ROBOTICS

Product manual

IRB 1410

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Product manual

IRB 1410

IRC5

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Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

Table of contents

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Overview of this manual

About this manual

This manual contains instructions for

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

Usage

This manual should be used during

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

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

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

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

Product manual scope

The manual covers covers all variants and designs of the IRB 1410. Some variants and designs may have been removed from the business offer and are no longer available for purchase.

Organization of chapters

The manual is organized in the following chapters:

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

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Chapter	Contents
Calibration information	Procedures that does not require specific calibration equipment.
Decommissioning	Environmental information about the robot and its components.
Reference information	Useful information when performing installation, maintenance or repair work (lists of necessary tools, reference documents, safety standards).
Part list	Complete list of robot parts, shown in the exploded views or foldouts.
Exploded views / Foldouts	Detailed illustrations of the robot with reference numbers to the part list.
Circuit diagram	References to the circuit diagram for the robot.

References

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

Document name	Document ID	Note
Product specification - IRB 2400	*3HAC042195-001*	M2004
Product manual, spare parts - IRB 1410	*3HAC049103-001*	
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*	M2004
Circuit diagram - IRB 1410	*3HAC2800-3*	
Product manual - IRC5 IRC5 with main computer DSQC 639.	*3HAC021313-001*	M2004
Product manual - IRC5 IRC5 with main computer DSQC1000.	*3HAC047136-001*	M2004
Product manual - S4Cplus M2000	*3HAC021333-001*	M2000
Product manual - S4Cplus M2000A	*3HAC022419-001*	M2000A
Operating manual - IRC5 with FlexPendant	*3HAC050941-001*	M2004
User's guide - S4Cplus (BaseWare OS 4.0)	*3HAC7793-1*	M2000/M2000A
Operating manual - Service Information System	*3HAC050944-001*	M2004
Operating manual - Calibration Pendulum	*3HAC16578-1*	
Operating manual - Levelmeter Calibration	*3HAC022907-001*	M2000/M2000A
Technical reference manual - Lubrication in gear-boxes	*3HAC042927-001*	
Technical reference manual - System parameters	*3HAC050948-001*	M2004
Application manual - Additional axes and stand alone controller	*3HAC051016-001*	M2004
Application manual - External axes	*3HAC9299-1*	M2000
Operating manual - RobotStudio	*3HAC032104-001*	M2004

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

Additional document references

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

Continues on next page

Revisions

Revision	Description
F	This revision includes the following updates: • The manual is partly restructured. • Released with R14.1. • *Spare parts and exploded views* are not included in this document but delivered as a separate document. See *Product manual, spare parts - IRB 1410*
G	This revision includes the following updates: • Minor corrections.
H	This revision includes the following updates: • Turning disk fixture is removed from special tools for Levelmeter calibration. • Information regarding SMB and battery is changed. • Information regarding axes-5 and -6 greasing is changed.
J	This revision includes the following updates: • Minor corrections. • The dimension of hole configuration is corrected.
K	Published in release R17.2. The following updates are made in this revision: • Information about coupled axes in *Updating revolution counters on page 127*. • Caution about removing metal residues added in sections about SMB boards. • Information about minimum resonance frequency added. • Updated list of applicable standards. • Section *Start of robot in cold environments on page 63* added. • Removed option 042 of air supply and signals for extra equipment to upper arm
L	Published in release R18.1. The following updates are made in this revision: • Added sections in *General procedures on page 80*. • Safety section restructured. • Information about myABB Business Portal added.
M	Published in release R18.2. The following updates are made in this revision: • Updated the refitting procedure for changing the axis-5 and xis-6 motor or driving belt. • Added section for inspection of labels in maintenance chapter.
N	Published in release R18.2. The following updates are made in this revision: • Reference updated.
P	Published in release 19B. The following updates are made in this revision: • New touch up color Graphite White available. See *Cut the paint or surface on the robot before replacing parts on page 86*. • New article numbers for manipulator cables in section *Robot cabling and connection points on page 57*.
Q	Published in release 20B. The following updates are made in this revision: • Clarified and added information in mounting instructions for rotating sealings, see *Mounting instructions for sealings on page 83*. • Added information about Wrist Optimization in calibration chapter. • Replaced article number and name of grease, previously 3HAB3537-1.
R	Published in release 20D. The following updates are made in this revision: • Minor corrections. • Updated the figure showing hole configuration of the robot base.

How to read the product manual

Reading the procedures

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

References to figures

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

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

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

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

References to required equipment

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

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

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

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

Safety information

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

Read more in the chapter *Safety on page 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.

Product documentation, M2000/M2000A

General

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

Product manuals

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

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

Software manuals

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

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

Controller hardware option manual

Each hardware option for the controller is supplied with its own documentation. Each document set contains the types of information specified below:

- Installation information
- Repair information
- Maintenance information

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

Product documentation

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

Product manuals

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

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

Technical reference manuals

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

Application manuals

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

An application manual generally contains information about:

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

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Operating manals

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

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1 Safety

1.1 Safety information

1.1.1 Limitation of liability

Limitation of liability

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

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

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

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

Spare parts and equipment

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

1.1.2 Requirements on personnel

General

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

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

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

Personal protective equipment

Use personal protective equipment, as stated in the product manual.

1.2 Safety signals and symbols

1.2.1 Safety signals in the manual

Introduction to safety signals

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

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

Hazard levels

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

For more information, see standard ISO 13849.

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

Continues on next page

1.2.1 Safety signals in the manual
Continued

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

1.2.2 Safety symbols on manipulator labels

Introduction to symbols

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

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

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

Types of symbols

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

The safety labels are language independent, they only use graphics. See *Symbols on safety labels on page 21*.

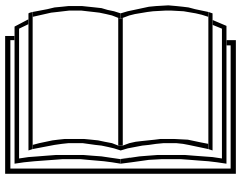
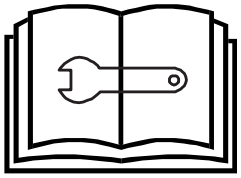
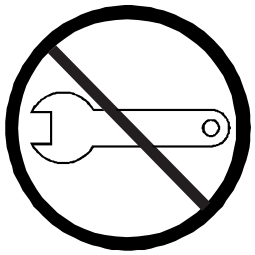
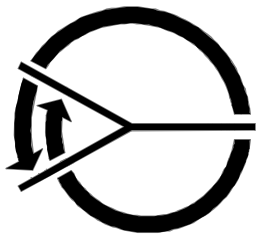
The information labels can contain information in text.

Symbols on safety labels

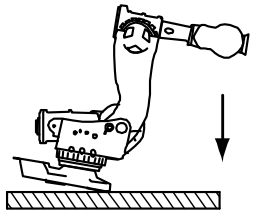
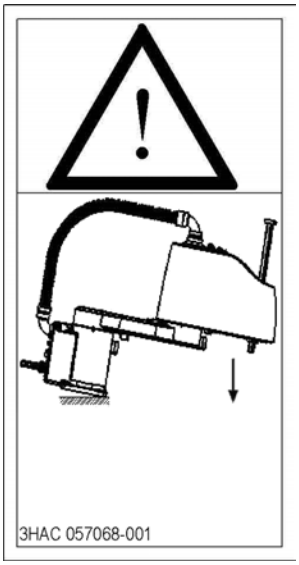
Symbol	Description
 xx0900000812	**Warning!** Warns that an accident *may* occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical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

Continues on next page

1.2.2 Safety symbols on manipulator labels
Continued

Symbol	Description
 xx0900000813	**See user documentation** Read user documentation for details. Which manual to read is defined by the symbol: • No text: *Product manual*. • EPS: *Application manual - Electronic Position Switches*.
 xx0900000816	**Before 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.

Continues on next page

Symbol	Description
 xx0900000810  xx1500002402	**Tip risk when loosening bolts** The robot can tip over if the bolts are not securely fastened.
  xx0900000817	**Crush** Risk of crush injuries.

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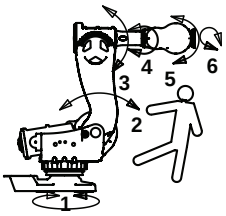
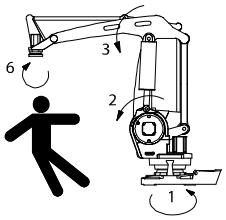
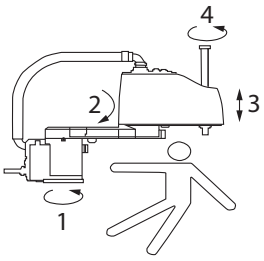
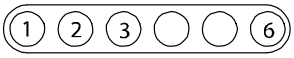
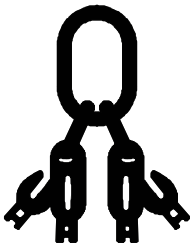
1.2.2 Safety symbols on manipulator labels
Continued

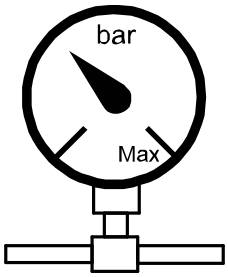
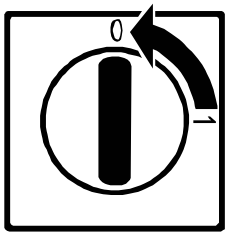
Symbol	Description
 xx0900000818  xx1300001087	**Heat** Risk of heat that can cause burns. (Both signs are used)
 xx0900000819  xx1000001141  xx1500002616	**Moving robot** The robot can move unexpectedly.

Continues on next page

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

Continues on next page

1.2.2 Safety symbols on manipulator labels
Continued

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

1.3 Robot stopping functions

Protective stop and emergency stop

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

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*

1.4 Installation and commissioning

National or regional regulations

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

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

The integrator of the robot system is required to perform an assessment of the hazards and risks.

Layout

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

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

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

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

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

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

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

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

Allergenic material

See *Environmental information on page 134* for specification of allergenic materials in the product, if any.

Securing the robot to the foundation

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

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

Electrical safety

The mains power must be installed to fulfill national regulations.

Continues on next page

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

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

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

Note

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

Safety devices

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

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

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

Other hazards

WARNING

Never stay beneath a robot arm. Gravity and the release of braking devices can create additional hazards.

A robot may perform unexpected limited movement.

WARNING

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

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

- Water
- Compressed air
- Hydraulics

Continues on next page

Pneumatic or hydraulic related hazards

Note

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

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

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

Dump valves should be used in case of emergency.

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

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

Verify the safety functions

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

1.5 Operation

1.5.1 Unexpected movement of robot arm

Unexpected movement of robot arm

WARNING

Never stay beneath a robot arm. Gravity and the release of braking devices can create additional hazards.

A robot may perform unexpected limited movement.

WARNING

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

1.6 Maintenance and repair

1.6.1 Maintenance and repair

General

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

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

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

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

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

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

Gearbox lubricants (oil or grease)

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

Note

Take special care when handling hot lubricants.

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

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

Hazards related to batteries

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

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

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

Operating temperatures are listed in *Operating conditions, robot on page 42*.

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

Continues on next page

1.6.1 Maintenance and repair
Continued

Unexpected movement of robot arm

WARNING

Never stay beneath a robot arm. Gravity and the release of braking devices can create additional hazards.

A robot may perform unexpected limited movement.

WARNING

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

Related information

See also the safety information related to installation and operation.

1.6.2 Emergency release of the robot axes

Description

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

How to release the brakes is described in the section:

- *Manually releasing the brakes on page 48*.

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

Increased injury

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

DANGER

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

Make sure no personnel is near or beneath the robot.

1.6.3 Brake testing

When to test

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

How to test

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

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

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

1.7 Troubleshooting

General

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

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

DANGER

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

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

WARNING

Never stay beneath a robot arm. Gravity and the release of braking devices can create additional hazards.

A robot may perform unexpected limited movement.

WARNING

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

Related information

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

1.8 Decommissioning

General

See section *Decommissioning on page 133*.

Unexpected movement of robot arm

WARNING

Never stay beneath a robot arm. Gravity and the release of braking devices can create additional hazards.

A robot may perform unexpected limited movement.

WARNING

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

2 Installation and commissioning

2.1 Introduction to installation and commissioning

General

This chapter contains assembly instructions and information for installing the IRB 1410 controller at the working site.

See also the product manual for the robot controller.

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

Safety information

Before any installation work is commenced, 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 1410 is connected to power, always make sure that the robot is connected to protective earth and a residual current device (RCD) before starting any installation work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*

2.2 Unpacking

2.2.1 Pre-installation procedure

Introduction

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

Prerequisites for installation personnel

Installation personnel working with an ABB product must:

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

Checking the pre-requisites for installation

	Action
1	Make a visual inspection of the packaging and make sure that nothing is damaged.
2	Remove the packaging.
3	Check for any visible transport damage. **Note** Stop unpacking and contact ABB if transport damages are found.
4	Clean the unit with a lint-free cloth, if necessary.
5	Make sure that the lifting accessory used (if required) is suitable to handle the weight of the robot as specified in: *Weight, robot on page 40*
6	If the robot is not installed directly, it must be stored as described in: *Storage conditions, robot on page 42*
7	Make sure that the expected operating environment of the robot conforms to the specifications as described in: *Operating conditions, robot on page 42*
8	Before taking the robot to its installation site, make sure that the site conforms to: • *Loads on foundation, robot on page 41* • *Protection classes, robot on page 42* • *Requirements, foundation on page 41*
9	Before moving the robot, please observe the stability of the robot: *Risk of tipping/stability on page 44*
10	When these prerequisites are met, the robot can be taken to its installation site as described in section: *On-site installation on page 47*
11	Install required equipment, if any.

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 1410	225 kg

Continues on next page

Note

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

Loads on foundation, robot

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

Note

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

WARNING

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

Floor mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±1500 N	±2000 N
Force z	2800 ±500 N	2800 ±700 N
Torque xy	±1800 Nm	±2000 Nm
Torque z	±400 Nm	±500 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	0°	

Continues on next page

2.2.1 Pre-installation procedure
Continued

Requirement	Value	Note
Minimum resonance frequency	25 Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment. [i] For information about compensating for foundation flexibility, see *Application manual - Controller software IRC5*, section *Motion Process Mode*.

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

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

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Note

If the manipulator should not be used immediately, all unpainted/unprotected surfaces must be treated with a rust inhibitor, type Vaseline or similar.

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	95% at constant temperature

Protection classes, robot

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

Protection type	Protection class
Manipulator, protection type Standard	IP 54

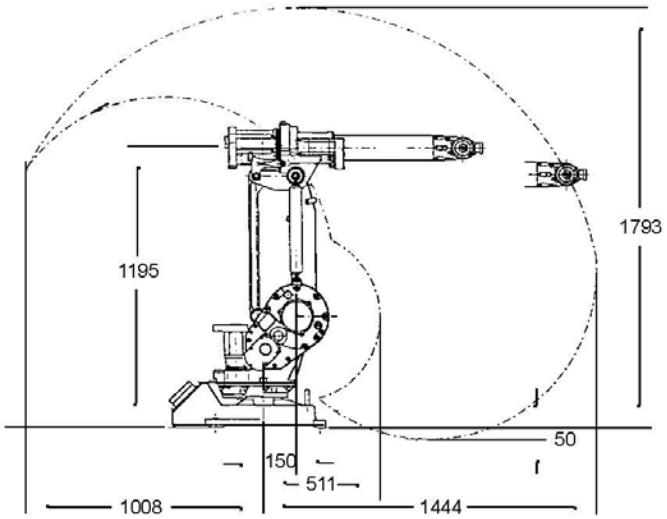
2.2.2 Amount of space required

General

The amount of working space required to operate the manipulator is illustrated in the figures below. The working range for axis 1 is +/- 170°.

CAUTION

There are no software or mechanical limits for the working space under the base of the manipulator.



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2.2.3 Risk of tipping/stability

Risk of tipping

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

The shipping position is the most stable position.

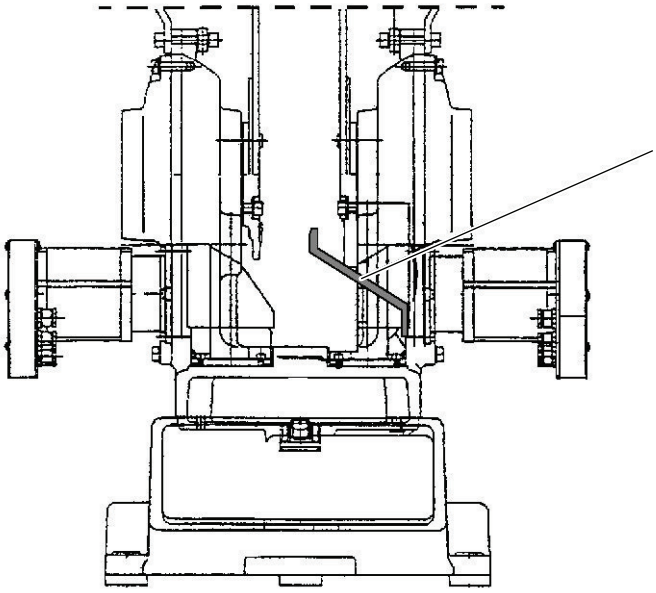
WARNING

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

2.2.4 Transport locking device

Manipulator

At delivery, axis 2 (= lower arm) is equipped with a transport locking device, see figure.



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2.2.5 The unit is sensitive to ESD

Description

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

Safe handling

	Action	Note
1	Use a wrist strap. The wrist strap button is located inside the controller.	Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly. • *Product manual - IRC5* • *Product manual - IRC5 Compact*
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.

2.3 On-site installation

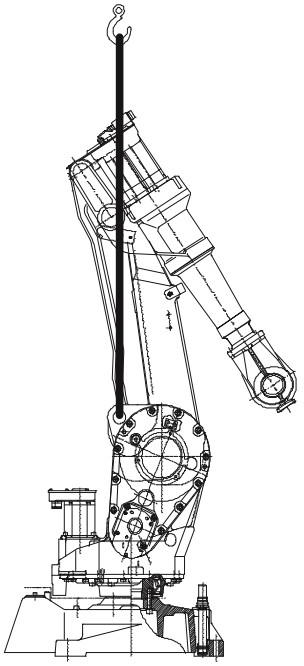
2.3.1 Lifting robot with lifting slings

Required equipment

Equipment	Note
Sling line Type: KDBK 7-8.	Length: 2 m. Load at 90°: 380 kg.

Illustration, attachment of lifting slings

The figure below shows how to attach the lifting slings to the robot.



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Lifting of robot

	Action	Note
1	Move the robot to the lifting position shown in the figure above.	If necessary, release the brakes as detailed in section *Manually releasing the brakes on page 48*.
2	Attach the straps to the special eye bolts on the gearboxes for axes 2 and 3.	
3	Lift the robot carefully.	

2.3.2 Manually releasing the brakes

General

The holding brakes of each axis' motor are of an electromechanical type and are released when voltage is applied. This section details how to release the brakes, using the internal brake release unit, in order to enable the axes to move manually.

The brake of each motor can also be released by connecting an external voltage supply directly on the motor connector, see the circuit diagram.

Releasing the brakes using the brake release unit

The procedure below details how to release the holding brakes using the internal brake release unit.

	Action	Note/Illustration
1	**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!	
2	If the robot is not connected to the controller, power must be supplied to the connector R1.MP.	Detailed in section *Supplying power to connector R1.MP on page 48*.
3	The internal brake release unit is located at the base of the robot and equipped with buttons for controlling the holding brakes for each axis separately. The buttons are numbered according to the numbers of the axes. To release the brake on a particular robot axis, push the corresponding button on the internal brake release panel and keep it depressed. The brake will function again as soon as the button is released.	

Supplying power to connector R1.MP

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

	Action	Note/Illustration
1	**CAUTION** Be careful not to interchange the 24 VDC and 0V pins! If they are mixed up, damage can be caused to a resistor diode and to the system board.	

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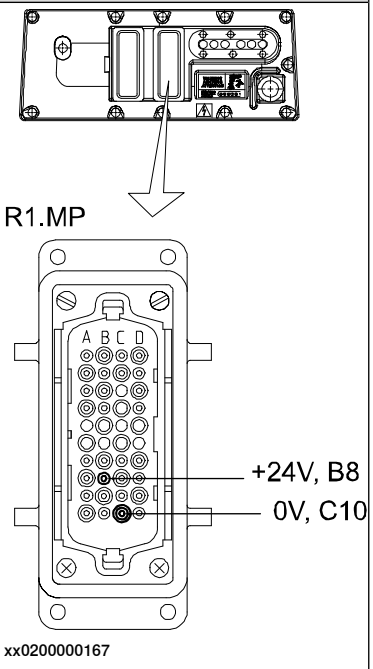
	Action	Note/Illustration
2	Connect an external power supply to connector R1.MP, at the robot base. Supply: • +24 V on pin B8 • 0 V on pin C10	
3	Release the brakes with the brake release unit as detailed in the previous procedure.	

2.3.3 Orienting and securing the robot

General

This section details how to orient and secure the robot to the foundation in order to safely run the robot. The requirements for the foundations are shown in *Requirements, foundation on page 41*.

Bolting requirements

When bolting a base plate or the base to a concrete floor, follow the general instructions for expansion-shell bolts. The screw joint must be able to withstand the stress loads defined in section *Pre-installation procedure on page 40*.

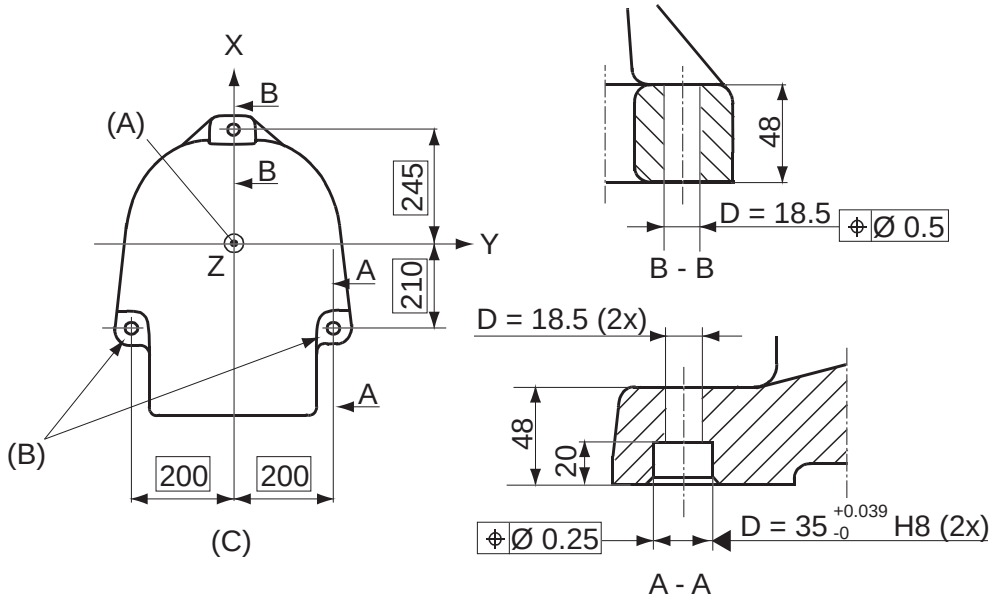
Attachment screws

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

Suitable screws, lightly lubricated:	M16 x 50
Quality	Quality 8.8
Suitable washer:	Thickness: 3 mm Outer diameter: 30 mm Inner diameter: 17 mm
Tightening torque:	190 Nm

Hole configuration

The figure below shows the hole configuration of the robot base, and cross section of the guide sleeve holes used when securing the robot.



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Guide sleeves

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

Equipment	Art. no.
Guide sleeves	2151 0024-169

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

General

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

CAUTION

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

References

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

- *Operating manual - IRC5 with FlexPendant*

Stopping time and braking distances

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

2.3.5 Installation of signal lamp (option)

Signal lamp

See the assembly instruction delivered with the signal lamp.

2.4 Restricting the working range

General

When installing the manipulator, make sure that it can move freely within its entire working range. If there is a risk that it may collide with other objects, its working range should be limited, both mechanically and in the system parameter configuration (software). Installation of an optional extra stop for the main axes 1, 2 and 3 is described below.

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

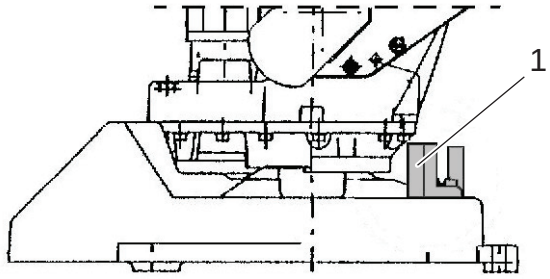
Axis 1

The range of rotation for axis 1 can be limited mechanically by fitting extra stop lugs to the base, see figure.

Instructions for necessary machining and mounting are supplied with the kit.

CAUTION

The original stop lug must never be removed.



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1	Extra stop lug for axis 1

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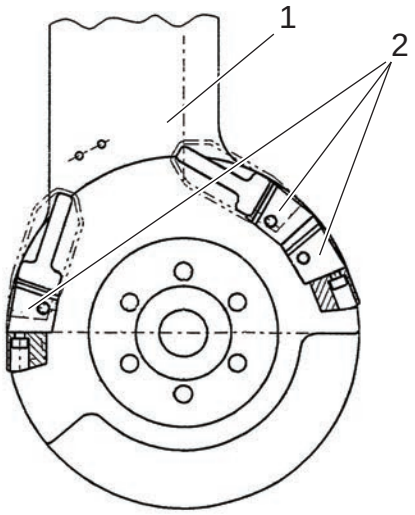
Axis 2

The working range of axis 2 can be limited mechanically by fitting extra stop lugs to the lower arm (see Figure 12). The lugs limit the arm movements in intervals of 20°. (20° = 1 lug, 40° = 2 lugs, etc.)

Instructions for doing this are supplied with the kit.



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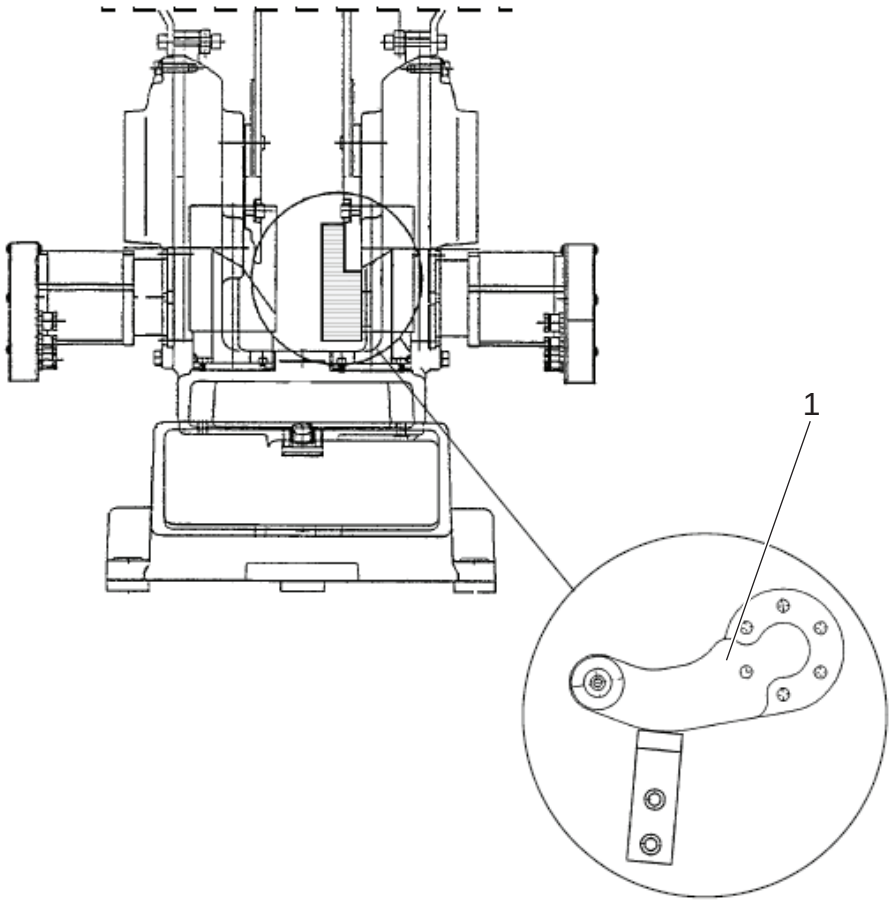
1	Lower arm
2	Extra stop lug for axis 2

Continues on next page

Axis 3

The working range of axis 3 can be limited mechanically by fitting a stop lug under the parallel arm (see Figure 13). Axis 3 is limited upwards to 0 or -10 degrees above the horizontal plane.

Instructions for doing this are supplied with the kit.



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1	Extra Stop Lug for limiting Axis 3

2.5 Electrical connections

2.5.1 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 57*.
Customer cables (option)	Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. See the product manual for the controller, 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

Art. no.	Cable
3HAC2492-1	Robot cable, power:L= 7 m
3HAC2529-1	Robot cable, power: L=15 m
3HAC2539-1	Robot cable, power: L=22 m
3HAC2564-1	Robot cable, power: L=30 m

Robot cable, signals

Art. no.	Description
3HAC068917-001	Control cable signal L=7 m
3HAC068918-001	Control cable signal L=15 m
3HAC068919-001	Control cable signal L=22 m
3HAC068920-001	Control cable signal L=30 m

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2.5.1 Robot cabling and connection points
Continued

Robot cable, signals

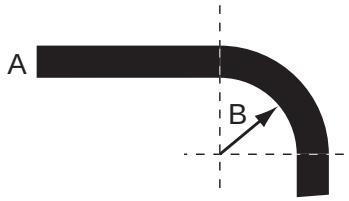
Cable	Art. no.
Robot cable signal, shielded: 7 m	
Robot cable signal, shielded: 15 m	
Robot cable signal, shielded: 22 m	
Robot cable signal, shielded: 30 m	

Tip

In case duplicate CP/CS harnesses are included on delivery, one can be saved as a spare part.

Bending radius for static floor cables

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



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A	Diameter
B	Diameter x10

2.5.2 Customer connections

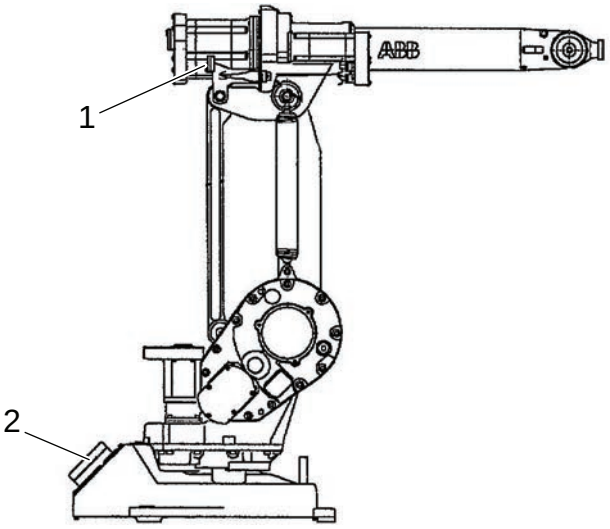
2.5.2.1 Air supply and signals for extra equipment to upper arm

Option 041

Hose for compressed air is integrated into the manipulator. There is an inlet at the base and an outlet on the upper arm housing. Connections: R1/4” in the upper arm housing and at the base. Max. 8 bar. Inner hose diameter: 6.5 mm.

For connection of extra equipment on the manipulator, there are cables integrated into the manipulator’s cabling.

Signals	
Number of signals	12 signals, 49V, 500 mA
Connector on upper arm	FCI 12-pin UT001412SHT
Connector on robot base	FCI 12-pin UT001412PHT



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1	R2.CS Air (only option 041)
2	R1.CS Air (only option 041)

To connect power and signal conductors to the manipulator base and to the upper arm connectors, the following parts are recommended:

- ABB’s recommended contact set, for connector R2.CS, has Art. No. 3HAC 12583-1
- ABB’s recommended contact set, for connector R1.CS, has Art. No. 3HAC 12493-1.

The complete contact set (option), which corresponds to item 4, 5, 6, 7, 8 and 9 according to Figure 17. contains:

- Pins for cable area 0.13 - 0.25 mm^2

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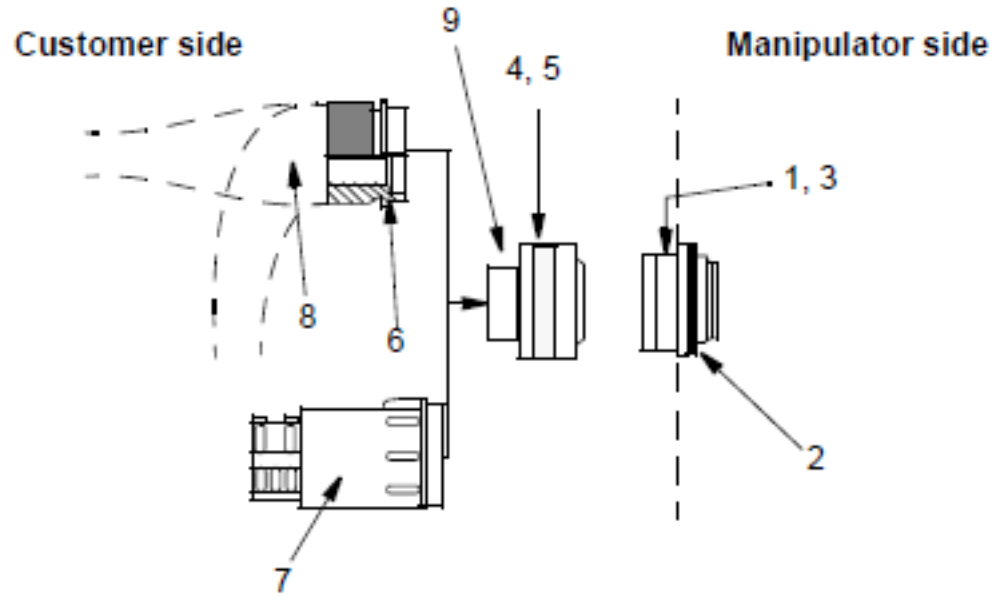
2.5.2.1 Air supply and signals for extra equipment to upper arm
Continued

- Shrinking hose, bottled shaped
- Shrinking hose, angled



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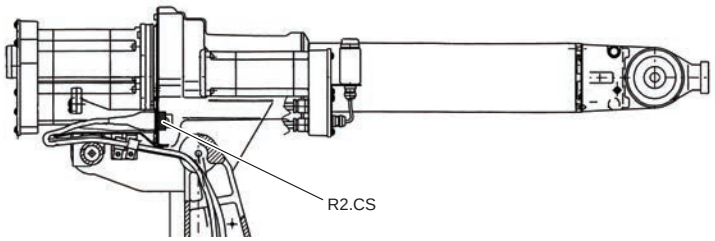
2.5.2.2 Connection of extra equipment to the manipulator

Technical data for customer connections.

Signals	
Conductor resistance	< 3 ohm, 0.154 mm^2
Max. voltage	50 V AC/DC
Max. current	250 mA

Connections on upper arm



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Signal	Terminal (Controller)	Contact on Upper Arm, R2	Contact on Manipulator Base (Cable not supplied)
CSA	XT5.1	R2.CS.A	R1.CS.A
CSB	XT5.2	R2.CS.B	R1.CS.B
CSC	XT5.3	R2.CS.C	R1.CS.C
CSD	XT5.4	R2.CS.D	R1.CS.D
CSE	XT5.5	R2.CS.E	R1.CS.E
CSF	XT5.6	R2.CS.F	R1.CS.F
CSG	XT5.7	R2.CS.G	R1.CS.G
CSH	XT5.8	R2.CS.H	R1.CS.H
CSJ	XT5.9	R2.CS.J	R1.CS.J
CSK	XT5.10	R2.CS.K	R1.CS.K
CSL	XT5.11	R2.CS.L	R1.CS.L
CSM	XT5.12	R2.CS.M	R1.CS.M

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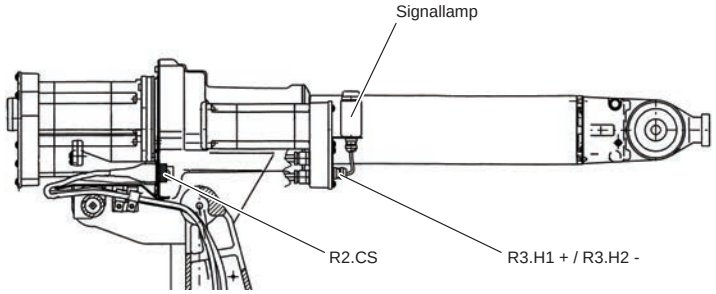
2.5.2.2 Connection of extra equipment to the manipulator
Continued

Connection of signal lamp on upper arm (option)



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2.6 Start of robot in cold environments

Introduction

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

Problems with starting the robot

Event message from Motion Supervision

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

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

Robot stopping with other event message

Use this procedure if the robot is not starting.

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

Adjusting the speed and acceleration during warm-up

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

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

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

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3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 1410.

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 1410 is connected to power, always make sure that the IRB 1410 is connected to protective earth and a residual current device (RCD) before starting any maintenance work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*
- *Robot cabling and connection points on page 57*.

3.2 Maintenance schedule

3.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 1410:

- 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.

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

3.2.2 Maintenance schedule

General

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

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

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

Activities and intervals, standard equipment

The table below specifies the required maintenance activities and intervals and also refers to the section where performing the activity is detailed.

Maintenance activity	Interval	Note	Detailed in section:
Oil inspection in gearboxes, axes 1,2, 3 and 4.	40000 h	Lubricated for life. Maintenance free units.	
Replacement of battery pack, SMB unit	Battery low alert [i]	Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A	*Replacement of SMB battery on page 70*.
Replacement of battery pack, SMB unit	36 months or battery low alert [ii]	Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact)	*Replacement of SMB battery on page 70*.
Inspection of all signal cabling in lower and upper arm	36 months	Replace if damaged.	
Inspection of information labels	12 months	Replace any damaged, missing or unreadable labels.	*Inspecting information labels on page 73*
Replacement of mechanical stop axis 1	60 months	Replace if bent.	
Lubrication of spring brackets	Every 2000 hours or 6 months		
Lubrication of gears, axis 5-6	Every 4000 hours or 1 year		

i 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.

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

See the replacement instruction for more details.

3.3 Changing activities

3.3.1 Type of lubrication in gearboxes

Introduction

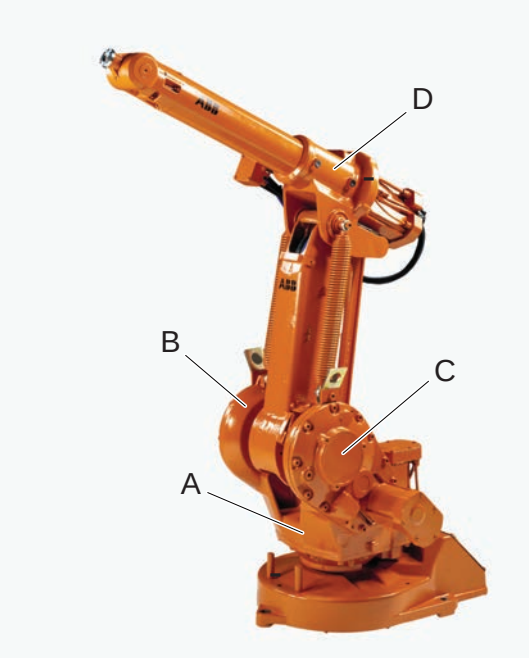
This section describes where to find information about the type of lubrication, article number and the amount of lubrication in the specific gearbox. It also describes the equipment needed when working with lubrication.

Type and amount of oil in gearboxes

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

Location of gearboxes

The figure shows the location of the gearboxes.



xx1300002641

A	Gearbox. axis 1
B	Gearbox, axis 2
C	Gearbox, axis 3
D	Gearbox, axis 4

Continues on next page

Equipment

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

3.3.2 Replacement of SMB battery

Note

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

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

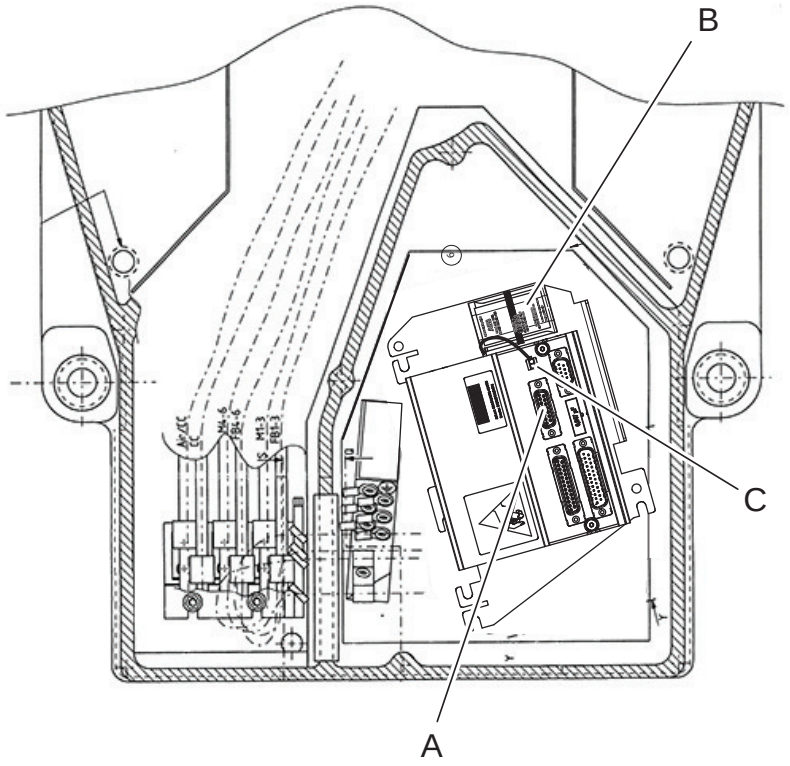
For an SMB board with 2-pole battery contact, the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See *Operating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

WARNING

See *Hazards related to batteries on page 33*.

Location of SMB battery unit

The SMB battery unit is located inside the robot base, as shown in the figure below.



xx1300002448

A	SMB connection
B	SMB battery RMU

Continues on next page

C	SMB battery connector

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 battery with the 3-pole contact has a longer lifetime.

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	Spare part no.	Note
Battery unit (2-pole battery contact)	3HAC16831-1	Lithium battery. This battery requires that the serial measurement unit 3HAC17396-1 is installed.
Battery unit (3-pole battery contact)	3HAC044075-001	RMU Lithium battery. Can only be used with SMB unit 3HAC046277-001 containing SMB board 3HAC044168-001.
Gasket, cover	3HAC3200-1	Always replace with a new one!
Standard toolkit		The content is defined in the section *Standard tools on page 143*.
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.

Replacement, SMB battery

The procedure below details how to replace the SMB battery.

	Action	Note
1	**DANGER** Turn off all electric power, hydraulic and pneumatic pressure supplies to the robot!	
2	xx0200000023 **WARNING** The unit is sensitive to ESD. Before handling the unit please read the safety information in the section *The unit is sensitive to ESD on page 46*	

Continues on next page

3.3.2 Replacement of SMB battery

Continued

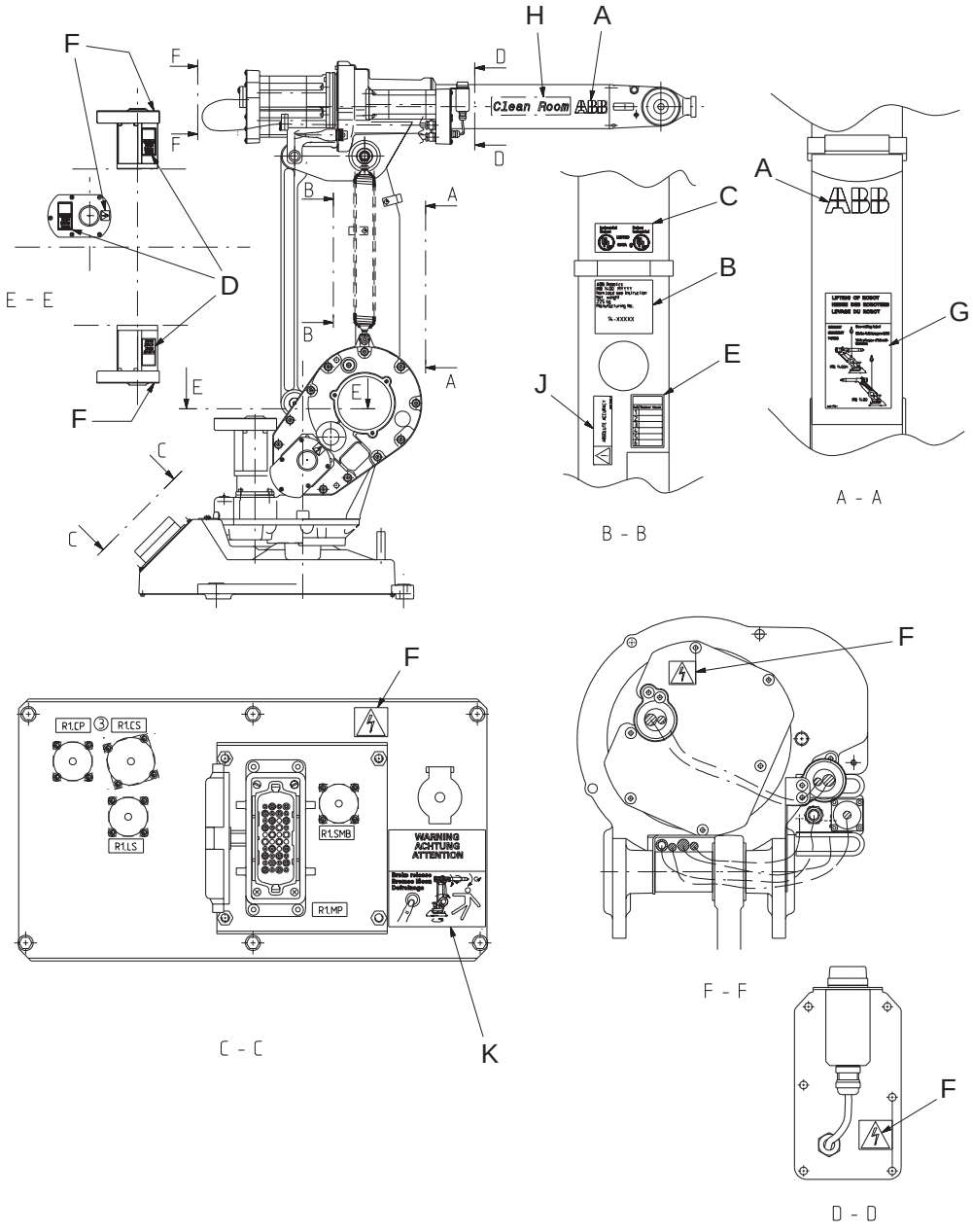
	Action	Note
3	Remove the rear cover plate (A) on the robot by unscrewing its attachment screws (B). **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	
4	Remove the battery terminals from the serial measuring board and cut the clasp that keeps the battery unit in place.	
5	Fit the new **battery** and connect the terminals to the serial measuring board.	Shown in the figure *Location of SMB battery unit on page 70*.
6	Refit the cover to the robot base, together with a new *gasket*.	Always replace a removed gasket with a new! Spare part no. is specified in *Required equipment on page 71*.
7	Update the revolution counters!	Detailed in the section *Updating revolution counters on page 127*.

3.4 Inspection activities

3.4.1 Inspecting information labels

Location of information labels

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



xx1800001453

A	ABB logotype
B	Rating label
C	UL/UR label
D	Instruction plate - High temperature (3 pcs)

Continues on next page

3.4.1 Inspecting information labels

Continued

E	Calibration label
F	Warning sign - Symbol of flash (6 pcs)
G	Instruction plate - Lifting of robot
H	Clean Room label, if applicable (on both sides)
J	Information sign - AbsAcc
K	Instruction plate - Brake release unit

Required equipment

Equipment	Spare part number	Note
Labels	See *Spare part list on page 147*.	

Inspecting labels

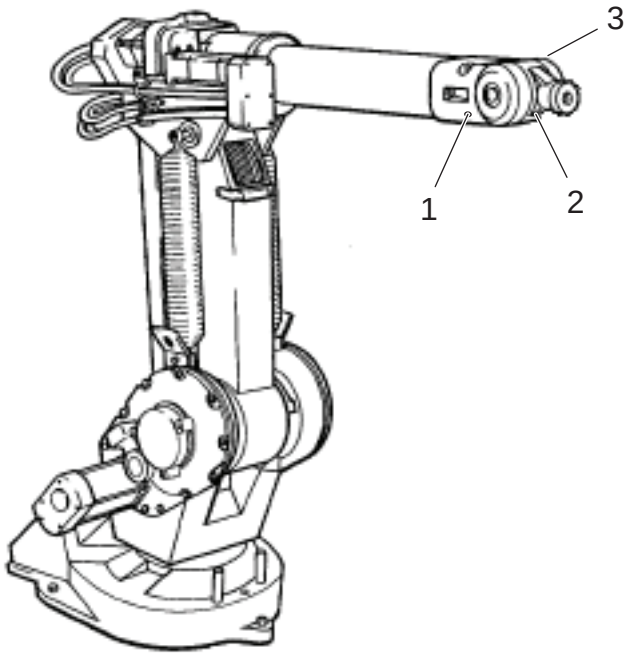
Use this procedure to inspect the labels on the robot.

	Action	Note
1	**DANGER** Turn off all: • electric power supply • hydraulic pressure supply • air pressure supply to the robot, before entering the robot working area.	
2	Check all labels.	See the figure in *Location of information labels on page 73*.
3	Replace any missing or damaged labels.	

3.5 Lubrication activities

Greasing axes-5 and -6

Grease is pressed through the 3 nipples.



xx0200000484

1	Nipple, axis 5
2	Nipple, axis 6
3	Nipple, axis 5

Grease is Energrease LS-EP2 S or equivalent.

Lubricating spring brackets

There are four lubrication places, located over and under the two balancing springs.

3.6 Cleaning activities

3.6.1 Cleaning the IRB 1410

DANGER

Turn off all:

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

to the robot, before entering the safeguarded space.

General

To secure high uptime it is important that the IRB 1410 is cleaned regularly. The frequency of cleaning depends on the environment in which the product works.

Different cleaning methods are allowed depending on the type of protection of the IRB 1410.

Note

Always verify the protection type of the robot before cleaning.

Special cleaning considerations

This section specifies some special considerations when cleaning the robot.

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

Continues on next page

Cleaning methods

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

Protection type	Cleaning method			
	Vacuum cleaner	Wipe with cloth	Rinse with water	High pressure water or steam
Standard	Yes	Yes. With light cleaning detergent.	Yes. It is highly recommended that the water contains a rust-prevention solution and that the manipulator is dried afterwards.	No

Cleaning with water and steam

Instructions for rinsing with water

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

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 700 kN/m^2 (7 bar) I
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum flow: 20 liters/min I

I Typical tap water pressure and flow

Cables

Movable cables need to be able to move freely:

- Remove waste material, such as sand, dust and chips, if it prevents cable movement.
- Clean the cables if they have a crusty surface, for example from dry release agents.

1 See *Cleaning methods on page 77* for exceptions.

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4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes repair activities for the IRB 1410. Each procedure contains the information required to perform the activity, for example spare parts numbers, required special tools, and materials.

WARNING

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

Report replaced units

Note

When replacing a part on the IRB 1410, report to your local ABB the serial number, the article number, and the revision of both the replaced unit and the replacement unit.

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

Safety information

Make sure to read through the chapter *Safety on page 17* before commencing any service work.

Note

If the IRB 1410 is connected to power, always make sure that the IRB 1410 is connected to protective earth and a residual current device (RCD) before starting any repair work.

For more information see:

- *Product manual - IRC5*
- *Product manual - IRC5 Compact*

4.2 General procedures

4.2.1 Performing a leak-down test

When to perform a leak-down test

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

Required equipment

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

Performing a leak-down test

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

4.2.2 Mounting instructions for bearings

General

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

Equipment

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

Assembly of all bearings

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

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

Assembly of tapered bearings

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

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

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

Greasing of bearings

Note

This instruction is not valid for solid oil bearings.

Continues on next page

4.2.2 Mounting instructions for bearings
Continued

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

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

Grease the different types of bearings as following description:

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

4.2.3 Mounting instructions for sealings

General

This section describes how to mount different types of sealings.

Equipment

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

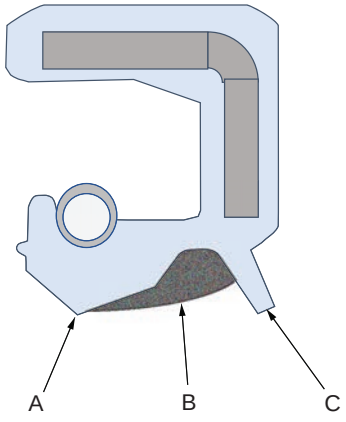
Rotating sealings

The procedure below describes how to fit rotating sealings.

CAUTION

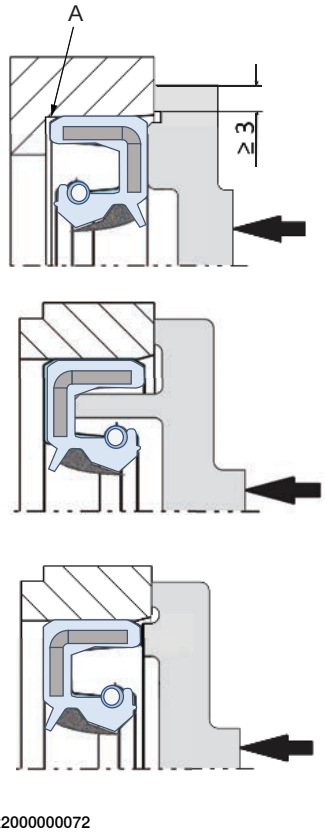
Please observe the following before commencing any assembly of sealings:

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

	Action	Note
1	Check the sealing to ensure that: • The sealing is of the correct type. • There is no damage on the main lip.	
2	Inspect the shaft surface before mounting. If scratches or damage are found, the shaft must be replaced since it may result in future leakage. Do not try to grind or polish the shaft surface to get rid of the defect.	
3	Lubricate the sealing with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the sealing.) Fill 2/3 of the space between the dust lip and the main lip with grease. If the sealing is without dust lip, just lubricate the main lip with a thin layer of grease.	Article number is specified in *Equipment on page 83*.  xx2000000071 A Main lip B Grease C Dust lip

Continues on next page

4.2.3 Mounting instructions for sealings
Continued

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

Flange sealings and static sealings

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

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

O-rings

The following procedure describes how to fit o-rings.

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

Continues on next page

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

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

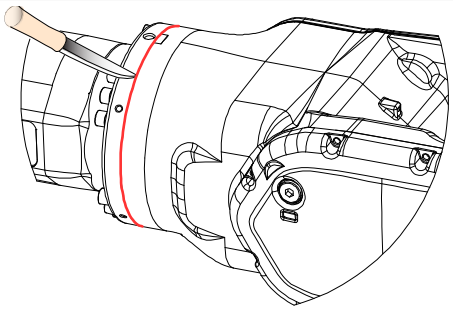
General

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

Required equipment

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

Removing

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

4.2.5 Checking for play in gearboxes and wrist

Checking for play

When checking for play in gearboxes the brakes must be disengaged. When trying to move an arm manually when the brakes are engaged, some play can be felt.

The play that can be felt is between the brake disk and the motor shaft, not in the gearbox itself. This is because the rotating brake disk is connected to the motor shaft by splines. This is why the brakes must be disengaged before testing for play in the gearboxes and wrist. The brakes are disengaged by pressing the enable button on the FlexPendant.

Note

The play in the brake disk does not affect the robot motion or accuracy.

4.3 Axis 1

4.3.1 Replacing the axis-1 motor

General

See foldouts 1 and 5 in chapter, Foldout.

The motor and the drive gear constitute one unit.

Removing

	Action	Note
1	Remove the cover of the motor.	
2	Loosen connectors R4.MP1 and R4.FB1.	
3	Remove the connection box by unscrewing.	See foldout/pos. <5/160>
	Note Note the position of the motor.	
4	Loosen the motor by unscrewing.	See foldout/pos. <1/10>

Refitting

	Action	Note
1	Check that the assembly surfaces are clean and the motor unscratched.	
2	Release the brake, apply 24V DC to terminals 7 and 8 in the 4.MP1 connector.	
3	Install the motor according to previously done markings, tighten screws.	See foldout/pos. <1/10>
4	Adjust the motor in relation to the gear in the gearbox.	
5	Screw the 3HAB 1201-1 crank tool into the end of the motor shaft.	
6	Make sure there is very small play by turning axis 1 at least 45o.	
7	Tighten screws using a torque of 8.3 Nm ±10%.	See foldout/pos. <1/10>
8	Connect the cabling.	
9	Calibrate the robot as specified.	Described in section: *Calibration information on page 121*

4.3.2 Replacing the axis-1 gearbox

General

Axis 1 gearbox is of the conventional type, manufactured with a high degree of precision and, together with the gearboxes for axes 2 and 3, forms a complete unit.

The gearbox is not normally serviced or adjusted. See foldout 1 in chapter, Foldout.

Note

If the gearbox on any of the axes 1, 2 or 3 is replaced, the whole unit must be replaced.

Removing

	Action	Note
1	Remove the motors on axes 1, 2 and 3.	Described in section: *Replacing the axis-1 motor on page 88*, *Replacing the axis-2 motor on page 93* and *Replacing the axis-3 motor on page 99*.
2	Remove the cabling and serial measurement board.	Described in section: *Replacing the serial measurement board (SMB) on page 112*
3	Remove the tie rod.	Described in section: *Replacing the tie rod on page 102*
4	Remove the parallel arm.	Described in section: *Replacing the parallel arm on page 101*
5	Remove the balancing springs.	Described in section: *Replacing the balancing springs on page 98*
6	Remove the upper arm.	Described in section: *Replacing the complete upper arm on page 103*
7	Remove the lower arm.	Described in section: *Replacing the lower arm on page 96*
8	Place the remaining parts of the manipulator upside-down on a table or similar surface, and remove the bottom plate.	See Figure 22, and foldout/pos. <1/5>.

Refitting

	Action	Note
1	Place a new gear unit on the table.	
2	Raise the base.	
3	Screw in the screws together with their washers.	See foldout/pos. <1/4> and <1/3>. Tighten using a torque of 68 Nm ±10%.
4	Refit the bottom plate using screws.	See foldout/pos. <1/5> and <1/7>
5	Turn the foot.	
6	Refit the lower arm.	Described in section: *Replacing the lower arm on page 96*

Continues on next page

4.3.2 Replacing the axis-1 gearbox
Continued

	Action	Note
7	Refit the parallel arm.	Described in section: *Replacing the parallel arm on page 101*
8	Refit the upper arm.	Described in section: *Replacing the complete upper arm on page 103*
9	Refit the cabling.	Described in section: *Replacing the axis-1, -2, and -3 cabling on page 113*
10	Refit the tie rod.	Described in section: *Replacing the tie rod on page 102*
11	Refit the balancingd springs.	Described in section: *Replacing the balancing springs on page 98*
12	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.3.3 Replacing the position indicator (Optional)

General

See foldouts 3 and 4 in chapter, Foldout.

Removing

	Action	Note
1	Remove the flange plate.	See foldout/pos. <4/138>
2	Loosen the connector R1.LS.	
3	Removing the two limit switches.	See foldout/pos. <3/174>
4	Loosen the cables from the switches.	
5	Remove the cabling through the base.	

Refitting

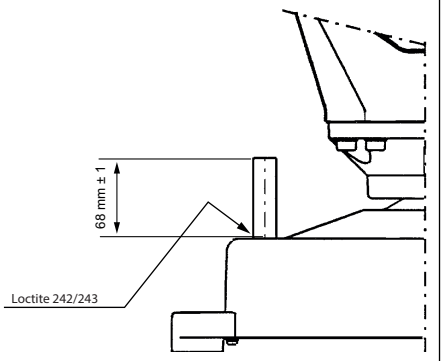
	Action	Note
1	Route the new cabling through the base.	
2	Connect the cables to the switches.	
3	Assemble the two limit switches.	See foldout/pos. <3/174>
4	Connect connector R1.LS.	
5	Assemble the flange plate.	See foldout/pos. <4/138>

4.3.4 Replacing the mechanical stop

General

If the stop pins are bent, they must be replaced. See foldout 1 in chapter, Foldout.

Replacement

	Action	Note
1	Remove the old stop pin.	
2	Fit the new pin according to the illustration.	

4.4 Axis 2

4.4.1 Replacing the axis-2 motor

General

See foldouts 1 and 5 in chapter, Foldout.

The motor and the drive gear constitute one unit.

Removing

WARNING

Lock the arm system before dismantling the motor; the brake is located in the motor.

	Action	Note
1	Remove the cover of the motor.	
2	Loosen connectors R3.MP2 and R3.FB2.	
3	Remove the connection box by unscrewing the screws.	See foldout/pos. <5/160>
4	Note the position of the motor before removing it.	
	Note The oil will start to run out when loosen the motor.	
5	Loosen the motor by unscrewing the motor screws.	See foldout/pos. <1/10>

Refitting

	Action	Note
1	Check that the assembly surfaces are clean and the motor unscratched.	
2	Release the brake, apply 24 V DC to terminals 7 and 8 on the R3.MP2 connector.	
3	Install the motor according to previously done markings, tighten screws.	See foldout/pos. <1/10> Torque, approximately 2 Nm.
4	Adjust the motor in relation to the drive in the gearbox.	
5	Screw the 3HAB 1201-1 crank tool into the end of the motor shaft.	
6	Make sure there is no play.	
7	Tighten screws.	See foldout/pos. <1/10> Torque 8.3 Nm ±10%
8	Fill with oil.	Described in section: *Type of lubrication in gearboxes on page 68*
9	Connect the cabling.	

Continues on next page

4.4.1 Replacing the axis-2 motor

Continued

	Action	Note
10	Calibrate the robot.	Described in section: *Calibration*

4.4.2 Replacing the axis-2 gearbox

General

Axis 2 gearbox is of a conventional type, manufactured with a high degree of precision and, together with the gearbox for axes 1 and 3, forms a complete unit. See foldout 1 in chapter, Foldout.

The gearbox is not normally serviced or adjusted.

> **Note**
>
> If the gearbox of any of the axes 1, 2 or 3 needs to be changed, the whole unit must be changed.

Replace

How to replace the gearbox is described in section *Replacing the axis-1 gearbox on page 89*

4.4.3 Replacing the lower arm

General

See foldouts 1 in chapter, Foldout.

Removing

	Action	Note
1	Remove the balancing springs.	Described in section: *Replacing the balancing springs on page 98*
2	Remove the cabling down to axis 1.	Described in section: *Replacing the axis-1, -2, and -3 cabling on page 113*
3	Remove the upper arm.	Described in section: *Replacing the complete upper arm on page 103*
4	Attach a hoist with lifting slings to the lower arm.	
5	Remove the parallel arm.	Described in section: *Replacing the parallel arm on page 101*
6	Loosen screws.	See foldout/pos. <1/13>
7	Remove the lower arm.	

Refitting

	Action	Note
1	Transfer the damping element and calibration marking to the new lower arm.	
2	Lift the lower arm into position.	
3	Fix the lower arm to gear 2 using screws <1/13> and tighten them to a torque of 68 Nm ±10%.	
	WARNING To prevent clicking during operation of the robot, grease the bearing seating of the parallel arm in the lower arm.	
4	Refit the parallel arm.	Described in section: *Replacing the parallel arm on page 101*
5	Refit the upper arm.	Described in section: *Replacing the complete upper arm on page 103*
6	Refit the balancing springs.	Described in section: *Replacing the balancing springs on page 98*
7	Refit the cabling.	Described in section: *Replacing the axis-1, -2, and -3 cabling on page 113*
8	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.4.4 Replacing the bearings in the upper arm

General

See foldouts 1 and 2 in chapter, Foldout.

Removing

	Action	Note
1	Loosen the upper bracket of the tie rod.	Described in section: *Replacing the tie rod on page 102*
2	Unscrew screws which hold the parallel arm to gear 3.	See foldout/pos. <1/13>
3	Remove the bearings from the parallel arm.	

Refitting

	Action	Note
1	Fit new bearings to the parallel arm.	
2	Replace the parallel arm using screws and tighten.	See foldout/pos. <1/13>. Torque of 68 Nm ±10%.
3	Attach the upper bracket of the tie rod as specified in.	Described in section: *Replacing the tie rod on page 102*
4	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.4.5 Replacing the balancing springs

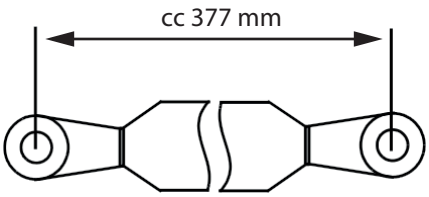
General

See foldout 1, in chapter, Foldout.

Removing

	Action	Note
1	Place the lower arm in a vertical position.	
2	Loosen the locking nut.	See foldout/pos. <1/76>
3	Release the spring using tool 3HAB 1214-6 and undo the screw at the same time.	See foldout/pos. <1/13>
	WARNING If the tool 3HAB 1214-6 is not available, but there are two persons, then the spring can be released manually.	
4	Unscrew the screw in the upper bracket of the spring.	See foldout/pos. <2/65>
5	Remove the springs.	

Refitting

	Action	Note
1	Before installing new springs, make sure that the distance between the attachment points is correct, see illustration.	 xx1300002637
2	Lock the link heads using Loctite 601.	
3	Lubricate the link heads with grease.	
4	Attach the springs to the top bracket using screws and tighten.	See foldout/pos. <2/65> Torque of 68 Nm ±10%.
5	Pull the springs down using tool 3HAB1214-6 and attach screws, together with lifting lug and washer.	
6	Attach the locking nut <1/76>.	

4.5 Axis 3

4.5.1 Replacing the axis-3 motor

General

See foldouts 1 and 5 in chapter, Foldout.

The motor and the drive gear constitute one unit.

Removing

	Action	Note
1	Remove the cover of the motor.	
2	Loosen connectors R5.MP3 and R5.FB3.	
3	Remove the connection box by unscrewing.	See foldout/pos. <5/160>
4	Note the position of the motor before removing it.	
	Note The oil will start to run out when loosing the motor.	
5	Loosen the motor by unscrewing the motor screws.	See foldout/pos. <1/10>

Refitting

	Action	Note
1	Check that the assembly surfaces are clean and the motor unscratched.	
2	Release the brake, apply 24V DC to terminals 7 and 8 in the 4.MP1 connector.	
3	Install the motor according to previously done markings, tighten screws.	See foldout/pos. <1/10> Torque, approximately 2 Nm
4	Adjust the motor in relation to the gear in the gearbox.	
5	Screw the 3HAB 1201-1 crank tool into the end of the motor shaft.	
6	Make sure there is no play.	
7	Tighten screws.	See foldout/pos. <1/10> Torque of 8.3 Nm ±10%.
8	Fill with oil	Described in section: *Type of lubrication in gearboxes on page 68*
9	Connect the cabling.	
10	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.5.2 Replacing the axis-3 gearbox

General

Axis 3's gearbox is of a conventional type, manufactured with a high degree of precision and, together with the gearbox for axes 1 and 2, forms a complete unit. See foldout 1 in chapter, Foldout.

The gearbox is not normally serviced or adjusted.

Note

If the gearbox of any of the axes 1, 2 or 3 needs to be changed, the whole unit must be changed.

Replace

How to replace the gearbox is described in section *Replacing the axis-1 gearbox on page 89*

4.5.3 Replacing the parallel arm

General

See foldout1 in chapter, Foldout.

Removing

	Action	Note
1	Loosen the upper bracket of the tie rod.	Described in section: *Replacing the tie rod on page 102*
2	Unscrew screws which fix the parallel arm to gear 3.	
3	Remove the bearings from the parallel arm.	See foldout/pos. <1/13>

Refitting

	Action	Note
1	Fit the bearings on the parallel arm.	
2	Replace the parallel arm using screws and tighten.	See foldout/pos. <1/13> Torque, 68 Nm ±10%.
3	Attach the upper bracket of the tie rod.	Described in section: *Replacing the tie rod on page 102*
4	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.5.4 Replacing the tie rod

General

See foldout 2 in chapter, Foldout.

Removing

	Action	Note
1	Lock the upper arm in a horizontal position with the help of a hoist and lifting slings.	
2	Unscrew screw.	See foldout/pos. <2/74>
3	Undo the two screws for fixing the cabling bracket of the upper arm housing.	
4	Fold back the cabling bracket.	
5	Screw the screw back into the shaft.	See foldout/pos. <2/74> and <2/71>
6	Carefully knock the shaft out.	
7	Remove housing.	See foldout/pos. <2/72>
8	Unscrew on the lower bracket.	See foldout/pos. <2/70>
9	Carefully tap the rod off the shaft.	

Refitting

	Action	Note
1	Fit bearings on the parallel arm.	
2	Make sure you replace the rod the correct way up.	
3	Install grommets: (3 x) and (1 x).	
	Note The grommet is bevelled and must be inserted the right way up in the lower bearing.	
4	Place the lower bearing of the tie rod on the parallel arm.	
5	Screw in the screw and its washer. Lock using Loctite 242 or 243.	
6	Replace shaft. **Note** Do not forget the sleeve <72>.	See foldout/pos. <1/71>
7	Mount washer <73> and tighten the shaft using a temporary screw, M8x35.	
8	Replace this screw by screw <74> and mount the cable bearer <163>.	
9	Lock using Loctite 242 or 243.	

4.5.5 Replacing the complete upper arm

General

See foldout 2 in chapter, Foldout.

Required equipment

Equipment	Art no.	Note
Measuring instrument	3HAB 1205-1	
Withdrawing tool for shaft spindles	3HAB 1259-1	

Removing

WARNING

Attach a hoist with lifting slings to the upper arm.

	Action	Note
1	Unscrew the upper bracket of the tie rod as specified in.	Described in section: *Replacing the tie rod on page 102*
2	Loosen the connectors of the motors of axes 4, 5 and 6.	
3	Disconnect the connection box from the motors.	
4	Detach the balancing springs.	Described in section: *Replacing the balancing springs on page 98*
5	Undo the KM nuts.	See foldout/pos. <2/64>
6	Remove washers and shims on the same side as axis 3.	See foldout/pos. <2/61, 2/62> and <2/63>.
7	Attach the withdrawing tool 3HAB 1259-1 to the shaft spindle, and pull off.	See foldout/pos. <2/59>.
8	Repeat the step 6, 7 and 8 on axis 2 side.	

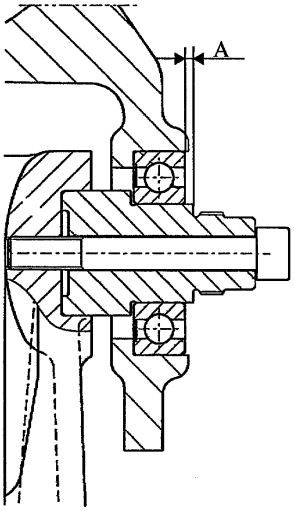
Refitting

	Action	Note
1	Raise the upper arm into assembly position.	
2	Install shaft spindles (both sides), use two temporary screws M10x90.	See foldout/pos. <2/59>
3	Insert bearings (both sides) using tool 3HAB1200-1 and screws.	See foldout/pos. <2/60> and <2/65>.
4	Detach the tool and tighten the screws once more, only to prevent rotation of the axis when the KM nut is tightened.	Tool no.3HAB 1259-1
	Note Assemble the same side as axis 2 first.	

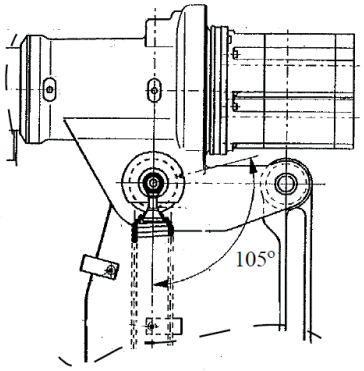
Continues on next page

4.5.5 Replacing the complete upper arm

Continued

	Action	Note
5	Mount two washers and calibration washer.	See foldout/pos. <2/63> and <2/50>
6	Tighten using the KM nut.	See foldout/pos. <2/64>
7	Attach the measuring instrument 3HAB 1205-1 to the shaft spindle on axis 3.	
	Note If measuring instrument is not available, you can use a micrometer thickness gauge.	
8	Hold the tool against the shoulder of the shaft spindle and measure the dimension “A”. See illustration.	 xx1300002642
9	(If you are not using the measuring instrument, tighten using the KM nut and, before measuring with the micrometer thickness gauge, then undo it again.)	
10	Make a note of the dimension “A”. Fit one washer and shims , and using the micrometer, measure the thickness so that the total thickness is 0.10 - 0.20 mm more than the noted dimension “A”. This will result in a preloading of the bearing of 0.10 - 0.20 mm.	See foldout/pos. <2/63>, <2/61> and <2/62>
11	Fit the shims and washer and tighten the KM nut.	See foldout/pos. <2/64>
12	Replace the upper attachment of the tie rod as specified in.	Described in section: *Replacing the tie rod on page 102*
13	Replace the balancing springs.	Described in section: *Replacing the balancing springs on page 98*
14	Reconnect the connection boxes and the cabling.	
15	Calibrate the robot.	Described in section: *Calibration*
16	Undo the KM-nut on the axis 2 side, just to be able to adjust the calibration washer.	See foldout/pos. <2/50>

Continues on next page

	Action	Note
17	If the old arm house is mounted: • Adjust the calibration washer according to the punch mark. If the arm house is new: • Adjust the washer according to illustration and make new punch marks for axes 3 and 4.	 xx1300002643

4.6 Axis 4

4.6.1 Replacing the axis-4 motor

General

See foldouts 5 and 8 in chapter, Foldout.

The motor and the drive gear constitute one unit.

Position the arm system in such a way that the motor of axis 4 points upwards.

Removing

	Action	Note
1	Remove the cover of the motor.	
2	Loosen connectors R3.MP4 and R3.FB4.	
3	Remove the connection box by unscrewing the screw.	See foldout/pos. <5/160>
	Note Note the position of the motor before removing it.	
4	Loosen the motor by unscrewing the screw.	See foldout/pos. <8/23>

Refitting

	Action	Note
1	Check that the assembly surfaces are clean and the motor unscratched.	
2	Put O-ring on the motor.	See foldout/pos. <8/21>
3	Release the brake, and apply 24 V DC to terminals 7 and 8 on the R3.MP4 connector.	
4	Install the motor according to previously done markings, tighten screws.	See foldout/pos. <8/23> Torque, approximately 2 Nm
5	Adjust the position of the motor in relation to the drive in the gearbox.	
6	Screw the crank tool into the end of the motor shaft.	Tool no. 3HAB 1201-1
7	Make sure there is a small clearance.	
8	Unscrew one screw at a time, apply Loctite 242 or 243 and tighten.	Torque, 4.1 Nm ±10%.
9	Reconnect the cabling.	
10	Calibrate the robot.	Described in section: *Calibration*

4.6.2 Replacing the intermediate gear including sealing

General

See foldout 8 in chapter, Foldout.

Removing

	Action	Note
1	Remove the wrist.	Described in section: *Replacing the wrist on page 116*
2	Remove the drive mechanism.	Described in section: *Replacing the wrist on page 116*
3	Remove the motor of axis 4.	Described in section: *Replacing the axis-4 motor on page 106*
4	Remove the cover.	See foldout/pos. <8/25>.
5	Undo screws fixing the large drive gear and dismantle it.	See foldout/pos. <8/18> and <8/17>.
6	**Note** Put the shims in a safe place.	
7	Undo screws.	See foldout/pos. <8/12>.
8	Push the intermediate gear out of the arm housing.	

Refitting

	Action	Note
1	Grease the seating of the arm housing to provide radial sealing.	
2	Push the gear unit down into the arm housing.	
3	Screw in screws together with their washers and pull the gear down.	See foldout/pos. <8/12> and <8/13>
4	Mount the drive gear <17> using screws <18> and tighten to a torque of 8.3 Nm ±10%.	
	Note Do not forget to insert shims under the drive gear.	See foldout/pos. <8/14, 8/15 and 8/16>
5	Tighten the screws.	See foldout/pos. <8/12>. Torque, approximately 5 Nm.
6	Bend the pinion towards the large drive gear, and then rotate it around the tubular shaft a couple of times so that the clearance in the gears can adjust itself in relation to the highest point of the large drive gear.	
7	Then tighten the screws.	See foldout/pos. <8/12>. Torque, 20 Nm ±10%.

Continues on next page

4.6.2 Replacing the intermediate gear including sealing

Continued

	Action	Note
8	Check the clearance in relation to the tightening torque.	
9	Replace the cover using screws. Use a drop of Loctite 242 or 243.	See foldout/pos. <8/25> and <8/26>.
10	Position the manipulator so that the tubular shaft points upwards.	
11	Fill oil into axis-4 gear.	Described in section: *Type of lubrication in gearboxes on page 68*
12	Install the axis-4 motor.	Described in section: *Replacing the axis-4 motor on page 106*
13	Install drive mechanism.	See foldout/pos. <8/28>. Described in section: *Replacing the wrist on page 116*
14	Replace the wrist in accordance with.	Described in section: *Replacing the wrist on page 116*
15	Calibrate the robot as specified in .	Described in section: *Calibration information on page 121*

4.6.3 Replacing the drive gear on the tubular shaft

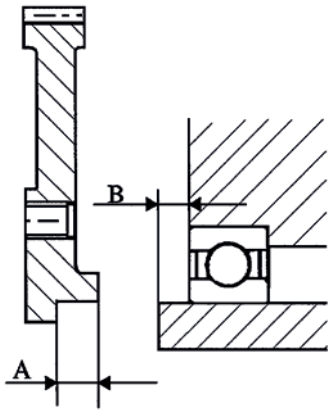
General

See foldout 8 in chapter, Foldout.

Removing

	Action	Note
1	Remove the wrist.	Described in section: xx
2	Remove the drive mechanism in accordance with.	Described in section: xx
3	Remove the axis-4 motor as specified in.	Described in section: *Replacing the axis-4 motor on page 106*
4	Remove the cover.	See foldout/pos. <8/25>.
5	Unscrew screws that hold the intermediate gear in place.	See foldout/pos. <8/12>.
6	Unscrew screws that hold the large drive gear and then dismantle it.	See foldout/pos. <8/18> and <8/17>.
7		
	Note Put the shims from under the drive gear in a safe place.	

Refitting

	Action	Note
1	Shim between drive gear and the rear bearing.	See foldout/pos. <8/17> and <8/3>.  xx1300002638 Shim thickness = B - A + 0.05 mm, see Figure 27.
2	Install the drive gear using screws	See foldout/pos. <8/18> (screws). Torque, 8.3 Nm ±10%.
3	**Note** Do not forget the shims.	

Continues on next page

4.6.3 Replacing the drive gear on the tubular shaft

Continued

	Action	Note
4	Screw the screw and 2 washers into the drive gear. Lock using Loctite 242 or 243.	See foldout/pos. <8/19> and <8/20>.
5	Mount the intermediate gear.	Described in section: *Replacing the intermediate gear including sealing on page 107*
6	Lubricate the drive gear with grease (30 g).	
7	Install the axis-4 motor.	Described in section: *Replacing the axis-4 motor on page 106*
8	Replace the cover using screws. Lock using a drop of Loctite 242 or 243.	See foldout/pos. <8/25> and <8/26>.
9	Mount the drive mechanism.	Described in section: *Replacing the complete axis-5 and axis-6 drive mechanism on page 117*
10	Mount the wrist.	Described in section: *Replacing the wrist on page 116*
11	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.6.4 Dismantling the tubular shaft and changing bearings

General

See foldout 8 in chapter, Foldout.

Removing

	Action	Note
1	Remove the drive gear.	Described in section: *Replacing the drive gear on the tubular shaft on page 109*
2	Push out the tubular shaft.	

Refitting

	Action	Note
1	Fit a new bearing on the tubular shaft using the tool.	See foldout/pos. <8/3> Tool no. 6896 134-V.
2	Push the tube into the housing of the upper arm.	
3	Insert the rear bearing using the tool.	See foldout/pos. <8/3> Tool no. 6896 134-JB
4	Mount the drive gear.	Described in section: *Replacing the drive gear on the tubular shaft on page 109*
5	Calibrate the robot.	Described in section: *Calibration information on page 121*

4.7 Cabling and serial measurement board

4.7.1 Replacing the serial measurement board (SMB)

General

See foldout 4 in chapter, Foldout.

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

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

Removing

	Action	Note
1	Remove flange plate.  **CAUTION** Clean cover from metal residues before opening. Metal residues can cause shortage on the boards which can result in hazardous failures.	See foldout/pos. <4/138>.
2	Cut tie around bundle.	See foldout/pos. <4/144>.
3	Unscrew the serial measuring board using screws.	See foldout/pos. <4/135> and <4/7>.
4	Remove the board and loosen the connectors	

Refitting

	Action	Note
1	Fit the new serial measurement board.	
2	Reconnect connectors.	
3	Fit new cable ties around the bundle.	
4	Refit the flange plate.	

4.7.2 Replacing the axis-1, -2, and -3 cabling

General

See foldouts 3 and 4 in chapter, Foldout.

Removing

	Action	Note
1	Remove the cover of the motors.	
2	Remove the flange plate.	See foldout/pos. <4/138>
3	Loosen connectors R1.MP, R2.FB1-3.	
4	Cut tie around bundle and detach the cable brackets.	
5	Detach the cable guides and undo screws.	See foldout/pos. <3/104 and 105> (cable guides). See foldout/pos. <3/149> (screw).
6	Loosen the connectors in the motors.	
7	Disconnect the connection boxes in the motors.	
8	Feed the cabling up through the middle of axis 1.	

Refitting

	Action	Note
1	Feed the new cabling down through the middle of axis 1.	
2	Connect the connection boxes in the motors.	
3	Reconnect the connectors in the motors.	
4	Attach the cable guides and fasten screws.	
5	Fit new cables tie around bundle and attach the cable brackets.	
6	Reconnect connectors R1.MP, R2.FB1-3.	
7	Refit the flange plate.	
8	Refit the cover of the motors.	

4.7.3 Replacing the axis-4, -5, and -6 cabling

General

See foldouts 2, 3 and 4 in chapter, Foldout.

Removing

	Action	Note
1	Remove the cover of the motors.	
2	Remove the flange plate.	See foldout/pos. <4/138>.
3	Loosen connectors R2.MP4-6 and R2.FB4-6, including customer connector R1.CS (if there is one) and the air hose.	
4	Detach the cable guides.	See foldout/pos. <3/104, 105>.
5	Loosen the cable brackets between gears 2 and 3 and cut the tie around them.	See foldout/pos. <3/149>.
6	Feed the cabling and air hose up through axis 1.	
7	Loosen the cable bracket on the lower arm and undo screws.	See foldout/pos. <3/147>.
8	Undo screw which fixes the shaft of the tie rod.	See foldout/pos. <2/74>.
9	Disconnect the connection boxes in the motors.	
10	Loosen the remaining cable brackets and remove the cabling.	

Refitting

	Action	Note
1	Refit in reverse order.	

4.8 The wrist, axis 5, and axis 6

4.8.1 Introduction

General

The wrist, which includes axes 5 and 6, is a complete unit, comprising drive units and gears. It is of such a complex design that it is not normally serviced on-site, but should be sent to ABB to be serviced.

4.8.2 Replacing the wrist

Removing

	Action	Note
1	Remove the 2 plastic plugs on the rear of the wrist.	
2	Release the brake in axes 5 and 6.	
3	Rotate axes 5 and 6 so that you can see screws in the clamping sleeve through the hole.	See foldout/pos. <9/15>
4	Disconnect the clamping sleeve.	
5	Undo screws and remove the wrist.	See foldout/pos. <1/53>

Refitting

	Action	Note
1	Mount the wrist, tighten screws.	See foldout/pos. <1/53> Torque, 8.3 Nm ±10%.
	Note The grease nipple on the tilt house should point towards the base.	
2	Screw the clamping sleeves together using screws.	See foldout/pos. <9/15>.
3	Replace the plastic plugs.	
4	Calibrate the robot.	Described in section: *Calibration.*

4.8.3 Replacing the complete axis-5 and axis-6 drive mechanism

General

See foldouts 8 and 9 in chapter, Foldout.

Removing

	Action	Note
1	Dismantle the wrist.	Described in section: *Replacing the wrist on page 116*
2	Loosen the connectors on the motors of axes-5 and -6.	
3	Undo screws.	See foldout/pos. <8/29>
4	Squeeze the drive shafts together at the tip of the tubular shaft, in order that they can pass through the tube.	See foldout/pos. <9/1>
5	Pull out the complete axes-5 and -6 drive mechanism.	

Refitting

	Action	Note
1	Install the drive mechanism in the tubular shaft.	
2	Tighten screws.	See foldout/pos. <8/29> Torque, 8.3 Nm ±10%
3	Insert the cabling.	
4	Mount the wrist.	Described in section: *Replacing the wrist on page 116*

4.8.4 Changing the axis-5 and axis-6 motor or driving belt

General

See foldout 9 in chapter, Foldout.

Removing

	Action	Note
1	Dismantle the wrist.	Described in section: *Replacing the wrist on page 116*
2	Dismantle the drive mechanism.	Described in section: *Replacing the complete axis-5 and axis-6 drive mechanism on page 117*
3	Undo screws and remove the motor.	See foldout/pos. <9/9>
4	If the driving belt is to be changed, both motors must be removed.	
5	Undo screws and remove plate.	See foldout/pos. <9/9> and <9/7>.

Refitting

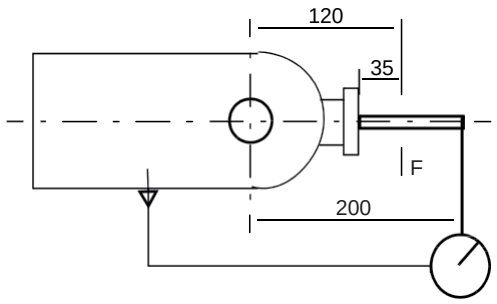
	Action	Note
1	Install the driving belts.	
2	Mount the plate using screws.	See foldout/pos. <9/7> and <9/9>
	Note Do not forget the nuts of the motors.	
3	Install the motors.	
4	Push the motors in sideways to tension the belts using the tool, and tighten screws.	See foldout/pos. <9/9> Tool no. 3HAA 7601-050 Torque, 4.1 Nm.
5	Install the drive mechanism.	Described in section: *Replacing the complete axis-5 and axis-6 drive mechanism on page 117*
6	Mount the wrist.	Described in section: *Replacing the wrist on page 116*
7	Calibrate the robot.	Described in section: *Calibration*

4.8.5 Measuring the play in axis-5 and axis-6

Axis-5

Axis 4 shall be turned 90o. The maximum accepted play in axis 5 is 4.7 arc. minutes when loading axis 5 with a moment of 4.8 Nm in one direction, unloading to 0.24 Nm and start measuring the play, loading in the other direction with 4.8 Nm unloading to 0.24 Nm and reading the play. This correspond to play of 0.27 mm on a radius of 200 mm when the load is F=40

N and 2 N on radius 120 mm. See illustration.



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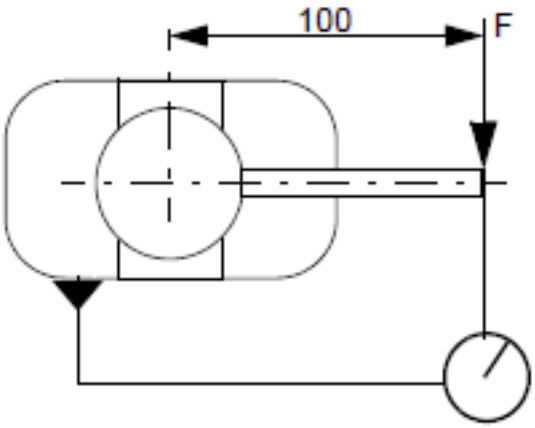
Axis-6

The maximum accepted play in axis 6 is 12.8 arc.minutes when loading axis 6 with a moment of 4.2 Nm in one direction, unloading to 0.2 Nm and start measuring the play, loading in the other direction with 4.2 Nm unloading to 0.2 Nm and reading the play.

This correspond to a play of 0.37 mm on a radius of 100 mm when the load is F=42 N and 2 N. See illustration.



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4.9 Motor units

4.9.1 Introduction

General

Each axis (6 axes) of the manipulator has its own motor unit, and is regarded as one complete

unit, comprising:

- A synchronous motor
- A brake (built into the motor)
- A feedback device.

Description

The power and signal cables are run to the respective motor from the cable connector points on the manipulator. The cables are connected to the motor units by connectors.

The drive shaft of the electric motor forms a part of the gearbox of the manipulator axis. A brake, operated electromagnetically, is mounted on the rear end of the motor shaft and a pinion is mounted on its drive end. The brake releases when power is supplied to the electromagnets.

The commutation value of the motors is: 1.570800.

Note

There is a feedback device mounted on each motor unit. The device is installed by the supplier of the motor and should never be removed from the motor. The motor need never be commutated.

5 Calibration information

5.1 When to calibrate

When to calibrate

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

The resolver values are changed

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

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

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

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See *Updating revolution counters on page 127*. This will occur when:

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

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

The robot is rebuilt

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

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

5.2 Calibration methods

Overview

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

Types of calibration

Type of calibration	Description	Calibration method
Standard calibration	The calibrated robot is positioned at calibration position. Standard calibration data is found on the SMB (serial measurement board) or EIB in the robot. For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.	Calibration Pendulum Levelmeter calibration (alternative method)
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the SMB (serial measurement board) in the robot. For robots with RobotWare 5.05 or older, the absolute accuracy calibration data is delivered in a file, absacc.cfg, supplied with the robot at delivery. The file replaces the calib.cfg file and identifies motor positions as well as absolute accuracy compensation parameters. A robot calibrated with Absolute accuracy has a sticker next to the identification plate of the robot. To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.  xx0400001197	CalibWare
Optimization	Optimization of TCP reorientation performance. The purpose is to improve reorientation accuracy for continuous processes like welding and gluing. Wrist optimization will update standard calibration data for axes 4 and 5.	Wrist Optimization

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.

Wrist Optimization method

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

The following routines are available for the Wrist Optimization method:

- Wrist Optimization

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

Levelmeter calibration - alternative method

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

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

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

CalibWare - Absolute Accuracy calibration

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

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

References

Article numbers for the calibration tools are listed in the section *Special tools on page 144*.

Continues on next page

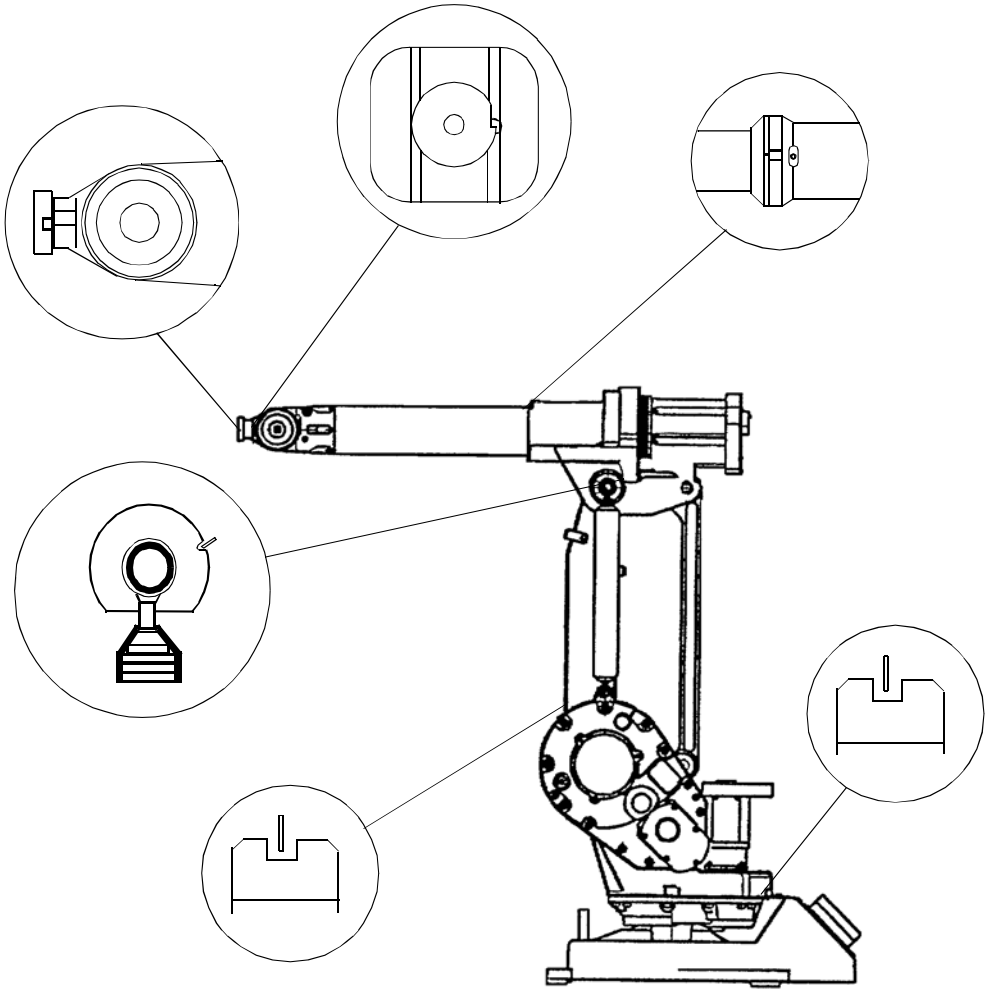
The calibration equipment for Calibration Pendulum is delivered as a complete toolkit, including the *Operating manual - Calibration Pendulum*, which describes the method and the different routines further.

5.3 Synchronization marks and synchronization position for axes

Introduction

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

Synchronization marks, IRB 1410



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5.4 Calibration movement directions for all axes

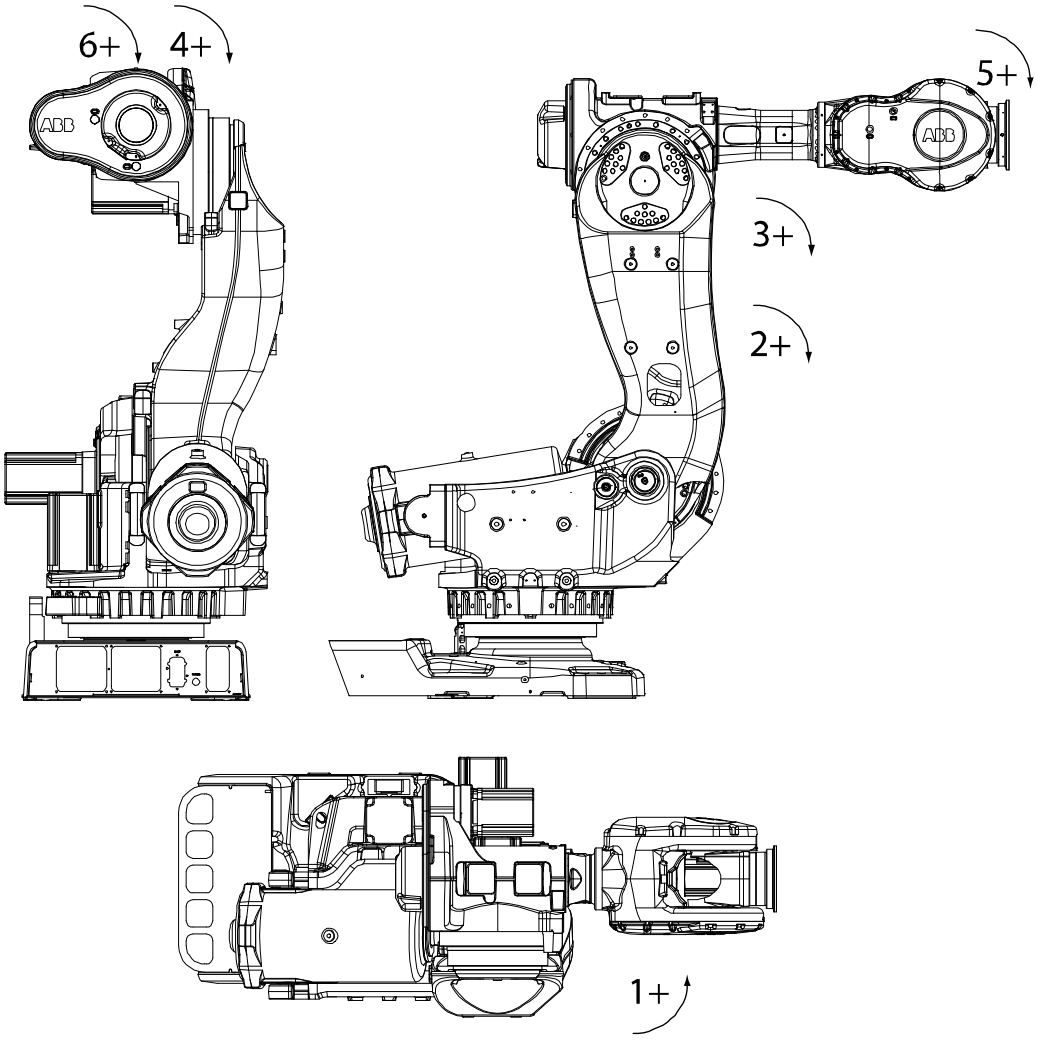
Overview

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

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

Manual movement directions, 6 axes

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



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5.5 Updating revolution counters

Introduction

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

Coupled axes

When updating the revolution counters for a coupled axis, also the axis it is coupled to needs to be at its synchronization position for the update to be correct; i.e. axis 4 needs to be in synchronization position when updating axis 5 and 6.

With reversed coupled joints, the relationship is the opposite, i.e. axis 4 needs to be in synchronization position to update axis 3.

Coupled axes	IRB 140	IRB 1410	IRB 1520	IRB 1600	IRB 1600ID	IRB 1660ID	IRB 910 SC	IRB 2400	IRB 2600	IRB 2600ID	IRB 4400	IRB 4450S	IRB 4600
Axis 4, 5, 6	x			x				x	x		x	x	x
Axis 5, 6		x	x		x	x				x			
Axis 4, 3							x						

Step 1 - Manually running the manipulator to the synchronization position

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

	Action	Note
1	Select axis-by-axis motion mode.	
2	Jog the manipulator to align the synchronization marks. IRB 140, 1400, 2400, 4400, 6600ID/6650ID, 6640ID: Axes 5 and 6 must be positioned together!	See *Synchronization marks and synchronization position for axes on page 125*.
3	When all axes are positioned, update the revolution counter.	*Step 2 - Updating the revolution counter with the FlexPendant on page 128*.

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.

Continues on next page

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:

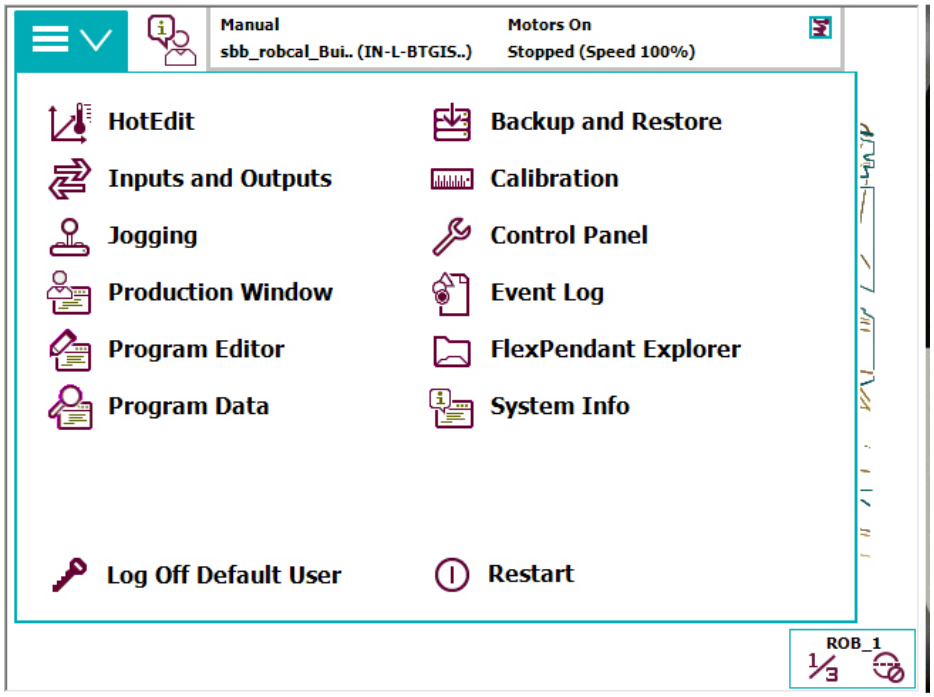
Manipulator variant	Axis 4	Axis 6
IRB 1410	No	No

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).

Step 2 - Updating the revolution counter with the FlexPendant

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

	Action
1	On the **ABB** menu, tap **Calibration**.



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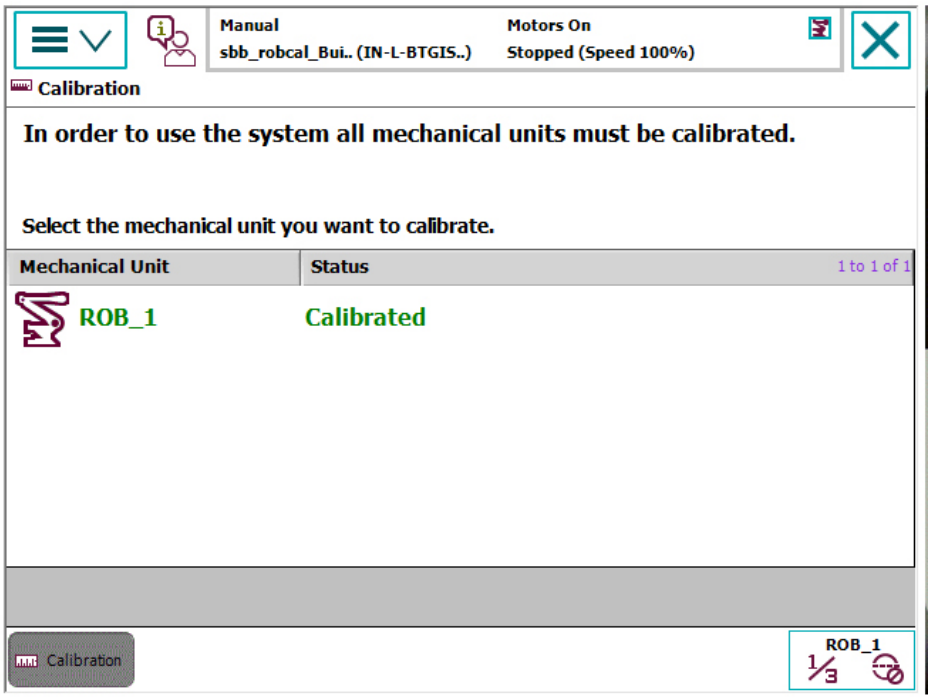
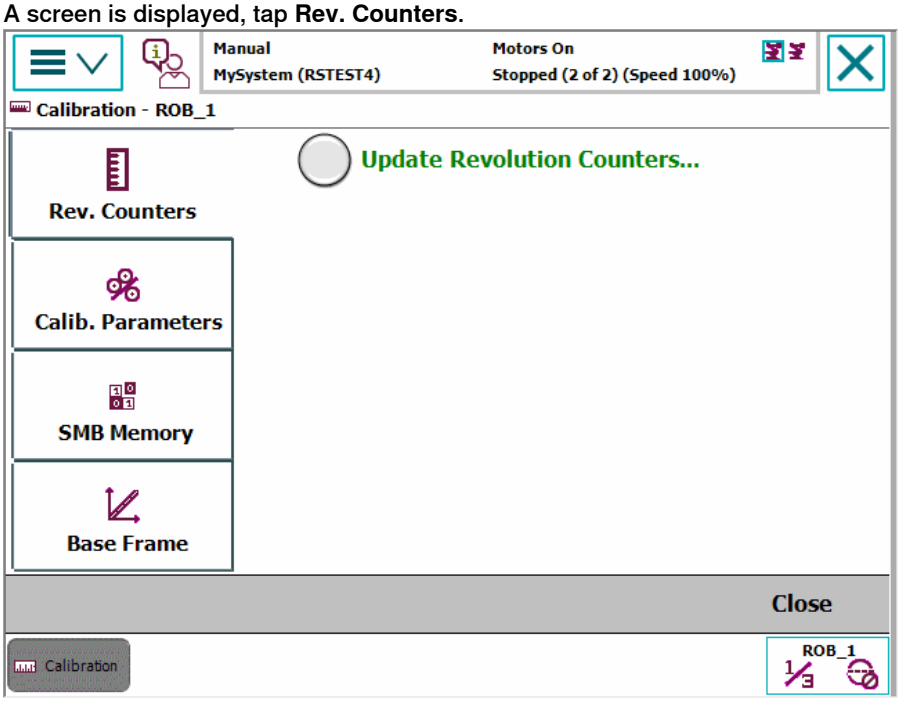
	Action
2	All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.  xx1500000943
3	A screen is displayed, tap **Rev. Counters**.  en0400000771

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5.5 Updating revolution counters
Continued

	Action
4	Tap **Update Revolution Counters...**. A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: • Tap **Yes** to update the revolution counters. • Tap **No** to cancel updating the revolution counters. Tapping **Yes** displays the axis selection window.
5	Select the axis to have its revolution counter updated by: • Ticking in the box to the left • Tapping **Select all** to update all axes. Then tap **Update**.
6	A dialog box is displayed, warning that the updating operation cannot be undone: • Tap **Update** to proceed with updating the revolution counters. • Tap **Cancel** to cancel updating the revolution counters. Tapping **Update** updates the selected revolution counters and removes the tick from the list of axes.
7	**CAUTION** If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury! Check the synchronization position very carefully after each update. See *Checking the synchronization position on page 131*.

5.6 Checking the synchronization position

Introduction

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

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

Using a `MoveAbsJ` instruction

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

	Action	Note
1	On ABB menu tap **Program editor**.	
2	Create a new program.	
3	Use **MoveAbsJ** in the **Motion&Proc** menu.	

4	Create the following program:
	`MoveAbsJ [[0,0,0,0,0,0],`
	`[9E9,9E9,9E9,9E9,9E9,9E9]]`
	`\NoEOffs, v1000, fine, tool0`	

5	Run the program in manual mode.	
6	Check that the synchronization marks for the axes align correctly. If they do not, update the revolution counters.	See *Synchronization marks and synchronization position for axes on page 125* and *Updating revolution counters on page 127*.

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 125* and *Updating revolution counters on page 127*.

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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

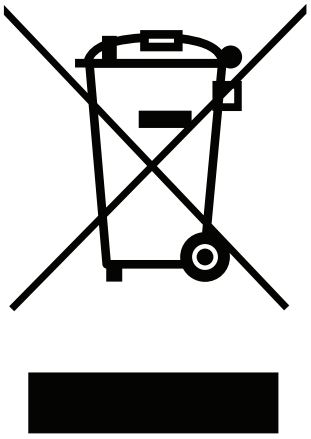
All used grease/oils and dead batteries **must** be disposed of in accordance with the current legislation of the country in which the robot and the control unit are installed.

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.

6.2 Environmental information

Symbol

The following symbol indicates that the product must not be disposed of as common garbage. Handle each product according to local regulations for the respective content (see table below).



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Hazardous material

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

Dispose components properly according to local regulations to prevent health or environmental hazards.

Material	Example application
Batteries, 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, sync. 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.

7 Reference information

7.1 Introduction

General

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

7.2 Applicable standards

Standards, EN ISO

The manipulator system is designed in accordance with the requirements of:

Standard	Description
EN ISO 10218-1:2011	Robots for industrial environments – Safety requirements
EN ISO 12100:2010	Safety of machinery – General principles for design - Risk assessment and risk reduction
EN ISO 13849-1:2008	Safety of machinery – Safety-related parts of control systems
EN ISO 13850:2008	Safety of machinery – Emergency stop - Principles for design
EN ISO 13857:2008	Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs
EN ISO 60204-1:2008	Safety of machinery – Electrical equipment of machines
EN 349	Safety of machinery – Minimum gaps to avoid crushing of parts of the human body
EN 614-1	Safety of machinery, ergonomic design principles

Note

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

General

The product is designed in accordance with EN ISO 10218-1, Robots for industrial environments - Safety requirements -Part 1 Robot. If there are deviations, these are listed in the declaration of incorporation which is included on delivery.

Standards, EN ISO

The product is designed in accordance with selected parts of:

Standard	Description
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1:2015	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
ISO 9283:1998	Manipulating industrial robots, performance criteria, and related test methods
EN ISO 14644-1:2015 [i]	Classification of air cleanliness
EN ISO 13732-1:2008	Ergonomics of the thermal environment - Part 1

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Standard	Description
EN 61000-6-4:2007 + A1:2011 IEC 61000-6-4:2006 + A1:2010 (option 129-1)	EMC, Generic emission
EN 61000-6-2:2005 IEC 61000-6-2:2005	EMC, Generic immunity
EN IEC 60974-1:2012 [ii]	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10:2014 [ii]	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1:2016	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529:1989 + A2:2013	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

The product is designed in accordance with selected parts of:

Standard	Description
EN 614-1:2006 + A1:2009	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574:1996 + A1:2008	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design

UL, ANSI, and 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

7.3 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 ABB robots.

The instructions and torque values are valid for screw joints comprised of metallic materials and do *not* apply to soft or brittle materials.

UNBRAKO screws

UNBRAKO is a special type of screw recommended by ABB for certain screw joints. It features special surface treatment (Gleitmo as described below) and is extremely resistant to fatigue.

Whenever used, this is specified in the instructions, and in such cases, *no other type of replacement screw* is allowed. Using other types of screws will void any warranty and may potentially cause serious damage or injury.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

When handling screws treated with Gleitmo, protective gloves of **nitrile rubber** type should be used.

Screws lubricated in other ways

Screws lubricated with Molycote 1000 should *only* be used when specified in the repair, maintenance or installation procedure descriptions.

In such cases, proceed as follows:

1. Apply lubricant to the screw thread.
2. Apply lubricant between the plain washer and screw head.
3. Screw dimensions of M8 or larger must be tightened with a torque wrench. Screw dimensions of M6 or smaller may be tightened without a torque wrench *if* this is done by trained and qualified personnel.

Lubricant	Article number
Molycote 1000 (molybdenum disulphide grease)	3HAC042472-001

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard torques** are specified in the following tables. Any **special torques** are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct tightening torque* for each type of screw joint.
- Only use *correctly calibrated* torque keys.

Continues on next page

- Always *tighten the joint by hand,* and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not* jerk. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is **10%**!

Oil-lubricated screws with slotted or cross-recess head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *slotted or cross-recess head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 8.8, oil-lubricated	Tightening torque (Nm) Class 10.9, oil-lubricated	Tightening torque (Nm) Class 12.9, oil-lubricated
M5	6	-	-
M6	10	-	-
M8	24	34	40
M10	47	67	80
M12	82	115	140
M16	200	290	340
M20	400	560	670
M24	680	960	1150

Lubricated screws (Molycote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for *screws lubricated with Molycote 1000, Gleitmo 603 or equivalent* with *allen head screws.*

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M8	28	35

Continues on next page

Dimension	Tightening torque (Nm) Class 10.9, lubricated [i]	Tightening torque (Nm) Class 12.9, lubricated [i]
M10	55	70
M12	96	120
M16	235	280
M20	460	550
M24	790	950

i Lubricated with Molycote 1000, Gleitmo 603 or equivalent

Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one* or *both* connectors are made of *brass*.

Note

A special torque specified in the repair, maintenance or installation procedure overrides the standard torque.

Dimension	Tightening torque Nm - Nominal	Tightening torque Nm - Min.	Tightening torque Nm - Max.
1/8	12	8	15
1/4	15	10	20
3/8	20	15	25
1/2	40	30	50
3/4	70	55	90

7.5 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 arm weighs 25 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.

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 143*, and of special tools, listed directly in the instructions and also gathered in this section.

Calibration equipment, Levelmeter (alternative method)

The table below specifies the calibration equipment required when calibrating the robot with the alternative method, Levelmeter Calibration.

Description	Art. no.	Note
Angle bracket	68080011-LP	
Calibration bracket	3HAC13908-9	
Calibration tool ax1	3HAC13908-4	
Levelmeter 2000 kit	6369901-347	Includes one sensor.
Measuring pin	3HAC13908-5	
Sensor fixture	68080011-GM	
Sensor plate	3HAC0392-1	
Sync. adapter	3HAC13908-1	
Turn disk fixture	3HAC68080011-GU	

Calibration equipment, Calibration Pendulum

The table below specifies the calibration equipment needed when calibrating the robot with the Calibration Pendulum method.

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

7.8 Lifting equipment and lifting instructions

General

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

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

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

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8 Spare part list

8.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document for registered users on myABB Business Portal, *www.myportal.abb.com*.

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9 Circuit diagram

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but are available for registered users on myABB Business Portal, *www.myportal.abb.com*.

See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
Circuit diagram - IRC5	*3HAC024480-011*
Circuit diagram - IRC5 Compact	*3HAC049406-003*
Circuit diagram - IRC5 Panel Mounted Controller	*3HAC026871-020*
Circuit diagram - Euromap	*3HAC024120-004*
Circuit diagram - Spot welding cabinet	*3HAC057185-001*

Robots

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 120	*3HAC031408-003*
Circuit diagram - IRB 140 type C	*3HAC6816-3*
Circuit diagram - IRB 260	*3HAC025611-001*
Circuit diagram - IRB 360	*3HAC028647-009*
Circuit diagram - IRB 460	*3HAC036446-005*
Circuit diagram - IRB 660	*3HAC025691-001*
Circuit diagram - IRB 760	*3HAC025691-001*
Circuit diagram - IRB 1200	*3HAC046307-003*
Circuit diagram - IRB 1410	*3HAC2800-3*
Circuit diagram - IRB 1600/1660	*3HAC021351-003*
Circuit diagram - IRB 1520	*3HAC039498-007*
Circuit diagram - IRB 2400	*3HAC6670-3*
Circuit diagram - IRB 2600	*3HAC029570-007*
Circuit diagram - IRB 4400/4450S	*3HAC9821-1*
Circuit diagram - IRB 4600	*3HAC029038-003*
Circuit diagram - IRB 6620	*3HAC025090-001*
Circuit diagram - IRB 6620 / IRB 6620LX	*3HAC025090-001*
Circuit diagram - IRB 6640	*3HAC025744-001*
Circuit diagram - IRB 6650S	*3HAC13347-1* *3HAC025744-001*

Continues on next page

9.1 Circuit diagrams
Continued

Product	Article numbers for circuit diagrams
Circuit diagram - IRB 6660	*3HAC025744-001* *3HAC029940-001*
Circuit diagram - IRB 6700 / IRB 6790	*3HAC043446-005*
Circuit diagram - IRB 7600	*3HAC13347-1* *3HAC025744-001*
Circuit diagram - IRB 14000	*3HAC050778-003*
Circuit diagram - IRB 910SC	*3HAC056159-002*

Index

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