Robots

KR AGILUS-2

Specification

Issued: 26.02.2019

Spez KR AGILUS-2 V4

KUKA Deutschland GmbH

Other functions not described in this documentation may be operable in the controller. The user has no claims to these functions, however, in the case of a replacement or service work.

We have checked the content of this documentation for conformity with the hardware and software described. Nevertheless, discrepancies cannot be precluded, for which reason we are not able to guarantee total conformity. The information in this documentation is checked on a regular basis, however, and necessary corrections will be incorporated in the subsequent edition.

Subject to technical alterations without an effect on the function.

KIM-PS5-DOC

Translation of the original documentation

Publication:	Pub Spez KR AGILUS-2 (PDF) en PB10511
Book structure:	Spez KR AGILUS-2 V1.1 BS9717
Version:	Spez KR AGILUS-2 V4

Contents

1 Introduction

1.1 Industrial robot documentation

The industrial robot documentation consists of the following parts:

- Documentation for the robot arm
- Documentation for the robot controller
- Documentation for the smartPAD-2
- Operating and programming instructions for the System Software
- Instructions for options and accessories
- Spare parts in KUKA.Xpert

Each of these sets of instructions is a separate document.

1.2 Representation of warnings and notes

Safety

These warnings are provided for safety purposes and **must** be observed.

DANGER
These warnings mean that it is certain or highly probable that death or severe injuries **will** occur, if no precautions are taken.

WARNING
These warnings mean that death or severe injuries **may** occur, if no precautions are taken.

CAUTION
These warnings mean that minor injuries **may** occur, if no precautions are taken.

NOTICE
These warnings mean that damage to property **may** occur, if no precautions are taken.

These warnings contain references to safety-relevant information or general safety measures. These warnings do not refer to individual hazards or individual precautionary measures.

This warning draws attention to procedures which serve to prevent or remedy emergencies or malfunctions:

SAFETY INSTRUCTION
The following procedure must be followed exactly!

Procedures marked with this warning **must** be followed exactly.

Notices

These notices serve to make your work easier or contain references to further information.

Tip to make your work easier or reference to further information.

1.3 Terms used

Term	Description
AIR	Air Cable set: Air line
CTR	Control Cable set: Control cable
EDS	Electronic Data Storage
GIG	Gigabit Cable set: Ethernet cable
MEMD	Micro Electronic Mastering Device
KL	KUKA linear unit
RDC	Resolver Digital Converter
smartPAD	The smartPAD teach pendant has all the operator control and display functions required for operating and programming the industrial robot.

2 Purpose

2.1 Target group

This documentation is aimed at users with the following knowledge and skills:

- Advanced knowledge of mechanical engineering
- Advanced knowledge of electrical engineering
- Knowledge of the robot controller system

For optimal use of our products, we recommend that our customers take part in a course of training at KUKA College. Information about the training program can be found at www.kuka.com or can be obtained directly from our subsidiaries.

2.2 Intended use

Use

The industrial robot is intended for handling tools and fixtures or for processing and transferring components or products. Use is only permitted under the specified environmental conditions.

Misuse

Any use or application deviating from the intended use is deemed to be misuse and is not allowed. This includes e.g.:

- Use as a climbing aid
- Operation outside the specified operating parameters
- Operation without the required safety equipment

NOTICE

Changing the structure of the robot, e.g. by drilling holes, can result in damage to the components. This is considered improper use and leads to loss of guarantee and liability entitlements.

NOTICE

Deviations from the operating conditions specified in the technical data or the use of special functions or applications can lead to premature wear. KUKA Deutschland GmbH must be consulted.

The robot system is an integral part of a complete system and may only be operated in a CE-compliant system.

3 Product description

3.1 Overview of the robot system

A robot system (>>> *Fig. 3-1*) comprises all the assemblies of an industrial robot, including the manipulator (mechanical system and electrical installations), control cabinet, connecting cables, end effector (tool) and other equipment. The KR AGILUS-2 product family comprises the robot variants:

- KR 6 R700-2
- KR 6 R900-2
- KR 10 R900-2
- KR 10 R1100-2

An industrial robot of this product family comprises the following components:

- Manipulator
- Robot controller
- Connecting cables
- KUKA smartPAD teach pendant
- Software
- Options, accessories

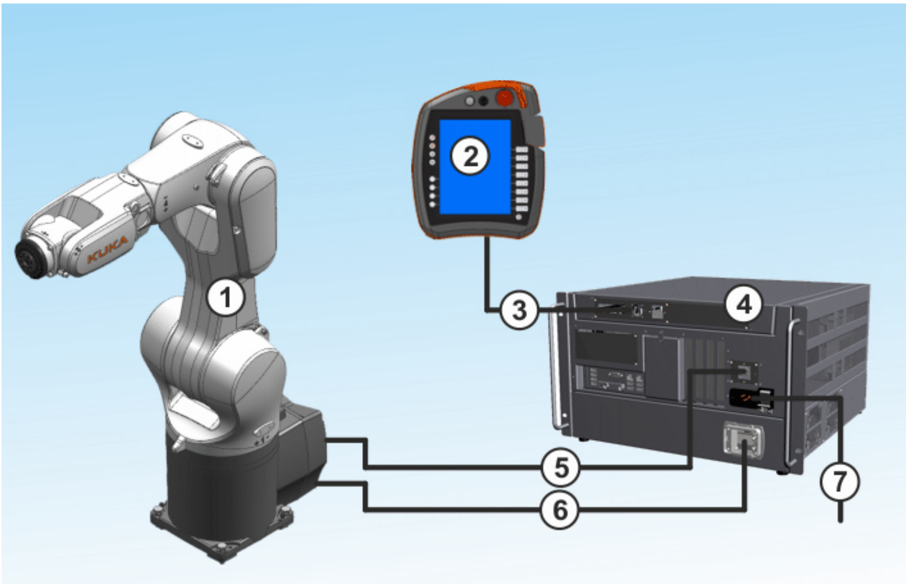


Fig. 3-1: Example of an industrial robot

1 Manipulator
2 Teach pendant, KUKA smartPAD
3 Connecting cable/KUKA smartPAD
4 Robot controller
5 Connecting cable/data cable
6 Connecting cable/motor cable
7 Device connection cable

3.2 Description of the manipulator

Overview

The manipulators (= robot arm and electrical installations) of the variants are designed as 6-axis jointed-arm kinematic systems made of cast light alloy. Each axis is fitted with a brake. All motor units and current-carrying cables are protected against dirt and moisture beneath screwed-on cover plates.

The manipulators consist of the following main assemblies:

- In-line wrist
- Arm
- Link arm
- Rotating column
- Base frame
- Electrical installations

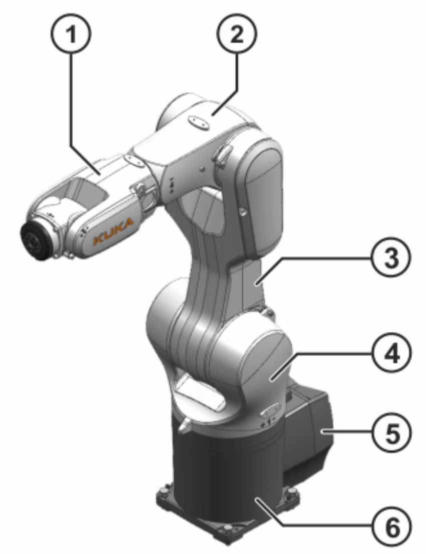


Fig. 3-2: Principal components

1	In-line wrist	4	Rotating column
2	Arm	5	Electrical installations
3	Link arm	6	Base frame

In-line wrist – A4, A5, A6

The robot is fitted with a 3-axis in-line wrist. The in-line wrist consists of axes 4, 5 and 6.

Interface A4 for the energy supply system is located on the side of the in-line wrist.

Further information can be found in the chapter (>>> *6.4 "Connecting cables and interfaces" Page 106*).

Arm – A3

The arm is the link between the in-line wrist and the link arm. The arm is driven by the motor of axis 3.

Link arm – A2

The link arm is the assembly located between the arm and the rotating column. It houses the motor and gear unit of axis 3. The supply lines of the energy supply system and the cable set for axes 2 to 6 are routed through the link arm.

Rotating column – A1

The rotating column houses the motors of axes 1 and 2. The rotational motion of axis 1 is performed by the rotating column. This is screwed to the base frame via the gear unit of axis 1 and is driven by a motor in the rotating column. The link arm is also mounted in the rotating column.

Base frame

The base frame is the base of the robot. Interface A1 is located at the rear of the base frame. It constitutes the interface for the connecting cables between the robot, the controller and the energy supply system.

Electrical installations

The electrical installations include all the motor and data cables for the motors of axes 1 to 6, as well as the connections for the internal energy supply system and external axes A7 and A8. All connections are pluggable. The electrical installations also include the RDC, which is integrated into the robot. The connectors for the motor and data cables are mounted on the robot base frame. The connecting cables from the robot controller are connected here by means of connectors. The electrical installations also include a protective circuit.

Options

The robot can be fitted and operated with various options, e.g. axis limitation A1 or brake release device. The option is described in separate documentation.

The following options are also available:

- Connector bypack CTR AIR
  (>>> *8.1 "Connector bypack CTR AIR (optional)" Page 121*)
- Connector bypack AIR CTR GIG
  (>>> *8.2 "Connector bypack AIR CTR GIG (optional)" Page 122*)
- Optional connecting cables
  (>>> *8.3 "Optional connecting cables" Page 123*)

4 Technical data

4.1 Technical data, overview

The technical data for the individual robot types can be found in the following sections:

Robot	Technical data
KR 6 R700-2	• Technical data (>>> *4.2 "Technical data, KR 6 R700-2" Page 16*) • Supplementary loads (>>> *4.6 "Supplementary load" Page 57*) • Plates and labels (>>> *4.7 "Plates and labels" Page 61*) • Stopping distances and times (>>> *4.9.3 "Stopping distances and times, KR 6 R700-2" Page 65*)
KR 6 R900-2	• Technical data (>>> *4.3 "Technical data, KR 6 R900-2" Page 26*) • Supplementary loads (>>> *4.6 "Supplementary load" Page 57*) • Plates and labels (>>> *4.7 "Plates and labels" Page 61*) • Stopping distances and times (>>> *4.9.4 "Stopping distances and times, KR 6 R900-2" Page 70*)
KR 10 R900-2	• Technical data (>>> *4.4 "Technical data, KR 10 R900-2" Page 37*) • Supplementary loads (>>> *4.6 "Supplementary load" Page 57*) • Plates and labels (>>> *4.7 "Plates and labels" Page 61*) • Stopping distances and times (>>> *4.9.5 "Stopping distances and times, KR 10 R900-2" Page 75*)
KR 10 R1100-2	• Technical data (>>> *4.5 "Technical data, KR 10 R1100-2" Page 47*) • Supplementary loads (>>> *4.6 "Supplementary load" Page 57*) • Plates and labels (>>> *4.7 "Plates and labels" Page 61*) • Stopping distances and times (>>> *4.9.6 "Stopping distances and times, KR 10 R1100-2" Page 80*)

4.2 Technical data, KR 6 R700-2

4.2.1 Basic data, KR 6 R700-2

Basic data

	KR 6 R700-2
Number of axes	6
Number of controlled axes	6
Volume of working envelope	1.47 m³
Pose repeatability (ISO 9283)	± 0.02 mm
Weight	approx. 53 kg
Rated payload	3 kg
Maximum payload	6.6 kg
Maximum reach	726 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 57 dB (A)
Mounting position	Floor; Ceiling; Wall; Desired angle
Footprint	208 mm x 208 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: gray aluminum (RAL 9007); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R700_2 C4SR

Protection classification IP67 can only be assured with a compressed air connection (venting connection PURGE) of 0.3 bar.

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 4 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3

Ambient temperature	
During operation	0 °C to 45 °C (273 K to 318 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

For operation at low temperatures, it may be necessary to warm up the robot.

Connecting cables

Cable designation	Connector designation robot controller - robot	Interface with robot
Motor cable	X20 - X30	Han Yellock 30
Data cable	X21 - X31	Han Q12
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

	Cable lengths
Standard	1 m, 4 m, 7 m, 15 m, 25 m

For further connecting cables and detailed specifications, see "Description of the connecting cables".

4.2.2 Axis data, KR 6 R700-2

Axis data

Motion range	
A1	±170 °
A2	-190 ° / 45 °
A3	-120 ° / 156 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	450 °/s
A5	450 °/s
A6	540 °/s

In the case of manipulators with a payload of 6 kg and a reach of R700, not every angle for axis A4 can be reached in the end position.

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> *Fig. 4-1*).

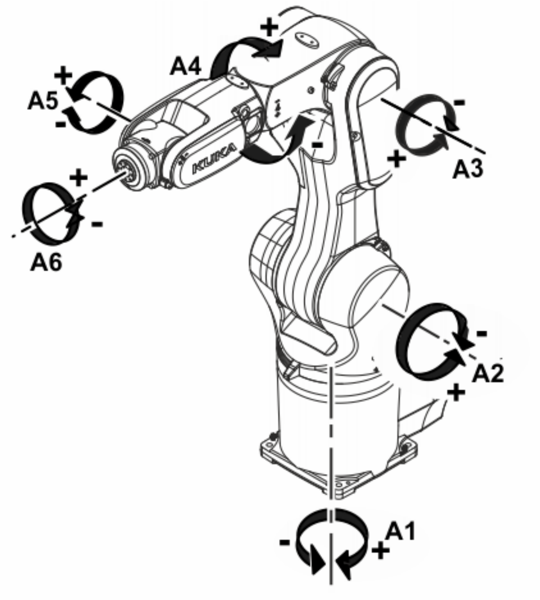


Fig. 4-1: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	0 °
A2	-90 °
A3	90 °
A4	90 °
A5	0 °
A6	0 °

Working envelope

The following diagrams show the shape and size of the working envelope for these variants of this product family.

The reference point for the working envelope is the intersection of axes 4 and 5.

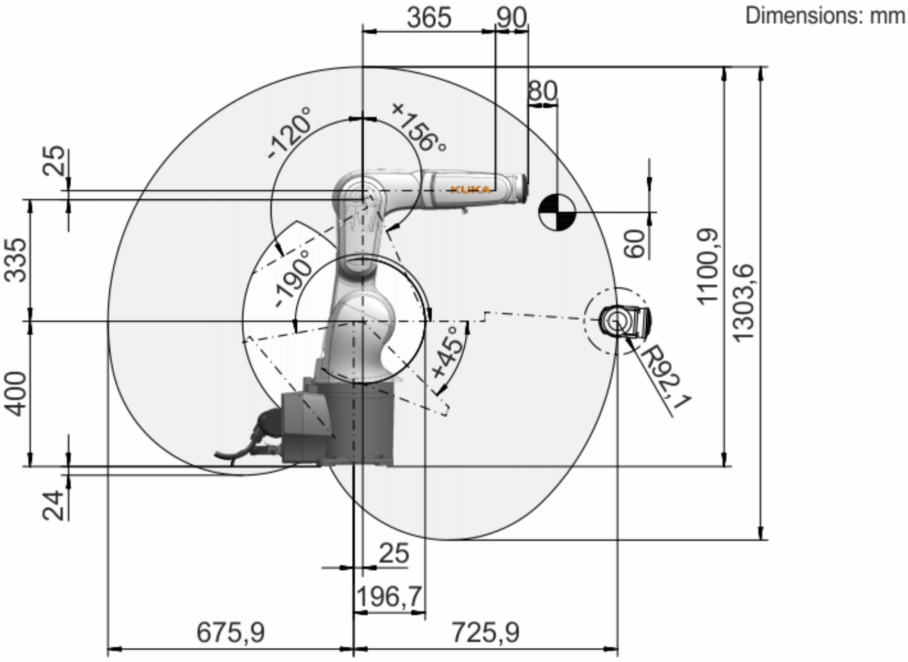


Fig. 4-2: KR 6 R700-2, working envelope, side view

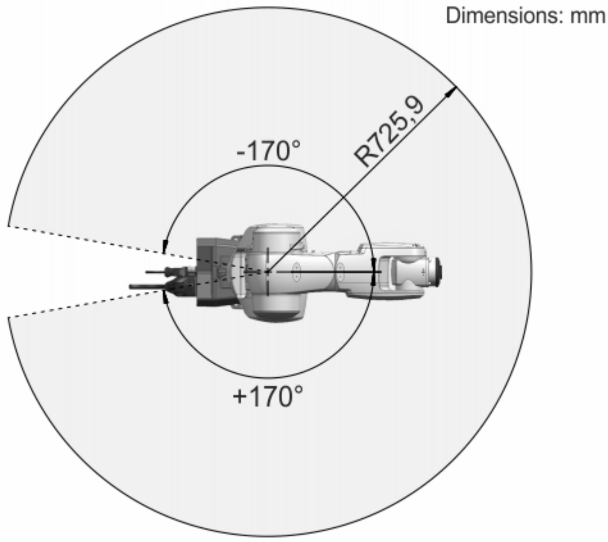


Fig. 4-3: KR 6 R700-2, working envelope, top view

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). The following figure shows the possible limitation of the motion range of axis 1, as a function of the angle of inclination of the robot.

The inclination angles for the robot must be entered correctly into the controller if the robot is not operated in the floor-mounted position. Configuration of the angles is possible via WorkVisual.

The inclination angles for an unchanged main working direction of the robot:

Floor: A:0°, B:0°, C:0°

Wall: A:0°, B:90°, C:0°

Ceiling: A:0°, B:0°, C:180°

CAUTION

The inclined installation angles must be individually checked and entered. An incorrectly entered inclined installation angle can lead to unforeseen motion and/or to an overload and, potentially, damage to the robot.

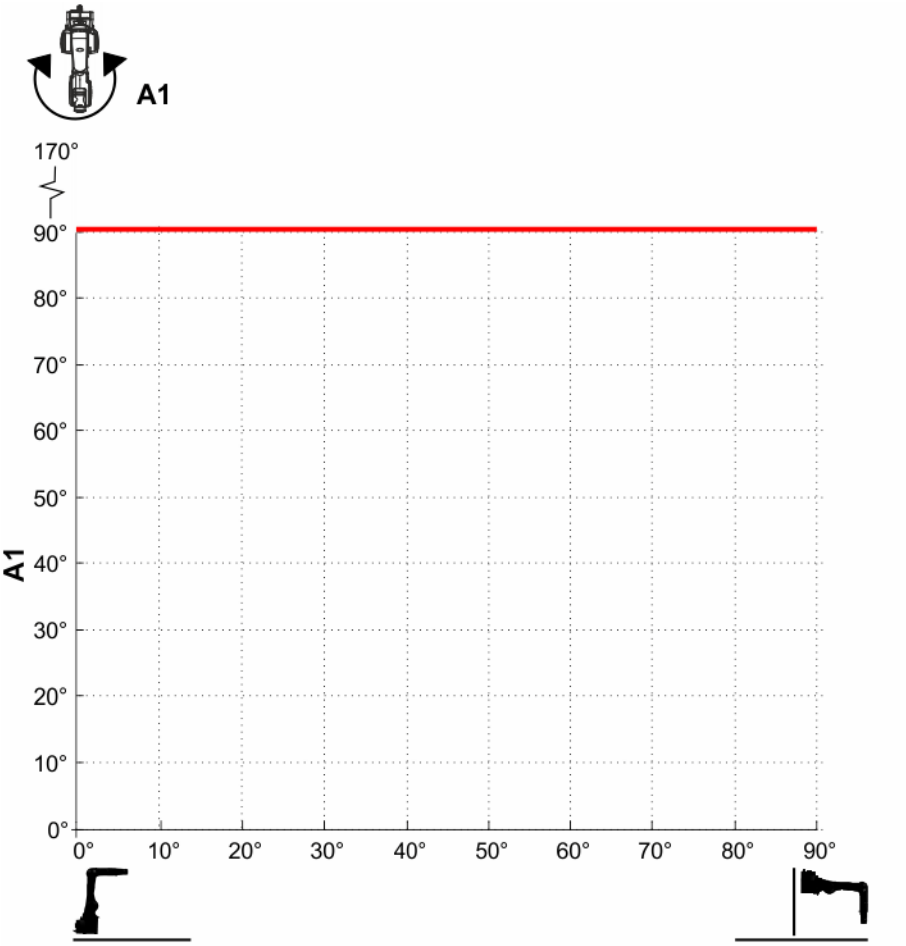


Fig. 4-4: Motion range of axis 1 with inclined installation

4.2.3 Payloads, KR 6 R700-2

Payloads

Rated payload	3 kg
Maximum payload	6.6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	0 kg
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	1 kg
Rated supplementary load, link arm	0 kg

Maximum supplementary load, link arm	1 kg
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	2 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

⚠ The sum of all loads mounted on the robot must not exceed the maximum payload.

Load center of gravity

For all payloads, the load center of gravity refers to the distance from the face of the mounting flange on axis 6.

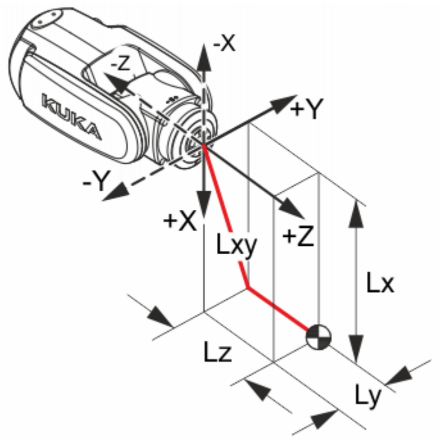


Fig. 4-5: Load center of gravity

Payload diagram

NOTICE
This loading curve corresponds to the maximum load capacity. Both values (payload and mass moment of inertia) must be checked in all cases. Exceeding this capacity will reduce the service life of the robot and overload the motors and the gears; in any such case KUKA Deutschland GmbH must be consulted beforehand. The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with the operating and programming instructions of the KUKA System Software. The mass inertia must be verified using KUKA.Load. It is imperative for the load data to be entered in the robot controller!

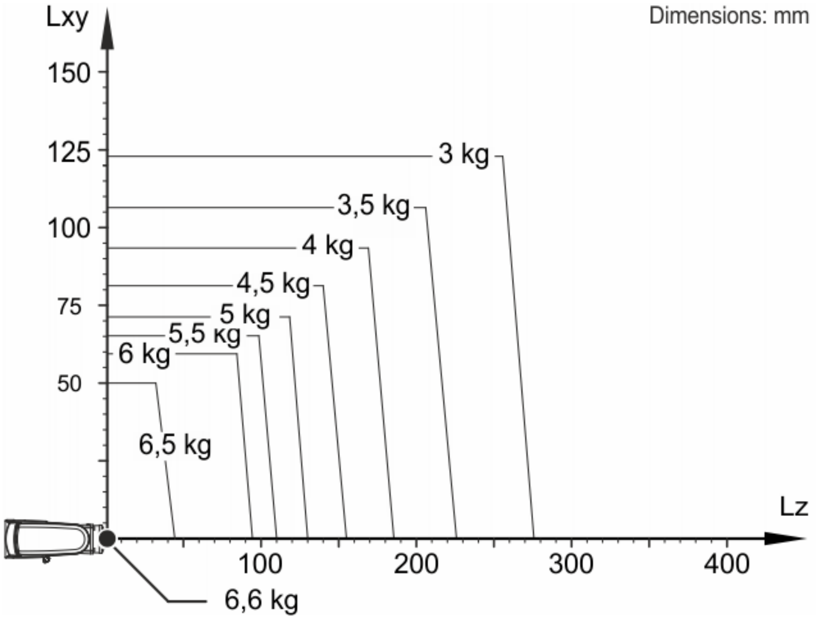


Fig. 4-6: KR 6 R700-2, payload diagram

The KR 6 R700-2 is designed for a rated payload of 3 kg in order to optimize the dynamic performance of the robot. With reduced load center distances, higher loads up to the maximum payload may be used. The specific load case must be verified using KUKA.Load. For further consultation, please contact KUKA Support.

Mounting flange

In-line wrist type	ZH Arm KR6
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	12.9
Screw size	M5
Number of fastening threads	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5^{H7}
Standard	See diagram.

The mounting flange is depicted (>>> *Fig. 4-7*) with axes 4 and 6 in the zero position. The symbol X_m indicates the position of the locating element (bushing) in the zero position.

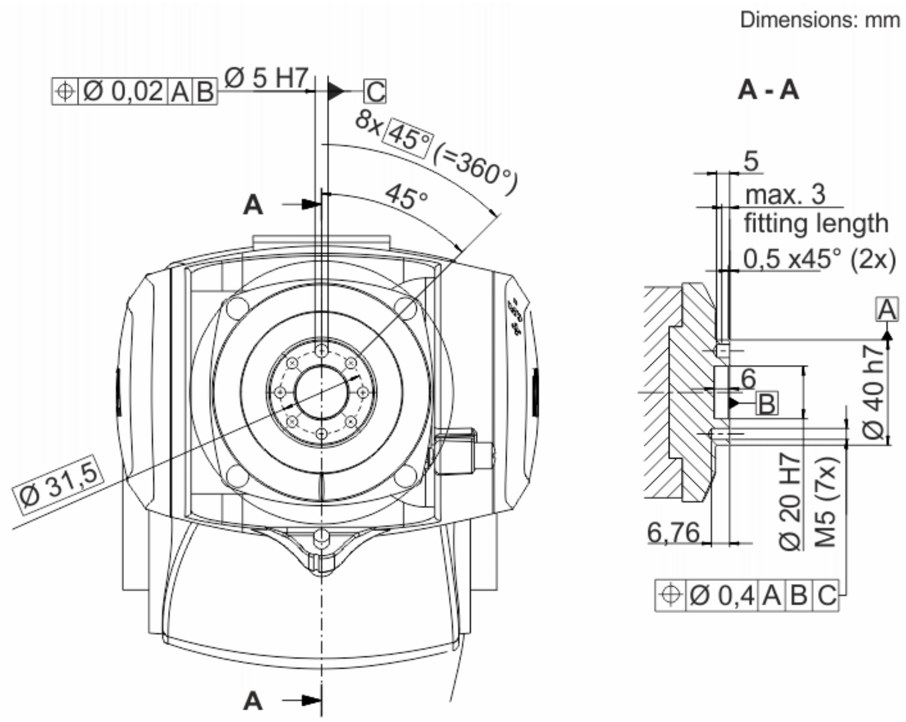


Fig. 4-7: Mounting flange

Flange loads

Due to the motion of the payload (e.g. tool) mounted on the robot, forces and torques act on the mounting flange. These forces and torques depend on the motion profile as well as the mass, load center of gravity and mass moment of inertia of the payload.

The specified values refer to nominal payloads at the nominal distance and do not include safety factors. It is imperative for the load data to be entered in the robot controller. The robot controller takes the payload into consideration during path planning. A reduced payload does not necessarily result in lower forces and torques.

The values are guide values determined by means of trial and simulation and refer to the most heavily loaded machine in the robot family. The actual forces and torques may differ due to internal and external influences on the mounting flange or a different point of application. It is therefore advisable to determine the exact forces and torques where necessary on site under the real conditions of the actual robot application.

The operating values may occur permanently in the normal motion profile. It is advisable to rate the tool for its fatigue strength.

The EMERGENCY STOP values may arise in the event of an Emergency Stop situation of the robot. As these should only occur very rarely during the service life of the robot, a static strength verification is usually sufficient.

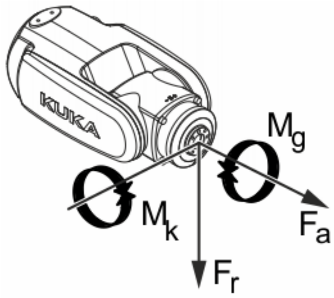


Fig. 4-8: Flange loads

Flange loads during operation	
F(a)	209 N
F(r)	235 N
M(k)	31 Nm
M(g)	17 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	324 N
F(r)	297 N
M(k)	36 Nm
M(g)	24 Nm

Axial force F(a), radial force F(r), tilting torque M(k), torque about mounting flange M(g)

4.2.4 Foundation loads, KR 6 R700-2

Foundation loads

The specified forces and moments already include the payload and the inertia force (weight) of the robot.

Foundation loads for floor mounting position	
F(v normal)	801 N
F(v max)	1105 N
F(h normal)	451 N
F(h max)	684 N
M(k normal)	420 Nm
M(k max)	595 Nm
M(r normal)	162 Nm
M(r max)	301 Nm
Foundation loads for ceiling mounting position	
F(v normal)	909 N
F(v max)	949 N
F(h normal)	472 N
F(h max)	677 N
M(k normal)	440 Nm
M(k max)	649 Nm
M(r normal)	180 Nm

M(r max)	307 Nm
Foundation loads for wall mounting position	
F(v normal)	900 N
F(v max)	1016 N
F(h normal)	320 N
F(h max)	593 N
M(k normal)	459 Nm
M(k max)	712 Nm
M(r normal)	172 Nm
M(r max)	285 Nm

Vertical force F(v), horizontal force F(h), tilting torque M(k), torque about axis 1 M(r)

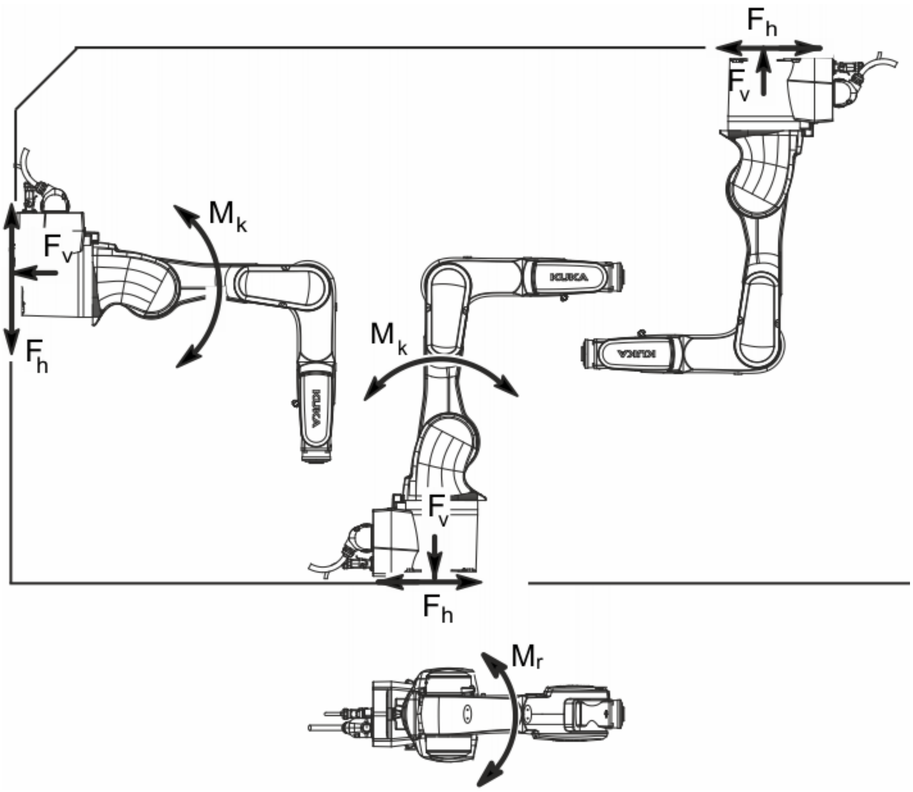


Fig. 4-9: Foundation loads

WARNING
Normal loads and maximum loads for the foundations are specified in the table. The maximum loads must be referred to when dimensioning the foundations and must be adhered to for safety reasons. Failure to observe this can result in personal injury and damage to property. The normal loads are average expected foundation loads. The actual loads are dependent on the program and on the robot loads and may therefore be greater or less than the normal loads. The supplementary loads (A1 and A2) are not taken into consideration in the calculation of the mounting base load. These supplementary loads must be taken into consideration for F_v.

4.3 Technical data, KR 6 R900-2

4.3.1 Basic data, KR 6 R900-2

Basic data

	KR 6 R900-2
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.84 m³
Pose repeatability (ISO 9283)	± 0.02 mm
Weight	approx. 55 kg
Rated payload	3 kg
Maximum payload	6.5 kg
Maximum reach	901 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 57 dB (A)
Mounting position	Floor; Ceiling; Wall; Desired angle
Footprint	208 mm x 208 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: gray aluminum (RAL 9007); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R900_2 C4SR

Protection classification IP67 can only be assured with a compressed air connection (venting connection PURGE) of 0.3 bar.

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 4 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3

Ambient temperature	
During operation	0 °C to 45 °C (273 K to 318 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

For operation at low temperatures, it may be necessary to warm up the robot.

Connecting cables

Cable designation	Connector designation robot controller - robot	Interface with robot
Motor cable	X20 - X30	Han Yellock 30
Data cable	X21 - X31	Han Q12
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

	Cable lengths
Standard	1 m, 4 m, 7 m, 15 m, 25 m

For further connecting cables and detailed specifications, see “Description of the connecting cables”.

4.3.2 Axis data, KR 6 R900-2

Axis data

Motion range	
A1	±170 °
A2	-190 ° / 45 °
A3	-120 ° / 156 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	450 °/s
A5	450 °/s
A6	540 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> *Fig. 4-10*).

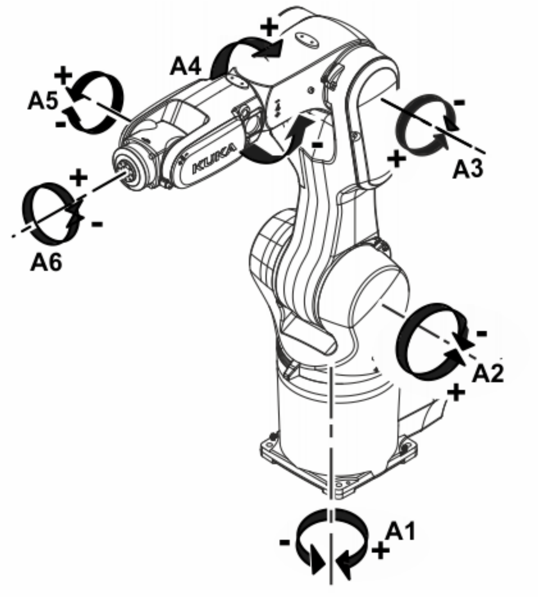


Fig. 4-10: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	0 °
A2	-90 °
A3	90 °
A4	90 °
A5	0 °
A6	0 °

Working envelope

The following diagrams show the shape and size of the working envelope for these variants of this product family.

The reference point for the working envelope is the intersection of axes 4 and 5.

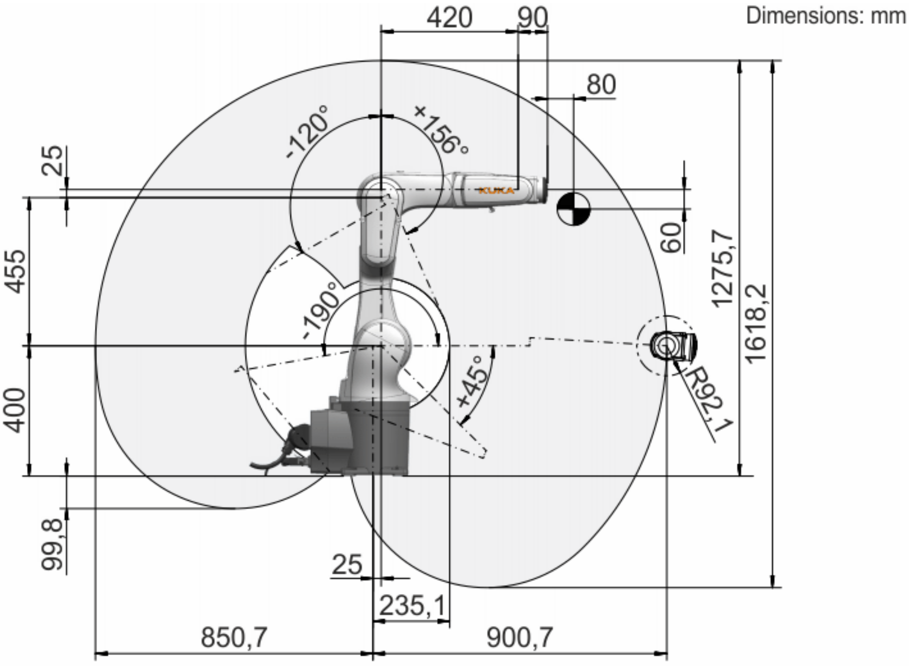


Fig. 4-11: KR 6 R900-2, working envelope, side view

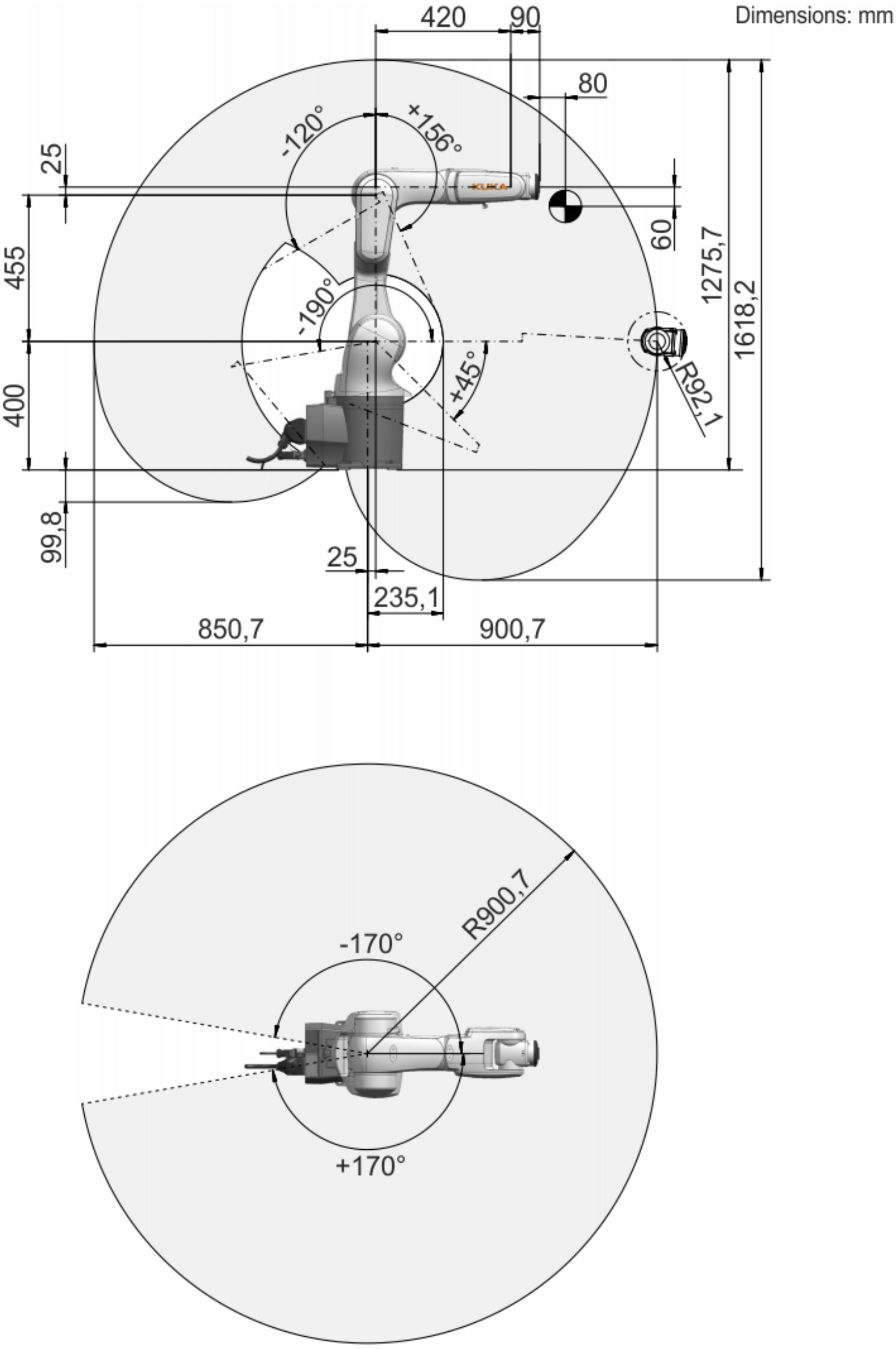


Fig. 4-12: KR 6 R900-2, working envelope

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). The following figure shows the possible limitation of the motion range of axis 1, as a function of the angle of inclination of the robot.

The inclination angles for the robot must be entered correctly into the controller if the robot is not operated in the floor-mounted position. Configuration of the angles is possible via WorkVisual.

The inclination angles for an unchanged main working direction of the robot:

Floor: A:0°, B:0°, C:0°

Wall: A:0°, B:90°, C:0°

Ceiling: A:0°, B:0°, C:180°

CAUTION

The inclined installation angles must be individually checked and entered. An incorrectly entered inclined installation angle can lead to unforeseen motion and/or to an overload and, potentially, damage to the robot.

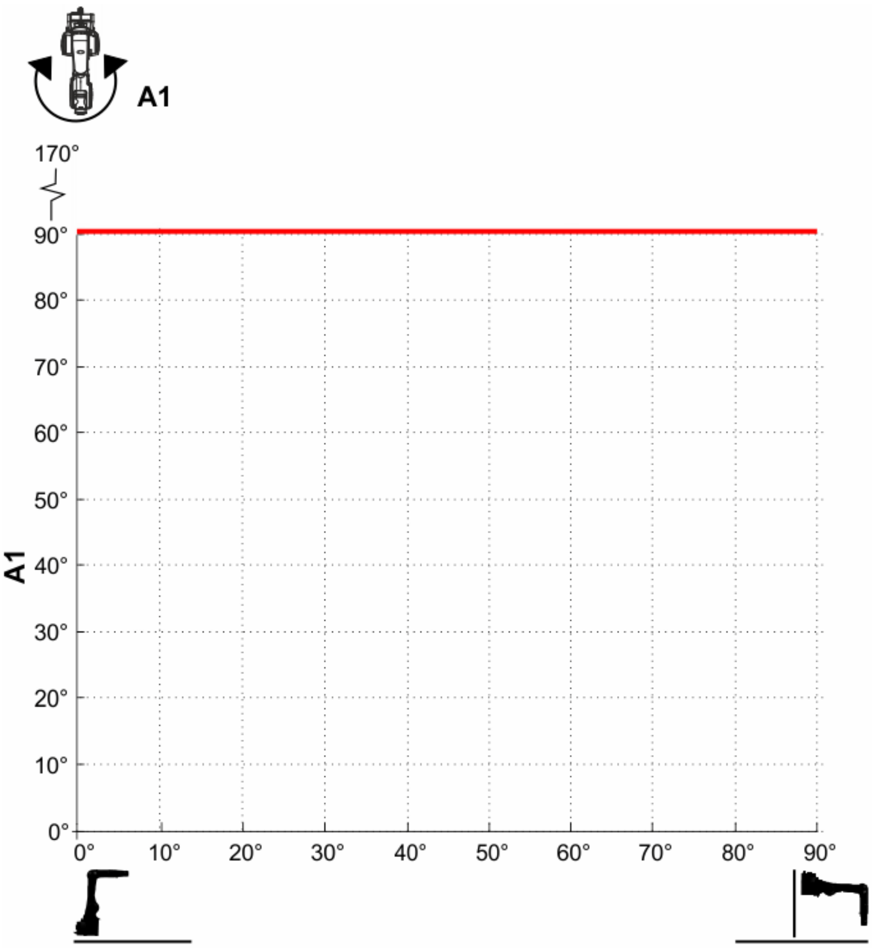


Fig. 4-13: Motion range of axis 1 with inclined installation

4.3.3 Payloads, KR 6 R900-2

Payloads

Rated payload	3 kg
Maximum payload	6.5 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	0 kg
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	1 kg
Rated supplementary load, link arm	0 kg

Maximum supplementary load, link arm	1 kg
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	2 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

The sum of all loads mounted on the robot must not exceed the maximum payload.

Load center of gravity

For all payloads, the load center of gravity refers to the distance from the face of the mounting flange on axis 6.

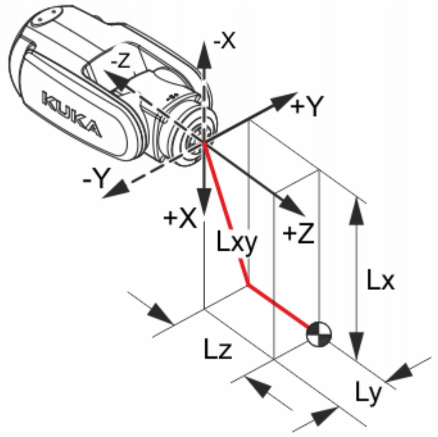


Fig. 4-14: Load center of gravity

Payload diagram

NOTICE

This loading curve corresponds to the maximum load capacity. Both values (payload and mass moment of inertia) must be checked in all cases. Exceeding this capacity will reduce the service life of the robot and overload the motors and the gears; in any such case KUKA Deutschland GmbH must be consulted beforehand.
The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with the operating and programming instructions of the KUKA System Software.
The mass inertia must be verified using KUKA.Load. It is imperative for the load data to be entered in the robot controller!

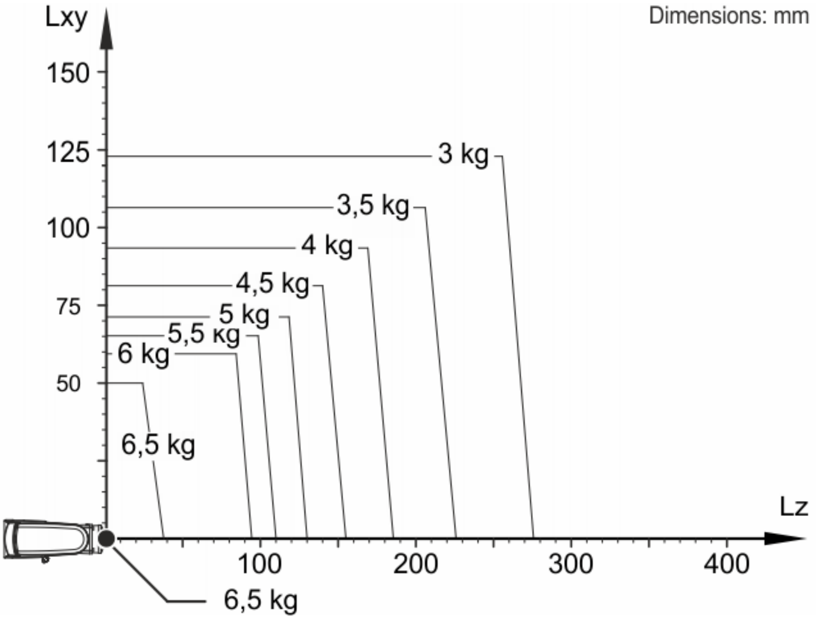


Fig. 4-15: KR 6 R900-2, payload diagram

The KR 6 R900-2 is designed for a rated payload of 3 kg in order to optimize the dynamic performance of the robot. With reduced load center distances, higher loads up to the maximum payload may be used. The specific load case must be verified using KUKA.Load. For further consultation, please contact KUKA Support.

Mounting flange

In-line wrist type	ZH Arm KR6
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	12.9
Screw size	M5
Number of fastening threads	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 ^{H7}
Standard	See diagram.

The mounting flange is depicted (>>> *Fig. 4-16*) with axes 4 and 6 in the zero position. The symbol X_m indicates the position of the locating element (bushing) in the zero position.

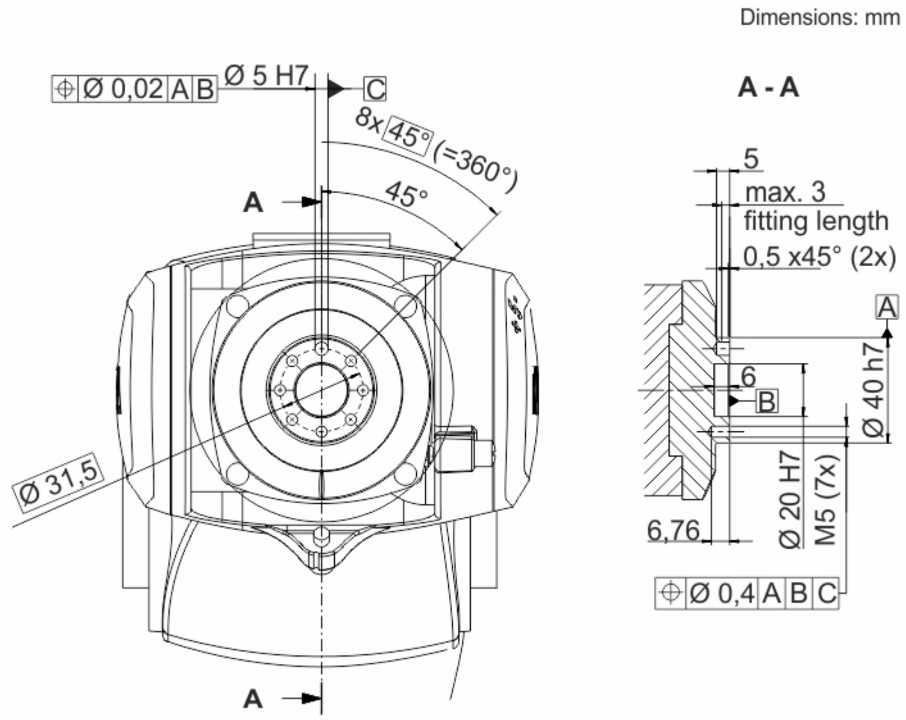


Fig. 4-16: Mounting flange

Flange loads

Due to the motion of the payload (e.g. tool) mounted on the robot, forces and torques act on the mounting flange. These forces and torques depend on the motion profile as well as the mass, load center of gravity and mass moment of inertia of the payload.

The specified values refer to nominal payloads at the nominal distance and do not include safety factors. It is imperative for the load data to be entered in the robot controller. The robot controller takes the payload into consideration during path planning. A reduced payload does not necessarily result in lower forces and torques.

The values are guide values determined by means of trial and simulation and refer to the most heavily loaded machine in the robot family. The actual forces and torques may differ due to internal and external influences on the mounting flange or a different point of application. It is therefore advisable to determine the exact forces and torques where necessary on site under the real conditions of the actual robot application.

The operating values may occur permanently in the normal motion profile. It is advisable to rate the tool for its fatigue strength.

The EMERGENCY STOP values may arise in the event of an Emergency Stop situation of the robot. As these should only occur very rarely during the service life of the robot, a static strength verification is usually sufficient.

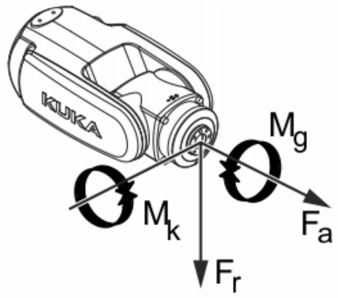


Fig. 4-17: Flange loads

Flange loads during operation	
F(a)	215 N
F(r)	264 N
M(k)	27 Nm
M(g)	16 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	323 N
F(r)	309 N
M(k)	35 Nm
M(g)	23 Nm

Axial force F(a), radial force F(r), tilting torque M(k), torque about mounting flange M(g)

4.3.4 Foundation loads, KR 6 R900-2

Foundation loads

The specified forces and moments already include the payload and the inertia force (weight) of the robot.

Foundation loads for floor mounting position	
F(v normal)	873 N
F(v max)	1127 N
F(h normal)	563 N
F(h max)	756 N
M(k normal)	605 Nm
M(k max)	763 Nm
M(r normal)	200 Nm
M(r max)	334 Nm
Foundation loads for ceiling mounting position	
F(v normal)	926 N
F(v max)	1055 N
F(h normal)	620 N
F(h max)	736 N
M(k normal)	624 Nm
M(k max)	763 Nm
M(r normal)	311 Nm

M(r max)	363 Nm
Foundation loads for wall mounting position	
F(v normal)	1004 N
F(v max)	1115 N
F(h normal)	343 N
F(h max)	649 N
M(k normal)	619 Nm
M(k max)	864 Nm
M(r normal)	205 Nm
M(r max)	325 Nm

Vertical force F(v), horizontal force F(h), tilting torque M(k), torque about axis 1 M(r)

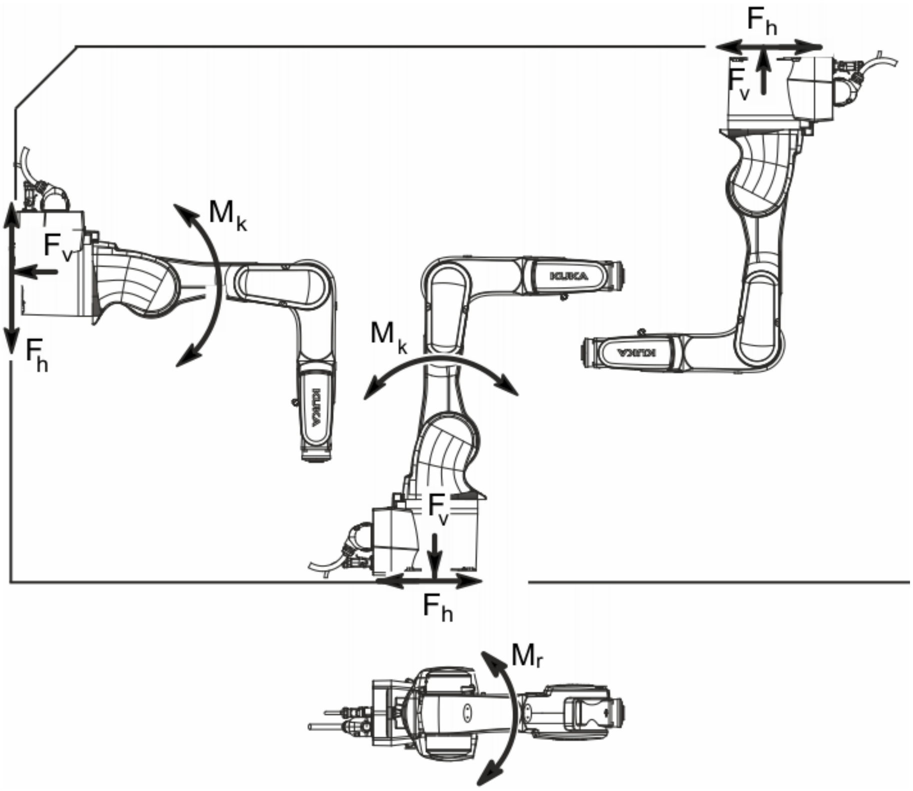


Fig. 4-18: Foundation loads

WARNING
Normal loads and maximum loads for the foundations are specified in the table. The maximum loads must be referred to when dimensioning the foundations and must be adhered to for safety reasons. Failure to observe this can result in personal injury and damage to property. The normal loads are average expected foundation loads. The actual loads are dependent on the program and on the robot loads and may therefore be greater or less than the normal loads. The supplementary loads (A1 and A2) are not taken into consideration in the calculation of the mounting base load. These supplementary loads must be taken into consideration for F_v.

4.4 Technical data, KR 10 R900-2

4.4.1 Basic data, KR 10 R900-2

Basic data

	KR 10 R900-2
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.84 m³
Pose repeatability (ISO 9283)	± 0.02 mm
Weight	approx. 55 kg
Rated payload	5 kg
Maximum payload	11.1 kg
Maximum reach	901 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 57 dB (A)
Mounting position	Floor; Ceiling; Wall; Desired angle
Footprint	208 mm x 208 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: gray aluminum (RAL 9007); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R900_2 C4SR

Protection classification IP67 can only be assured with a compressed air connection (venting connection PURGE) of 0.3 bar.

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 4 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3

Ambient temperature	
During operation	0 °C to 45 °C (273 K to 318 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

For operation at low temperatures, it may be necessary to warm up the robot.

Connecting cables

Cable designation	Connector designation robot controller - robot	Interface with robot
Motor cable	X20 - X30	Han Yellock 30
Data cable	X21 - X31	Han Q12
Ground conductor, equi-potential bonding (can be ordered as an option)		M4 ring cable lug

	Cable lengths
Standard	1 m, 4 m, 7 m, 15 m, 25 m

For further connecting cables and detailed specifications, see “Description of the connecting cables”.

4.4.2 Axis data, KR 10 R900-2

Axis data

Motion range	
A1	±170 °
A2	-190 ° / 45 °
A3	-120 ° / 156 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	330 °/s
A4	360 °/s
A5	360 °/s
A6	433 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> *Fig. 4-19*).

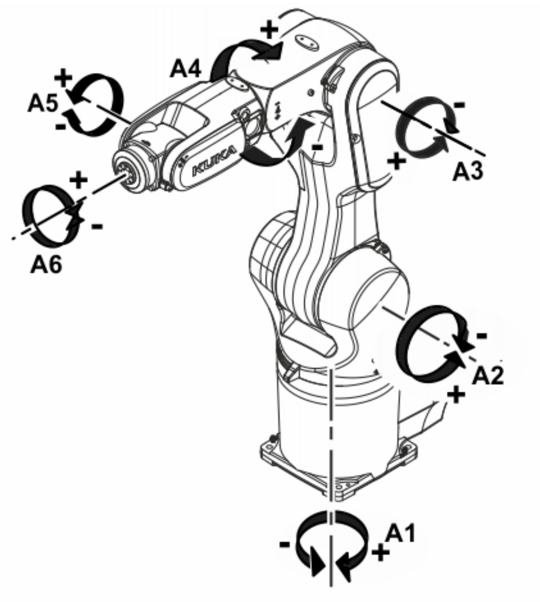


Fig. 4-19: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	0 °
A2	-90 °
A3	90 °
A4	90 °
A5	0 °
A6	0 °

Working envelope

The following diagrams show the shape and size of the working envelope for these variants of this product family.

The reference point for the working envelope is the intersection of axes 4 and 5.

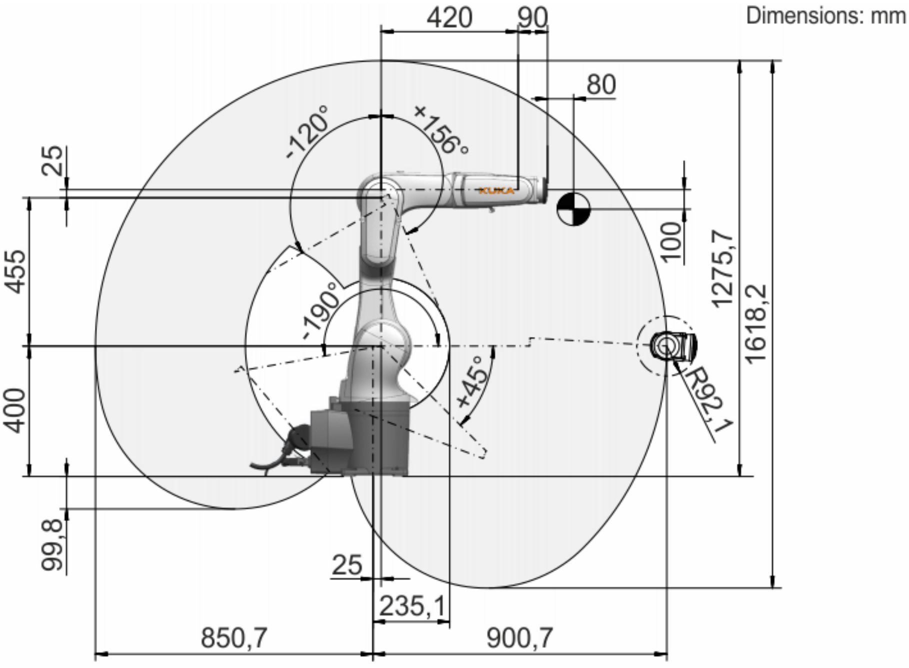


Fig. 4-20: KR 10 R900-2, working envelope, side view

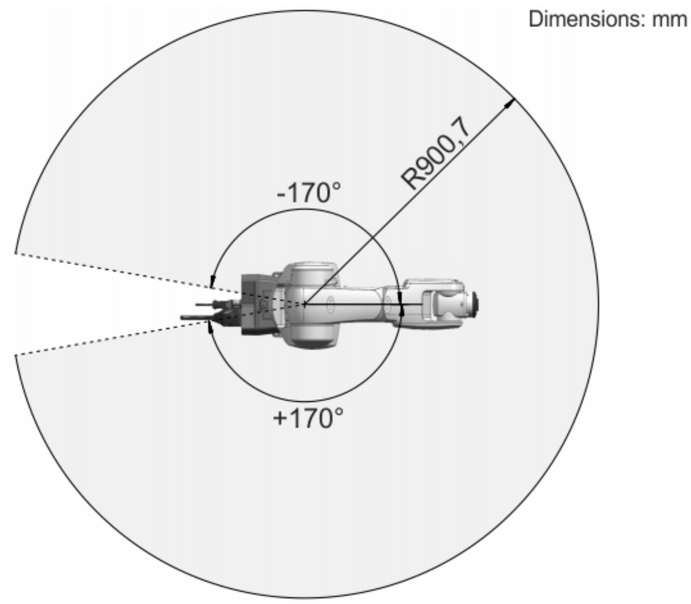


Fig. 4-21: KR 10 R900-2, working envelope, top view

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). The following figure shows the possible limitation of the motion range of axis 1, as a function of the angle of inclination of the robot.

The inclination angles for the robot must be entered correctly into the controller if the robot is not operated in the floor-mounted position. Configuration of the angles is possible via WorkVisual.

The inclination angles for an unchanged main working direction of the robot:

Floor: A:0°, B:0°, C:0°

Wall: A:0°, B:90°, C:0°

Ceiling: A:0°, B:0°, C:180°

CAUTION

The inclined installation angles must be individually checked and entered. An incorrectly entered inclined installation angle can lead to unforeseen motion and/or to an overload and, potentially, damage to the robot.

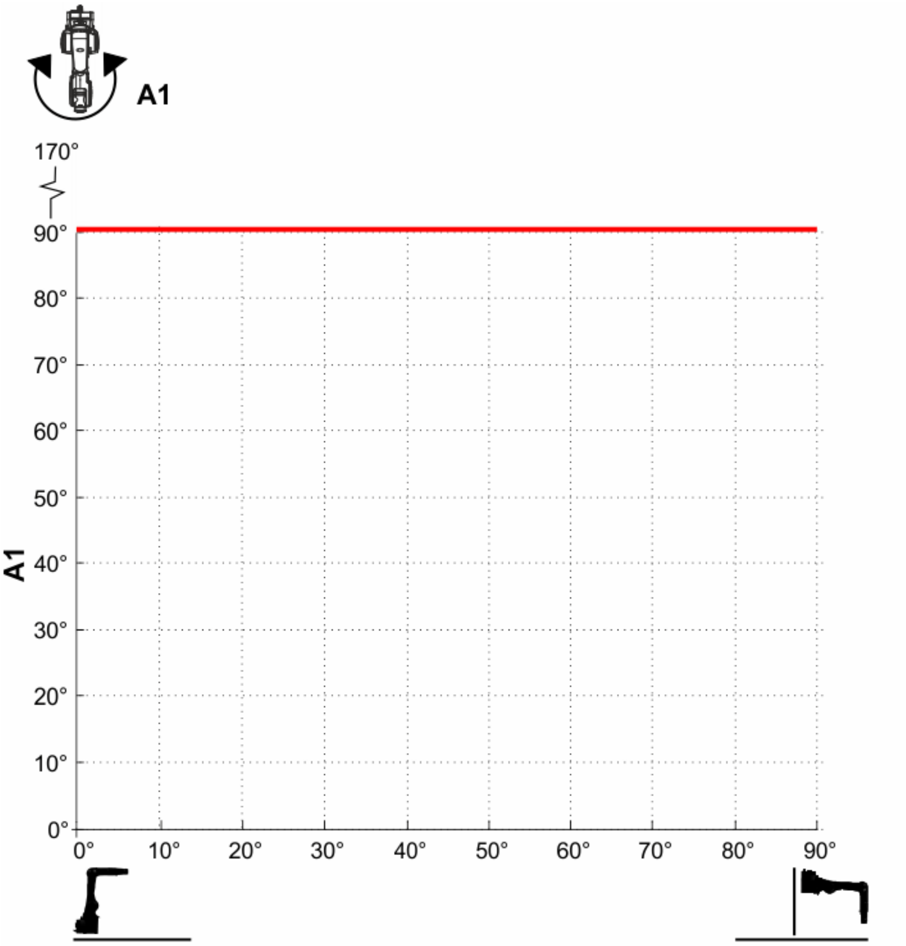


Fig. 4-22: Motion range of axis 1 with inclined installation

4.4.3 Payloads, KR 10 R900-2

Payloads

Rated payload	5 kg
Maximum payload	11.1 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	0 kg
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	1 kg
Rated supplementary load, link arm	0 kg

Maximum supplementary load, link arm	1 kg
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	2 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

The sum of all loads mounted on the robot must not exceed the maximum payload.

Load center of gravity

For all payloads, the load center of gravity refers to the distance from the face of the mounting flange on axis 6.

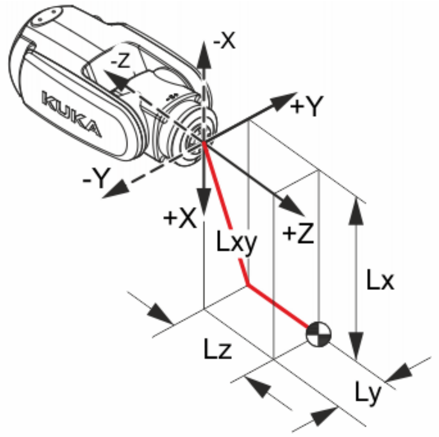


Fig. 4-23: Load center of gravity

Payload diagram

NOTICE
This loading curve corresponds to the maximum load capacity. Both values (payload and mass moment of inertia) must be checked in all cases. Exceeding this capacity will reduce the service life of the robot and overload the motors and the gears; in any such case KUKA Deutschland GmbH must be consulted beforehand. The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with the operating and programming instructions of the KUKA System Software. The mass inertia must be verified using KUKA.Load. It is imperative for the load data to be entered in the robot controller!

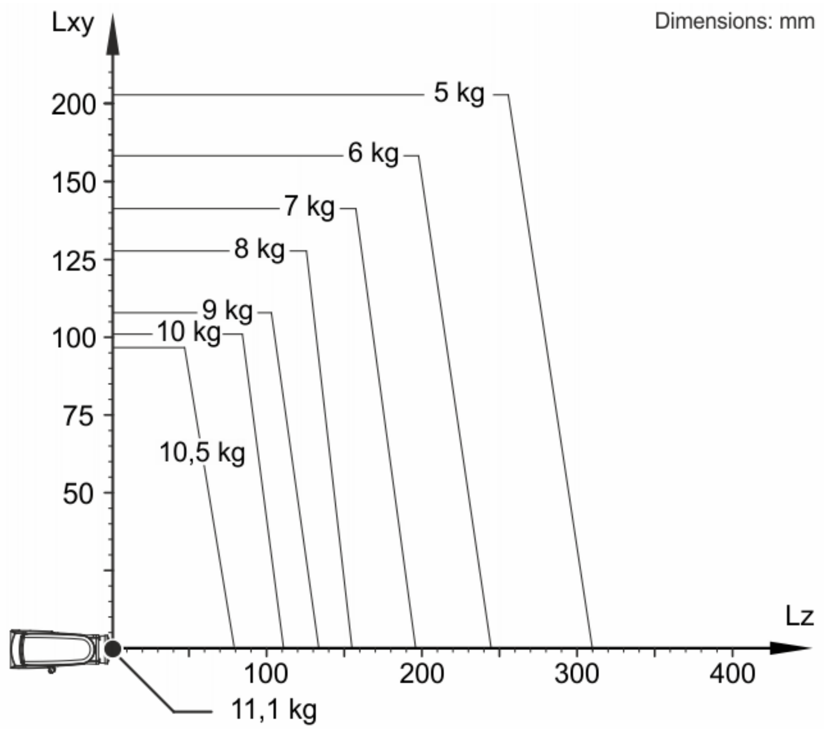


Fig. 4-24: KR 10 R900-2, payload diagram

The KR 10 R900-2 is designed for a rated payload of 5 kg in order to optimize the dynamic performance of the robot. With reduced load center distances, higher loads up to the maximum payload may be used. The specific load case must be verified using KUKA.Load. For further consultation, please contact KUKA Support.

Mounting flange

In-line wrist type	ZH Arm KR10
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	12.9
Screw size	M5
Number of fastening threads	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5^{H7}
Standard	See diagram.

The mounting flange is depicted (>>> *Fig. 4-25*) with axes 4 and 6 in the zero position. The symbol X_m indicates the position of the locating element (bushing) in the zero position.

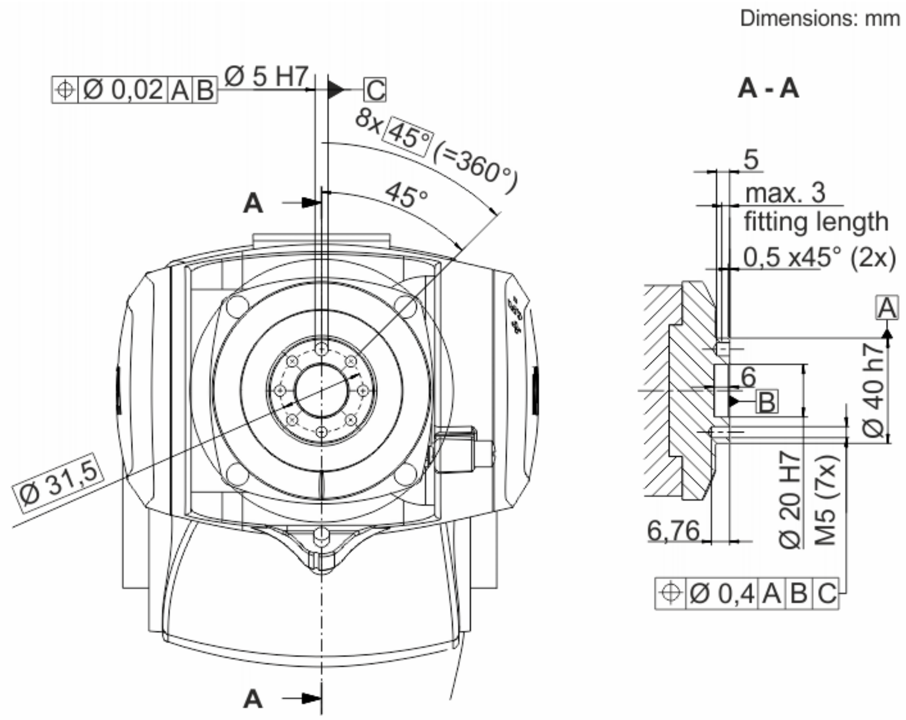


Fig. 4-25: Mounting flange

Flange loads

Due to the motion of the payload (e.g. tool) mounted on the robot, forces and torques act on the mounting flange. These forces and torques depend on the motion profile as well as the mass, load center of gravity and mass moment of inertia of the payload.

The specified values refer to nominal payloads at the nominal distance and do not include safety factors. It is imperative for the load data to be entered in the robot controller. The robot controller takes the payload into consideration during path planning. A reduced payload does not necessarily result in lower forces and torques.

The values are guide values determined by means of trial and simulation and refer to the most heavily loaded machine in the robot family. The actual forces and torques may differ due to internal and external influences on the mounting flange or a different point of application. It is therefore advisable to determine the exact forces and torques where necessary on site under the real conditions of the actual robot application.

The operating values may occur permanently in the normal motion profile. It is advisable to rate the tool for its fatigue strength.

The EMERGENCY STOP values may arise in the event of an Emergency Stop situation of the robot. As these should only occur very rarely during the service life of the robot, a static strength verification is usually sufficient.

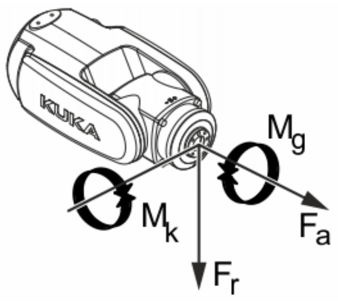


Fig. 4-26: Flange loads

Flange loads during operation	
F(a)	275 N
F(r)	309 N
M(k)	35 Nm
M(g)	27 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	460 N
F(r)	423 N
M(k)	60 Nm
M(g)	43 Nm

Axial force F(a), radial force F(r), tilting torque M(k), torque about mounting flange M(g)

4.4.4 Foundation loads, KR 10 R900-2

Foundation loads

The specified forces and moments already include the payload and the inertia force (weight) of the robot.

Foundation loads for floor mounting position	
F(v normal)	866 N
F(v max)	1223 N
F(h normal)	499 N
F(h max)	693 N
M(k normal)	465 Nm
M(k max)	821 Nm
M(r normal)	226 Nm
M(r max)	403 Nm
Foundation loads for ceiling mounting position	
F(v normal)	919 N
F(v max)	1052 N
F(h normal)	491 N
F(h max)	757 N
M(k normal)	475 Nm
M(k max)	892 Nm
M(r normal)	302 Nm

M(r max)	416 Nm
Foundation loads for wall mounting position	
F(v normal)	1015 N
F(v max)	1121 N
F(h normal)	343 N
F(h max)	715 N
M(k normal)	619 Nm
M(k max)	879 Nm
M(r normal)	244 Nm
M(r max)	385 Nm

Vertical force F(v), horizontal force F(h), tilting torque M(k), torque about axis 1 M(r)

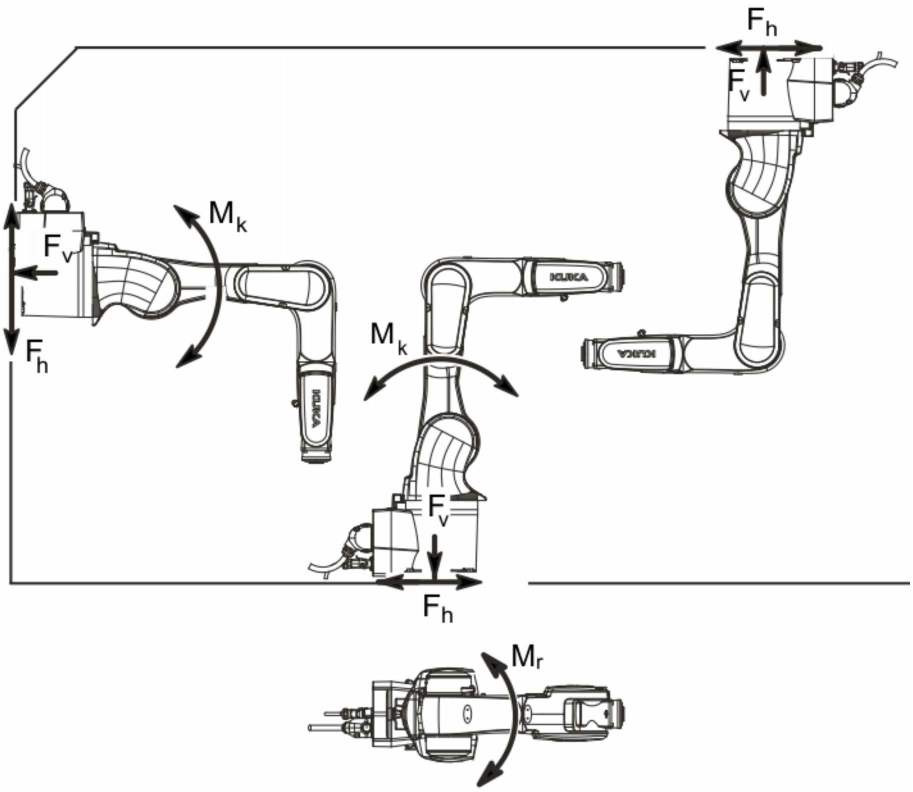


Fig. 4-27: Foundation loads

WARNING
Normal loads and maximum loads for the foundations are specified in the table. The maximum loads must be referred to when dimensioning the foundations and must be adhered to for safety reasons. Failure to observe this can result in personal injury and damage to property. The normal loads are average expected foundation loads. The actual loads are dependent on the program and on the robot loads and may therefore be greater or less than the normal loads. The supplementary loads (A1 and A2) are not taken into consideration in the calculation of the mounting base load. These supplementary loads must be taken into consideration for F_v.

4.5 Technical data, KR 10 R1100-2

4.5.1 Basic data, KR 10 R1100-2

Basic data

	KR 10 R1100-2
Number of axes	6
Number of controlled axes	6
Volume of working envelope	5.2 m^3
Pose repeatability (ISO 9283)	± 0.02 mm
Weight	approx. 56.5 kg
Rated payload	5 kg
Maximum payload	10.9 kg
Maximum reach	1101 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 57 dB (A)
Mounting position	Floor; Ceiling; Wall; Desired angle
Footprint	208 mm x 208 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: gray aluminum (RAL 9007); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R1100_2 C4SR

Protection classification IP67 can only be assured with a compressed air connection (venting connection PURGE) of 0.3 bar.

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 4 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3

Ambient temperature	
During operation	0 °C to 45 °C (273 K to 318 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

For operation at low temperatures, it may be necessary to warm up the robot.

Connecting cables

Cable designation	Connector designation robot controller - robot	Interface with robot
Motor cable	X20 - X30	Han Yellock 30
Data cable	X21 - X31	Han Q12
Ground conductor, equi-potential bonding (can be ordered as an option)		M4 ring cable lug

	Cable lengths
Standard	1 m, 4 m, 7 m, 15 m, 25 m

For further connecting cables and detailed specifications, see “Description of the connecting cables”.

4.5.2 Axis data, KR 10 R1100-2

Axis data

Motion range	
A1	±170 °
A2	-190 ° / 45 °
A3	-120 ° / 156 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	330 °/s
A4	360 °/s
A5	360 °/s
A6	433 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> *Fig. 4-28*).

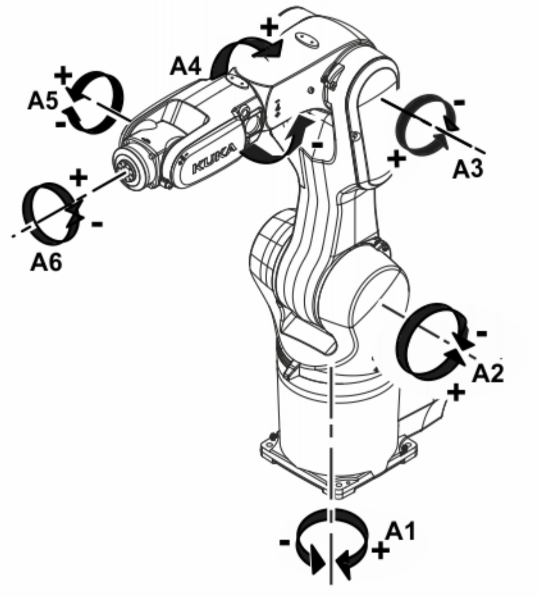


Fig. 4-28: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	0 °
A2	-90 °
A3	90 °
A4	90 °
A5	0 °
A6	0 °

Working envelope

The following diagrams show the shape and size of the working envelope for these variants of this product family.

The reference point for the working envelope is the intersection of axes 4 and 5.

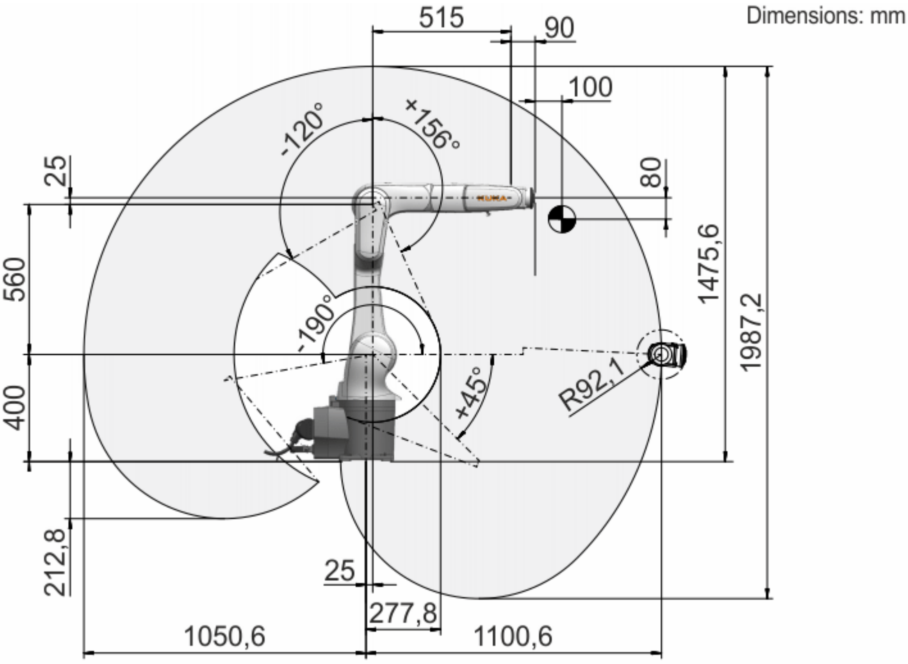


Fig. 4-29: KR 10 R1100-2, working envelope, side view

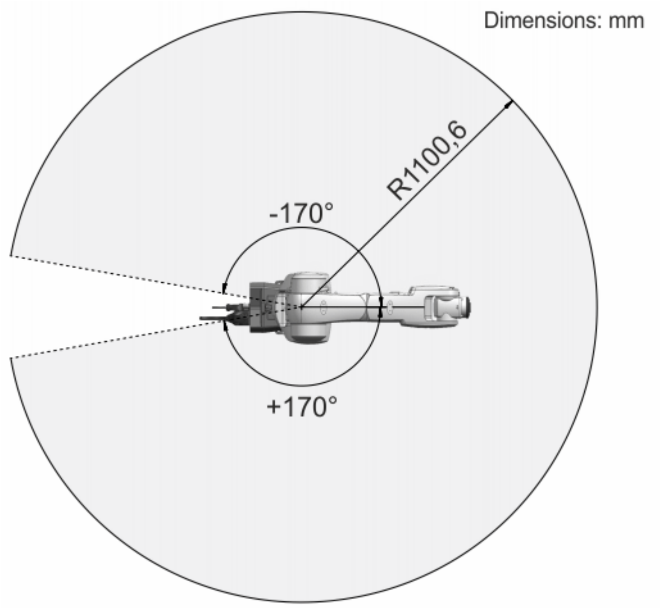


Fig. 4-30: KR 10 R1100-2, working envelope, top view

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). The following figure shows the possible limitation of the motion range of axis 1, as a function of the angle of inclination of the robot.

The inclination angles for the robot must be entered correctly into the controller if the robot is not operated in the floor-mounted position. Configuration of the angles is possible via WorkVisual.

The inclination angles for an unchanged main working direction of the robot:

Floor: A:0°, B:0°, C:0°

Wall: A:0°, B:90°, C:0°

Ceiling: A:0°, B:0°, C:180°

CAUTION

The inclined installation angles must be individually checked and entered. An incorrectly entered inclined installation angle can lead to unforeseen motion and/or to an overload and, potentially, damage to the robot.

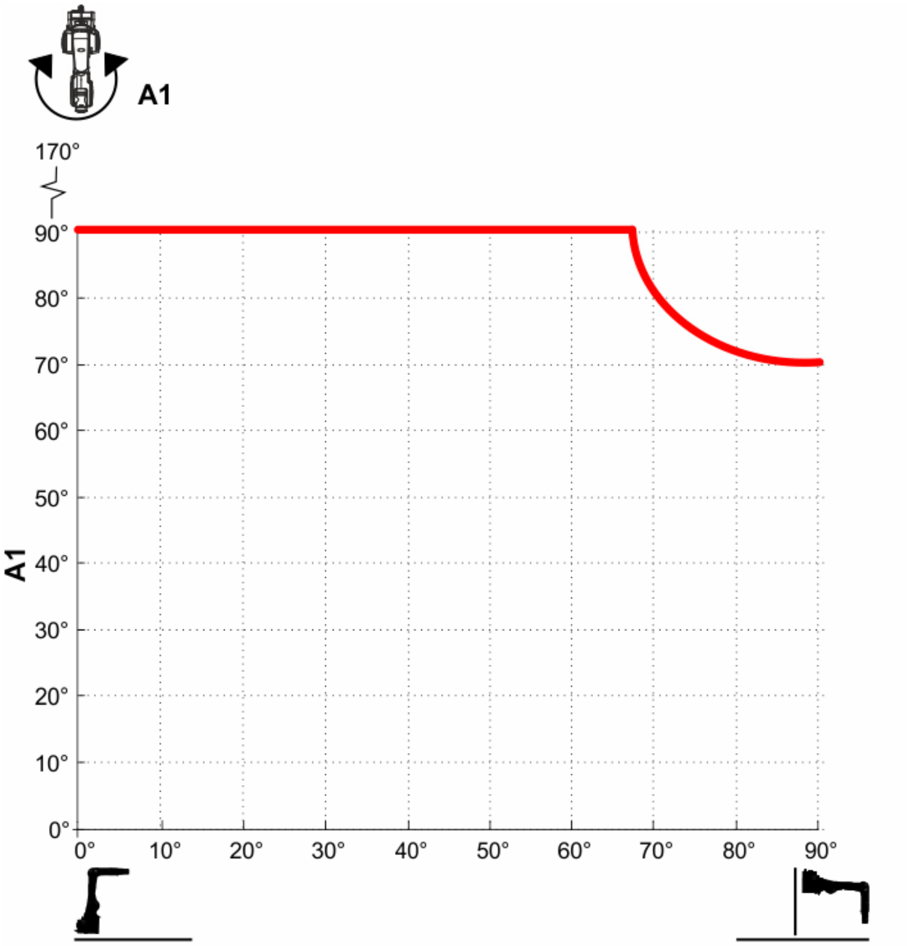


Fig. 4-31: Motion range of A1 with inclined installation

4.5.3 Payloads, KR 10 R1100-2

Payloads

Rated payload	5 kg
Maximum payload	10.9 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	0 kg
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	1 kg
Rated supplementary load, link arm	0 kg

Maximum supplementary load, link arm	1 kg
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	2 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

⚠ The sum of all loads mounted on the robot must not exceed the maximum payload.

Load center of gravity

For all payloads, the load center of gravity refers to the distance from the face of the mounting flange on axis 6.

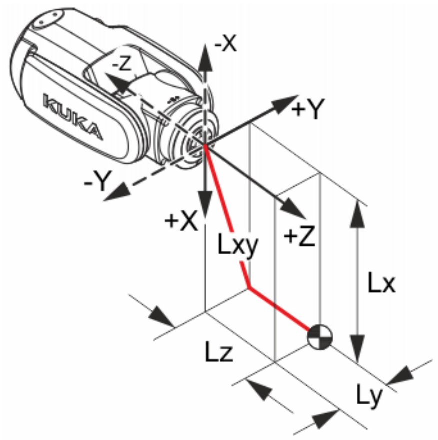


Fig. 4-32: Load center of gravity

Payload diagram

NOTICE
This loading curve corresponds to the maximum load capacity. Both values (payload and mass moment of inertia) must be checked in all cases. Exceeding this capacity will reduce the service life of the robot and overload the motors and the gears; in any such case KUKA Deutschland GmbH must be consulted beforehand. The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with the operating and programming instructions of the KUKA System Software. The mass inertia must be verified using KUKA.Load. It is imperative for the load data to be entered in the robot controller!

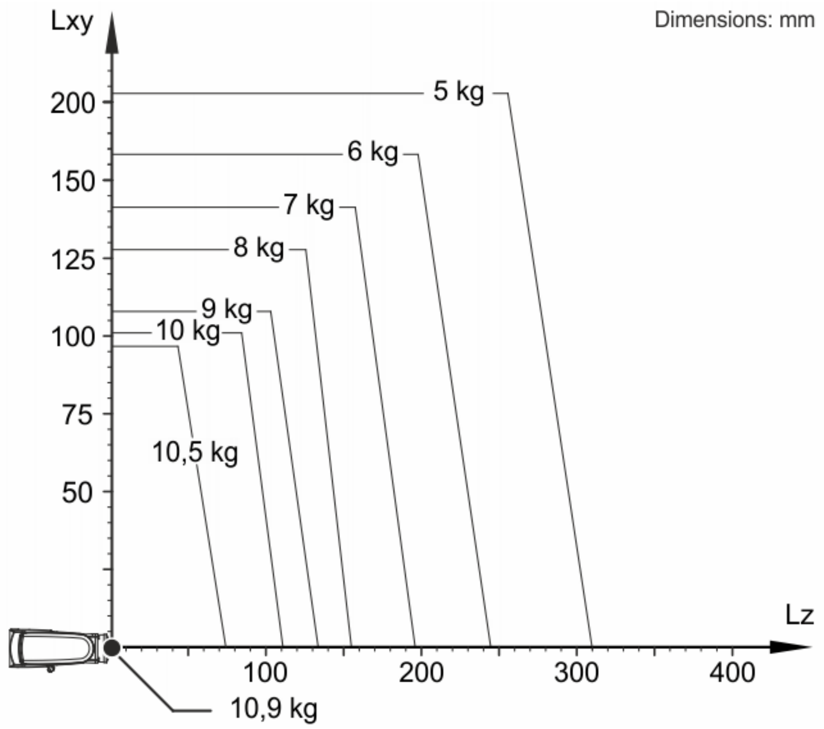


Fig. 4-33: KR 10 R1100-2, payload diagram

The KR 10 R1100-2 is designed for a rated payload of 5 kg in order to optimize the dynamic performance of the robot. With reduced load center distances, higher loads up to the maximum payload may be used. The specific load case must be verified using KUKA.Load. For further consultation, please contact KUKA Support.

Mounting flange

In-line wrist type	ZH Arm KR10
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	12.9
Screw size	M5
Number of fastening threads	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5^{H7}
Standard	See diagram.

The mounting flange is depicted (>>> *Fig. 4-34*) with axes 4 and 6 in the zero position. The symbol X_m indicates the position of the locating element (bushing) in the zero position.

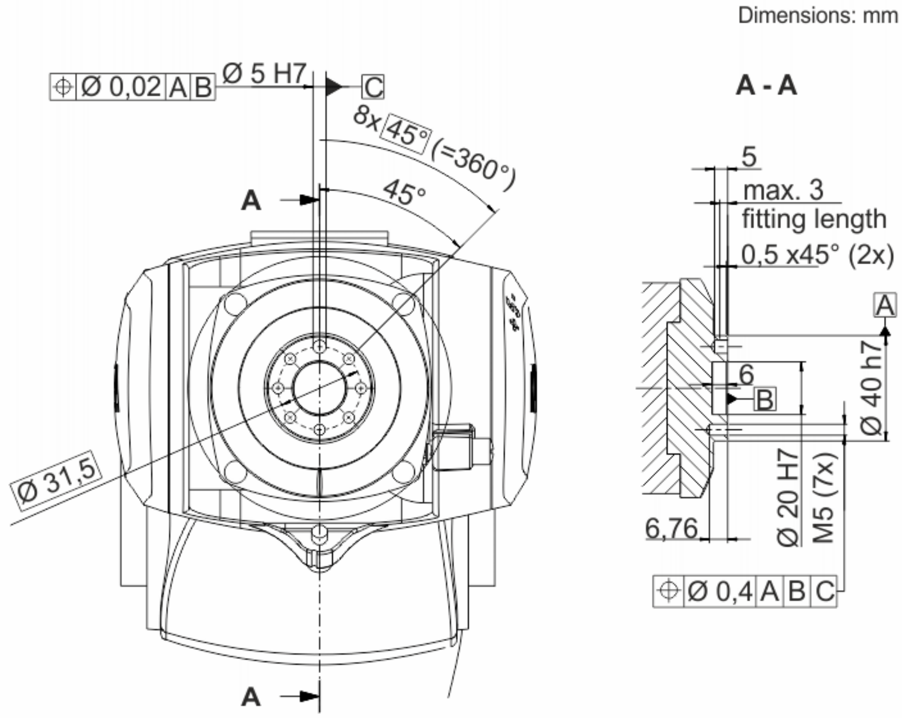


Fig. 4-34: Mounting flange

Flange loads

Due to the motion of the payload (e.g. tool) mounted on the robot, forces and torques act on the mounting flange. These forces and torques depend on the motion profile as well as the mass, load center of gravity and mass moment of inertia of the payload.

The specified values refer to nominal payloads at the nominal distance and do not include safety factors. It is imperative for the load data to be entered in the robot controller. The robot controller takes the payload into consideration during path planning. A reduced payload does not necessarily result in lower forces and torques.

The values are guide values determined by means of trial and simulation and refer to the most heavily loaded machine in the robot family. The actual forces and torques may differ due to internal and external influences on the mounting flange or a different point of application. It is therefore advisable to determine the exact forces and torques where necessary on site under the real conditions of the actual robot application.

The operating values may occur permanently in the normal motion profile. It is advisable to rate the tool for its fatigue strength.

The EMERGENCY STOP values may arise in the event of an Emergency Stop situation of the robot. As these should only occur very rarely during the service life of the robot, a static strength verification is usually sufficient.

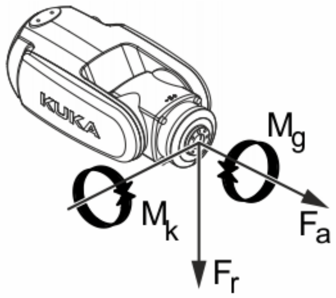


Fig. 4-35: Flange loads

Flange loads during operation	
F(a)	289 N
F(r)	265 N
M(k)	34 Nm
M(g)	27 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	390 N
F(r)	407 N
M(k)	54 Nm
M(g)	42 Nm

Axial force F(a), radial force F(r), tilting torque M(k), torque about mounting flange M(g)

4.5.4 Foundation loads, KR 10 R1100-2

Foundation loads

The specified forces and moments already include the payload and the inertia force (weight) of the robot.

Foundation loads for floor mounting position	
F(v normal)	916 N
F(v max)	1200 N
F(h normal)	558 N
F(h max)	762 N
M(k normal)	542 Nm
M(k max)	894 Nm
M(r normal)	249 Nm
M(r max)	430 Nm
Foundation loads for ceiling mounting position	
F(v normal)	957 N
F(v max)	1156 N
F(h normal)	575 N
F(h max)	805 N
M(k normal)	574 Nm
M(k max)	913 Nm
M(r normal)	282 Nm

M(r max)	455 Nm
Foundation loads for wall mounting position	
F(v normal)	1018 N
F(v max)	1172 N
F(h normal)	425 N
F(h max)	711 N
M(k normal)	688 Nm
M(k max)	1038 Nm
M(r normal)	280 Nm
M(r max)	420 Nm

Vertical force F(v), horizontal force F(h), tilting torque M(k), torque about axis 1 M(r)

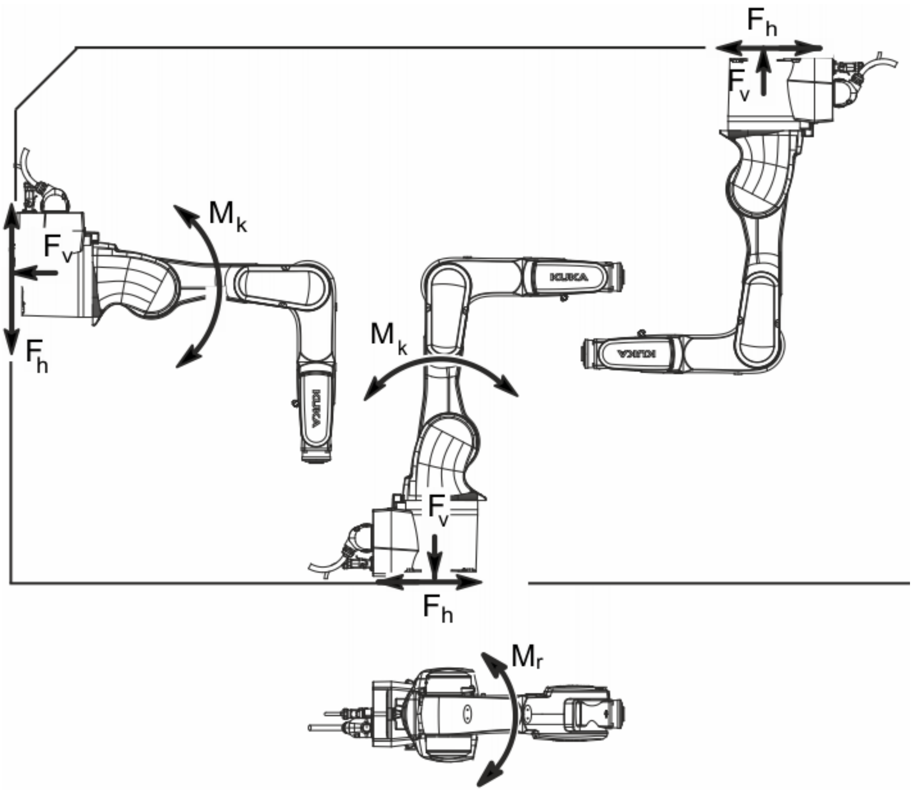


Fig. 4-36: Foundation loads

WARNING
Normal loads and maximum loads for the foundations are specified in the table. The maximum loads must be referred to when dimensioning the foundations and must be adhered to for safety reasons. Failure to observe this can result in personal injury and damage to property. The normal loads are average expected foundation loads. The actual loads are dependent on the program and on the robot loads and may therefore be greater or less than the normal loads. The supplementary loads (A1 and A2) are not taken into consideration in the calculation of the mounting base load. These supplementary loads must be taken into consideration for F_v.

4.6 Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. The fastening holes on the arm, link arm and rotating column are used, for example, for fastening the covers or external energy supply systems. The fastening holes on the in-line wrist are exclusively for fastening holders for energy supply systems (e.g. holders for compressed air hose).

When mounting the supplementary loads, be careful to observe the maximum permissible total load. The dimensions and positions of the installation options can be seen in the following diagram.

⚠ The sum of all loads mounted on the robot must not exceed the maximum total load.

Further information about the supplementary load on the robot can be found in the following sections.

Robot	Description
KR 6 R700-2	(>>> *4.6.1 "Supplementary load, reach R700" Page 57*)
KR 6 R900-2 KR 10 R900-2	(>>> *4.6.2 "Supplementary load, reach R900" Page 58*)
KR 10 R1100-2	(>>> *4.6.3 "Supplementary load, reach R1100" Page 60*)

4.6.1 Supplementary load, reach R700

The following diagrams (>>> *Fig. 4-37*) and (>>> *Fig. 4-38*) show the dimensions and position of the installation options on the arm, in-line wrist, link arm and rotating column.

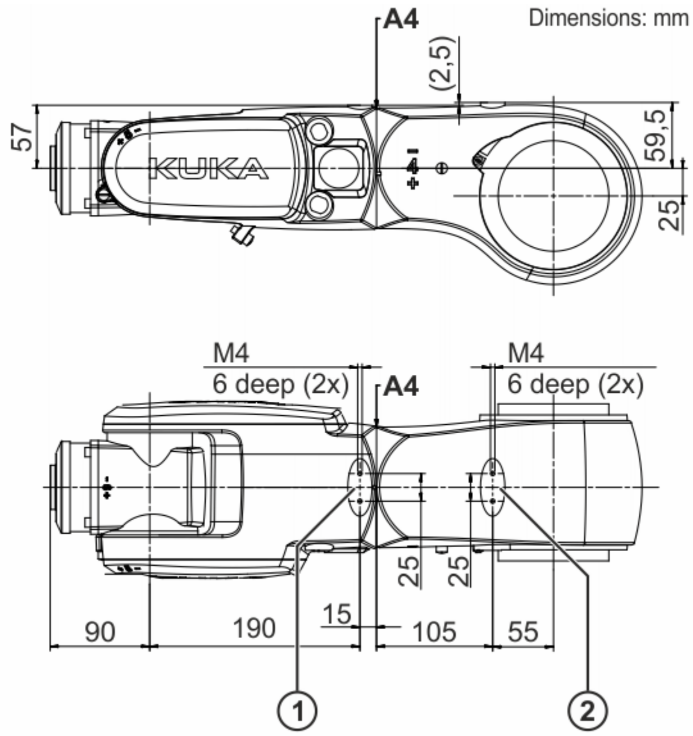


Fig. 4-37: Installation options on arm and in-line wrist

1 Fastening holes, in-line wrist
2 Support for supplementary load, arm

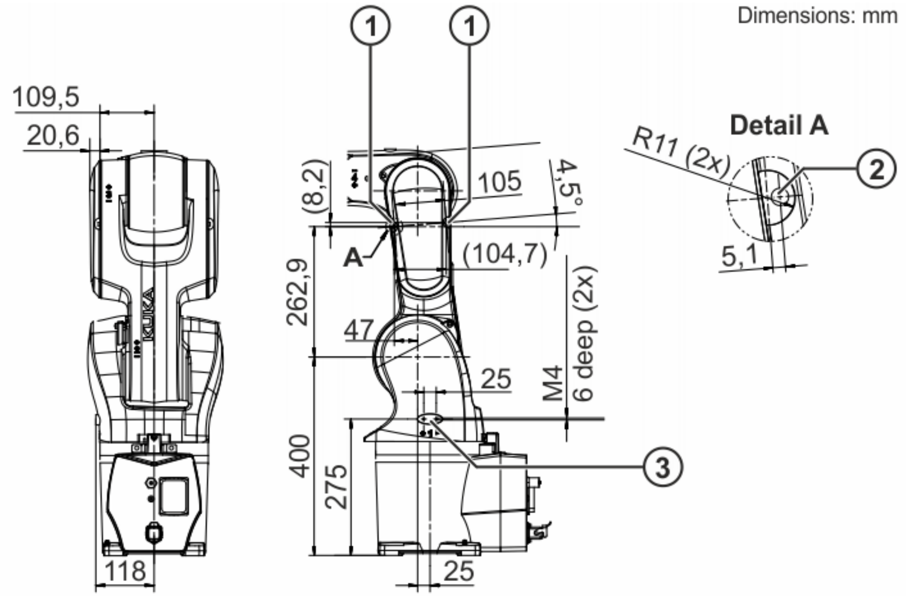


Fig. 4-38: Installation options on link arm and rotating column

1 Support for supplementary load, link arm
2 Fastening holes, link arm
3 Support for supplementary load, rotating column

For the fastening holes on the link arm, the following must be observed:

- Screw without supplementary load: 2x M4x8-8.8-A2K
- Screw with supplementary load: 8 mm + part thickness of supplementary load + max. 1 mm

4.6.2 Supplementary load, reach R900

The following diagrams (>>> *Fig. 4-39*) and (>>> *Fig. 4-40*) show the dimensions and position of the installation options on the arm, in-line wrist, link arm and rotating column.

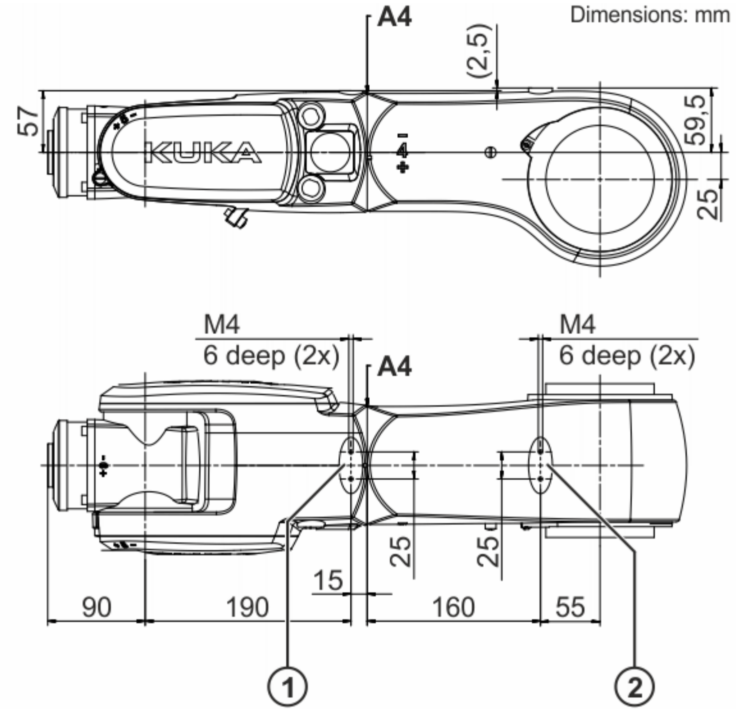


Fig. 4-39: Installation options on arm and in-line wrist

1 Fastening holes, in-line wrist
2 Support for supplementary load, arm

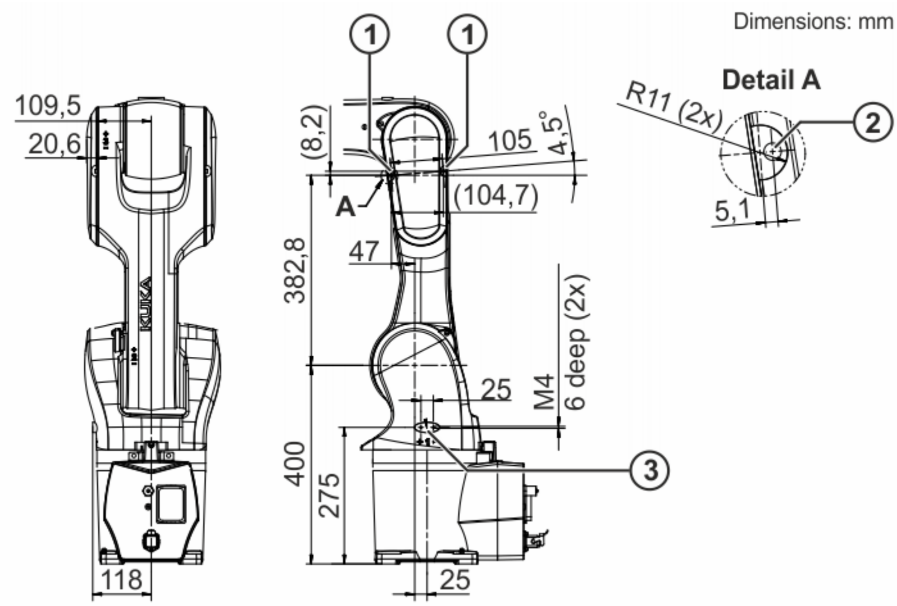


Fig. 4-40: Installation options on link arm and rotating column

1 Support for supplementary load, link arm
2 Fastening holes, link arm
3 Support for supplementary load, rotating column

For the fastening holes on the link arm, the following must be observed:

- Screw without supplementary load: 2x M4x8-8.8-A2K
- Screw with supplementary load: 8 mm + part thickness of supplementary load + max. 1 mm

4.6.3 Supplementary load, reach R1100

The following diagrams (>>> Fig. 4-41) and (>>> Fig. 4-42) show the dimensions and position of the installation options on the arm, in-line wrist, link arm and rotating column.

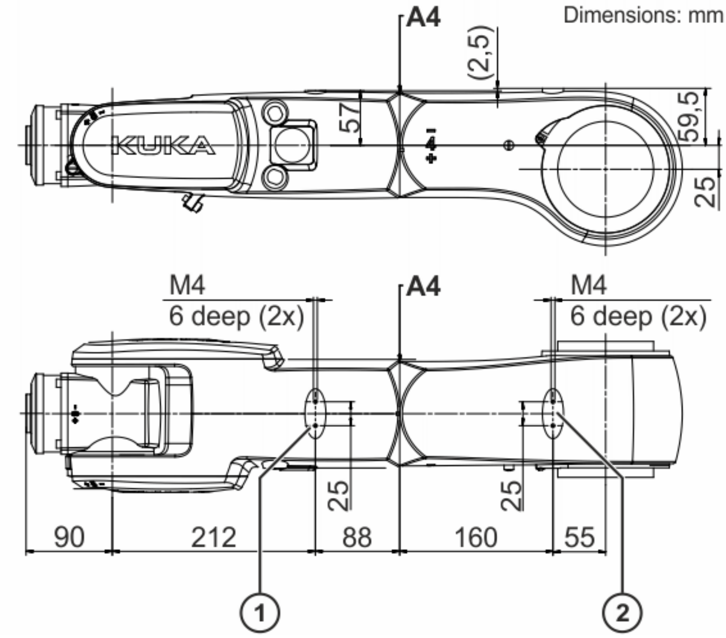


Fig. 4-41: Installation options on arm and in-line wrist

1 Fastening holes, in-line wrist
2 Support for supplementary load, arm

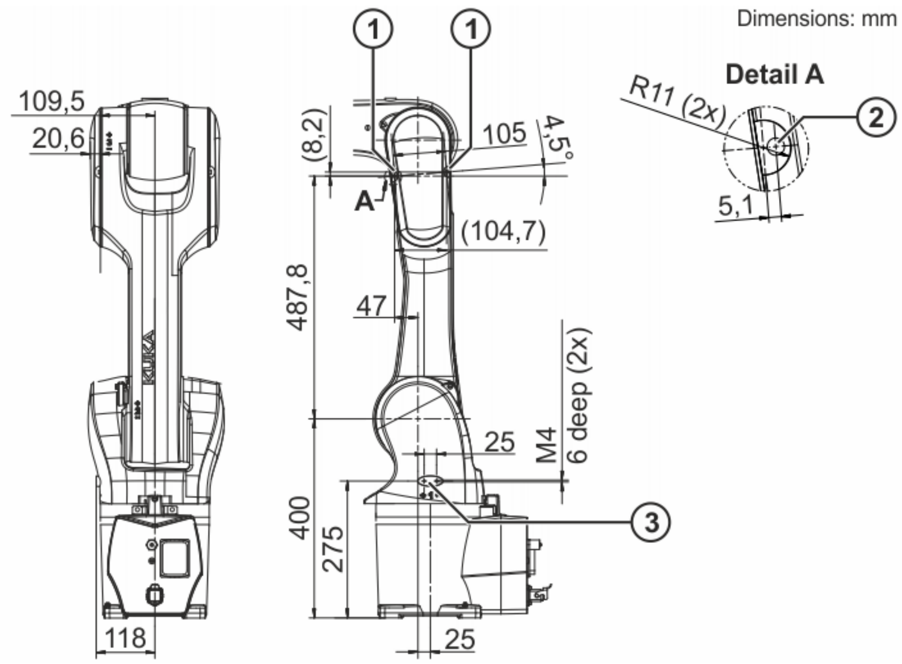


Fig. 4-42: Installation options on link arm and rotating column

1 Support for supplementary load, link arm
2 Fastening holes, link arm
3 Support for supplementary load, rotating column

For the fastening holes on the link arm, the following must be observed:

- Screw without supplementary load: 2x M4x8-8.8-A2K
- Screw with supplementary load: 8 mm + part thickness of supplementary load + max. 1 mm

4.7 Plates and labels

Plates and labels

The following plates and labels are attached to the robot. They must not be removed or rendered illegible. Illegible plates and labels must be replaced.

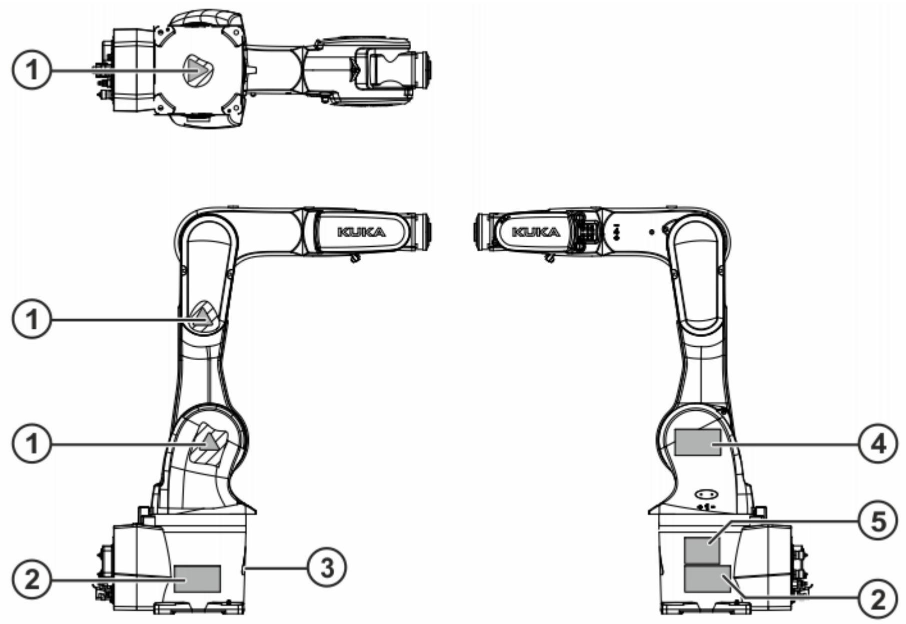
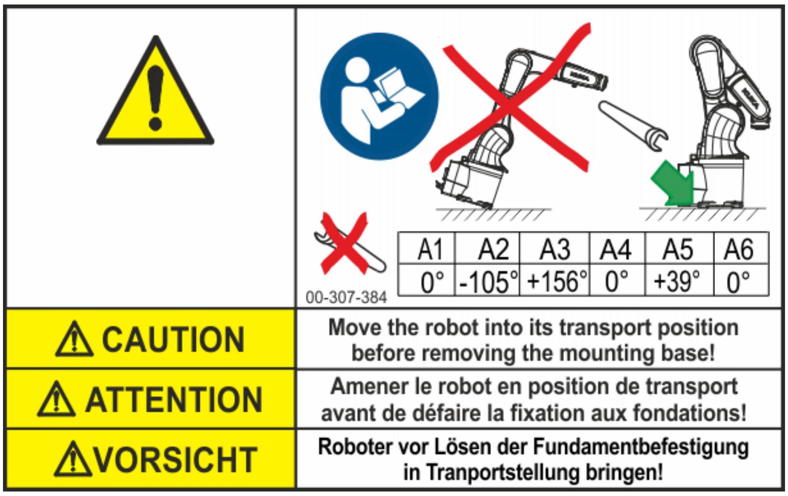


Fig. 4-43: Plates and labels

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>1</td><td>

Secure the axes
Before exchanging any motor, secure the corresponding axis through safeguarding by suitable means/devices to protect against possible movement. The axis can move. Risk of crushing!

</td></tr>
<tr><td>2</td><td>

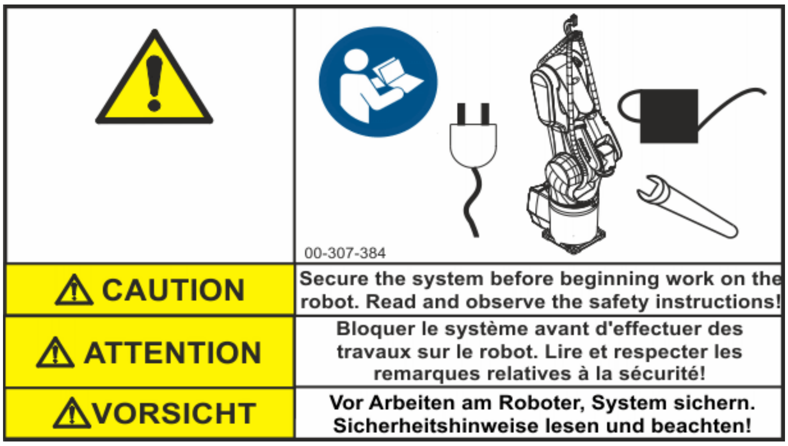


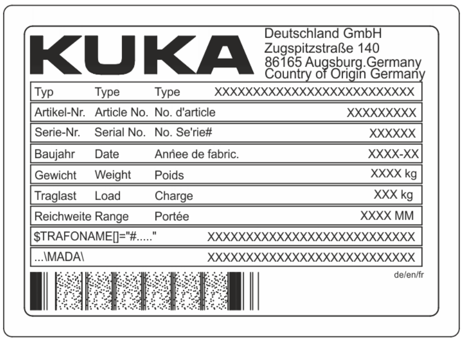
Transport position
Before loosening the bolts of the mounting base, the robot must be in the transport position as indicated in the table. Risk of toppling!

</td></tr>
<tr><td>3</td><td>

Danger zone
Entering the danger zone of the robot is prohibited if the robot is in operation or ready for operation. Risk of injury!

</td></tr>
</table>

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>4</td><td>


Work on the robot
Before start-up, transportation or maintenance, read and follow the assembly and operating instructions.
</td></tr>
<tr><td>5</td><td>


Identification plate
Content according to Machinery Directive.
</td></tr>
</table>

4.8 REACH duty to communicate information acc. to Art. 33 of Regulation (EC) 1907/2006

On the basis of the information provided by our suppliers, this product and its components contain no substances included on the "Candidate List" of Substances of Very High Concern (SVHCs) in a concentration exceeding 0.1 percent by mass.

4.9 Stopping distances and times

4.9.1 General information

Information concerning the data:

- The stopping distance is the angle traveled by the robot from the moment the stop signal is triggered until the robot comes to a complete standstill.
- The stopping time is the time that elapses from the moment the stop signal is triggered until the robot comes to a complete standstill.
- The data are given for the main axes A1, A2 and A3. The main axes are the axes with the greatest deflection.
- Superposed axis motions can result in longer stopping distances.

- Stopping distances and stopping times in accordance with DIN EN ISO 10218-1, Annex B.
- Stop categories:
  - Stop category 0 » STOP 0
  - Stop category 1 » STOP 1

  according to IEC 60204-1
- The values specified for Stop 0 are guide values determined by means of tests and simulation. They are average values which conform to the requirements of DIN EN ISO 10218-1. The actual stopping distances and stopping times may differ due to internal and external influences on the braking torque. It is therefore advisable to determine the exact stopping distances and stopping times where necessary under the real conditions of the actual robot application.
- Measuring technique

  The stopping distances were measured using the robot-internal measuring technique.
- The wear on the brakes varies depending on the operating mode, robot application and the number of STOP 0 stops triggered. It is therefore advisable to check the stopping distance at least once a year.

4.9.2 Terms used

Term	Description
m	Mass of the rated load and the supplementary load on the arm.
Phi	Angle of rotation (°) about the corresponding axis. This value can be entered in the controller via the KCP/smartPAD and can be displayed on the KCP/smartPAD.
POV	Program override (%) = velocity of the robot motion. This value can be entered in the controller via the KCP/smartPAD and can be displayed on the KCP/smartPAD.
Extension	Distance (l in %) (>>> *Fig. 4-44*) between axis 1 and the intersection of axes 4 and 5. With parallelogram robots, the distance between axis 1 and the intersection of axis 6 and the mounting flange.
KCP	KUKA Control Panel Teach pendant for the KR C2/KR C2 edition2005 The KCP has all the operator control and display functions required for operating and programming the industrial robot.
smartPAD	Teach pendant for the KR C4 The smartPAD has all the operator control and display functions required for operating and programming the industrial robot.

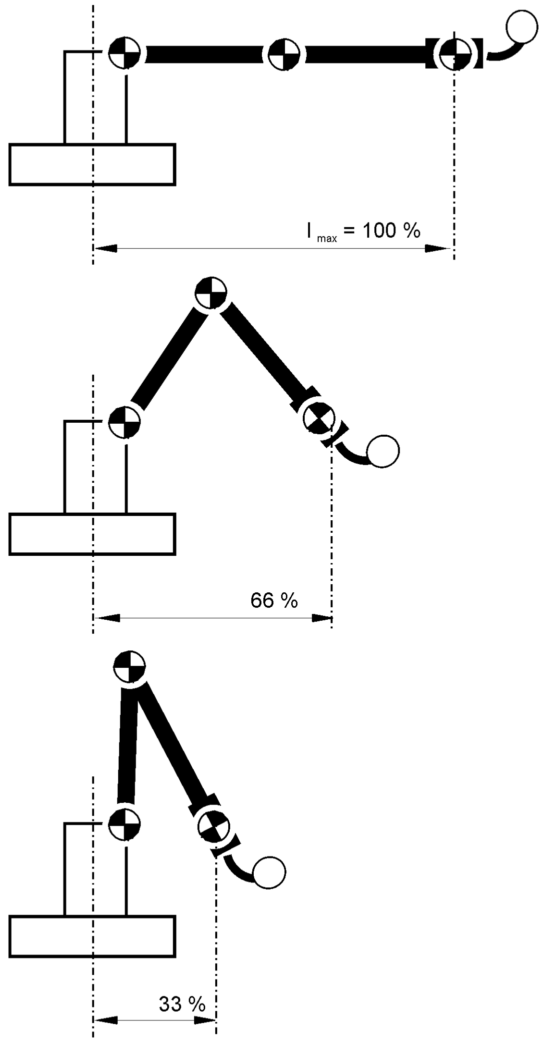


Fig. 4-44: Extension

4.9.3 Stopping distances and times, KR 6 R700-2

4.9.3.1 Stopping distances and stopping times for STOP 0, axis 1 to axis 3

The table shows the stopping distances and stopping times after a STOP 0 (category 0 stop) is triggered. The values refer to the following configuration:

- Extension l = 100%
- Program override POV = 100%
- Mass m = maximum load (rated load + supplementary load on arm)

	Stopping distance (°)	Stopping time (s)
Axis 1	33.06	0.39
Axis 2	38.65	0.22
Axis 3	36.40	0.16

4.9.3.2 Stopping distances and stopping times for STOP 1, axis 1

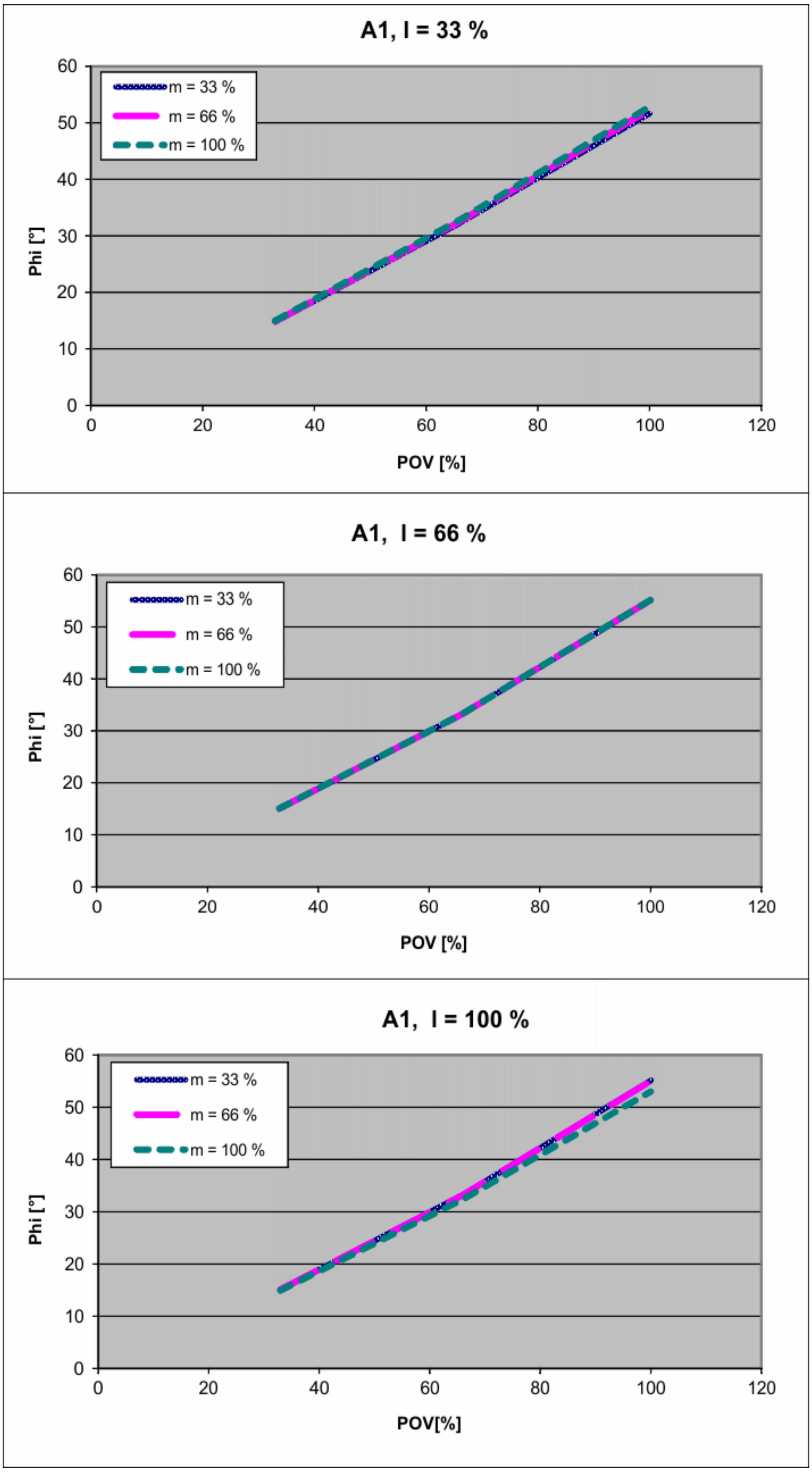


Fig. 4-45: Stopping distances for STOP 1, axis 1

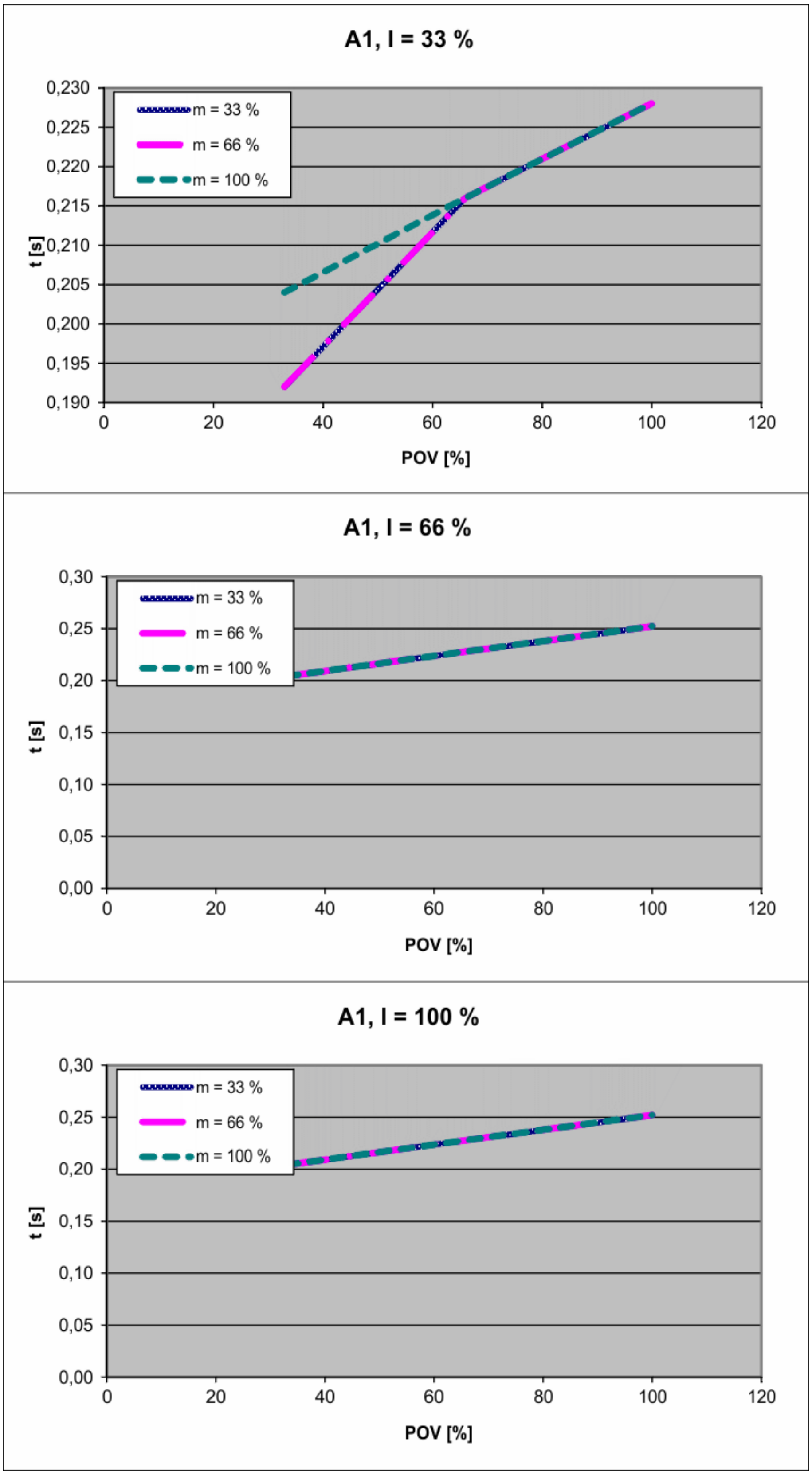


Fig. 4-46: Stopping times for STOP 1, axis 1

4.9.3.3 Stopping distances and stopping times for STOP 1, axis 2

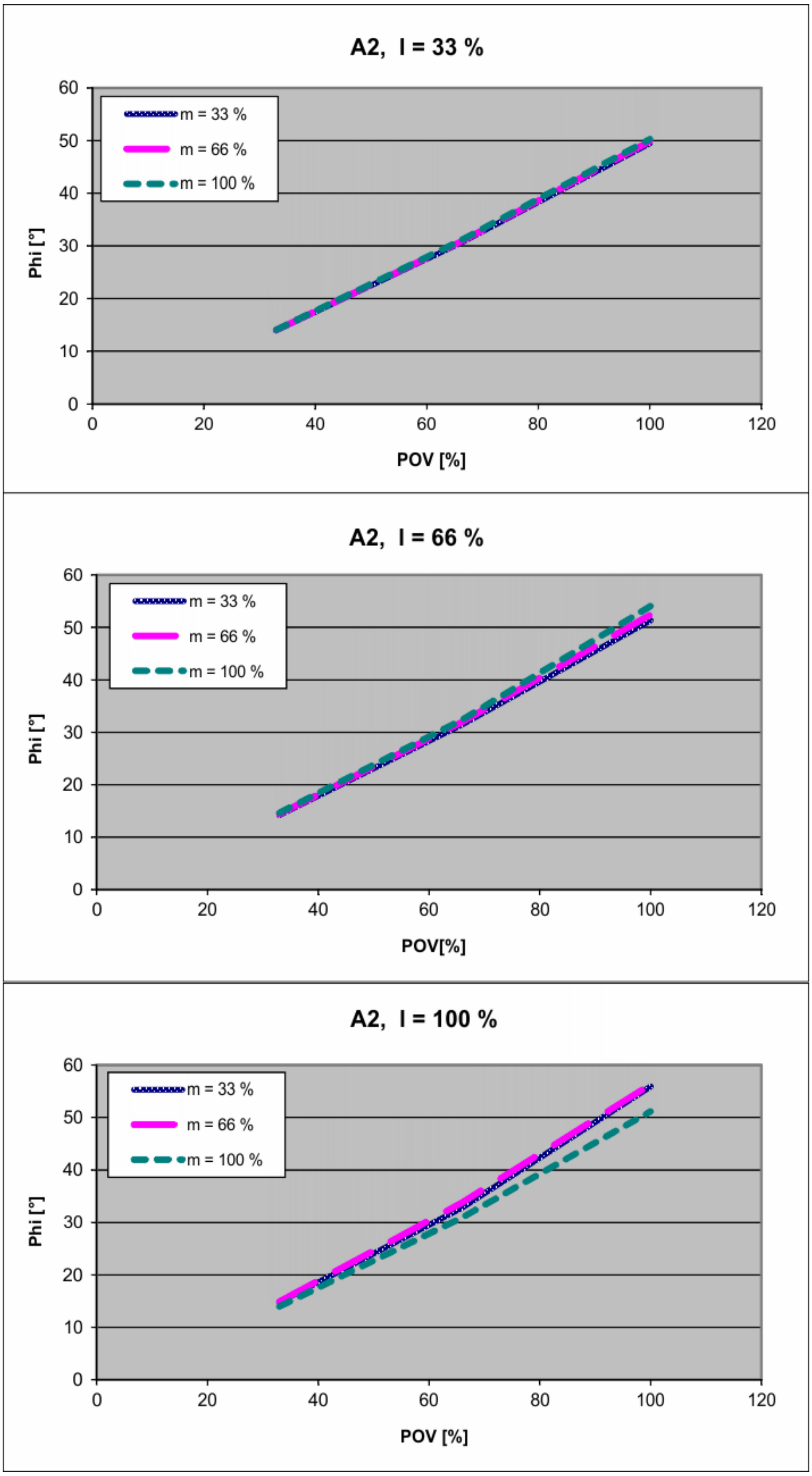


Fig. 4-47: Stopping distances for STOP 1, axis 2

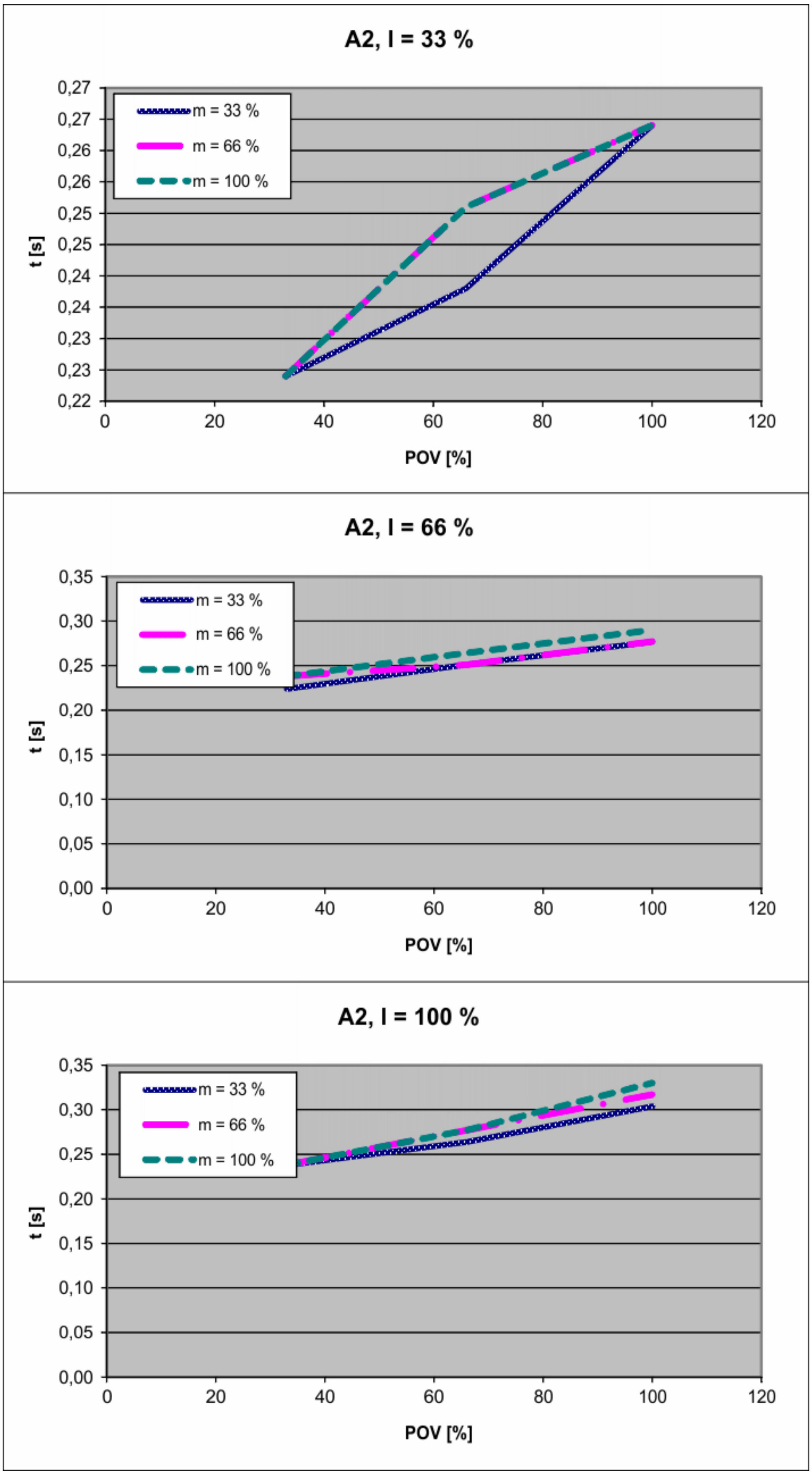


Fig. 4-48: Stopping times for STOP 1, axis 2

4.9.3.4 Stopping distances and stopping times for STOP 1, axis 3

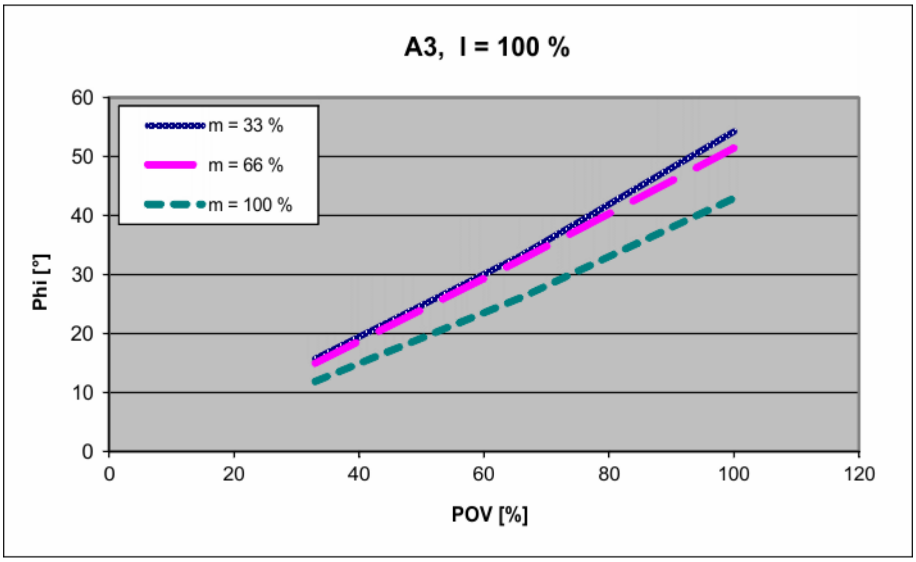


Fig. 4-49: Stopping distances for STOP 1, axis 3

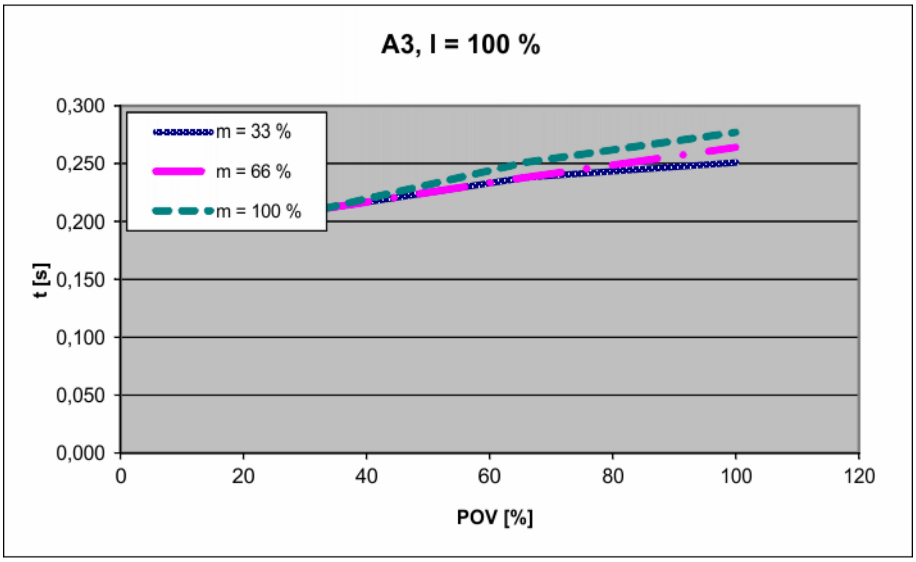


Fig. 4-50: Stopping times for STOP 1, axis 3

4.9.4 Stopping distances and times, KR 6 R900-2

4.9.4.1 Stopping distances and stopping times for STOP 0, axis 1 to axis 3

The table shows the stopping distances and stopping times after a STOP 0 (category 0 stop) is triggered. The values refer to the following configuration:

- Extension l = 100%
- Program override POV = 100%
- Mass m = maximum load (rated load + supplementary load on arm)

	Stopping distance (°)	Stopping time (s)
Axis 1	39.92	0.22
Axis 2	35.49	0.24

	Stopping distance (°)	Stopping time (s)
Axis 3	34.78	0.17

4.9.4.2 Stopping distances and stopping times for STOP 1, axis 1

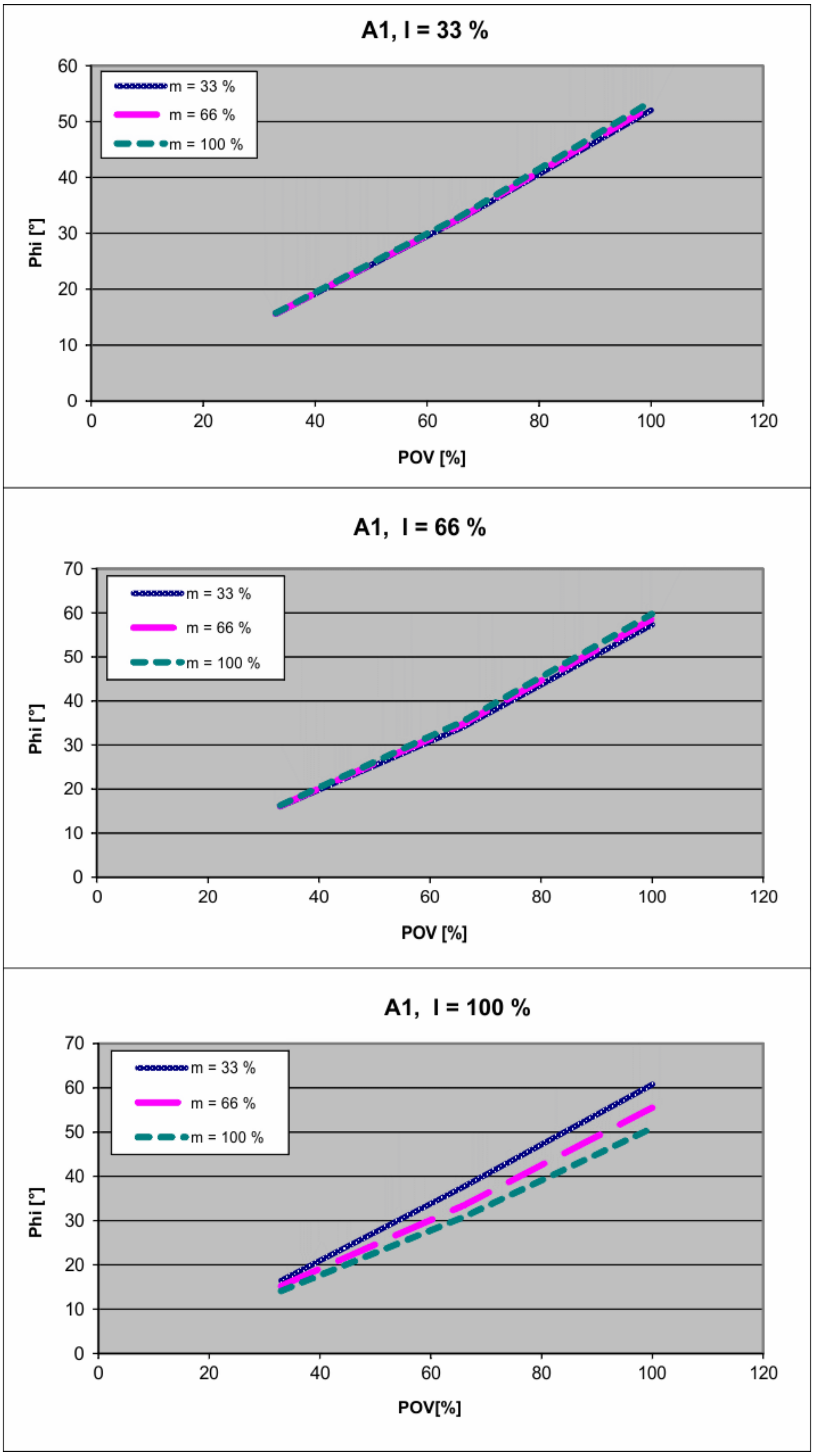


Fig. 4-51: Stopping distances for STOP 1, axis 1

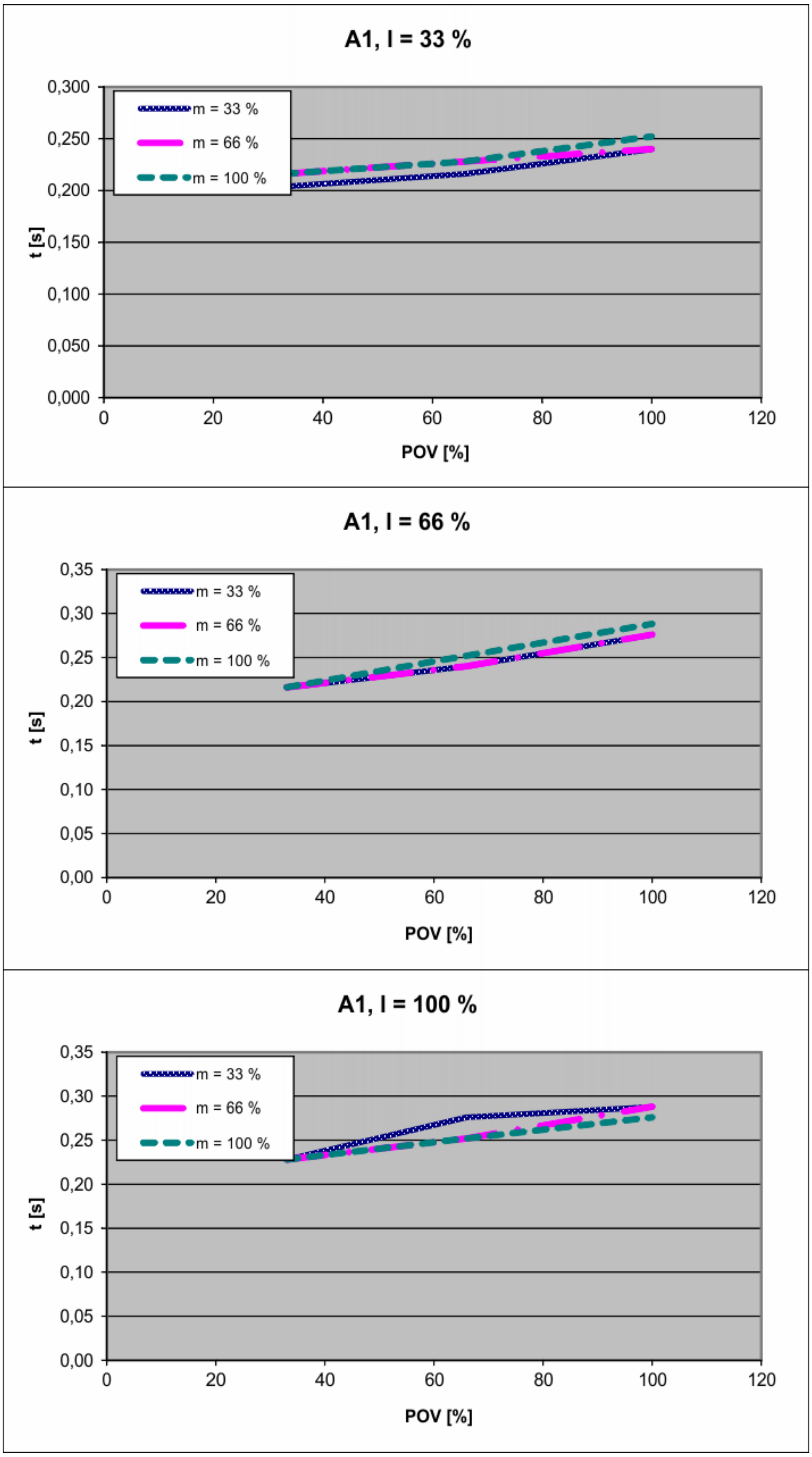


Fig. 4-52: Stopping times for STOP 1, axis 1

4.9.4.3 Stopping distances and stopping times for STOP 1, axis 2

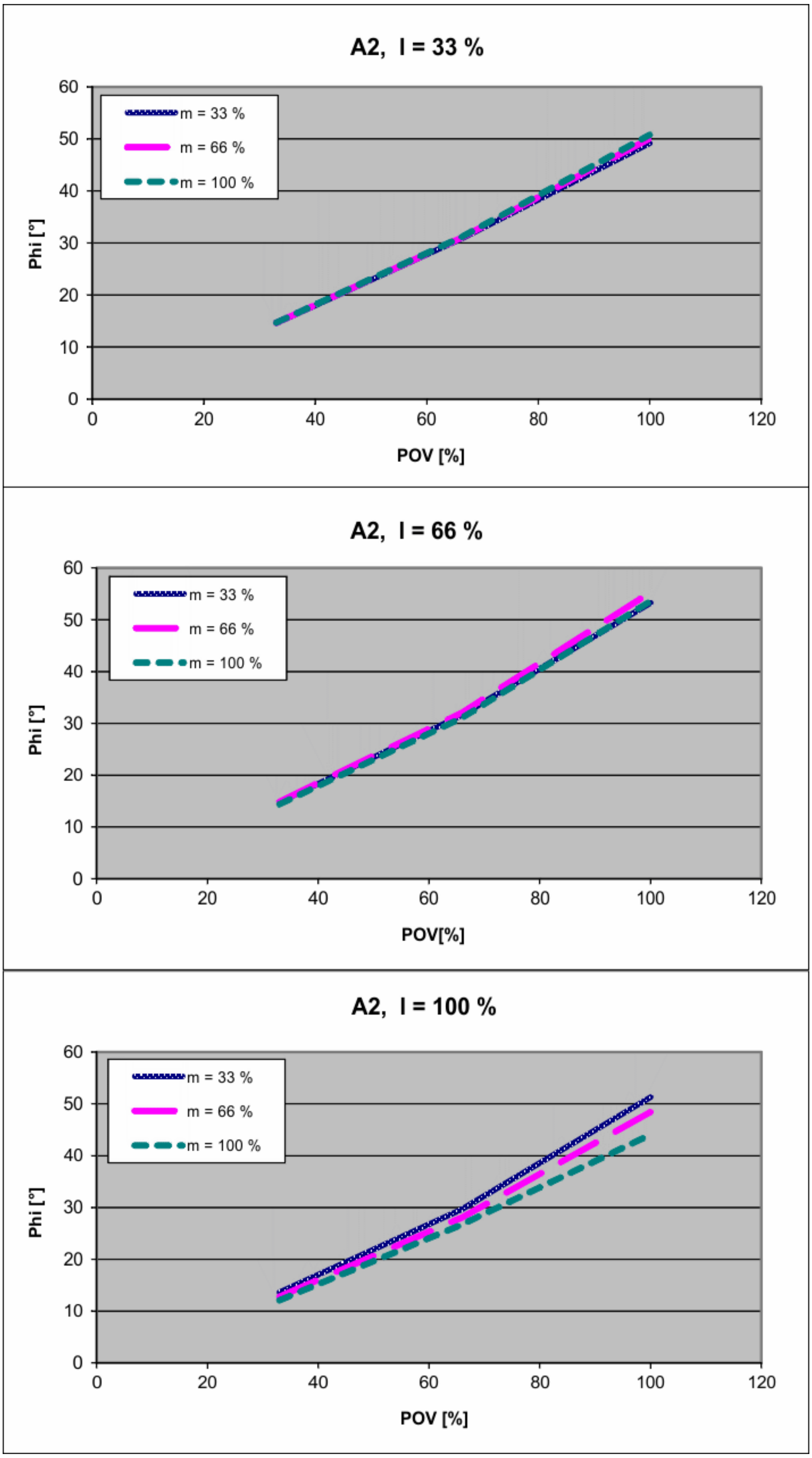


Fig. 4-53: Stopping distances for STOP 1, axis 2

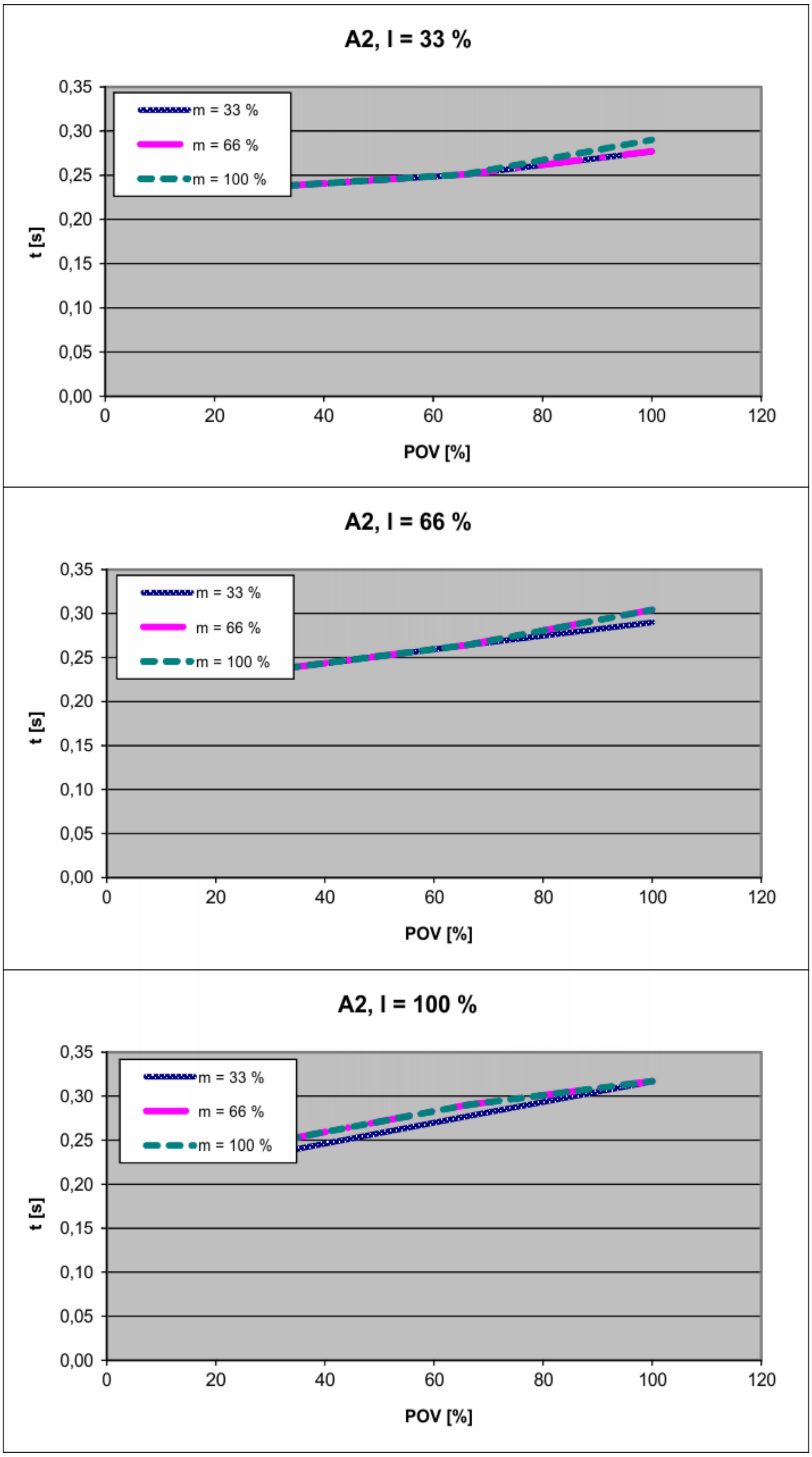


Fig. 4-54: Stopping times for STOP 1, axis 2

4.9.4.4 Stopping distances and stopping times for STOP 1, axis 3

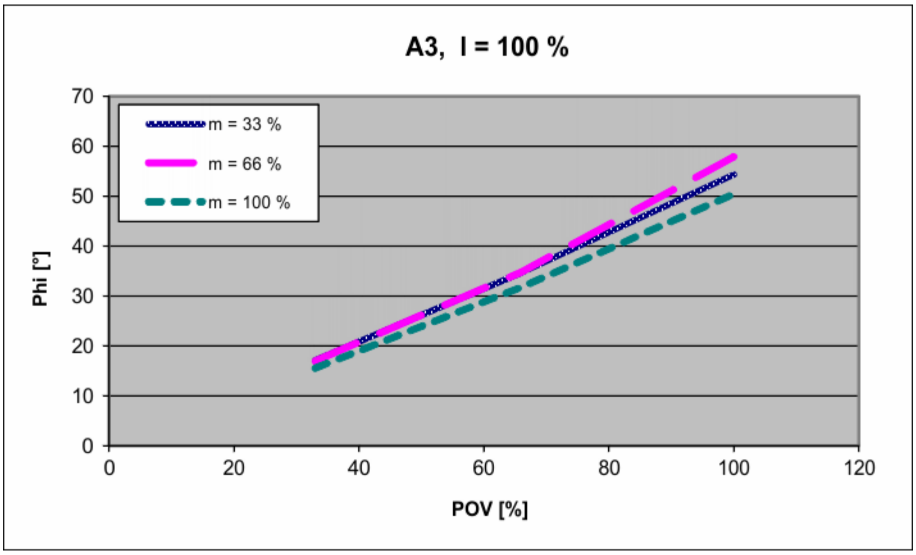


Fig. 4-55: Stopping distances for STOP 1, axis 3

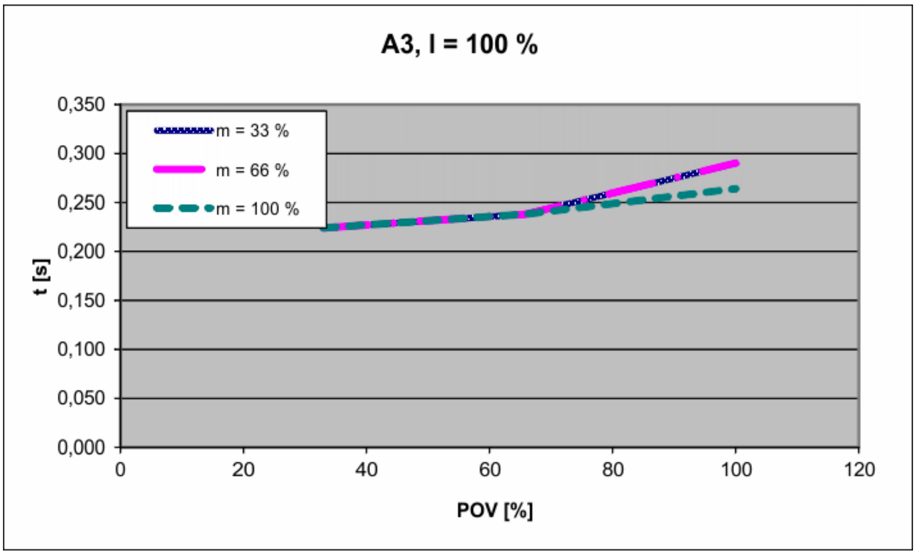


Fig. 4-56: Stopping times for STOP 1, axis 3

4.9.5 Stopping distances and times, KR 10 R900-2

4.9.5.1 Stopping distances and stopping times for STOP 0, axis 1 to axis 3

The table shows the stopping distances and stopping times after a STOP 0 (category 0 stop) is triggered. The values refer to the following configuration:

- Extension l = 100%
- Program override POV = 100%
- Mass m = maximum load (rated load + supplementary load on arm)

	Stopping distance (°)	Stopping time (s)
Axis 1	34.13	0.22
Axis 2	21.45	0.18

	Stopping distance (°)	Stopping time (s)
Axis 3	32.87	0.19

4.9.5.2 Stopping distances and stopping times for STOP 1, axis 1

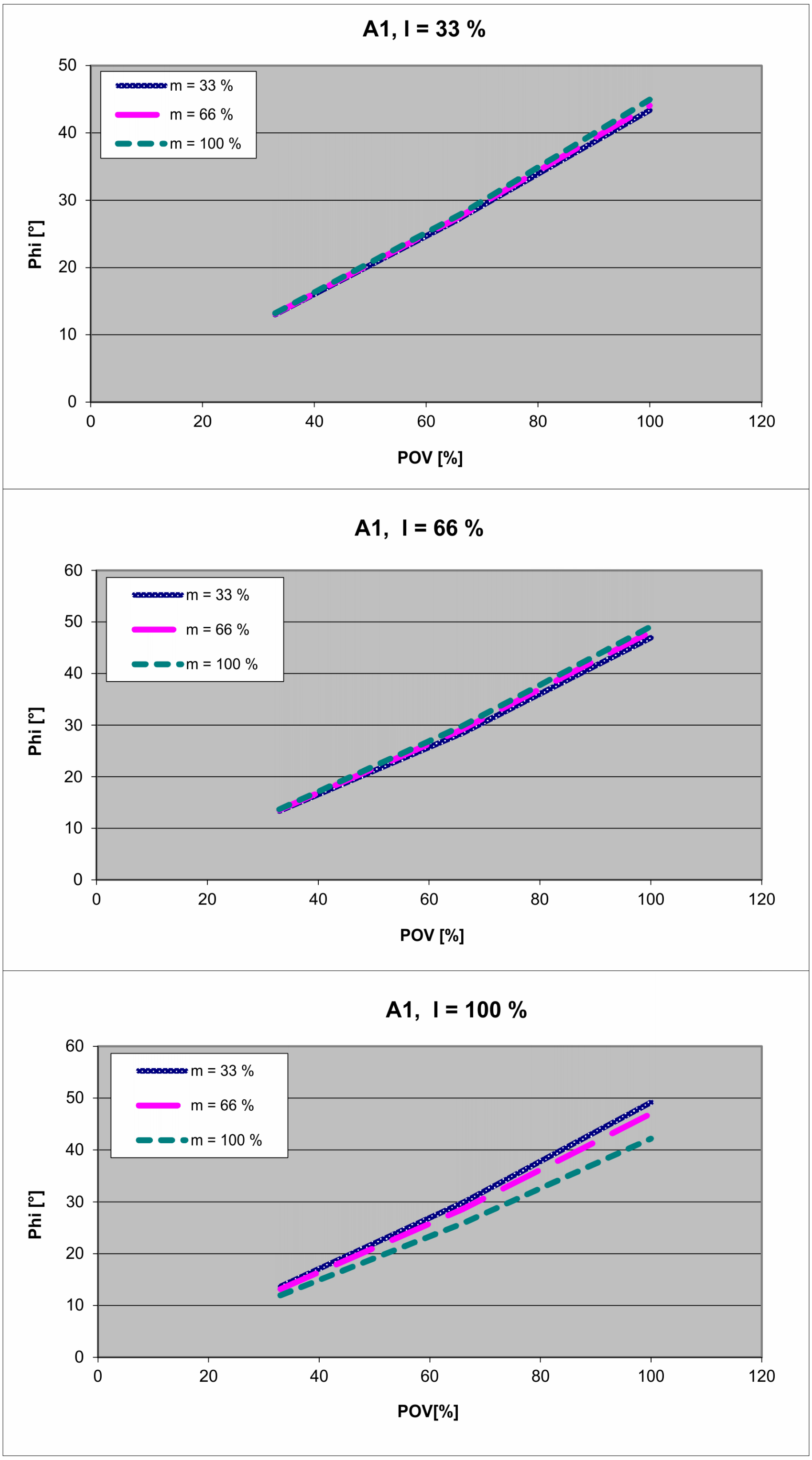


Fig. 4-57: Stopping distances for STOP 1, axis 1

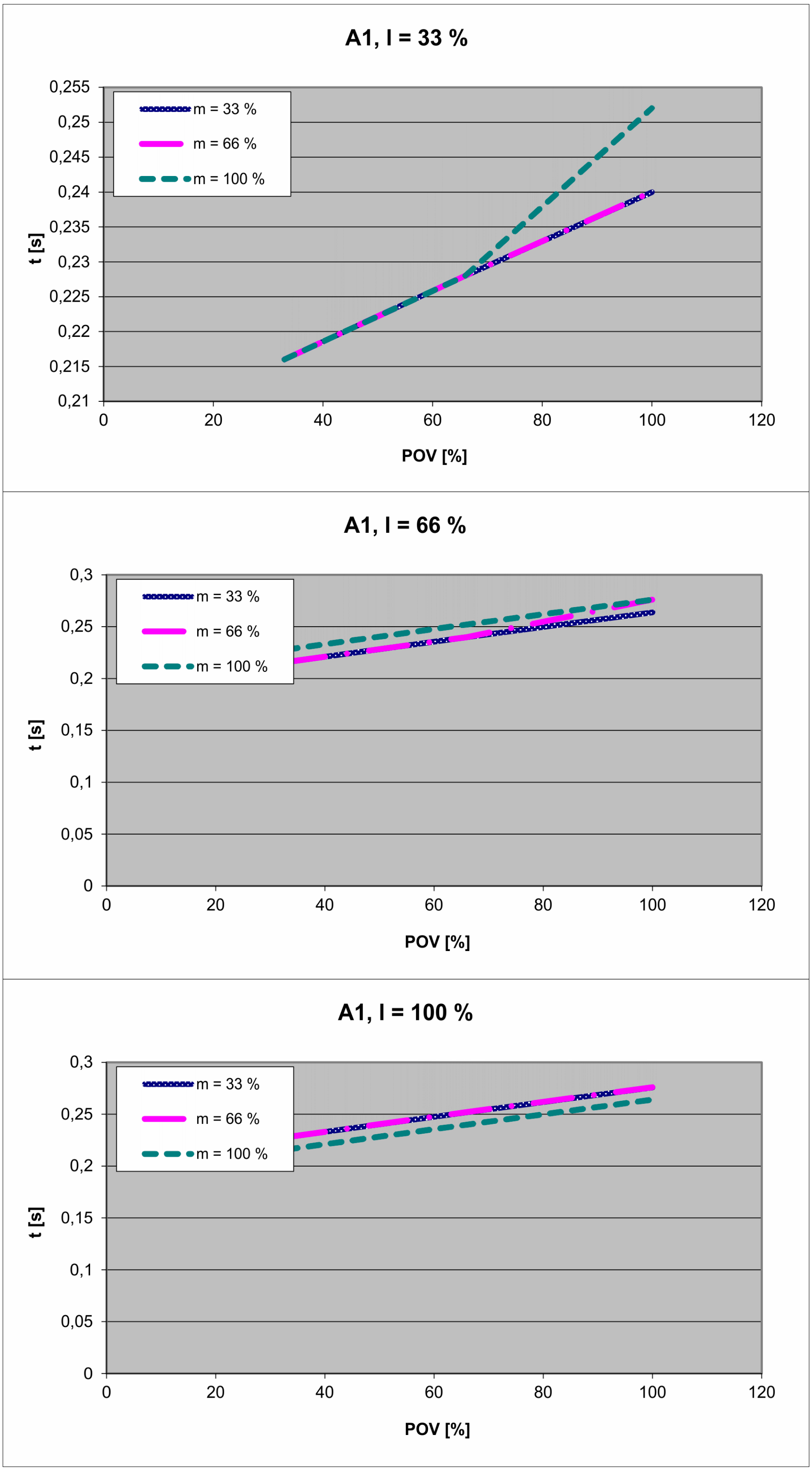


Fig. 4-58: Stopping times for STOP 1, axis 1

4.9.5.3 Stopping distances and stopping times for STOP 1, axis 2

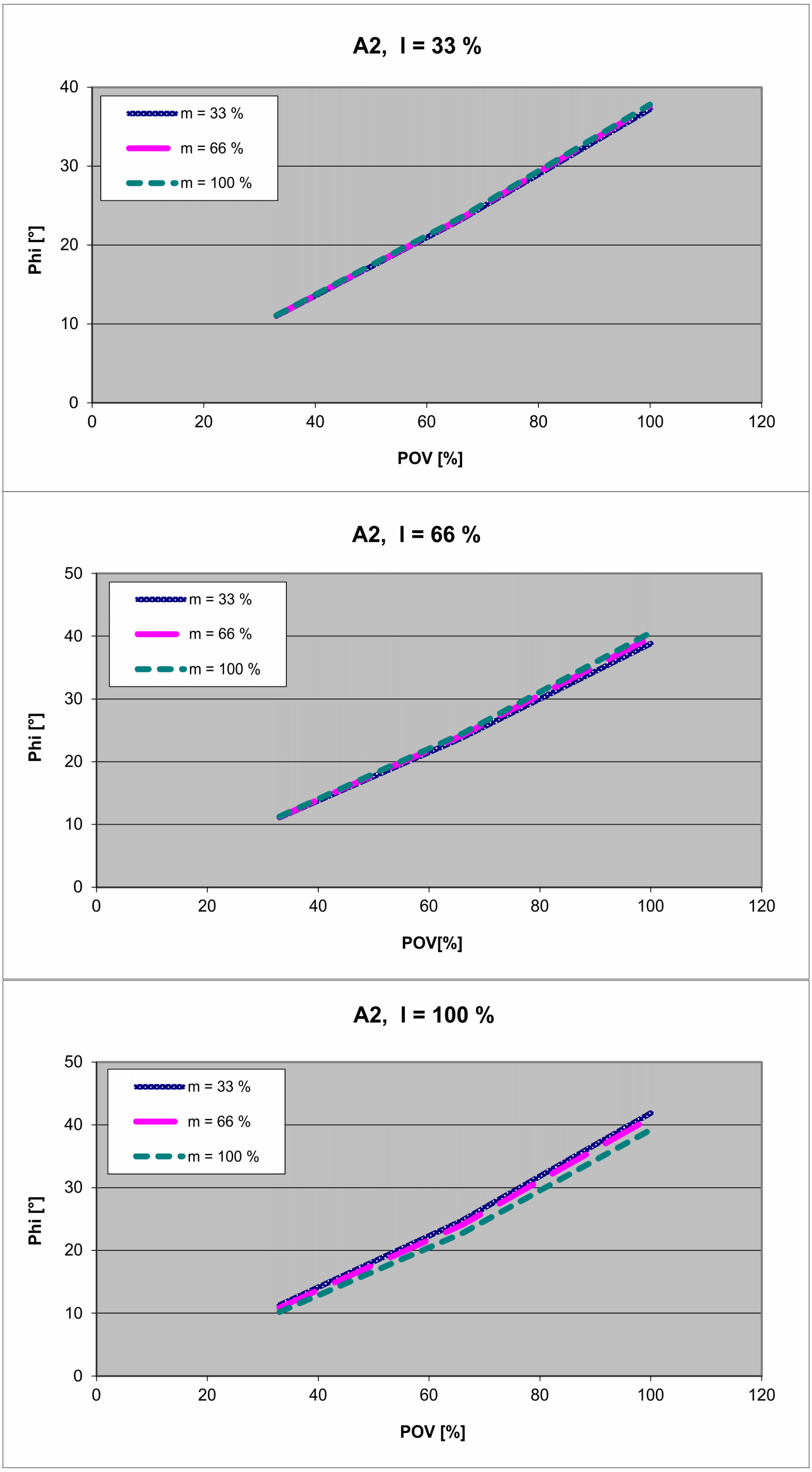


Fig. 4-59: Stopping distances for STOP 1, axis 2

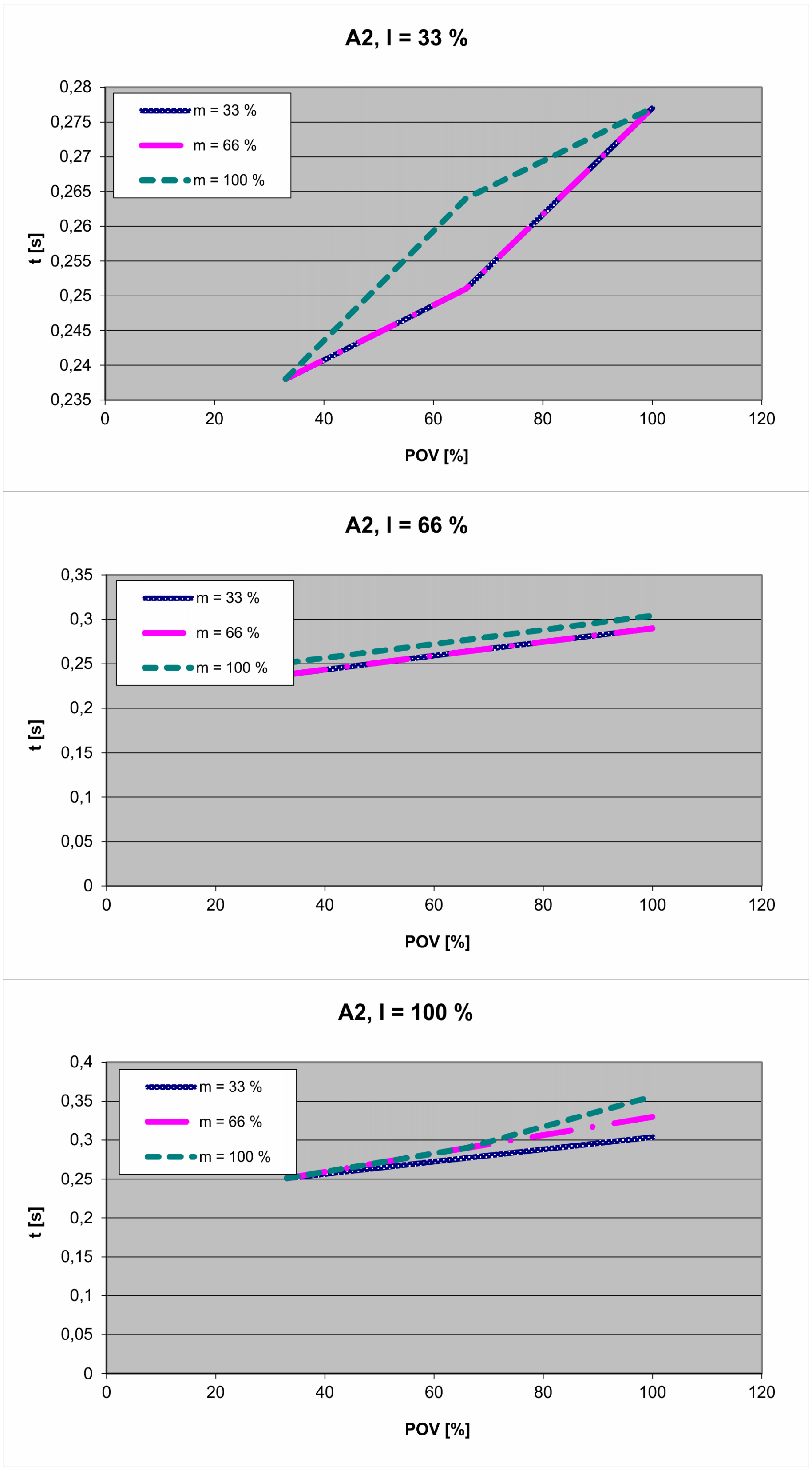


Fig. 4-60: Stopping times for STOP 1, axis 2

4.9.5.4 Stopping distances and stopping times for STOP 1, axis 3

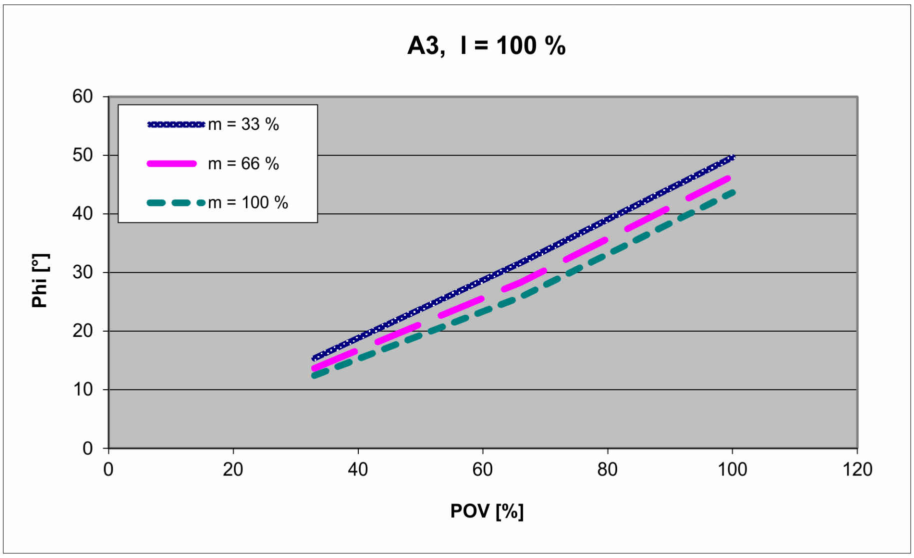


Fig. 4-61: Stopping distances for STOP 1, axis 3

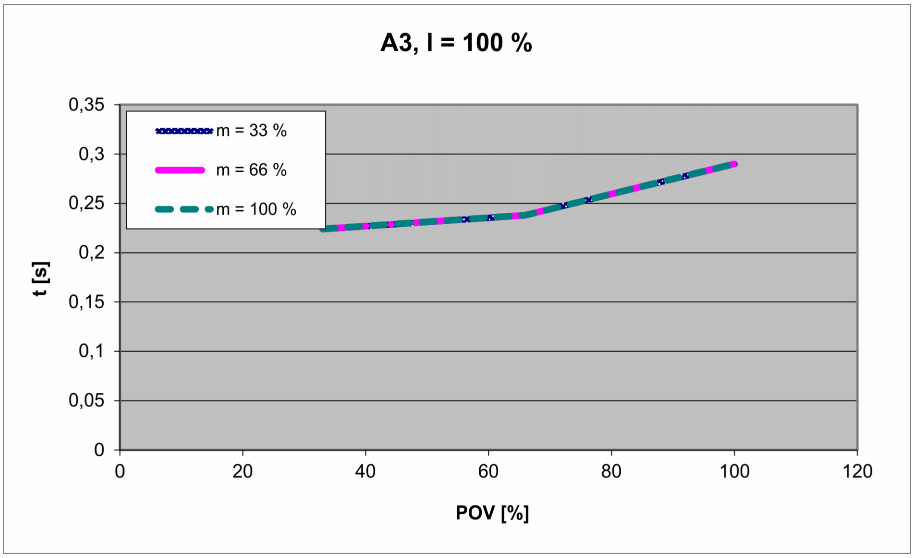


Fig. 4-62: Stopping times for STOP 1, axis 3

4.9.6 Stopping distances and times, KR 10 R1100-2

4.9.6.1 Stopping distances and stopping times for STOP 0, axis 1 to axis 3

The table shows the stopping distances and stopping times after a STOP 0 (category 0 stop) is triggered. The values refer to the following configuration:

- Extension l = 100%
- Program override POV = 100%
- Mass m = maximum load (rated load + supplementary load on arm)

	Stopping distance (°)	Stopping time (s)
Axis 1	28.77	0.22
Axis 2	23.55	0.22

	Stopping distance (°)	Stopping time (s)
Axis 3	28.47	0.17

4.9.6.2 Stopping distances and stopping times for STOP 1, axis 1

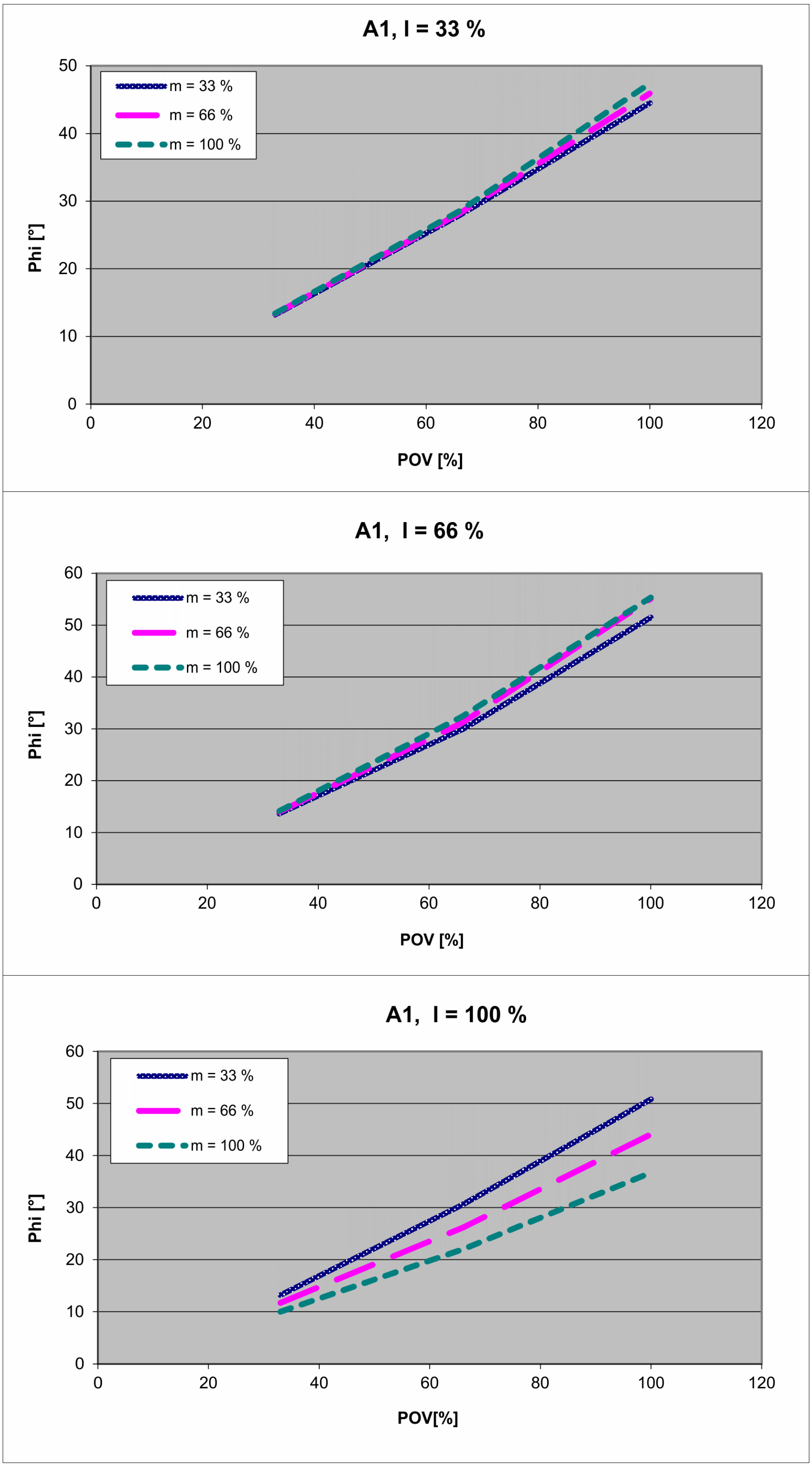


Fig. 4-63: Stopping distances for STOP 1, axis 1

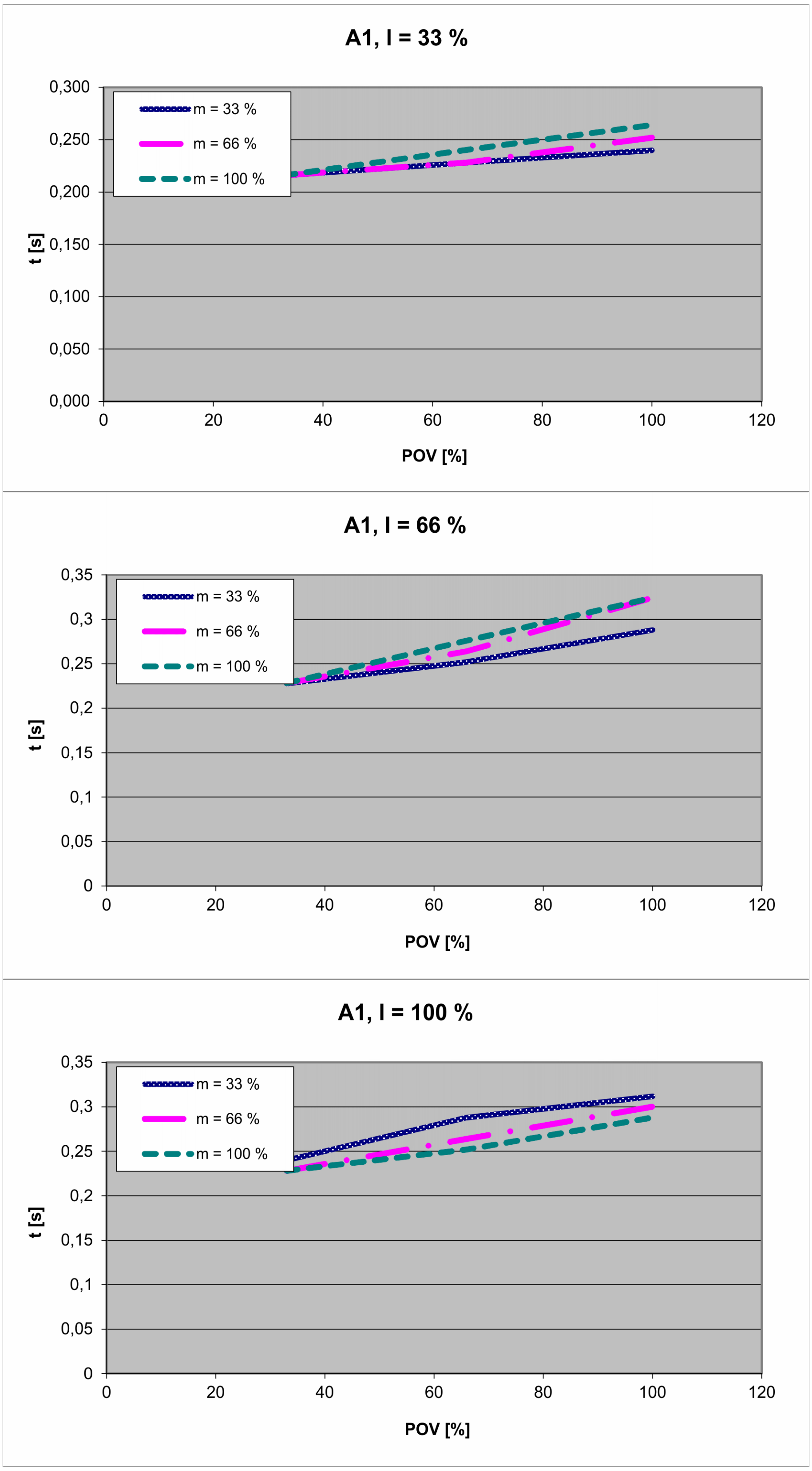


Fig. 4-64: Stopping times for STOP 1, axis 1

4.9.6.3 Stopping distances and stopping times for STOP 1, axis 2

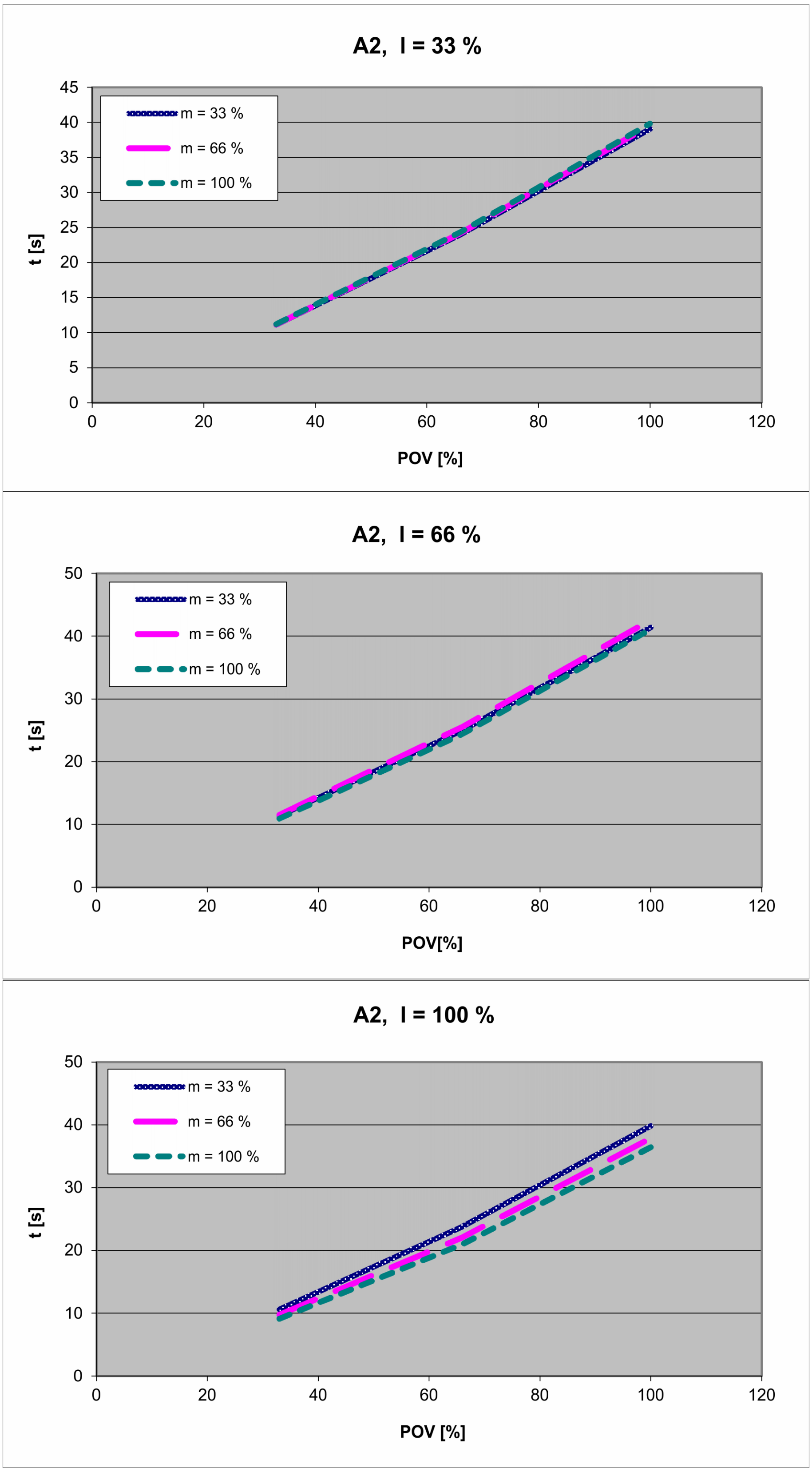


Fig. 4-65: Stopping distances for STOP 1, axis 2

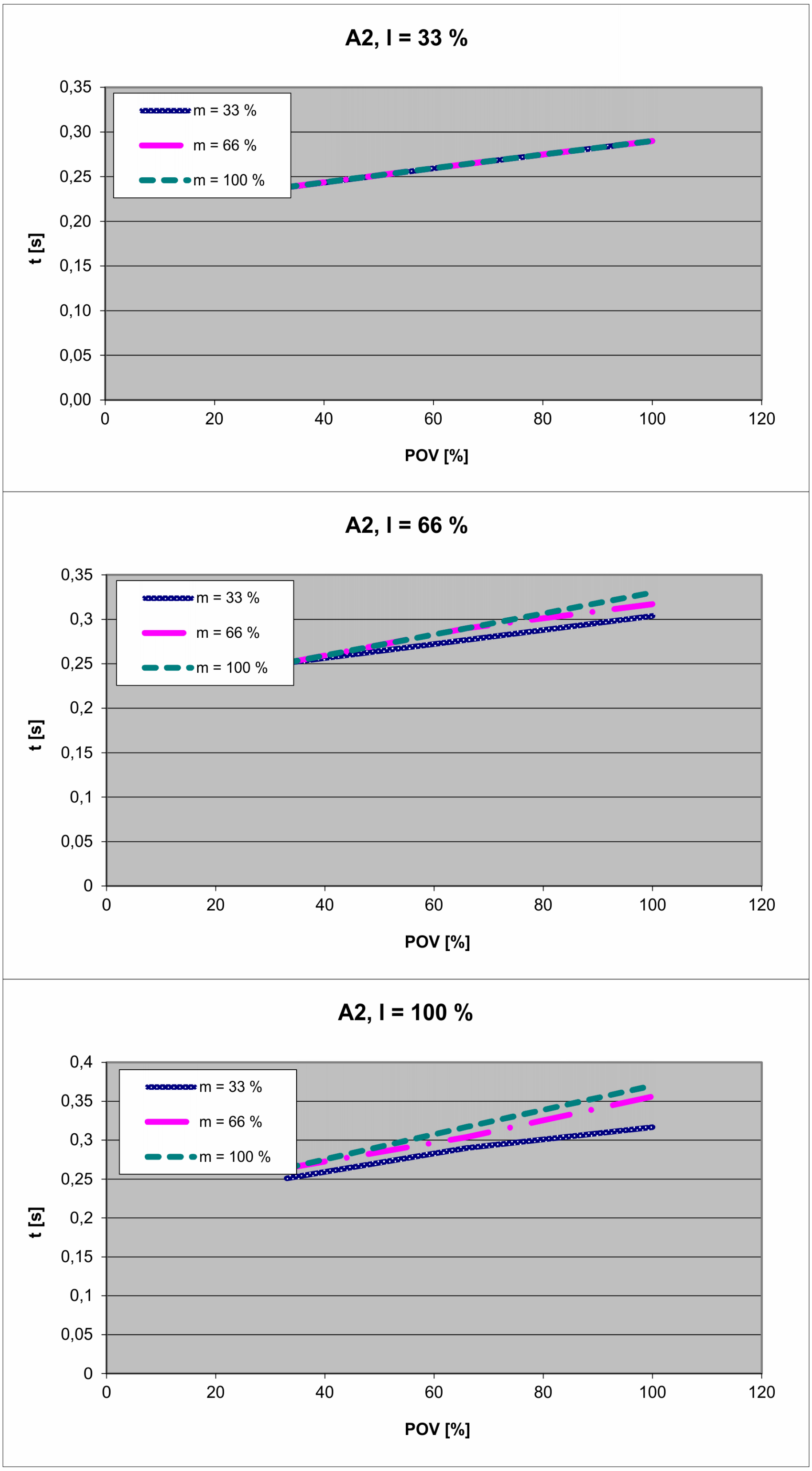


Fig. 4-66: Stopping times for STOP 1, axis 2

4.9.6.4 Stopping distances and stopping times for STOP 1, axis 3

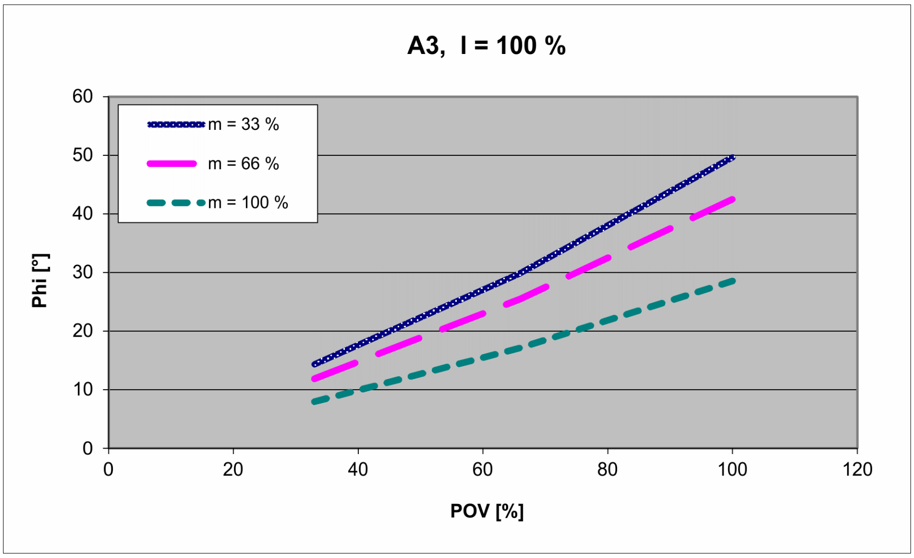


Fig. 4-67: Stopping distances for STOP 1, axis 3

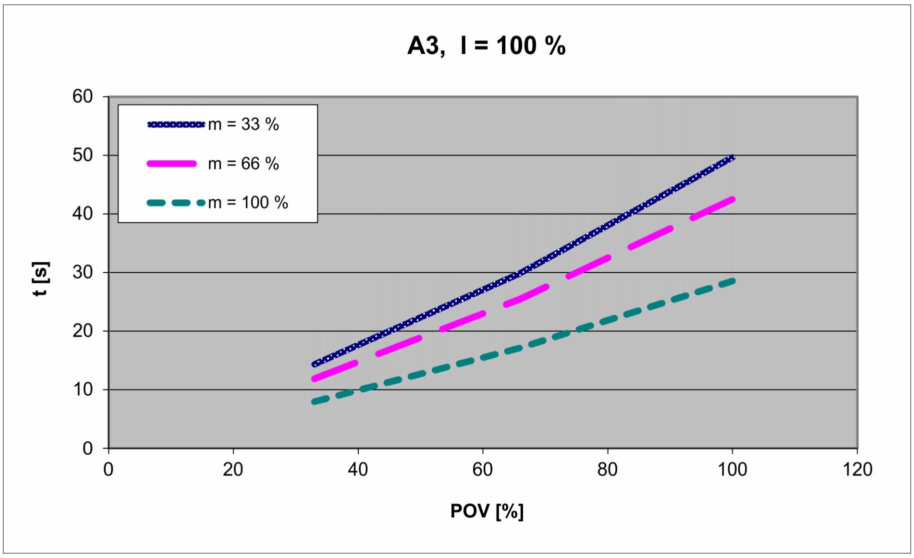


Fig. 4-68: Stopping times for STOP 1, axis 3

5 Safety

5.1 General

- This “Safety” chapter refers to a mechanical component of an industrial robot.
- If the mechanical component is used together with a KUKA robot controller, the “Safety” chapter of the operating instructions or assembly instructions of the robot controller must be used!

  This contains all the information provided in this “Safety” chapter. It also contains additional safety information relating to the robot controller which must be observed.
- Where this “Safety” chapter uses the term “industrial robot”, this also refers to the individual mechanical component if applicable.

5.1.1 Liability

The device described in this document is either an industrial robot or a component thereof.

Components of the industrial robot:

- Manipulator
- Robot controller
- Teach pendant
- Connecting cables
- External axes (optional)

  e.g. linear unit, turn-tilt table, positioner
- Software
- Options, accessories

The industrial robot is built using state-of-the-art technology and in accordance with the recognized safety rules. Nevertheless, misuse of the industrial robot may constitute a risk to life and limb or cause damage to the industrial robot and to other material property.

The industrial robot may only be used in perfect technical condition in accordance with its designated use and only by safety-conscious persons who are fully aware of the risks involved in its operation. Use of the industrial robot is subject to compliance with this document and with the declaration of incorporation supplied together with the industrial robot. Any functional disorders affecting safety must be rectified immediately.

Safety information

Information about safety may not be construed against KUKA Deutschland GmbH. Even if all safety instructions are followed, this is not a guarantee that the industrial robot will not cause personal injuries or material damage.

No modifications may be carried out to the industrial robot without the authorization of KUKA Deutschland GmbH. Additional components (tools, software, etc.), not supplied by KUKA Deutschland GmbH, may be integrated into the industrial robot. The user is liable for any damage these components may cause to the industrial robot or to other material property.

In addition to the Safety chapter, this document contains further safety instructions. These must also be observed.

5.1.2 Intended use of the industrial robot

The industrial robot is intended exclusively for the use designated in the "Purpose" chapter of the operating instructions or assembly instructions.

Any use or application deviating from the intended use is deemed to be misuse and is not allowed. The manufacturer is not liable for any damage resulting from such misuse. The risk lies entirely with the user.

Operation of the industrial robot in accordance with its intended use also requires compliance with the operating and assembly instructions for the individual components, with particular reference to the maintenance specifications.

Misuse

Any use or application deviating from the intended use is deemed to be misuse and is not allowed. This includes e.g.:

- Use as a climbing aid
- Operation outside the specified operating parameters
- Operation without the required safety equipment

5.1.3 EC declaration of conformity and declaration of incorporation

The industrial robot constitutes partly completed machinery as defined by the EC Machinery Directive. The industrial robot may only be put into operation if the following preconditions are met:

- The industrial robot is integrated into a complete system.

  or: The industrial robot, together with other machinery, constitutes a complete system.

  or: All safety functions and safeguards required for operation in the complete machine as defined by the EC Machinery Directive have been added to the industrial robot.
- The complete system complies with the EC Machinery Directive. This has been confirmed by means of a conformity assessment procedure.

EC declaration of conformity

The system integrator must issue an EC declaration of conformity for the complete system in accordance with the Machinery Directive. The EC declaration of conformity forms the basis for the CE mark for the system. The industrial robot must always be operated in accordance with the applicable national laws, regulations and standards.

The robot controller has a CE mark in accordance with the EMC Directive and the Low Voltage Directive.

Declaration of incorporation

The partly completed machinery is supplied with a declaration of incorporation in accordance with Annex II B of the Machinery Directive 2006/42/EC. The assembly instructions and a list of essential requirements complied with in accordance with Annex I are integral parts of this declaration of incorporation.

The declaration of incorporation declares that the start-up of the partly completed machinery is not allowed until the partly completed machinery has been incorporated into machinery, or has been assembled with other parts to form machinery, and this machinery complies with the terms of the EC Machinery Directive, and the EC declaration of conformity is present in accordance with Annex II A.

5.1.4 Terms used

Term	Description
Axis range	Range of each axis, in degrees or millimeters, within which it may move. The axis range must be defined for each axis.
Stopping distance	Stopping distance = reaction distance + braking distance The stopping distance is part of the danger zone.
Workspace	The manipulator is allowed to move within its workspace. The workspace is derived from the individual axis ranges.
Operator (User)	The user of the industrial robot can be the management, employer or delegated person responsible for use of the industrial robot.
Danger zone	The danger zone consists of the workspace and the stopping distances.
Service life	The service life of a safety-relevant component begins at the time of delivery of the component to the customer. The service life is not affected by whether the component is used in a controller or elsewhere or not, as safety-relevant components are also subject to aging during storage
KCP	KUKA Control Panel Teach pendant for the KR C2/KR C2 edition2005 The KCP has all the operator control and display functions required for operating and programming the industrial robot.
KUKA smartPAD	see “smartPAD”
KUKA smartPAD-2	
Manipulator	The robot arm and the associated electrical installations
Safety zone	The safety zone is situated outside the danger zone.
Safety options	Generic term for options which make it possible to configure additional safe monitoring functions in addition to the standard safety functions. Example: SafeOperation
smartPAD	Teach pendant for the KR C4 The smartPAD has all the operator control and display functions required for operating and programming the industrial robot. 2 models exist: • smartPAD • smartPAD-2 In turn, for each model there are variants, e.g. with different lengths of connecting cables. The designation “KUKA smartPAD” or “smartPAD” refers to both models unless an explicit distinction is made.
Stop category 0	The drives are deactivated immediately and the brakes are applied. The manipulator and any external axes (optional) perform path-oriented braking. **Note:** This stop category is called STOP 0 in this document.
Stop category 1	The manipulator and any external axes (optional) perform path-maintaining braking. The drives are deactivated after 1 s and the brakes are applied. **Note:** This stop category is called STOP 1 in this document.

Term	Description
Stop category 2	The drives are not deactivated and the brakes are not applied. The manipulator and any external axes (optional) are braked with a normal braking ramp. **Note:** This stop category is called STOP 2 in this document.
System integrator (plant integrator)	System integrators are people who safely integrate the industrial robot into a complete system and commission it.
T1	Test mode, Manual Reduced Velocity (<= 250 mm/s)
T2	Test mode, Manual High Velocity (> 250 mm/s permissible)
External axis	Axis of motion that does not belong to the manipulator, yet is controlled with the same controller. e.g. KUKA linear unit, turn-tilt table, Posiflex

5.2 Personnel

The following persons or groups of persons are defined for the industrial robot:

- User
- Personnel

> ⚠ All persons working with the industrial robot must have read and understood the industrial robot documentation, including the safety chapter.

User

The user must observe the labor laws and regulations. This includes e.g.:

- The user must comply with his monitoring obligations.
- The user must carry out briefing at defined intervals.

Personnel

Personnel must be instructed, before any work is commenced, in the type of work involved and what exactly it entails as well as any hazards which may exist. Instruction must be carried out regularly. Instruction is also required after particular incidents or technical modifications.

Personnel includes:

- System integrator
- Operators, subdivided into:
  - Start-up, maintenance and service personnel
  - Operating personnel
  - Cleaning personnel

> ⚠ Installation, exchange, adjustment, operation, maintenance and repair must be performed only as specified in the operating or assembly instructions for the relevant component of the industrial robot and only by personnel specially trained for this purpose.

System integrator

The industrial robot is safely integrated into a complete system by the system integrator.

The system integrator is responsible for the following tasks:

- Installing the industrial robot
- Connecting the industrial robot
- Performing risk assessment
- Implementing the required safety functions and safeguards
- Issuing the EC declaration of conformity
- Attaching the CE mark
- Creating the operating instructions for the system

Operators

The operator must meet the following preconditions:

- The operator must be trained for the work to be carried out.
- Work on the system must only be carried out by qualified personnel. These are people who, due to their specialist training, knowledge and experience, and their familiarization with the relevant standards, are able to assess the work to be carried out and detect any potential hazards.

⚠ Work on the electrical and mechanical equipment of the industrial robot may only be carried out by specially trained personnel.

5.3 Workspace, safety zone and danger zone

Workspaces are to be restricted to the necessary minimum size. A workspace must be safeguarded using appropriate safeguards.

The safeguards (e.g. safety gate) must be situated inside the safety zone. In the case of a stop, the manipulator and external axes (optional) are braked and come to a stop within the danger zone.

The danger zone consists of the workspace and the stopping distances of the manipulator and external axes (optional). It must be safeguarded by means of physical safeguards to prevent danger to persons or the risk of material damage.

5.4 Overview of protective equipment

The protective equipment of the mechanical component may include:

- Mechanical end stops
- Mechanical axis limitation (optional)
- Release device (optional)
- Brake release device (optional)
- Labeling of danger areas

Not all equipment is relevant for every mechanical component.

5.4.1 Mechanical end stops

Depending on the robot variant, the axis ranges of the main and wrist axes of the manipulator are partially limited by mechanical end stops.

Additional mechanical end stops can be installed on the external axes.

WARNING

If the manipulator or an external axis hits an obstruction or a mechanical end stop or mechanical axis limitation, the manipulator can no longer be operated safely. The manipulator must be taken out of operation and KUKA Deutschland GmbH must be consulted before it is put back into operation.

5.4.2 Mechanical axis limitation (optional)

Some manipulators can be fitted with mechanical axis limitation systems in axes A1 to A3. The axis limitation systems restrict the working range to the required minimum. This increases personal safety and protection of the system.

In the case of manipulators that are not designed to be fitted with mechanical axis limitation, the workspace must be laid out in such a way that there is no danger to persons or material property, even in the absence of mechanical axis limitation.

If this is not possible, the workspace must be limited by means of photoelectric barriers, photoelectric curtains or obstacles on the system side. There must be no shearing or crushing hazards at the loading and transfer areas.

This option is not available for all robot models. Information on specific robot models can be obtained from KUKA Deutschland GmbH.

5.4.3 Options for moving the manipulator without drive energy

The system user is responsible for ensuring that the training of personnel with regard to the response to emergencies or exceptional situations also includes how the manipulator can be moved without drive energy.

Description

The following options are available for moving the manipulator without drive energy after an accident or malfunction:

- Release device (optional)

  The release device can be used for the main axis drive motors and, depending on the robot variant, also for the wrist axis drive motors.
- Brake release device (option)

  The brake release device is designed for robot variants whose motors are not freely accessible.
- Moving the wrist axes directly by hand

  There is no release device available for the wrist axes of variants in the low payload category. This is not necessary because the wrist axes can be moved directly by hand.

Information about the options available for the various robot models and about how to use them can be found in the assembly and operating instructions for the robot or requested from KUKA Deutschland GmbH.

NOTICE

Moving the manipulator without drive energy can damage the motor brakes of the axes concerned. The motor must be replaced if the brake has been damaged. The manipulator may therefore be moved without drive energy only in emergencies, e.g. for rescuing persons.

5.4.4 Labeling on the industrial robot

All plates, labels, symbols and marks constitute safety-relevant parts of the industrial robot. They must not be modified or removed.

Labeling on the industrial robot consists of:

- Identification plates
- Warning signs
- Safety symbols
- Designation labels
- Cable markings
- Rating plates

Further information is contained in the technical data of the operating instructions or assembly instructions of the components of the industrial robot.

5.5 Safety measures

5.5.1 General safety measures

The industrial robot may only be used in perfect technical condition in accordance with its intended use and only by safety-conscious persons. Operator errors can result in personal injury and damage to property.

It is important to be prepared for possible movements of the industrial robot even after the robot controller has been switched off and locked out. Incorrect installation (e.g. overload) or mechanical defects (e.g. brake defect) can cause the manipulator or external axes to sag. If work is to be carried out on a switched-off industrial robot, the manipulator and external axes must first be moved into a position in which they are unable to move on their own, whether the payload is mounted or not. If this is not possible, the manipulator and external axes must be secured by appropriate means.

DANGER

In the absence of operational safety functions and safeguards, the industrial robot can cause personal injury or material damage. If safety functions or safeguards are dismantled or deactivated, the industrial robot may not be operated.

DANGER

Standing underneath the robot arm can cause death or injuries. For this reason, standing underneath the robot arm is prohibited!

CAUTION

The motors reach temperatures during operation which can cause burns to the skin. Contact must be avoided. Appropriate safety precautions must be taken, e.g. protective gloves must be worn.

KCP/smartPAD

The user must ensure that the industrial robot is only operated with the KCP/smartPAD by authorized persons.

If more than one KCP/smartPAD is used in the overall system, it must be ensured that each device is unambiguously assigned to the corresponding industrial robot. They must not be interchanged.

WARNING

The operator must ensure that decoupled KCPs/smartPADs are immediately removed from the system and stored out of sight and reach of personnel working on the industrial robot. This serves to prevent operational and non-operational EMERGENCY STOP devices from becoming interchanged.
Failure to observe this precaution may result in death, severe injuries or considerable damage to property.

External keyboard, external mouse

An external keyboard and/or external mouse may only be used if the following conditions are met:

- Start-up or maintenance work is being carried out.
- The drives are switched off.
- There are no persons in the danger zone.

The KCP/smartPAD must not be used as long as an external keyboard and/or external mouse are connected to the control cabinet.

The external keyboard and/or external mouse must be removed from the control cabinet as soon as the start-up or maintenance work is completed or the KCP/smartPAD is connected.

Modifications

After modifications to the industrial robot, checks must be carried out to ensure the required safety level. The valid national or regional work safety regulations must be observed for this check. The correct functioning of all safety functions must also be tested.

New or modified programs must always be tested first in Manual Reduced Velocity mode (T1).

After modifications to the industrial robot, existing programs must always be tested first in Manual Reduced Velocity mode (T1). This applies to all components of the industrial robot and includes e.g. modifications of the external axes or to the software and configuration settings.

Faults

The following tasks must be carried out in the case of faults in the industrial robot:

- Switch off the robot controller and secure it (e.g. with a padlock) to prevent unauthorized persons from switching it on again.
- Indicate the fault by means of a label with a corresponding warning (tagout).
- Keep a record of the faults.
- Eliminate the fault and carry out a function test.

5.5.2 Transportation

Manipulator

The prescribed transport position of the manipulator must be observed. Transportation must be carried out in accordance with the operating instructions or assembly instructions of the robot.

Avoid vibrations and impacts during transportation in order to prevent damage to the manipulator.

Robot controller

The prescribed transport position of the robot controller must be observed. Transportation must be carried out in accordance with the operating instructions or assembly instructions of the robot controller.

Avoid vibrations and impacts during transportation in order to prevent damage to the robot controller.

External axis (optional)

The prescribed transport position of the external axis (e.g. KUKA linear unit, turn-tilt table, positioner) must be observed. Transportation must be carried out in accordance with the operating instructions or assembly instructions of the external axis.

5.5.3 Start-up and recommissioning

Before starting up systems and devices for the first time, a check must be carried out to ensure that the systems and devices are complete and operational, that they can be operated safely and that any damage is detected.

The valid national or regional work safety regulations must be observed for this check. The correct functioning of all safety circuits must also be tested.

⚠ The passwords for logging onto the KUKA System Software as “Expert” and “Administrator” must be changed before start-up and must only be communicated to authorized personnel.

⚠ **WARNING**

The robot controller is preconfigured for the specific industrial robot. If cables are interchanged, the manipulator and the external axes (optional) may receive incorrect data and can thus cause personal injury or material damage. If a system consists of more than one manipulator, always connect the connecting cables to the manipulators and their corresponding robot controllers.

⚠ If additional components (e.g. cables), which are not part of the scope of supply of KUKA Deutschland GmbH, are integrated into the industrial robot, the user is responsible for ensuring that these components do not adversely affect or disable safety functions.

NOTICE

If the internal cabinet temperature of the robot controller differs greatly from the ambient temperature, condensation can form, which may cause damage to the electrical components. Do not put the robot controller into operation until the internal temperature of the cabinet has adjusted to the ambient temperature.

Function test

The following tests must be carried out before start-up and recommissioning:

It must be ensured that:

- The industrial robot is correctly installed and fastened in accordance with the specifications in the documentation.

- There is no damage to the robot that could be attributed to external forces. Example: Dents or abrasion that could be caused by an impact or collision.

WARNING
In the case of such damage, the affected components must be exchanged. In particular, the motor and counterbalancing system must be checked carefully. External forces can cause non-visible damage. For example, it can lead to a gradual loss of drive power from the motor, resulting in unintended movements of the manipulator. Death, injuries or considerable damage to property may otherwise result.

- There are no foreign bodies or loose parts on the industrial robot.
- All required safety equipment is correctly installed and operational.
- The power supply ratings of the industrial robot correspond to the local supply voltage and mains type.
- The ground conductor and the equipotential bonding cable are sufficiently rated and correctly connected.
- The connecting cables are correctly connected and the connectors are locked.

5.5.4 Manual mode

Manual mode is the mode for setup work. Setup work is all the tasks that have to be carried out on the industrial robot to enable automatic operation. Setup work includes:

- Jog mode
- Teaching
- Programming
- Program verification

The following must be taken into consideration in manual mode:

- If the drives are not required, they must be switched off to prevent the manipulator or the external axes (optional) from being moved unintentionally.
- New or modified programs must always be tested first in Manual Reduced Velocity mode (T1).
- The manipulator, tooling or external axes (optional) must never touch or project beyond the safety fence.
- Workpieces, tooling and other objects must not become jammed as a result of the industrial robot motion, nor must they lead to short-circuits or be liable to fall off.
- All setup work must be carried out, where possible, from outside the safeguarded area.

If the setup work has to be carried out inside the safeguarded area, the following must be taken into consideration:

In **Manual Reduced Velocity mode (T1)**:

- If it can be avoided, there must be no other persons inside the safeguarded area.

  If it is necessary for there to be several persons inside the safeguarded area, the following must be observed:

  – Each person must have an enabling device.

  - All persons must have an unimpeded view of the industrial robot.
  - Eye-contact between all persons must be possible at all times.
- The operator must be so positioned that he can see into the danger area and get out of harm's way.

In **Manual High Velocity mode (T2)**:

- This mode may only be used if the application requires a test at a velocity higher than possible in T1 mode.
- Teaching and programming are not permissible in this operating mode.
- Before commencing the test, the operator must ensure that the enabling devices are operational.
- The operator must be positioned outside the danger zone.
- There must be no other persons inside the safeguarded area. It is the responsibility of the operator to ensure this.

5.5.5 Automatic mode

Automatic mode is only permissible in compliance with the following safety measures:

- All safety equipment and safeguards are present and operational.
- There are no persons in the system.
- The defined working procedures are adhered to.

If the manipulator or an external axis (optional) comes to a standstill for no apparent reason, the danger zone must not be entered until an EMERGENCY STOP has been triggered.

5.5.6 Maintenance and repair

After maintenance and repair work, checks must be carried out to ensure the required safety level. The valid national or regional work safety regulations must be observed for this check. The correct functioning of all safety functions must also be tested.

The purpose of maintenance and repair work is to ensure that the system is kept operational or, in the event of a fault, to return the system to an operational state. Repair work includes troubleshooting in addition to the actual repair itself.

The following safety measures must be carried out when working on the industrial robot:

- Carry out work outside the danger zone. If work inside the danger zone is necessary, the user must define additional safety measures to ensure the safe protection of personnel.
- Switch off the industrial robot and secure it (e.g. with a padlock) to prevent it from being switched on again. If it is necessary to carry out work with the robot controller switched on, the user must define additional safety measures to ensure the safe protection of personnel.
- If it is necessary to carry out work with the robot controller switched on, this may only be done in operating mode T1.
- Label the system with a sign indicating that work is in progress. This sign must remain in place, even during temporary interruptions to the work.
- The EMERGENCY STOP devices must remain active. If safety functions or safeguards are deactivated during maintenance or repair work, they must be reactivated immediately after the work is completed.

DANGER

Before work is commenced on live parts of the robot system, the main switch must be turned off and secured against being switched on again. The system must then be checked to ensure that it is deenergized.
It is not sufficient, before commencing work on live parts, to execute an EMERGENCY STOP or a safety stop, or to switch off the drives, as this does not disconnect the robot system from the mains power supply. Parts remain energized. Death or severe injuries may result.

Faulty components must be replaced using new components with the same article numbers or equivalent components approved by KUKA Deutschland GmbH for this purpose.

Cleaning and preventive maintenance work is to be carried out in accordance with the operating instructions.

Robot controller

Even when the robot controller is switched off, parts connected to peripheral devices may still carry voltage. The external power sources must therefore be switched off if work is to be carried out on the robot controller.

The ESD regulations must be adhered to when working on components in the robot controller.

Voltages in excess of 50 V (up to 600 V) can be present in various components for several minutes after the robot controller has been switched off! To prevent life-threatening injuries, no work may be carried out on the industrial robot in this time.

Water and dust must be prevented from entering the robot controller.

Counterbalancing system

Some robot variants are equipped with a hydropneumatic, spring or gas cylinder counterbalancing system.

The hydropneumatic and gas cylinder counterbalancing systems are pressure equipment and, as such, are subject to obligatory equipment monitoring and the provisions of the Pressure Equipment Directive.

The user must comply with the applicable national laws, regulations and standards pertaining to pressure equipment.

Inspection intervals in Germany in accordance with Industrial Safety Order, Sections 14 and 15. Inspection by the user before commissioning at the installation site.

The following safety measures must be carried out when working on the counterbalancing system:

- The manipulator assemblies supported by the counterbalancing systems must be secured.
- Work on the counterbalancing systems must only be carried out by qualified personnel.

Hazardous substances

The following safety measures must be carried out when handling hazardous substances:

- Avoid prolonged and repeated intensive contact with the skin.
- Avoid breathing in oil spray or vapors.
- Clean skin and apply skin cream.

⚠ To ensure safe use of our products, we recommend regularly requesting up-to-date safety data sheets for hazardous substances.

5.5.7 Decommissioning, storage and disposal

The industrial robot must be decommissioned, stored and disposed of in accordance with the applicable national laws, regulations and standards.

5.6 Applied norms and regulations

Name/Edition	Definition
2006/42/EC:2006	**Machinery Directive:** Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)
2014/68/EU:2014	**Pressure Equipment Directive**: Directive 2014/68/EU of the European Parliament and of the Council dated 15 May 2014 on the approximation of the laws of the Member States concerning pressure equipment (Only applicable for robots with hydropneumatic counterbalancing system.)
EN ISO 13850:2015	**Safety of machinery:** Emergency stop - Principles for design
EN ISO 13849-1:2015	**Safety of machinery:** Safety-related parts of control systems - Part 1: General principles of design
EN ISO 13849-2:2012	**Safety of machinery:** Safety-related parts of control systems - Part 2: Validation
EN ISO 12100:2010	**Safety of machinery:** General principles of design, risk assessment and risk reduction
EN ISO 10218-1:2011	**Industrial robots – Safety requirements:** Part 1: Robots **Note:** Content equivalent to **ANSI/RIA R.15.06-2012, Part 1**
EN 614-1:2006+A1:2009	**Safety of machinery:** Ergonomic design principles - Part 1: Terms and general principles
EN 61000-6-2:2005	**Electromagnetic compatibility (EMC):** Part 6-2: Generic standards; Immunity for industrial environments
EN 61000-6-4:2007 + A1:2011	**Electromagnetic compatibility (EMC):** Part 6-4: Generic standards; Emission standard for industrial environments

EN 60204-1:2006/ A1:2009	**Safety of machinery:** Electrical equipment of machines - Part 1: General requirements

6 Planning

6.1 Information for planning

In the planning and design phase, care must be taken regarding the functions or applications to be executed by the kinematic system. The following conditions can lead to premature wear. They necessitate shorter maintenance intervals and/or earlier exchange of components. In addition, the permissible operating parameters specified in the technical data must be taken into account and observed during planning.

- Continuous operation near temperature limits or in abrasive environments
- Continuous operation close to the performance limits, e.g. high rpm of an axis
- High duty cycle of individual axes
- Monotonous motion profiles, e.g. short, frequently recurring axis motions
- Static axis positions, e.g. continuous vertical position of a wrist axis
- External forces (process forces) acting on the robot

If one or more of these conditions are to apply during operation of the kinematic system, KUKA Deutschland GmbH must be consulted.

If the robot reaches its corresponding operation limit or if it is operated near the limit for a period of time, the built-in monitoring functions come into effect and the robot is automatically switched off.

This protective function can limit the availability of the robot system.

6.2 Mounting base

Description

The mounting base with centering is used when the robot is fastened to the floor, i.e. directly on a concrete foundation.

The mounting base with centering consists of:

- Bedplate
- Resin-bonded anchors (chemical anchors)
- Fastening elements

This mounting variant requires a level and smooth surface on a concrete foundation with adequate load bearing capacity. The concrete foundation must be able to accommodate the forces occurring during operation. There must be no layers of insulation or screed between the bedplate and the concrete foundation.

The minimum dimensions must be observed.

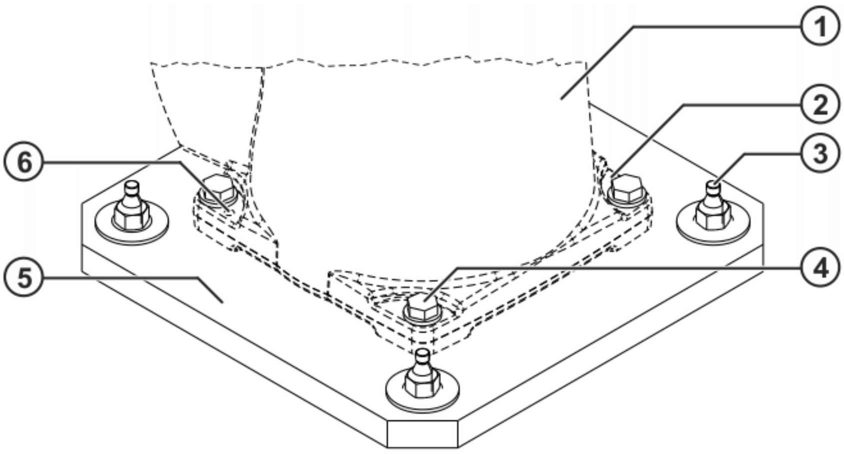


Fig. 6-1: Mounting base

1	Robot base frame	4	Hexagon bolt
2	Locating pin, cylindrical	5	Bedplate
3	Resin-bonded anchor	6	Locating pin, flat-sided

Grade of concrete for foundations

When producing foundations from concrete, observe the load-bearing capacity of the ground and the country-specific construction regulations. There must be no layers of insulation or screed between the bedplate/ bedplates and the concrete foundation. The quality of the concrete must meet the requirements of the following standard:

- C20/25 according to DIN EN 206-1:2001/DIN 1045-2:2008

Dimensioned drawing

The following illustration (>>> *Fig. 6-2*) provides all the necessary information on the mounting base, together with the required foundation data. The specified foundation dimensions refer to the safe transmission of the foundation loads into the foundation and not to the stability of the foundation.

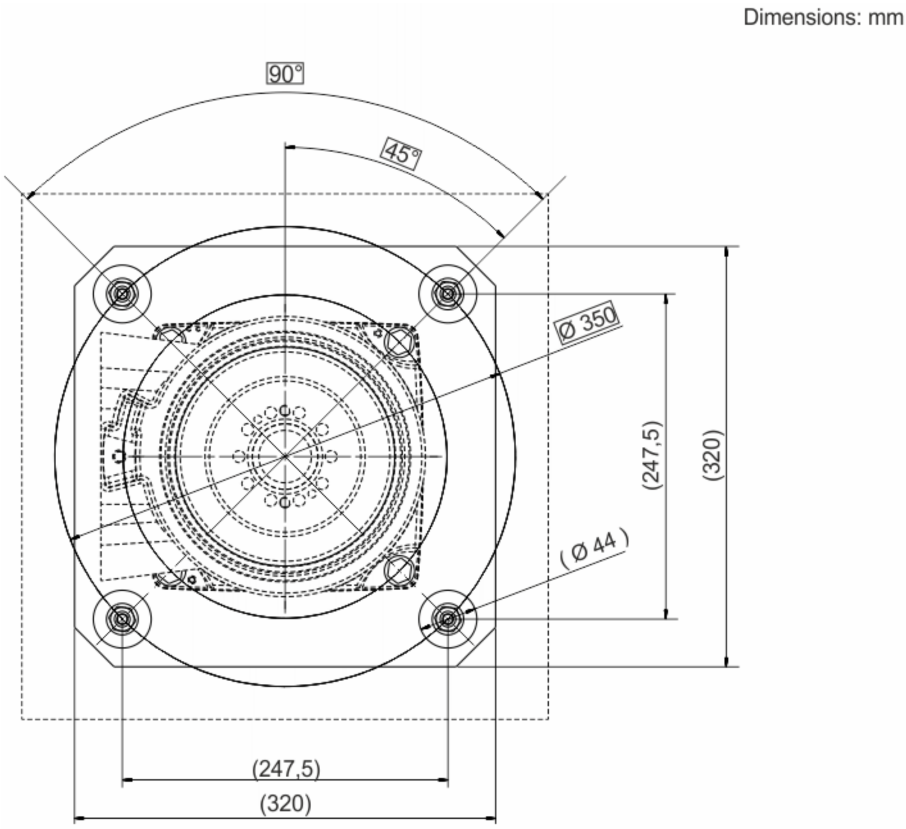


Fig. 6-2: Mounting base, dimensioned drawing

To ensure that the anchor forces are safely transmitted to the foundation, observe the dimensions for concrete foundations specified in the following illustration (>>> *Fig. 6-3*).

NOTICE
The dimensions specified for the distance to the edge are valid for non-reinforced or normally reinforced concrete without verification of concrete edge failure. For safety against concrete edge failure in accordance with ETAG 001 Annex C, the concrete foundation must be provided with an appropriate edge reinforcement.

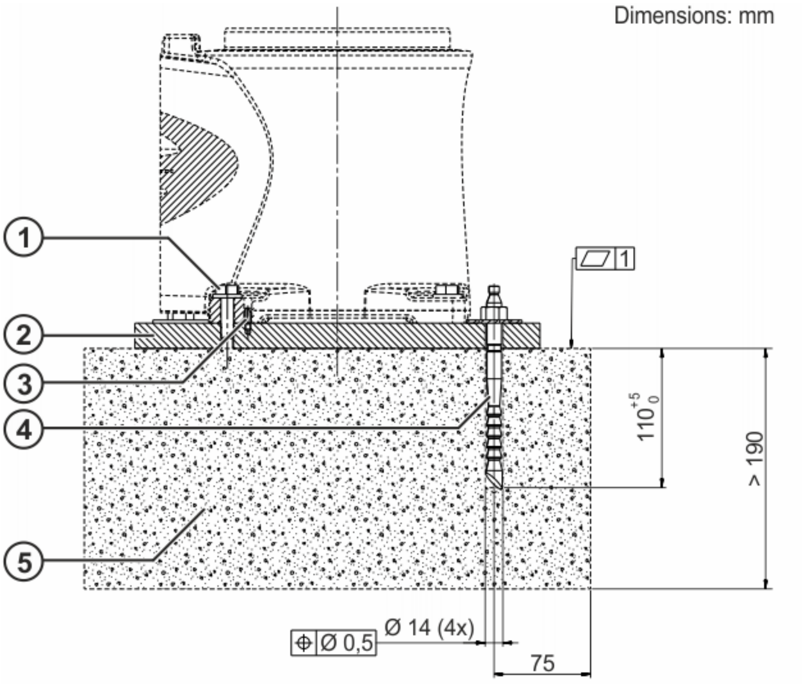


Fig. 6-3: Cross-section of foundations

1	Hexagon bolt	4	Resin-bonded anchor
2	Bedplate	5	Concrete foundation
3	Locating pin		

6.3 Machine frame mounting

Description

The machine frame mounting assembly is used when the robot is fastened on a steel structure, a booster frame (pedestal) or a KUKA linear unit. This assembly is also used if the robot is installed on the wall or ceiling. It must be ensured that the substructure is able to withstand safely the forces occurring during operation (foundation loads). The following diagram contains all the necessary information that must be observed when preparing the mounting surface (>>> Fig. 6-4).

The machine frame mounting assembly consists of:

- Locating pin
- Hexagon bolts with conical spring washers

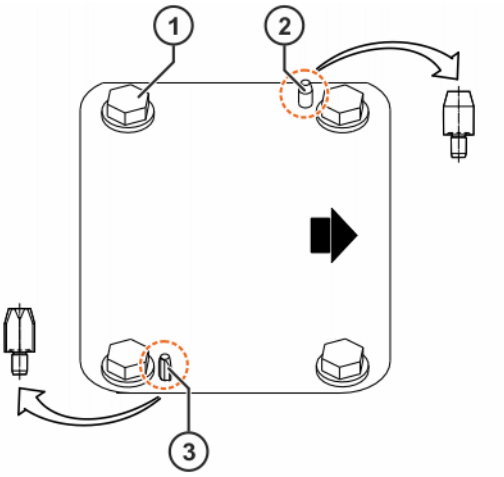


Fig. 6-4: Machine frame mounting

1 Hexagon bolt
2 Locating pin, cylindrical
3 Locating pin, flat-sided

Dimensioned drawing

The following illustration (>>> *Fig. 6-5*) provides all the necessary information on machine frame mounting, together with the required foundation data.

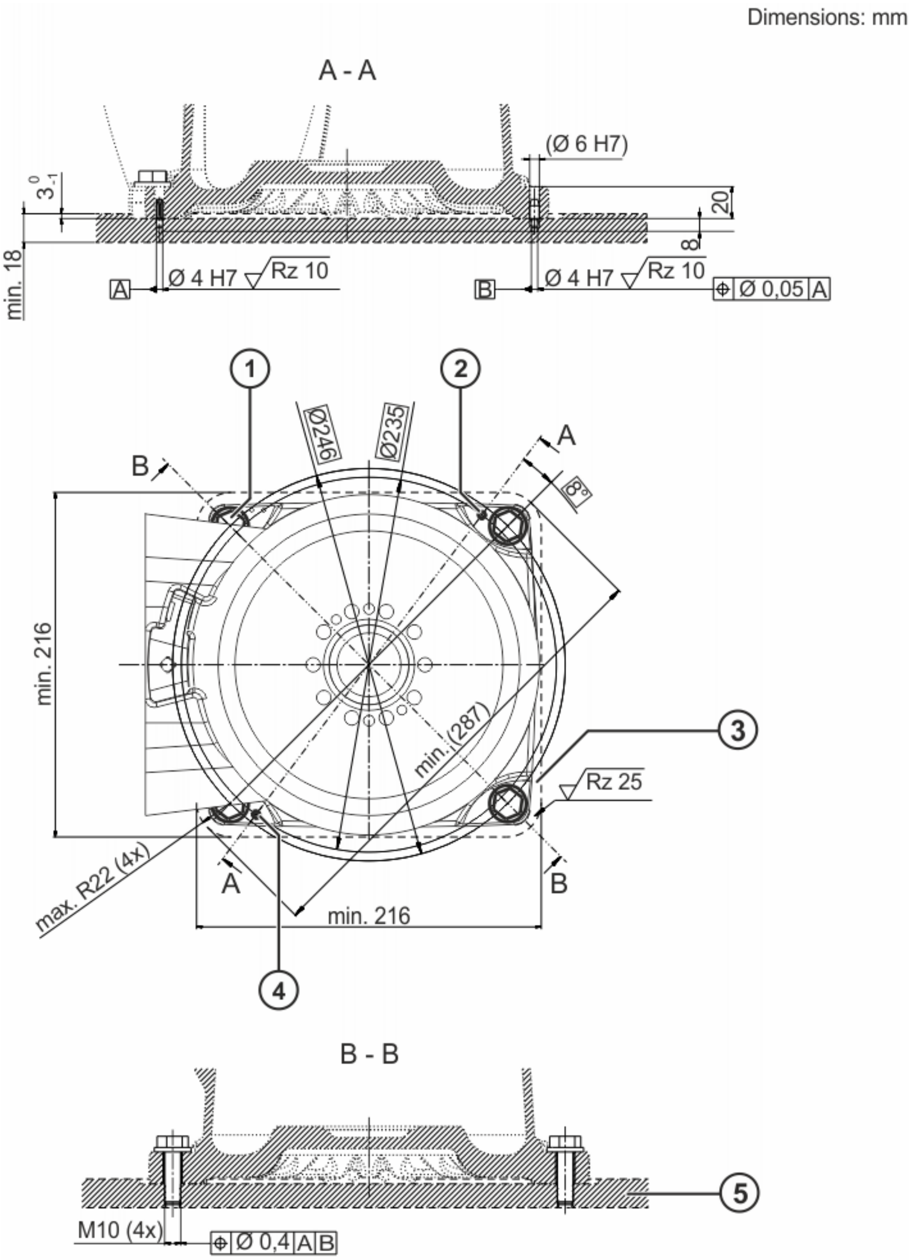


Fig. 6-5: Machine frame mounting, dimensioned drawing

1 Hexagon bolt (4x)
2 Locating pin, cylindrical
3 Mounting surface
4 Locating pin, flat-sided
5 Steel structure

6.4 Connecting cables and interfaces

Connecting cables

The connecting cables comprise all the cables for transferring energy and signals between the robot and the robot controller. They are connected on the robot side with connectors at interface A1. Connection to the controller is always the same, irrespective of the controller variant.

Cable lengths of 1 m, 4 m, 7 m, 15 m and 25 m are available as standard. The maximum length of the connecting cables must not exceed 25 m. Thus if the robot is operated on a linear unit which has its own energy supply chain, these cable lengths must also be taken into account.

For the connecting cables, an additional ground conductor is always required to provide a low-resistance connection between the robot and the control cabinet in accordance with DIN EN 60204. The ground conductors are connected via ring cable lugs. The threaded bolts for connecting the two ground conductors are located on the base frame of the robot.

The following points must be observed when planning and routing the connecting cables:

- The bending radius for fixed routing must not be less than 50 mm for motor cables and 30 mm for control cables.
- Protect cables against exposure to mechanical stress.
- Route the cables without mechanical stress – no tensile forces on the connectors
- Cables are only to be installed indoors.
- Observe the permissible temperature range (fixed installation) of 263 K (-10 °C) to 318 K (+45 °C).
- Route the motor cables and the data cables separately in metal ducts; if necessary, additional measures must be taken to ensure electromagnetic compatibility (EMC).

Interface A1

Interface A1 is located at the rear of the base frame. The connections for the motor and data cables are shown in the following illustration.

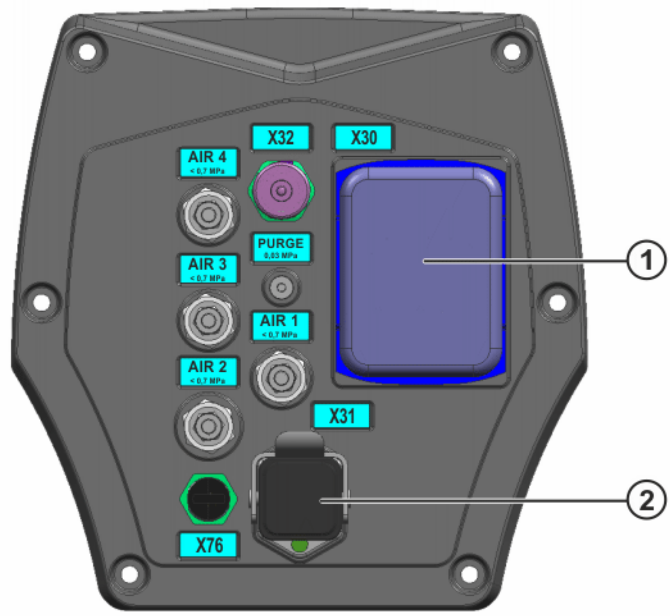


Fig. 6-6: Interface A1

1 Motor cable connection X30

2 Data cable connection X31

Interface for energy supply system

Depending on the selected variant, the robot contains different energy supply system options. The connections of the energy supply system are located at interface plate A1 and on the side of the robot wrist (A4). Detailed information about the energy supply system option, e.g. connectors and connector pin allocation, can be found under (>>> *6.4.1 "Energy supply system CTR AIR" Page 108*) and (>>> *6.4.2 "Energy supply system AIR CTR GIG" Page 110*).

6.4.1 Energy supply system CTR AIR

Customer interface A1

Customer interface A1 is located at the rear of the base frame.

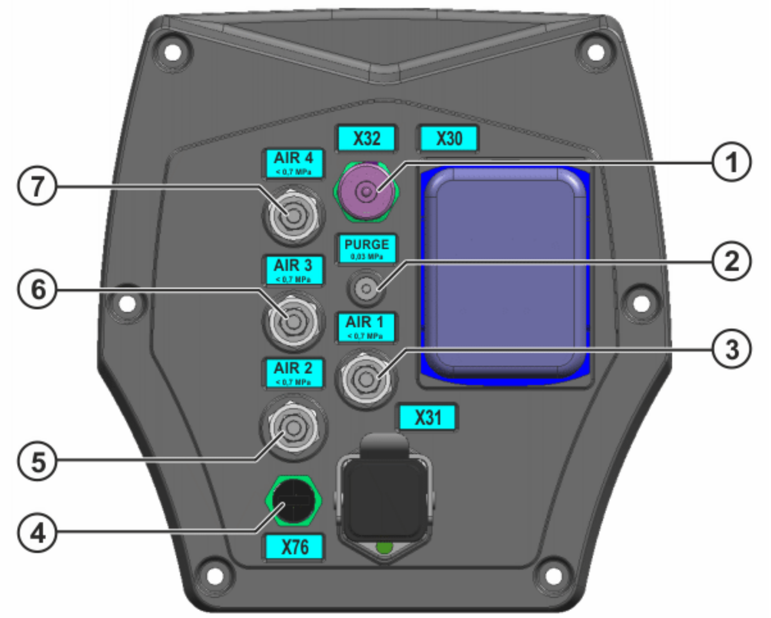


Fig. 6-7: Customer interface A1, CTR AIR

1 Connection MEMD X32

2 PURGE venting connection (optionally for IP67)

Max. pressure: 0.3 bar
Air, oil-free, dry, filtered
according to: ISO 8573.1-1, 1.2 to 16.2

3 Connection for air line AIR 1

Outside diameter: 4 mm

4 I/O cable connection X76

5 Connection for air line AIR 2

Outside diameter: 4 mm

6 Connection for air line AIR 3

Outside diameter: 4 mm

7 Connection for air line AIR 4

Outside diameter: 4 mm

Customer interface A4

Customer interface A4 is located on the side of the in-line wrist.

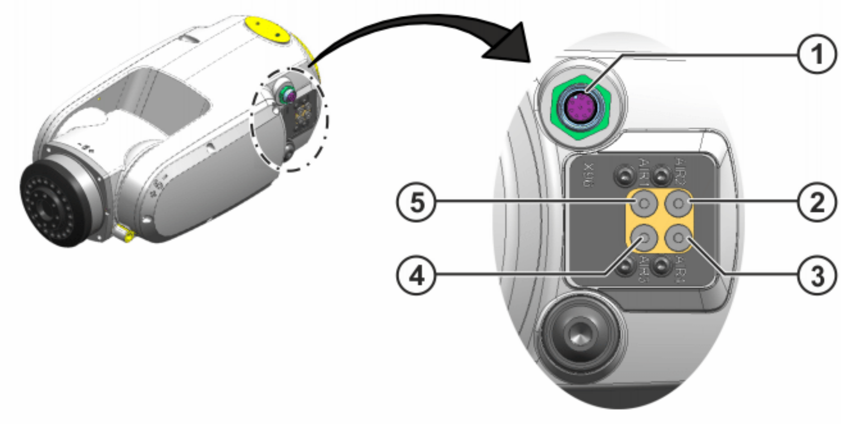


Fig. 6-8: Customer interfaces A4, example

1	Connection X96	4	Air line AIR3
2	Air line AIR2	5	Air line AIR1
3	Air line AIR4		

The optional connector bypack is required for use of connection X76/X96.

Energy supply system X76-X96

Designation	Limit values
Rated current	2 A
Rated voltage	24 V
Connector type	M12
Number of poles	8
Coding	A standard

The entire energy supply system must be safeguarded against overload and short circuit by the customer upstream of connector X76.

The following connectors are required for connections X76 and X96:

- X76: M12, female, A-coded, 8-pole
- X96: M12, male, A-coded, 8-pole

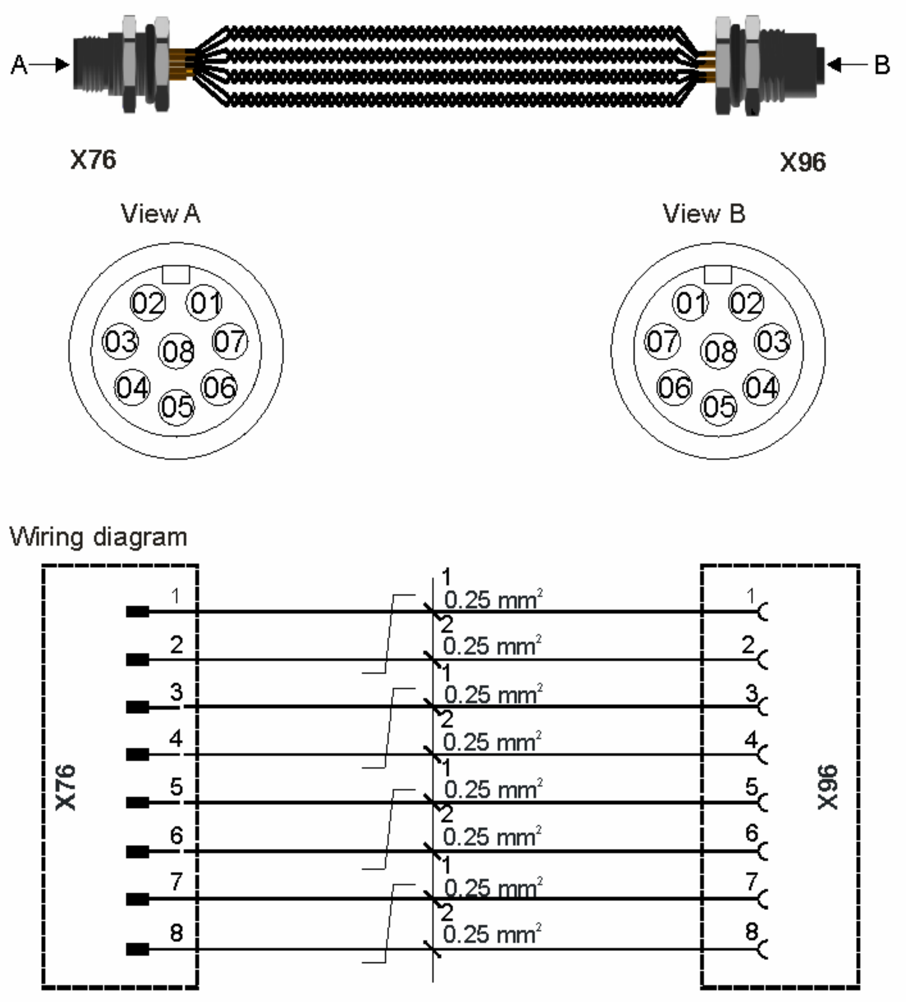


Fig. 6-9: Wiring diagram, energy supply system, X76-X96

Air connections AIR 1 to AIR 4

Customer-specific air connections AIR 1 to AIR 4 with the following values:

Designation	Limit values
Max. pressure	7 bar
Vacuum	Atmospheric pressure minus 0.95 bar

6.4.2 Energy supply system AIR CTR GIG

Customer interfaces A1

Customer interfaces A1 are located at the rear of the base frame.

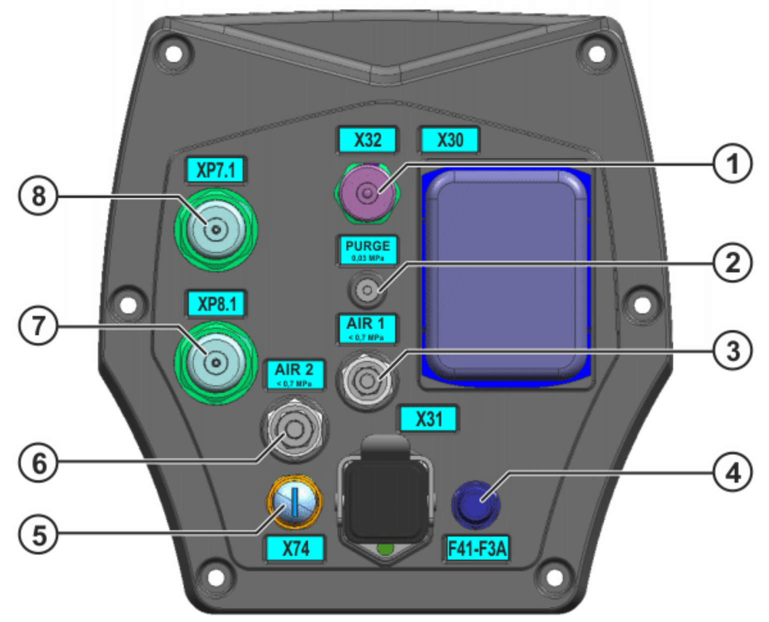


Fig. 6-10: Customer interface A1, AIR CTR GIG

1 MEMD connection X32

2 PURGE venting connection (optionally for IP67)

   Max. pressure: 0.3 bar
   Air, oil-free, dry, filtered
   according to: ISO 8573.1-1, 1.2 to 16.2

3 Air line connection AIR1 (valve unit)

   Outside diameter: 4 mm

4 Fuse for I/O and power supply (F41-F3A)

5 CAT5e data cable connection X74

   Gigabit Ethernet (1000 Base-T)

6 Air line connection AIR2

   Outside diameter: 6 mm

7 Connection for external axis A8 (XP8.1)

8 Connection for external axis A7 (XP7.1)

Fuse F41-F3A

The fuse protects the digital inputs and outputs, the power supply and the valve activation against overloading.

Fuse	Miniature fuse
Type	Fine-wire fuse, 5x20 mm
Tripping characteristic	Quick-acting
Switching capacity	3 A

Interface A4

Customer interface A4 is located on the side of the in-line wrist.

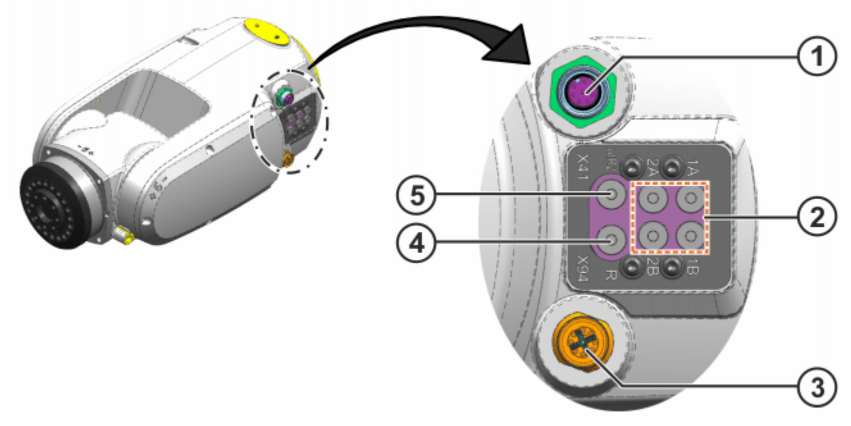


Fig. 6-11: Customer interfaces A4, example

1 Connection X41
2 Air connections, valve unit
3 Connection X94
4 Valve venting R
5 Air line AIR2

> The inputs and outputs are not preconfigured and must be configured in WorkVisual.
> Further information about mapping inputs and outputs can be found in the **WorkVisual** documentation.

Signal table for interface A4:

Name WorkVisual EM8905-1001		Input/output	Notice
Channel 1	Input	DI1	Digital input, customer interface X41
Channel 2		DI2	
Channel 3		DI3	
Channel 4		DI4	
Channel 5		DI5	Not assigned
Channel 6		DI6	Not assigned
Channel 7	Output	DO1	Valve 2/12 (2B)
Channel 8		DO2	Valve 2/14 (2A)
Channel 9		DO3	Not assigned
Channel 10		DO4	Valve 1/12 (1B)
Channel 11		DO5	Valve 1/14 (1A)
Channel 12		DO6	Not assigned
Channel 13		DO7	Digital output, customer interface X41
Channel 14		DO8	

Valve activation

Designation	Limit values
Valve type	5/3-way solenoid valve
Operating pressure	min. 3 bar, max. 7 bar
Switching frequency	10 Hz
Threaded union	M5

Designation		Limit values
Medium		Air, oil-free, dry, filtered according to: ISO 8573.1-1, 1.2 to 16.2 Degree of filtration: max. 5 µm Operating temperature: +5 °C to +45 °C (278 K to 318 K) Free from condensation
Digital outputs (for valve activation)		4 Not short-circuit proof
	Rated voltage	24 V DC (-15%/+20%)
	Output current	max. 25 mA

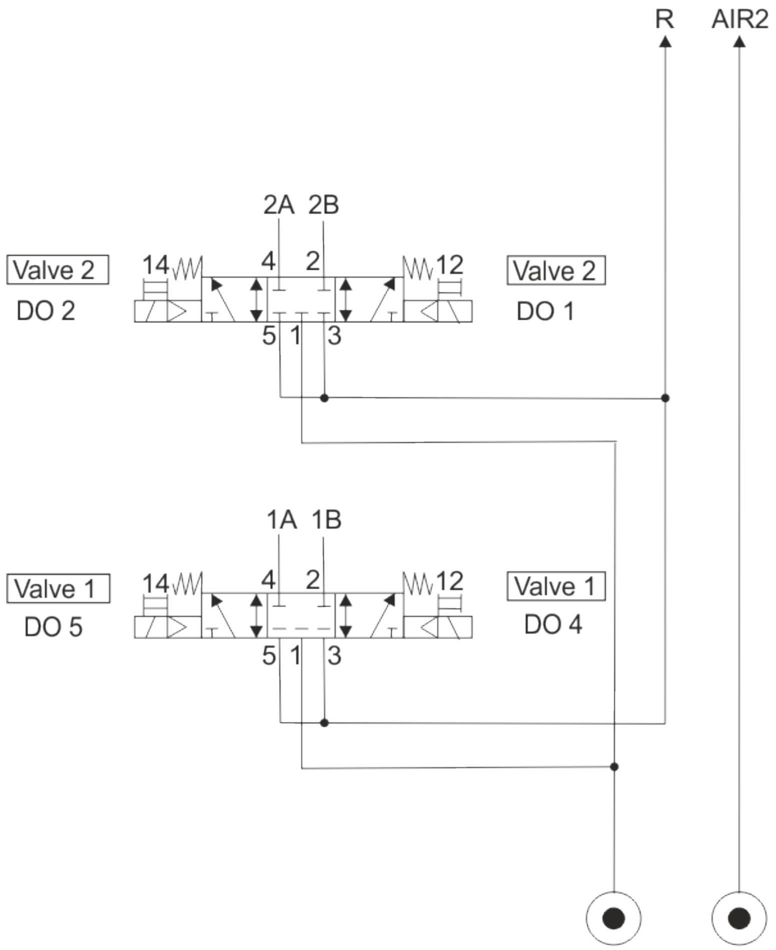


Fig. 6-12: Valve diagram

Connection X41

Designation		Values
Digital outputs (for customer interface X41)		2 short-circuit proof
	Rated voltage	24 V DC (-15%/+20%)
	Output current	max. 0.5 A
	Short-circuit current	max. 2 A

Designation		Values
	Load type	Ohmic, inductive Lamp load
Digital inputs (for customer interface X41)		4
	Signal voltage “0”	-3 V … +5 V EN 61131-2, type 3
	Signal voltage “1”	15 V … 30 V EN 61131-2, type 3
	Input current	Typically 3 mA EN 61131-2, type 3
	Input filter	Typically 0.3 ms
Power supply		24 V / 3 A If 3 A is selected, no digital outputs/valves can be switched.
Connector type		M12
Number of poles		8
Coding		A standard

An M12, male, A-coded, 8-pole connector is required for connection X41.

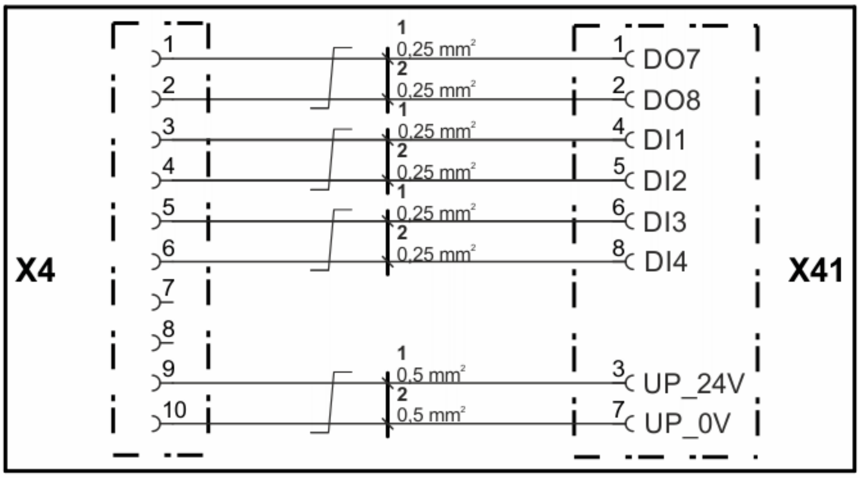


Fig. 6-13: Wiring diagram, connection X41

Connection X94

Designation	Limit values
Connector type	M12
Number of poles	8
Coding	X standard

An M12, male, A-coded, 8-pole connector is required for connections X74 and X94.

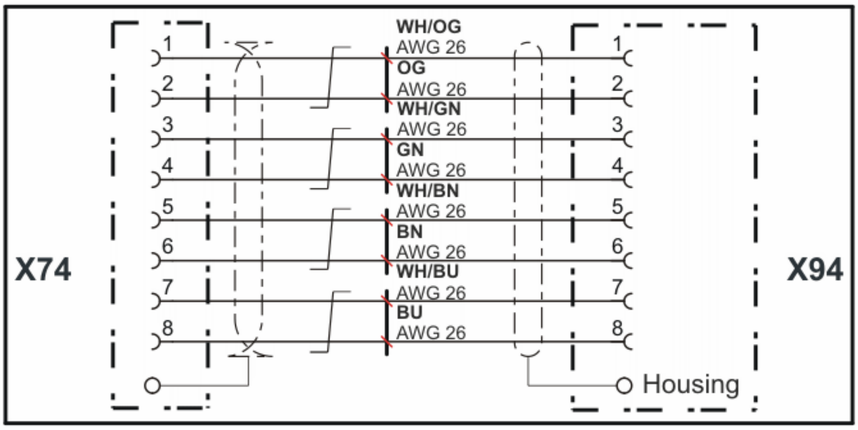


Fig. 6-14: Wiring diagram, connection X94

Air connection AIR 2

Customer-specific air connection AIR 2 with the following values:

Designation	Limit values
Max. pressure	7 bar
Vacuum	Atmospheric pressure minus 0.95 bar

7 Transportation

7.1 Transporting the manipulator

Description

Move the robot into its transport position each time it is transported. It must be ensured that the robot is stable while it is being transported. The robot must remain in its transport position until it has been fastened to the foundation. Before the robot is lifted, it must be ensured that it is free from obstructions. Remove all transport safeguards, such as nails and screws, in advance. First remove any corrosion or glue on contact surfaces.

Transport position

The robot must be in the transport position before it can be transported (>>> *Fig. 7-1*). The robot is in the transport position when the axes are in the following positions:

Axis	A1	A2	A3	A4	A5	A6
Angle	0°	-105°	+156°	0º	+39º	0º

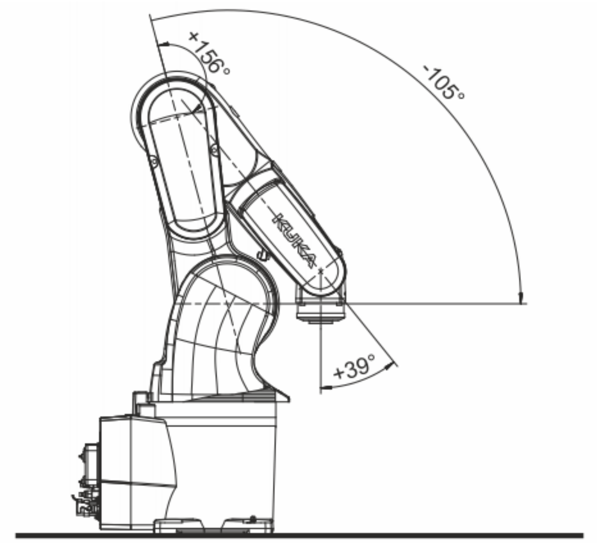


Fig. 7-1: Transport position

Transport dimensions

The transport dimensions for the robot can be noted from the following figures. The position of the center of gravity and the weight vary according to the specific configuration. The specified dimensions refer to the robot without equipment.

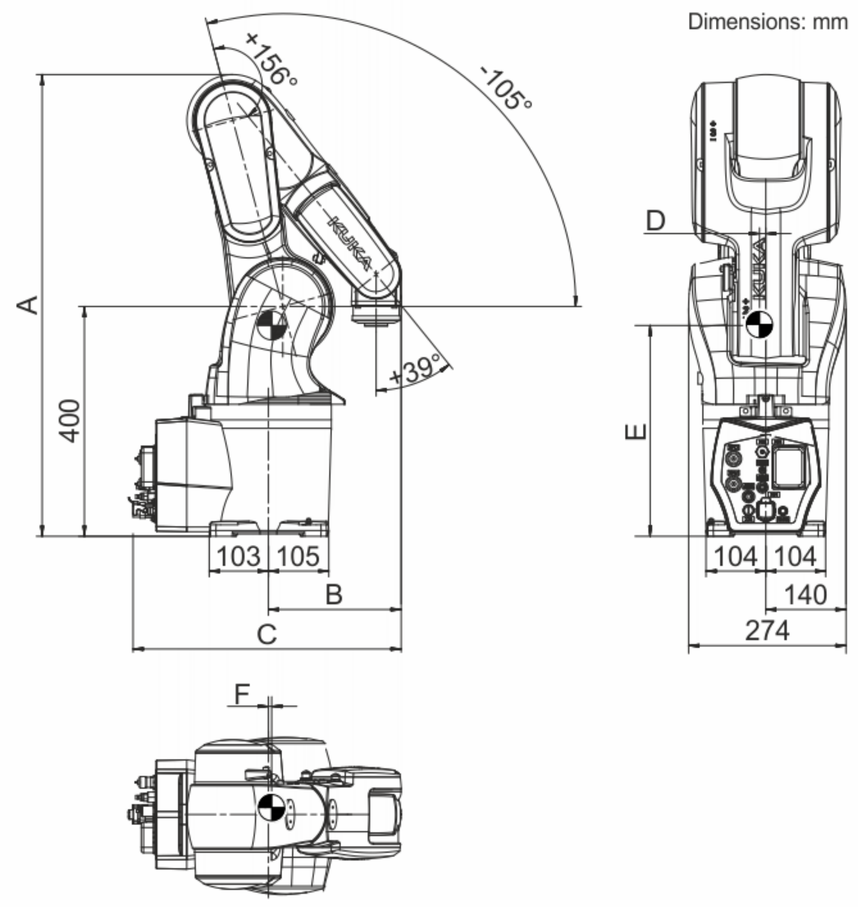


Fig. 7-2: Transport dimensions

1 Robot
2 Center of gravity
3 Fork slots

Transport dimensions and centers of gravity

Robot	A	B	C	D	E	F
KR 6 R700-2	804	231	466	11	367	6
KR 6 R900-2 KR 10 R900-2	919	234	470	11	407	1
KR 10 R1100-2	1021	267	502	10	439	4

Transportation using lifting tackle

WARNING

Use of unsuitable handling equipment may result in damage to the robot or injury to persons. Only use authorized handling equipment with a sufficient load-bearing capacity. Only transport the robot in the manner specified here.

The robot is transported using lifting tackle . For this, it must be in the transport position. The loops of the lifting tackle are passed around the link arm and rotating column. All ropes must be long enough and must be routed in such a way that the robot is not damaged. Installed tools and items of equipment can cause undesirable shifts in the center of gravity.

WARNING

The robot may tip during transportation. Risk of personal injury and damage to property.
If the robot is being transported using lifting tackle, special care must be exercised to prevent it from tipping. Additional safeguarding measures must be taken. It is forbidden to pick up the robot in any other way using a crane!

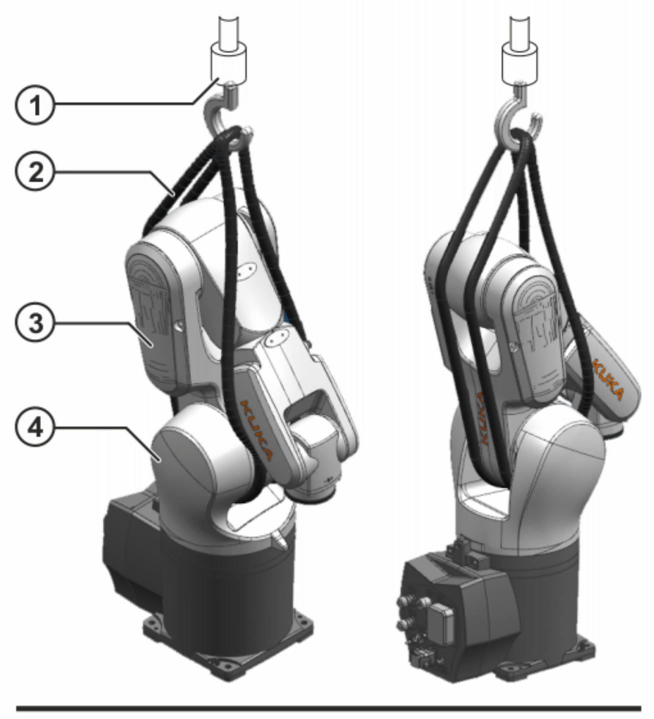


Fig. 7-3: Transportation using lifting tackle

1	Crane	3	Link arm
2	Lifting tackle	4	Rotating column

8 Options

8.1 Connector bypack CTR AIR (optional)

The following electrical connector bypacks are available.

Interface A1

X76

- M12 connector
- A-coding
- 8-pole
- Connection type: screw terminal
- Female
- Connector design: straight

Interface A4

X96 – variant 1

- M12 connector
- A-coding
- 8-pole
- Open cable end
- Including 3 m cable
- Male
- Connector design: angled

X96 – variant 2

- M12 connector
- A-coding
- 8-pole
- Connection type: crimp
- Male
- Connector design: angled

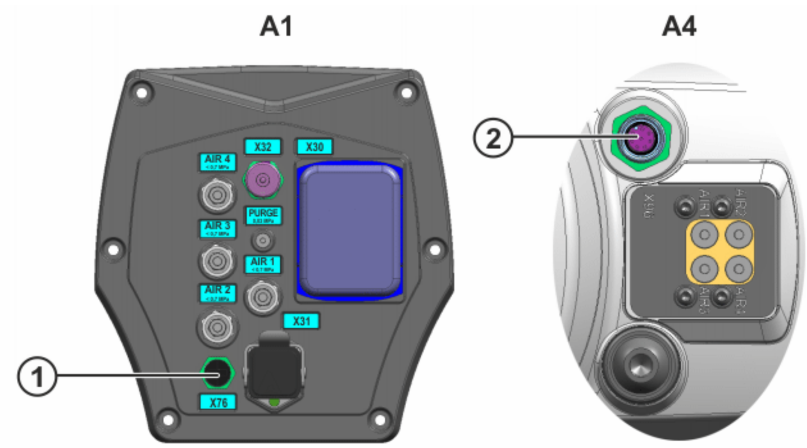


Fig. 8-1: Connector bypack CTR AIR

1 Connection X76

2 Connection X96

The following pneumatic connector bypacks are available.

Interface A1

- PURGE option 0.3 bar

Interface A4

- Pneumatic connector bypack valve unit
- Pneumatic connector bypack

8.2 Connector bypack AIR CTR GIG (optional)

The following electrical connector bypacks are available.

Interface A1

X74

- M12 connector
- X-coding
- 8-pole
- Connection type: crimp
- Male
- Connector design: straight

Interface A4

X41 – variant 1

- M12 connector
- A-coding
- 8-pole
- Open cable end
- Including 3 m cable
- Male
- Connector design: angled

X41 – variant 2

- M12 connector
- A-coding
- 8-pole
- Connection type: crimp
- Male
- Connector design: angled

X94 – variant 1

- M12 connector
- X-coding
- 8-pole
- Open cable end
- Including 3 m cable
- Male
- Connector design: angled

X94 – variant 2

- M12 connector
- X-coding
- 8-pole
- Connection type: crimp
- Male
- Connector design: angled

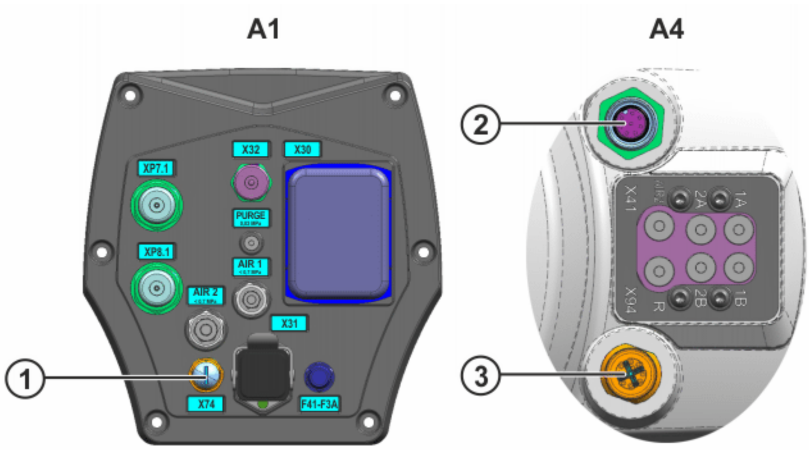


Fig. 8-2: Connector bypack AIR CTR GIG

1 Connection X74
2 Connection X41
3 Connection X94

The following pneumatic connector bypacks are available.

Interface A1

- PURGE option 0.3 bar

Interface A4

- Pneumatic connector bypack valve unit
- Pneumatic connector bypack

8.3 Optional connecting cables

The following connecting cables are optionally available for transferring signals between the robot and the robot controller.

- Standard I/O cable (optional)
  (>>> *Fig. 8-3*)
- CAT5e data cable (optional)
  (>>> *Fig. 8-4*)
- Connecting cable, external axes A7 and A8 (optional)
  (>>> *Fig. 8-5*)
- External ground conductor

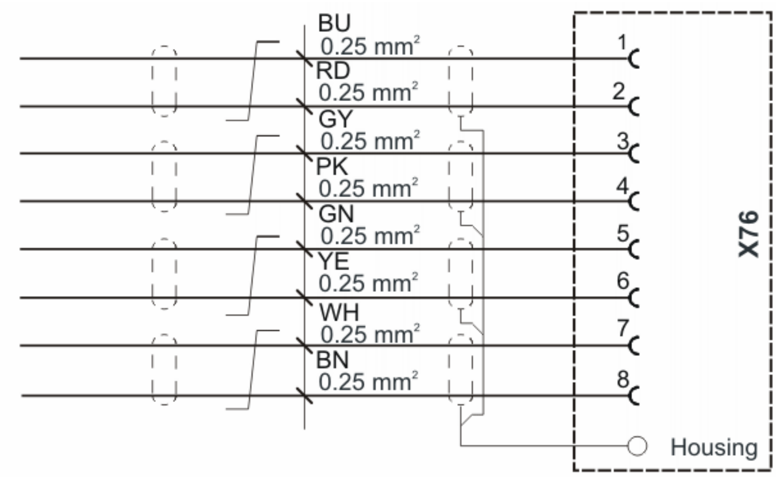


Fig. 8-3: Connecting cable, I/O cable X76 – open

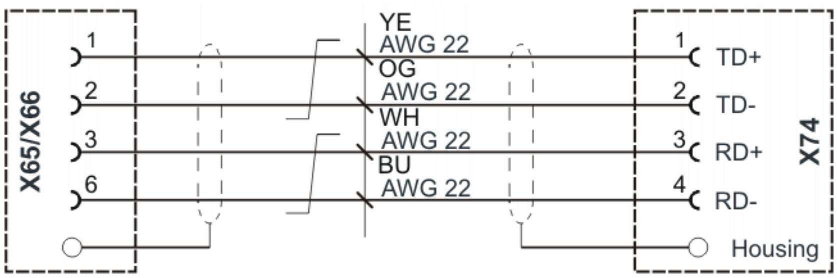


Fig. 8-4: Connecting cable, data cable CAT5e X65/X66 – X74

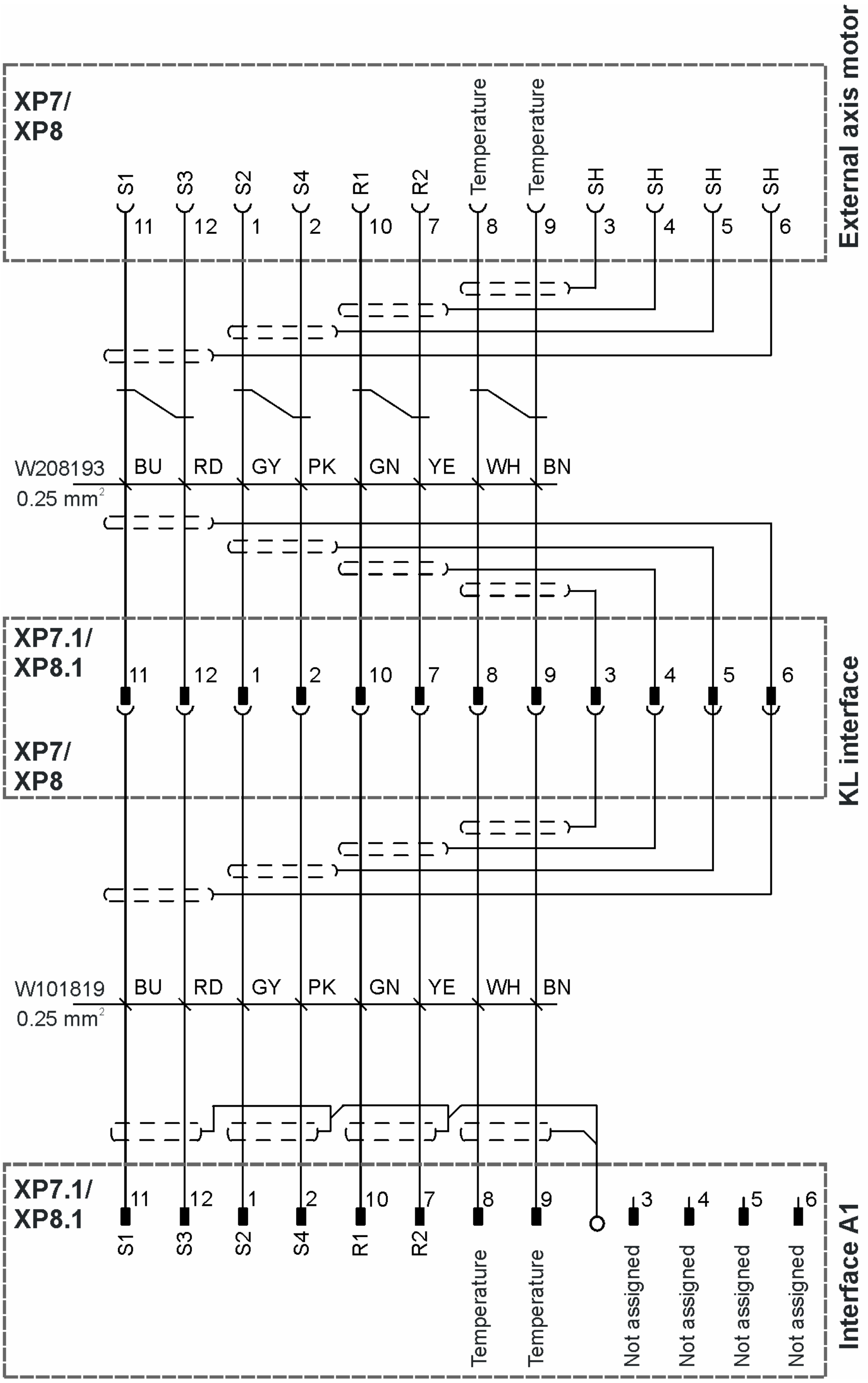


Fig. 8-5: Connecting cable, external axes A7 and A8

9 Appendix

9.1 Tightening torques

Tightening torques

The following tightening torques (Nm) are valid for screws and nuts where no other specifications are given.

The specified values apply to lightly oiled black (e.g. phosphated) and coated (e.g. mech. galv., zinc flake plating) screws and nuts.

	Strength class		
Thread	**8.8**	**10.9**	**12.9**
M1.6	0.17 Nm	0.24 Nm	0.28 Nm
	0.35 Nm	0.48 Nm	0.56 Nm
M2.5	0.68 Nm	0.93 Nm	1.10 Nm
M3	1.2 Nm	1.6 Nm	2.0 Nm
M4	2.8 Nm	3.8 Nm	4.4 Nm
M5	5.6 Nm	7.5 Nm	9.0 Nm
M6	9.5 Nm	12.5 Nm	15.0 Nm
M8	23.0 Nm	31.0 Nm	36.0 Nm
M10	45.0 Nm	60.0 Nm	70.0 Nm
M12	78.0 Nm	104.0 Nm	125.0 Nm
M14	125.0 Nm	165.0 Nm	195.0 Nm
M16	195.0 Nm	250.0 Nm	305.0 Nm
M20	370.0 Nm	500.0 Nm	600.0 Nm
M24	640.0 Nm	860.0 Nm	1030.0 Nm
M30	1330.0 Nm	1700.0 Nm	2000.0 Nm

	Strength class	
Thread	**8.8 ISO7991 Allen screw**	**10.9 ISO7380, ISO07381 Fillister head screw**
M3	0.8 Nm	0.8 Nm
M4	1.9 Nm	1.9 Nm
M5	3.8 Nm	3.8 Nm

	Strength class
Thread	**10.9 DIN7984 pan head screws**
M4	2.8 Nm

Tighten M5 domed cap nuts with a torque of 4.2 Nm.

9.2 Auxiliary and operating materials used

Product designation	Use	Manufacturer designation/Address

DREI BOND type 1118	Adhesive and sealant	**Drei Bond GmbH** Carl-Zeiss-Ring 17 D-85737 Ismaning Germany
DREI BOND type 1305	Adhesive and sealant	**Drei Bond GmbH** Carl-Zeiss-Ring 17 D-85737 Ismaning Germany
DREI BOND type 1342	Adhesive and sealant	**Drei Bond GmbH** Carl-Zeiss-Ring 17 D-85737 Ismaning Germany
DREI BOND type 1385	Adhesive and sealant	**Drei Bond GmbH** Carl-Zeiss-Ring 17 D-85737 Ismaning Germany
DREI BOND TYPE 5204HV	Adhesive and sealant	**Drei Bond GmbH** Carl-Zeiss-Ring 17 D-85737 Ismaning Germany
PETAMO GHY 133 N	Lubricating grease	**Klüber Lubrication München AG** Geisenhausenerstr. 7 D-81379 München Germany
Harmonic Drive grease 4B No. 2	Grease	**Harmonic Drive AG** Hoenbergstrasse 14 D-65555 Limburg a. d. Lahn Germany
Optitemp RB 2	Lubricating grease	**Deutsche BP Aktiengesellschaft - Industrial Lubricants & Services** Erkelenzer Straße 20 D-41179 Mönchengladbach Germany

⚠ To ensure safe use of our products, we recommend regularly requesting up-to-date safety data sheets from the manufacturers of auxiliary and operating materials.

10 KUKA Service

10.1 Requesting support

Introduction

This documentation provides information on operation and operator control, and provides assistance with troubleshooting. For further assistance, please contact your local KUKA subsidiary.

Information

The following information is required for processing a support request:

- Description of the problem, including information about the duration and frequency of the fault
- As comprehensive information as possible about the hardware and software components of the overall system

  The following list gives an indication of the information which is relevant in many cases:

  - Model and serial number of the kinematic system, e.g. the manipulator
  - Model and serial number of the controller
  - Model and serial number of the energy supply system
  - Designation and version of the system software
  - Designations and versions of other software components or modifications
  - Diagnostic package KRCDiag

    Additionally for KUKA Sunrise: existing projects including applications

    For versions of KUKA System Software older than V8: archive of the software (KRCDiag is not yet available here.)
  - Application used
  - External axes used

10.2 KUKA Customer Support

Availability

KUKA Customer Support is available in many countries. Please do not hesitate to contact us if you have any questions.

Argentina

Ruben Costantini S.A. (Agentur)
Luis Angel Huergo 13 20
Parque Industrial
2400 San Francisco (CBA)
Argentina
Tel. +54 3564 421033
Fax +54 3564 428877
ventas@costantini-sa.com

Australia

KUKA Robotics Australia Pty Ltd
45 Fennell Street
Port Melbourne VIC 3207
Australia
Tel. +61 3 9939 9656
info@kuka-robotics.com.au
www.kuka-robotics.com.au

Belgium

KUKA Automatisering + Robots N.V.
Centrum Zuid 1031
3530 Houthalen
Belgium
Tel. +32 11 516160
Fax +32 11 526794
info@kuka.be
www.kuka.be

Brazil

KUKA Roboter do Brasil Ltda.
Travessa Claudio Armando, nº 171
Bloco 5 - Galpões 51/52
Bairro Assunção
CEP 09861-7630 São Bernardo do Campo - SP
Brazil
Tel. +55 11 4942-8299
Fax +55 11 2201-7883
info@kuka-roboter.com.br
www.kuka-roboter.com.br

Chile

Robotec S.A. (Agency)
Santiago de Chile
Chile
Tel. +56 2 331-5951
Fax +56 2 331-5952
robotec@robotec.cl
www.robotec.cl

China

KUKA Robotics China Co., Ltd.
No. 889 Kungang Road
Xiaokunshan Town
Songjiang District
201614 Shanghai
P. R. China
Tel. +86 21 5707 2688
Fax +86 21 5707 2603
info@kuka-robotics.cn
www.kuka-robotics.com

Germany

KUKA Deutschland GmbH
Zugspitzstr. 140
86165 Augsburg
Germany
Tel. +49 821 797-1926
Fax +49 821 797-41 1926
Hotline.robotics.de@kuka.com
www.kuka.com

France

KUKA Automatisme + Robotique SAS
Techvallée
6, Avenue du Parc
91140 Villebon S/Yvette
France
Tel. +33 1 6931660-0
Fax +33 1 6931660-1
commercial@kuka.fr
www.kuka.fr

India

KUKA India Pvt. Ltd.
Office Number-7, German Centre,
Level 12, Building No. - 9B
DLF Cyber City Phase III
122 002 Gurgaon
Haryana
India
Tel. +91 124 4635774
Fax +91 124 4635773
info@kuka.in
www.kuka.in

Italy

KUKA Roboter Italia S.p.A.
Via Pavia 9/a - int.6
10098 Rivoli (TO)
Italy
Tel. +39 011 959-5013
Fax +39 011 959-5141
kuka@kuka.it
www.kuka.it

Japan

KUKA Japan K.K.
YBP Technical Center
134 Godo-cho, Hodogaya-ku
Yokohama, Kanagawa
240 0005
Japan
Tel. +81 45 744 7531
Fax +81 45 744 7541
info@kuka.co.jp

Canada

KUKA Robotics Canada Ltd.
2865 Argentia Road, Unit 4-5
Mississauga
Ontario L5N 8G6
Canada
Tel. +1 905 858-5852
Fax +1 905 858-8581
KUKAFocusCenter@KUKARobotics.com
www.kukarobotics.ca

Korea

KUKA Robotics Korea Co. Ltd.
RIT Center 306, Gyeonggi Technopark
1271-11 Sa 3-dong, Sangnok-gu
Ansan City, Gyeonggi Do
426-901
Korea
Tel. +82 31 501-1451
Fax +82 31 501-1461
info@kukakorea.com

Malaysia

KUKA Robot Automation (M) Sdn Bhd
South East Asia Regional Office
No. 7, Jalan TPP 6/6
Taman Perindustrian Puchong
47100 Puchong
Selangor
Malaysia
Tel. +60 (03) 8063-1792
Fax +60 (03) 8060-7386
info@kuka.com.my

Mexico

KUKA de México S. de R.L. de C.V.
Progreso #8
Col. Centro Industrial Puente de Vigas
Tlalnepantla de Baz
54020 Estado de México
Mexico
Tel. +52 55 5203-8407
Fax +52 55 5203-8148
info@kuka.com.mx
www.kuka-robotics.com/mexico

Norway

KUKA Sveiseanlegg + Roboter
Sentrumsvegen 5
2867 Hov
Norway
Tel. +47 61 18 91 30
Fax +47 61 18 62 00
info@kuka.no

Austria

KUKA CEE GmbH
Gruberstraße 2-4
4020 Linz
Austria
Tel. +43 732 784 752 0
Fax +43 732 793 880
KUKAAustriaOffice@kuka.com
www.kuka.at

Poland

KUKA CEE GmbH Poland
Spółka z ograniczoną odpowiedzialnością
Oddział w Polsce
Ul. Porcelanowa 10
40-246 Katowice
Poland
Tel. +48 327 30 32 13 or -14
Fax +48 327 30 32 26
ServicePL@kuka.com

Portugal

KUKA Robots IBÉRICA, S.A.
Rua do Alto da Guerra n° 50
Armazém 04
2910 011 Setúbal
Portugal
Tel. +351 265 729 780
Fax +351 265 729 782
info.portugal@kukapt.com
www.kuka.com

Russia

KUKA Russia OOO
1-y Nagatinskiy pr-d, 2
117105 Moskau
Russia
Tel. +7 495 665-6241
support.robotics.ru@kuka.com

Sweden

KUKA Svetsanläggningar + Robotar AB
A. Odhners gata 15
421 30 Västra Frölunda
Sweden
Tel. +46 31 7266-200
Fax +46 31 7266-201
info@kuka.se

Switzerland

KUKA Roboter CEE GmbH
Linz, Zweigniederlassung Schweiz
Heinrich Wehrli-Strasse 27
5033 Buchs
Switzerland
Tel. +41 62 837 43 20
info@kuka-roboter.ch

Slovakia

KUKA CEE GmbH
organizačná zložka
Bojnická 3
831 04 Bratislava
Slovakia
Tel. +420 226 212 273
support.robotics.cz@kuka.com

Spain

KUKA Iberia, S.A.U.
Pol. Industrial
Torrent de la Pastera
Carrer del Bages s/n
08800 Vilanova i la Geltrú (Barcelona)
Spain
Tel. +34 93 8142-353
comercial@kukarob.es

South Africa

Jendamark Automation LTD (Agentur)
76a York Road
North End
6000 Port Elizabeth
South Africa
Tel. +27 41 391 4700
Fax +27 41 373 3869
www.jendamark.co.za

Taiwan

KUKA Automation Taiwan Co. Ltd.
1F, No. 298 Yangguang ST.,
Nei Hu Dist., Taipei City, Taiwan 114
Taiwan
Tel. +886 2 8978 1188
Fax +886 2 8797 5118
info@kuka.com.tw

Thailand

KUKA (Thailand) Co. Ltd.
No 22/11-12 H-Cape Biz Sector Onnut
Sukhaphiban 2 road, Prawet
Bangkok 10250
Thailand
Tel. +66 (0) 90-940-8950
HelpdeskTH@kuka.com

Czech Republic

KUKA Roboter CEE GmbH
organizační složka
Pražská 239
25066 Zdiby
Czech Republic
Tel. +420 226 212 273
support.robotics.cz@kuka.com

Hungary

KUKA HUNGÁRIA Kft.
Fö út 140
2335 Taksony
Hungary
Tel. +36 24 501609
Fax +36 24 477031
info@kuka-robotics.hu

USA

KUKA Robotics Corporation
51870 Shelby Parkway
Shelby Township
48315-1787
Michigan
USA
Tel. +1 866 873-5852
Fax +1 866 329-5852
CustomerService@kuka.com
www.kuka.com

United Kingdom

KUKA Robotics UK Ltd
Great Western Street
Wednesbury West Midlands
WS10 7LL
United Kingdom
Tel. +44 121 505 9970
Fax +44 121 505 6589
service@kuka-robotics.co.uk
www.kuka-robotics.co.uk

Index

U

W