

ABB Robotics

Product specification IRB 1600



Product specification

Articulated robot

IRB 1600-6/1.2

IRB 1600-6/1.45

IRB 1600-8/1.2

IRB 1600-8/1.45

IRB 1600ID-4/1.5

M2004

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Revision: M

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Overview of this manual

About this Product specification

It 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 requirements
- The load diagrams, mounting of extra equipment, the motion and the robot reach
- The integrated auxiliary equipments as that is: Customer Connections
- The specification of variant and options available

Users

It is intended for:

- Product managers and Product personnel
- Sales and Marketing personnel
- Order and Customer Service personnel

Contents

Please see Table of Contents.

References

Reference	Document ID
<i>Product specification - Controller IRC5 with FlexPendant</i>	3HAC021785-001
<i>Product specification - Controller software IRC5</i>	3HAC022349-001
<i>Product specification - Robot user documentation</i>	3HAC024534-001
<i>Product manual - IRB 1600</i>	3HAC023637-001

Revisions

Revision	Description
3	- Calibration positions and Absolute Accuracy information added in chapter 1.4 - New Inside address for ABB RobotLoad - New wrist, Type A added in chapter 1.5.5 - Figures for customer connections added
D	- Option 287-5 Wash removed
E	- New versions IRB 1600ID-4/1.5, IRB 1600-6/x and IRB 1600-8/x added - Changes in Safety/Standards - Directions of forces added - Increased payloads for standard robots - Arc welding options added - Warranty information for load diagrams
F	- Old versions removed and AW offer changed.

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Continued

Revision	Description
G	<ul style="list-style-type: none">- Changes for Calibration data- Work range- Explanation of ISO values (new figure and table)- Stopping distance- Changes in chapter Specification of Variants and Options, Track Motion and Process equipment- User documentation on DVD
H	<ul style="list-style-type: none">- Added information about mounting equipment on upper arm
J	<ul style="list-style-type: none">- General update for 9.1 release
K	<ul style="list-style-type: none">- Updated/Corrected Clean Room Class- Option 17/6 removed in Variants and Options
L	<ul style="list-style-type: none">- Foundry Plus 2- Clean Room removed
M	<ul style="list-style-type: none">- Text for Standards updated

1 Description

1.1 Structure

1.1.1. Introduction

Robot family

A number of new possibilities open up with ABB's IRB 1600 robot. It is available in five versions, and the latest one is the dedicated AW robot, IRB 1600ID-4/1.5 with an compact AW dressed process upper arm.

The IRB 1600 family is ideal for Arc Welding, Machine Tending, Material Handling, Gluing and Deburring/Grinding applications.

Software product range

We have added a range of software products - all falling under the umbrella designation of Active Safety - to protect not only personnel in the unlikely event of an accident, but also robot tools, peripheral equipment and the robot itself.

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 etc. 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 features - network communication - and advanced functions such as multitasking, sensor control etc. For a complete description on optional software, see the *Product specification - Controller software IRC5*.

Foundry Plus 2

The Foundry Plus option is designed for harsh environments where the robot is exposed to sprays of coolants, lubricants and metal spits that are typical for die casting applications or other similar applications. Typical applications are spraying insertion and part extraction of die-casting machines, cast cleaning, handling in sand casting and gravity casting, etc. (Please refer to Foundry Prime for washing applications or other similar applications). Special care must be taken in regard to operational and maintenance requirements for applications in foundry are as well as in other applications areas. Please contact ABB Robotics Sales organization if in doubt regarding specific application feasibility for the Foundry Plus protected robot. The Foundry Plus robot is painted with two-component epoxy on top of a primer for corrosion protection. To further improve the corrosion protection additional rust preventive are applied to exposed and crucial areas, e.g. has the tool flange a special preventive coating. Although, continuous splashing of water or other similar rust formation

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1 Description

1.1.1. Introduction

Continued

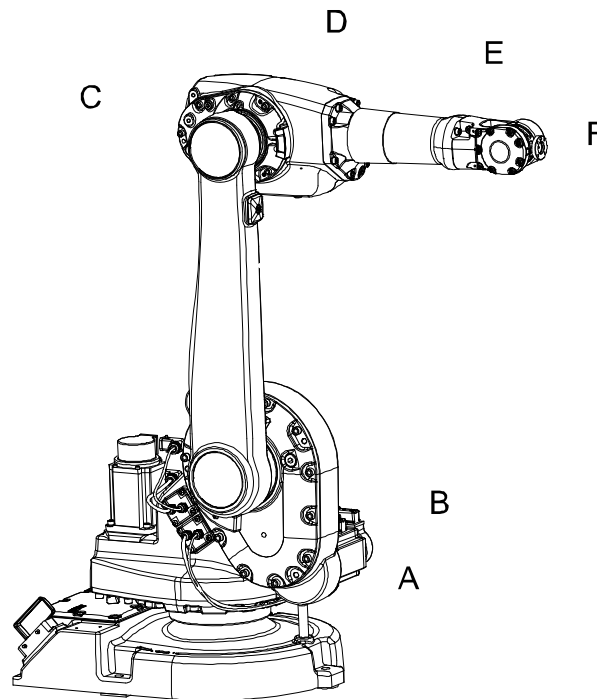
fluids may cause rust to attach on the robot's unpainted areas, joints, or other unprotected surfaces. Under these circumstances it is recommended to add rust inhibitor to the fluid or take other measures to prevent potential rust formation on the mentioned. The entire robot is IP67 compliant according to IEC 60529 - from base to wrist, which means that the electrical compartments are sealed against liquid and solid contaminants. Among other things all sensitive parts are better protected than the standard offer.

Selected Foundry Plus/Foundry Plus 2 features:

- Improved sealing to prevent penetration into cavities to secure IP67
- Additional protection of cabling and electronics
- Special covers protecting cavities
- Well-proven connectors
- Nickel coated tool flange (Foundry Plus 2)
- Rust preventives on screws, washers and unpainted/machined surfaces

The Foundry Plus robot can be cleaned with appropriate washing equipment according to product manual. Appropriate cleaning and maintenance are required to maintain the Foundry Plus 2 protection, for example can rust preventive be washed off with wrong cleaning method.

Manipulator axes



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Pos	Description	Pos	Description
A	Axis 1	B	Axis 2
C	Axis 3	D	Axis 4
E	Axis 5	F	Axis 6

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1.1.2. Different robot versions

General

The IRB 1600 is available in five versions and four of them can be mounted on the floor, wall, tilted (up to 60 degrees around the Y-axis) or inverted. See *Robot Motion on page 38* for limitations.

The IRB 1600ID-4/1.5 can only be mounted on the floor or inverted.

Robot type	Handling capacity (kg)	Reach (m)
IRB 1600	6 kg	1.2 m
IRB 1600	6 kg	1.45 m
IRB 1600	8 kg	1.2 m
IRB 1600	8 kg	1.45 m
IRB 1600ID	4 kg	1.5 m

Manipulator weight

Robot	Weight
IRB 1600-X/1.2	250 kg
IRB 1600-X/1.45	250 kg
IRB 1600ID-4/1.5	250 kg

Other technical data

Data	Description	Note
Airborne noise level	The sound pressure level outside the working space	< 70 dB (A) Leq (acc. to Machinery directive 89/392 EEC)

Power consumption

Path E1-E2-E3-E4 in the ISO Cube, max.load.

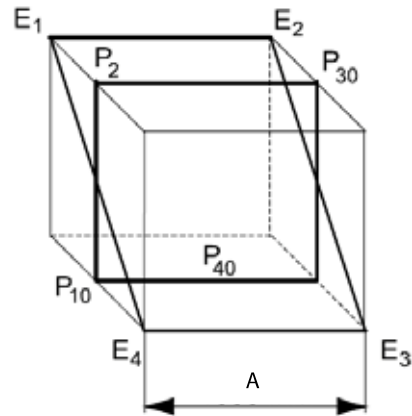
Speed (mm/s)	Power consumption (kW)	
	IRB 1600-x/1.2	IRB 1600(ID)-x/1.45(1.5)
Max.	0.58	0.57
1000	0.49	0.50
500	0.45	0.45
100	0.41	0.43

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1 Description

1.1.2. Different robot versions

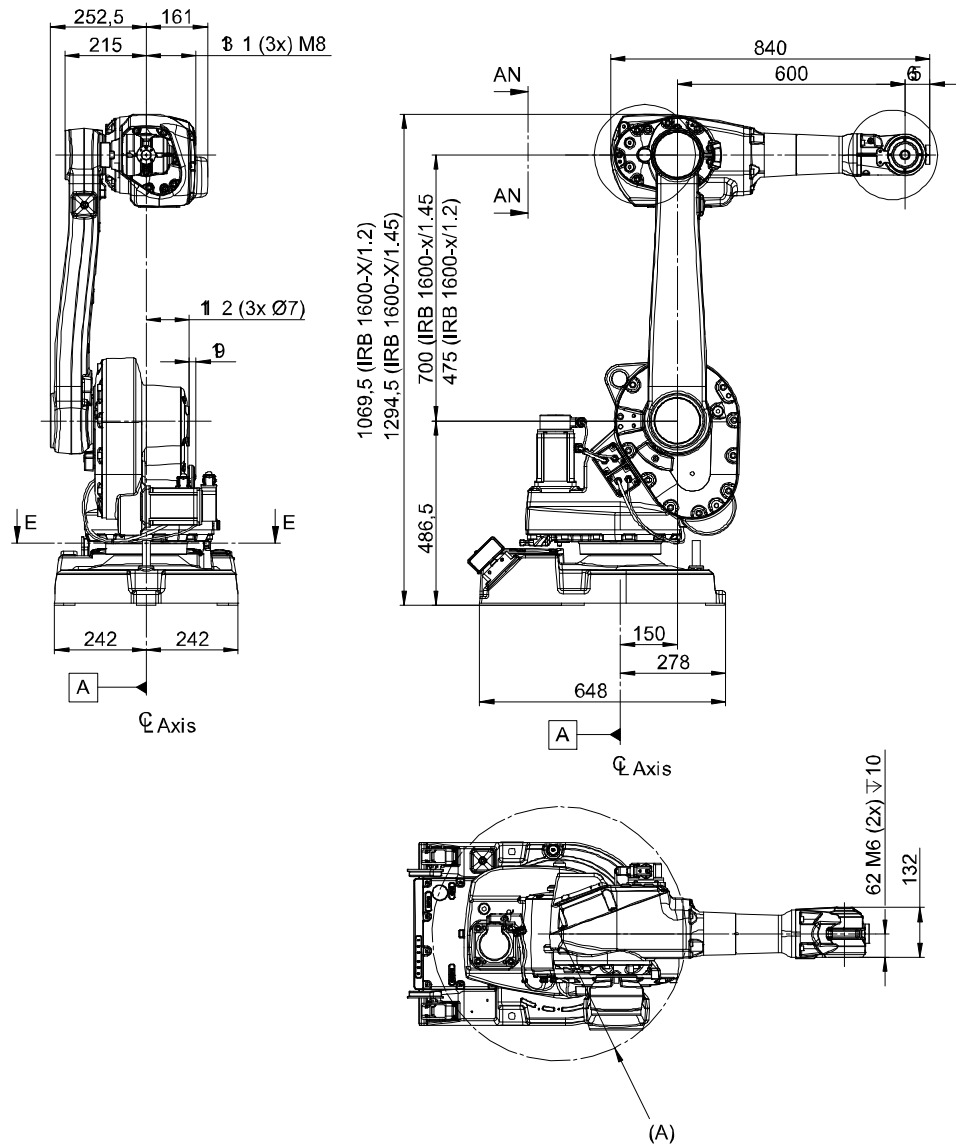
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Pos	Description
A	400

Dimensions IRB 1600-X/1.2 (1.45)



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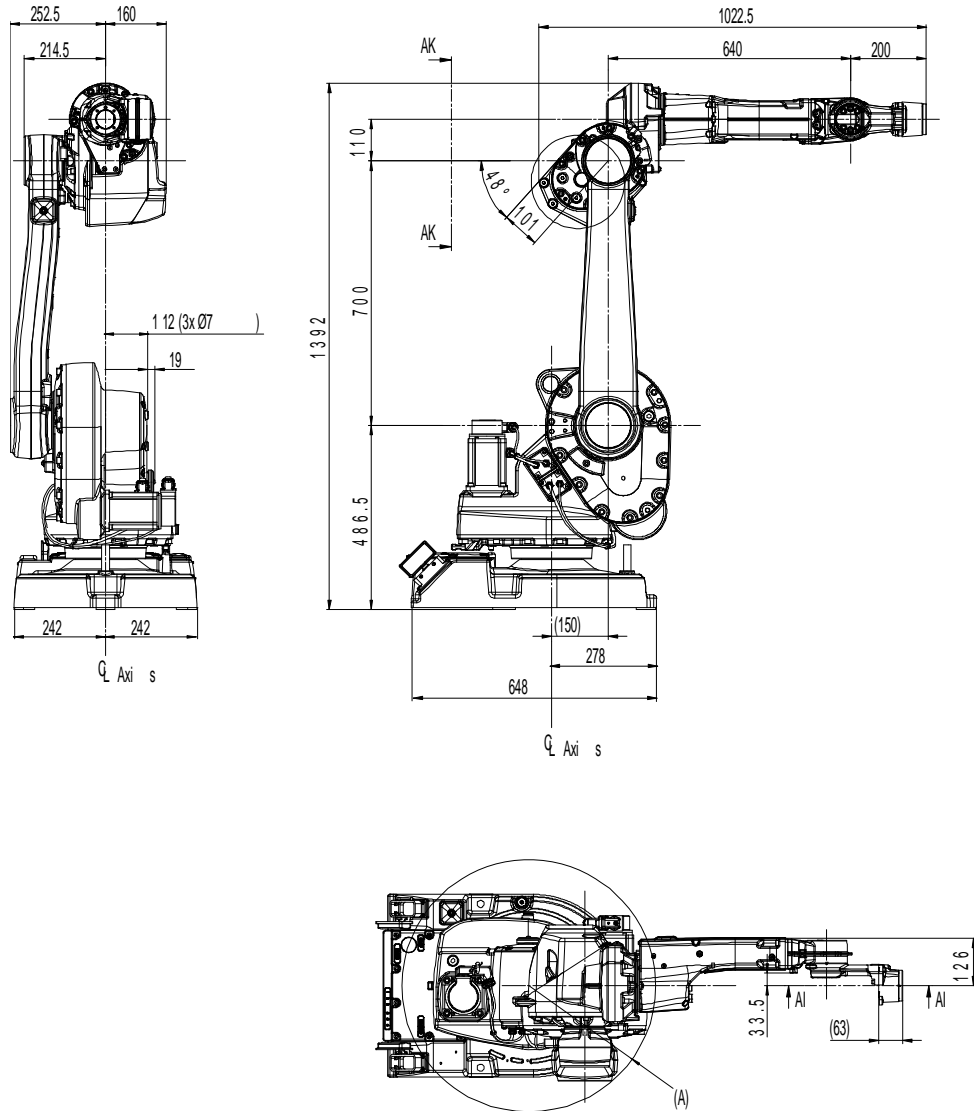
Pos	Description
A	R335 Minimum turning radius

1 Description

1.1.2. Different robot versions

Continued

Dimensions IRB 1600ID-4/1.5



xx1000000893

Pos	Description
A	R335 Minimum turning radius

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1.2 Standards

1.2.1. Standards

Standards, EN ISO

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

Standard	Description
EN ISO 12100 -1	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
EN ISO 12100 -2	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles
EN ISO 13849-1	Safety of machinery, safety related parts of control systems - Part 1: General principles for design
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 10218-1 ¹	Robots for industrial environments - Safety requirements -Part 1 Robot
EN ISO 9787	Manipulating industrial robots, Coordinate systems and motion nomenclatures
EN ISO 9283	Manipulating industrial robots, Performance criteria and related test methods
EN ISO 14644-1 ²	Classification of air cleanliness
EN ISO 13732-1	Ergonomics of the thermal environment - Part 1
EN IEC 61000-6-4 (option 129-1)	EMC, Generic emission
EN IEC 61000-6-2	EMC, Generic immunity
EN IEC 60974-1 ³	Arc welding equipment - Part 1: Welding power sources
EN IEC 60974-10 ³	Arc welding equipment - Part 10: EMC requirements
EN IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 General requirements
IEC 60529	Degrees of protection provided by enclosures (IP code)

1. There is a deviation from paragraph 6.2 in that only worst case stop distances and stop times are documented.

2. Only robots with Protection Clean Room.

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

European standards

Standard	Description
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 574	Safety of machinery - Two-hand control devices - Functional aspects - Principles for design
EN 953	Safety of machinery - General requirements for the design and construction of fixed and movable guards

Continues on next page

1 Description

1.2.1. Standards

Continued

Other standards

Standard	Description
ANSI/RIA R15.06	Safety Requirements for Industrial Robots and Robot Systems
ANSI/UL 1740(option 429-1)	Safety Standard for Robots and Robotic Equipment
CAN/CSA Z 434-03(option 429-1)	Industrial Robots and Robot Systems - General Safety Requirements

1.3 Installation

1.3.1. Introduction

General

IRB 1600 can be mounted on the floor, wall, tilted (up to 60 degrees around the Y-axis) or inverted. See *Robot Motion on page 38* for limitations.

IRB 1600ID-4/1.5 can only be mounted on the floor or inverted. An end effector with max. weight of 6 kg or 8 kg including payload, can be mounted on the tool flange (axis 6), 4 kg valid for the IRB 1600ID-4/1.5 robot. See *Load diagrams on page 25*.

Extra equipment can be mounted on to the hip and on the upper arm. See *Mounting of equipment on page 33*.

Extra Loads

Extra load, which is included in the load diagrams, can be mounted on the upper arm. No extra arm load is included in the load diagram for IRB 1600ID-4/1.5. An extra load of 15 kg can also be mounted on the frame of axis 1. See *Mounting hole for equipment on page 35*.

Working Range

The working range of axes 1-3 can be limited by mechanical stops. Electronic Position Switches can be used on all axes for position indication of the manipulator.

1 Description

1.3.2. Operating requirements

1.3.2. Operating requirements

Protection Standards

Robot version	Protection Standard IEC60529
Standard manipulator	IP 54
Protection Foundry Plus 2	IP 67
IRB 1600ID-4/1.5	IP 40

Explosive Environments

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

Ambient Temperature

Description	Standard/Option	Temperature
Manipulator during operation	Standard	+ 5°C (+ 41°F) to + 45°C (+ 113°F)
For the controller	Standard/Option	See <i>Product specification - Controller IRC5 with FlexPendant</i>
Complete robot (incl. controller) during transportation and storage	Standard	- 25°C (- 13°F) to + 55°C (+ 131°F) For short periods not > 24 hours: + 70°C (+ 158°F)

Relative Humidity

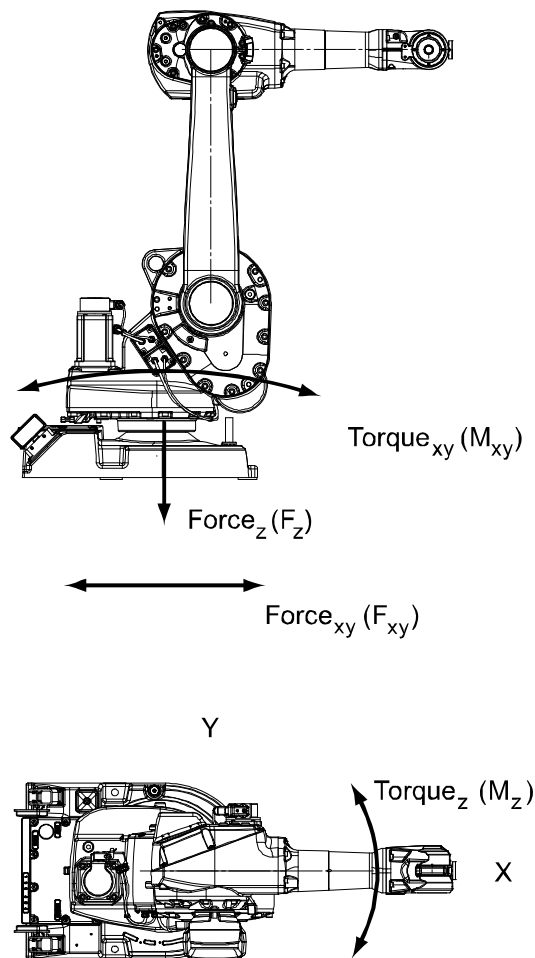
Description	Relative humidity
Complete robot during operation, transportation and storage	Max. 95% at constant temperature

1.3.3. Mounting the manipulator

General

Maximum load in relation to the base coordination system. See Figure on next page.

	Mounting	Endurance load in operation	Max. load at Emergency stop
Force XY	Floor mounted	$\pm 1650 \text{ N}$	$\pm 3150 \text{ N}$
	Suspended	$\pm 1650 \text{ N}$	$\pm 3150 \text{ N}$
	Wall mounted	$\pm 3900 \text{ N}$	$\pm 5300 \text{ N}$
	Tilted $\pm 30^\circ$	$\pm 2500 \text{ N}$	$\pm 6000 \text{ N}$
Force Z	Floor mounted	$- 2500 \pm 1150 \text{ N}$	$- 2500 \pm 2200 \text{ N}$
	Suspended	$+ 2500 \pm 1150 \text{ N}$	$+ 2500 \pm 2200 \text{ N}$
	Wall mounted	$\pm 1300 \text{ N}$	$\pm 2400 \text{ N}$
	Tilted $\pm 30^\circ$	$+ 2100 \pm 1600 \text{ N}$	$+ 2100 \pm 3000 \text{ N}$
Torque XY	Floor, suspended	$\pm 1700 \text{ Nm}$	$\pm 3750 \text{ Nm}$
Torque Z	Floor, suspended	$\pm 855 \text{ Nm}$	$\pm 1400 \text{ Nm}$
Torque XY	Wall mounted	$\pm 2310 \text{ Nm}$	$\pm 3850 \text{ Nm}$
Torque Z	Wall mounted	$\pm 855 \text{ Nm}$	$\pm 1430 \text{ Nm}$



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1 Description

1.3.3. Mounting the manipulator

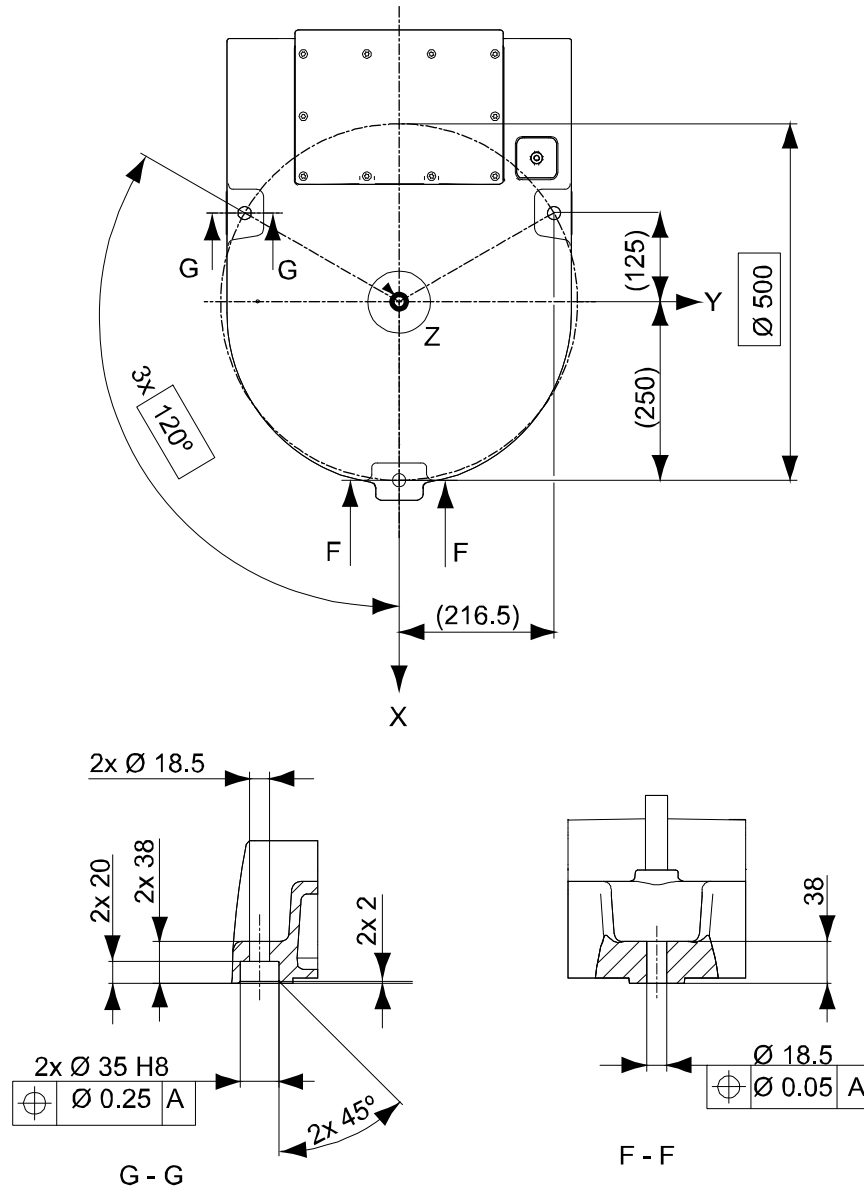
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Note regarding M_{xy} and F_{xy}

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}).

Fastening holes Robot base



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Attachment bolts, specification

The table below specifies required bolts and washers for securing the robot at installation site.

Specification	Description
Attachment bolts, 3 pcs	M16 x 60 (installation directly on foundation) M16 x 70/80 (installation on foundation or base plate, using guiding sleeves)

Continues on next page

Continued

Specification	Description
Washers, 3 pcs	17 x 30 x 3
Quality	Quality 8.8, wall mounted quality 12.9
Tightening torque	200 Nm



NOTE!

Note: For wall mounted robot, two guide bushings according to Figure below are needed.

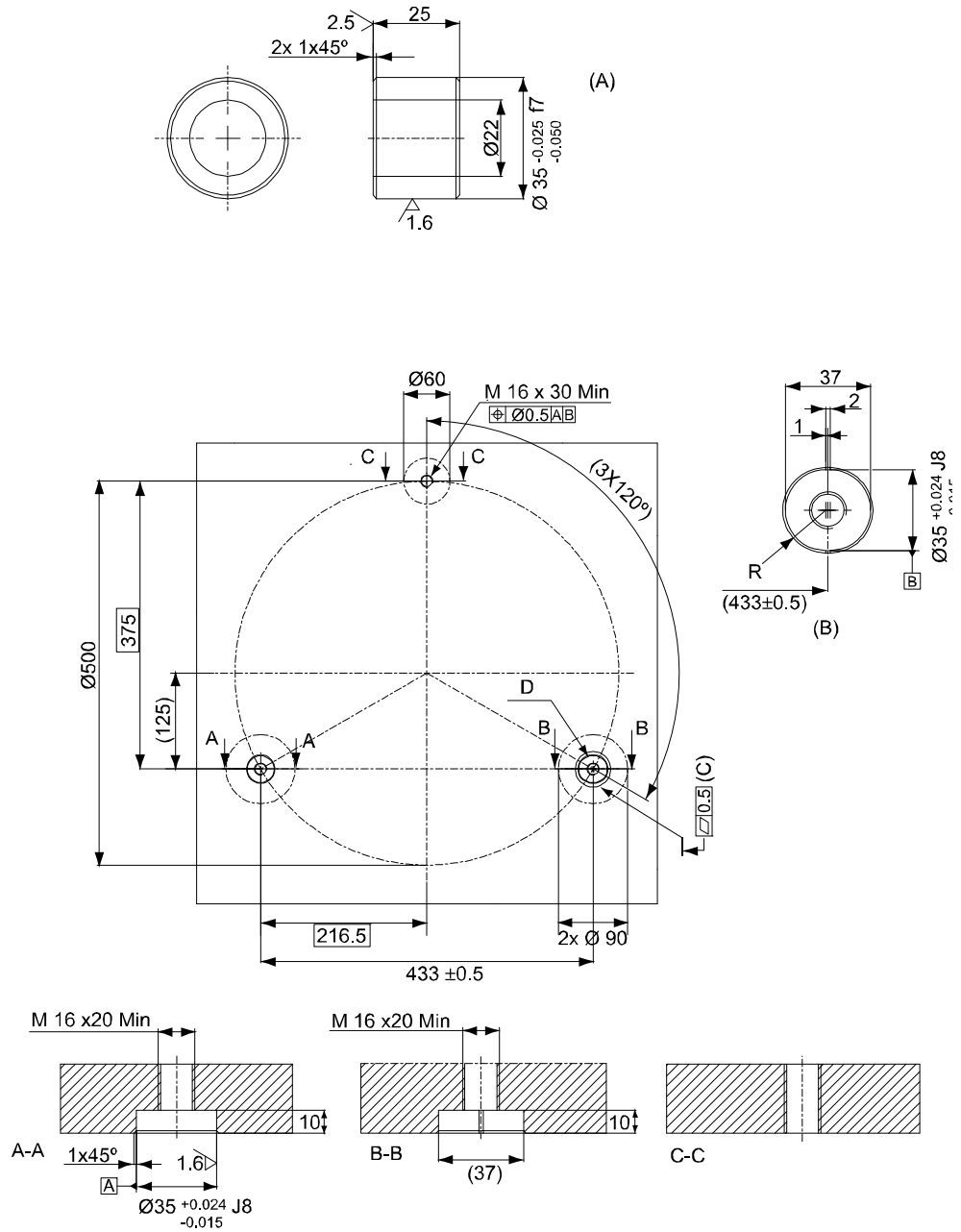
Regarding Abs.Acc. performance, the chosen guide holes according to Figure in the beginning of this chapter are recommended.

1 Description

1.3.3. Mounting the manipulator

Continued

Mounting surface and bushings



Pos	Description
A	Surface treatment, ISO 2081 Fe/Zn 8 c2, Guide bushing
B	View D
C	3x common zone

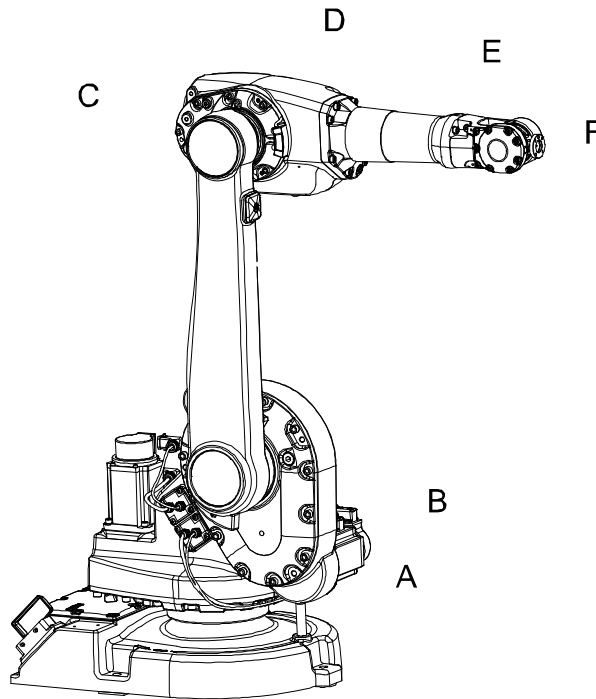
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1.4 Calibration and References

1.4.1. Fine calibration

General

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



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Pos	Description	Pos	Description
A	Axis 1	B	Axis 2
C	Axis 3	D	Axis 4
E	Axis 5	F	Axis 6

Calibration

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

1 Description

1.4.2. Absolute Accuracy calibration

1.4.2. Absolute Accuracy calibration

General

Requires RobotWare option Absolute Accuracy, please see *Product specification - Controller software IRC5/RobotWare Options* for more details.

The calibration concept

Absolute Accuracy (AbsAcc) is a calibration concept, which ensures a TCP absolute accuracy of better than ± 1 mm in the entire working range (working range of bending backward robots, for example IRB 1600, are limited to only forward positions).

Absolute accuracy compensates for:

- Mechanical tolerances in the robot structure
- Deflection due to load

Absolute accuracy calibration is focusing on positioning accuracy in the cartesian coordinate system for the robot. It also includes load compensation for deflection caused by the tool and equipment. Tool data from robot program is used for this purpose. The positioning will be within specified performance regardless of load.

Calibration data

The user is supplied with robot calibration data (compensation parameters saved on the manipulator SMB) and a certificate that shows the performance (Birth certificate). The difference between an ideal robot and a real robot without AbsAcc can typically be 8 mm, resulting from mechanical tolerances and deflection in the robot structure.

If there is a difference, at first start-up, between calibration data in controller and the robot SMB, correct by copying data from SMB to controller.

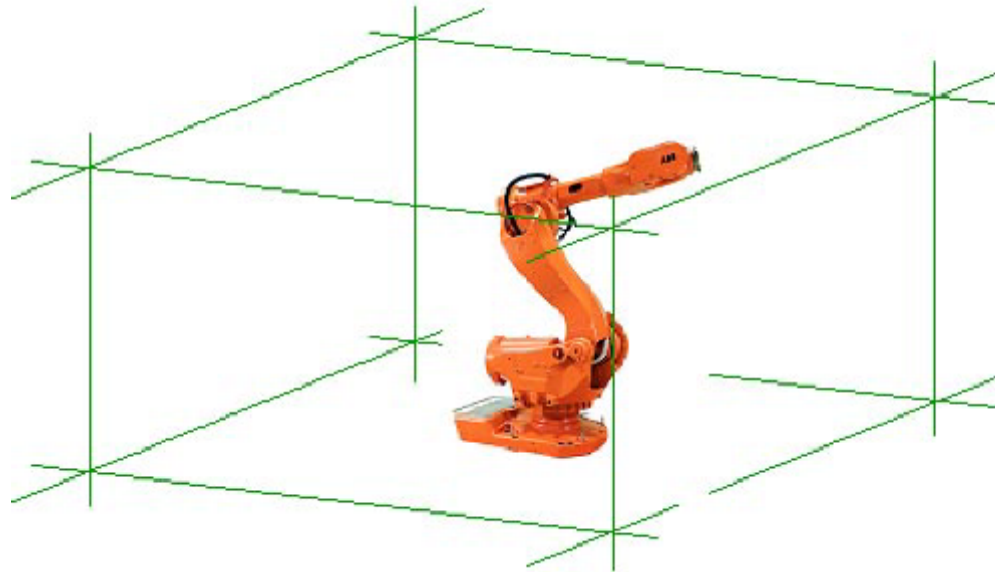
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Absolute Accuracy option

Absolute Accuracy option is integrated in the controller algorithms for compensation of this difference and does not need external equipment or calculation.

Absolute Accuracy is a RobotWare option and includes an individual calibration of the robot (mechanical arm).

Absolute Accuracy is a TCP calibration in order to Reach (m) a good positioning in the Cartesian coordinate system.



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Production data

Typical production data regarding calibration are:

Robot	Positioning accuracy (mm)		
	Average	Max	% Within 1 mm
IRB 1600-6/1.2 -6/1.45 -8/1.2 -8/1.45	0.30	0.65	100
IRB 1600ID-4/1.5	0.35	0.65	100

1 Description

1.5.1. Introduction

1.5 Robot load and Load diagrams

1.5.1. Introduction

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

- motors
- gearboxes
- mechanical structure

**WARNING!**

In the robot system is the service routine LoadIdentify available, which allows the user to make an automatic definition of the tool and load, to determine correct load parameters. Please see *Operating Manual - IRC5 with FlexPendant*, art. No. 3HAC16590-1, for detailed information.

**WARNING!**

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

General

The load diagrams include a nominal pay load inertia, J_0 of 0.012 kgm², and an extra load of 15 kg for the IRB 1600-6/x variants and IRB 1600ID-4/1.5 (hose package included), 5 kg for the IRB 1600-8/x variants, at the upper arm housing.

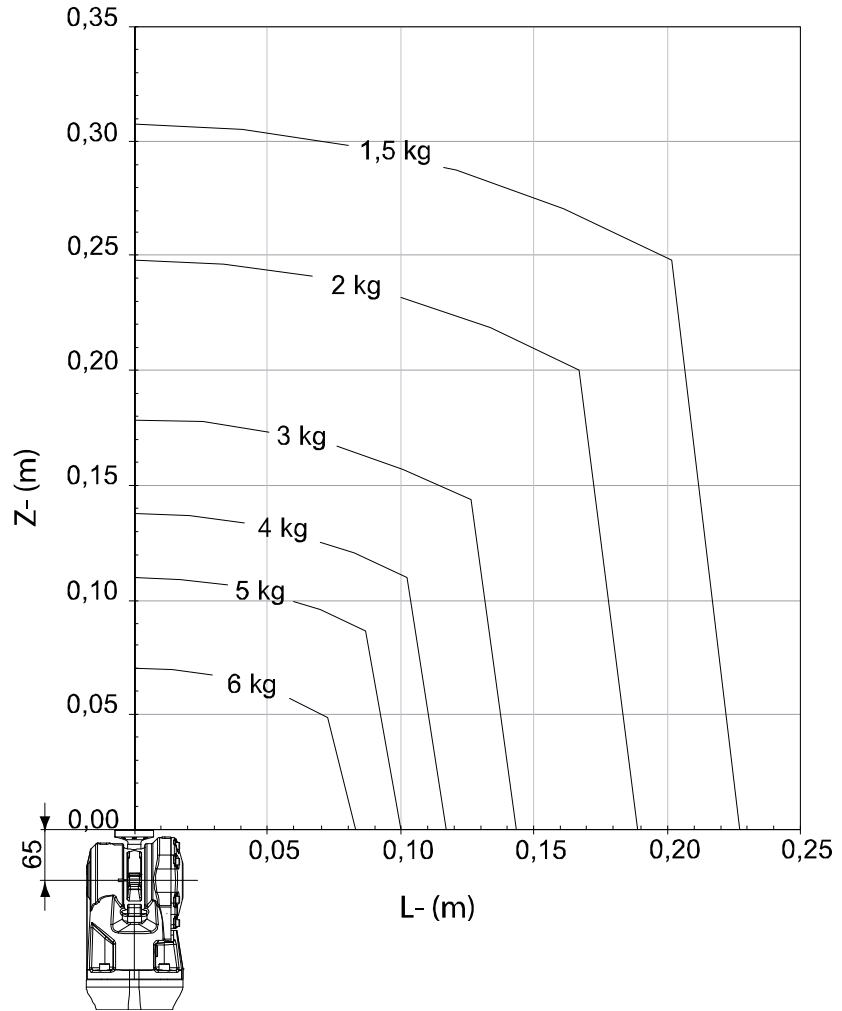
At different arm load and moment of inertia the load diagram will be changed.

Control of load case by “RobotLoad”

For an easy check of a specific load case, use the calculation program ABB RobotLoad. Please contact your local ABB organization.

1.5.2. Load diagrams

IRB 1600-6/1.2, IRB 1600-6/1.45



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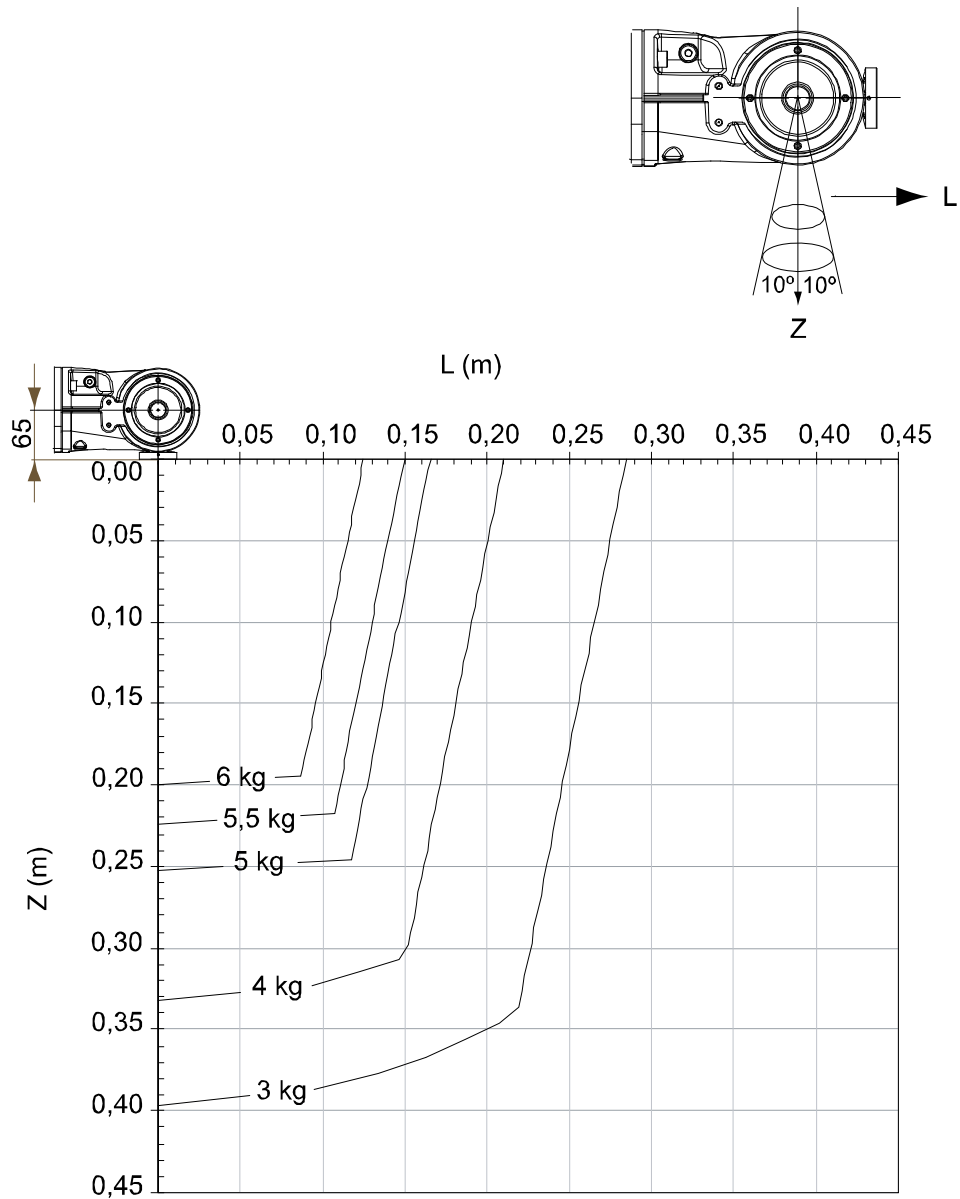
Extra load of 15 kg at the upper arm housing included in the load diagram.

1 Description

1.5.2. Load diagrams

Continued

IRB 1600-6/1.2, IRB 1600-6/1.45 "Vertical Wrist" ($\pm 10^\circ$)



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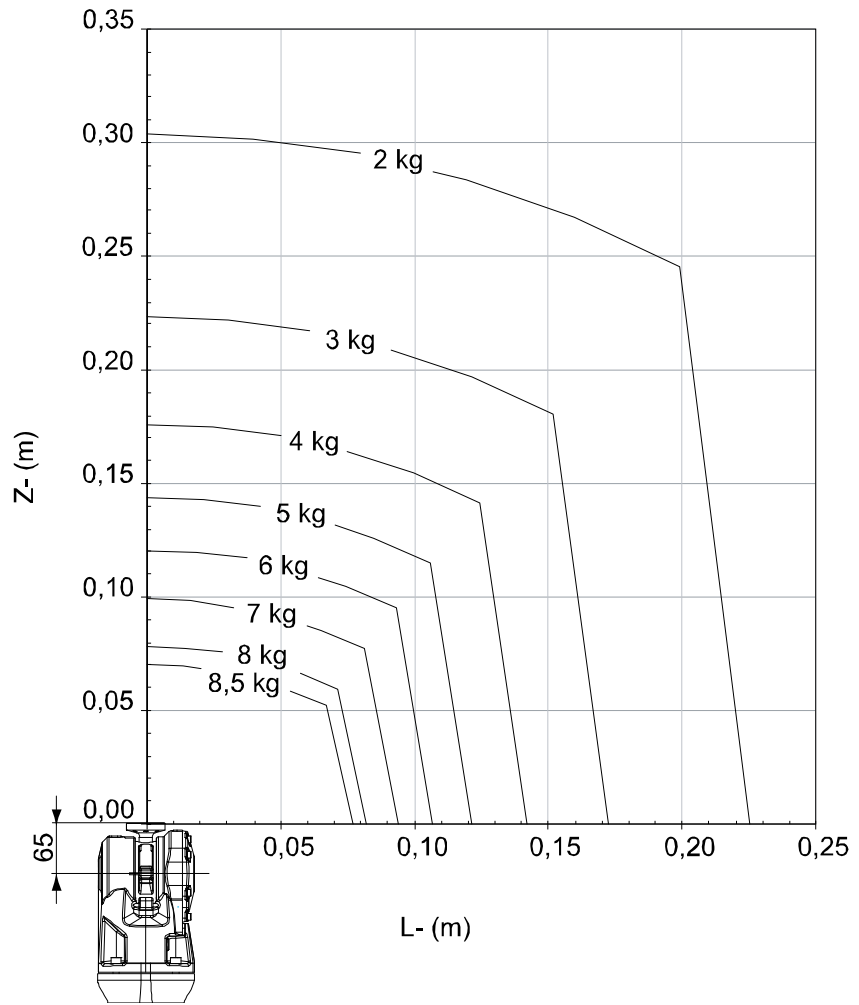
Extra load of 15 kg at the upper arm housing included in the load diagram.

Description	Values
For wrist down (0° deviation from the vertical line) and no arm loads.	Max load = 13 kg $Z_{\text{Max}} = 0.057 \text{ m}$ $L_{\text{Max}} = 0.031 \text{ m}$

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IRB 1600-8/1.2, IRB 1600-8/1.45



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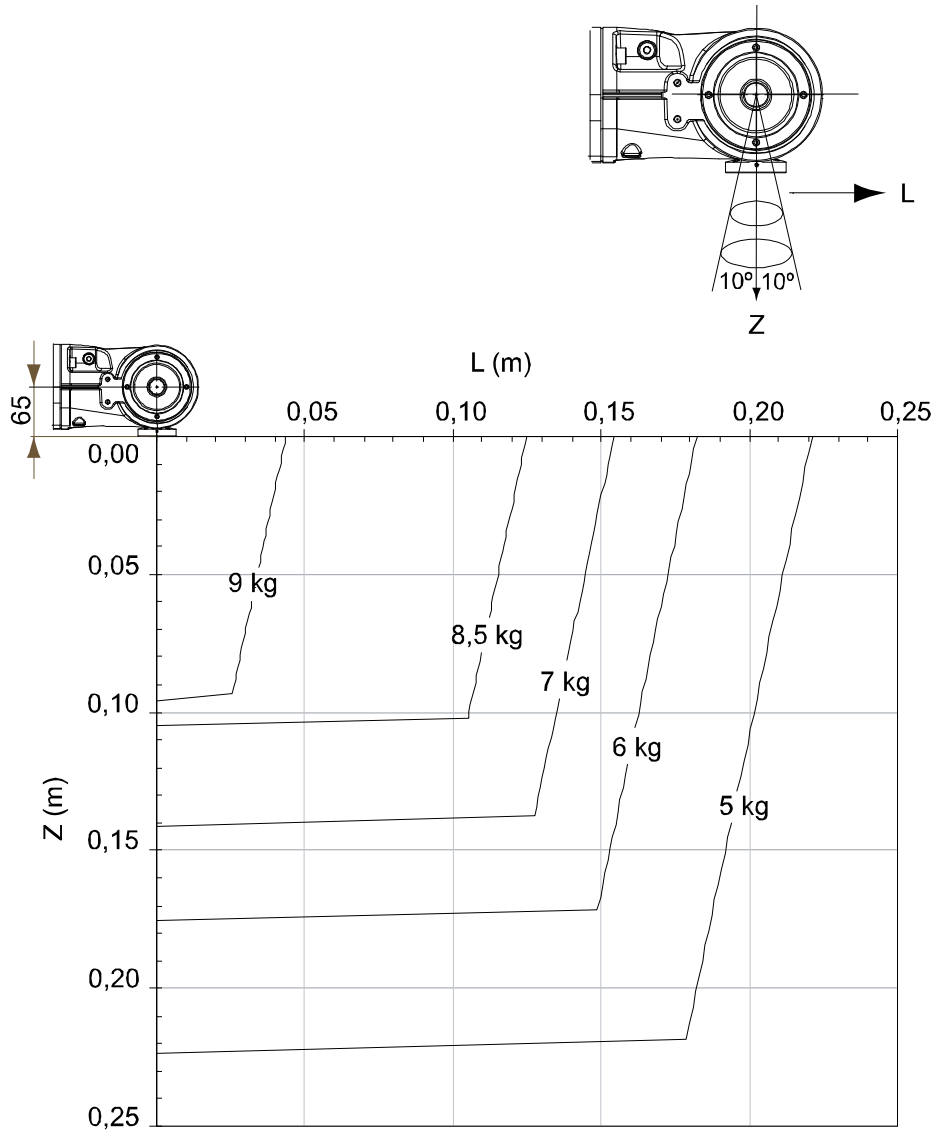
Extra load of 5 kg at the upper arm housing included in the load diagram.

1 Description

1.5.2. Load diagrams

Continued

IRB 1600-8/1.2, IRB 1600-8/1.45 "Vertical Wrist" ($\pm 10^\circ$)



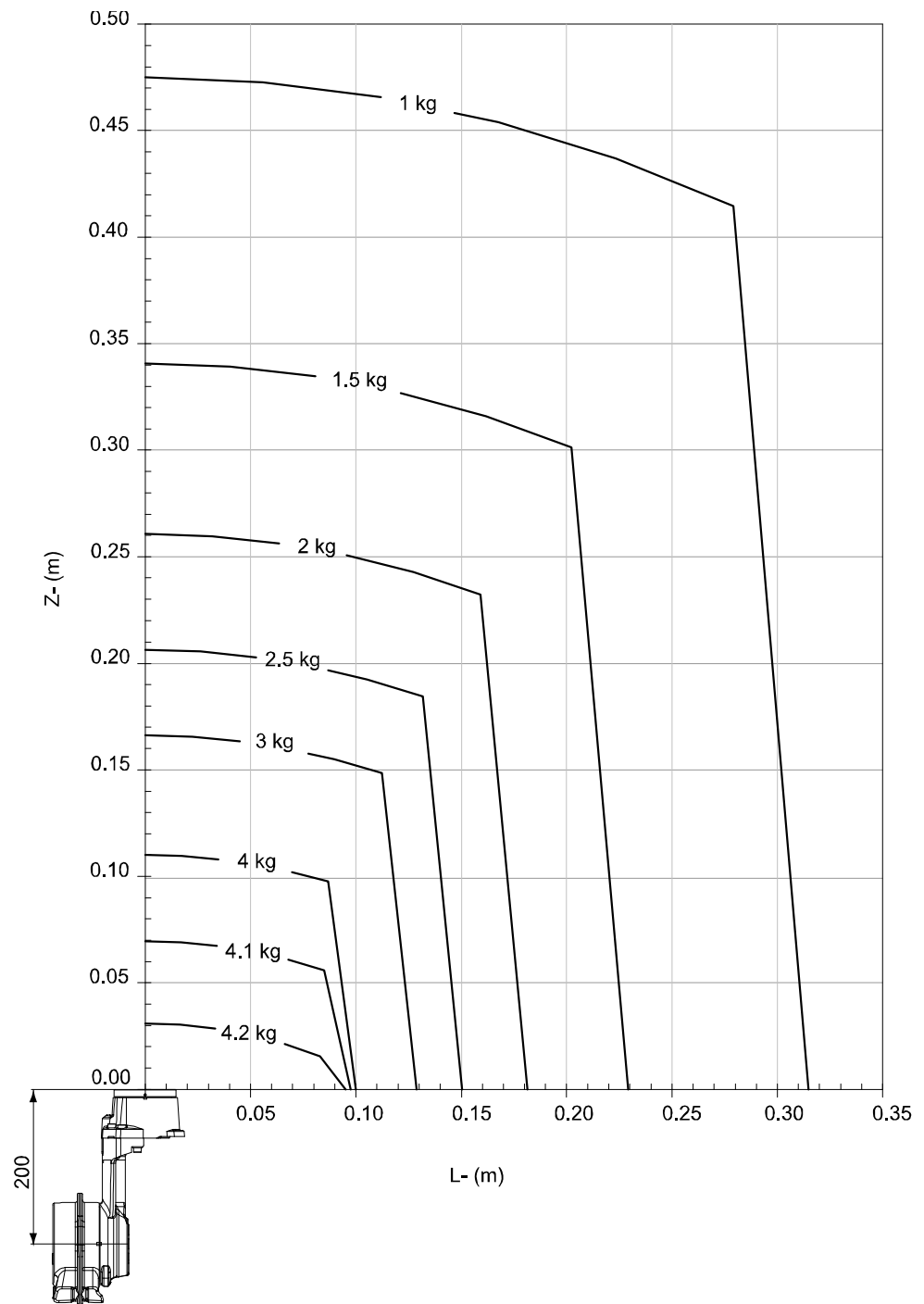
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Extra load of 5 kg at the upper arm housing included in the load diagram.

Description	Values
For wrist down (0° deviation from the vertical line) and no arm loads.	Max load = 12 kg ZMax = 0.055 m LMax = 0.017 m

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IRB 1600ID-4/1.5



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Extra load of 15 kg (hose package included) at the upper arm housing included in the load diagram.

1 Description

1.5.3. Maximum load and moment of inertia for full and limited axis 5 (center line down) movement

1.5.3. Maximum load and moment of inertia for full and limited axis 5 (center line down) movement

General

Total load given as: Mass in kg, center of gravity (Z and L) in m and moment of inertia (J_{ox} , J_{oy} , J_{oz}) in kgm^2 . $L = \sqrt{X^2 + Y^2}$, see Figure below.

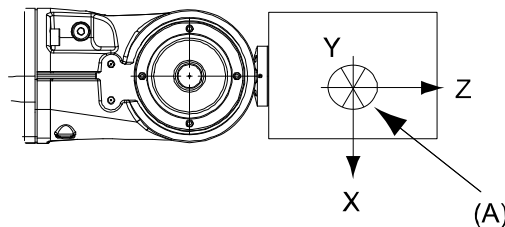
Full movement of Axis 5 ($\pm 115^\circ$)

Axis	Robot Type	Max. value
5	IRB 1600-6/x	$J_5 = \text{Mass} \times ((Z + 0.065)^2 + L^2) + \max(J_{ox}, J_{oy}) \leq 0.42 \text{ kgm}^2$
6	IRB 1600-6/x	$J_6 = \text{Mass} \times L^2 + J_{oz} \leq 0.30 \text{ kgm}^2$

Axis	Robot Type	Max. value
5	IRB 1600-8/x	$J_5 = \text{Mass} \times ((Z + 0.065)^2 + L^2) + \max(J_{ox}, J_{oy}) \leq 0.53 \text{ kgm}^2$
6	IRB 1600-8/x	$J_6 = \text{Mass} \times L^2 + J_{oz} \leq 0.39 \text{ kgm}^2$

Full movement of Axis 5 ($+155^\circ$ to -90°)

Axis	Robot Type	Max. value
5	IRB 1600ID-4/1.5	$J_5 = \text{Mass} \times ((Z + 0.200)^2 + L^2) + \max(J_{ox}, J_{oy}) \leq 0.58 \text{ kgm}^2$
6	IRB 1600ID-4/1.5	$J_6 = \text{Mass} \times L^2 + J_{oz} \leq 0.24 \text{ kgm}^2$



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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.

Limited axis 5, Center line down

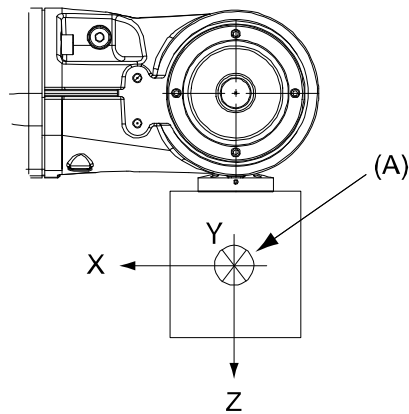
Axis	Robot Type	Max. value
5	IRB 1600-6/x	$J_5 = \text{Mass} \times ((Z + 0.065)^2 + L^2) + \max(J_{ox}, J_{oy}) \leq 0.55 \text{ kgm}^2$
5	IRB 1600-8/x	$J_5 = \text{Mass} \times ((Z + 0.065)^2 + L^2) + \max(J_{ox}, J_{oy}) \leq 0.65 \text{ kgm}^2$
6	IRB 1600-6/x	$J_6 = \text{Mass} \times L^2 + J_{oz} \leq 0.40 \text{ kgm}^2$
6	IRB 1600-8/x	$J_6 = \text{Mass} \times L^2 + J_{oz} \leq 0.48 \text{ kgm}^2$

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Continues on next page

1.5.3. Maximum load and moment of inertia for full and limited axis 5 (center line down) movement

Continued



xx1000000904

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.

1 Description

1.5.4. Wrist torque

1.5.4. Wrist torque

General



The table below shows the maximum permissible torque due to payload.

NOTE!

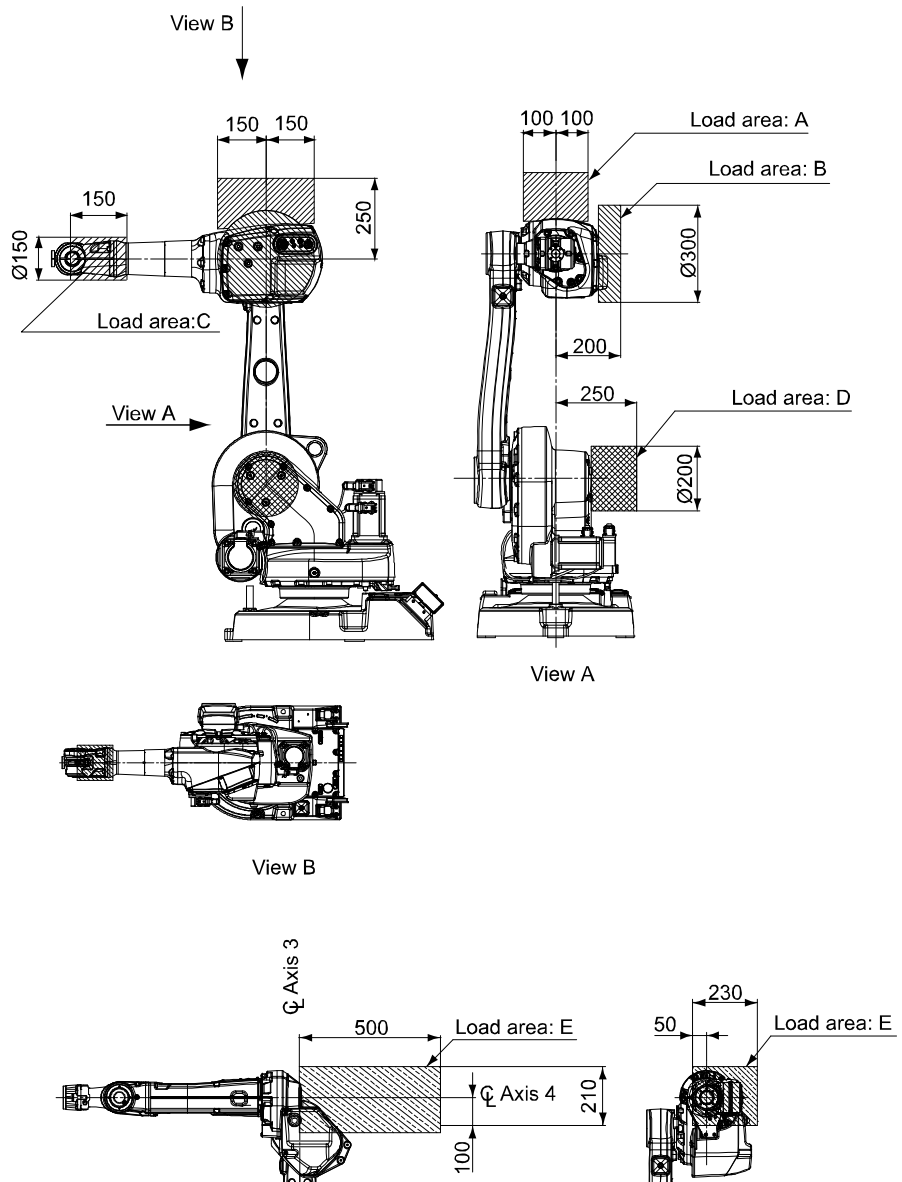
Note! The values are for reference only, and should not be used for calculating permitted load offset (position of center of gravity) within the load diagram, since those also are limited by main axes torques as well as dynamic loads. Also arm loads will influence the permitted load diagram. For finding the absolute limits of the load diagram, please use the ABB RobotLoad. Please contact your local ABB organization.

Robot type	Max wrist torque axis 4 and 5	Max wrist torque axis 6	Max torque valid at load
IRB 1600-6/1.2(1.45)	8.58 Nm	4.91 Nm	5 kg
IRB 1600-81.2(1.45)	11.25 Nm	6.43 Nm	6.5 kg
RB 1600ID-4/1.5	12.16 Nm	3.92 Nm	4 kg

1.5.5. Mounting of equipment

General

Extra loads can be mounted on the wrist, the upper arm housing and on the frame. Definitions of load areas and permitted load are shown in Figure below. The center of gravity of the extra load shall be within the marked load areas. The robot is supplied with holes for mounting of extra equipment. (See Figure on next page).



xx1000000905

Load areaRobot	Max. load					
	A	B	A+B	C	D	E
IRB 1600-6/X	15 kg	5 kg	15 kg	0.5 kg	15 kg	-
IRB 1600-8/X	5 kg	5 kg	5 kg	0.5 kg	15 kg	-
IRB 1600ID-4/1.5	-	-	-	-	15 kg	15 kg

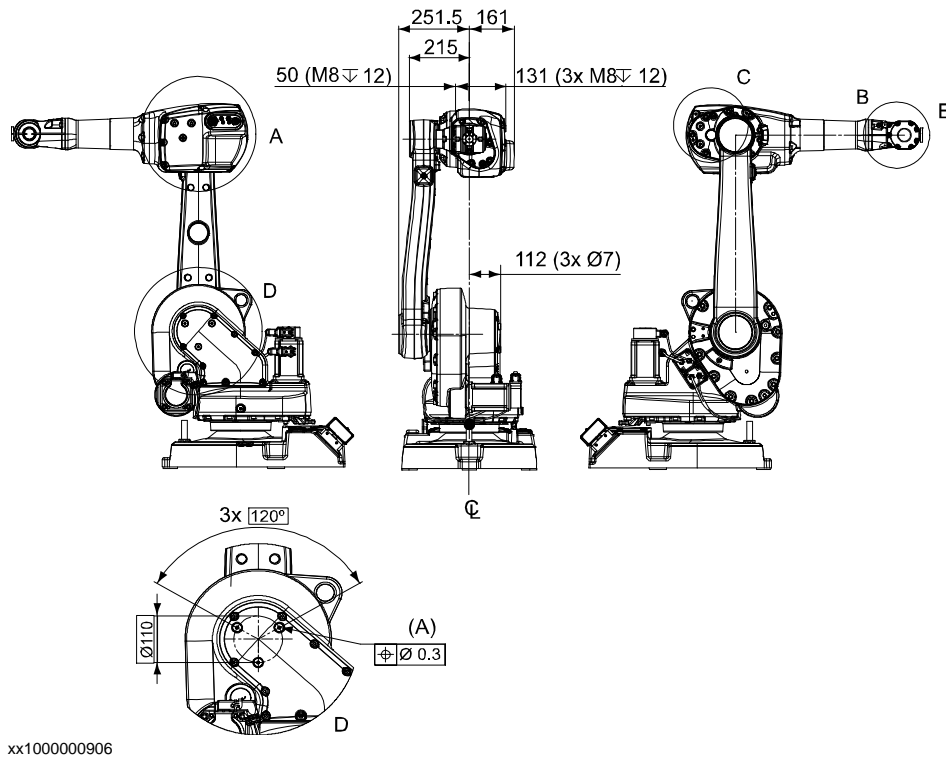
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1 Description

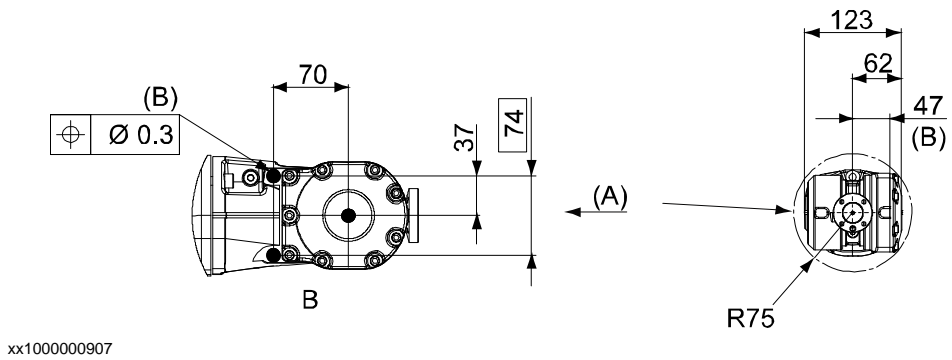
1.5.5. Mounting of equipment

Continued

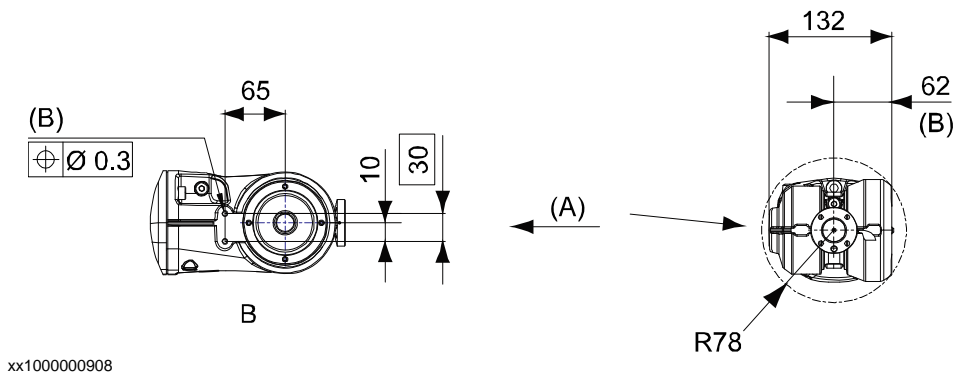
Holes for mounting of extra equipment



Design until June 2006



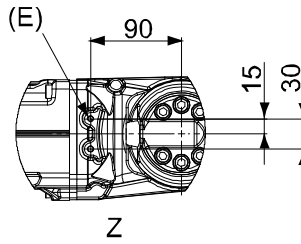
Design after June 2006, Type A



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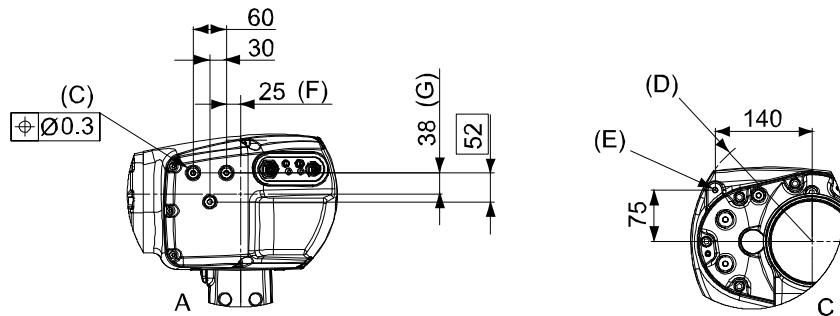
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Design IRB 1600ID-4/1.5



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Mounting hole for equipment



xx1000000910

Pos	Description
A	View E
B	Design until June 2006: 2x M5 depth 7.5, Mounting holes for equipment Design after June 2006, Type A: 2x M6 depth 10, Mounting holes for equipment
C	3x M8 depth 12, Mounting holes for equipment
D	R175, Axis 3 turning radius
E	3 x M8 depth 16, Mounting hole for equipment
F	From center line axis 2
G	From center line axis 4

NOTE!

Note! When mounting heavier equipment, e.g. wire feeders, in holes (C) must the bracket be support in the opposite holes (E).

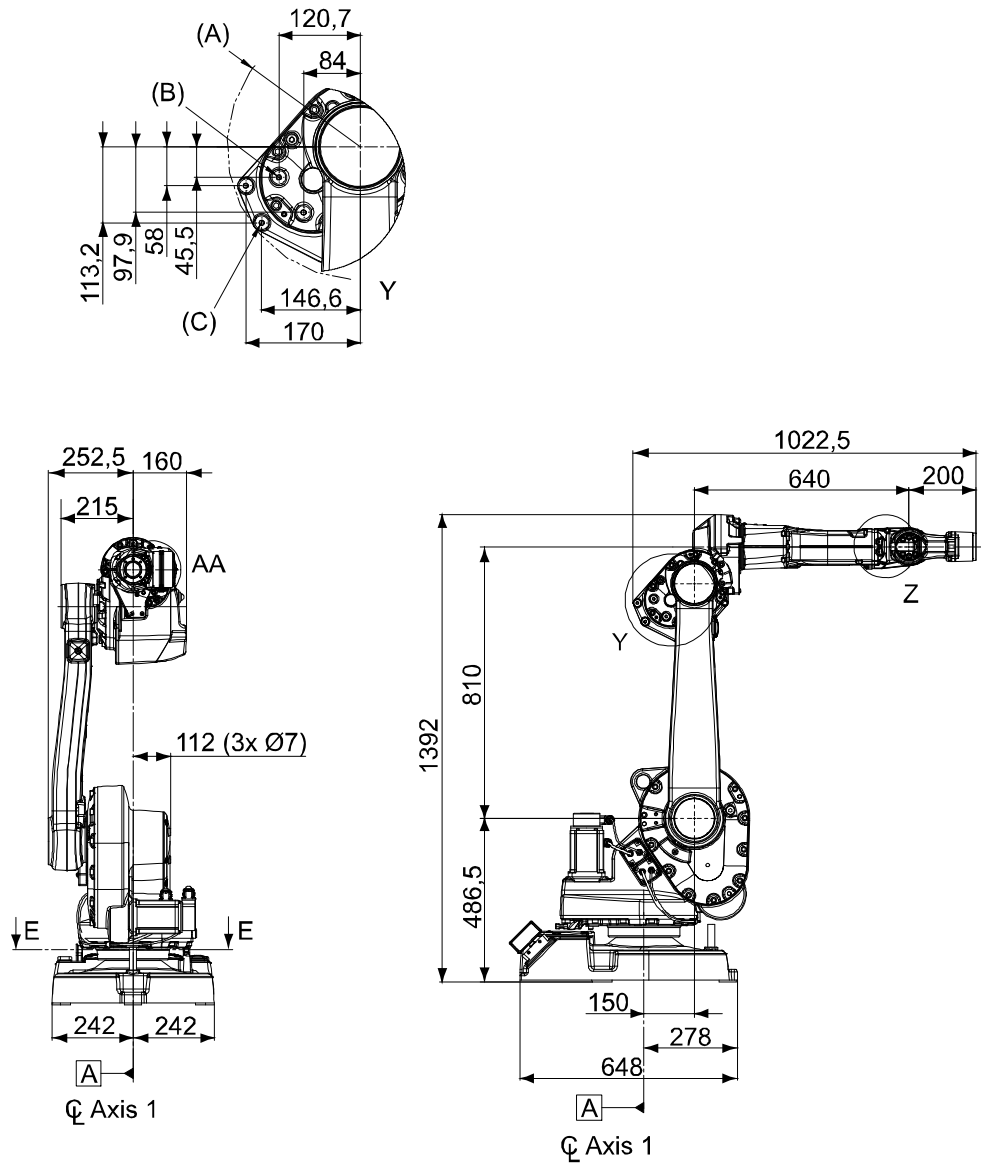


1 Description

1.5.5. Mounting of equipment

Continued

Holes for mounting of extra equipment for IRB 1600ID-4/1.5



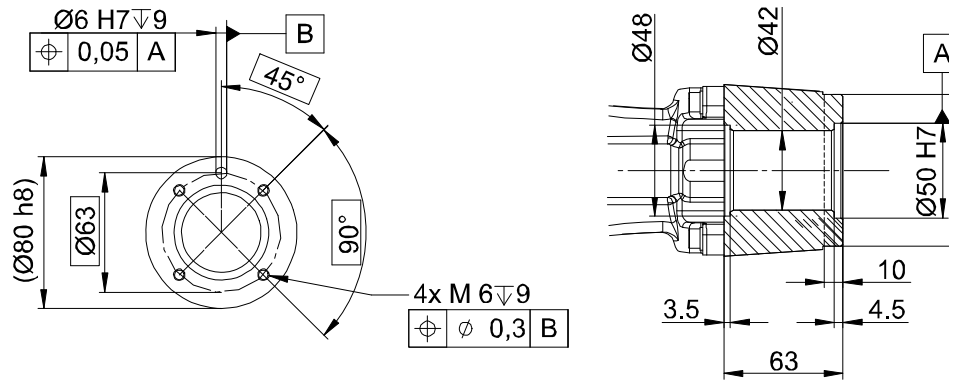
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Pos	Description
A	R198, Axis 3 turning radius
B	2x M8 depth 16, Mounting holes for equipment
C	2x M8, Mounting holes for equipment

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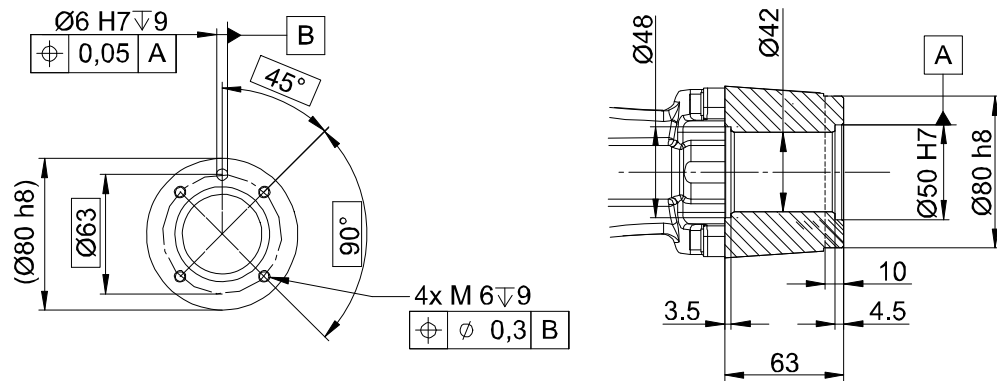
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Robot tool flange



xx1000000912

Robot tool flange for IRB 1600ID-4/1.5



xx1000000913

1 Description

1.6.1. Introduction

1.6 Robot Motion

1.6.1. Introduction

IRB 1600-X/1.2 and 1.45

Axis	Type of motion	Range of movement 1.2 m reach	Range of movement 1.45 m reach
1	Rotation motion	+180° to -180° ^a	+180° to -180° ^a
2	Arm motion	+110° to -63° +136° to -63° with Axis 1 limited to ±100°	+120° to -90° +150° to -90° with Axis 1 limited to ±95°
3	Arm motion	+55° to -235°	+65° to -245°
4	Rotation motion	+200° to -200° Default +190 rev. ^b to -190 rev. Max. ^c	+200° to -200° Default +190 rev. ^b to -190 rev. Max. ^c
5	Bend motion	+115° to -115°	+115° to -115°
6	Turn motion	+400° to -400° default +288 rev. ^b to -288 rev. Max. ^c	+400° to -400° default +288 rev. ^b to -288 rev. Max. ^c

a. In wall mounted position the axis 1 working range has the following limitations:

IRB 1600-6/X the axis 1 limit is ± 20°

IRB 1600-8/X the limit axis 1 is ± 60°

The following axis 1 and tilt angle combinations are allowed:

IRB 1600-6/x axis 1 ± 45° with tilt angles up to 30°

IRB 1600-8/x axis 1 ± 180° with tilt angles up to 60°

b. rev. = Revolutions

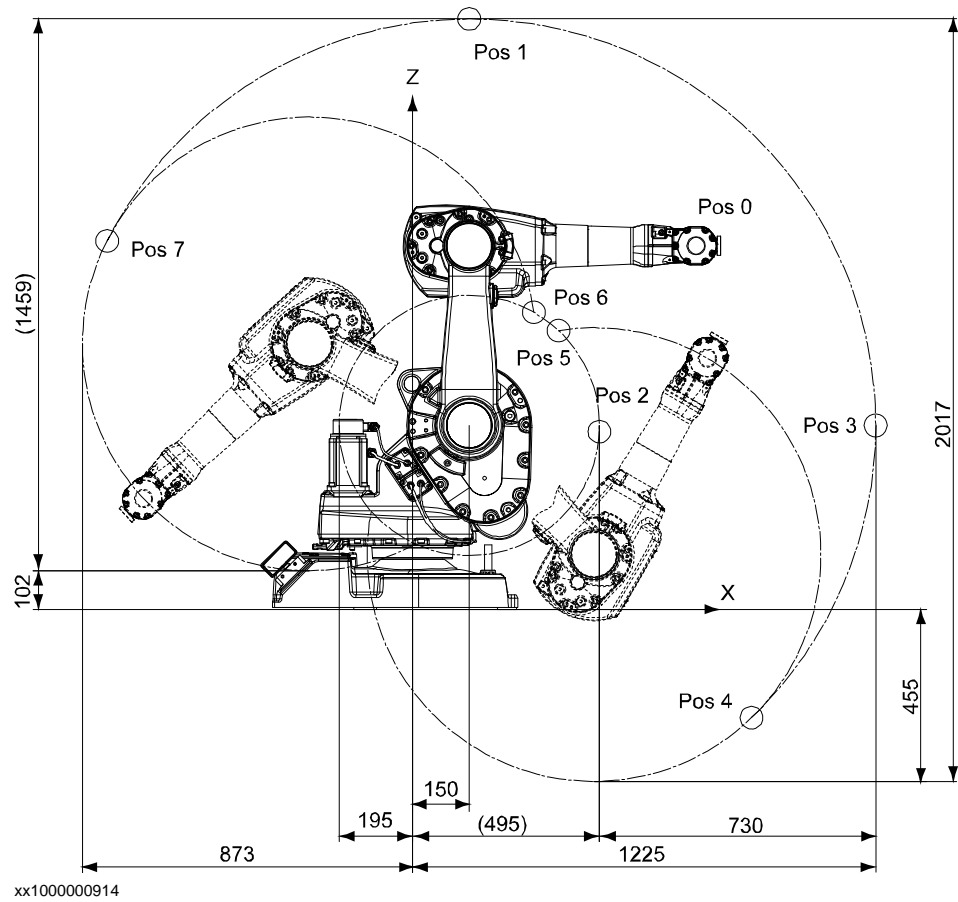
c. The default working range for axis 4 and axis 6 can be extended by changing parameter values in the software.

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).

IRB 1600ID-4/1.5

Axis	Type of motion	Range of movement
1	Rotation motion	+180° to -180°
2	Arm motion	+150° to -90°
3	Arm motion	+79° to -238°
4	Rotation motion	+155° to -155°
5	Bend motion	+135° to -90°
6	Turn motion	+200° to -200°

Continued



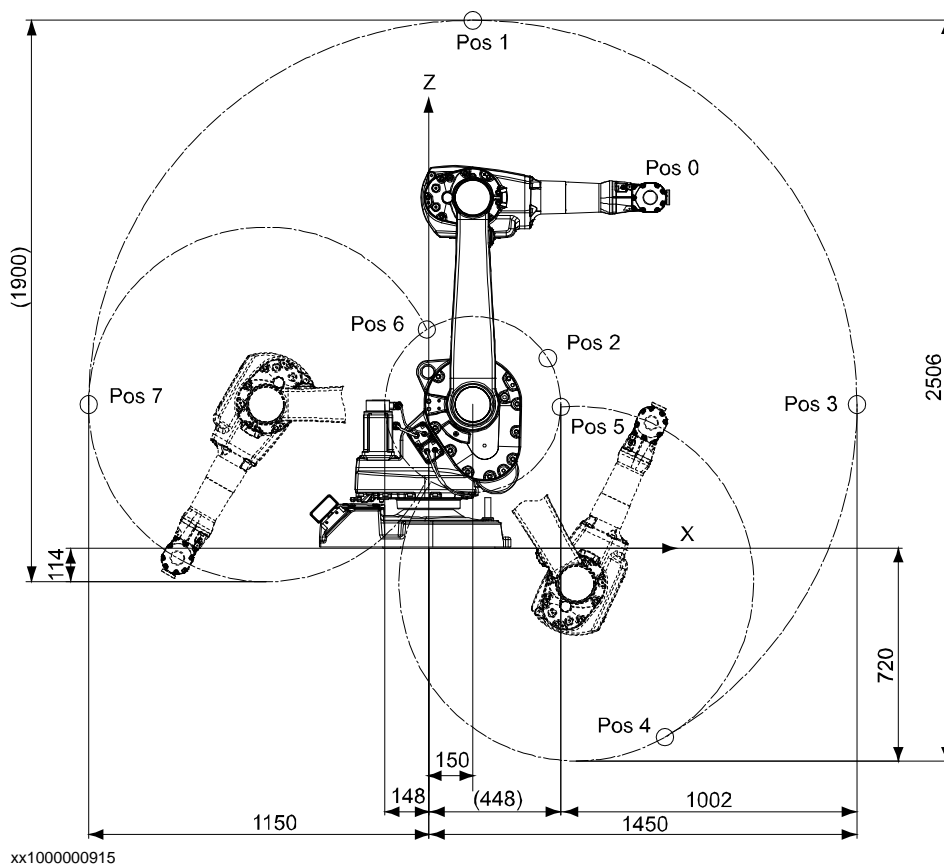
Positions at wrist center 1.2 m reach

Pos No. see Figure above	X Position (mm)	Z Position (mm)	Axis 2 Angle (degrees)	Axis 3 Angle (degrees)
0	750	962	0	0
1	150	1562	0	-90
2	494	470	0	+55
3	1225	487	+90	-90
4	897	-287	+136	-90
5	386	737	+136	-235
6	321	786	-63	+55
7	-808	975	-63	-90

1 Description

1.6.1. Introduction

Continued

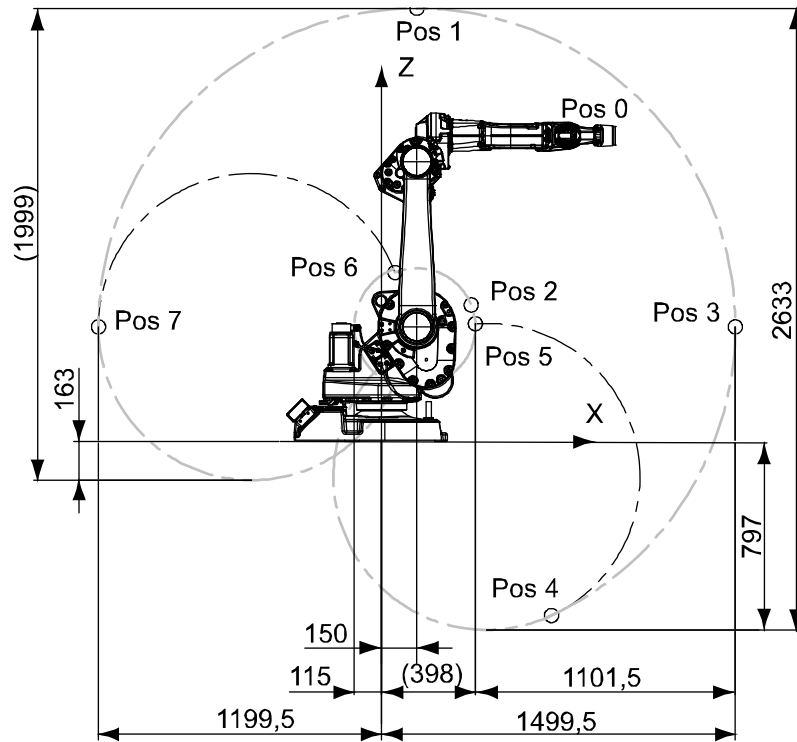


Positions at wrist center 1.45 m reach

Pos No. see Figure above	X Position (mm)	Z Position (mm)	Axis 2 Angle (degrees)	Axis 3 Angle (degrees)
0	750	1187	0	0
1	150	1787	0	-90
2	404	643	0	+65
3	1450	487	+90	-90
4	800	-639	+150	-90
5	448	478	+150	-245
6	-6	740	-90	+65
7	-1150	487	-90	-90

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Continues on next page



xx1000000916

Positions at wrist center IRB 1600ID-4/1.5

Pos No. see Figure above	X Position (mm)	Z Position (mm)	Axis 2 Angle (degrees)	Axis 3 Angle (degrees)
0	790	1297	0	0
1	150	1836	0	-80
2	380	579	0	+79
3	1500	487	+90	-80
4	721	-737	+150	-80
5	398	500	+150	-238
6	58	717	-90	+79
7	-1200	487	-90	-80

1 Description

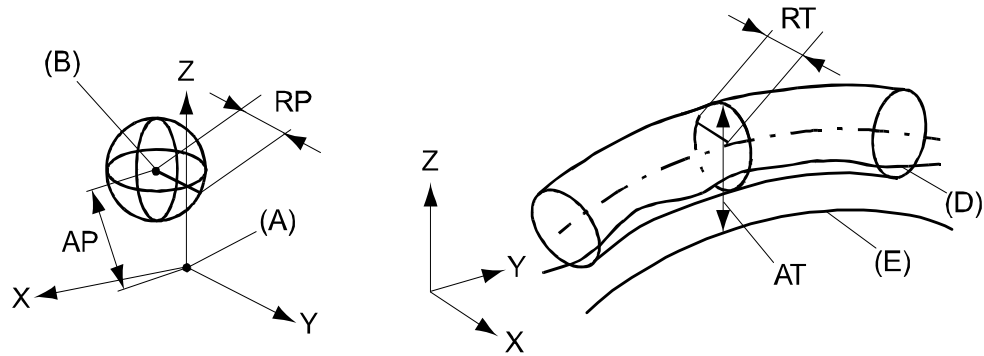
1.6.2. Performance according to ISO 9283

1.6.2. 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

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
RP	Tolerance of position B at repeated positioning	RT	Tolerance of the path at repeated program execution

Description	IRB 1600				IRB 1600ID
	-6/1.2	-6/1.45	-8/1.2	-8/1.45	ID-4/1.5
Pose repeatability, RP (mm)	0.02	0.02	0.04	0.05	0.02
Pose accuracy, AP ^a (mm)	0.04	0.04	0.04	0.05	0.04
Linear path repeatability, RT (mm)	0.13	0.19	0.14	0.12	0.48 ^b
Linear path accuracy, AT (mm)	0.97	1.03	0.96	0.42	1.98
Pose stabilization time, (PSt) to within 0.2 mm of the position (s)	0.11	0.11	0.20	0.04	0.35

a. AP according to the ISO test above, is the difference between the taught position (position manually modified in the cell) and the average position obtained during program execution.

b. Measured at a velocity of 100 mm/s.

The above values are the range of average test results from a number of robots.

1.6.3. Velocity

Maximum axis speeds

Axis No.	IRB 1600-6/1.2 IRB 1600-6/1.45	IRB 1600-8/1.2 IRB 1600-8/1.45	IRB 1600ID-4/1.5
1	150°/s	180°/s	180°/s
2	160°/s	180°/s	180°/s
3	170°/s	200°/s	180°/s
4	320°/s	400°/s	320°/s
5	400°/s	400°/s	380°/s
6	460°/s	460°/s	460°/s

Axis Resolution

Approx. 0.01° on each axis.

1 Description

1.6.4. Stopping distance/time

1.6.4. Stopping distance/time

General

Stopping distance/time for emergency stop (category 0), program stop (category 1) and at mains power supply failure at max speed, max stretched out and max load, categories according to EN 60204-1. All results are from tests on one moving axis. All stop distances are valid for floor mounted robot, without any tilting.

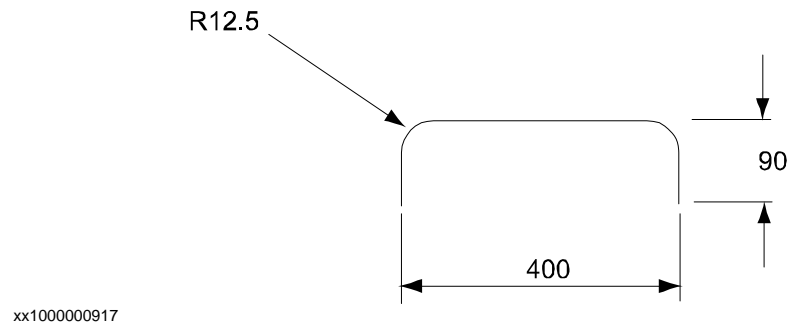
Robot Type	Axis	Category 0		Category 1		Main power failure	
		A	B	A	B	A	B
IRB 1600-6/1.2 (1.45) IRB 1600-8/1.2 (1.45)	1	25	0.2	45	0.4	31	n.a.
	2	23	0.2	32	0.3	30	n.a.
	3	14	0.2	25	0.2	18	n.a.
IRB 1600ID-4/1.5	1	23	0.2	47	0.5	29	n.a.
	2	24	0.3	34	0.4	27	n.a.
	3	17	0.2	32	0.3	24	n.a.

	Description
A	Distance in degrees
B	Stop time (s)

1.7 Typical cycle times

1.7.1. Introduction

General



Approx. cycle times

	IRB 1600-6/x	IRB 1600-8/x
Pay load at wrist down	7 kg	10 kg
Cycle time Packer cycle	0.95 s	1.01 s

1 Description

1.8.1. Introduction

1.8 Customer connections

1.8.1. Introduction

General

Customer connections are options, the cables for them are integrated in the robot and the connectors are placed on the upper arm housing.

The customer connections are:

- The Standard connections for Signals, Power and Air.
- The Integrated wire feed cabling for Signals and Power.
- The 7-Axis connection.

For the specification of the customer connection, see chapter 1 Specification of Variants and Options, Application interface Connection type.

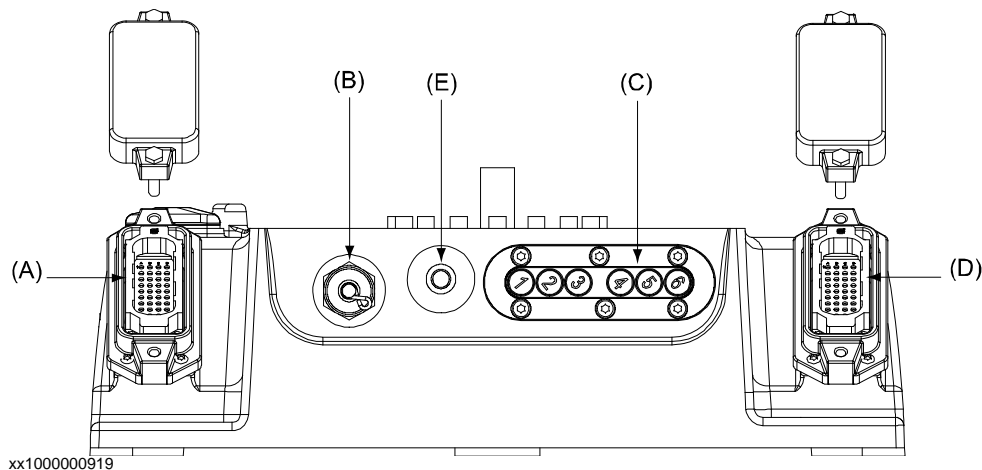
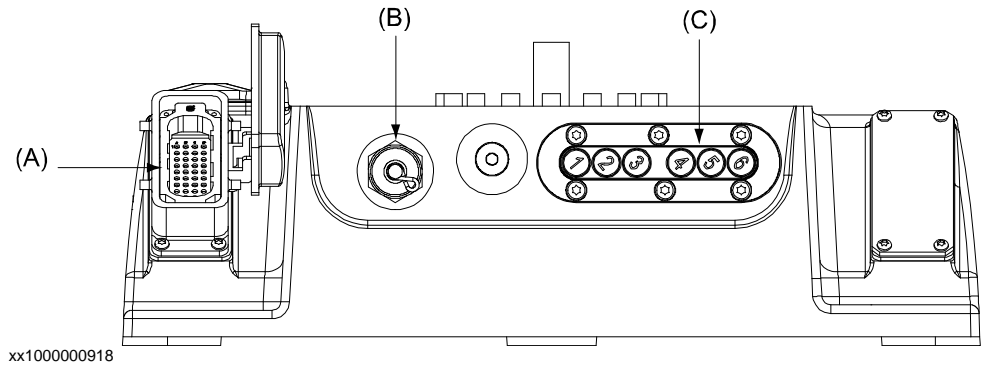


NOTE!

Note: No customer/application connections available for IRB 1600ID-4/1.5.

Connections at robot base

Figures below show the customer connections at the robot base. For description of all connection types see table below Figure on next page.



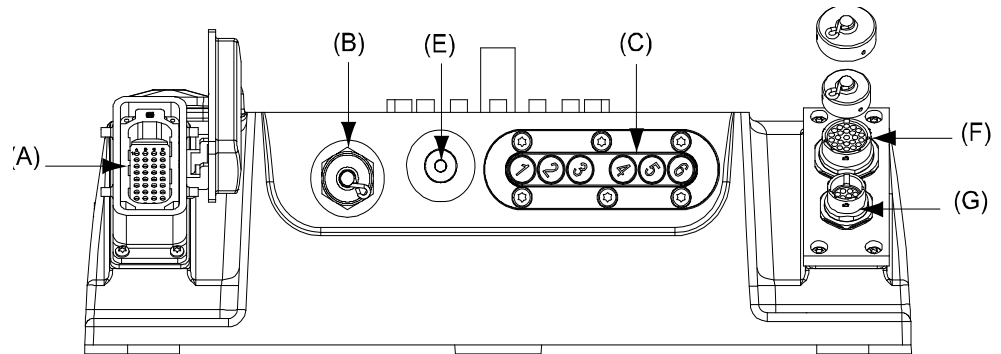
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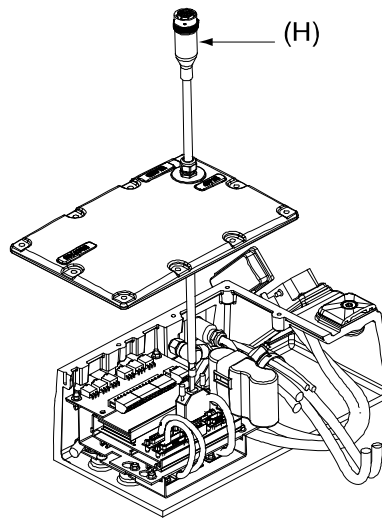
1 Description

1.8.1. Introduction

Continued



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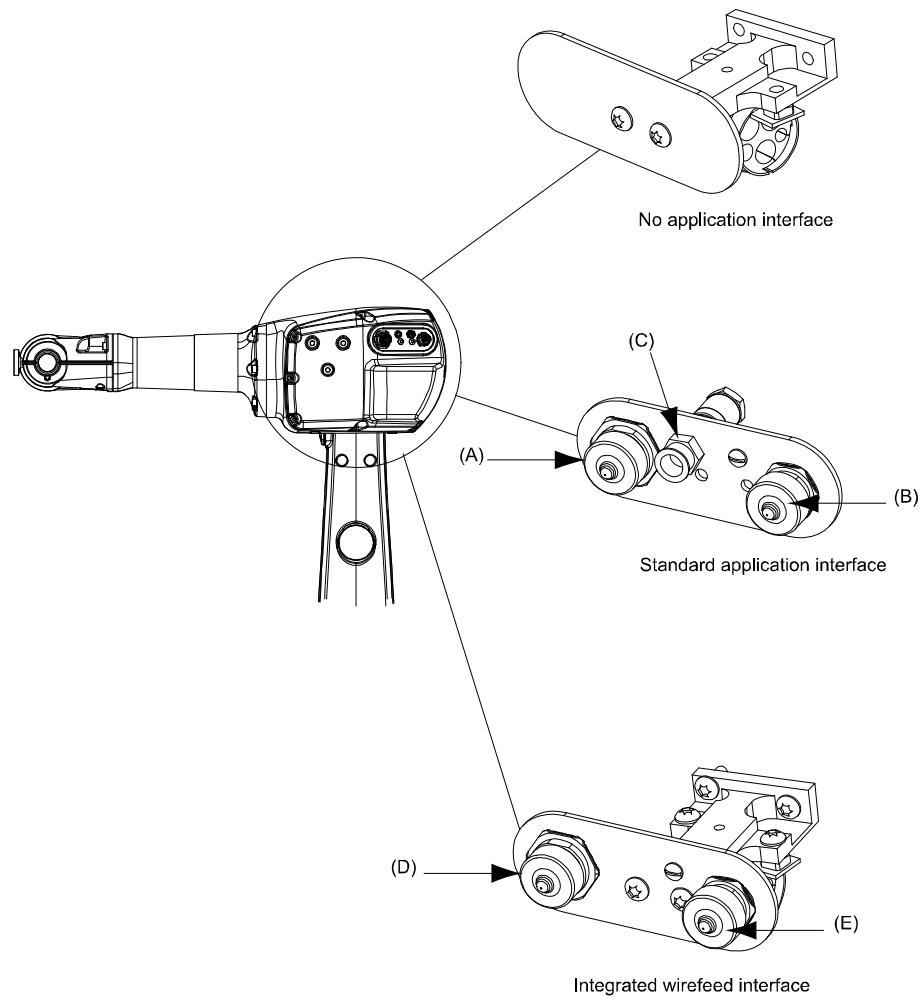
Pos	Connection type	Description
A	R1.MP	Motor power
B	R1.SMB	Serial measurement board signal
C	-	Robot axes brake release buttons
D	R.1 CP/CS	Standard Customer Power and Customer Signal
E	R.1Air	Standard Air
F	R1.CS	Customer Signal for Integrated wirefeed interface
G	R1.CP	Customer Power for Integrated wirefeed interface
H	R1.FB7	Axis 7 connection, 1.5 m cable

1 Description

1.8.1. Introduction

Continued

Connections at upper arm



xx100000922

Pos	Connection type	Description
A	R3.CP	Standard Customer Power
B	R3.CS	Standard Customer Signal
C	R3.Air	Standard Air
D	R3.CP	Customer Power for Integrated wirefeed interface
E	R3.CS	Customer Signal for Integrated wirefeed interface

1.9 Maintenance and Troubleshooting

1.9.1. Introduction

General

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

- Maintenance-free AC motors are used.
- Oil and grease are 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.
- It has a program memory “battery low” alarm.

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 1600*.

1 Description

1.9.1. Introduction

2 Specification of Variants and Options

2.1 Introduction

2.1.1. General

Introduction

The different variants and options for the IRB 1600 are described below. The same numbers are used here as in the Specification Form.

For controller options, see *Product specification - Controller software IRC5* and *Product specification - Controller IRC5 with FlexPendant*

2 Specification of Variants and Options

2.1.2. Manipulator

2.1.2. Manipulator

Variants

Option	IRB Type	Handling capacity (kg)/Reach (m)
435-79	1600ID	4/1.5
435-89	1600	8/1.2
435-90	1600	8/1.45
435-91	1600	6/1.2
435-92	1600	6/1.45

Manipulator color

Option	Name	Description
209-1	ABB Standard	The robot is painted in color ABB Orange.
209-2	ABB White	The robot is painted in white color.
209-4--192	RAL code	The manipulator is painted with the chosen RAL-color.

Protection

Option	Name	Description
287-4	Standard	IP 54, IP 40 for IRB 1600ID-4/1.5

Continued

Option	Name	Description
287-3	Foundry Plus	<p>The Foundry Plus option is designed for harsh environments where the robot is exposed to sprays of coolants, lubricants and metal spits that are typical for die casting applications or other similar applications. Typical applications are spraying insertion and part extraction of die-casting machines, cast cleaning, handling in sand casting and gravity casting, etc. (Please refer to Foundry Prime for washing applications or other similar applications). Special care must be taken in regard to operational and maintenance requirements for applications in foundry are as well as in other applications areas. Please contact ABB Robotics Sales organization if in doubt regarding specific application feasibility for the Foundry Plus robot. The Foundry Plus robot is painted with two-component epoxy on top of a primer for corrosion protection. To further improve the corrosion protection additional rust preventive are applied to exposed and crucial areas, e.g. has the tool flange a special preventive coating. Although, continuous splashing of water or other similar rust formation fluids may case rust attach on the robots unpainted areas, joints, or other unprotected surfaces. Under these circumstances it is recommended to add rust inhibitor to the fluid or take other measures to prevent potential rust formation on the mentioned. The entire robot is IP67 compliant according to IEC 60529 - from base to wrist, which means that the electrical compartments are sealed against liquid and solid contaminants. Among other things all sensitive parts are better protected than the standard offer.</p> <p>Selected Foundry Plus/Foundry Plus 2 features:</p> <ul style="list-style-type: none"> • Improved sealing to prevent penetration into cavities to secure IP67 • Additional protection of cabling and electronics • Special covers protecting cavities • Well-proven connectors • Rust preventives on screws, washers and unpainted/machined surfaces • Extended service and maintenance program <p>Selected Foundry Plus/Foundry Plus 2 features: The Foundry Plus 2 robot can be cleaned with appropriate washing equipment. Not valid for IRB 1600ID-4/1.5.</p>

Application interface Connected to

Option	Name	Description
16-1	Cabinet ^a	<p>The signals are connected to 12-pole screw terminals, Phoenix MSTB 2.5/12-ST-5.08, to the Control Module. Not together with option 17-6 Integrated wire feed cabling. Not valid for IRB 1600ID-4/1.5.</p>

a. Note! 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.

Continues on next page

2 Specification of Variants and Options

2.1.2. Manipulator

Continued

Application interface Connection type

Option	Name	Description
17-5 ^a	Standard	One Souriau UTOW6 1210 P-H One Souriau UTOW6 1626 P-H Signals 23 Power 10 Air 1
17-7	No application interface	

a. Not valid for IRB 1600ID-4/1.5.

Connector kit upper arm

The kit consists of connector, pins and sockets, fitting connectors in option 17-5.

Option	Name	Description
431-1	Upper arm	Customer Power (CP) and Customer Signals (CS).

Safety lamp

Option	Name	Description
213-1	Safety lamp	It has an orange fixed light, is active in MOTORS ON mode and is std. on an UL/UR approved robot.

Electronic Position Switches (EPS)

The mechanical position switches indicating the position of the three main axes are replaced with electronic position switches for up to 7 axes, for increased flexibility and robustness.

For more detailed information, see *Product specification - Controller IRC5 with FlexPendant* and *Application manual - Electronic Position Switches*, art. No. 3HAC027709-001.

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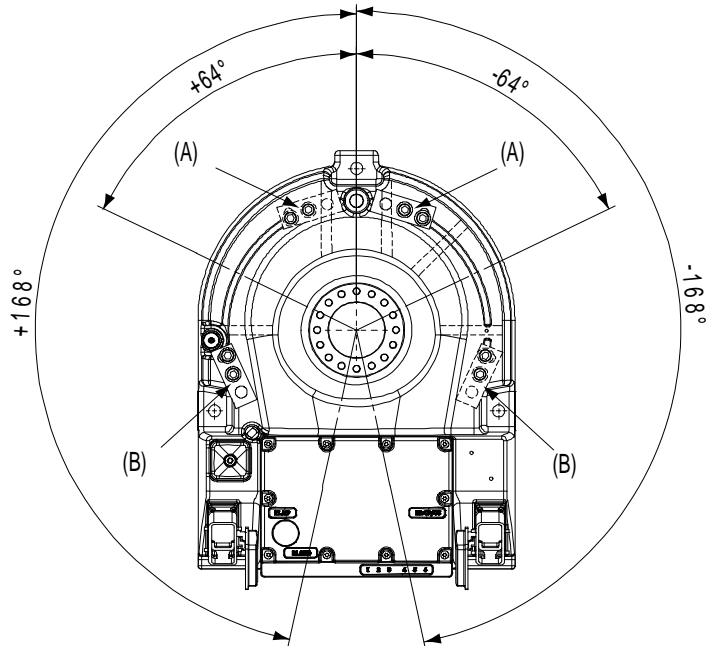
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Working range limit

To increase the safety of the robot, the working range of axis 1, 2 and 3 can be restricted.

Option	Name	Description
28-1	Axis 1 Working range limit	One or two mechanical stops for restricting the working range of axis 1. The option includes two stops. See Figure below.

The working range can be restricted freely within the shown scope, depending on where the mechanical stop is installed along the casted groove.



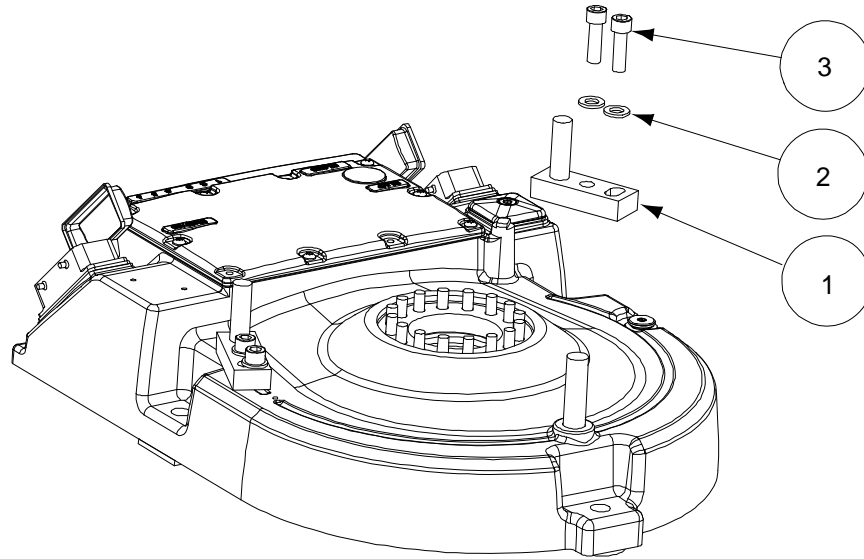
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Pos	Description
A	Mounting position of two additional stops for maximum working area (+/- 160°).
B	Mounting position of two additional stops for maximum working area (+/- 64°).

2 Specification of Variants and Options

2.1.2. Manipulator

Continued

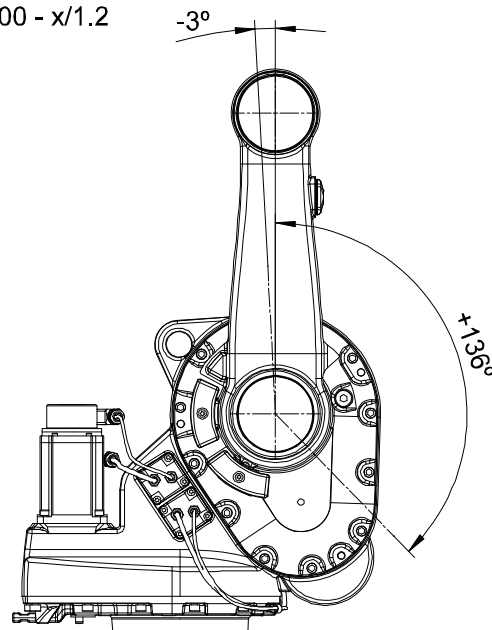


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Pos	Description
1	Mechanical stop (x2)
2	Washers (x4)
3	Screws (x4)

Option	Name	Description
32-1	Axis 2 working range limit	An additional mechanical stop for restricting the working range of axis 2 can be mounted on the frame. The working range can only be restricted backwards as shown in Figure below. Notice the different working range for the different models.

IRB 1600 - x/1.2



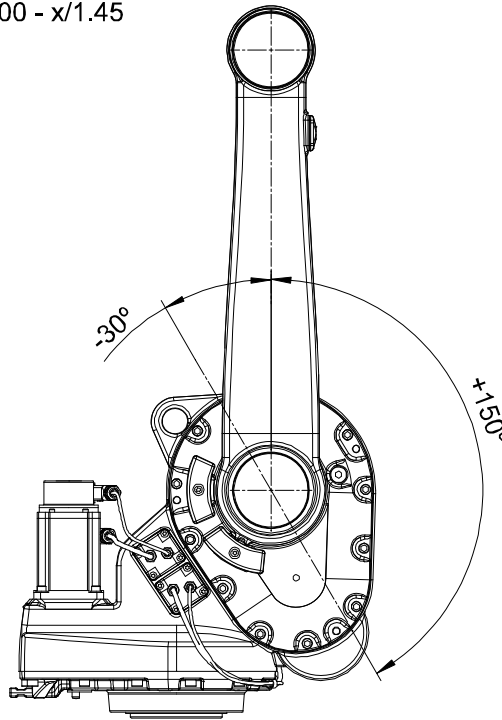
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IRB 1600 - x/1.45



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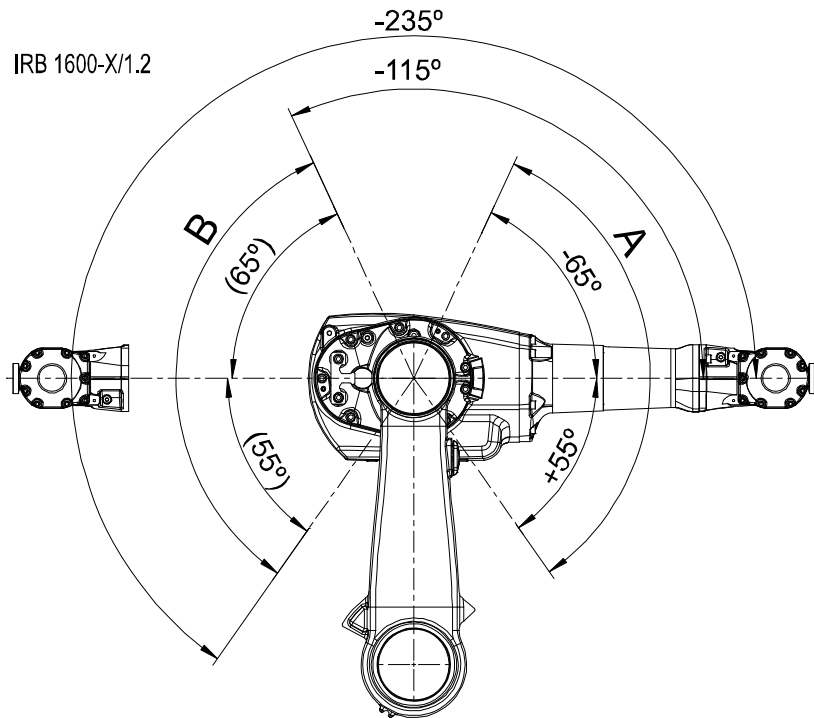
Option	Name	Description
34-1 ^a	Axis 3 working range limit	The mechanical stop to restrict the working range within zone A and B for axis 3 can be mounted at the upper arm housing. See Figure 4. Notice the different working range for the different models.

2 Specification of Variants and Options

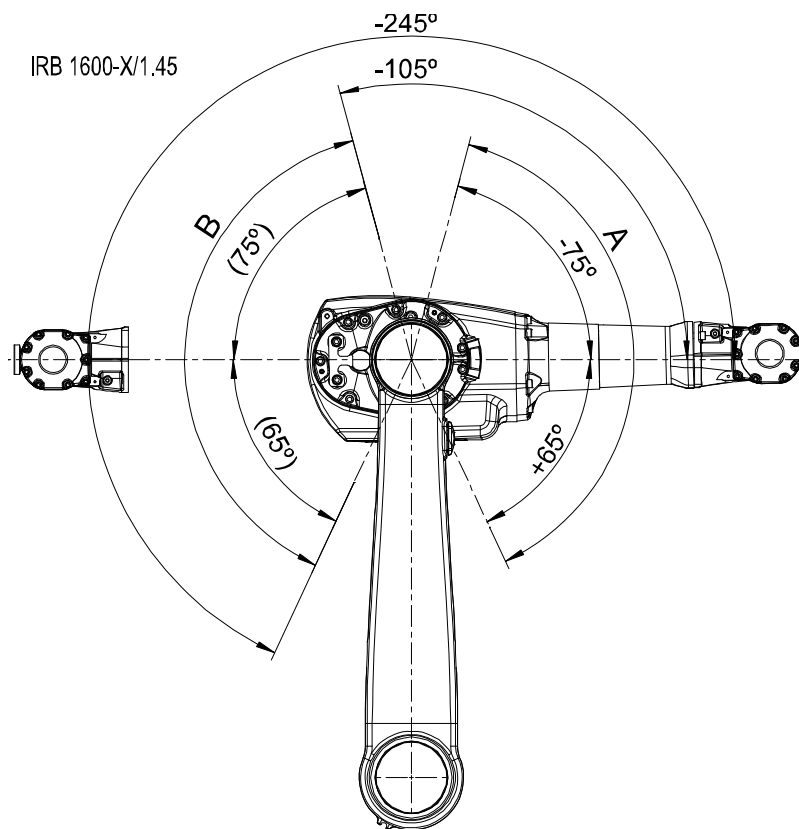
2.1.2. Manipulator

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a. Not valid for IRB 1600ID-4/1.5.



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2.1.3. Positioners

General

Regarding positioners, see Product specification - 3HAC028283-001.

2 Specification of Variants and Options

2.1.4. Track Motion

2.1.4. Track Motion

Track Motion type

Option	Type	Description
1000-5	no AW	For IRB 1600/2400 robot, with a travel length of 1.7 m For for example material handling robot.
1000-6	for AW	For IRB 1600/2400 robot, with a travel length of 1.7 m For AW robot with Marthon-pac or Bobbin holder.

Additional travel length

Option	Description	Note
1001-1	(1-18) Add travel length	Chose additional travel length in meter, above the min. length under Track Motion Type. The selection 1 adds 1m travel length, 2 adds 2m travel length and so on...

Example of ordering a track motion RTT, with a requested travel length of 7.5 m:

Track Motion Type

- 1000-5 RTT with Bobbin
- 1001-1 Add travel length

In this case, option 1000-5 specify a track motion with a travel length of 1.7 m, option 1001-1 adds 6 meters to that, ending up with a total travel length of 7.7 m.

RoboCare

Option	Type	Description
935-1	RoboCare II	2 years. REQUIRES: Remote Service [890-1]
935-2	RoboCare III	3 years. REQUIRES: Remote Service [890-1]

Warranty

Option	Type	Description
438-1	Standard Warranty	Standard warranty is 18 months (1 1/2 years)
438-2	Standard + 12 months	18 + 12 months (2 1/2 years)
438-4	Standard + 18 months	18 + 18 months (3 years)
438-5	Standard + 24 months	18 + 24 months (3 1/2 years)
438-6	Standard + 6 months	18 + 6 months (2 years)
438-7	Standard + 30 months	Warranty extension 30 months
438-8	Stock Warranty	Maximum 6 months postponed warranty starting from shipment date ABB Robotics Production unit (PRU) + Option 438-1. Warranty commences automatically after 6 months or from activation date of standard warranty. (See ABB Robotics BA Warranty Rules).

2.2 Floor cables

2.2.1. Manipulator

Manipulator cable length

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

Connection of Parallel communication

Option	Lengths
94-1	7 m
94-2	15 m
94-3	22 m
94-4	30 m

2 Specification of Variants and Options

2.2.2. Positioner

2.2.2. Positioner

Positioner cable 1

Option	Lengths
1067-1	7 m
1067-2	10 m (Standard length)
1067-3	15 m

Positioner cable 2

Option	Lengths
1068-1	7 m
1068-2	10 m (Standard length)
1068-3	15 m

Positioner cable type

Option	Type	Description
1048-1	Flexible	Only available with one or two MTC 250/500/750/2000/5000

Weld return cable

Option	Lengths
1056-1	7 m
1056-2	7 m x 2
1056-3	10 m
1056-4	10 m x 2
1056-5	15 m
1056-6	15 m x 2

Return cable

Option	Type	Description
1057-1	OKC T-connection	Choose quantity, 1-2

2.3 Process

2.3.1. DressPack

Welding torch package



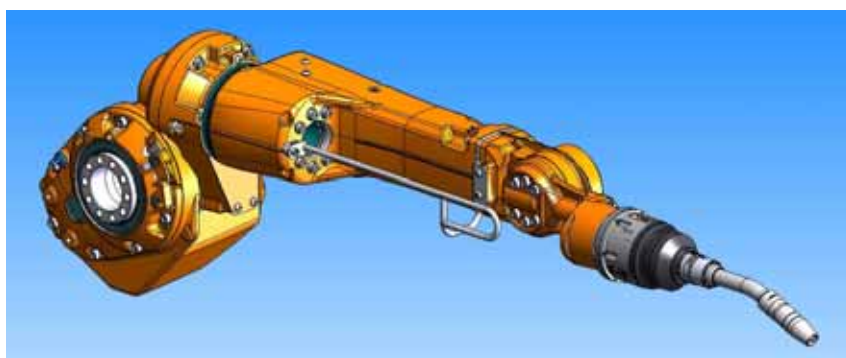
NOTE!

The robot can either be ordered without AW equipment (option 878-1) or fully dressed with torch including hose package (option 878-2 or 878-3) and AristoMig 4000i (option 1029-13) or 5000i (option 1029-14). Only torch and hose package without AristoMig is not possible to order from SEROP but can be ordered from supplier locally.

Option	Description
878-1	None, upper arm without any AW process equipment
878-2	Self cooled torch, iSTM-ABIROB A 22 degrees
878-3	Water cooled torch, iSTM-ABIROB W 22 degrees

Side impact protection (SIP)

Option	Description
883-1	Upper arm process cable protection, see Figure below.



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Process module

Option	Type	Description
768-1	Empty cabinet small	See <i>Product specification - Controller IRC5 with Flex-Pendant</i> , see chapter 2.2.1
768-2	Empty cabinet large	See <i>Product specification - Controller IRC5 with Flex-Pendant</i> , chapter 2.2.1
768-5	AWC / WeldGuide	Only together with AristoMig 4000i/5000i, MigRob and TPS power sources.

Continues on next page

2 Specification of Variants and Options

2.3.1. DressPack

Continued

Installation kit

Option	Type	Description
715-1	Installation kit	See <i>Product specification - Controller IRC5 with Flex-Pendant</i> , chapter 2.2.1

2.3.2. Process equipment

Power source

Option	Type	Description
1029-13	AristoMig 4000i	400V (requires option 650-10) Only together with option 878-2 or 878-3.
1029-14	AristoMig 5000i	400V (requires option 650-10) Only together with option 878-2 or 878-3.

Current/Hose set

Option	Type	Description
1030-4	7.5 m	For external suspension mounting, not included. Only together with option 1029-13 or 1029-14.
1030-5	10 m	Internal suspension mounting, hose package attached to the robot base. Protective hose included. Only together with option 1029-13 or 1029-14.

Feed kit

Option	Type	Description
1033-2	Marathon Pac Octagon	Liner for 250 kg Marathon Pac. Plastic hood for round Maraton-Pac included.
1033-3	Bobin	A 15 kg bobin holder on the robot.

Torch service

Option	Type	Description
1037-1	ABB TSC	ABB Torch Service Center.
1037-2	ABB TC96	ABB Torch cleaner.
1037-5	BullsEye	BullsEye stand alone.

2 Specification of Variants and Options

2.3.3. AW Safety options

2.3.3. AW Safety options

Working area

Option	Type	Description
1072-1	One working area	
1072-2	Two working areas	

Operator panel

Option	Type	Description
1054-1	Operator panel 1 area	For one working area
1054-2	Operator panel 2 areas	For two working areas.
1054-3	2 x operators panel 2 areas	Two operator panels, one for each working area.

AW Safety interface

Option	Type	Description
1058-1	Safety interface	SIB
1058-2	Active relay	Active relay supervision (open relay).

Gate switch

Option	Type	Description
1060-1	Gate switch	
1060-2	Gate switch/ ext. reset	

Lightbeam

Option	Type	Description
1059-1	Lightbeam	Qty 1 or 2, one working area requires one PC of "two level light beams". Two working areas require two PCs of "two level light beams".

Home position switch

Option	Type	Description
1061-1	Home position switch	Home position switch for IRB 1600/2400, one working area.

Continued

Station indication

Option	Type	Description
1062-1	Station indication	Station indication for IRB 1600/2400, two working areas.

Pre-reset unit

Option	Type	Description
1063-1	Pre-reset unit	Qty 1 or 2, one working area requires one PC of "Pre-reset". Two working areas require two PCs of "Pre-reset".

Activation unit

Option	Type	Description
1064-1	Activation unit	Qty 1 or 2, one requires one PC of "Activation unit". Two working areas require two PCs of "Activation unit".

Extended EM stop

Option	Type	Description
1065-1	Extended EM stop	Required when using external EM-stop push buttons and when ordering a dual arc system (two welding packages).

2 Specification of Variants and Options

2.3.4. Documentation

2.3.4. Documentation

DVD User Documentation

Option	Type	Description
808-1	Documentation on DVD	See <i>Product specification - Robot user documentation</i>

3 Accessories

3.1. Introduction

General

There is a range of tools and equipment available, especially designed for the robot.

Robot software options for robot and PC

For more information, see Product specification - Controller IRC5 with FlexPendant and Product specification - Controller software IRC5/RobotWare Options.

Robot Peripherals

- Track Motion
- Motor Units

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