ROBOTICS

Product specification

IRB 660

Trace back information:
Workspace 26B version a3
Checked in 2026-06-01
Skribenta version 5.6.019

Product specification

IRB 660-180/3.15
IRB 660-250/3.15

IRC5

Document ID: 3HAC023932-001

Revision: AB

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Overview of this specification

About this product specification

This product specification describes the performance of the manipulator or a complete family of manipulators in terms of:

- The structure and dimensional prints
- The fulfilment of standards, safety, and operating equipment
- The load diagrams, mounting or extra equipment, the motion, and the robot reach
- The specification of available variants and options

The specification covers the manipulator using the IRC5 controller.

Usage

Product specifications are used to find data and performance about the product, for example to decide which product to buy. How to handle the product is described in the product manual.

The specification is intended for:

- Product managers and product personnel
- Sales and marketing personnel
- Order and customer service personnel
- Integrators and customers

References

Reference	Document ID
Product manual - IRB 660	*3HAC025755-001*
Product specification - Controller IRC5 IRC5 with main computer DSQC1000.	*3HAC047400-001*
Product specification - Controller software IRC5 IRC5 with main computer DSQC1000 and RobotWare 5.6x.	*3HAC050945-001*
Product specification - Controller software IRC5 IRC5 with main computer DSQC1000 and RobotWare 6.	*3HAC050945-001*
Product specification - Robot user documentation, IRC5 with RobotWare 6	*3HAC052355-001*
Product specification - Robot stopping distances according to ISO 10218-1	*3HAC048645-001*

Revisions

Revision	Description
-	- New Product specification
A	- General corrections
B	- Changes in Figure 3 and Figure 16.

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Continued

Revision	Description
C	- Update Customer connections- Interbus removed - Footnote added to “Pose accuracy” - Stock Warranty
D	- Changes in chapter Standards - Directions of forces - Warranty information for Load diagrams
E	- Position switches removed.
F	- Work range - Explanation of ISO values (new figure and table) - Stopping distance - User documentation on DVD
G	- General update for 9.1 release
H	- Text for Standards updated
J	- Tightening torque adjusted
K	• Table for ambient temperature adjusted • New picture of tool flange • Minor corrections of foundation forces
L	• Machinery directive updated • Minor corrections
M	• Base plate drawing updated
N	• Minor corrections/update
P	• Text for ISO test adjusted
Q	• Minor corrections/update
R	Published in release R17.1. The following updates are done in this revision: • Axis Calibration method added • Restriction of load diagram added.
S	Published in release R17.2. The following updates are done in this revision: • Updated list of applicable standards. • TCP acceleration information added
T	Published in release R18.2. The following updates are done in this revision: • Added locating hole position in tool flange view.
U	Published in release R20D. The following updates are done in this revision: • Minor changes. • New customer option cable harness (with ethernet cable) added. • Warranty section updated.
V	Published in release 21B. The following updates are done in this revision: • Text regarding fastener quality is updated. • Specification updated in customer connection section for DressPack, Parallel and Ethernet communication. • Removed Axis resolution. • Updated information about the option *Extended working range*.

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Revision	Description
X	Published in release 21D. The following updates are done in this revision: • Minor changes. • The data for robot stopping distances is removed. See *Product specification - Robot stopping distances according to ISO 10218-1*. • Description for option 455-8 updated.
Y	Published in release 24D. The following updates are done in this revision: • Updated data for power consumption. • Updated the section *Technical data on page 25*. • Add RAL code in manipulator color.
Z	Published in release 25.3. The following updates are done in this revision: • Company name updated to reflect current legal entities. • Updated portal name from myABB to ABB Robotics One.
AA	Published in release 26.1. The following updates are made in this revision: • Removed duplication of robot weight specification. • Company name updated to reflect current legal entities.
AB	Published in release 26B. The following updates are made in this revision: • Added section *Impacting robot lifetime* and section *Intended use*.

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1 Description

1.1 Structure

1.1.1 Introduction

Robot family

IRB 660 is ABB Robotics latest generation of 4-axis robot, designed with a focus on its high production capacity, short cycle time at a high payload, long reach together with the very high uptime, which is significant for ABB's robots.

It is available in two versions; a handling capacity of 180 kg and 250 kg, both with a reach of 3.15 m.

Customer connections such as power signals, Bus signals and twin air are integrated in the robot, from the robot base to connections at the robot tool flange.

Intended use

IRB 660 is ideal for use in palletizing, material handling, gluing and cutting in food and beverage, Electric Vehicle (EV), automotive, and the general industries.

See *Impacting robot lifetime on page 16*.

Operating system

The robot is equipped with the IRC5 controller and robot control software, RobotWare. RobotWare supports every aspect of the robot system, such as motion control, development and execution of application programs, communication and so on. For more information, see *Product specification - Controller IRC5 with FlexPendant*.

Safety

Safety standards valid for complete robot, manipulator and controller.

Additional functionality

For additional functionality, the robot can be equipped with optional software for application support. For example, gluing and welding, communication feature such as network communication, and advanced functions such as multitasking, sensor control and so on. For a complete description on optional software, see *Product specification - Controller software IRC5*.

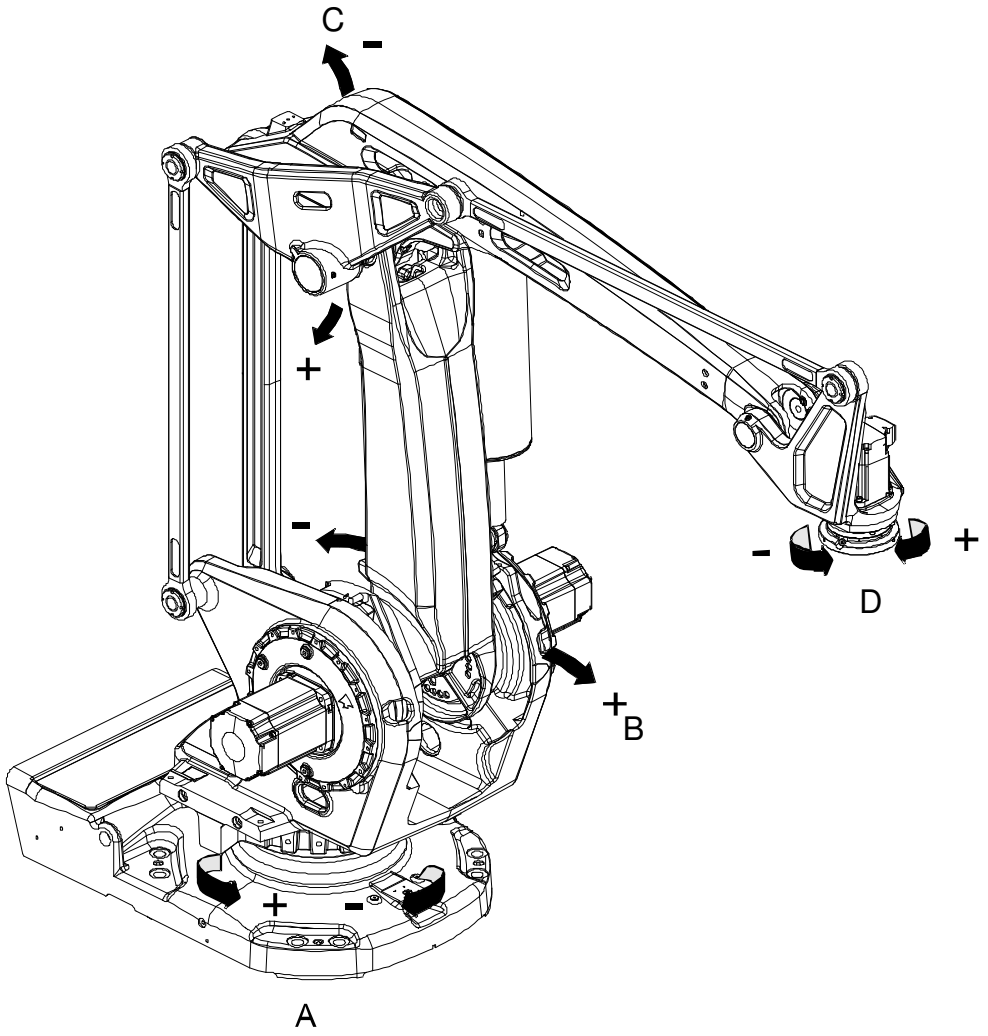
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1.1.1 Introduction
Continued

Manipulator axes

The IRB 660 manipulator has 4 axes as shown in the following figure.



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Pos.	Description
A	Axis 1
B	Axis 2
C	Axis 3
D	Axis 6

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1.1.2 Different robot versions

General

The IRB 660 is available in two versions.

Robot type	Maximum handling capacity (kg)	Maximum reach at wrist center (m)
IRB 660	180	3.15
IRB 660	250	3.15

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1.1.3 Definition of version designation

IRB 660 Mounting

	Description
Mounting	Floor-mounted manipulator

Airborne noise level

Data	Description	Note
Airborne noise level	The sound pressure level outside the working space	< 70 dB (A) Leq (acc. to Machiney directive 2006/42/EG).

Power consumption at max speed (vmax)

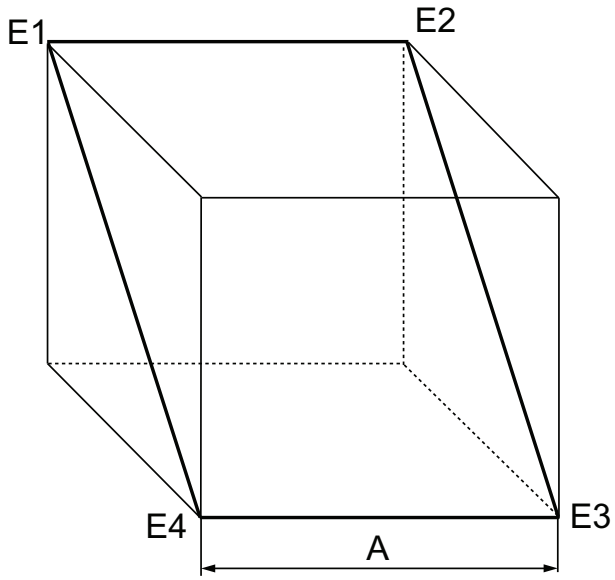
Type of Movement	IRB 660 (all variants)
ISO Cube	2.8 kW

Robot in calibration position	IRB 660 (all variants)
Brakes engaged	0.13 kW
Brakes disengaged	0.53 kW

General Palletizing movements in 48s. at maximum speed.

General Palletizing movements	Power consumption [kW] IRB 660-180/3.15
Max. speed	3.08

The path E1-E2-E3-E4 in the ISO Cube is shown in the following figure.



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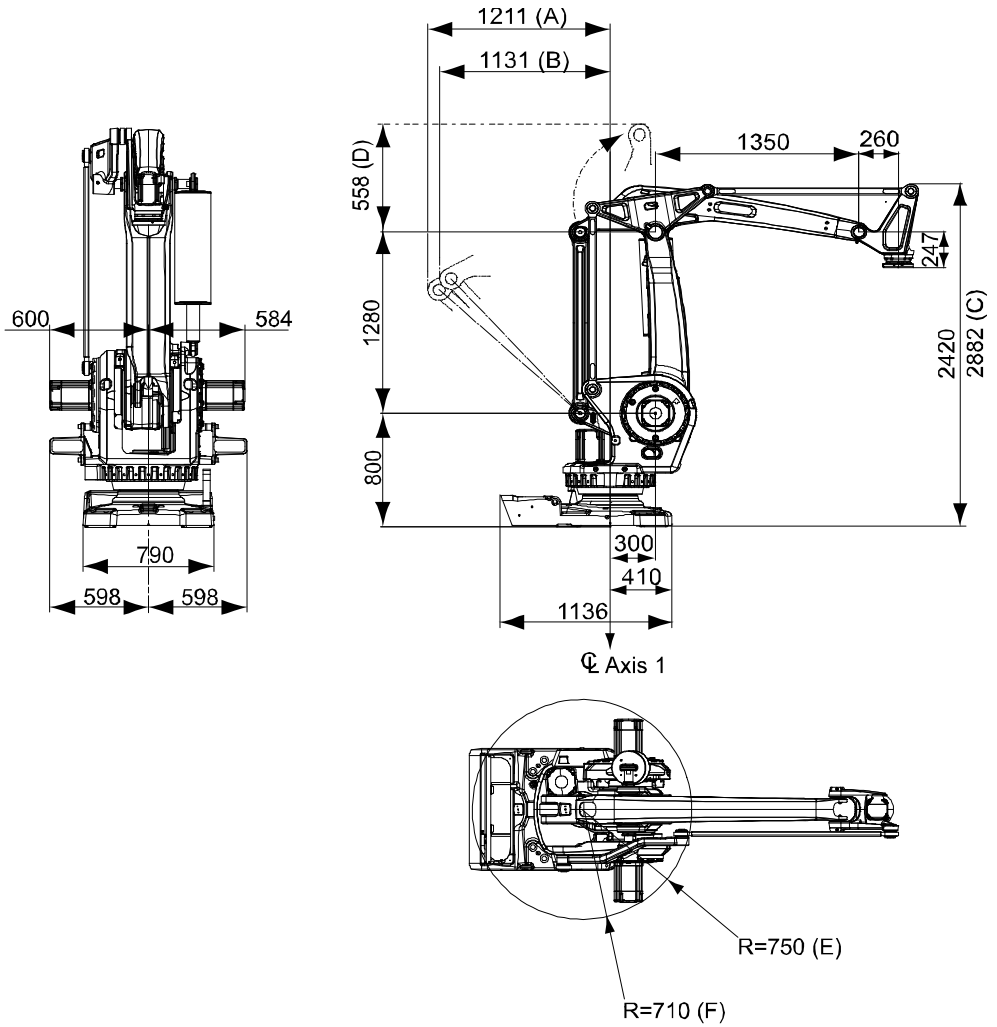
Pos	Description
A	1,000 mm

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Dimensions of IRB 660

The following figure shows the front, side, and top view of the manipulator (dimensions in mm). Allow 200 mm behind the manipulator foot for cables.



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Position	Description
A	At mechanical stop
B	At max. working range axis 2
C	At max. working range axis 3
D	At min. working range axis 3
E	Radius for fork lift pocket
F	Radius for axis 3 motor

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1.2 Impacting robot lifetime

Introduction

The expected lifetime of a robot is an important factor when planning an installation. This information is aiming to help you to maximize the lifetime of your robot and avoid unnecessary downtime or repair.

The lifetime of a robot is influenced by the following, but not limited to, factors:

- *Robot type selection on page 16*
- *Duty factor on page 16*
- *Environmental conditions on page 17*
- *Application and usage on page 17*
- *Design limitations on page 18*
- *Maintenance on page 19*
- *Individual lifetime variability on page 19*
- *Extreme usage on page 19*

Robot type selection

Selecting the right robot for the application is generally done based on payload and reach criteria, but other factors can influence the selection, such as the duty factor. Selecting the most suitable variant is crucial to achieve the expected high performance, uptime, and lifetime. Always select a robot in accordance with the intended use, see *Intended use on page 11*.

ABB robots are capable of high accelerations and speeds. It is generally recommended to use RobotStudio to find out if a robot model is suitable for a specific application and duty factor. RobotStudio is an excellent tool to help with the assessment of the duty factor and the selection of the most suitable robot variant.

This robot is not specifically designed for use in demanding applications with a very high duty factor. If used in such conditions, a significant reduction in lifetime is possible for all axes, depending on the cycle. See *Extreme usage on page 19*.

When selecting the robot variant, consider using application-specific robot, and suitable protection type.

Note

Use the Mechanical Analysis add-in in RobotStudio (see details below) for help with the assessment, or get technical support from ABB.

Duty factor

Duty factor is the percentage of time the robot is moving divided by the total time, including movement and wait time during the complete robot work cycle. It is a measurement of how much the robot is being used. Gearbox lifetime is reduced more rapidly by a higher duty cycle than by a lower one. See *Extreme usage on page 19*.

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Note

The duty factor impact on lifetime can be analyzed in the add-in *Mechanical Analysis* in RobotStudio (see details below) and *Service Information System* (SIS) data in the controller. Contact ABB to analyze the SIS data.

Environmental conditions

Following factors within environmental conditions of the robot has an impact on the robot lifetime:

- Temperature:

  The robot usage at high temperatures or extreme usage can lead to gearbox and motor cooling problems. Observe operating temperature limits stated in manipulator product manual. Extreme usage normally requires means of reduction of motor and gearbox oil heat.

  Note

  The add-in Mechanical Analysis in RobotStudio (see details below) or technical support from ABB can provide recommendation whether means of reduction of motor and gearbox oil heat is required.

- Exposure to chemicals might impact sealings, which can cause oil leakage.
- Vibrations caused by not following the foundation requirements might cause reduction of lifetime, for example for bearings. See *Requirements, foundation on page 27*.
- Cleaning. Wrong cleaning can cause particles entering the sealings which can cause oil leakage. Proper cleaning is described in *Product manual - IRB 660*.

Application and usage

Following factors within robot application and usage has an impact on the robot lifetime:

- Payload definition and overload:

  It is important to define the payload within specification and correctly defined tool data. See section *Load diagrams on page 40*, and *Technical reference manual - RAPID Overview*.

  The service routine for load identification, *LoadIdentify*, is available to support tool data definition. See *Operating manual - IRC5 with FlexPendant*.

- Acceleration/deceleration:

  The gearbox lifetime is reduced more rapidly by high accelerations/decelerations than by lower ones.

  Note

  Smoother movements bring reduced energy consumption.

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Note

Acceleration/deceleration can be modified with the instruction `AccSet`. See *Technical reference manual - RAPID Overview*.

Acceleration/deceleration is optimized by using automatic path planning functionality, either offline, or in RobotStudio, or using the online software.

- Limited movements:

  If the range or the rotation angle for an axis is 10° or less, the expected life of the reduction gears may be reduced due to poor lubrication of internal parts or the internal parts being subject to a concentrated load. Add extra lubrication motion to the robot program or to maintenance schedule.

Note

Use RobotStudio *Signal Analyzer* or get technical support from ABB.

- High forces applied externally to the manipulator:

  Some applications or not correctly programmed paths apply external forces to the manipulator, which might reduce its lifetime. Example of external force: gripper under constraint when gripping a part or load sharing between multiple robots.
- Number of collisions:

  Collisions, especially at high speed and/or with high loads reduce the lifetime of the gearboxes. Avoid collisions and set collision detection sensitivity to the appropriate level.

Note

See the application manual for the controller software, section *Collision detection*, listed in *References on page 7*.

- Number of emergency stops:

  Emergency stops, especially at high speed and/or high loads reduce the lifetime of the gearboxes. Whenever permitted by risk assessment, set the robot stopping functions to stop category 1.

Note

See the product manual for the robot controller, listed in *References on page 7*.

Design limitations

See the section *Expected component life* in *Product manual - IRB 660*.

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Maintenance

The maintenance and use of the robot will affect the performance and lifetime. For example:

- Preventive maintenance will optimize the lifetime of the robot. The recommended maintenance activities and intervals are described in *Product manual - IRB 660*.
- Observance of lubricant types and maintenance periods recommended by ABB.
- Possible pollution of the lubricant by an external cause, for example, water in the oil caused by high humidity.
- Extreme usage, for example high duty factor or environmental factors, will affect the maintenance schedule, for example, shorter intervals for oil change.

Contact your local ABB office to get technical support from ABB.

Individual lifetime variability

The lifetime varies with individual robots. For example, a cycle with a lower duty factor may fail earlier than one with a higher duty factor. But a cycle with a higher duty factor is more likely to fail earlier than a cycle with lower duty factor.

Extreme usage

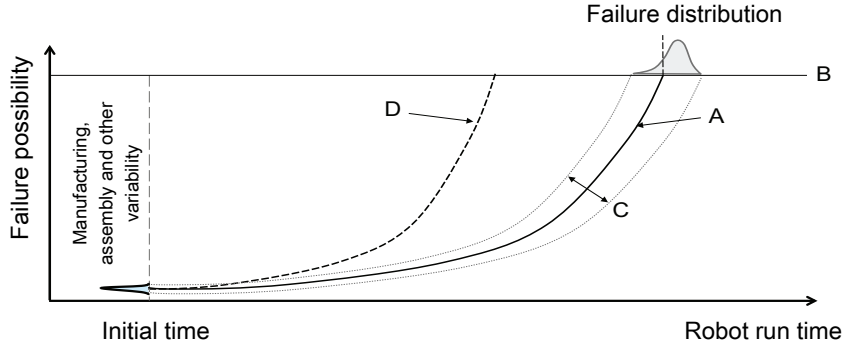
Examples of extreme usage in regard to movement: a stress index range that shows up as red (51) in the RobotStudio add-in *Mechanical Analysis*, press tending application, very severe palletizing applications, major use of axis 1, 2, or 3 movement.

The controller can issue a duty factor warning on the FlexPendant, if applicable. See the chapter *Troubleshooting* in *Product manual - IRB 660*.

Extreme usage requires specific maintenance, for example, shorter interval for oil change. See *Maintenance schedule* in *Product manual - IRB 660*.

Summary

The diagram illustrates the relationship between robot run time and failure possibility.



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A	Design lifetime

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B	Failure threshold
C	Individual variability
D	Negatively affected lifetime

The curve (A) represents the design lifetime, showing how failure probability increases over time following a normal distribution pattern. The failure threshold (B) indicates the point at which component failure becomes likely.

Individual variability between robots is shown by the dotted lines (C), representing the natural variation in component life due to manufacturing, assembly, and other factors. This variability means that while most robots will follow the design lifetime curve, some individual units may experience earlier or later failures within the normal distribution.

As highlighted with the curve (D) in the diagram, robot lifetime can be negatively affected by not following best practices in the key areas discussed in this chapter:

- *Robot type selection on page 16*
- *Duty factor on page 16*
- *Environmental conditions on page 17*
- *Application and usage on page 17*
- *Maintenance on page 19*

By adhering to the recommendations outlined in each of these sections, users can maximize their robot's operational lifetime and ensure performance stays within the design lifetime curve, avoiding premature failure and unnecessary downtime.

Available tools

There are several tools available throughout the lifecycle of an ABB robot, from support with selecting the most suitable manipulator and optimizing its lifetime, to operation, maintenance, and repair:

ABB toolbox	Type	Product lifecycle		
		Sales, pre-study	Installation, commissioning	Operation, maintenance, repair
Product specification	Document	x	x	
Product manual	Document		x	x
Mechanical Analysis add-in	Add-in in RobotStudio	x	x	x
Service Information System (SIS) / Condition Based Maintenance (CBM)	RobotWare functionality / Customer service analysis		x	x
Connected Services	Hardware and Software		x	x
Automatic Path Planning	RobotStudio functionality and online software	x	x	(x)

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ABB toolbox	Type	Product lifecycle		
		Sales, pre-study	Installation, commissioning	Operation, maintenance, repair
Signal Analyzer / TuneMaster	RobotStudio functionality / Software	x	x	x
ABB support	Customer support	x	x	x

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1.3 Standards

1.3.1 Applicable standards

Note

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

General

The product is designed in accordance with ISO 10218-1:2011, Robots for industrial environments - Safety requirements -Part 1 Robots, and applicable parts in the normative references, as referred to from ISO 10218-1:2011. In case of deviations from ISO 10218-1:2011, these are listed in the declaration of incorporation which is part of the product delivery.

Normative standards as referred to from ISO 10218-1

Standard	Description
ISO 9283:1998	Manipulating industrial robots - Performance criteria and related test methods
ISO 10218-2	Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration
ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
ISO 13850	Safety of machinery - Emergency stop - Principles for design
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Region specific standards and regulations

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

Other standards used in design

Standard	Description
ISO 9787:2013	Robots and robotic devices -- Coordinate systems and motion nomenclatures
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments

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Standard	Description
ISO 13732-1:2006	Ergonomics of the thermal environment - Part 1
IEC 60974-1:2012[i]	Arc welding equipment - Part 1: Welding power sources
IEC 60974-10:2014[i]	Arc welding equipment - Part 10: EMC requirements
ISO 14644-1:2015[ii]	Classification of air cleanliness
IEC 60529:1989 + A2:2013	Degrees of protection provided by enclosures (IP code)

i Only valid for arc welding robots. Replaces IEC 61000-6-4 for arc welding robots.
ii Only robots with protection Clean Room.

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1.4 Installation

1.4.1 Introduction

General

IRB 660 is designed for floor mounting (no tilting allowed around X or Y axis). Depending on the robot version, an end effector with maximum weight of 180 to 250 kg including payload, can be mounted on the mounting flange (axis 6). For more information on Load diagrams, see *Load diagrams on page 41*.

Working range

The working range of axis 1 can be limited by mechanical stops.

The option *Electronic Position Switches* can be used on all axes, for position indication of the manipulator.

External Mains Transformer

Include an external transformer for mains voltage 200V and 220V.

Explosive environments

The robot must not be located or operated in an explosive environment.

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1.4.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Weight
IRB 660	1750 kg

Note

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

Mounting positions

The table shows valid mounting options for the manipulator.

Mounting option	Installation angle	Note
Floor mounted	0°	

Note

The actual mounting angle must always be configured in the system parameters, otherwise the performance and lifetime is affected. See the product manual for details.

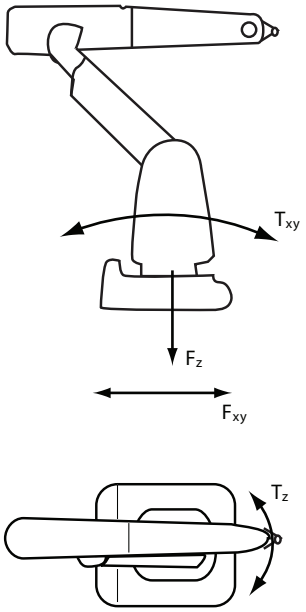
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Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

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



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

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

Note

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

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	± 8.0 kN	± 11.7 kN
Force z	18.0 ±4.9 kN	18.0 ±8.2 kN
Torque xy	± 23.2 kNm	± 31.2 kNm
Torque z	± 7.7 kNm	± 9.9 kNm

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Requirements, foundation

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

Requirement	Value	Note
Flatness of foundation surface	0.3 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base.
Minimum resonance frequency	22 Hz **Note** It may affect the manipulator lifetime to have a lower resonance frequency than recommended.	The value is recommended for optimal performance. Due to foundation stiffness, consider robot mass including equipment. [i] For information about compensating for foundation flexibility, see the application manual of the controller software, section *Motion Process Mode*.

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

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

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	0° C
Maximum ambient temperature	+50° C
Maximum ambient humidity	95% at constant temperature

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1.4.2 Technical data
Continued

Protection classes, robot

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

Protection type	Protection class [i]
Manipulator, protection type Standard	IP 67

[i] According to IEC 60529.

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1.4.3 Mounting the manipulator

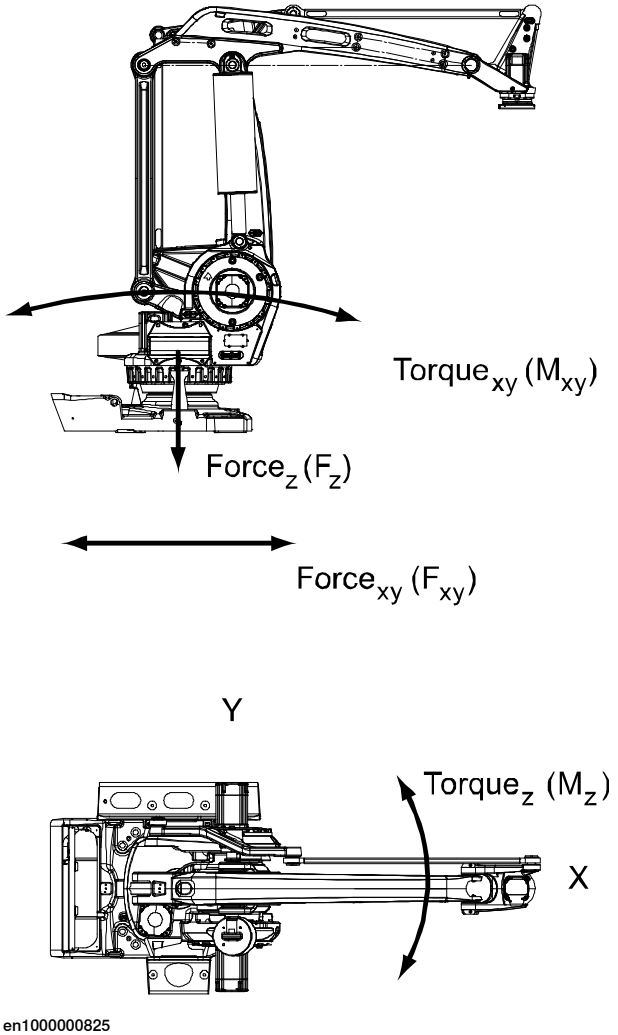
Maximum Load

Maximum load in relation to the base coordinate system.

Floor Mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	± 8.0 kN	± 11.7 kN
Force z	18.0 ±4.9 kN	18.0 ±8.2 kN
Torque xy	± 23.2 kNm	± 31.2 kNm
Torque z	± 7.7 kNm	± 9.9 kNm

The following figure shows the direction of forces.



en1000000825

Note regarding M_{xy} and F_{xy}

The bending torque (M_{xy}) can occur in any direction in the XY-plane of the base coordinate system.

The same applies to the transverse force (F_{xy}).

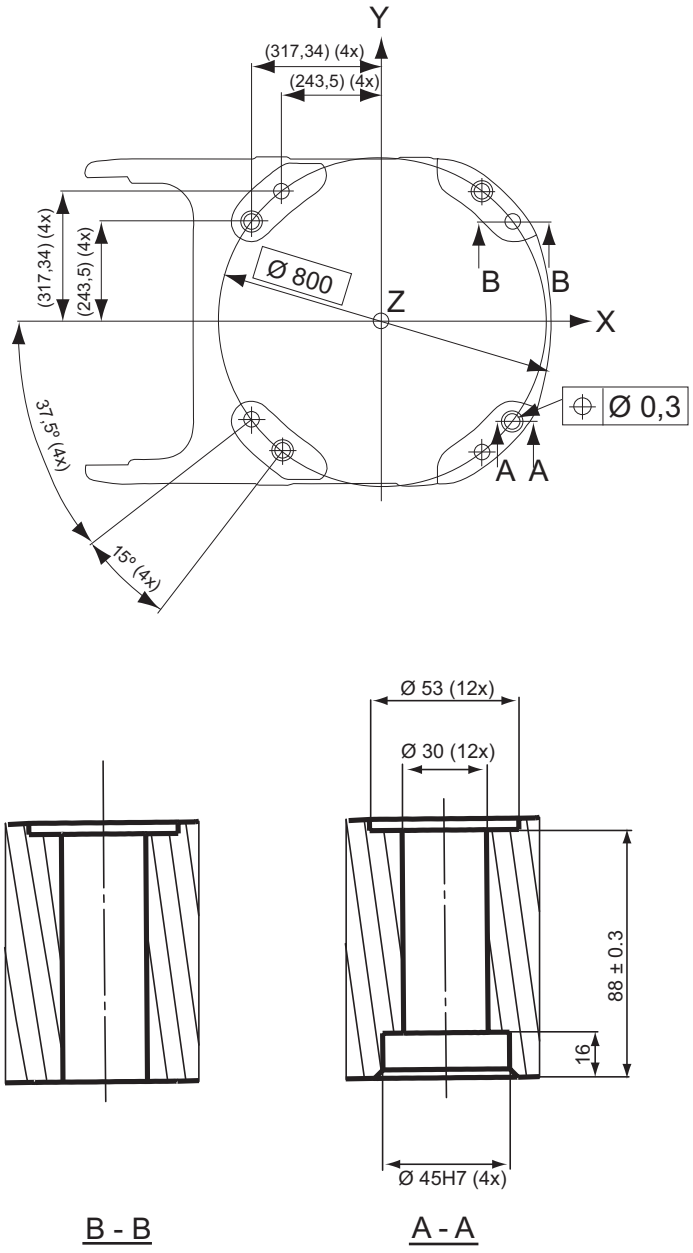
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1.4.3 Mounting the manipulator
Continued

Fastening holes robot base

The following figure shows the hole configuration (dimensions in mm).



xx1000000826

Recommended screws for fastening the manipulator to a base plate:

- M24 x 140 8.8 with 4 mm flat washer. Torque value 725 Nm.

Note

Only two guiding sleeves shall be used. The corresponding holes in the base plate shall be circular and oval according to the following base plate drawing.

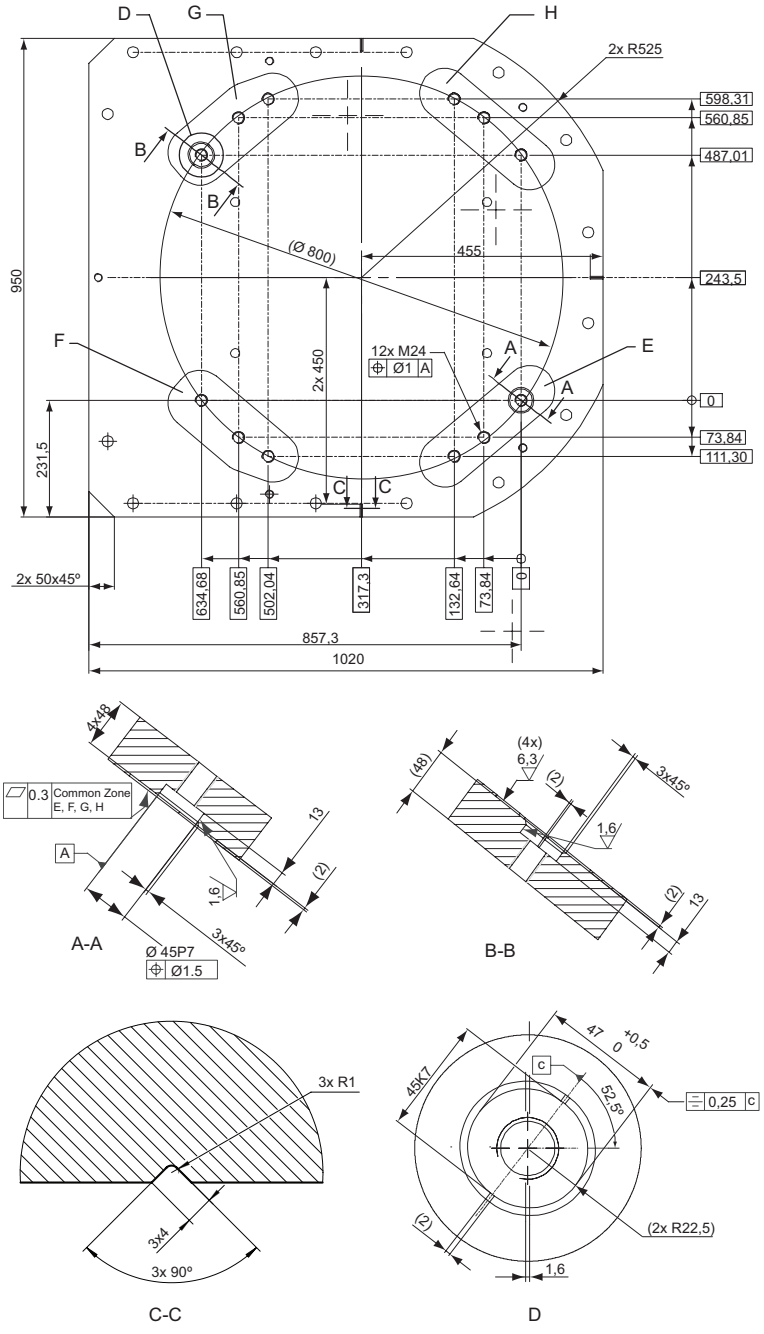
Regarding AbsAcc performance, the recommended are the chosen guide holes those are according to the following base plate drawing.

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Base plate drawing

The following figure shows the option base plate (dimensions in mm).



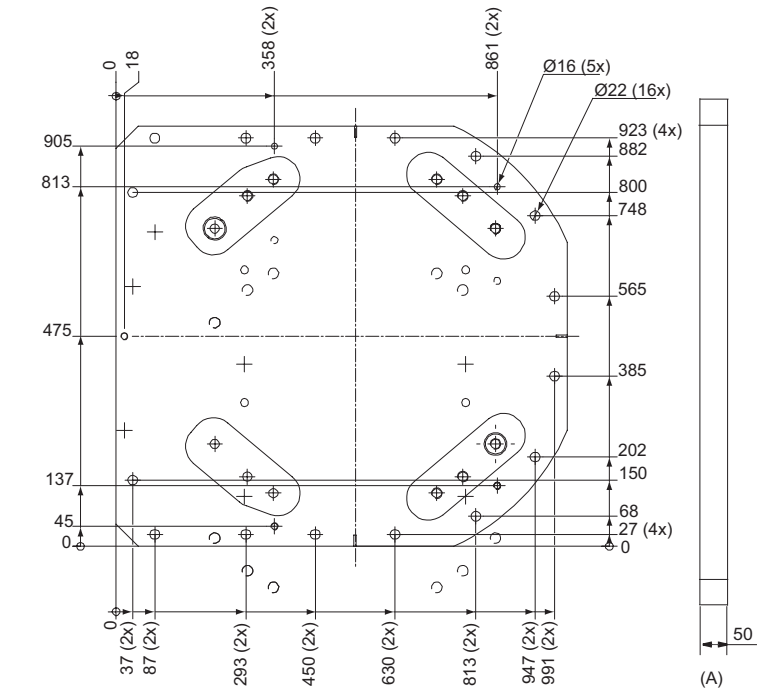
xx1000001053

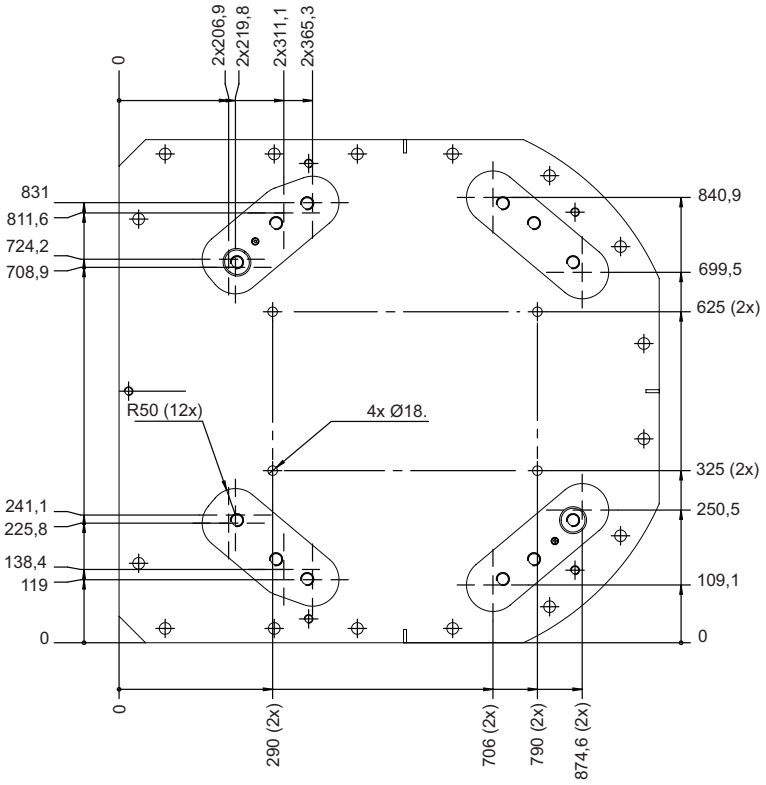
E, F, G, H	Common tolerance zone (accuracy all over the base plate from one contact surface to the other)

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1.4.3 Mounting the manipulator
Continued



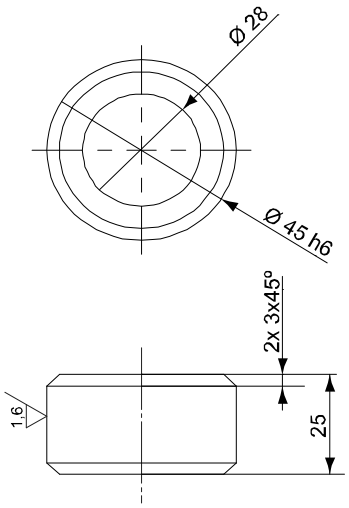


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Pos	Description
A	Color: RAL 9005 Thickness: 80-100 µm

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Pos	Description
A	Guide sleeve protected from corrosion

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1.5 Calibration

1.5.1 Calibration methods

Overview

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

More information is available in the product manual.

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.	Axis Calibration

Brief description of calibration methods

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 660. It is the recommended method in order to achieve proper performance.

The following routines are available for the Axis Calibration method:

- Fine calibration
- Update revolution counters
- Reference calibration

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

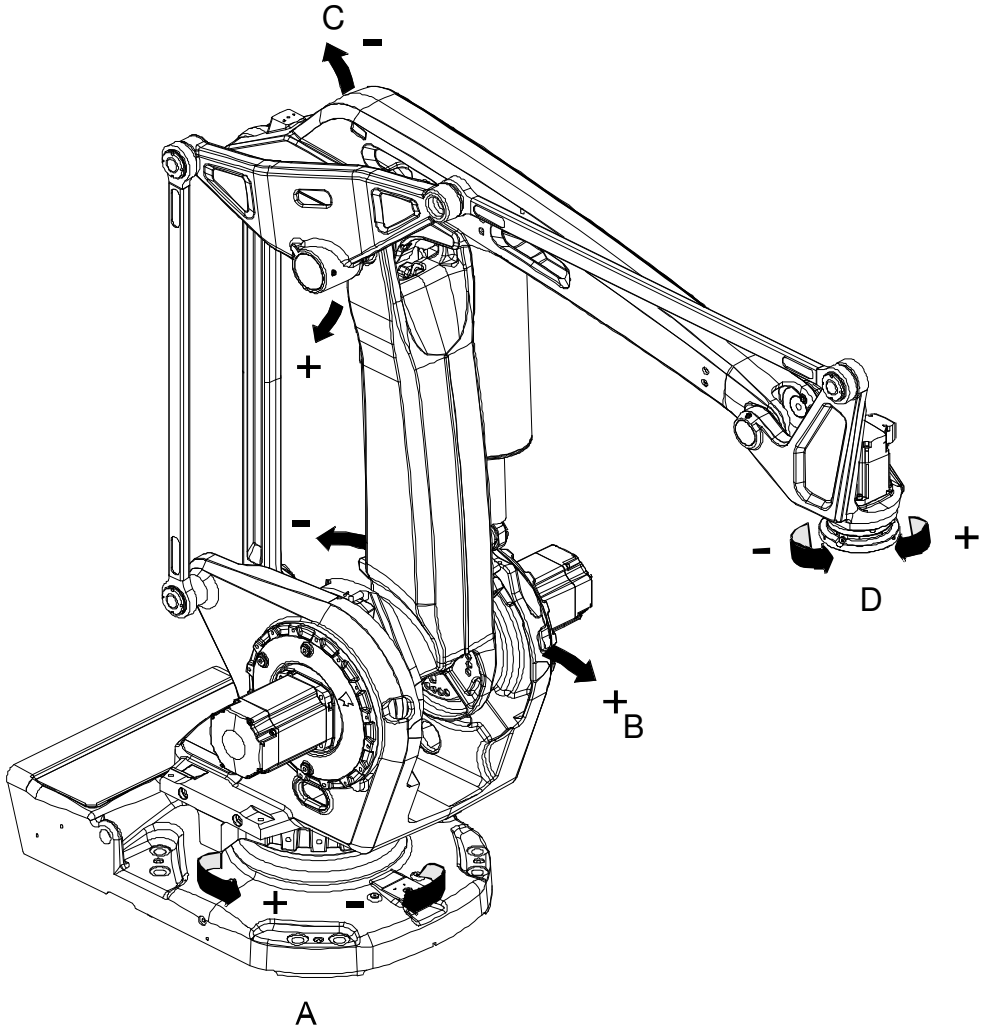
The actual instructions of how to perform the calibration procedure and what to do at each step is given on the FlexPendant. You will be guided through the calibration procedure, step by step.

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1.5.2 Fine calibration

General

Fine calibration is made using *Calibration Pendulum*, see *Operating manual - Calibration Pendulum*.



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Position	Description
A	Axis 1
B	Axis 2
C	Axis 3
D	Axis 6

Calibration	Position
Calibration of all axes	All axes are in zero position
Calibration of axis 1 and 2	Axis 1 and 2 in zero position Axis 3 to 6 in any position

Continues on next page

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1.5.2 Fine calibration

Continued

Calibration	Position
Calibration of axis 1	Axis 1 in zero position Axis 2 to 6 in any position

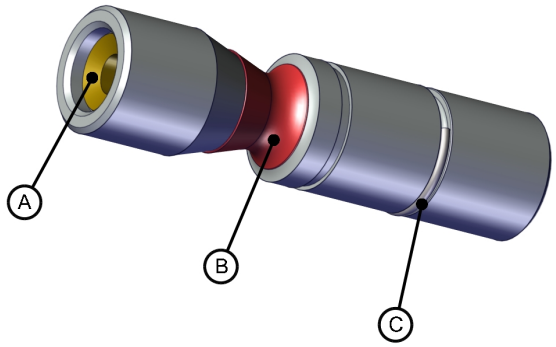
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1.5.3 Calibration tools for Axis Calibration

Calibration tools

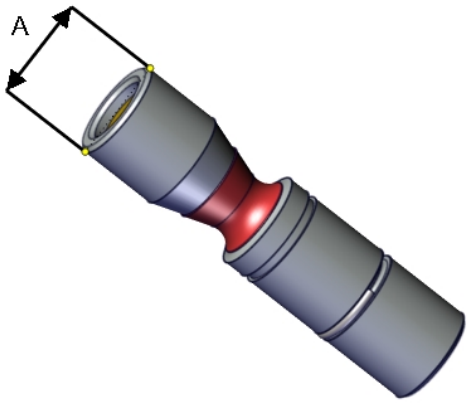
WARNING

If any part is missing or damaged, the tool must be replaced immediately.



xx1500001914

A	Tube insert
B	Plastic protection
C	Steel spring ring



xx1500000951

A	Outer diameter

If including the calibration tool in a local periodic check system, the following measures should be checked.

- Outer diameter within Ø12g4 mm, Ø8g4 mm or Ø6g5 mm (depending on calibration tool size).
- Straightness within 0.005 mm.

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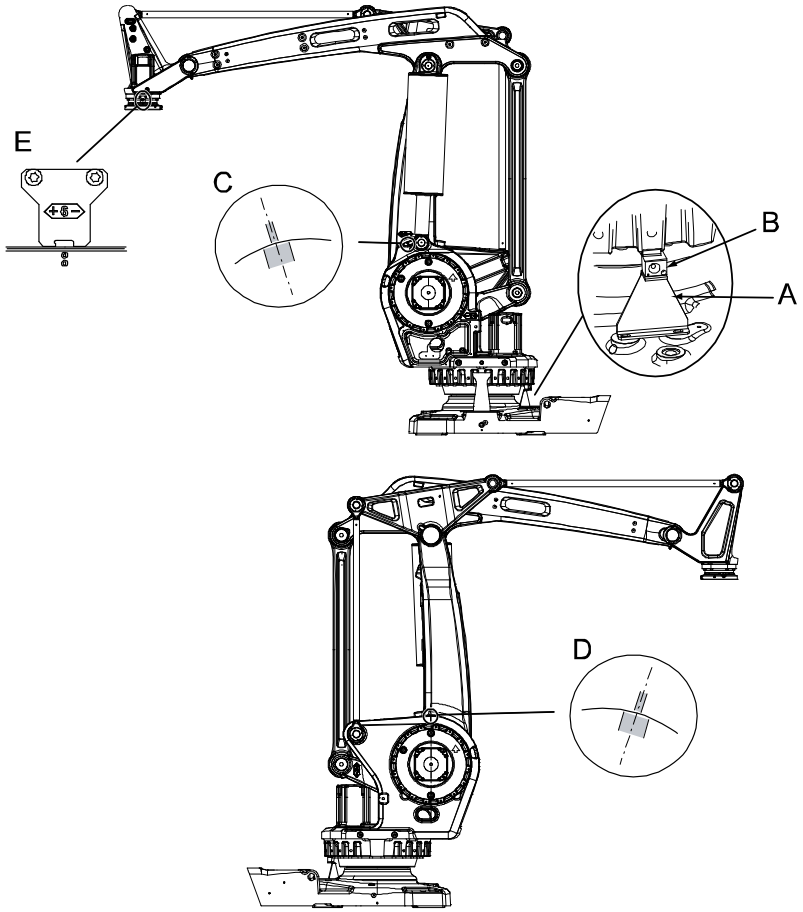
1.5.4 Synchronization marks and axis movement directions

1.5.4.1 Synchronization marks and synchronization position for axes

Introduction

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

Synchronization marks, IRB 660



xx0500002487

A	Synchronization plate, axis 1
B	Synchronization tab on robot
C	Synchronization mark, axis 2
D	Synchronization mark, axis 3
E	Synchronization plate and mark, axis 6

Synchronization marks at axes 2 and 3

The synchronization marks at axes 2, 3 and 6, shown in the figure above, consist of two single marks that should be positioned opposite to one another when the robot is standing in its synchronization position. One of the marks is more narrow than the other and should be positioned within the limits of the wider mark.

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1.5.4.2 Calibration movement directions for all axes

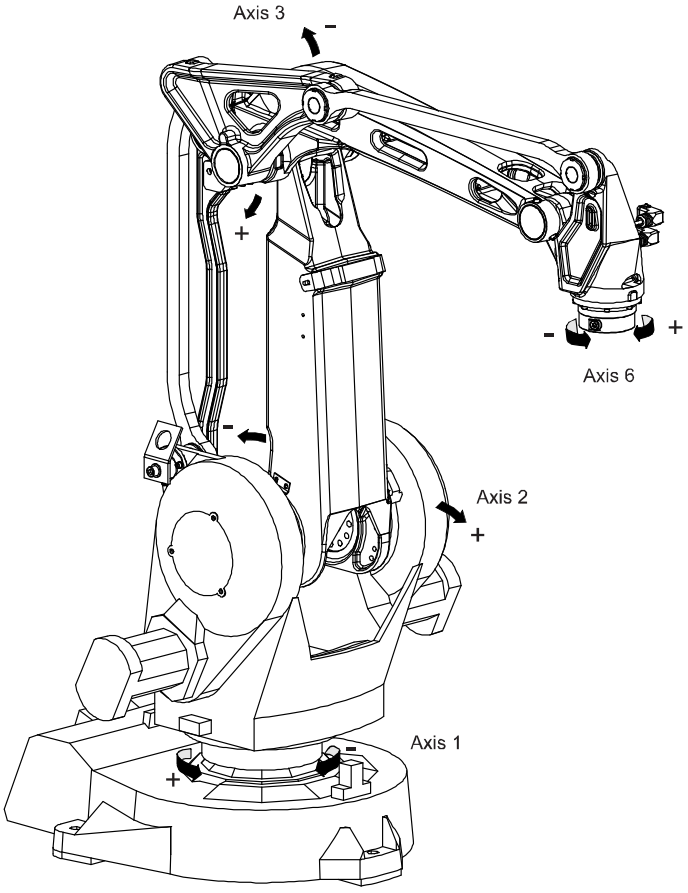
Overview

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

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

Manual movement directions, 4 axes

Note! The graphic shows an IRB 260. The positive direction is the same for all 4-axis robots



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1.6 Load diagrams

1.6.1 Introduction to Load diagrams

Information

WARNING

It is very important to always define correct actual load data and correct payload of the robot. Incorrect definitions of load data can result in overloading of the robot.

If incorrect load data is used, and/or if loads outside the load diagram are used, the following parts can be damaged due to overload:

- motors
- gearboxes
- mechanical structure

WARNING

In RobotWare, the service routine LoadIdentify can be used to determine correct load parameters. The routine automatically defines the tool and the load.

See *Operating manual - IRC5 with FlexPendant*, for detailed information.

WARNING

Robots running with incorrect load data and/or with loads outside the load diagram, will not be covered by robot warranty.

General

The load diagrams include a nominal payload inertia, J_0 of 15 kgm^2, and an extra load of 50 kg at the upper arm housing.

At different moment of inertia the load diagram will be changed. For robots that are allowed tilted, wall or inverted mounted, the load diagrams as given are valid and thus it is also possible to use RobotLoad within those tilt and axis limits.

Control of load case with RobotLoad

To verify a specific load case, use the RobotStudio add-in RobotLoad.

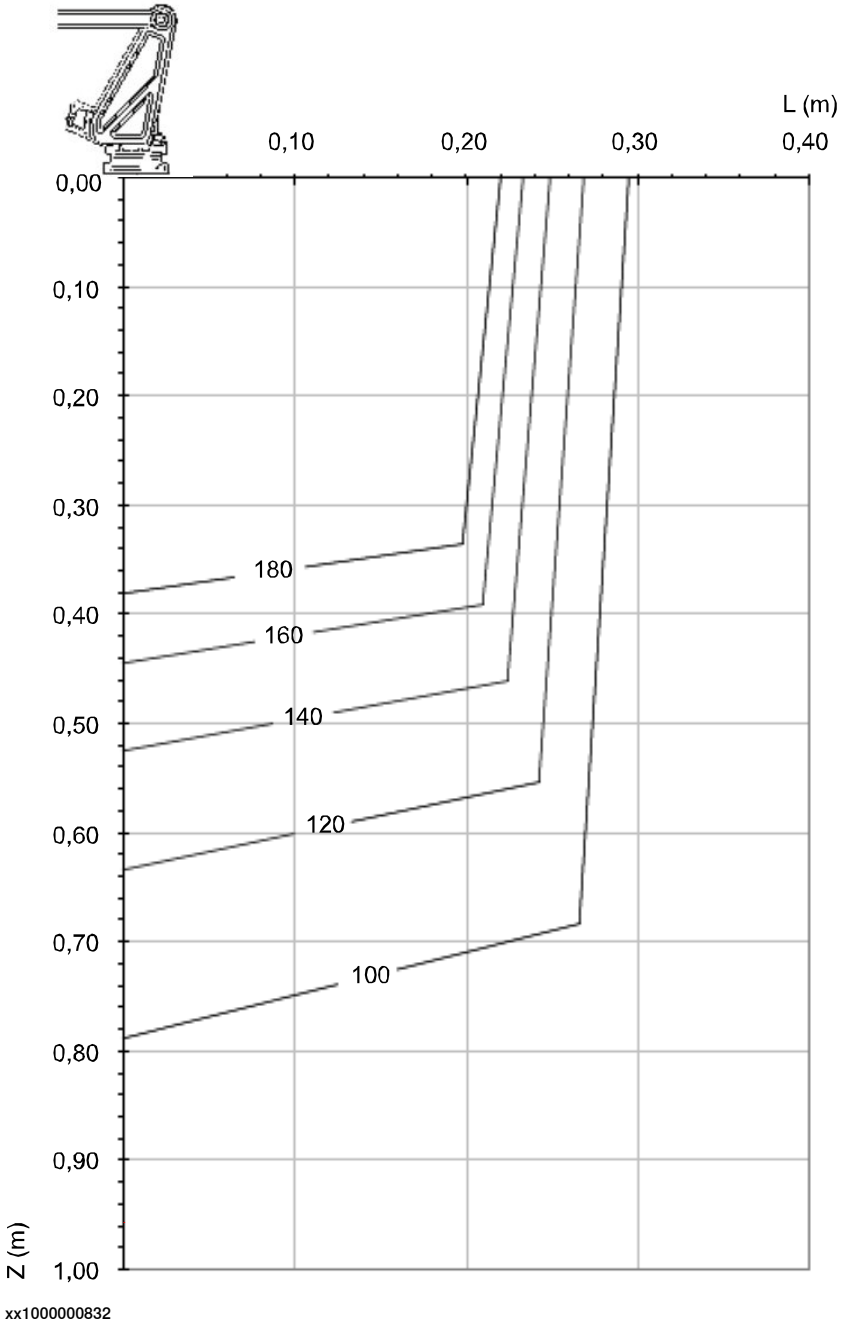
The result from RobotLoad is only valid within the maximum loads and tilt angles. There is no warning if the maximum permitted arm load is exceeded. For over-load cases and special applications, contact ABB for further analysis.

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1.6.2 Load diagrams

IRB 660-180/3.15

The following figures shows the maximum permitted load mounted on the robot tool flange at different positions (center of gravity).



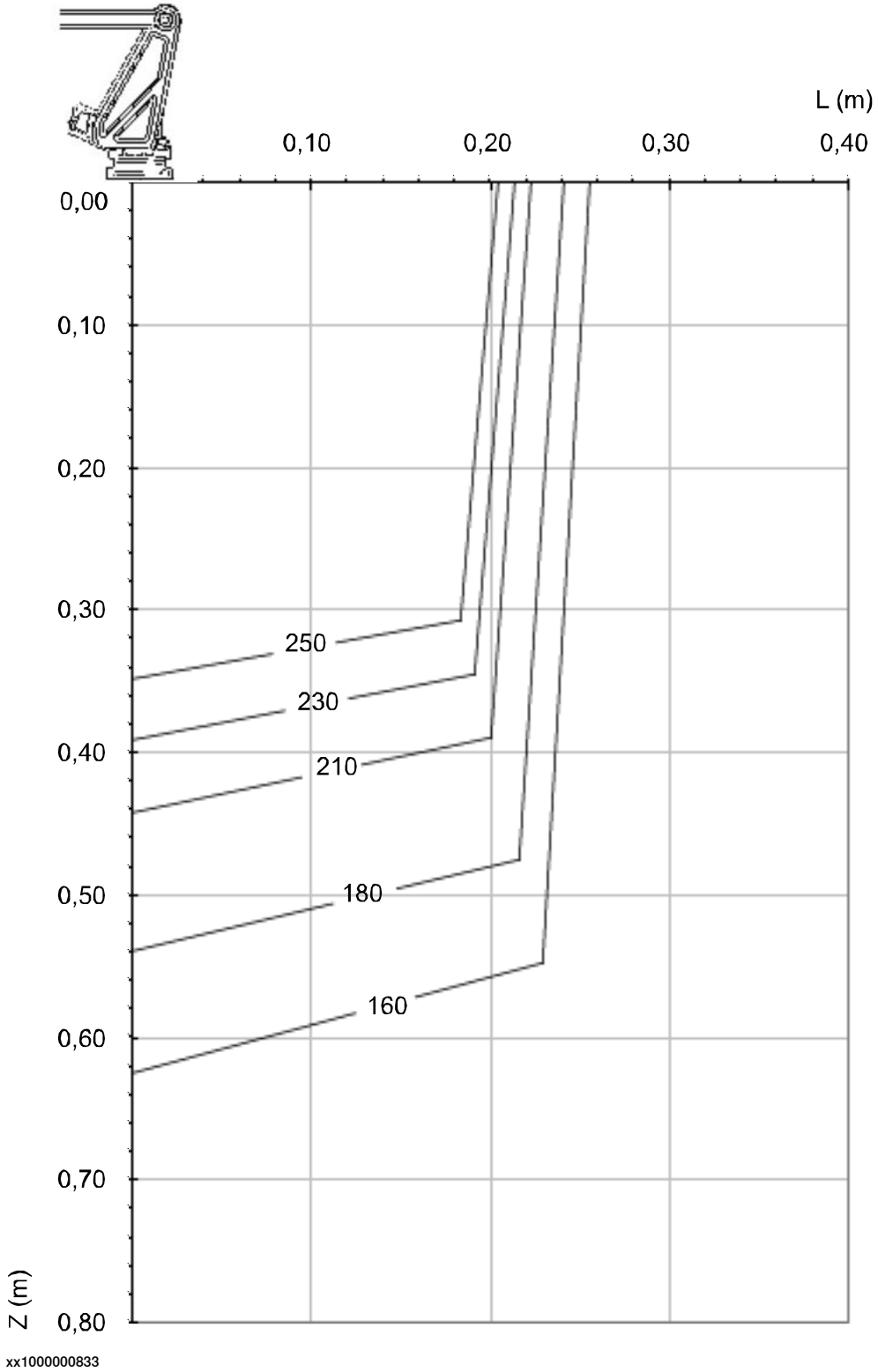
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1.6.2 Load diagrams
Continued

IRB 660-250/3.15

The following figures shows the maximum permitted load mounted on the robot tool flange at different positions (center of gravity).



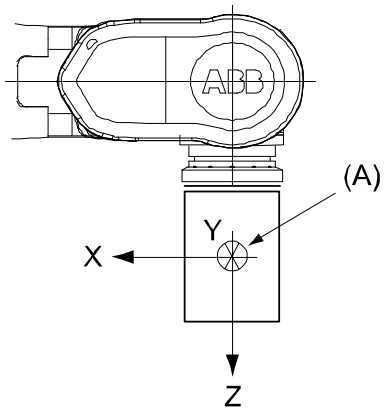
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1.6.3 Maximum load and moment of inertia

Overview

Load in kg, Z and L in m and J in kgm^2.

Axis	Maximum moment of inertia
6	Ja6 = Load x L^2 + $J_{0Z} \leq 250$ kgm^2



xx1000000834

Pos	Description
A	Center of gravity

	Description
J_{ox} , J_{oy} , J_{oz}	Max. moment of inertia around the X, Y and Z axes at center of gravity.

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1.6.4 Maximum TCP acceleration

General

Higher values can be reached with lower loads than the nominal because of our dynamical motion control QuickMove2. For specific values in the unique customer cycle, or for robots not listed in the table below, we recommend to use RobotStudio.

Maximum Cartesian design acceleration for nominal loads

Robot type	E-stop Max acceleration at nominal load COG [m/s^2]	Controlled Motion Max acceleration at nominal load COG [m/s^2]
IRB 660 - 250/3.15	31	18
IRB 660 - 180/3.15	37	24

Note

Acceleration levels for emergency stop and controlled motion includes acceleration due to gravitational forces. Nominal load is defined with nominal mass and cog with max offset in Z and L (see the load diagram).

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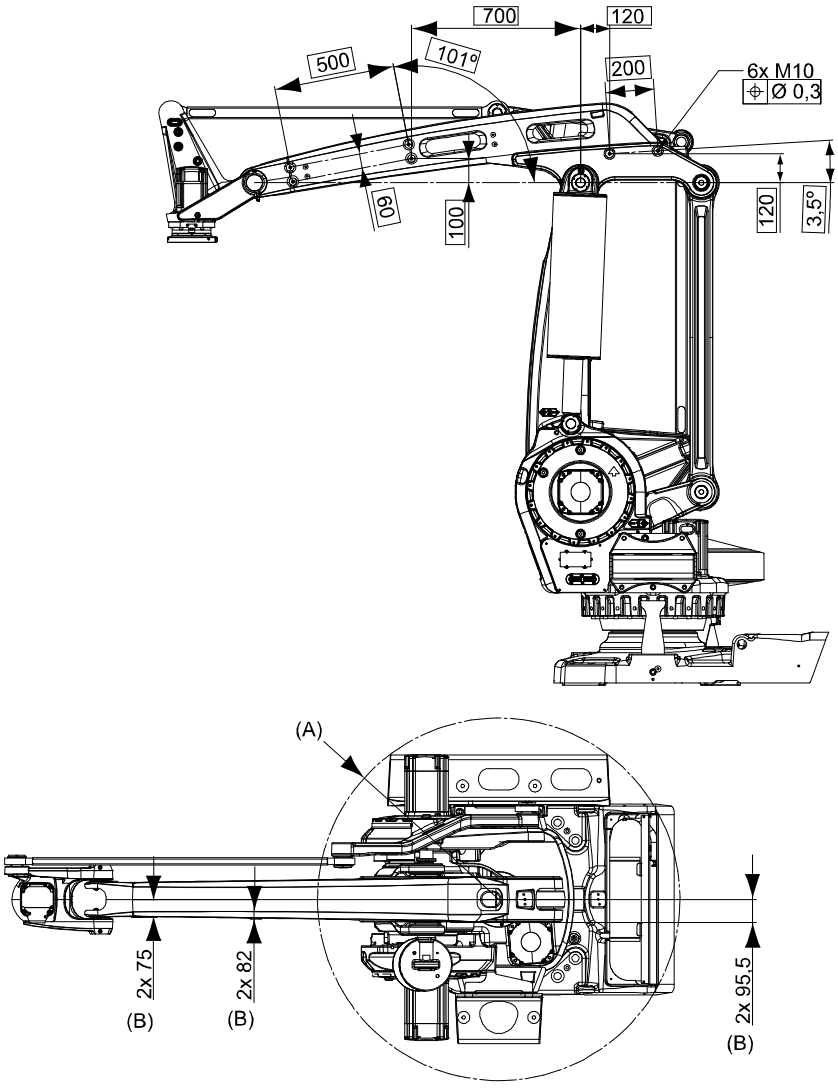
1.7 Mounting of equipment

1.7.1 Overview

General

Extra loads can be mounted on to the upper arm and on to the left side of the frame. Holes and definitions of masses are shown in following figures.

For mounting of an external vacuum hose there are six holes on the upper arm (see the following figure). The maximum weight for the vacuum hose and fastening device is 35kg. When using the holes, the weight of the vacuum hose shall be reduced from the maximum handling capacity, for each variant respectively.



xx1000000835

Position	Description
A	R750 Right fork lift pocket
B	M10 Mounting hole, upper arm

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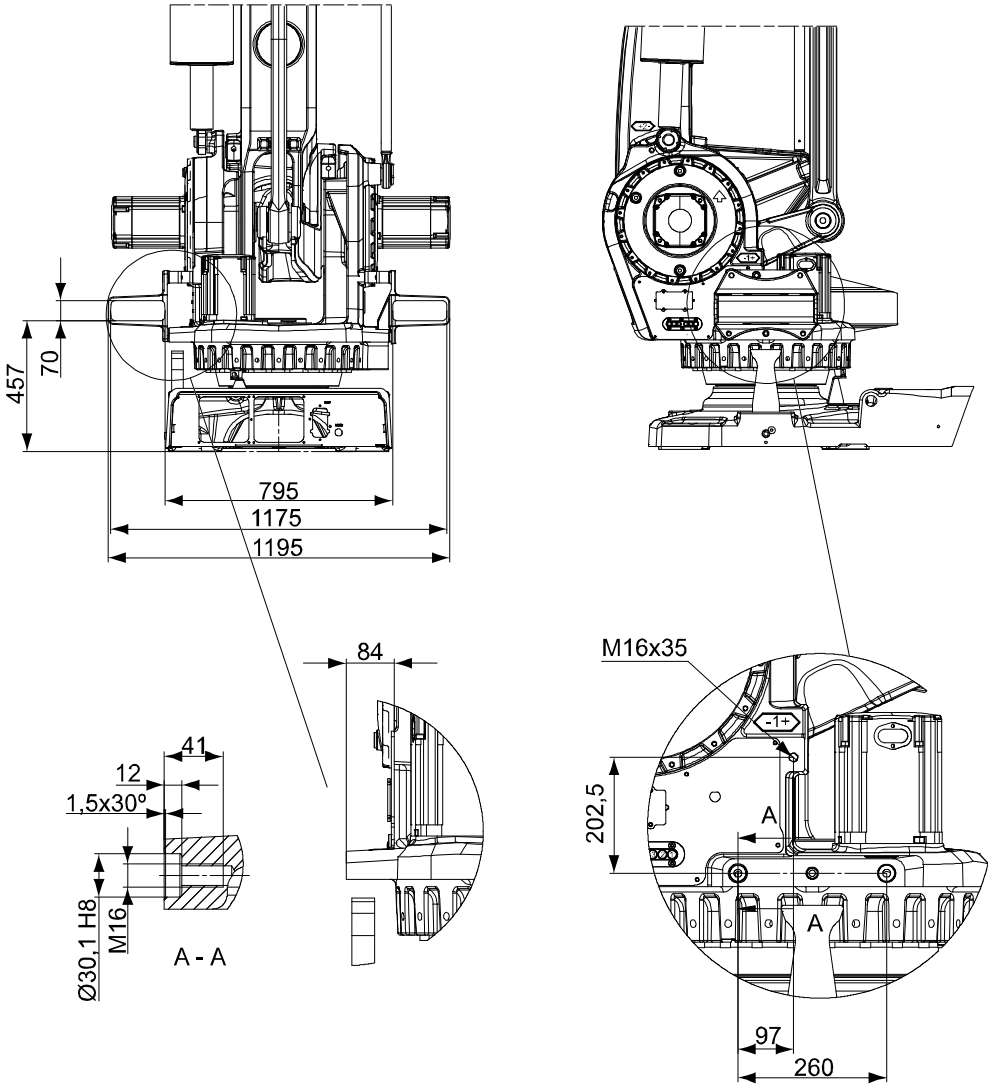
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1.7.1 Overview
Continued

Frame

For mounting of extra load on to the frame there are three holes on the left side (see the following figure). The maximum weight of the extra load is 150kg and the maximum moment of inertia is 120kgm^2.

Description	Value and definition
Permitted extra load on frame	M = 150 kg
Max. moment of inertia for extra load	J_H = 120 kgm^2
Recommended position as shown in the following figure	$J_H = J_{H0} + M \times R^2$ J_{H0} is the moment of inertia (kgm^2) for the extra load. R is the radius (m) from the center of axis1. M is the total mass (kg) of the extra load.

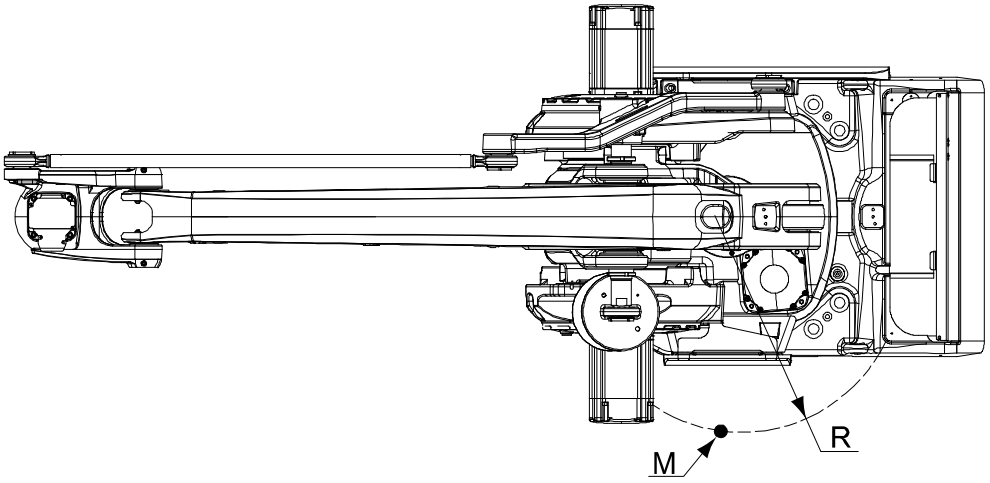


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The following figure shows the radius for extra load on frame.

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xx1000000837

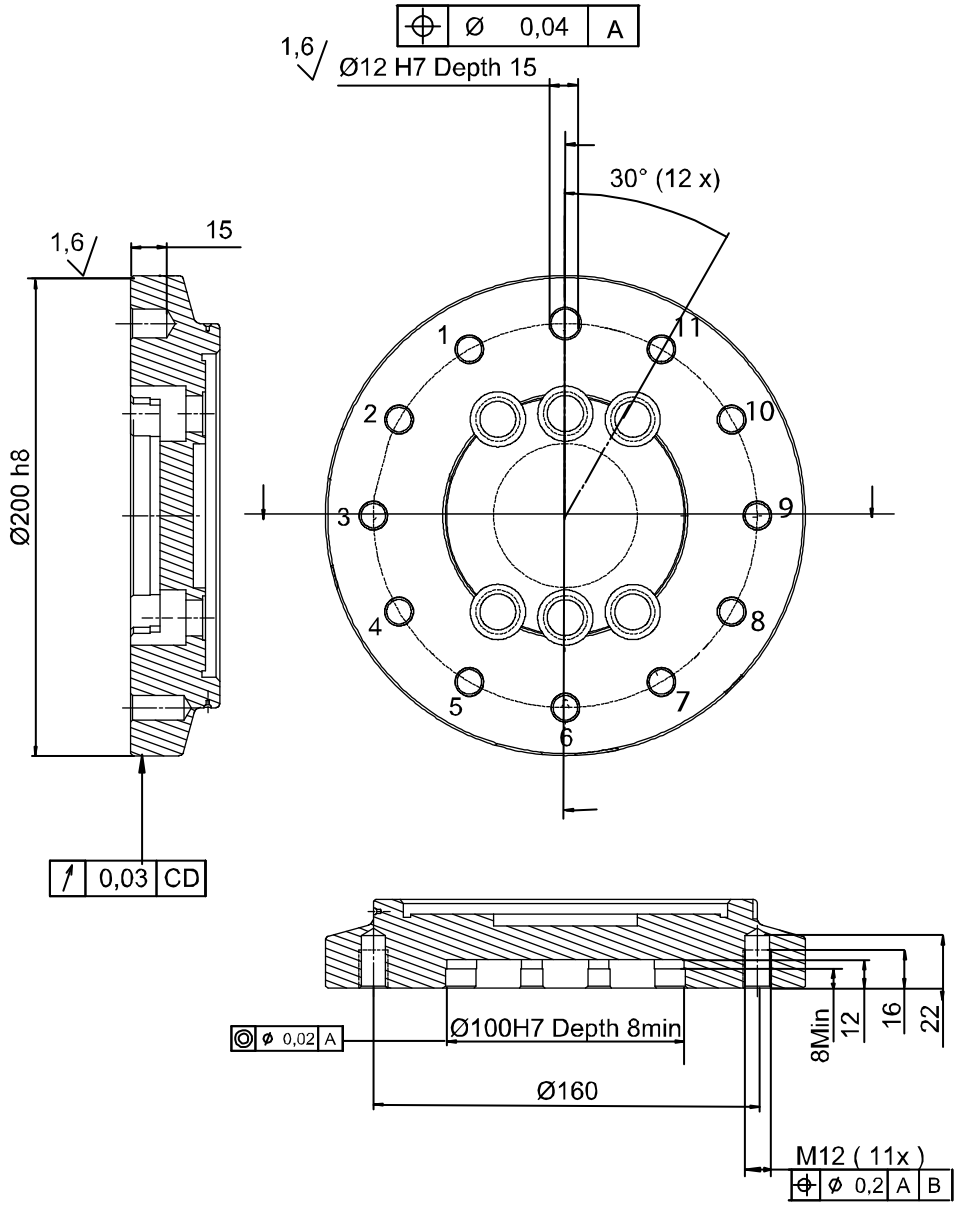
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1.7.1 Overview
Continued

Robot tool flange

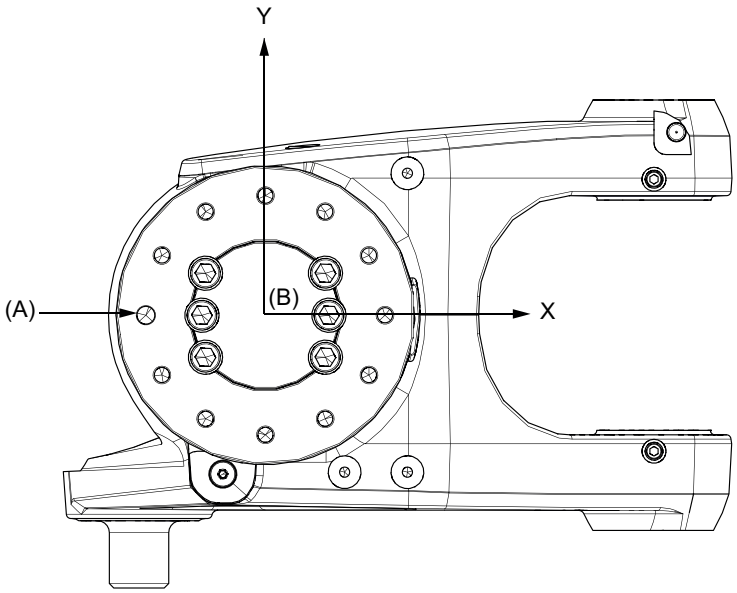
The following figure shows the robot tool flange SS-EN ISO 9409-1;2004 (dimensions in mm).



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xx1800001377

-	Tool flange in bottom view
A	Locating hole
B	Tool coordinate system

Fastener quality

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

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1.8 Robot motion

1.8.1 Introduction

Type of Motion

Axis	Type of motion	Range of movement	Option
1	Rotation motion	+180° to -180°	+220° to -220°
2	Arm motion	+85° to -42°	
3	Arm motion	+120° to -20°	
6	Turn motion	+300° to -300° (default) +150 revolutions to -150 revolutions Max (see the following note)	

Note

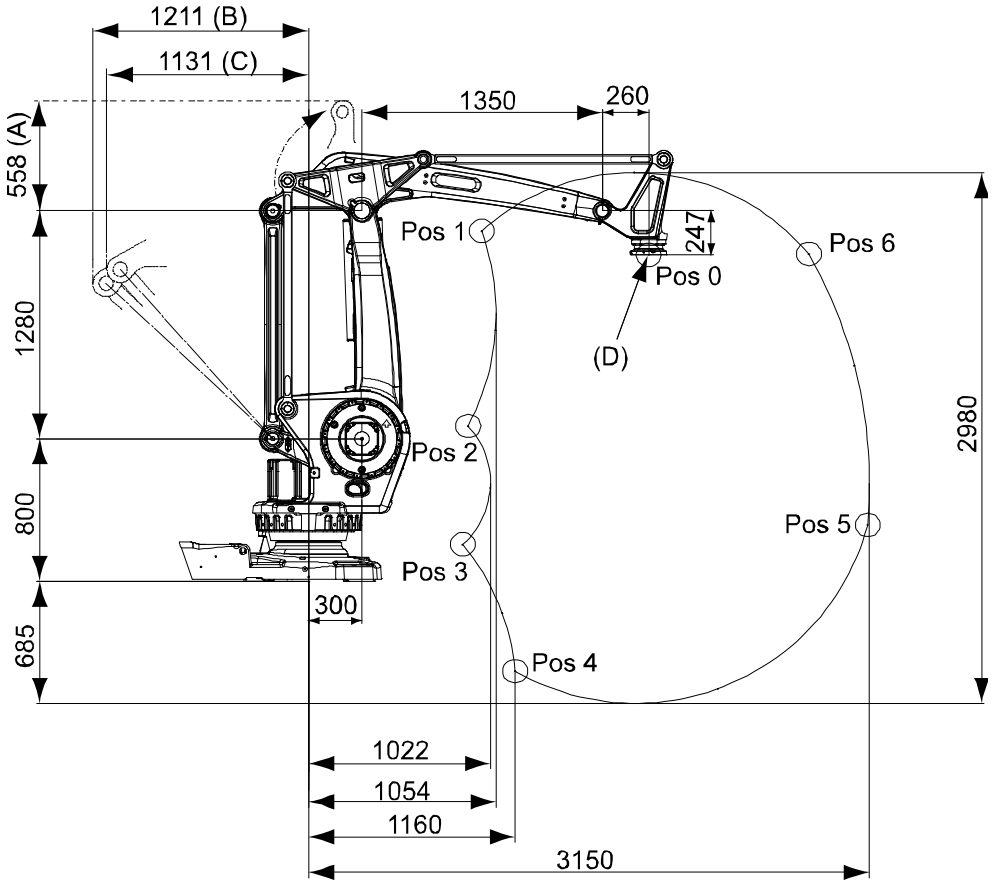
- The default working range for axis 6 can be extended by changing parameter values in the software.
- Option 610-1 *Independent axis* can be used for resetting the revolution counter after the axis has been rotated (no need for “rewinding” the axis).

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Illustration

The following figure shows the extreme positions of the robot arm specified at the tool flange center (dimensions in mm).



xx1000000839

Position	Description
A	Min. working stop
B	Mechanical stop
C	Max. working stop
D	Tool flange center

Positions at wrist center

Position number (see preceding figure)	X Position (mm)	Z Position (mm)	Axis2 Angle (degrees)	Axis3 Angle (degrees)
0	1910	1833	0	0
1	972	1966	-42	-20
2	895	870	-42	28
3	866	207	50	120
4	1160	-505	85	120
5	3139	315	85	15
6	2809	1837	50	-20

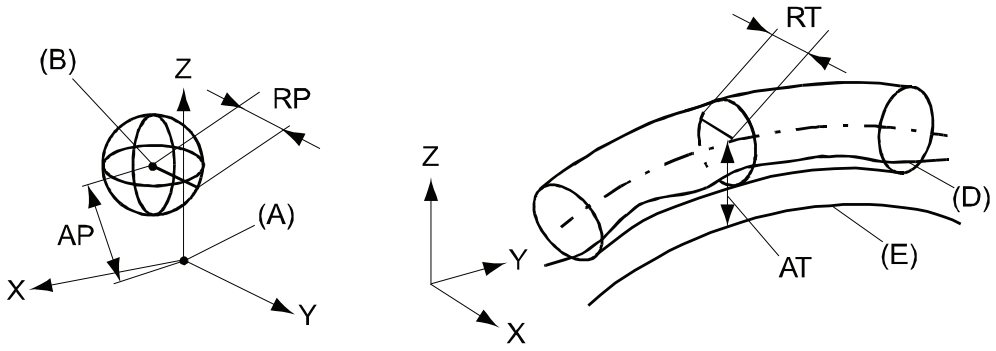
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1.8.2 Performance according to ISO 9283

General

At rated maximum load, maximum offset and 1.6 m/s velocity on the inclined ISO test plane, with all six axes in motion. Values in the table below are the average result of measurements on a small number of robots. The result may differ depending on where in the working range the robot is positioning, velocity, arm configuration, from which direction the position is approached, the load direction of the arm system. Backlashes in gearboxes also affect the result.

The figures for AP, RP, AT and RT are measured according to figure below.



xx0800000424

Pos	Description	Pos	Description
A	Programmed position	E	Programmed path
B	Mean position at program execution	D	Actual path at program execution
AP	Mean distance from programmed position	AT	Max deviation from E to average path
RP	Tolerance of position B at repeated positioning	RT	Tolerance of the path at repeated program execution

Description	IRB 660-180/3.15	IRB 660-250/3.15
Undirectional pose accuracy, AP[i] (mm)	0.20	0.20
Unidirectional pose repeatability, RP (mm)	0.05	0.05
Linear path repeatability, RT (mm)	0.23	0.17
Linear path accuracy, AT (mm)	2.20	2.13
Pose stabilization time PST (s)	0.17	0.22

i AP according to the ISO test above, is the difference between the teached position (position manually modified in the cell) and the average position obtained during program execution.
The above values are the range of average test results from a number of robots.

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1.8.3 Velocity

Maximum axis speeds

Axis No.	IRB 660-180/3.15	IRB 660-250/3.15
1	130°/s	95°/s
2	130°/s	95°/s
3	130°/s	95°/s
6	300°/s	240°/s

There is a supervision function to prevent overheating in applications with intensive and frequent movements.

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1.8.4 Robot stopping distances and times

Introduction

The stopping distances and times for category 0 and category 1 stops, as required by EN ISO 10218-1 Annex B, are listed in *Product specification - Robot stopping distances according to ISO 10218-1* (*3HAC048645-001*).

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1.9 Customer connections

1.9.1 Introduction

General

Depending on the choice of options above the DressPack will have different content. The choice of routing will not affect the content. See tables for signal content below.

For further information on the customer connection, see *Application interface connection type on page 64*.

DressPack, Parallel, bus and air communication

Type	Application	Specification	Connection type	Harting Article No.	Comment
Power (CP)	Utility power	4x0.75mm^2 (5A/250VAC)	3-module Harting, shell size 10B, EE	Female, EE, 8 pin9 140 083 101	1x0.75 mm^2 protective earth
Signals (CS)	Parallel communication	16x AWG24 + 10x AWG24 (50V/1A)	3-module Harting, shell size 10B, HD+EE	Female, HD, 25 pin9 140 253 101	4 quad twisted, 5 screened pair twisted
Signals (CS)		5x2AWG24 (50V/1A)	3-module Harting, shell size 10B, HD	Female, HD, 25 pin9 140 253 101	Sep. Screened
Bus Communication (BUS)	Profibus	2xAWG26, Z=150 Ohm (1MHz)	3-module Harting, shell size 10B, DD	Female, DD, 12 pin9 140 123 101	
	CANBus	2xAWG26, Z=120 Ohm (1MHz)			
	BUS power & BUS utility	2x2 AWG24			
Air (AIR)	Utility air	2x12.7 (1/2”) P Nom = 16 bar	Parker Push-lock,1/2” M22x1,5 Brass 24 degree seal		

DressPack, Parallel and Ethernet communication

Type	Application	Specification	Connection type	Supplier Article No.	Comment
Functional Earth (FE)		10mm^2	M8 Cable lug		
Bus communication (BUS)	Ethernet/IP, PROFINET	4x0.4mm^2	M12 PFT Slim Design, 4-poles, D-coded	Male,Harting 21038821425	Ethernet CAT5e 100 Mbit[1].
Power (CP)	Utility power	4x0.75mm^2 (5A/250VAC)	3-module Harting, shell size 10B, EE	Female, EE, 8 pin9 140 083 101	1x0.75mm^2 protective earth

1 Ethernet with wire colors according to PROFINET standard

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1.9.1 Introduction
Continued

Type	Application	Specification	Connection type	Supplier Article No.	Comment
Signals (CS)	Parallel communication	16x AWG24 + 10x AWG24 (50V/1A)	3-module Harting, shell size 10B, HD+EE	Female, HD, 25 pin9 140 253 101	4 quad twisted, 5 screened pair twisted
Air (AIR)	Utility air	2x12.7 (1/2”) P_{Nom} = 16 bar	Parker Push-lock,1/2” M22x1,5 Brass 24 degree seal		

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1.10 Maintenance and troubleshooting

1.10.1 Introduction

General

The robot requires only minimum maintenance during operation. It has been designed to make it as easy to service as possible:

- Maintenance-free AC motors are used
- Oil is used for the gear boxes
- The cabling is routed for longevity, and in the unlikely event of a failure, its modular design makes it easy to change

Maintenance

The maintenance intervals depend on the use of the robot, the required maintenance activities also depends on selected options. For detailed information on maintenance procedures, see *Product manual - IRB 660*, chapter *Maintenance*.

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2 Specification of variants and options

2.1 Introduction to variants and options

General

The different variants and options for the IRB 660 are described in the following sections. The same option numbers are used here as in the specification form.

The variants and options related to the robot controller are described in the product specification for the controller.

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2.2 Manipulator

Variants

Option	IRB Type	Handling capacity (kg)	Reach (m)
435-58	660	180	3.15
435-59	660	250	3.15

Manipulator color

Option	Color	RAL code[i]
209-1	ABB orange standard	NCS 2070-Y60R
209-2	ABB white standard	RAL 9003
209-202	ABB Graphite White std Standard color	RAL 7035
209	RAL code should be specified (ABB non-standard colors)	

i The colors can differ depending on supplier and the material on which the paint is applied.

Note

Notice that delivery time for painted spare parts will increase for ABB none standard colors.

Equipment

Option	Type	Description
213-1	Safety lamp	A safety lamp with an orange fixed light can be mounted on the manipulator. The lamp is active in MOTORS ON mode. The safety lamp is required on a UL/UR approved robot.
159-1	Fork lift device	Lifting device on the manipulator for fork-lift handling.
37-1	Base plate	Can also be used for IRB 7600. See dimension drawing in *Mounting the manipulator on page 29*.

Resolver connection, axis 7

Option	Description	Note
864-1	On base	Used together with first additional drive, option 907-1.

Electronic Position Switches (EPS)

Electronic Position Switches (EPS) is an additional safety computer in the controller, with the purpose of providing safe output signals representing the position of robot axes. The output signals are typically connected to cell safety circuitry and/or a safety PLC which takes care of interlocking the robot cell, for example in order to prevent robot and operator to enter a common area simultaneously. See *Application manual - Electronic Position Switches*.

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Work range limit Axis 1

To increase the safety of the robot, the working range of axis 1 can be restricted by extra mechanical stops.

Option	Type	Description
29-2	Axis 1, 7.5 degrees	Two stops which allow the working range to be restricted in increments of 7.5°.

Extended work range

Option	Type	Description
561-1	Extended work range axis 1	To extend the working range on Axis1 from ±180° to ±220°. When the option is used the mechanical stop shall be removed. Requires options SafeMove or EPS (Electronic Position Switches).

CAUTION

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

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

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

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

Warranty

For the selected period of time, ABB will provide spare parts and labor to repair or replace the non-conforming portion of the equipment without additional charges. During that period, it is required to have a yearly *Preventative Maintenance* according to ABB manuals to be performed by ABB. If due to customer restrains no data can be analyzed with ABB Connected Services for robots with OmniCore controllers, and ABB has to travel to site, travel expenses are not covered. The *Extended Warranty* period always starts on the day of warranty expiration. Warranty Conditions apply as defined in the *Terms & Conditions*.

Note

This description above is not applicable for option *Stock warranty* [438-8]

Continues on next page

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Option	Type	Description
438-1	Standard warranty	Standard warranty is 12 months from *Customer Delivery Date* or latest 18 months after *Factory Shipment Date*, whichever occurs first. Warranty terms and conditions apply.
438-2	Standard warranty + 12 months	Standard warranty extended with 12 months from end date of the standard warranty. Warranty terms and conditions apply. Contact Customer Service in case of other requirements.
438-4	Standard warranty + 18 months	Standard warranty extended with 18 months from end date of the standard warranty. Warranty terms and conditions apply. Contact Customer Service in case of other requirements.
438-5	Standard warranty + 24 months	Standard warranty extended with 24 months from end date of the standard warranty. Warranty terms and conditions apply. Contact Customer Service in case of other requirements.
438-6	Standard warranty + 6 months	Standard warranty extended with 6 months from end date of the standard warranty. Warranty terms and conditions apply.
438-7	Standard warranty + 30 months	Standard warranty extended with 30 months from end date of the standard warranty. Warranty terms and conditions apply.
438-8	Stock warranty	Maximum 6 months postponed start of standard warranty, starting from factory shipment date. Note that no claims will be accepted for warranties that occurred before the end of stock warranty. Standard warranty commences automatically after 6 months from *Factory Shipment Date* or from activation date of standard warranty in WebConfig.  **Note** Special conditions are applicable, see *Robotics Warranty Directives*.

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2.3 Floor cables

General

Additional floor cables for customer connections see *Process on page 64*.

Manipulator cable length

Option	Lengths
210-2	7 m
210-3	15 m
210-4	22 m
210-5	30 m

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2.4 Process

Application interface connection type

Option	Description	
16-1	Cabinet [i]	The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08, to the control module.

[i] In a MultiMove application, additional robots have no control module. The screw terminal with internal cabling are then delivered separately to be mounted in the main robot control module or in another encapsulation, for example a PLC cabinet.

Communication

Option	Type	Description
455-6	Parallel, Bus and Air Communication	Includes Customer Signals (CS), Customer Power (CP), Bus signals and two hoses for Air (inner diameter 12.5 mm)
455-8	Parallel and Ethernet communication	Includes CP, customer signals and PROFINET or Ethernet/IP for process cable package and two hoses for Air (inner diameter 12.5 mm)

Parallel/CAN/DeviceNet/Profibus/Ethernet

The following information specifies the cable length for Parallel/CAN/DeviceNet/Profibus/Ethernet for connection to cabinet.

Option	Lengths
90-2/92-2/859-1/94-1	7 m
90-3/92-3/859-2/94-2	15 m
90-4/859-3	22 m
90-5/92-5/859-4/94-4	30 m

Empty cabinet

Option	Type	Description
768-1	Empty cabinet small	See *Product specification - Controller IRC5 with FlexPendant*
715-1	Installation kit	See *Product specification - Controller IRC5 with FlexPendant*

Connector kits upper arm

Option	Type	Description
431-1	Upper arm	Connector for customer Power/Signals/ and bus at axis 6 tool side.

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2.5 User documentation

User documentation

The user documentation describes the robot in detail, including service and safety instructions.



Tip

All documents can be found via ABB Robotics One, *https://one.robotics.abb.com/en/knowledge-hub*.

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2.6 Warranty

Warranty

For the selected period of time, ABB will provide spare parts and labor to repair or replace the non-conforming portion of the equipment without additional charges. During that period, it is required to have a yearly *Preventative Maintenance* according to ABB manuals to be performed by ABB. If due to customer restrains no data can be analyzed with ABB Connected Services for robots with OmniCore controllers, and ABB has to travel to site, travel expenses are not covered. The *Extended Warranty* period always starts on the day of warranty expiration. Warranty Conditions apply as defined in the *Terms & Conditions*.

Note

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3 Accessories

3.1 Introduction to accessories

General

There is a range of tools and equipment available.

Basic software and software options for robot and PC

For more information, see *Product specification - Controller IRC5* and *Application manual - Controller software IRC5*.

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3HAC023932-001, Rev AB, en

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