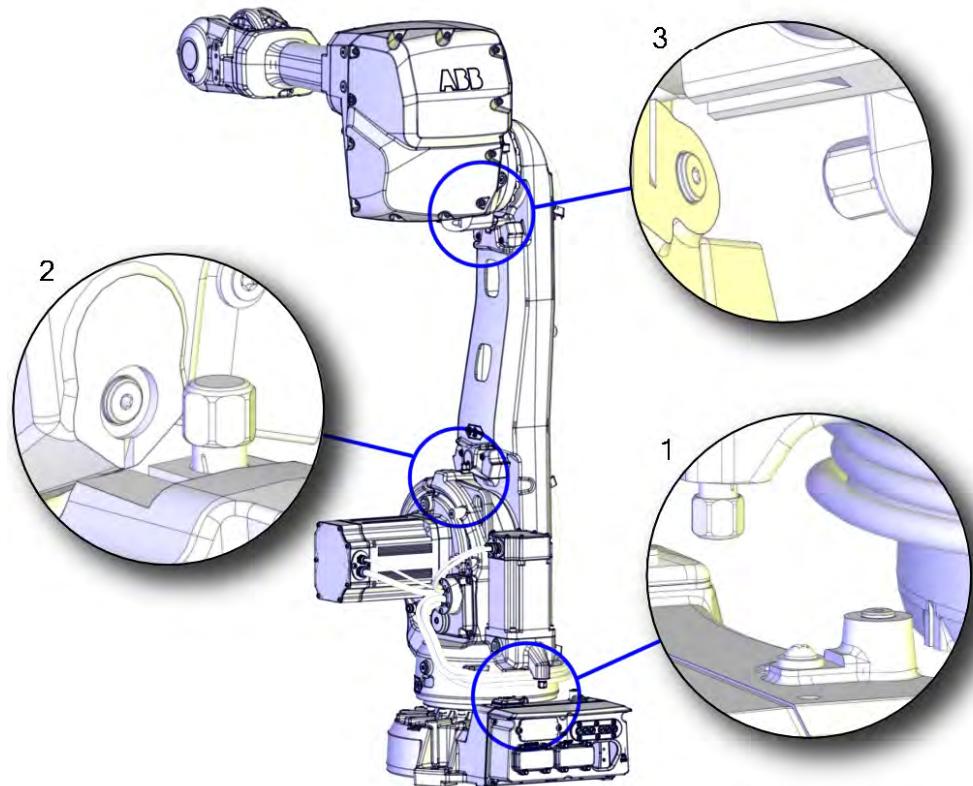
5.4.3 Installation locations for the calibration tools

Location of fixed calibration items

The figure shows how the robot is equipped with items for installation of calibration tools for Axis Calibration (fixed calibration pins and/or bushings). The figure does not show installed calibration tools.

A fixed calibration pin and a bushing for the movable calibration tool are located on each axis as follows.

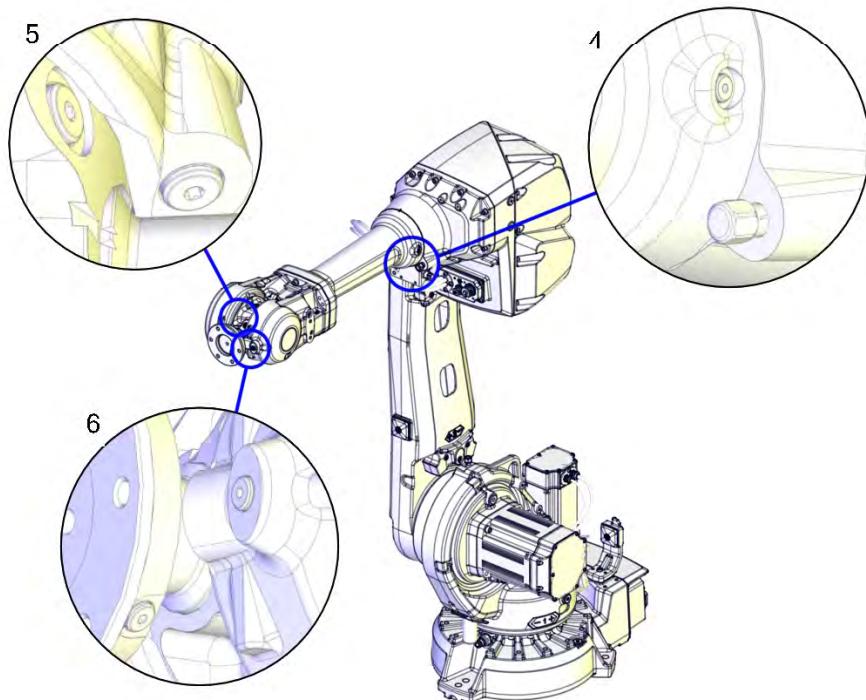
If there is not enough space on an axis to install a fixed calibration pin, the axis is equipped with two bushings instead, for installation of two calibration tools when calibration is carried out. This is shown in the figure.



xx1600000641

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5.4.3 Installation locations for the calibration tools

Continued

xx1600000642

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, if needed.

Spare part	Article number	Note
Protection cover and plug set	3HAC060730-001 (protection type Foundry Prime)	Contains replacement calibration pin covers and protective plugs for the bushing.
Protective plug on turning disc	3HAC057511-001	Only on IRB 4600 - 20/2.50. Replace if damaged or missing.

5 Calibration

5.4.4 Axis Calibration - Running the calibration procedure

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	3HAC058080-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. Contains a removal tool for removing special protection plugs on the turning disk.

Required consumables

Consumable	Article number	Note
Clean cloth	-	

Spare parts

Spare part	Article number	Note
Protection cover and plug set	3HAC060730-001 (protection type Foundry Prime)	Contains replacement calibration pin covers and protective plugs for the bushing.
Protective plug on turning disc	3HAC057511-001	Only on IRB 4600 - 20/2.50. Replace if damaged or missing.

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 363](#).
- 2 Choose which axis/axes to calibrate.
- 3 The robot moves to synchronization position.
- 4 Validate the synchronization marks.

Continues on next page

- 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.
Use the removal tool included in the calibration tool box to remove the special protection plug(s) on the turning disc.
- 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.
Refit the protection plug(s) to the turning disc, push until the steel spring ring snaps into place.
- 9 The robot moves to verify that the calibration tool is removed.
- 10 Choose whether to save the calibration data or not.

Calibration of the robot is not finished until the calibration data is saved, as last step of the calibration procedure.

Preparation prior to calibration

The calibration procedure is described in the FlexPendant while conducting it.

	Action	Note
1	 DANGER While conducting the calibration, the robot needs to be connected to power. Make sure that the robots working area is empty, as the robot can make unpredictable movements.	
2	 CAUTION Always cut the paint with a knife and grind the paint edge when disassembling parts of the robot! See Replacing parts on the robot on page 205	
3	 Note Wipe the calibration tool clean. The calibration method is exact. Dust, dirt or color flakes will affect the calibration value.	Use a clean cloth.

Continues on next page

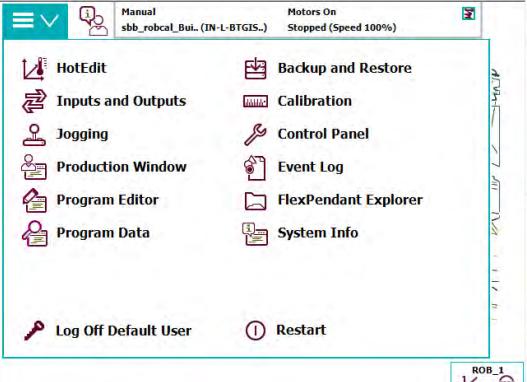
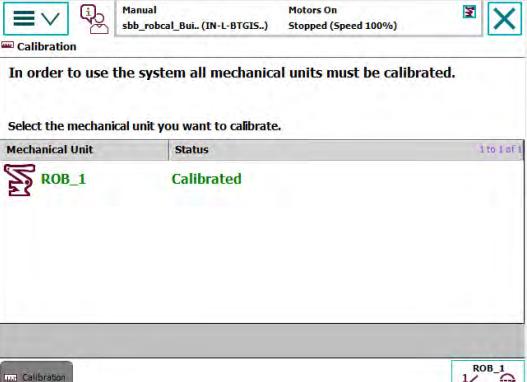
5 Calibration

5.4.4 Axis Calibration - Running the calibration procedure

Continued

Starting the calibration procedure

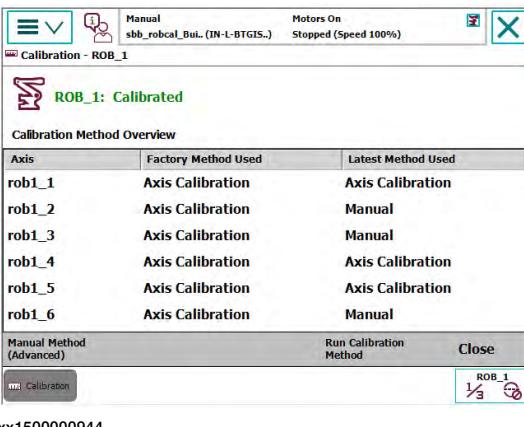
Use this procedure to call for the Axis Calibration method on the FlexPendant.

Action	Note
<p>1 On the ABB menu, tap Calibration.</p>  <p>xx1500000942</p>	
<p>2 All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p>  <p>xx1500000943</p>	

Continues on next page

5.4.4 Axis Calibration - Running the calibration procedure

Continued

Action	Note
<p>3 Calibration method used at factory for each axis is shown, as well as calibration method used for the robot during last field calibration.</p> <p>Tap Run Calibration Method. The software will automatically call for the procedure for the valid calibration method.</p> 	The FlexPendant will give all information needed to proceed with Axis Calibration.
4 Follow the instructions given on the FlexPendant.	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 368 .

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.	<p>Remove the calibration tool, if it is installed, and restart the calibration procedure from the beginning. See Starting the calibration procedure on page 370.</p> <p>If the calibration tool is in contact the robot axis needs to be jogged in order to release the calibration tool. Jogging the axis in wrong direction will cause the calibration tool to break. Directions of axis movement is shown in Calibration movement directions for all axes on page 357</p>

Axis Calibration with SafeMove option

To be able to run Axis Calibration SafeMove needs to be unsynchronized. The Axis Calibration routine recognizes if the robot is equipped with SafeMove and will force SafeMove to unsynchronize automatically.

Continues on next page

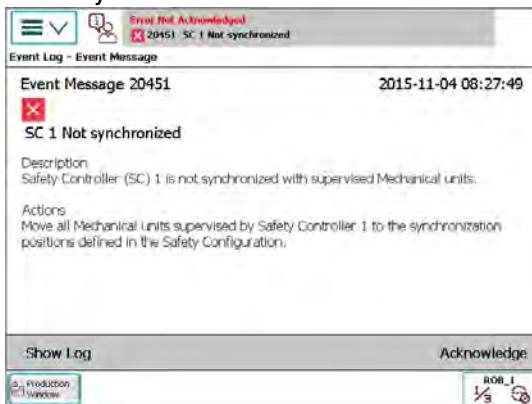
5 Calibration

5.4.4 Axis Calibration - Running the calibration procedure

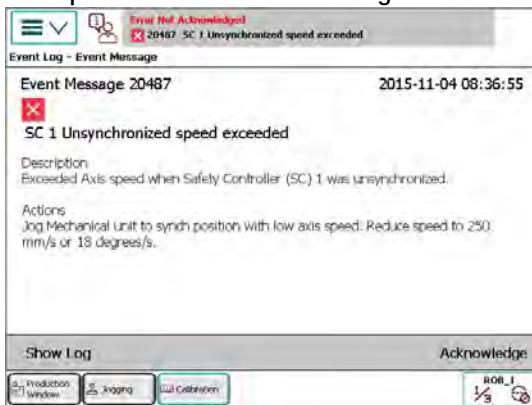
Continued

However, SafeMove may generate other warning messages anytime during the Axis Calibration routine.

Safety controller not synchronized - SafeMove message

Action	Note
<p>1 SafeMove generates the message "Safety controller not synchronized".</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays an event message for 'SC 1 Not synchronized'. The message details: Event Message 20451, Date 2015-11-04 08:27:49, and a description: 'Safety Controller (SC) 1 is not synchronized with supervised Mechanical units.' Actions: 'Move all Mechanical Units supervised by Safety Controller 1 to the synchronization positions defined in the Safety Configuration.' Below the message, there are 'Show Log' and 'Acknowledge' buttons. The 'Acknowledge' button is highlighted with a green border. The status bar at the bottom shows 'xx1500002480'.</p>	
<p>2 Confirm unsynchronized state by pressing Acknowledge to continue Axis Calibration procedure.</p>	
<p>3 Restart Axis Calibration procedure by pressing Play.</p>	

Unsynchronized speed exceeded - SafeMove message while saving robot data

Action	Note
<p>1 SafeMove generates the message "Unsynchronized speed exceeded" while saving robot data.</p>  <p>The screenshot shows the 'Event Log - Event Message' window. It displays an event message for 'SC 1 Unsynchronized speed exceeded'. The message details: Event Message 20487, Date 2015-11-04 08:36:55, and a description: 'Exceeded Axis speed when Safety Controller (SC) 1 was unsynchronized.' Actions: 'Jog Mechanical Unit to synch position with low axis speed. Reduce speed to 250 mm/s or 18 degrees/s.' Below the message, there are 'Show Log' and 'Acknowledge' buttons. The 'Acknowledge' button is highlighted with a green border. The status bar at the bottom shows 'xx1500002481'.</p>	
<p>2 Press Acknowledge to continue Axis Calibration procedure.</p>	
<p>3 Restart Axis Calibration procedure by pressing Play.</p>	

Continues on next page

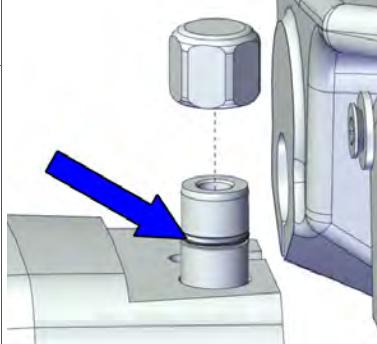
5.4.4 Axis Calibration - Running the calibration procedure

Continued

Unsynchronized time limit expired - SafeMove message anytime during Axis Calibration routine

Action	Note
1 SafeMove generates the message "Unsynchronized time limit expired" (anytime). 	
2 Press OK to continue Axis Calibration procedure.	
3 Restart Axis Calibration procedure by pressing Play.	

After calibration

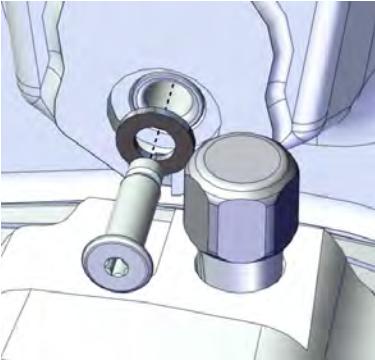
Action	Note
1 Check the o-ring on the fixed calibration pin. Replace if damaged or missing.	
2 Reinstall the protective cover on the fixed calibration pin on each axis, directly after the axis has been calibrated. Replace the cover with new spare part, if missing or damaged.	 xx1600002102 Protection cover and plug set: . 3HAC060730-001 (protection type Foundry Prime)

Continues on next page

5 Calibration

5.4.4 Axis Calibration - Running the calibration procedure

Continued

	Action	Note
3	<p>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.</p> <p>Tighten the plug lightly so that the sealing washer is just about fastened between the plug and the bushing. Then tighten 1/4 turn more.</p> <p>Replace the plug and the sealing with new spare part, if missing or damaged.</p>	 xx1600002103 <p>Protection cover and plug set: . 3HAC060730-001 (protection type Foundry Prime)</p>

5.5 Calibrating with Calibration Pendulum method

Where to find information for Calibration Pendulum

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

5 Calibration

5.6 Verifying the calibration

Introduction

Always verify the results after calibrating *any* robot axis to verify that all calibration positions are correct.

Verifying the calibration

Use this procedure to verify the calibration result.

Action	Note
1 Run the calibration home position program twice. Do not change the position of the robot axes after running the program!	See Checking the synchronization position on page 377 .
2 Adjust the <i>synchronization marks</i> when the calibration is done, if necessary.	This is detailed in section Synchronization marks and synchronization position for axes on page 355 .
3 Write down the values on a new label and stick it on top of the calibration label. The label is located on the lower arm.	
4 Remove any calibration equipment from the robot.	

5.7 Checking the synchronization position

Introduction

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

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

Using a **MoveAbsJ** instruction

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

	Action	Note
1	On ABB menu tap Program editor .	
2	Create a new program.	
3	Use MoveAbsJ in the Motion&Proc menu.	
4	Create the following program: <pre>MoveAbsJ [[0,0,0,0,0,0], [9E9,9E9,9E9,9E9,9E9,9E9]] \NoEOoffs, v1000, fine, tool0</pre>	
5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See Synchronization marks and synchronization position for axes on page 355 and Updating revolution counters on page 358 .

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 355 and Updating revolution counters on page 358 .

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6 Decommissioning

6.1 Introduction

Introduction

This section contains information to consider when taking a product, robot or controller, out of operation.

It deals with how to handle potentially dangerous components and potentially hazardous materials.

General

All used grease/oils and dead batteries **must** be disposed of in accordance with the current legislation of the country in which the robot and the control unit are installed.

If the robot or the control unit is partially or completely disposed of, the various parts **must** be grouped together according to their nature (which is all iron together and all plastic together), and disposed of accordingly. These parts **must** also be disposed of in accordance with the current legislation of the country in which the robot and control unit are installed.

6 Decommissioning

6.2 Environmental information

6.2 Environmental information

Hazardous material

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

Dispose components properly to prevent health or environmental hazards.

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

Oil and grease

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

Also note that:

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

6.3 Scrapping of robot

Important when scrapping the robot



DANGER

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

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

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7 Reference information

7.1 Introduction

General

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

7 Reference information

7.2 Applicable standards

7.2 Applicable standards



Note

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

Standards, EN ISO

The product is designed in accordance with the requirements of:

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

ⁱ Only robots with protection Clean Room.

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

European standards

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

Continues on next page

Other standards

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

7 Reference information

7.3 Unit conversion

7.3 Unit conversion

Converter table

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

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

7.4 Screw joints

General

This section describes how to tighten the various types of screw joints on the IRB 4600 Foundry Prime.

The instructions and torque values are valid for screw joints comprised of metallic materials and do *not* apply to soft or brittle materials.

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

When handling screws treated with Gleitmo, protective gloves of **nitrile rubber** type should be used.

Screws lubricated in other ways

Screws lubricated with Molycote 1000 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

- 1 Apply lubricant to the screw thread.
- 2 Apply lubricant between the plain washer and screw head.
- 3 Screw dimensions of M8 or larger must be tightened with a torque wrench. Screw dimensions of M6 or smaller may be tightened without a torque wrench if this is done by trained and qualified personnel.

Lubricant	Article number
Molycote 1000 (molybdenum disulphide grease)	11712016-618

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard** torques are specified in the following tables. Any **special** torques are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct* tightening torque for each type of screw joint.
- Only use *correctly calibrated* torque keys.

Continues on next page

7 Reference information

7.4 Screw joints

Continued

- Always *tighten the joint by hand*, and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not jerk*. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is 10%!

Oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with slotted or cross-recess head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670
M24	680	960	1150

Lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molykote 1000, Gleitmo 603 or equivalent with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque (Nm) Class 10.9, lubricated ⁱ	Tightening torque (Nm) Class 12.9, lubricated ⁱ
M8	28	35
M10	55	70
M12	96	120
M16	235	280
M20	460	550
M24	790	950

ⁱ Lubricated with Molykote 1000, Gleitmo 603 or equivalent

Continues on next page

Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one or both* connectors are made of *brass*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

Dimension	Tightening torque Nm - Nominal	Tightening torque Nm - Min.	Tightening torque Nm - Max.
1/8	12	8	15
1/4	15	10	20
3/8	20	15	25
1/2	40	30	50
3/4	70	55	90

7 Reference information

7.5 Weight specifications

7.5 Weight specifications

Definition

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

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

Example

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

	Action	Note
	 CAUTION The robot weighs 440 kg. All lifting accessories used must be sized accordingly!	

7.6 Standard tools

General

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

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

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

Contents, standard toolkit

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

7 Reference information

7.7 Special tools

7.7 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section [Standard tools on page 391](#), and of special tools, listed directly in the instructions and also gathered in this section.

Measuring tools, play

The tools listed for measuring the play are used after service work on axes 5 and 6.

Description	Robot variant	Art. no.
Measuring tool, play	IRB 4600 - 60/2.05, -45/2.05, -40/2.55	3HAB1611-6
Measuring tool, play	IRB 4600 - 20/2.50	3HAB6337-1

Special tools

The following table specifies the special tools required during several of the service procedures. The tools may be ordered separately and are also specified directly in concerned instructions in the product manual.

Description	Qty	Art. no.
Guide pins, removal/refitting of axis 1 gearbox	2 pcs	-
Guide pins, removal/refitting of axis 3 gearbox	2 pcs	-

Oil change equipment

The following table specifies the oil change equipment. The tool is specified directly in concerned instructions in the product manual.

Description	Included parts	Art. no.
Oil change equipment	<ul style="list-style-type: none">vacuum pump with regulator, hose and couplingcouplings and adapterspump (manual) with hose and couplinggraduated measuring glassoil gunuser instructions.	3HAC021745-001

Calibration equipment, Levelmeter (alternative method)

The following table specifies the calibration equipment required when calibrating the robot with the alternative method, Levelmeter Calibration.

Description	Art. no.	Note
Angle bracket	68080011-LP	
Calibration bracket	3HAC13908-9	

Continues on next page

Description	Art. no.	Note
Calibration tool ax1	3HAC13908-4	
Levelmeter 2000 kit	6369901-347	Includes one sensor.
Measuring pin	3HAC13908-5	
Sensor fixture	68080011-GM	
Sensor plate	3HAC0392-1	
Sync. adapter	3HAC13908-1	

Calibration equipment, Calibration Pendulum

The following table specifies the calibration equipment needed when calibrating the robot with the Calibration Pendulum method.

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

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

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

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

Calibration equipment, Axis Calibration

The following table specifies the calibration equipment needed when calibrating the robot with the Axis Calibration method.

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

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

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

Description	Art. no.	Note
Calibration tool box, Axis Calibration	3HAC058080-001	Delivered as a set of calibration tools. Required if Axis Calibration is the valid calibration method for the robot. Contains a removal tool for removing special protection plugs on the turning disk.

Turning tool for suspended mounting

The following table specifies the lifting tool required when fitting the robot in a suspended position.

Description	Art. no.	Note
Turning tool (includes lifting instruction)	3HAC034766-001	Valid for other designs than type C.

Continues on next page

7 Reference information

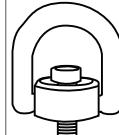
7.7 Special tools

Continued

Description	Art. no.	Note
Turning tool (includes lifting instruction 3HAC051688-001)	3HAC048502-001	Valid for all types

Lifting accessories

This table specifies the lifting accessories required during several of the service procedures. The lifting accessories can be ordered separately and are also specified directly in concerned instructions.

Description	Qty	Article no.	Note
Lifting accessory, axis 2			
Lifting accessory, axis 3			
Rotating lifting point	2 pcs	-	<p>For lifting of upper arm. Dimension: M8. Example: Gunnebo RLP GrabiQ M8-10.</p>  <p>xx1100000564</p>

7.8 Lifting accessories and lifting instructions

General

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

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

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

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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 on the documentation DVD.

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9 Circuit diagram

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but delivered as separate documents on the documentation DVD. See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRC5</i>	<i>3HAC024480-011</i>
<i>Circuit diagram - IRC5 Compact</i>	<i>3HAC049406-003</i>
<i>Circuit diagram - IRC5 Panel Mounted Controller</i>	<i>3HAC026871-020</i>
<i>Circuit diagram - Euromap</i>	<i>3HAC024120-004</i>
<i>Circuit diagram - Spot welding cabinet</i>	<i>3HAC057185-001</i>

Robots

Product	Article numbers for circuit diagrams
<i>Circuit diagram - IRB 120</i>	<i>3HAC031408-003</i>
<i>Circuit diagram - IRB 140 type C</i>	<i>3HAC6816-3</i>
<i>Circuit diagram - IRB 260</i>	<i>3HAC025611-001</i>
<i>Circuit diagram - IRB 360</i>	<i>3HAC028647-009</i>
<i>Circuit diagram - IRB 460</i>	<i>3HAC036446-005</i>
<i>Circuit diagram - IRB 660</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 760</i>	<i>3HAC025691-001</i>
<i>Circuit diagram - IRB 1200</i>	<i>3HAC046307-003</i>
<i>Circuit diagram - IRB 1410</i>	<i>3HAC2800-3</i>
<i>Circuit diagram - IRB 1600/1660</i>	<i>3HAC021351-003</i>
<i>Circuit diagram - IRB 1520</i>	<i>3HAC039498-007</i>
<i>Circuit diagram - IRB 2400</i>	<i>3HAC6670-3</i>
<i>Circuit diagram - IRB 2600</i>	<i>3HAC029570-007</i>
<i>Circuit diagram - IRB 4400/4450S</i>	<i>3HAC9821-1</i>
<i>Circuit diagram - IRB 4600</i>	<i>3HAC029038-003</i>
<i>Circuit diagram - IRB 6400RF</i>	<i>3HAC8935-1</i>
<i>Circuit diagram - IRB 6600 type A</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6600 type B</i>	<i>3HAC13347-1 3HAC025744-001</i>
<i>Circuit diagram - IRB 6620</i>	<i>3HAC025090-001</i>

Continues on next page

9 Circuit diagram

9.1 Circuit diagrams

Continued

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

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