ROBOTICS

Product specification

IRB 910INV

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Product specification

IRB 910INV-3/0.35
IRB 910INV-6/0.55

OmniCore

Document ID: 3HAC068057-001

Revision: Q

Original instructions.

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Overview of this manual

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 OmniCore 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

Document name	Document ID
Product specification - OmniCore C line	*3HAC065034-001*
Product specification - OmniCore E line	*3HAC079823-001*
Product manual - OmniCore C30	*3HAC060860-001*
Product manual - OmniCore C90XT Type A	*3HAC089065-001*
Product manual - OmniCore E10	*3HAC079399-001*
Product manual - IRB 910INV	*3HAC068055-001*

Revisions

Revision	Description
A	First edition.
B	Published in release R19D The following updates are done in this revision: • Protection option 3350-540 Base 54 and 3351-1 Cleanroom 1 added. 209-2 ABB white standard added. • Minor changes.
C	Published in release R20C. The following updates are done in this revision: • Minor Changes. • Absacc production data added.

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Revision	Description
D	Published in release R20D. The following updates are done in this revision: • Minor Changes. • Warranty section updated.
E	Published in release R21A. The following updates are done in this revision: • Maximum TCP acceleration added. • Connector types for CP/CS and Ethernet floor cable wiring are added.
F	Published in release R21B. The following updates are done in this revision: • Performance data according to ISO 9283 updated. • Modified the air hose diameter description. • Text regarding fastener quality is updated. • Added a note to remind users that mechanical stop locations cannot be adjusted. • Removed Axis resolution. • Added a note in manipulator protection chapter.
G	Published in release R21C. The following updates are done in this revision: • Removed option 438-4/5/7. • Option 3209-1 added.
H	Published in release R21D. The following updates are done in this revision: • Supported controller OmniCore E10 is added.
J	Published in release R22A. The following updates are done in this revision: • Added screwing depth information to attachment screws for robot foundation.
K	Published in release R22D. The following updates are done in this revision: • Updated power consumption data. • Added Mains cable [3203-x].
L	Published in release R23B. The following updates are done in this revision: • Added table for Max down force (Z stroke).
M	Published in release 23C. The following updates are done in this revision: • The updated robot stopping distances and times are moved to this document, and removed from the generic document, see *Robot stopping distances and times on page 47*.
N	Published in release 24B. The following updates are done in this revision: • Updated graphics for floor cables.
P	Published in release 24C. The following updates are done in this revision: • Added support for OmniCore C90XT Type A controller and removed information for C90XT.
Q	Published in release 24D. The following updates are done in this revision: • Updated options *[3203-X] Mains cable*.

1 Description

1.1 Structure

1.1.1 Introduction to structure

General

The IRB 910INV is ABB Robotics second generation SCARA robot, with 4 axes and a max payload of 3 kg and 6 kg in two different reach variants 0.35 m and 0.55 m, designed specifically for manufacturing industries that use flexible robot-based automation, e.g. 3C industry. The robot has an open structure that is especially adapted for flexible use, and can communicate extensively with external systems.

Clean room robots

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Particle emission from the robot fulfill Clean room class 1 standard according to DIN EN ISO 14644-1.

Clean room robots are specially designed to work in a clean room environment.

According to IPA test result:

The robot IRB 910INV is suitable for use in clean rooms fulfilling the Air Cleanliness Class 1 according to ISO 14644-1, when operated at a capacity of 50%.

The robot IRB 910INV is suitable for use in clean rooms fulfilling the Air Cleanliness Class 1 according to ISO 14644-1, when operated at a capacity of 100%.

Clean room robots are designed in order to prevent from particle emission from the robot. For example is, frequent maintenance work possible to perform without cracking the paint. The robot is painted with four layers of polyurethane paint. The last layer being a varnish over labels in order to simplify cleaning. The paint has been tested regarding outgassing of Volatile Organic Compounds (VOC) and been classified in accordance with ISO 14644-8.

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Classification of airborne molecular contamination, see below:

Parameter				Outgassing amount		
Area (m^2)	Test duration (s)	Temp (°C)	Performed test	Total detected (ng)	Normed based on $1m^2$ and 1s(g)	Classification in accordance to ISO 14644-8
4.5E-03	3600	23	TVOC	2848	1.7E-07	-6.8
4.5E-03	60	90	TVOC	46524	1.7E-04	-3.8

Classification results in accordance with ISO 14644-8 at different test temperatures.

IP54 protection

The robot has IP54 as an option. The option will add sealing, machining parts and gaskets.

Operating system

The robot is equipped with the OmniCore C30/C90XT/E10 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 *Operating manual - OmniCore*.

Safety

The safety standards are valid for the complete robot, manipulator and controller.

Additional functionality

For additional functionality, the robot can be equipped with optional software for application support - for example dispensing and cutting, communication features - network communication - and advanced functions such as multitasking, sensor control etc. For a complete description on optional software, see the *Product specification - OmniCore C line* and *Product specification - OmniCore E line*.

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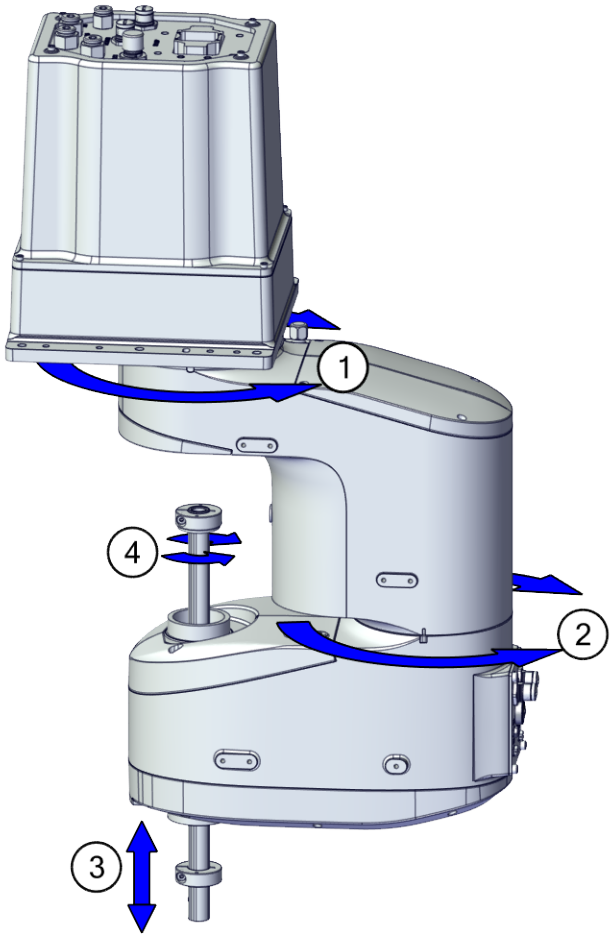
Manipulator axes



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Posi-tion	Description	Posi-tion	Description
1	Axis 1	2	Axis 2
3	Axis 3	4	Axis 4

1.1.2 The robot

General

The IRB 910INV is available in two variants and both can only be mounted on ceiling, no other mounting position is permitted.

Robot type	Maximum handling capacity (kg)	Reach (m)
IRB 910INV-3/0.35	3 kg	0.35 m
IRB 910INV-6/0.55	6 kg	0.55 m

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1.1.2.1 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
IRB 910INV	IRB 910INV-3/0.35: 19 kg IRB 910INV-6/0.55: 22 kg

Note

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

Mounting positions

The table shows valid mounting positions and the installation (mounting) angle for the manipulator.

Mounting position	Installation angle
Inverted	0° [i]

[i] A tilt of up to 3° does not affect the payload or reach, but it can have a negative impact on performance and lifetime. The actual value must be set in the system parameters.

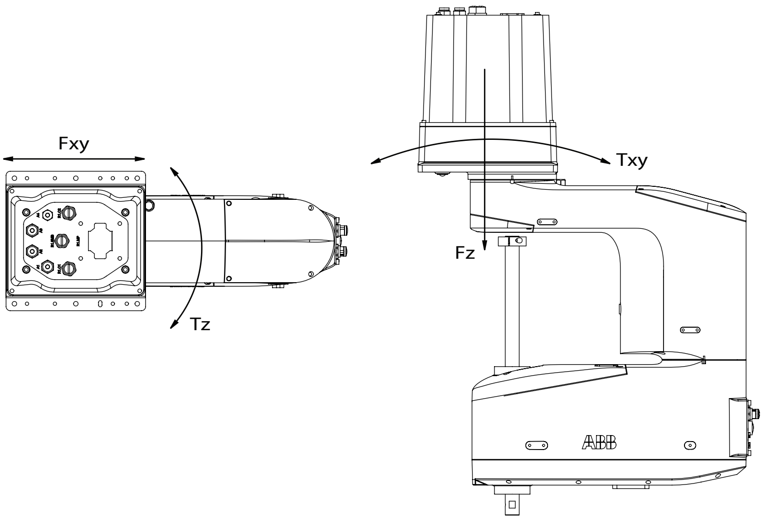
Note

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.

Loads on foundation, robot

The illustration shows the directions of the robots stress forces.

The directions are valid for all 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).

Inverted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±420/440 N	±770/710 N
Force z	190 ±135/220 ±200 N	190 ±660/220 ±110 N
Torque xy	±220/170 Nm	±220/320 Nm
Torque z	±90/125 Nm	±160/190Nm

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	0.1/500 mm	Flat foundations give better repeatability of the resolver calibration compared to original settings on delivery from ABB. The value for levelness aims at the circumstance of the anchoring points in the robot base. In order to compensate for an uneven surface, the robot can be recalibrated during installation. If resolver/encoder calibration is changed this will influence the absolute accuracy
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 description of *Motion Process Mode* in the manual that describes the controller software option, see *References on page 7*.

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Requirement	Value	Note
Minimum foundation material yield strength	150 MPa	

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

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

Storage conditions, robot

The table shows the allowed storage conditions for the robot:

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

Operating conditions, robot

The table shows the allowed operating conditions for the robot:

Parameter	Value
Minimum ambient temperature	5°C [i]
Maximum ambient temperature	45°C
Maximum ambient humidity	95% at constant temperature

i At low environmental temperature < 10ºC is, as with any other machine, a warm-up phase recommended to be run with the robot. Otherwise there is a risk that the robot stops or run with lower performance due to temperature dependent oil and grease viscosity.

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	IP30 [ii] IP54 (option 3350-540)
Manipulator, protection type Clean Room	ISO Class 1

i According to IEC 60529.
ii The protection class of the ballscrew area is IP20. For more information, please contact ABB.

Environmental information

The product complies with IEC 63000. *Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances*.

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Other technical data

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

Power consumption with OmniCore C30/C90XT

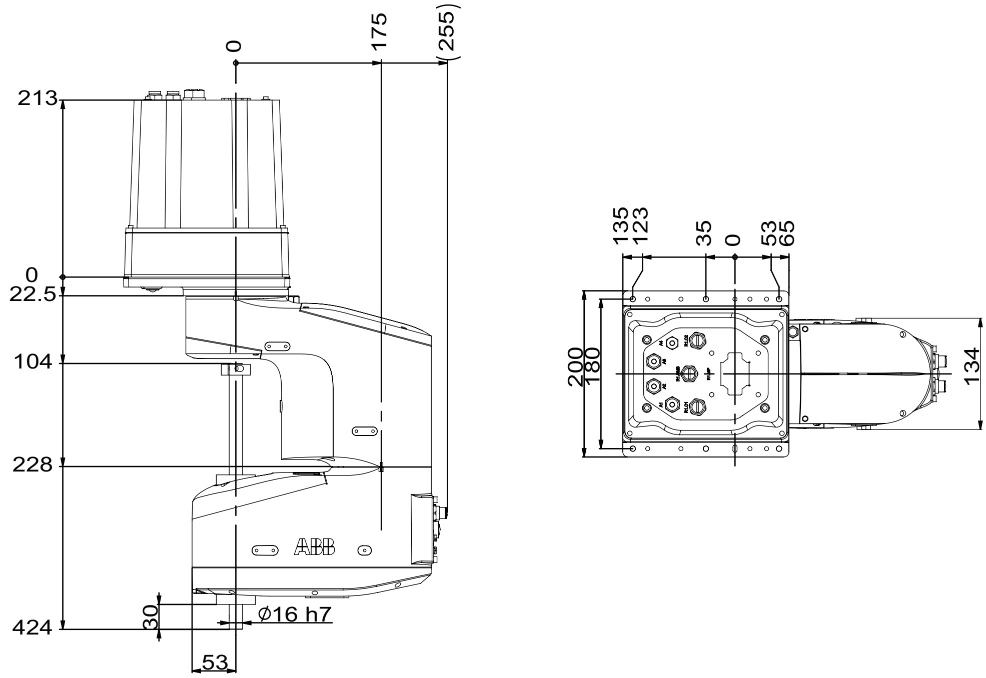
Robot in calibration position	All variants (kW)
Brakes engaged	0.10
Brakes disengaged	0.14

Power consumption with OmniCore E10

Robot in calibration position	All variants (kW)
Brakes engaged	0.06
Brakes disengaged	0.14

Dimensions of IRB 910INV-3/0.35

Robots with protection class IP30



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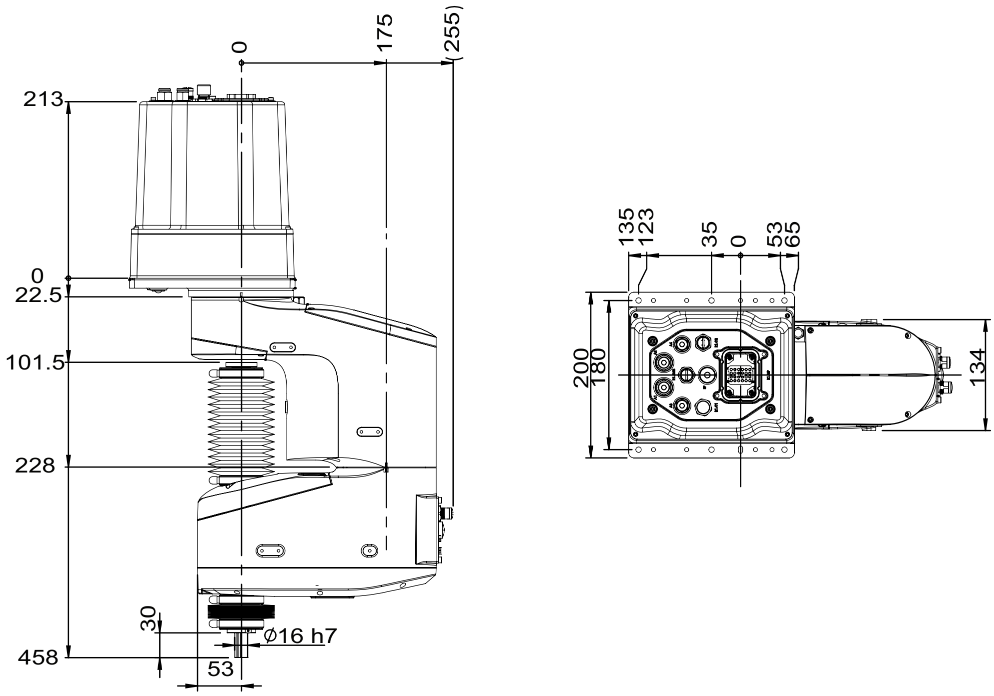
Robots with protection class IP54 or with protection type Clean Room



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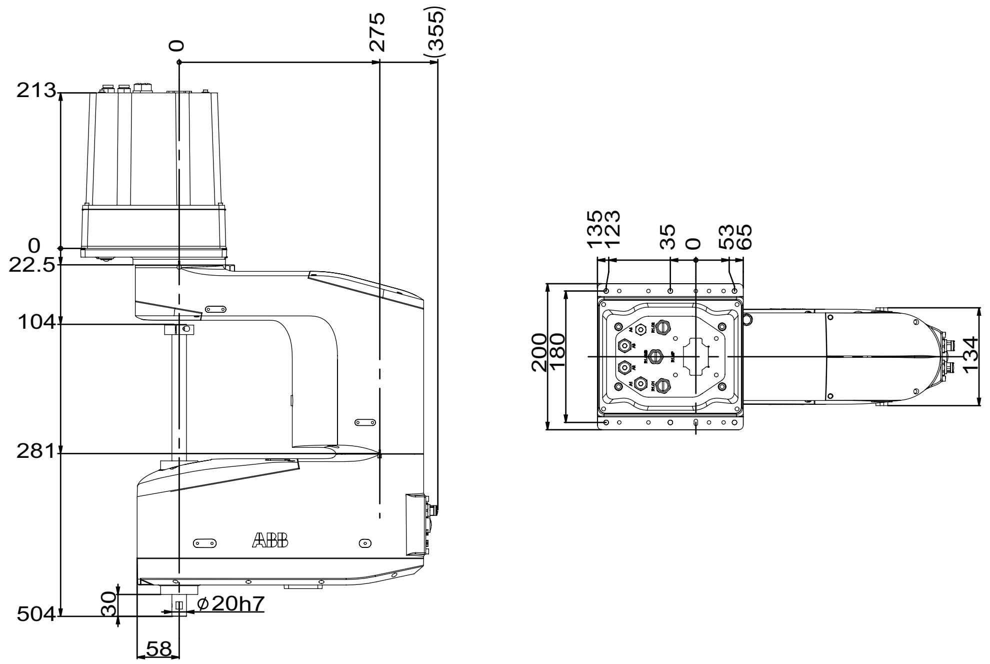
Dimensions of IRB 910INV-6/0.55

Robots with protection class IP30



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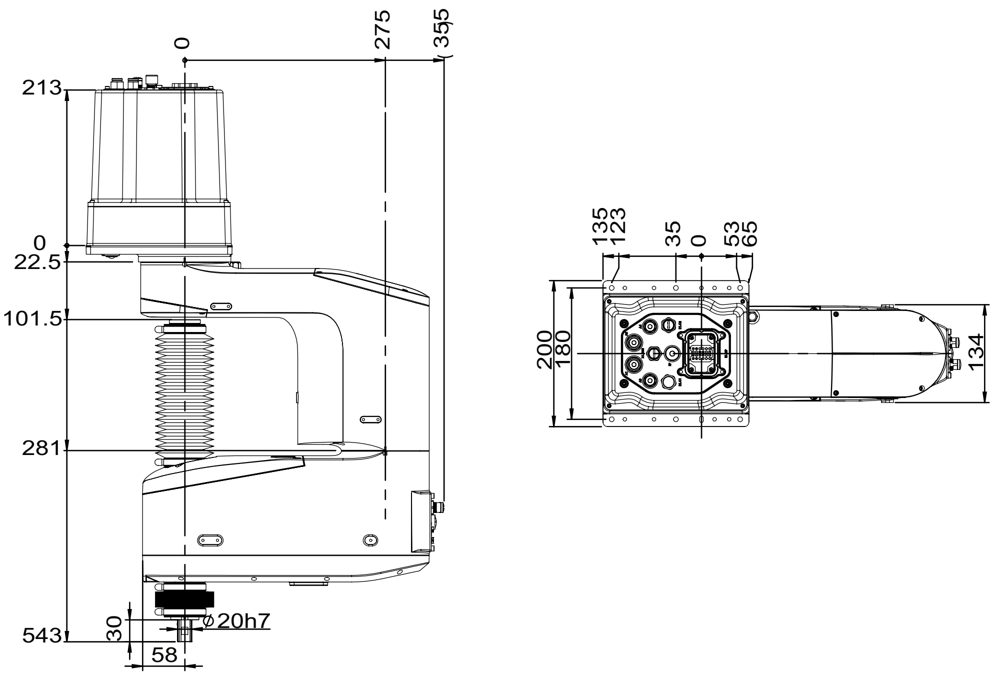
Robots with protection class IP54 or with protection type Clean Room

The figure shows the dimension of the IRB 910INV-6/0.55 for Clean Room/IP54.



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1.2 Standards

1.2.1 Applicable standards

General

The product is compliant 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 deviation from ISO 10218-1:2011, these are listed in the declaration of incorporation. The declaration of incorporation is part of the delivery.

Robot standards

Standard	Description
ISO 9283	Manipulating industrial robots – Performance criteria and related test methods
ISO 9787	Robots and robotic devices – Coordinate systems and motion nomenclatures
ISO 9946	Manipulating industrial robots – Presentation of characteristics

Other standards used in design

Standard	Description
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements, normative reference from ISO 10218-1
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
ISO 13849-1:2006	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design, normative reference from ISO 10218-1
IEC 61340-5-1	Protection of electronic devices from electrostatic phenomena - General requirements
UL 1740 (option) CSA Z434 (option)	Standards For Safety - Robots and Robotic Equipment Industrial robots and robot Systems - General safety requirements Valid for USA and Canada.

1.3 Installation

1.3.1 Introduction to installation

General

IRB 910INV is available in two variants and all variants can only be inverted/suspended. Depending on the robot variant, an end effector with max. weight of 3 kg or 6 kg, including payload, can be mounted on the lower end of the ball screw spline shaft (axis 4). See *Load diagram on page 27*.

Explosive environments

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

Working range limitations

EPS will not be selectable and no mechanical limitations available.

1.3.2 Technical data

Weight, robot

The table shows the weight of the robot.

Robot model	Nominal weight
IRB 910INV	IRB 910INV-3/0.35: 19 kg IRB 910INV-6/0.55: 22 kg

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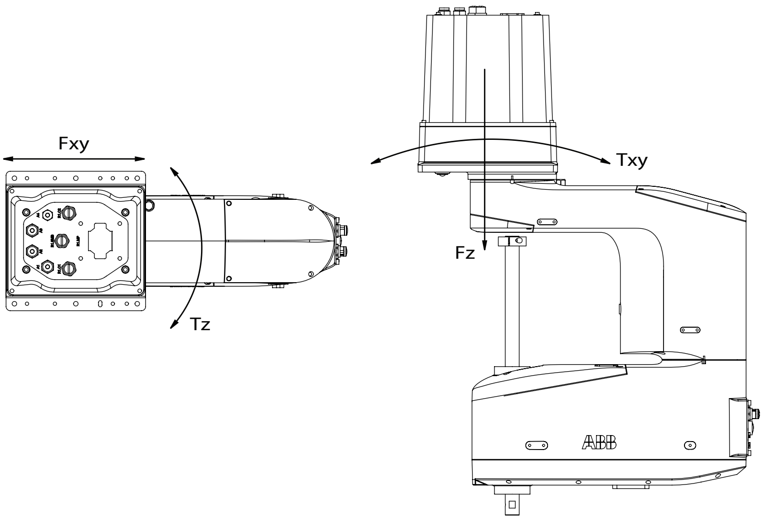

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Maximum ambient temperature	45°C
Maximum ambient humidity	95% at constant temperature

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ii The protection class of the ballscrew area is IP20. For more information, please contact ABB.

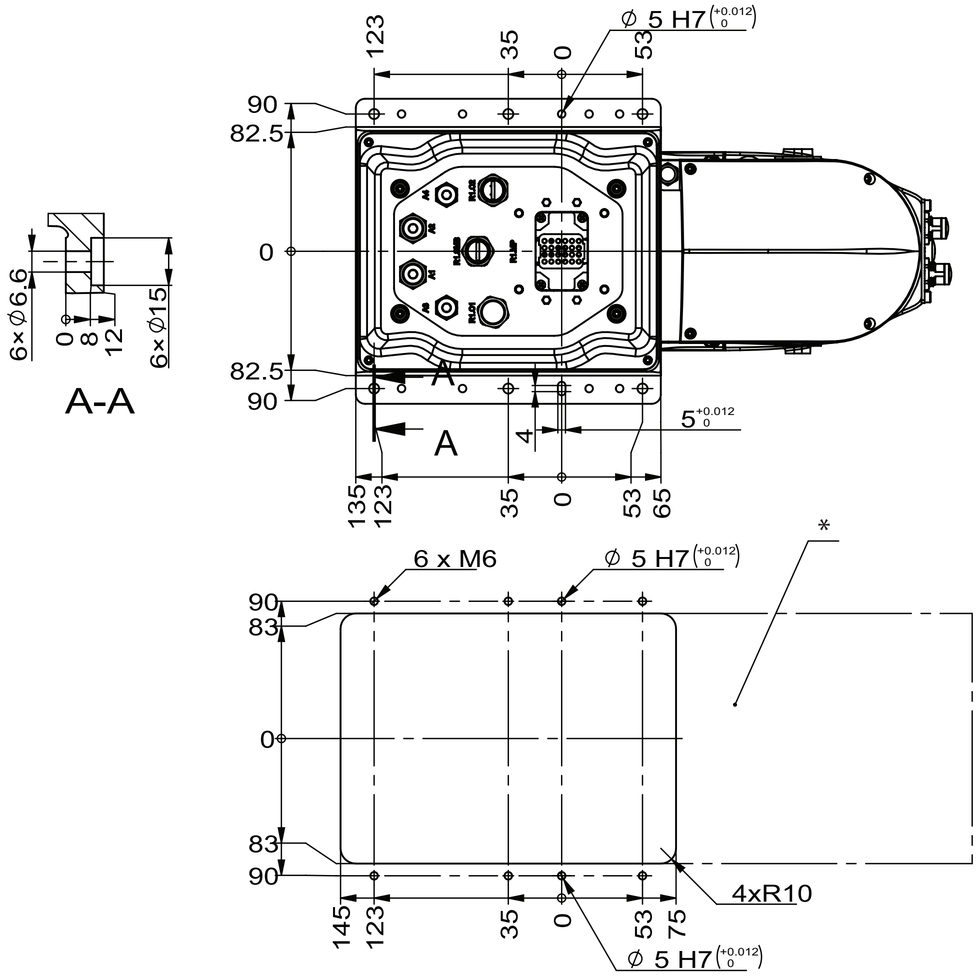
Environmental information

The product complies with IEC 63000. *Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances*.

1.3.3 Mounting the manipulator

Hole configuration, base

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



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* Maintenance window: Opening to access inner arm's cover is recommended.

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Attachment screws

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

Suitable screws	M6x25 (robot installation directly on foundation)
Quantity	6 pcs
Quality	10.9
Suitable washer	12 x 6.4 x 1.6, steel hardness class 300HV
Guide pins	2 pcs, D5x20, ISO 2338 - 5m6x20 - A1
Tightening torque	11 Nm±1.1 Nm
Length of thread engagement	Minimum 14 mm for ground with material yield strength 150 MPa
Level surface requirements	0.1/500 mm

1.4 Load diagrams

1.4.1 Introduction to load diagram

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
- ball screw spline unit

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 - OmniCore*, for detailed information.

WARNING

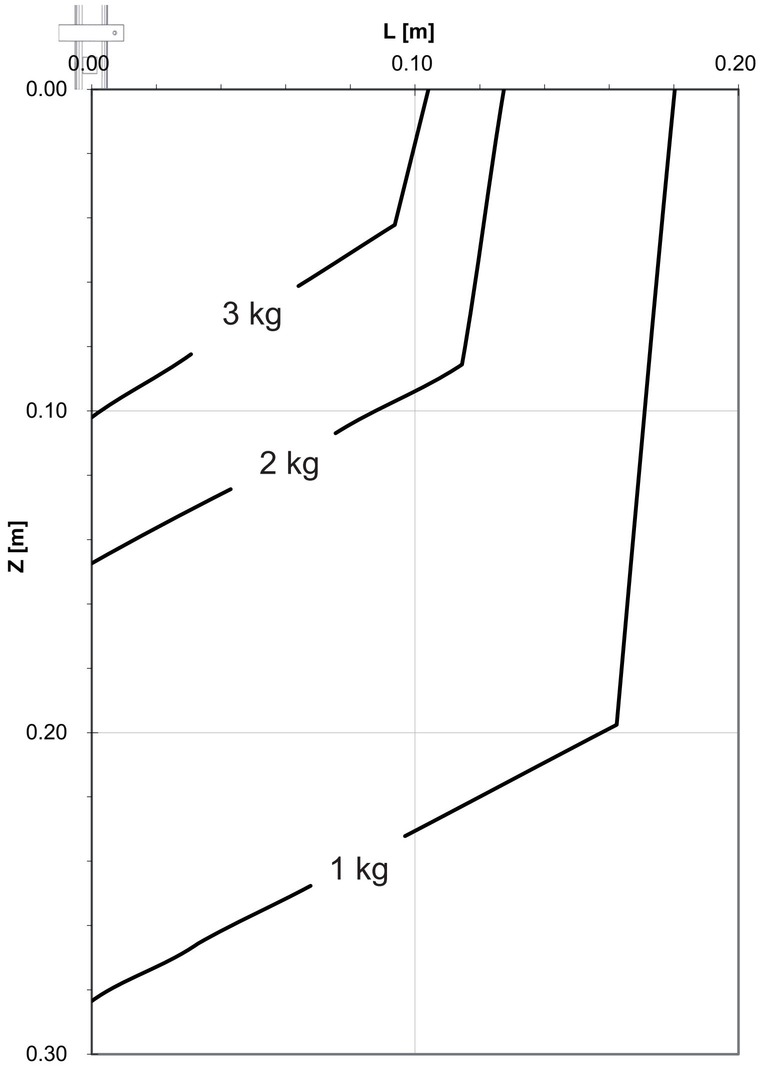
Robots running with incorrect load data and/or with loads outside the load diagram, will not be covered by robot warranty.

General

The load diagram includes a nominal pay load inertia, J_o of 0.01 kgm^2. At different moment of inertia the load diagram will be changed. For robots that are inverted mounted, the load diagrams as given are valid and thus it is also possible to use RobotLoad within those tilt and axis limits.

1.4.2 Load diagram

IRB 910INV-3/0.35



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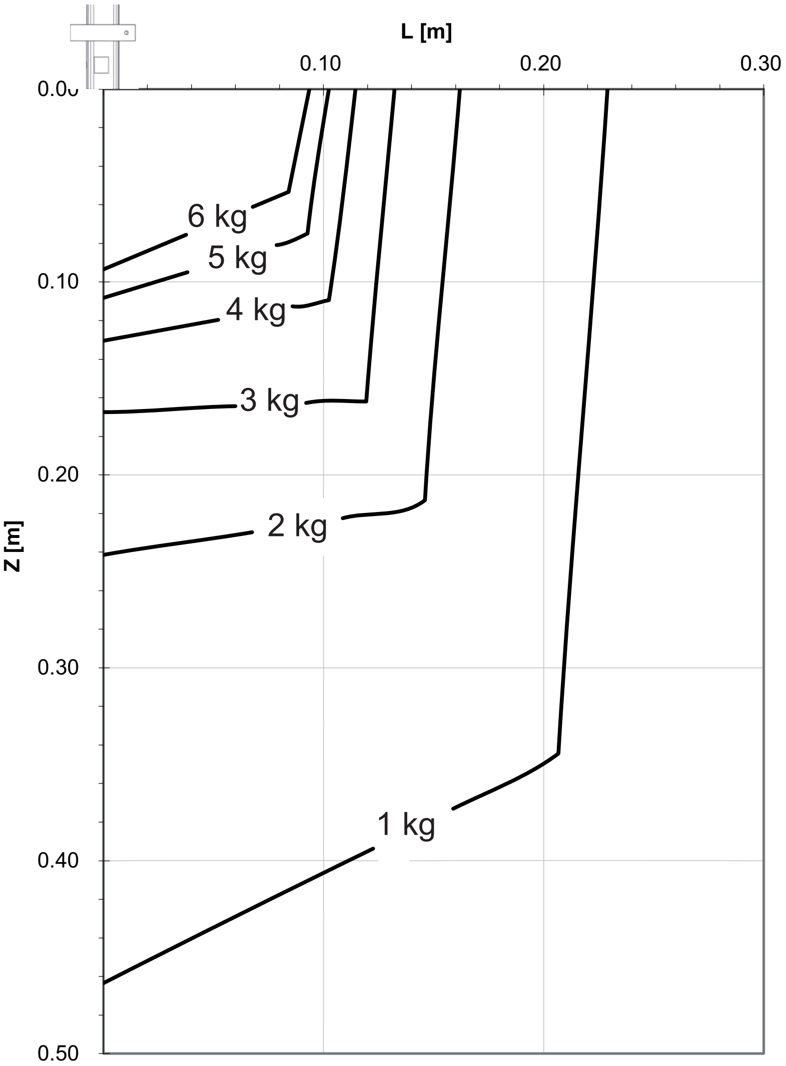
IRB 910INV-6/0.55



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1.4.3 Maximum load and moment of inertia

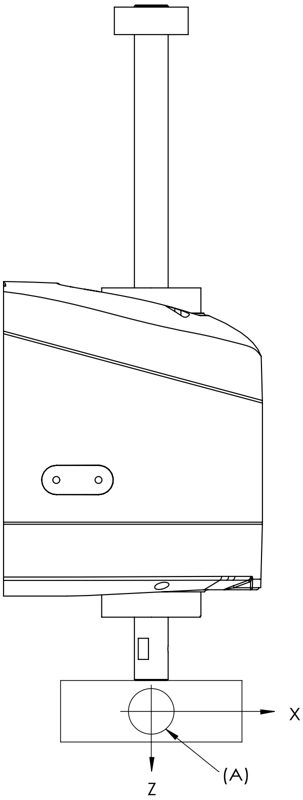
General

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

For IRB 910INV, L is 0 mm at the default rating and its maximum value changes with the payload. See *Load diagram on page 27*.

Full movement

Axis	Robot variant	Max. value
4	IRB 910INV-3/0.35	J_4= Mass x L^2 + J_{oz} ≤ 0.05 kgm^2
	IRB 910INV-6/0.55	J_4= Mass x L^2 + J_{oz} ≤ 0.12 kgm^2



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

1.4.4 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

Concerning SCARAs, as the movements types could be treated as combinations of horizontal movements alone and vertical movements alone, the detailed information of spacial acceleration values are listed. XYZ stands for 3-dimensional movements while XY stands for horizontal movements.

Robot type	E-stop Max acceleration at nominal load COG [m/s^2]		Controlled Motion Max acceleration at nominal load COG [m/s^2]	
	XYZ	XY	XYZ	XY
IRB 910INV-3/0.35	99	99	40	34
IRB 910INV-6/0.55	66	65	29	27

Note

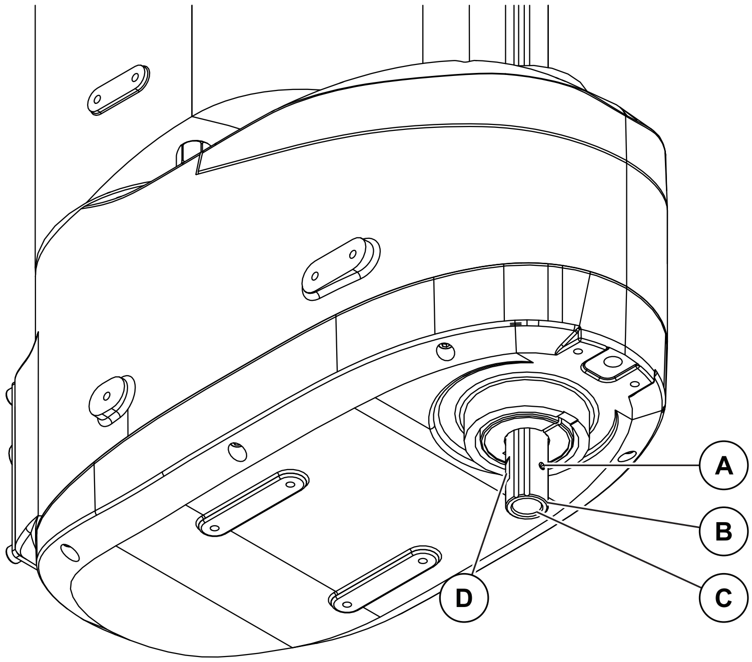
Acceleration levels for emergency stop and controlled motion includes acceleration due to gravitational forces. Nominal load is defined with nominal mass and cog with max offset in Z and L (see the load diagram).

1.5 Mounting of equipment

Fitting of end effector to the ball screw spline shaft

An end effector can be attached to the lower end of the shaft of the ball screw spline unit. The dimensions for fitting the end effector is shown in the following figure.

> **Note**
>
> Mounting of other equipment on the IRB 910INV may damage the gearboxes.



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A	Conical hole
B	Shaft diameter
C	Through hole
D	Flat cut

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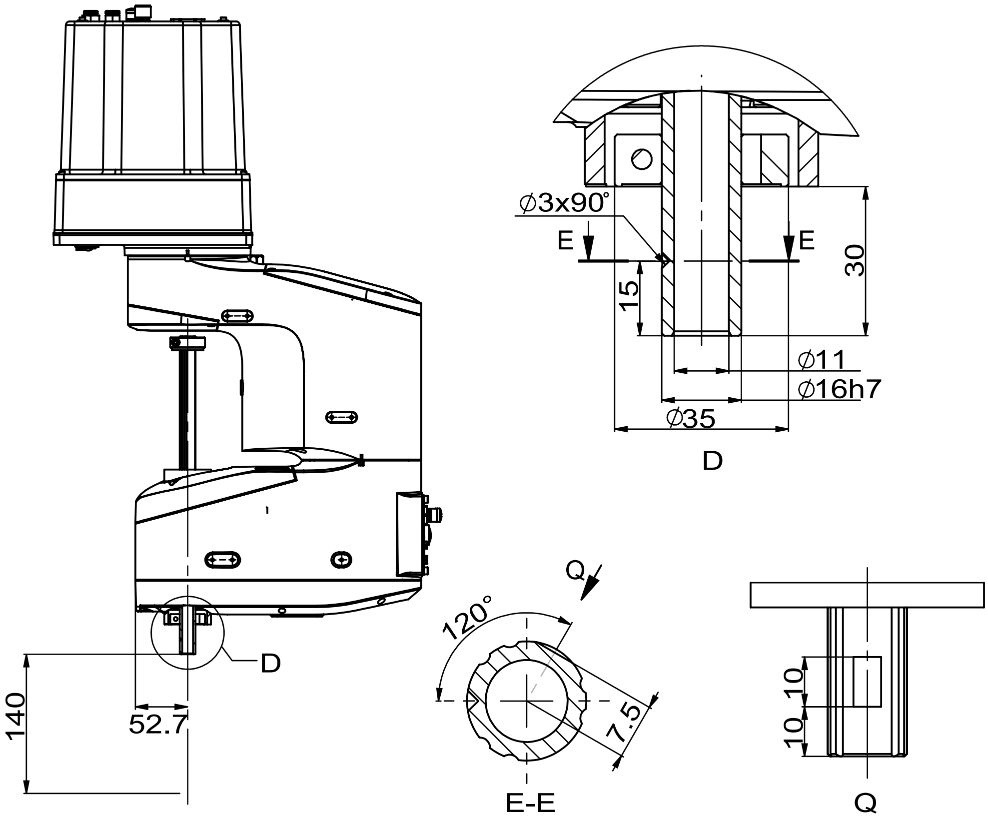
End effector flange of IRB 910INV-3/0.35

IP30



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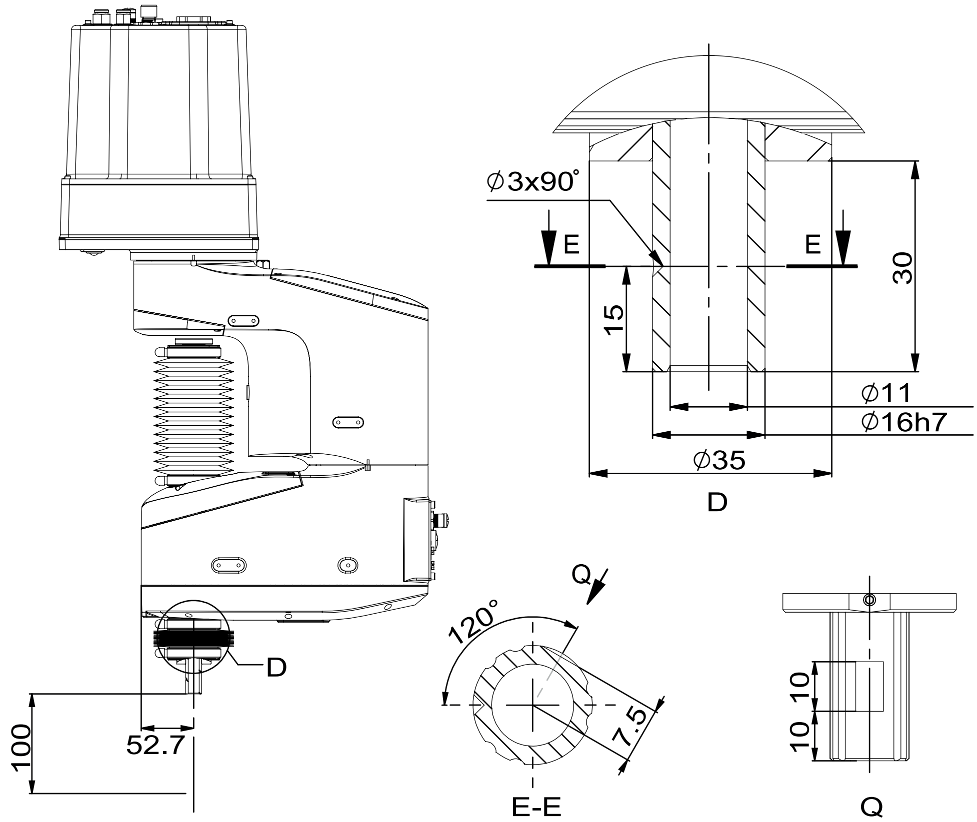
Clean Room/ IP54



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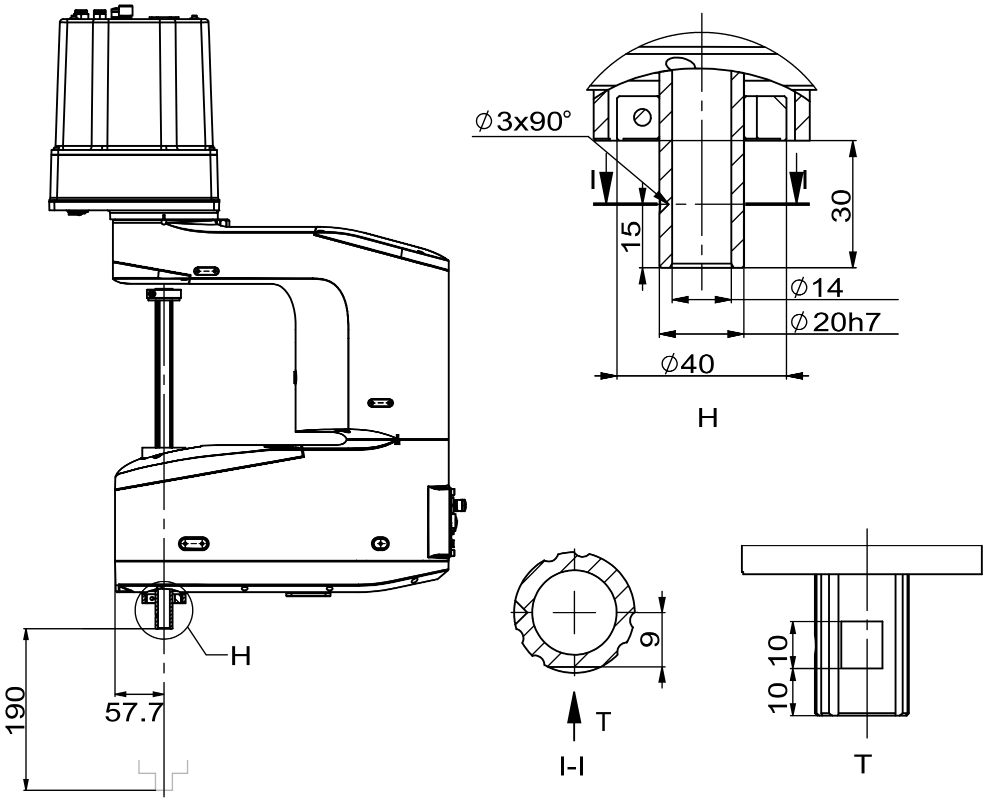
End effector flange of IRB 910INV-6/0.55

IP30



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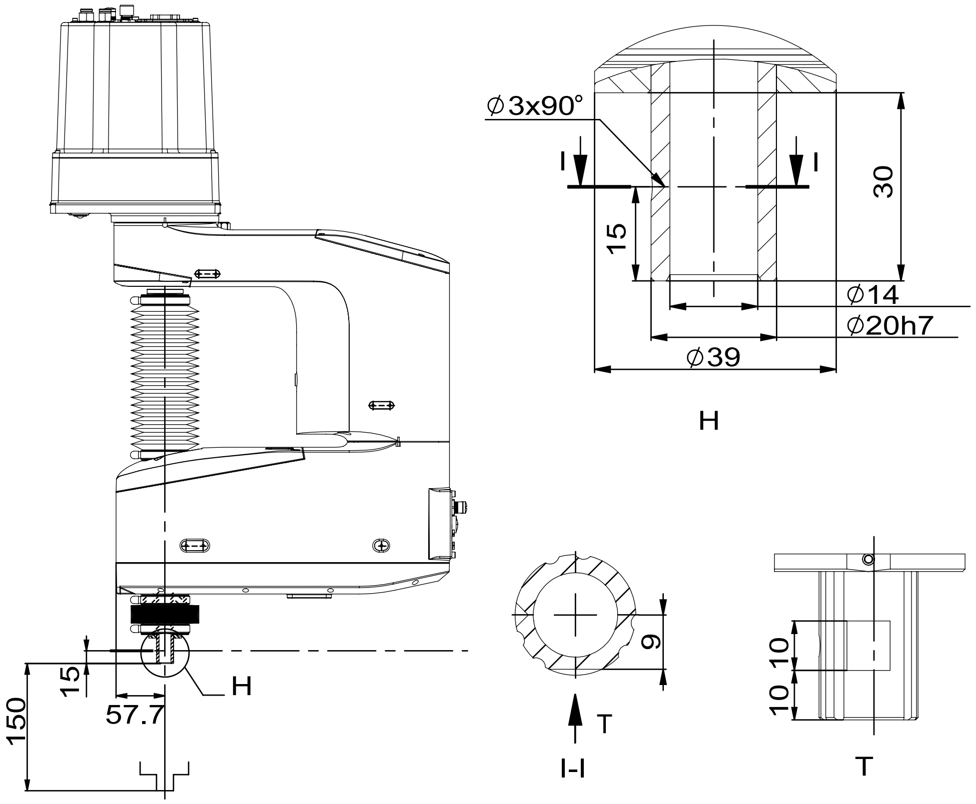
Clean Room/ IP54



xx1900001545

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.

1.6 Calibration

1.6.1 Calibration methods

Overview

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

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

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[i]
Absolute accuracy calibration (optional)	Based on standard calibration, and besides positioning the robot at synchronization position, the Absolute accuracy calibration also compensates for: • Mechanical tolerances in the robot structure • Deflection due to load Absolute accuracy calibration focuses on positioning accuracy in the Cartesian coordinate system for the robot. Absolute accuracy calibration data is found on the serial measurement board (SMB) or other robot memory. A robot calibrated with Absolute accuracy has the option information printed on its name plate (OmniCore). To regain 100% Absolute accuracy performance, the robot must be recalibrated for absolute accuracy after repair or maintenance that affects the mechanical structure.	CalibWare

i Only axes 1 and 2 can be calibrated using Axis Calibration method.

Brief description of calibration methods

Axis Calibration method

Axis Calibration is a standard calibration method for calibration of IRB 910INV. 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.

Continues on next page

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

CalibWare - Absolute Accuracy calibration

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

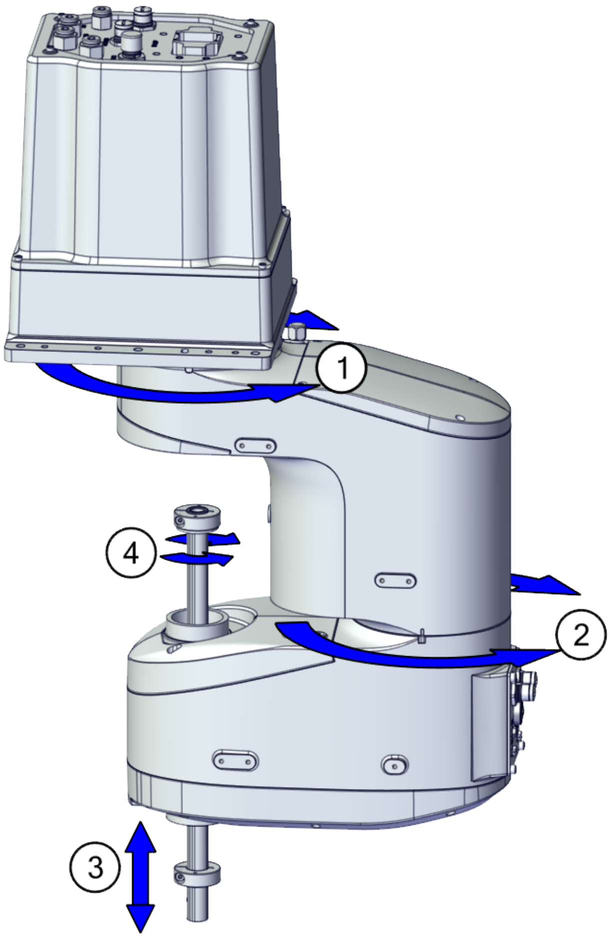
If a service operation is done to a robot with the option Absolute Accuracy, a new absolute accuracy calibration is required in order to establish full performance. For most cases after replacements that do not include taking apart the robot structure, standard calibration is sufficient.

The Absolute Accuracy option varies according to the robot mounting position. This is printed on the robot name plate for each robot. The robot must be in the correct mounting position when it is recalibrated for absolute accuracy.

1.6.2 Fine calibration

General

Fine calibration is made by moving the axes so that the synchronization mark on each joint is aligned. For detailed information on calibration of the robot see *Product manual - IRB 910INV*.



xx1900000084

Position	Description	Position	Description
1	Axis 1	2	Axis 2
3	Axis 3	4	Axis 4

1.6.3 Absolute Accuracy option

Purpose

Absolute Accuracy is a calibration concept that improves TCP accuracy. The difference between an ideal robot and a real robot can be several millimeters, resulting from mechanical tolerances and deflection in the robot structure. *Absolute Accuracy* compensates for these differences.

Here are some examples of when this accuracy is important:

- Exchangeability of robots
- Offline programming with no or minimum touch-up
- Online programming with accurate movement and reorientation of tool
- Programming with accurate offset movement in relation to eg. vision system or offset programming
- Re-use of programs between applications

The option *Absolute Accuracy* is integrated in the controller algorithms and does not need external equipment or calculation.

Note

The performance data is applicable to the corresponding RobotWare version of the individual robot.

Note

Singularities might appear in slightly different positions on a real robot compared to RobotStudio, where *Absolute Accuracy* is off compared to the real controller.

What is included

Every *Absolute Accuracy* robot is delivered with:

- compensation parameters saved in the robot memory
- a birth certificate representing the *Absolute Accuracy* measurement protocol for the calibration and verification sequence.

A robot with *Absolute Accuracy* calibration has a label with this information on the manipulator.

Absolute Accuracy supports floor mounted, wall mounted, and ceiling mounted installations. The compensation parameters that are saved in the robot memory differ depending on which Absolute Accuracy option is selected.

When is *Absolute Accuracy* being used

Absolute Accuracy works on a robot target in Cartesian coordinates, not on the individual joints. Therefore, joint based movements (e.g. `MoveAbsJ`) will not be affected.

Continues on next page

If the robot is inverted, the Absolute Accuracy calibration must be performed when the robot is inverted.

Absolute Accuracy active

Absolute Accuracy will be active in the following cases:

- Any motion function based on robtargets (e.g. `MoveL`) and ModPos on robtargets
- Reorientation jogging
- Linear jogging
- Tool definition (4, 5, 6 point tool definition, room fixed TCP, stationary tool)
- Work object definition

Absolute Accuracy not active

The following are examples of when Absolute Accuracy is not active:

- Any motion function based on a jointtarget (`MoveAbsJ`)
- Independent joint
- Joint based jogging

RAPID instructions

There are no RAPID instructions included in this option.

Production data

Typical production data regarding calibration are:

Robot	Positioning accuracy (mm)		
	Average	Max	% Within 1 mm
IRB 910INV-3/0.35	0.5	1	100
IRB 910INV-6/0.55	0.5	1	100

1.7 Maintenance and troubleshooting

1.7.1 Introduction to maintenance and trouble shooting

General

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

- Maintenance-free AC motors are used.
- Grease used for all gearboxes.
- 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 *Maintenance* section in the *Product Manual - IRB 910INV*.

1.8 Robot motion

General

Note

Robot moves faster when axis 3 is at a higher position. If the axis 3 is at a relatively low position, the acceleration and deceleration of axes 1, 2 and 4 may be reduced based on the actual position and speed of the axes, and the stabilization time for final positioning may also be longer when moving the robot horizontally.

Continues on next page

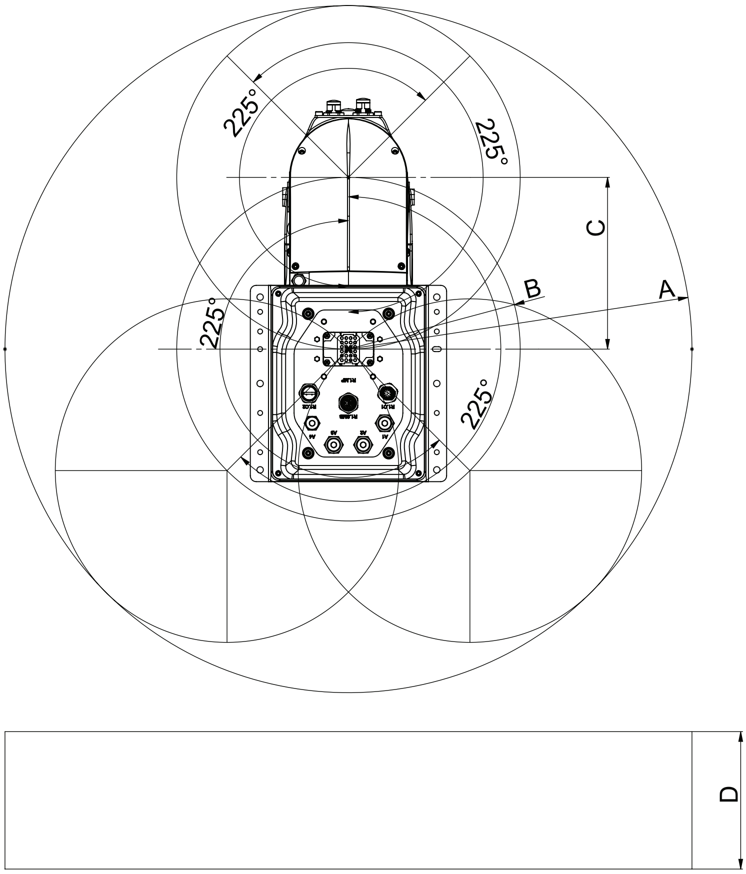
1.8.1 Working range and type of motion

Robot motion

Axis	Type of motion	Working range	
		IRB 910INV-3/0.35	IRB 910INV-6/0.55
Axis 1	Rotation motion	±225°	±225°
Axis 2	Rotation motion	±225°	±225°
Axis 3	Linear motion	-140 mm to 0 mm	-190 mm to 0 mm
Axis 3 (IP54 and Clean Room)	Linear motion	-100 mm to 0 mm	-150 mm to 0 mm
Axis 4	Rotation motion	±720°	±720°

Illustration, working range and turning radius

This illustration shows the unrestricted working range and turning radius.



xx1800002809

	IRB 910INV-3/0.35		IRB 910INV-6/0.55	
	IP30	Clean Room/IP54	IP30	Clean Room/IP54
A	R350	R350	R550	R550
B	R175	R175	R275	R275

Continues on next page

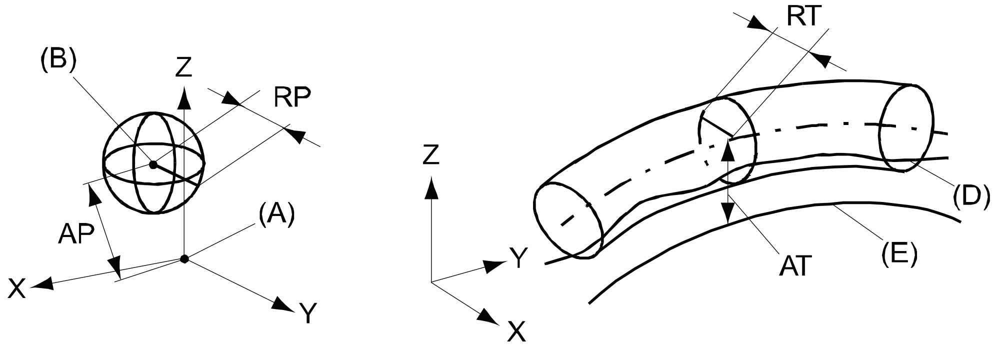
	IRB 910INV-3/0.35		IRB 910INV-6/0.55	
	IP30	Clean Room/IP54	IP30	Clean Room/IP54
C	175	175	275	275
D	140	100	190	150

1.8.2 Performance according to ISO 9283

General

At 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	Values [i]	
	IRB 910INV-3/0.35	IRB 910INV-6/0.55
Pose repeatability, RP (mm)	0.01	0.01
Pose accuracy, AP (mm) [ii]	0.01	0.01
Linear path repeatability, RT (mm)	0.06	0.05
Linear path accuracy, AT (mm)	1.77	1.26
Pose stabilization time, PSt (s) within 0.1 mm of the position	0.61	1.05

i The values are based on the zero position of axis 3.

ii 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.

1.8.3 Velocity

Maximum axis speed

Robot variant	Axis 1	Axis 2	Axis 3	Axis 4
IRB 910INV-3/0.35	672 °/s	780 °/s	1.1m/s	3,000 °/s
IRB 910INV-6/0.55	420 °/s	780 °/s	1.1 m/s	3,000 °/s

The velocities of axes 1, 2, and 4 are measured with 1 kg payload and axis 3 at position of 0 mm.

Supervision is required to prevent overheating in applications with intensive and frequent movements.

Down force (Z-stroke)

Robot Version	IRB 910INV-3/0.35	IRB 910INV-6/0.55
Max down force (Z stroke)	120 N	120 N

Suggested instruction:

Down force (N)	Force maintaining duration (S)	Force maintaining duty ratio[i] (%)	Force increment speed[ii] (mm/s)
<=120	<=15	<=50	<=1

i The ratio of down force maintaining duration / total cycle time
ii High speed is not recommended to avoid instantaneous down force larger than 120 N.

1.9 Robot stopping distances and times

1.9.1 Robot stopping distances according to ISO 10218-1

About the data for robot stopping distances and times

All measurements and calculations of stopping distances and times are done according to ISO 10218-1, with single axis motion on axes 1, 2, and 3. If more than one axis is used for the movement, then the stopping distance and time can be longer or shorter. The movement of the axes does not necessarily represent the actual application. Therefore, the braking distance must be validated for each application.

Normal delays of the hardware and software are taken into account. See more about the delays and their impact on the results, *Reading the data on page 50*.

The stopping distances and times are presented using the tool data and extension zones presented for the respected robot variant. These variables are 100%, 66%, and 33% of the maximum values for the robot.

The stop categories 0 and 1 are according to IEC 60204-1.

Note

The category 0 stop is not necessarily the worst case (depending on load, speed, application, wear, etc.).

Note

For SCARA robots without brakes on axis 1 and 2, the stopping distances for category 0 stops in actual applications can be longer than those stated in this document because without brakes, it is the friction that will stop the robot (on axes without brakes).

Note

The stop category 1 is a controlled stop and will therefore have less deviation from the programmed path compared with a stop category 0.

Loads

The tool data that is used is presented for the respective robot variant.

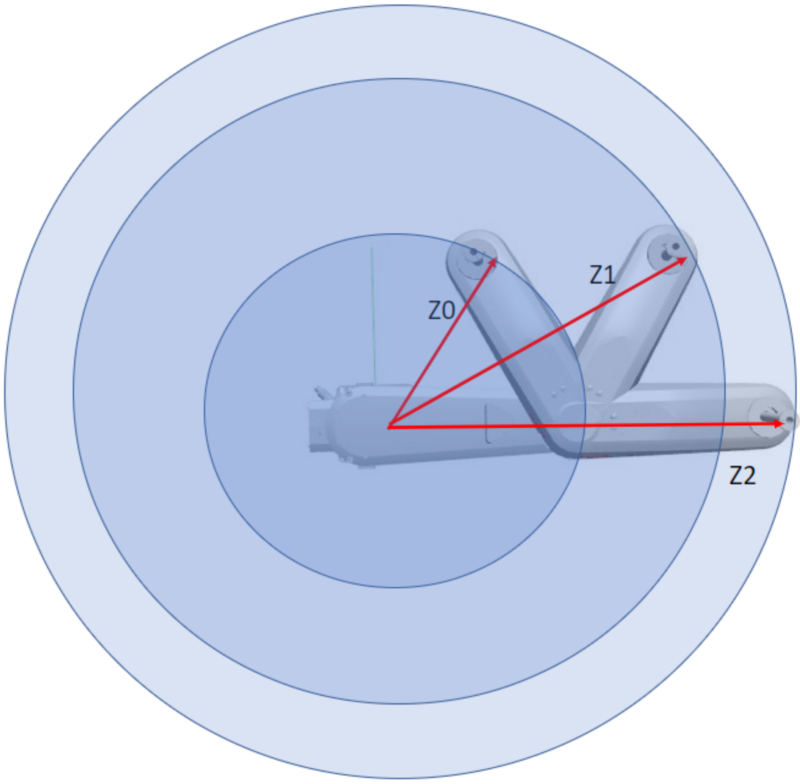
The used loads represent the rated load. No arm load is used. See the *Load diagrams on page 26*.

Continues on next page

Extension zones

The extension zone for the stop category 1 is based on the tool mounting interface (tool flange) with the axis angles according to the following illustrations. The zone data is presented for the respective robot variant.

The extension zone outer limits are defined by the TCP0 position for the stated angles.

Axis 1	 xx2300000863

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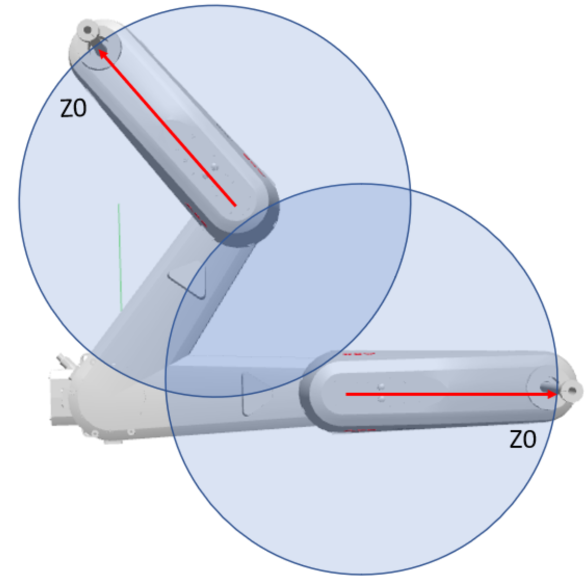
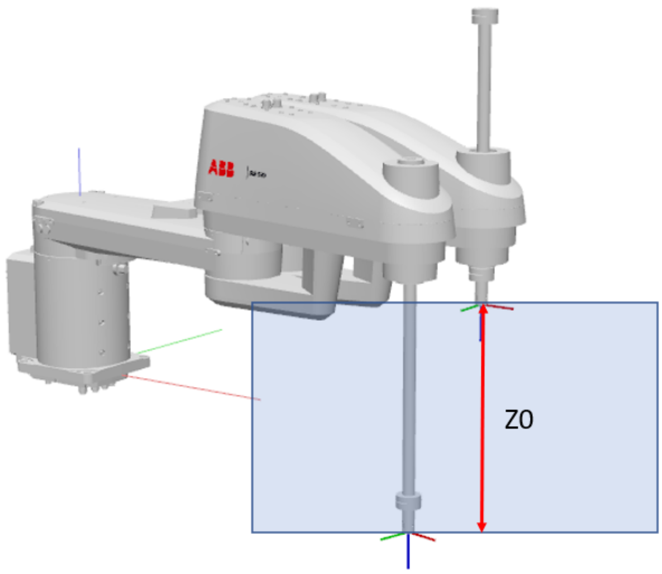
Axis 2	xx2300000864
Axis 3	xx2300000865

Speed

The speed in the simulations is based on TCP0.

The TCP0 speed is measured in meters per second when the stop is triggered.

Stopping distances

The stopping distance is measured in degrees or millimeters (depending on axis).

Stopping times

The stopping time is measured in seconds.

Continues on next page

Limitations

The stopping distance can vary depending on additional loads on the robot.

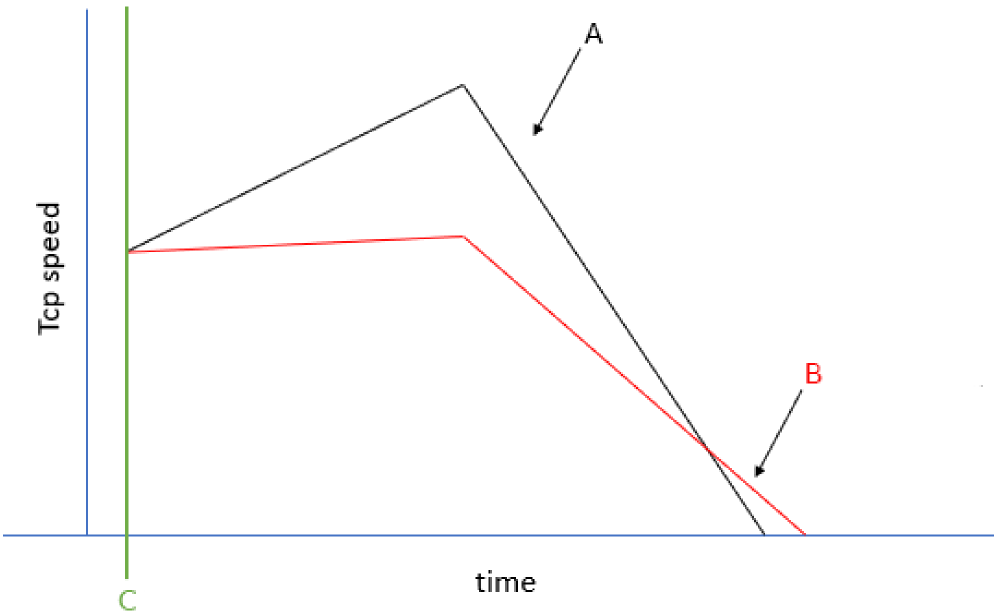
The stopping distance for category 0 stops can vary depending on the individual brakes and the joint friction.

Reading the data

The data for stop category 0 is presented in tables, with distance and time for each axis.

The data for stop category 1 is presented as graphs with curves representing the different loads.

There is a short delay in the stop, which means that if the axis is accelerating when the stop is initiated (C), it will continue to accelerate during this delay time. This can result in graphs where a higher load (A) gives shorter stopping distance than a smaller load (B).



xx2300001041

The tcp speed is the actual speed when the stop is initiated, which is not necessarily the programmed speed.

1.9.2 Measuring stopping distance and time

Preparations before measuring

For measurement and calculation of overall system stopping performance, see ISO 13855:2010.

The measurement shall be done for the selected stop category. The emergency stop button on the robot controller is configured for stop category 0 on delivery. A risk assessment can conclude the need for another stop category. The stop category can be changed through the system parameter *Function* (topic *Controller*, type *Safety Run Chain*). In case of deviations of the default configuration of stop category 0, then this is detailed in the product specification for the respective manipulator.

CAUTION

The measurement and calculation of overall stopping performance for a robot must be tested with its correct load, speed, and tools, in its actual environment, before the robot is taken into production.

All load and tool data must be correctly defined (weight, CoG, moment of inertia). The load identification service routine can be used to identify the data.

CAUTION

Follow the safety instructions in the respective product manual for the robot.

Measuring with TuneMaster

The software TuneMaster can be used to measure stopping distances and times for ABB robots. The TuneMaster software contains documentation on how to use it.

1. Download TuneMaster from *www.abb.com/robotics*, section **RobotStudio - Downloads - RobotWare Tools and Utilities.**
2. Install TuneMaster on a computer. Start the TuneMaster app and select **Log Signals**.
3. Connect to the robot controller.
4. Define the I/O stop signal to use for measurement, for example, ES1 for emergency stop.
5. Define the signal number to use for measurement, 1298 for axis position. The value is given in radians.
6. Start the logging in TuneMaster.
7. Start the test program on the controller.

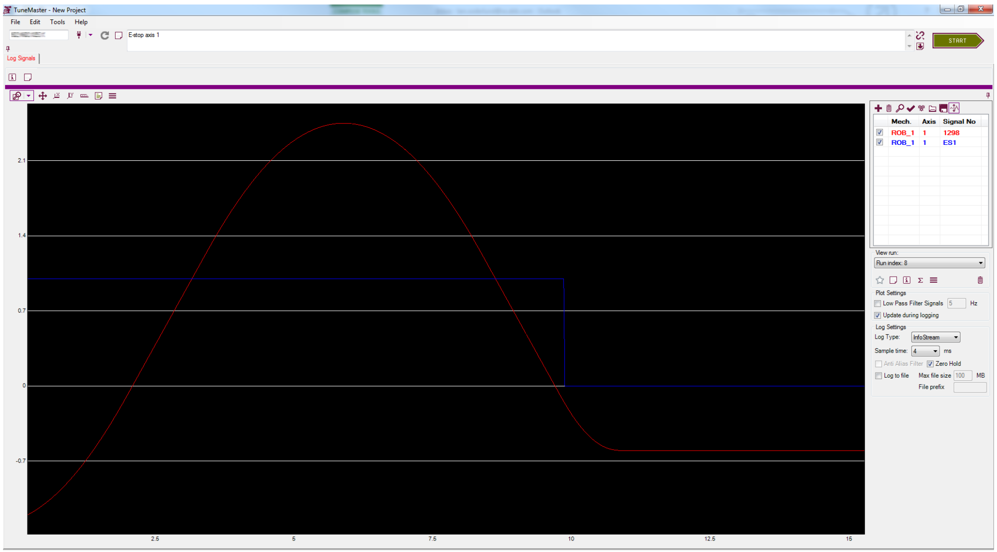
   Tip

   Use the tool and zone definitions for the respective variant in this document to get results that are comparable with this document.

Continues on next page

8 When the axis has reached maximum speed, press the emergency stop button.
9 In TuneMaster, measure the stopping distance and time.
10 Repeat for all installed emergency stop buttons until the identified hazards due to stopping distance and time for axes have been verified.

Example from TuneMaster



xx1600000386

1.9.3 IRB 910INV-3/0.35

Used tooldata

```
PERS tooldata P100:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [3, [0, 0,
     59], [1, 0, 0, 0], 0.0017, 0.0017, 0.0017]];
PERS tooldata P66:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [2, [0, 0,
     39], [1, 0, 0, 0], 0.00077, 0.00077, 0.00077]];
PERS tooldata P33:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [1, [0, 0,
     20], [1, 0, 0, 0], 0.00019, 0.00019, 0.00019]];
```

Category 0

The following table describes the stopping distance and time for category 0 stop.

Axis	Distance	Stop time
1*	66.5°	0.14 s
2*	68.0°	0.11 s
3	86.8 mm	0.1 s

*) The axis has no brake.

Category 1, extension zones

For definitions of the zones, see *Extension zones on page 48*.

The zone border is the mounting interface location for axis 2 and axis 3.

Axis 1

Zone border	Axis 2	Axis 3
z0-z1	120°	0 mm
z1-z2	60°	0 mm

Axis 2

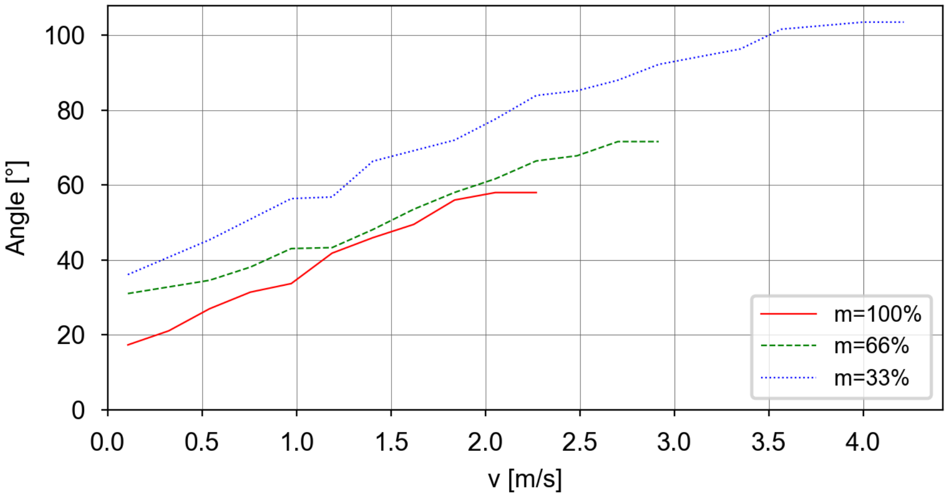
Only one zone exists.

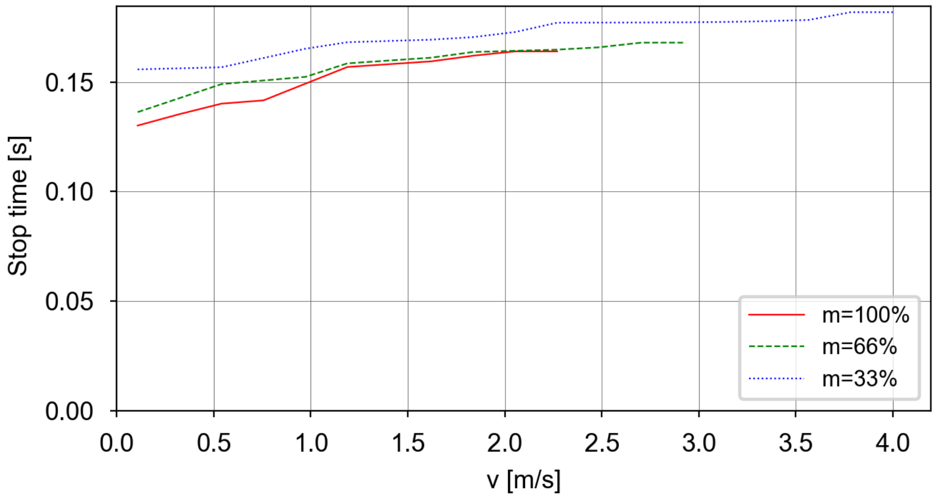
Axis 3

Only one zone exists.

Continues on next page

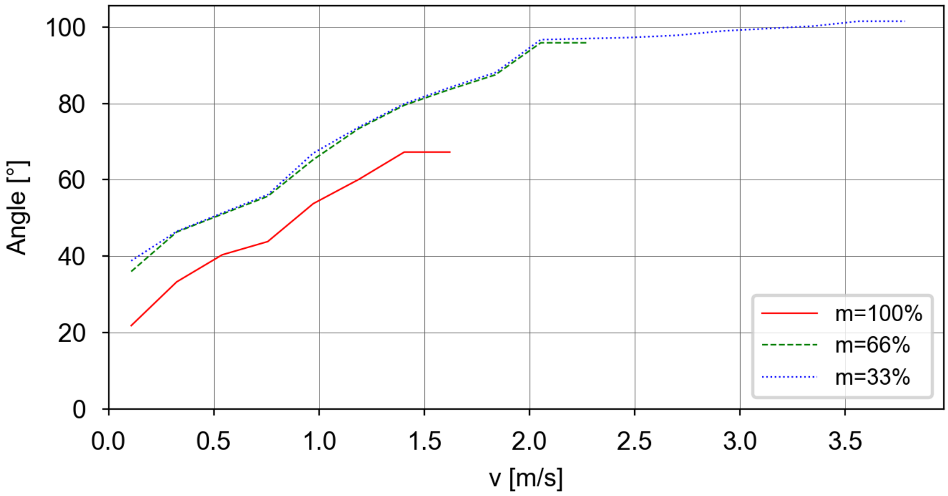
Category 1, Axis 1, Extension zone 0, stopping distance and stopping time

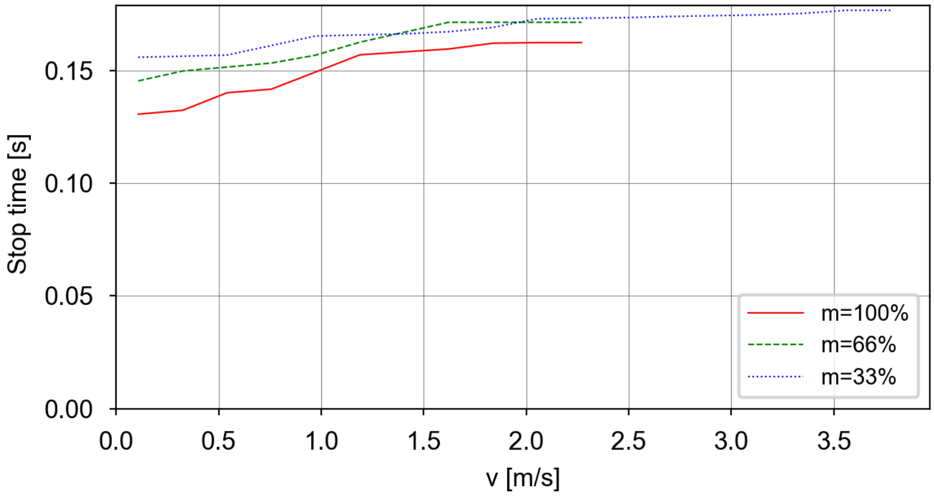




Continues on next page

Category 1, Axis 1, Extension zone 1, stopping distance and stopping time





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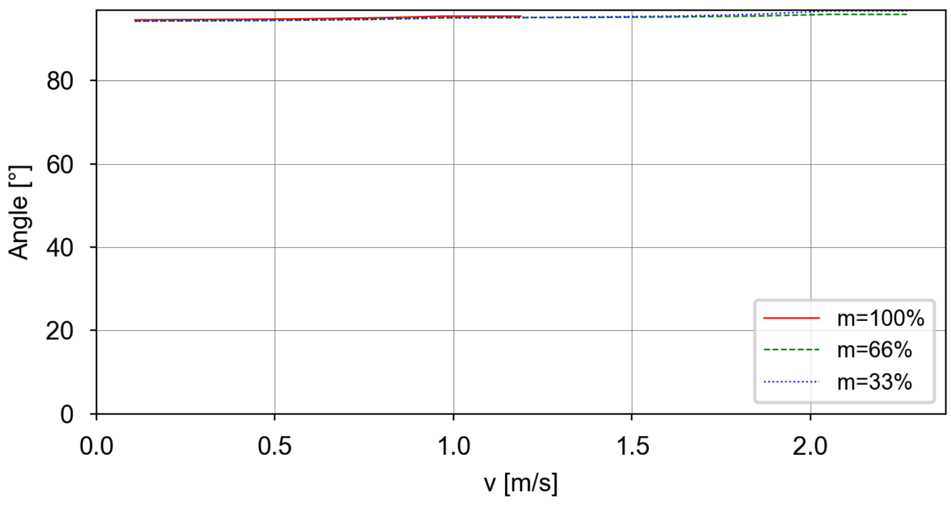
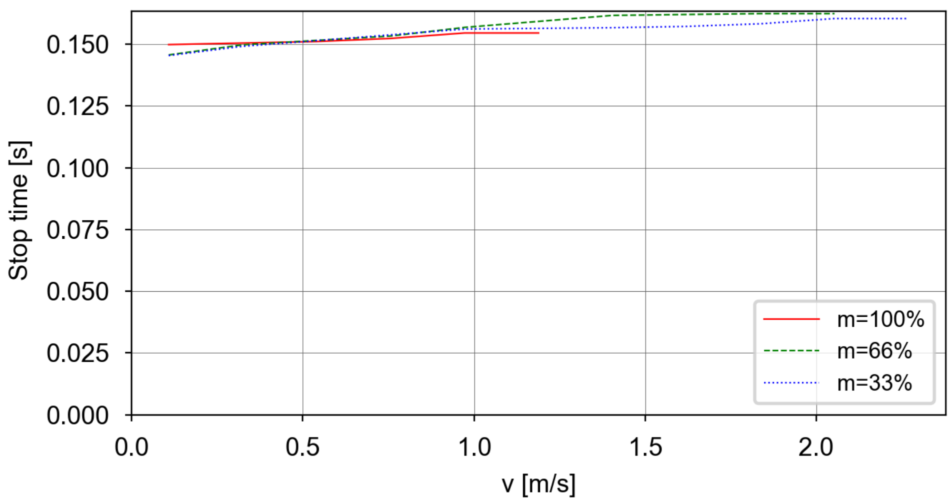
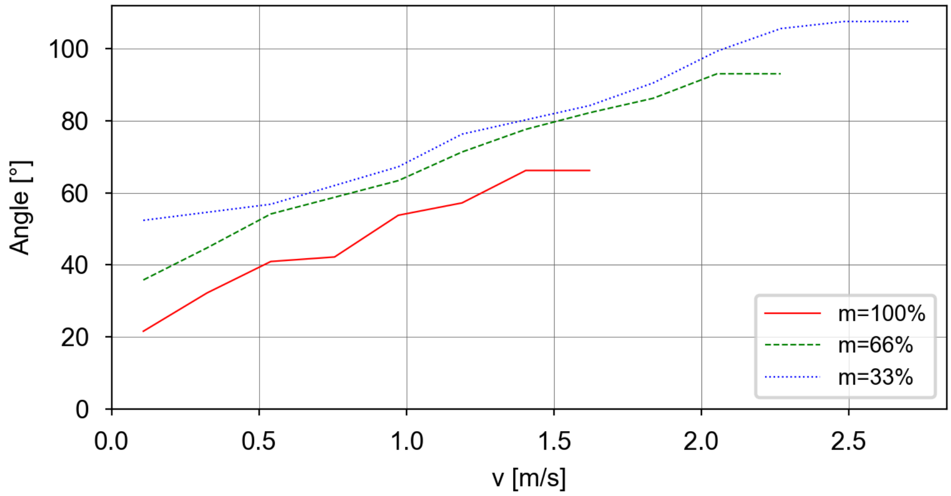
Category 1, Axis 1, Extension zone 2, stopping distance and stopping time

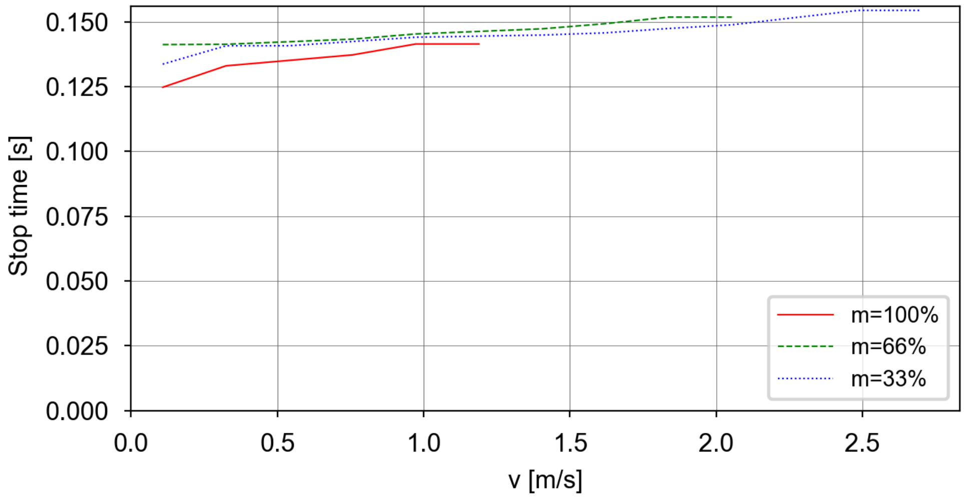




Continues on next page

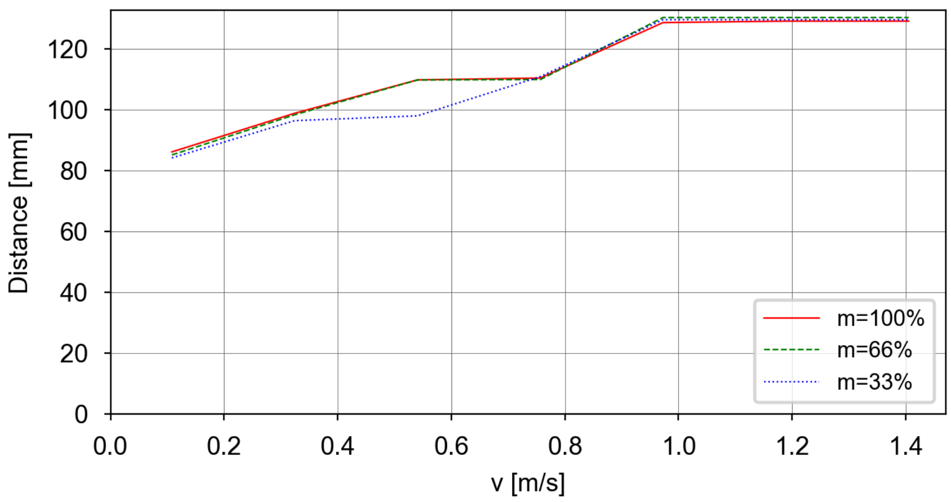
Category 1, Axis 2, Extension zone 0, stopping distance and stopping time

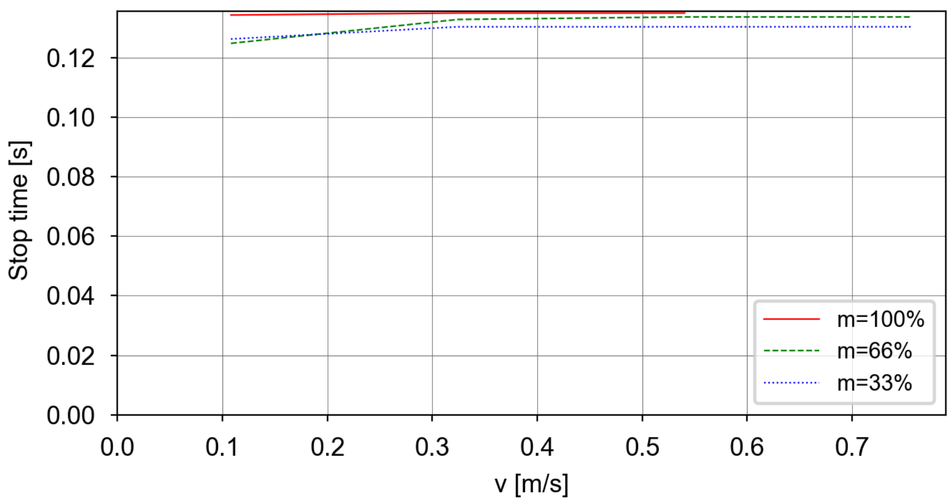




Continues on next page

Category 1, Axis 3, Extension zone 0, stopping distance and stopping time





1.9.4 IRB 910INV-3/0.35 IP54/CR

Used tooldata

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PERS tooldata P100:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [3, [0, 0,
     59], [1, 0, 0, 0], 0.0017, 0.0017, 0.0017]];
PERS tooldata P66:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [2, [0, 0,
     39], [1, 0, 0, 0], 0.00077, 0.00077, 0.00077]];
PERS tooldata P33:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [1, [0, 0,
     20], [1, 0, 0, 0], 0.00019, 0.00019, 0.00019]];
```

Category 0

The following table describes the stopping distance and time for category 0 stop.

Axis	Distance	Stop time
1*	74.1°	0.24 s
2*	70.4°	0.19 s
3	84.9 mm	0.1 s

*) The axis has no brake.

Category 1, extension zones

For definitions of the zones, see *Extension zones on page 48*.

The zone border is the mounting interface location for axis 2 and axis 3.

Axis 1

Zone border	Axis 2	Axis 3
z0-z1	120°	0 mm
z1-z2	60°	0 mm

Axis 2

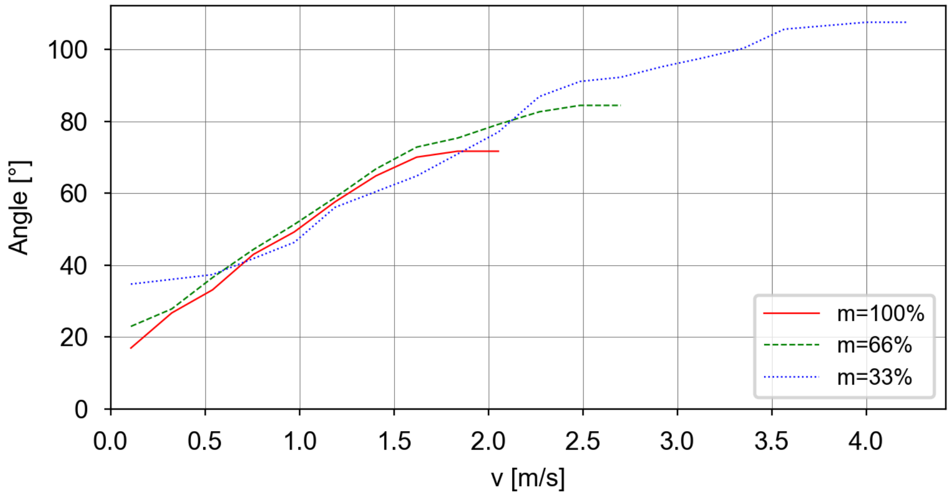
Only one zone exists.

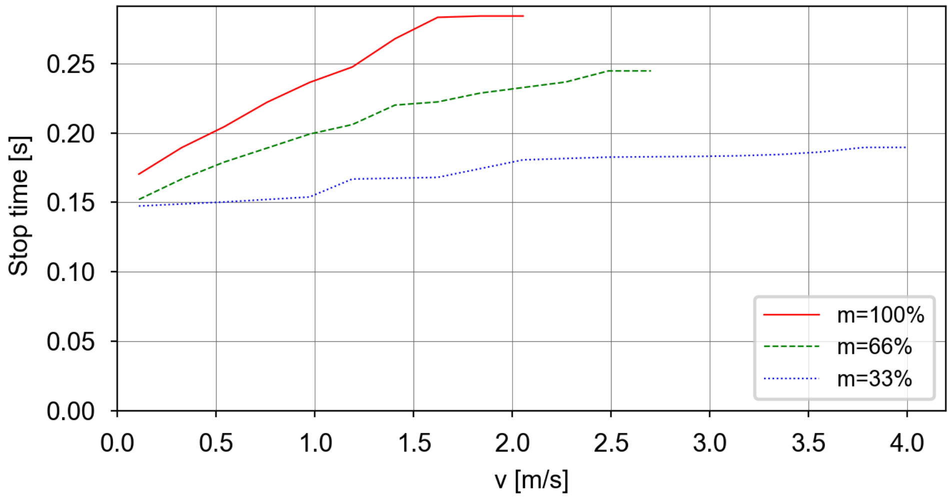
Axis 3

Only one zone exists.

Continues on next page

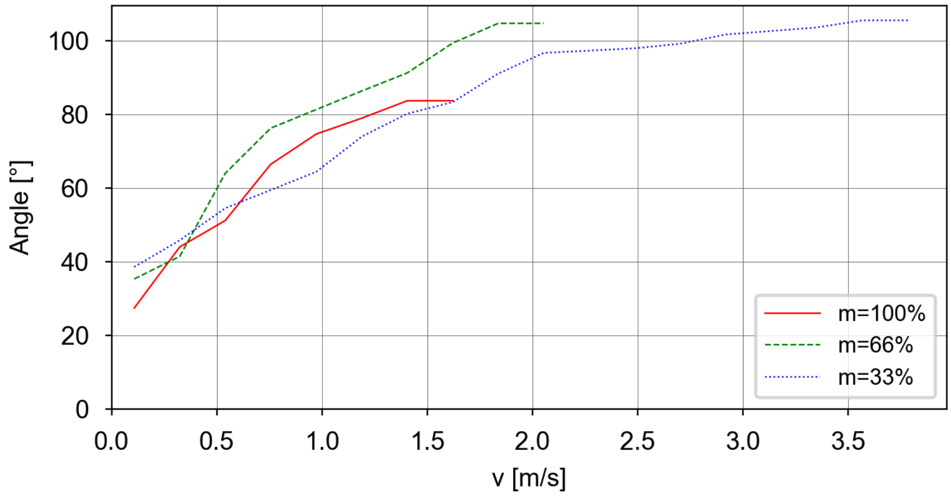
Category 1, Axis 1, Extension zone 0, stopping distance and stopping time

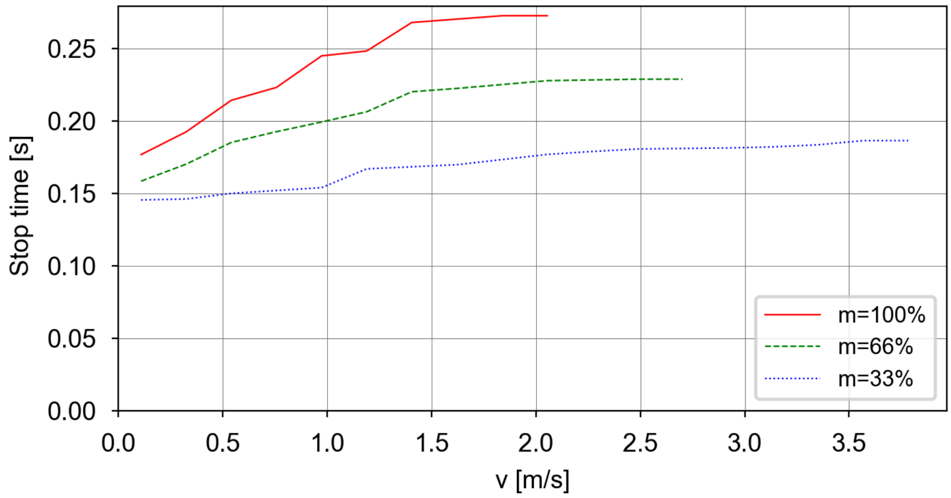




Continues on next page

Category 1, Axis 1, Extension zone 1, stopping distance and stopping time





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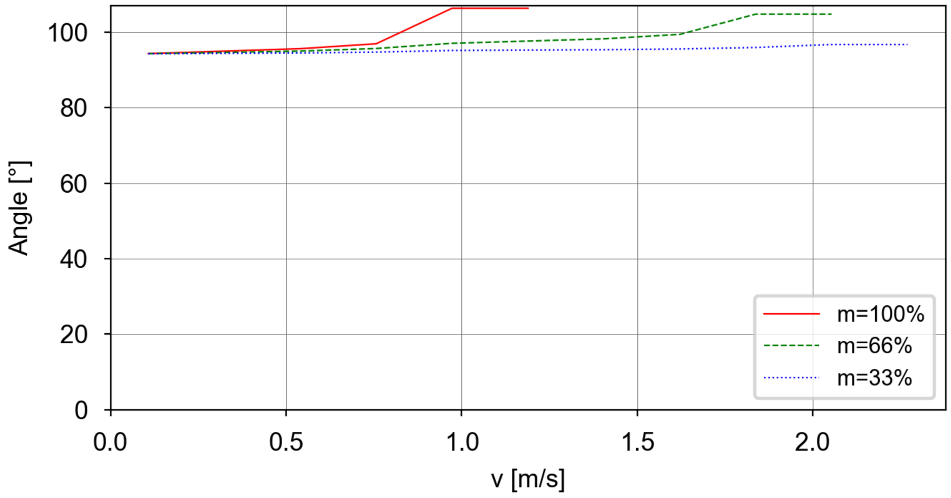
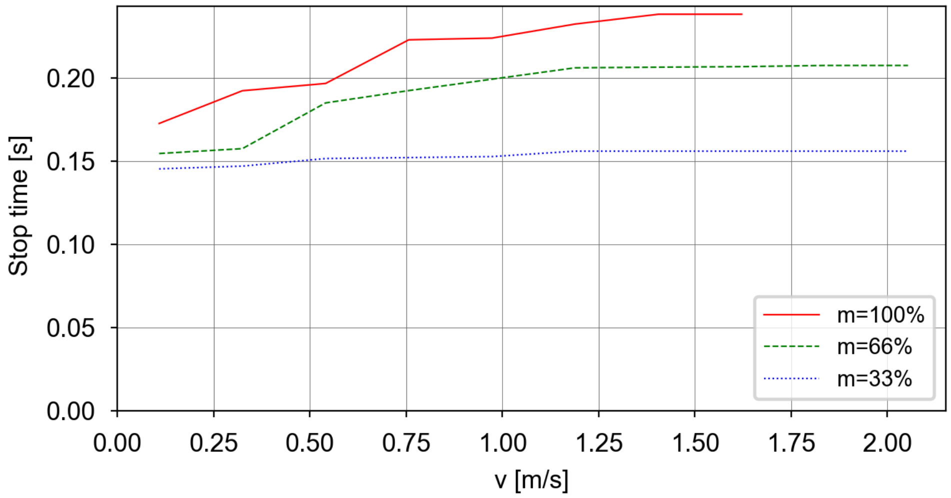
Category 1, Axis 1, Extension zone 2, stopping distance and stopping time





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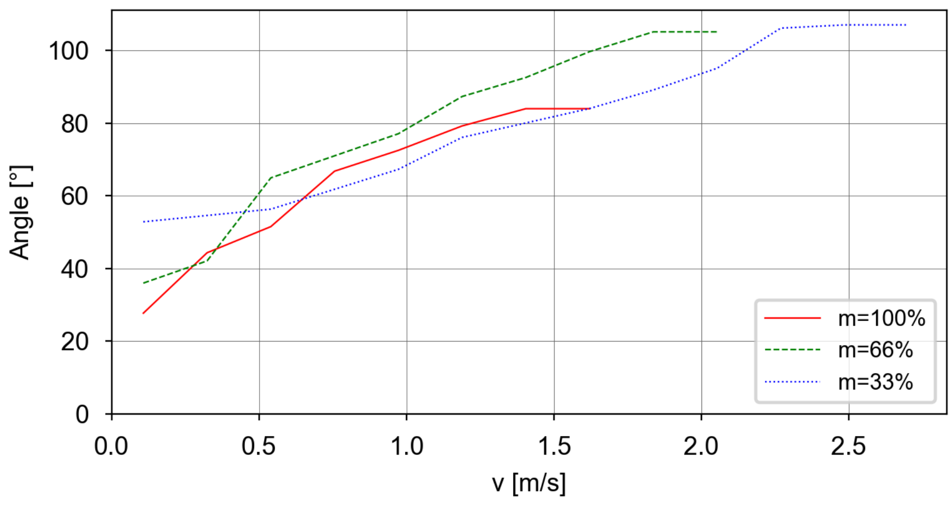
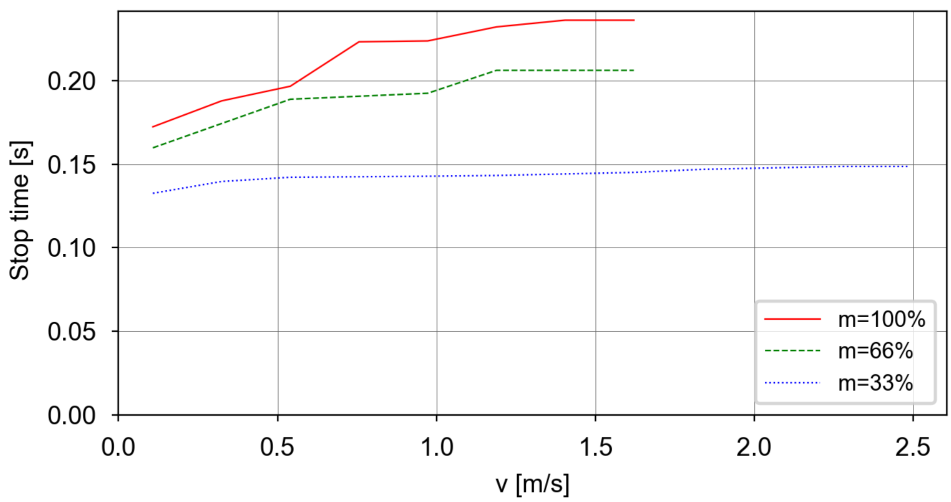
Category 1, Axis 2, Extension zone 0, stopping distance and stopping time





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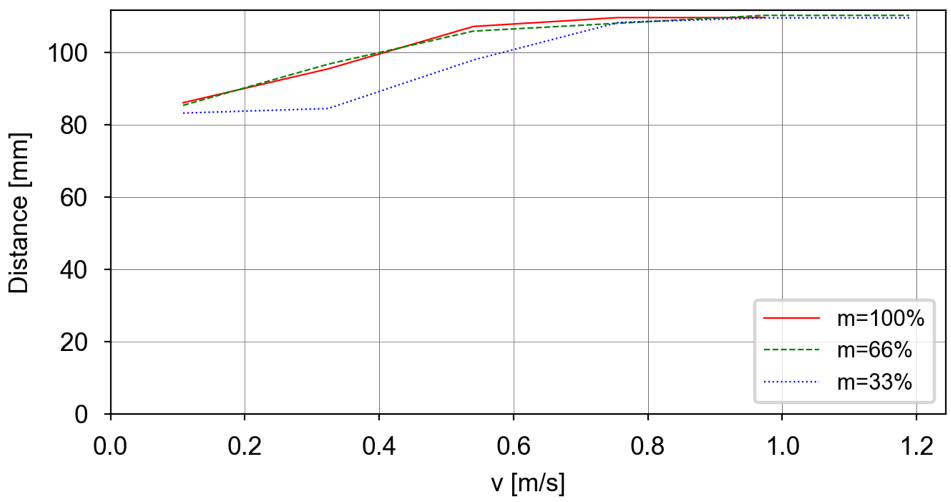
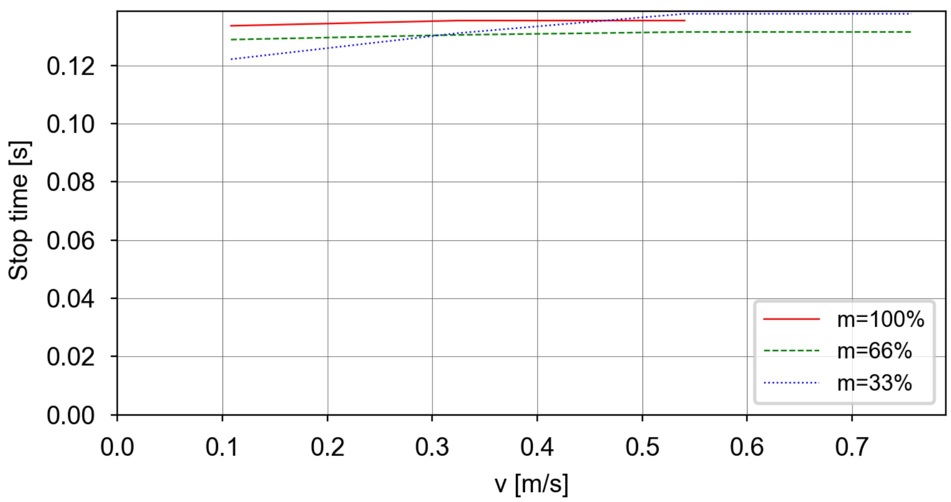
Category 1, Axis 3, Extension zone 0, stopping distance and stopping time





1.9.5 IRB 910INV-6/0.55

Used tooldata

```
PERS tooldata P100:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [6, [0, 0,
     157], [1, 0, 0, 0], 0.025, 0.025, 0.025]];
PERS tooldata P66:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [4, [0, 0,
     105], [1, 0, 0, 0], 0.011, 0.011, 0.011]];
PERS tooldata P33:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [2, [0, 0,
     52], [1, 0, 0, 0], 0.0027, 0.0027, 0.0027]];
```

Category 0

The following table describes the stopping distance and time for category 0 stop.

Axis	Distance	Stop time
1*	55.5°	0.2 s
2*	78.3°	0.16 s
3	99.2 mm	0.12 s

*) The axis has no brake.

Category 1, extension zones

For definitions of the zones, see *Extension zones on page 48*.

The zone border is the mounting interface location for axis 2 and axis 3.

Axis 1

Zone border	Axis 2	Axis 3
z0-z1	120°	0 mm
z1-z2	60°	0 mm

Axis 2

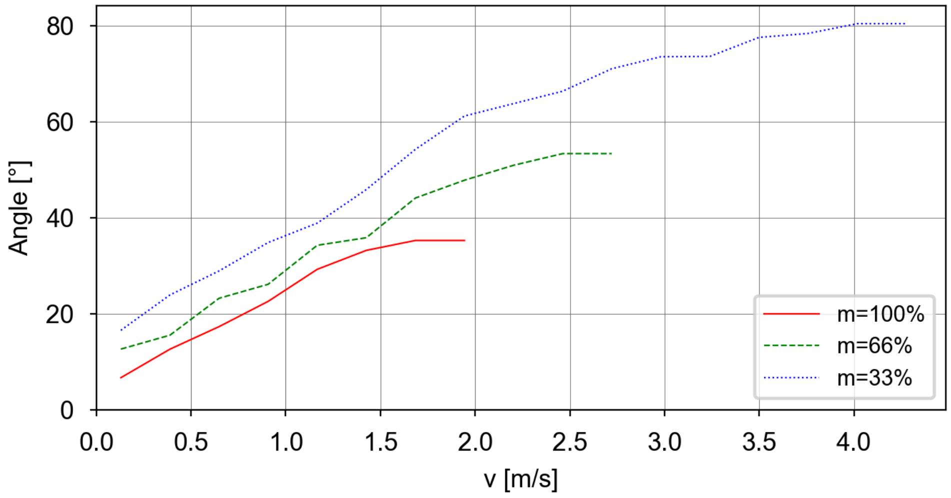
Only one zone exists.

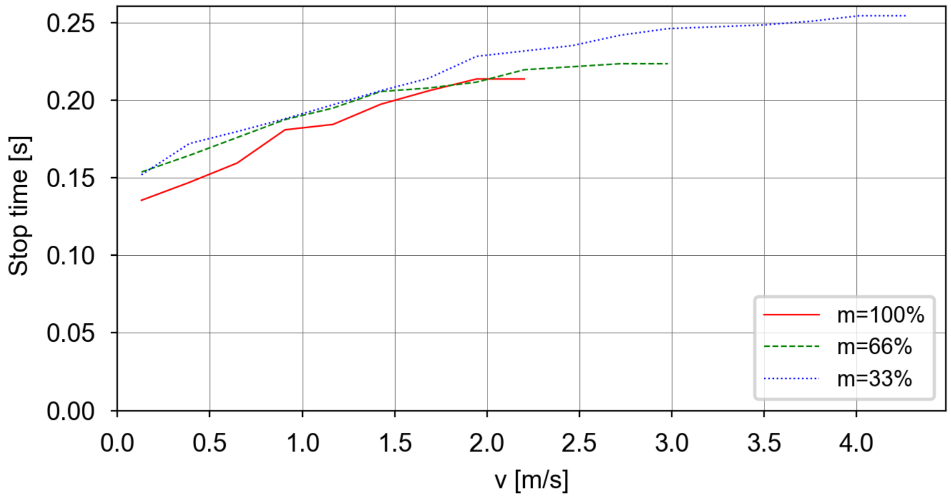
Axis 3

Only one zone exists.

Continues on next page

Category 1, Axis 1, Extension zone 0, stopping distance and stopping time





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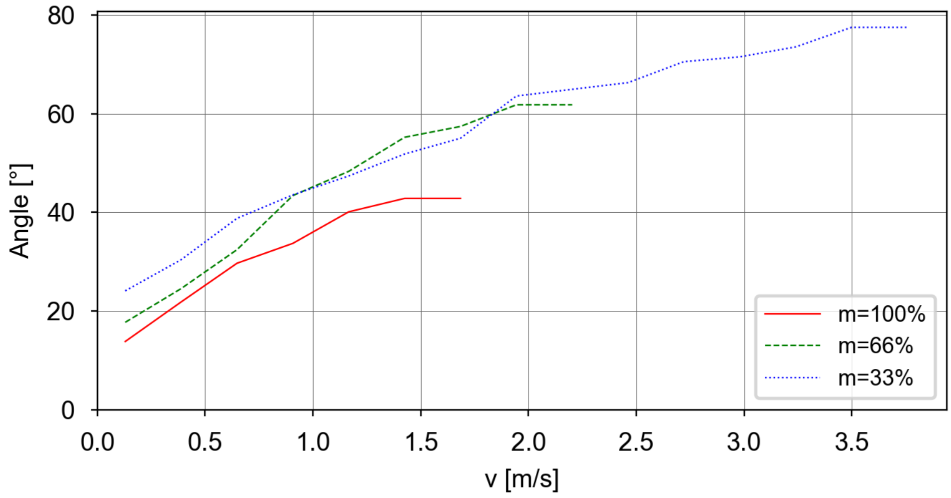
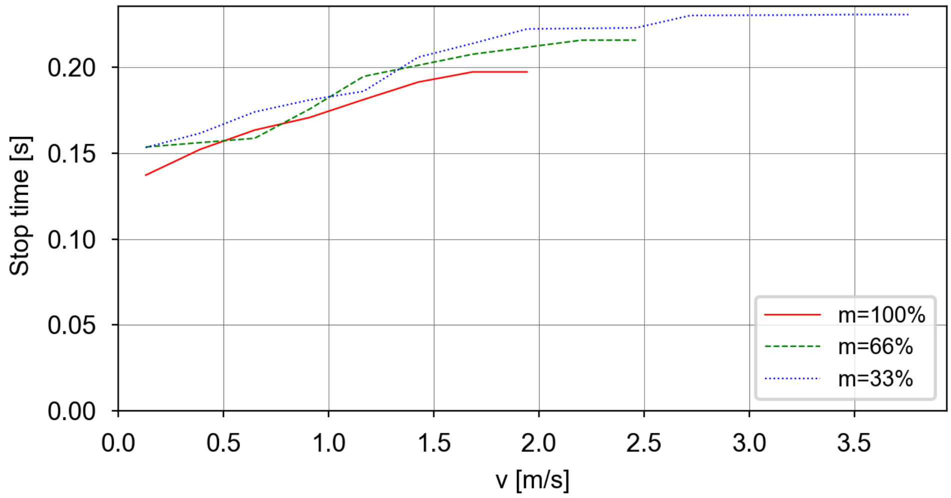
Category 1, Axis 1, Extension zone 1, stopping distance and stopping time





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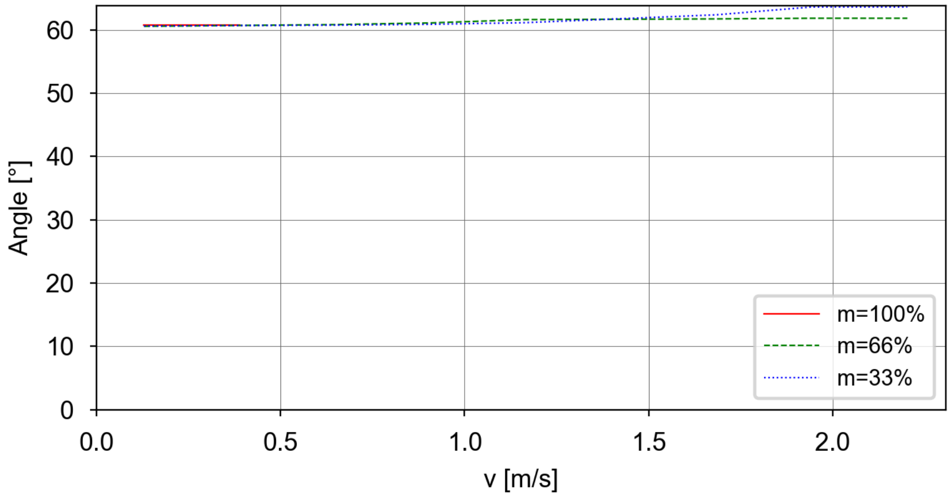
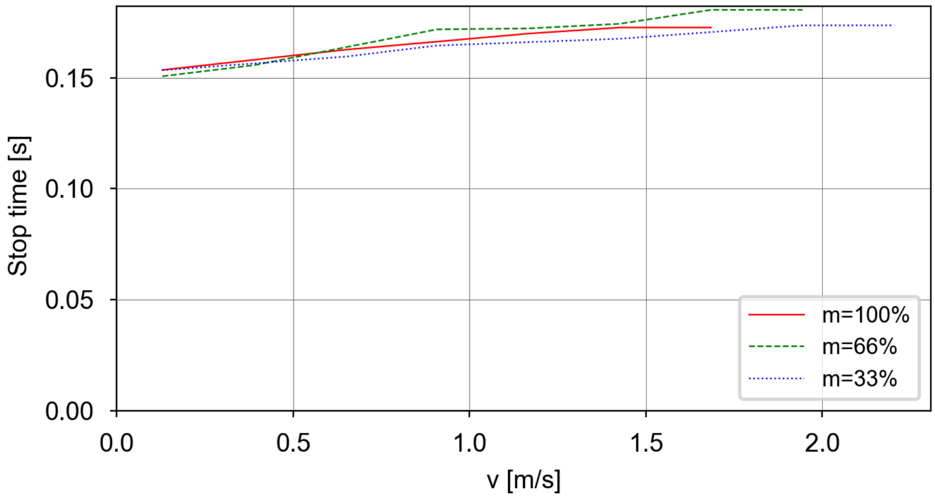
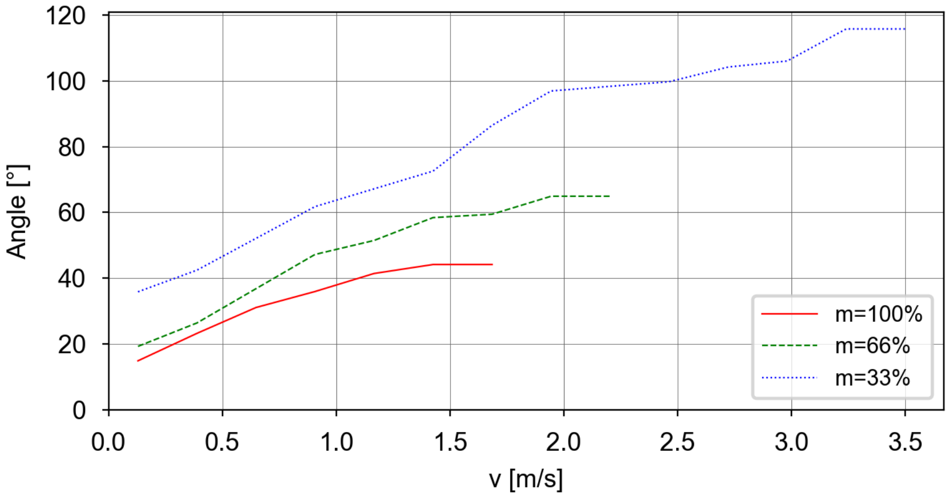
Category 1, Axis 1, Extension zone 2, stopping distance and stopping time

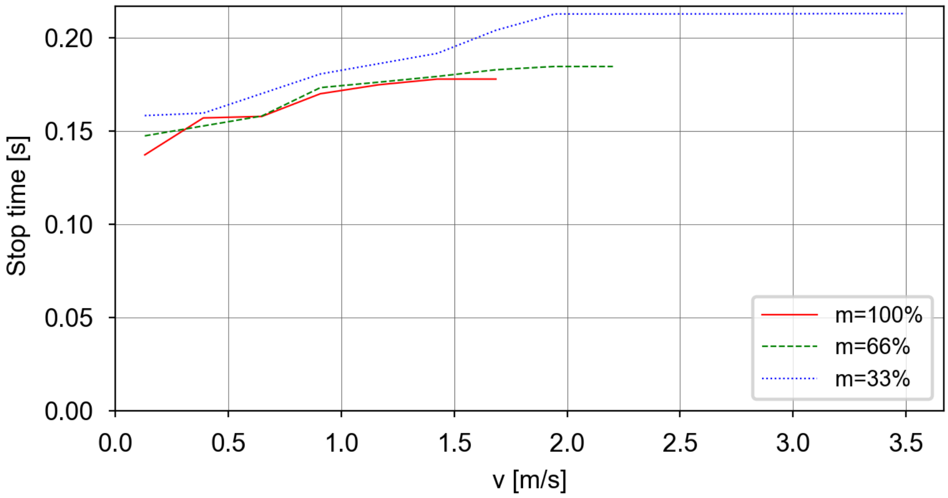




Continues on next page

Category 1, Axis 2, Extension zone 0, stopping distance and stopping time





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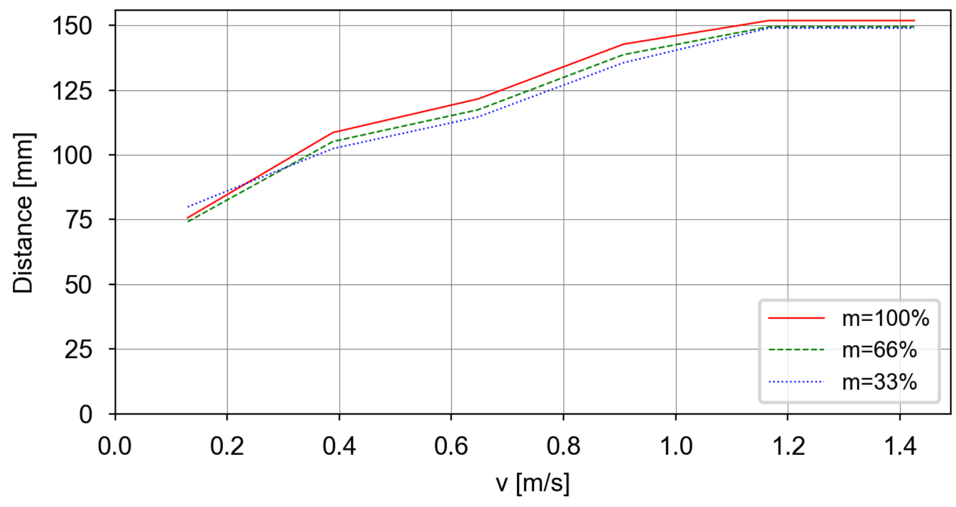
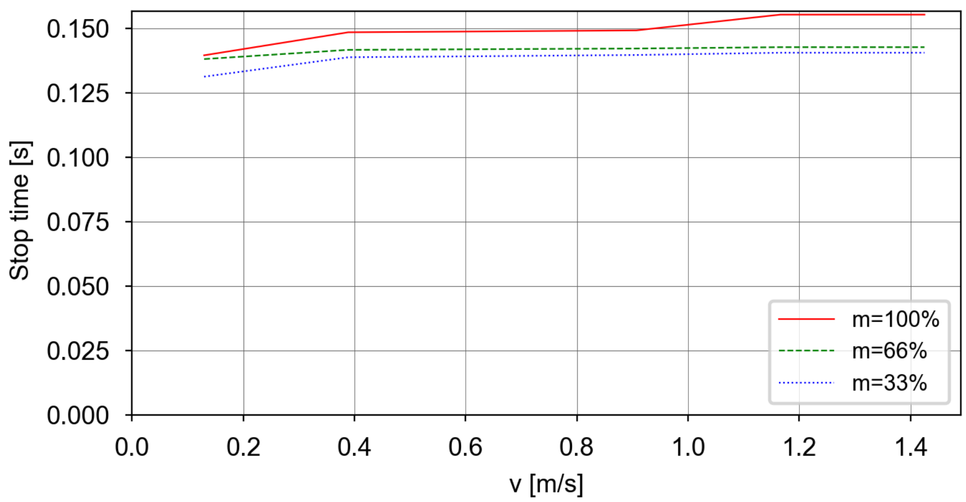
Category 1, Axis 3, Extension zone 0, stopping distance and stopping time





1.9.6 IRB 910INV-6/0.55 IP54/CR

Used tooldata

```
PERS tooldata P100:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [6, [0, 0,
     157], [1, 0, 0, 0], 0.025, 0.025, 0.025]];
PERS tooldata P66:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [4, [0, 0,
     105], [1, 0, 0, 0], 0.011, 0.011, 0.011]];
PERS tooldata P33:= [ TRUE, [[0, 0, 0], [1, 0, 0 ,0]], [2, [0, 0,
     52], [1, 0, 0, 0], 0.0027, 0.0027, 0.0027]];
```

Category 0

The following table describes the stopping distance and time for category 0 stop.

Axis	Distance	Stop time
1*	60.8°	0.3 s
2*	76.3°	0.27 s
3	102.6 mm	0.12 s

*) The axis has no brake.

Category 1, extension zones

For definitions of the zones, see *Extension zones on page 48*.

The zone border is the mounting interface location for axis 2 and axis 3.

Axis 1

Zone border	Axis 2	Axis 3
z0-z1	120°	0 mm
z1-z2	60°	0 mm

Axis 2

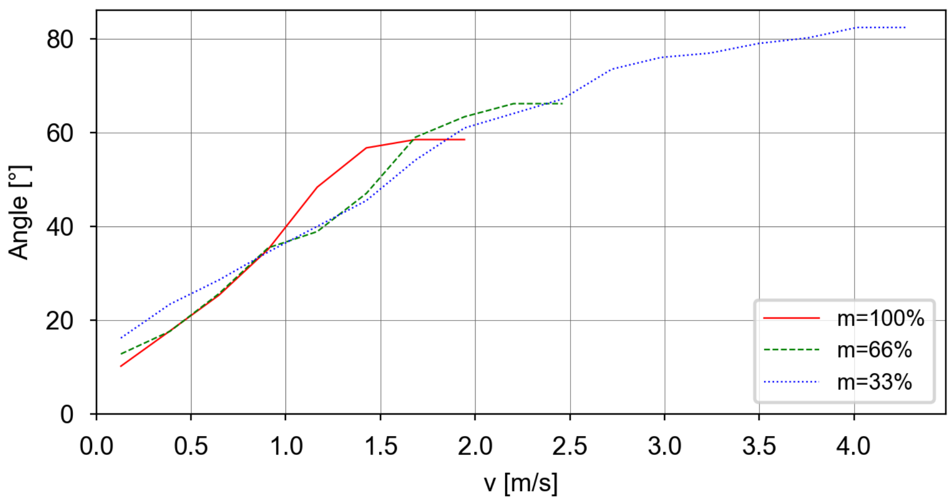
Only one zone exists.

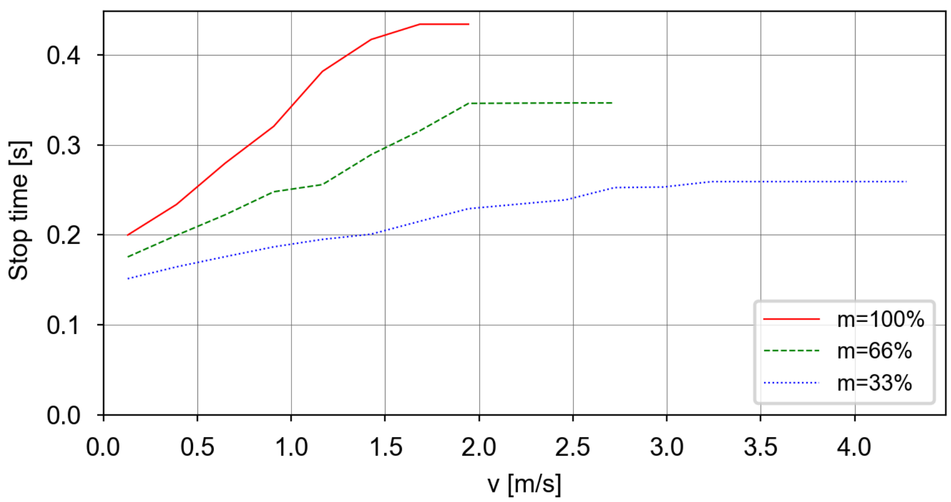
Axis 3

Only one zone exists.

Continues on next page

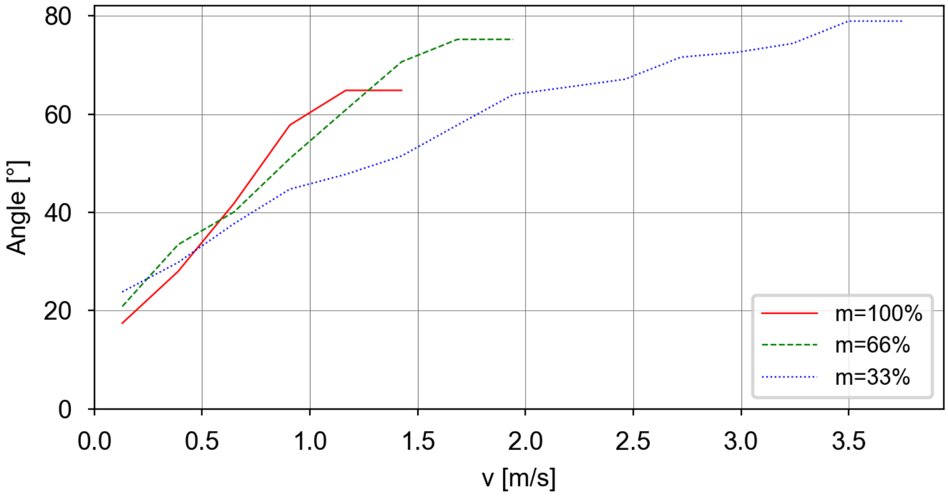
Category 1, Axis 1, Extension zone 0, stopping distance and stopping time

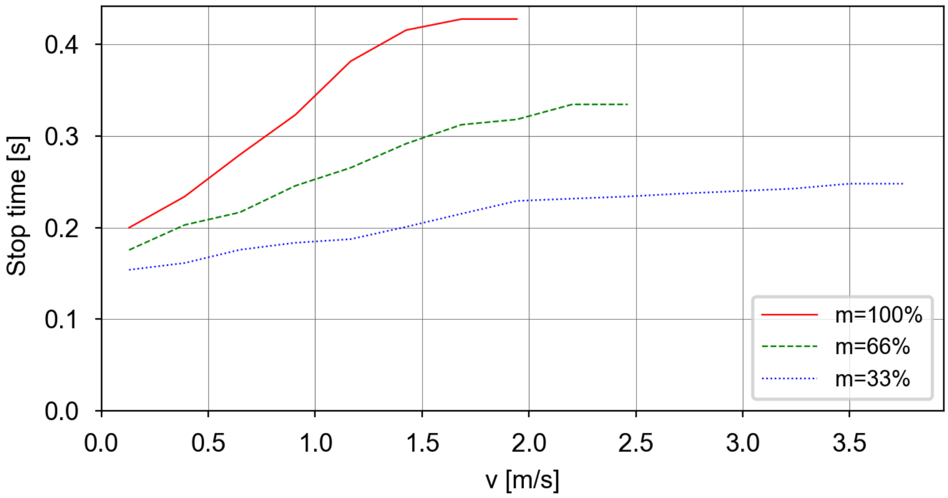




Continues on next page

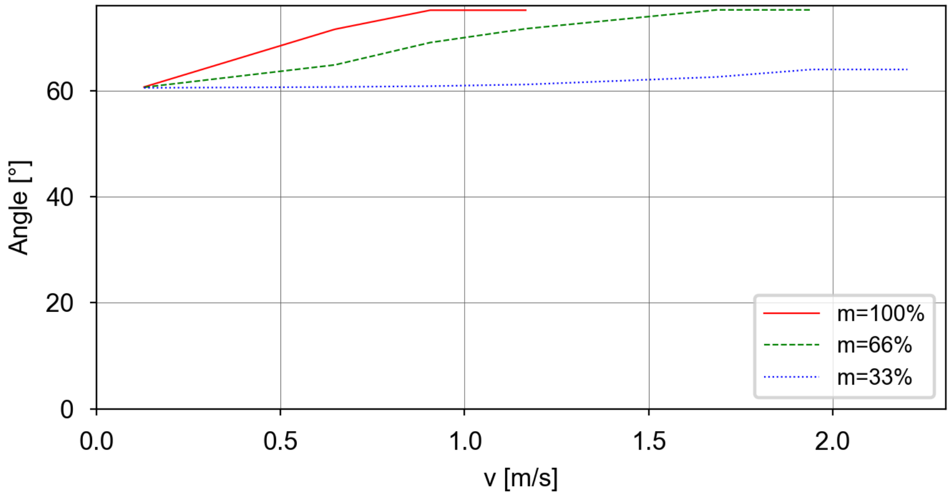
Category 1, Axis 1, Extension zone 1, stopping distance and stopping time

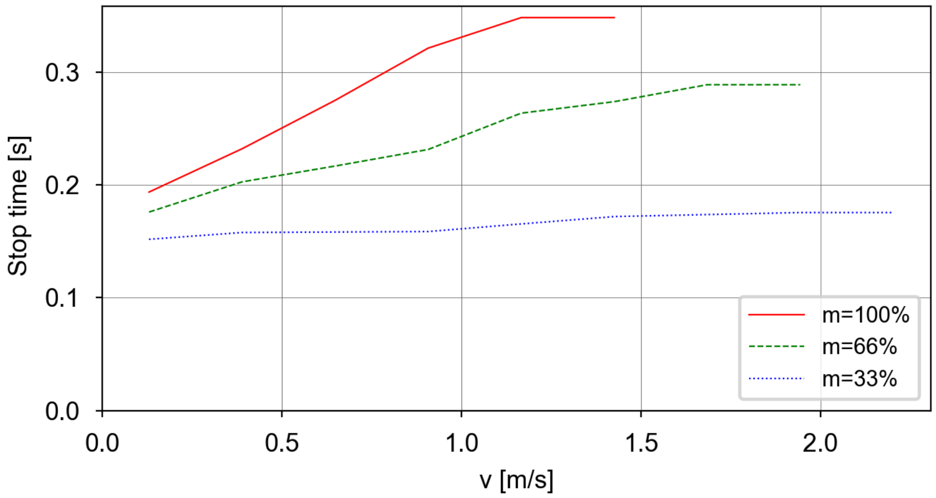




Continues on next page

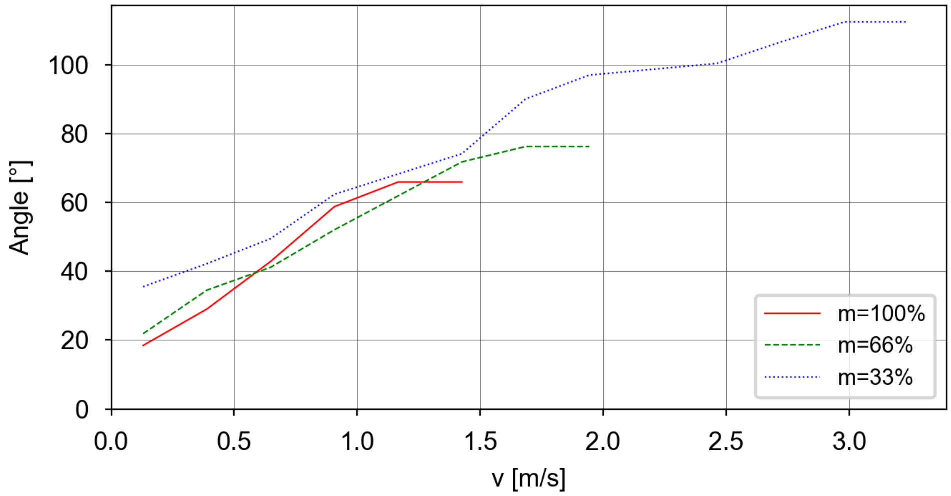
Category 1, Axis 1, Extension zone 2, stopping distance and stopping time

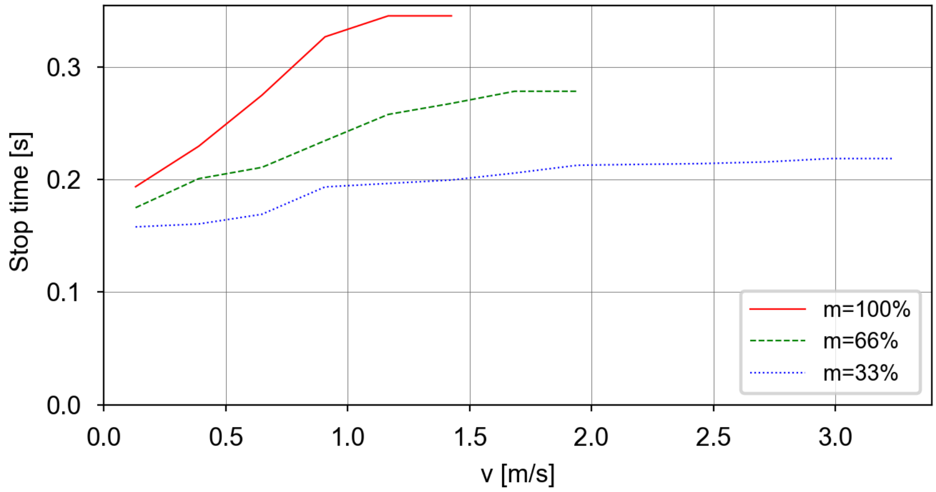




Continues on next page

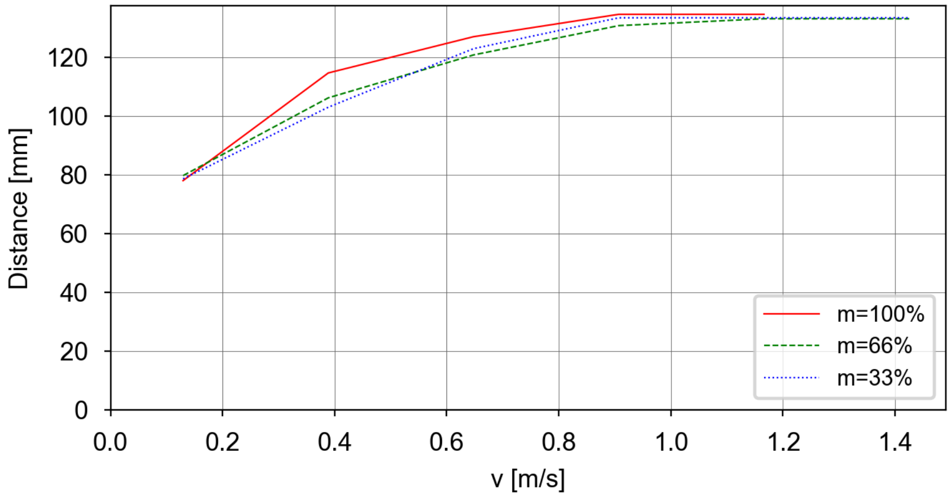
Category 1, Axis 2, Extension zone 0, stopping distance and stopping time

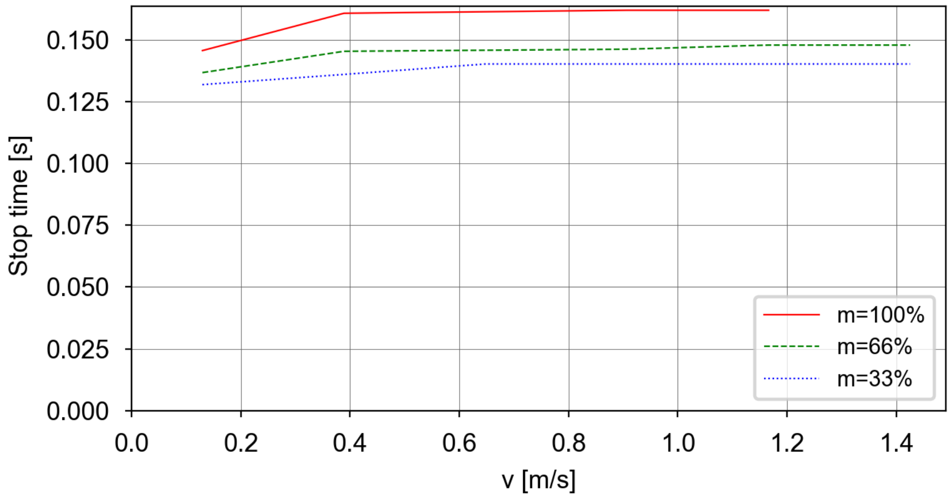




Continues on next page

Category 1, Axis 3, Extension zone 0, stopping distance and stopping time



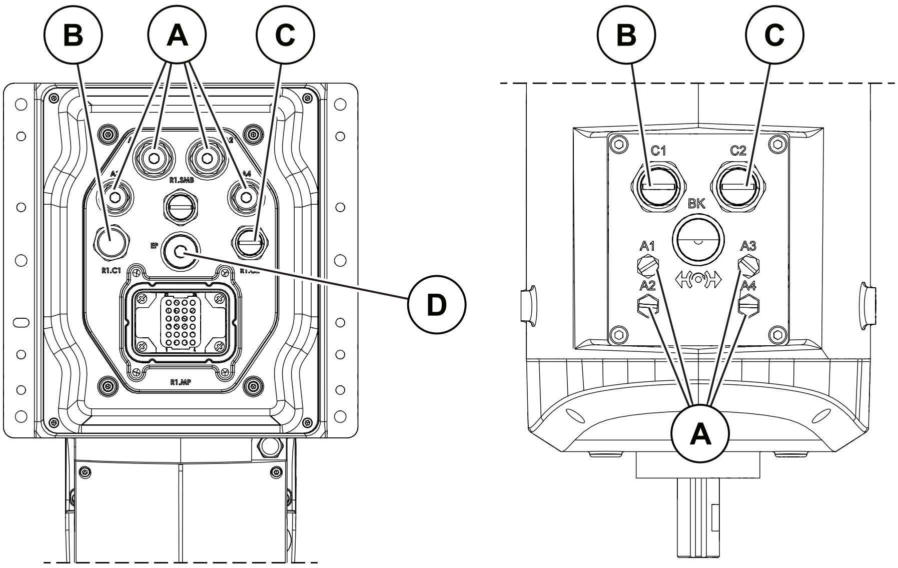


1.10 Customer connections

Introduction to customer connections

The cables for customer connection are integrated in the robot and the connectors are placed at the outer arm and base. There are two connectors C1/C2 at the outer arm. Corresponding connector R1.C1/R1.C2 are located at the base.

Hose for compressed air is also integrated into the manipulator. There are 4 inlets at the base (R1/8”)) and 4 outlets (M5) on the outer arm.



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Position	Connection	Description	Number	Value
A	Air	Max. 6 bar	4	Outer diameter of air hose: 4 mm X2 Outer diameter of air hose: 6 mm X2
B	C1	Customer power/signal	8 wires[i]	30 V, 1.5 A
C	C2	Customer power/signal or ethernet	8 wires	30 V, 1 A or 1 Gbits/s
D	EP	Exhaust port[ii]	1	Φ10 , 7~9L/min[iii]

i The connector has 12 pins. Only pins 1 to 8 are available for use.
ii Only available for protection type Clean Room.
iii To avoid the deformation of bellows, reduce the air flow if necessary.

Continues on next page

Connector kits

The tables describes the CP/CS and Ethernet (if any) connector kits for the outer arm.

Connector kits, outer arm

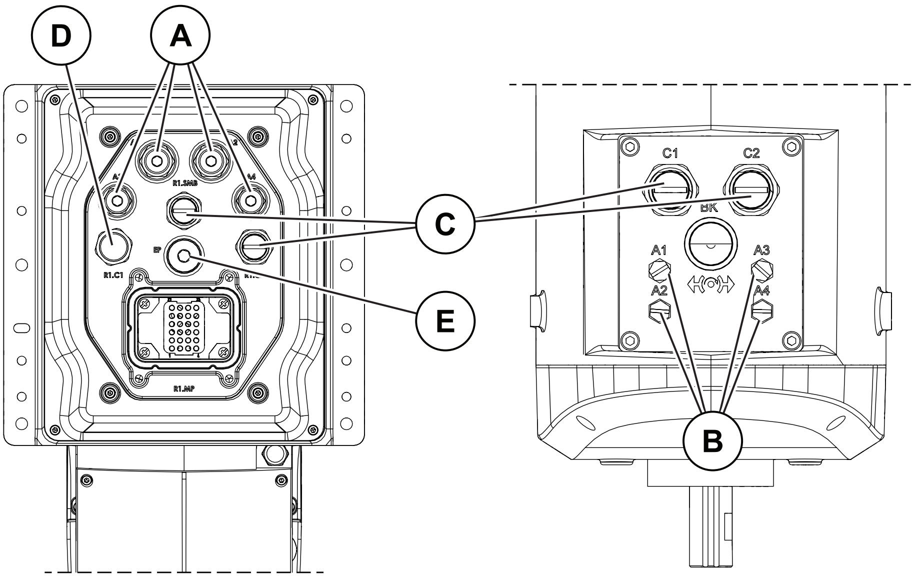
Position	Description		Art. no.
Connector kits	CP/CS	M12 CP/CS Male straight connector kits	3HAC066098-001
		M12 CP/CS Male angled connector kits	3HAC066099-001
	Ethernet	M12 Ethernet Cat5e Male straight connector kits	3HAC067413-001
		M12 Ethernet Cat5e Male angled connector kits	3HAC067414-001

Protection covers

Protection covers for water and dust proofing

Protection covers are delivered together with the robot and must be well fitted to the connectors in any application requiring water and dust proofing.

Always remember to refit the protection covers after removing them.



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A	Protection covers for air hose connector on the base
B	Protection covers for air hose connector on the process hub
C	Protection covers for C2/SMB connector on the base and C1/C2 connector on the process hub
D	Protection cover for C1 connector on the base
E	Protection cover for exhaust port connector on the base

2 Specification of variants and options

2.1 Introduction to variants and options

General

The different variants and options for the IRB 910INV 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.

2.2 Manipulator

Manipulator variants

Option	IRB Type	Max handling capacity (kg)	Reach (m)
3300-3	IRB 910INV	3	0.35
3300-4	IRB 910INV	6	0.55

Manipulator color

Option	Color	RAL code[i]
209-2	ABB white standard Standard color with protection option 3351-1 Cleanroom 1	RAL 9003
209-202	ABB Graphite White std Standard color	RAL 7035

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

Manipulator protection

Option	Description
3350-300	Base 30, IP30[i]
3350-540	Base 54, IP54
3351-1	Cleanroom 1, ISO Class 1

i The protection class of the ballscrew area is IP20.

Note

Base 30 includes IP30, according to standard IEC 60529.

Base 54 includes IP54, according to standard IEC 60529.

Clean Room class 1 includes ISO class 1 standard, according to DIN EN ISO 14644-1, -14.

Media & Communication

When 3303-1 Parallel & Air is selected then 3304-1 and 3305-1 options are activated for selecting.

When 3303-2 Ethernet, Parallel, Air is selected then 3304-1, 3305-1, 3306-1 and 3307-1 are activated for selecting.

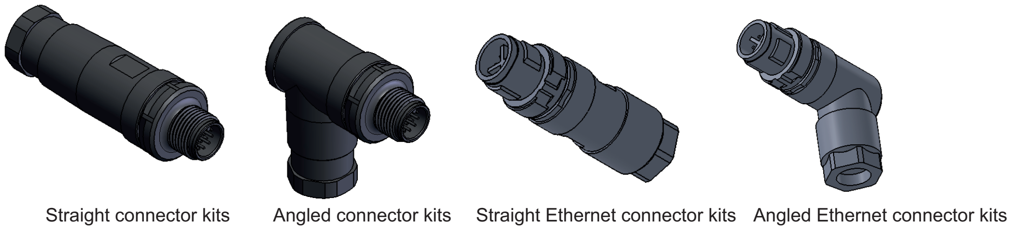
Option	Type	Description
3303-1	Parallel & Air	Includes customer power CP and customer signals CS + air.
3303-2	Ethernet, Parallel, Air	Includes CP, CS + air + Ethernet.

Continues on next page

Connector kits manipulator

The kit consists of connectors, pins and sockets.

Option	Description
3304-1	Male-type, Straight arm connector kits
3305-1	Male-type, Angled arm connector kits
3306-1	Male-type, Straight arm Ethernet connector kits
3307-1	Male-type, Angled arm Ethernet connector kits



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Note

The image shown here is indicative only. If there is inconsistency between the image and the actual product, the actual product shall govern.

The kits are designed and used for connectors on upper arm.

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]

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.

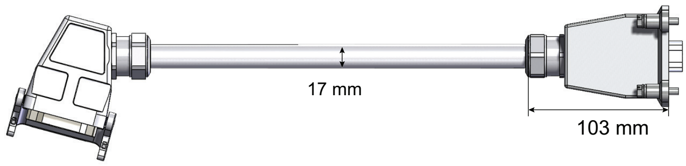
Continues on next page

Option	Type	Description
438-6	Standard warranty + 6 months	Standard warranty extended with 6 months from end date of the standard warranty. Warranty terms and conditions apply.
438-8	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*.

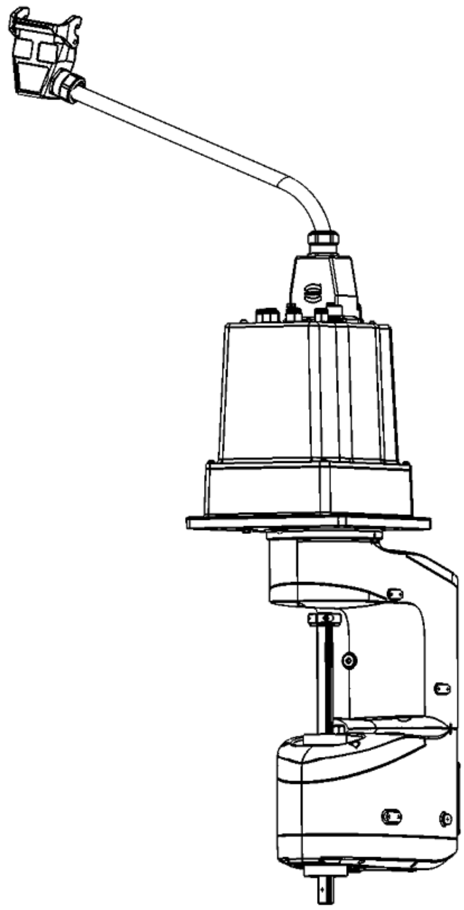
2.3 Floor cables

Manipulator cable - Straight

Option	Lengths
3200-1	3 m
3200-2	7 m
3200-3	15 m



xx2100001122



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Manipulator cable - Angled

Option	Lengths
3209-1	Angled type connector

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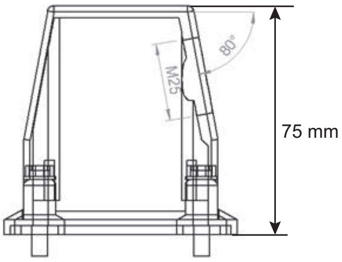
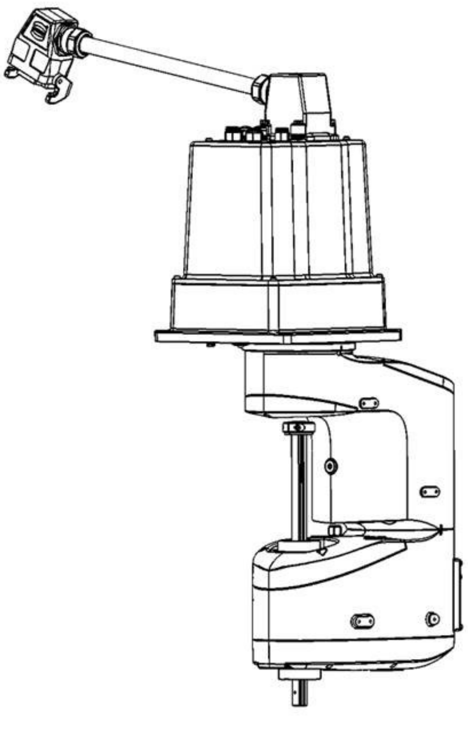


xx2100001124



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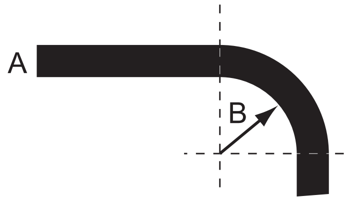
Bending radius for static floor cables

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



xx1600002016

A	Diameter
B	Diameter x10

Connection of parallell communication

Required 3303-1 Parallel & Air or 3303-2 Ethernet, Parallel, Air.

Option	Lengths
3201-1	3 m
3201-2	7 m
3201-3	15 m

Connection of Ethernet

Required 3303-2 Ethernet, Parallel, Air and occupies 1 Ethernet port.

Option	Lengths
3202-2	7 m
3202-3	15 m

Mains cable

Option	Lengths	Description
3203-1	EU mains cable, 3 m	Cable assembly with CEE7/VII line-side plug
3203-2	UK mains cable, 3 m	Cable assembly with BS1363 line-side plug, 5A fused
3203-5	CN mains cable, 3 m	Cable assembly with CPCS-CCC line-side plug
3203-6	AU mains cable, 3 m	Cable assembly with AS/NZS 3112 line-side
3203-7	All regions cable, 5 m	Cable assembly without line-side plug

Tip

The option *Mains cable* requires option *3000-105 OmniCore E10* or *3000-130 OmniCore C30*.

2.4 User documentation

User documentation

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

Tip

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

3 Accessories

General

There is a range of tools and equipment available.

Basic software and software options for robot and PC

For more information, see *Application manual - Controller software OmniCore*, *Product specification - OmniCore C line* and *Product specification - OmniCore E line*.

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ABB AB
Robotics & Discrete Automation
S-721 68 VÄSTERÅS, Sweden
Telephone +46 10-732 50 00

ABB AS
Robotics & Discrete Automation
Nordlysvegen 7, N-4340 BRYNE, Norway
Box 265, N-4349 BRYNE, Norway
Telephone: +47 22 87 2000

ABB Engineering (Shanghai) Ltd.
Robotics & Discrete Automation
No. 4528 Kangxin Highway
PuDong New District
SHANGHAI 201319, China
Telephone: +86 21 6105 6666

ABB Inc.
Robotics & Discrete Automation
1250 Brown Road
Auburn Hills, MI 48326
USA
Telephone: +1 248 391 9000

abb.com/robotics

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