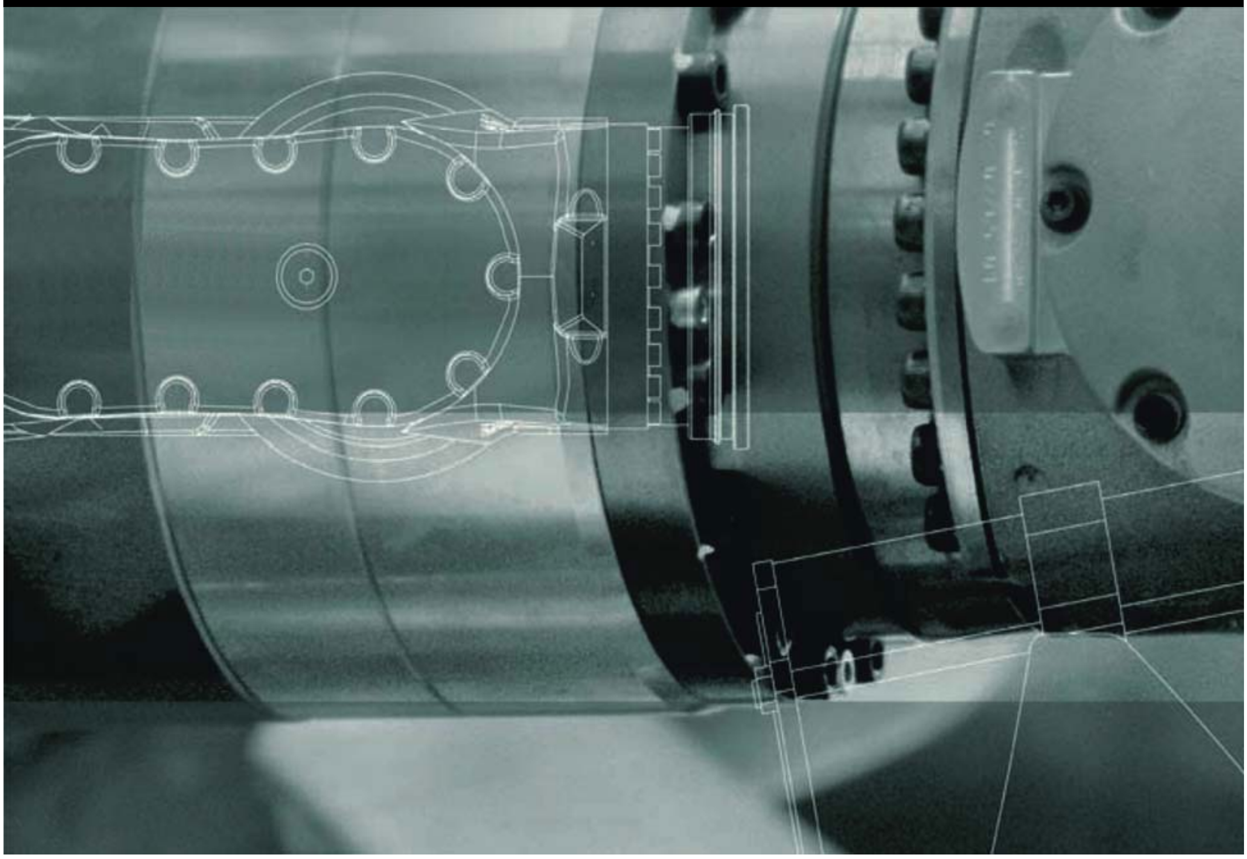
Robots

KUKA Roboter GmbH

KR CYBERTECH nano

Specification



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Version: Spez KR CYBERTECH nano V1

KUKA Roboter GmbH
Zugspitzstraße 140
D-86165 Augsburg
Germany

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.

Translation of the original documentation

KIM-PS5-DOC

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Book structure:	Spez KR CYBERTECH nano V2.1
Version:	Spez KR CYBERTECH nano V1

Contents

1 Introduction

1.1 Industrial robot documentation

The industrial robot documentation consists of the following parts:

- Documentation for the manipulator
- Documentation for the robot controller
- Operating and programming instructions for the System Software
- Instructions for options and accessories
- Parts catalog on storage medium

Each of these sets of instructions is a separate document.

1.2 Representation of warnings and notes

Safety

These warnings are relevant to safety 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 INSTRUCTIONS	Procedures marked with this warning **must** be followed exactly.

Notices

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

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

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 and electronic systems
- 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.:

- Transportation of persons and animals
- Use as a climbing aid
- Use outside the permissible operating parameters
- Use in potentially explosive environments
- Operation in underground mining

NOTICE Changing the structure of the manipulator, e.g. by drilling holes, etc., 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 Roboter 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 CYBERTECH nano product family comprises the robot variants:

- KR 10 R1420
- KR 8 R1620
- KR 6 R1820
- KR 10 R1420 HP
- KR 8 R1620 HP
- KR 6 R1820 HP

The robot variants with the designation HP are fitted with an in-line wrist that is particularly resistant against dirt.

All robots can be operated with the

- KR C4 compact (manufacture year 2016 and onwards) or
- KR C4 smallsize-2

controller.

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

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

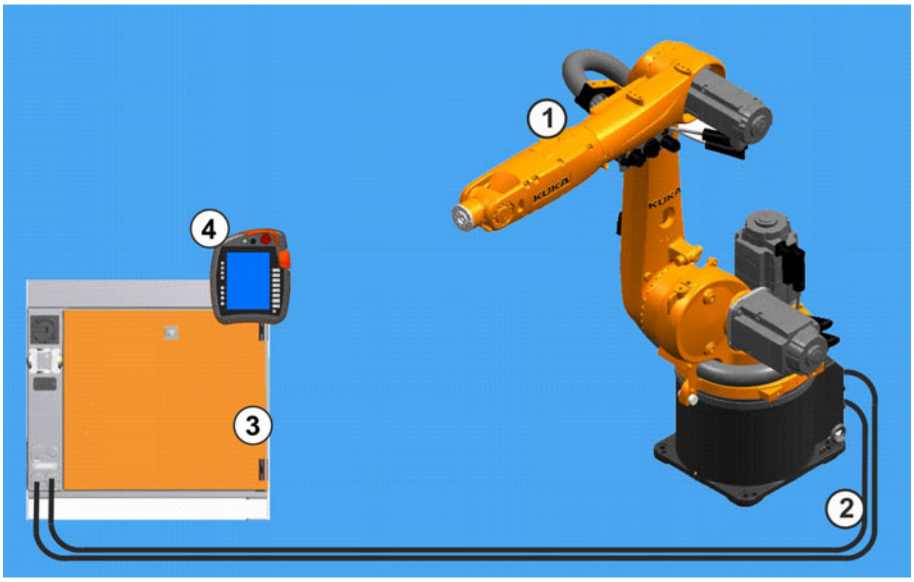


Fig. 3-1: Example of a robot system with KR C4 smallsize-2

1	Manipulator	3	Robot controller, KR C4 small-size-2
2	Connecting cables	4	Teach pendant, KUKA smart-PAD

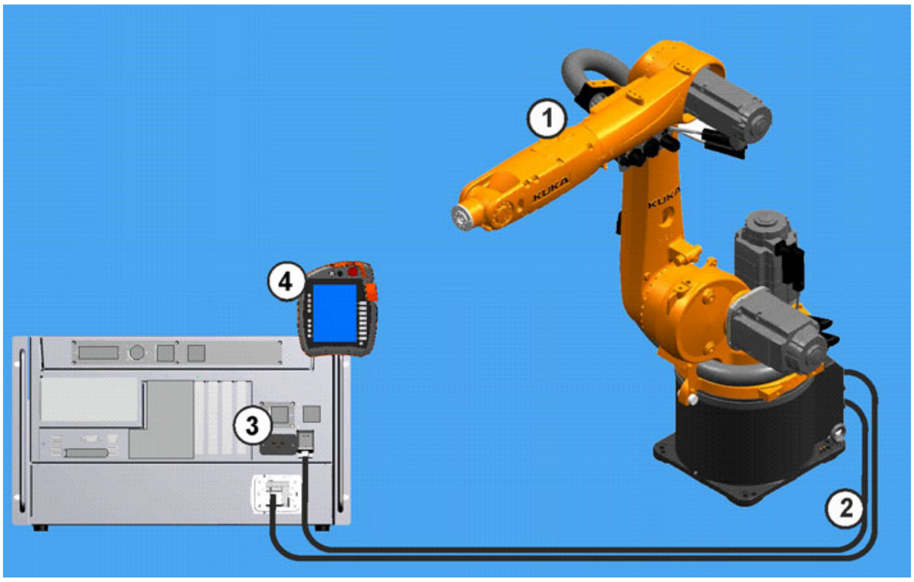


Fig. 3-2: Example of a robot system with KR C4 compact

1	Manipulator	3	Robot controller, KR C4 compact
2	Connecting cables	4	Teach pendant, KUKA smartPAD

3.2 Description of the manipulator

Overview

The manipulators (manipulator = robot arm and electrical installations) (>>> Fig. 3-3) of the KR CYBERTECH nano robot family are designed as 6-axis jointed-arm kinematic systems. They consist of the following principal components:

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

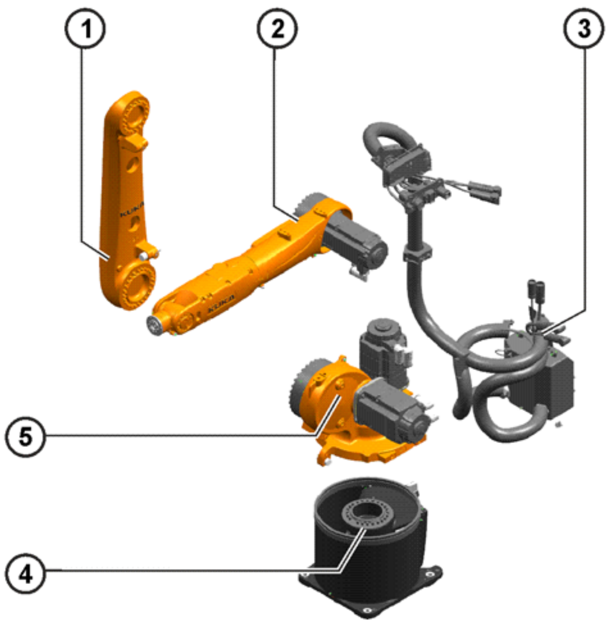


Fig. 3-3: Main assemblies of the manipulator

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

Robots of the HP variant (HP = High Protection) are designed in such a way as to offer greater resistance against dirt and water. The function and basic structure of these assemblies are identical to those of the standard variants.

Axes 1 to 5 are equipped with end stops. These serve only as machine protection. There are two options available for personnel protection:

- The Safe Robot functionality of the controller
- The use of mechanical supplementary stops for axes 1 to 3 (optional)

In-line wrist

The robot can be equipped with a triple-axis in-line wrist/arm combination for a payload of 6 to 10 kg. This arm/in-line wrist assembly is screwed directly to the link arm of the robot via gear unit A3. This in-line wrist/arm assembly is available in two length variants. End effectors are attached to the mounting flange of axis 6. Axes A1 to A5 have a measuring device, through which the mechanical zero of the respective axis can be checked by means of an electronic probe (accessory) and transferred to the controller. For axis A6, a vernier is available for locate the mechanical zero position. Directions of rotation, axis data and permissible loads can be found in the chapter (>>> 4 "Technical data" Page 15).

The in-line wrist is driven by the motors inside the in-line wrist. Power is transmitted within the in-line wrist directly by gear unit A4 for axis 4; for axes 5 and 6, gear units with bevel gears and a toothed belt stage are used.

The mounting flange conforms, with minimal deviations, to ISO 9409-1:2004.

Link arm

The link arm is the assembly located between the arm and the rotating column. It consists of the link arm body with the buffers for axis 2 and the measurement notch for axis 3. The link arm is available in two length variants.

Rotating column

The rotating column houses the gear units and motors A1 and A2. 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. It is screwed to the mounting base. The flexible tube for the electrical installations is installed in the base frame. Also located on the rear of the base frame are the junction box for the motor and data cable and the energy supply system.

Electrical installations

The electrical installations include all the motor and control cables for the motors of axes 1 to 6. The complete electrical installations consist of cable set A1 - A3 and cable set A4 - A6. For cable set A1 - A3, three variants are available:

- KR C4 robot cable set A1 - A3
- KR C4 robot cable set A1 - A3, Profinet
- KR C4 robot cable set A1 - A3, Multibus

Cable set A4 - A6 is identical for all CYBERTECH nano robot variants.

Included in the electrical installations are the relevant cable harness and the combo box with cover. The connecting cables to the controller and, if applicable, the cables and hoses of the integrated energy supply system are connected to the combo box.

All connections are implemented as connectors in order to enable the main axis motors to be exchanged quickly and reliably. The electrical installations also include a protective circuit. The ground conductors to the robot are connected to the base frame by means of ring cable lugs and setscrews.

Options

The robot can be fitted and operated with various options, such as an integrated energy supply system for axes 1 to 3, an energy supply system for axes 3 to 6, or working range limitation systems for axes A1, A2 and A3. The options are described in separate documentation.

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 10 R1420	■ Technical data (>>> 4.2 "Technical data, KR 10 R1420" Page 16) ■ Plates and labels (>>> 4.8 "Plates and labels" Page 75) ■ Stopping distances and times (>>> 4.10.3 "Stopping distances and times, KR 10 R1420" Page 79)
KR 8 R1620	■ Technical data (>>> 4.3 "Technical data, KR 8 R1620" Page 25) ■ Plates and labels (>>> 4.8 "Plates and labels" Page 75) ■ Stopping distances and times (>>> 4.10.4 "Stopping distances and times, KR 8 R1620" Page 85)
KR 6 R1820	■ Technical data (>>> 4.4 "Technical data, KR 6 R1820" Page 35) ■ Plates and labels (>>> 4.8 "Plates and labels" Page 75) ■ Stopping distances and times (>>> 4.10.5 "Stopping distances and times, KR 6 R1820" Page 90)
KR 10 R1420 HP	■ Technical data (>>> 4.5 "Technical data, KR 10 R1420 HP" Page 45) ■ Plates and labels (>>> 4.8 "Plates and labels" Page 75) ■ Stopping distances and times (>>> 4.10.6 "Stopping distances and times, KR 10 R1420 HP" Page 95)
KR 8 R1620 HP	■ Technical data (>>> 4.6 "Technical data, KR 8 R1620 HP" Page 55) ■ Plates and labels (>>> 4.8 "Plates and labels" Page 75) ■ Stopping distances and times (>>> 4.10.7 "Stopping distances and times, KR 8 R1620 HP" Page 100)
KR 6 R1820 HP	■ Technical data (>>> 4.7 "Technical data, KR 6 R1820 HP" Page 65) ■ Plates and labels (>>> 4.8 "Plates and labels" Page 75) ■ Stopping distances and times (>>> 4.10.8 "Stopping distances and times, KR 6 R1820 HP" Page 105)

4.2 Technical data, KR 10 R1420

4.2.1 Basic data, KR 10 R1420

Basic data

	KR 10 R1420
Number of axes	6
Number of controlled axes	6
Volume of working envelope	10.64 m³
Pose repeatability (ISO 9283)	± 0.04 mm
Weight	approx. 160 kg
Rated payload	10 kg
Maximum reach	1420 mm
Protection rating	IP54
Protection rating, in-line wrist	IP54
Sound level	< 75 dB (A)
Mounting position	Floor; Ceiling; Wall
Footprint	333.5 mm x 307 mm
Permissible angle of inclination	-
Default color	Base frame: black (RAL 9005); Moving parts: KUKA orange 2567
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: #KR10R1420 C4

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3
Ambient temperature	
During operation	5 °C to 45 °C (278 K to 318 K)
During storage/transportation	-20 °C to 60 °C (253 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 4 mm^2 (can be ordered as an option)		M4 ring cable lug at both ends

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

Minimum bending radius	5x D

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

4.2.2 Axis data, KR 10 R1420

Axis data

Motion range	
A1	±170 °
A2	-185 ° / 65 °
A3	-137 ° / 163 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	220 °/s
A2	210 °/s
A3	270 °/s
A4	381 °/s
A5	311 °/s
A6	492 °/s

The direction of motion and the arrangement of the individual axes may be noted from the following diagram.

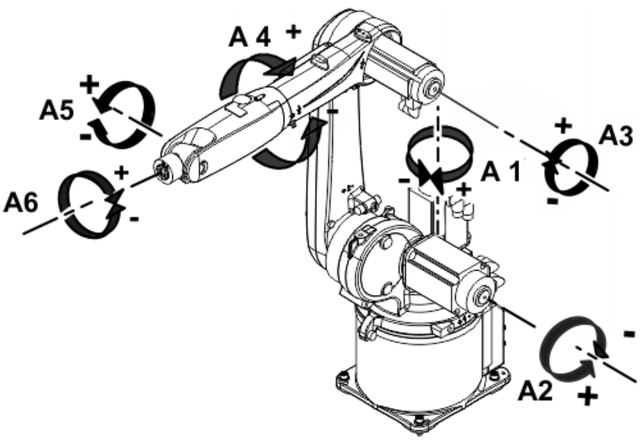


Fig. 4-1: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	38 °
A2	-110 °
A3	110 °
A4	0 °
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.

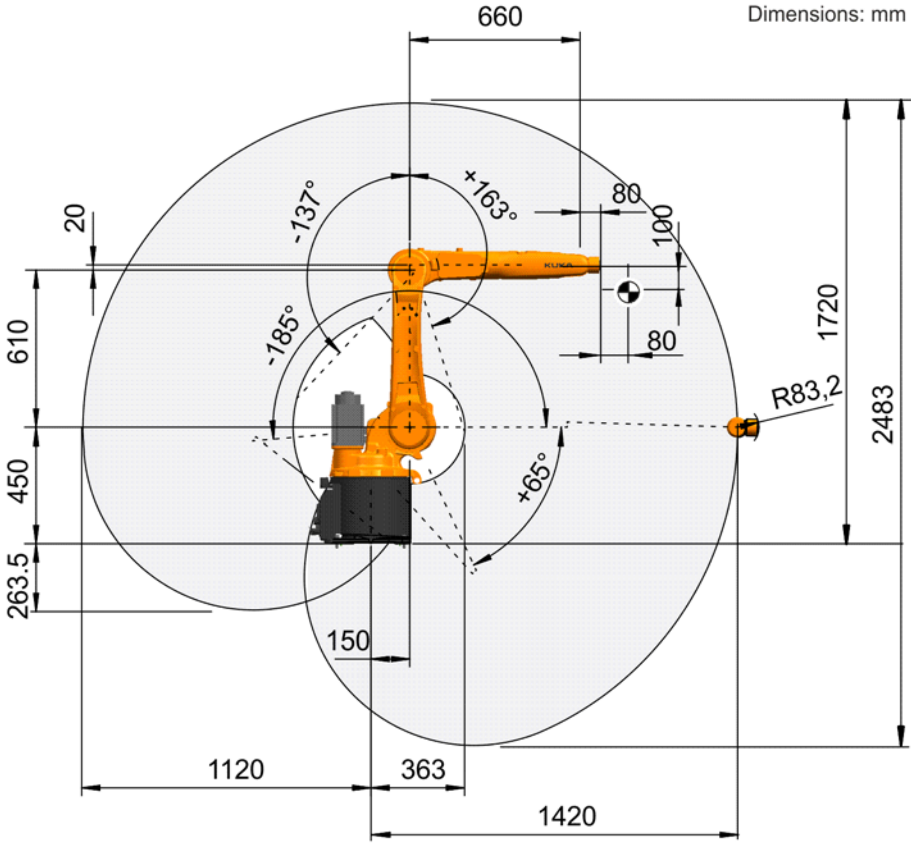


Fig. 4-2: Working envelope, side view, KR 10 R1420

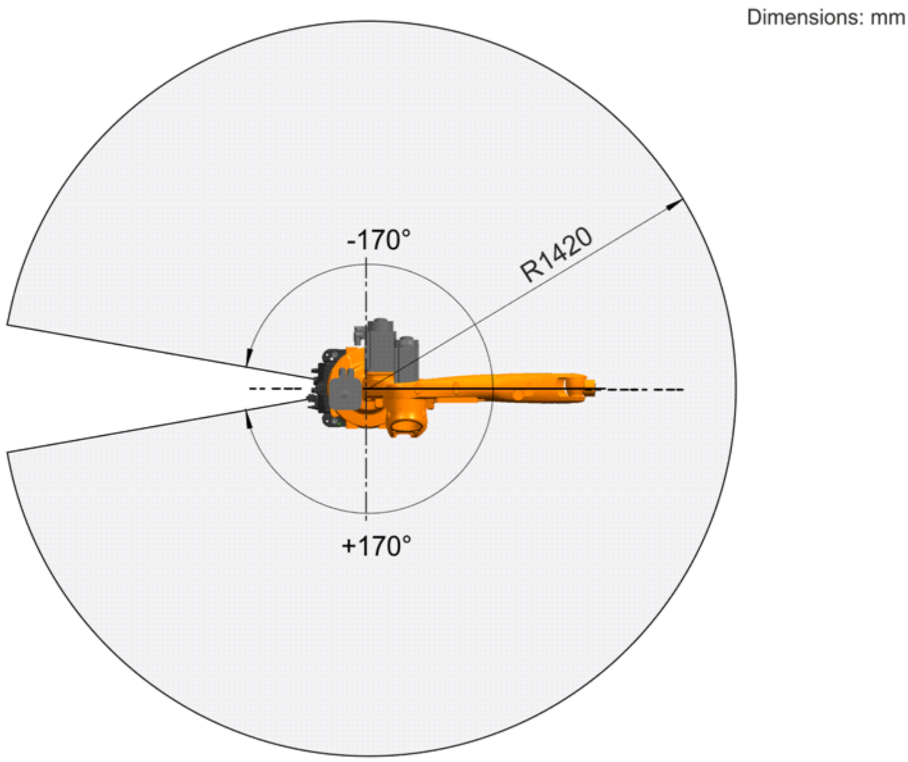


Fig. 4-3: Working envelope, top view, KR 10 R1420

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). This type of installation results in limitations to the range of motion in the plus and minus directions about axis 1. 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. A 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.

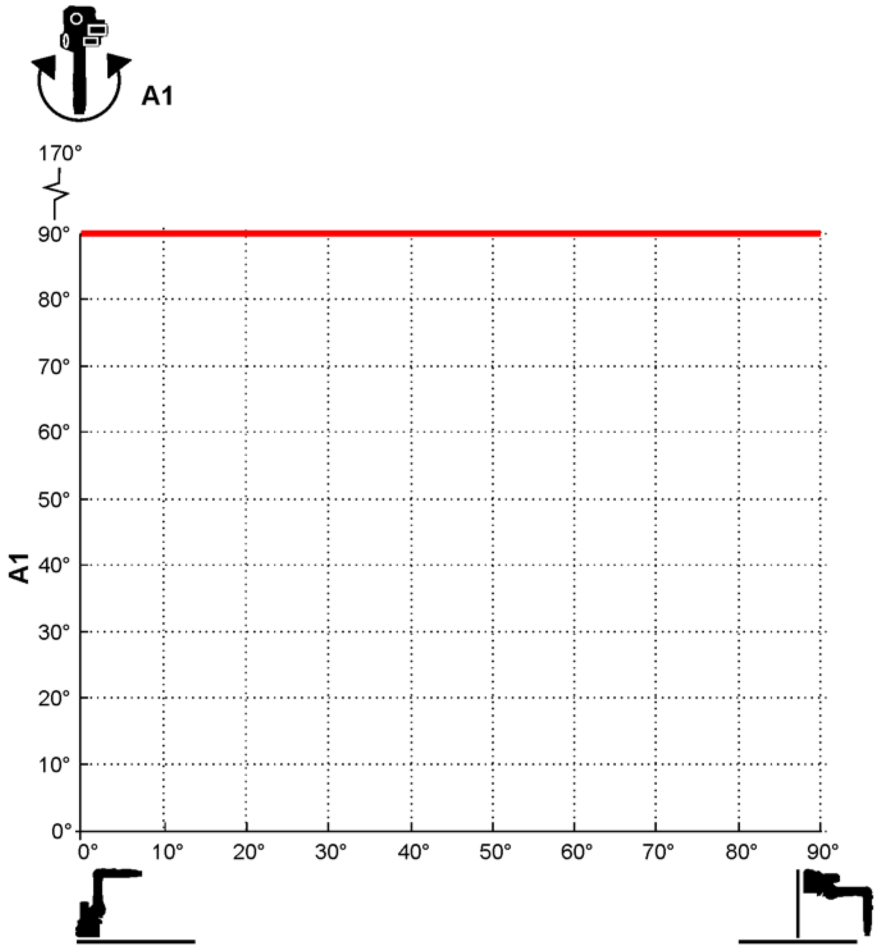


Fig. 4-4: Motion range, axis 1 inclined

4.2.3 Payloads, KR 10 R1420

Payloads

Rated payload	10 kg
Rated mass moment of inertia	0.1 kgm²
Rated total load	20 kg
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	20 kg
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	15 kg
Rated supplementary load, arm	10 kg
Maximum supplementary load, arm	15 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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. Refer to the payload diagram for the nominal distance.

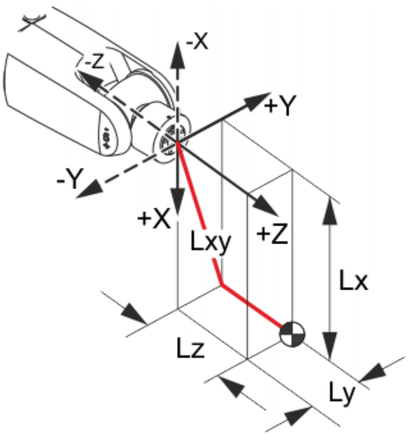


Fig. 4-5: Load center of gravity

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 the KUKA Roboter 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!

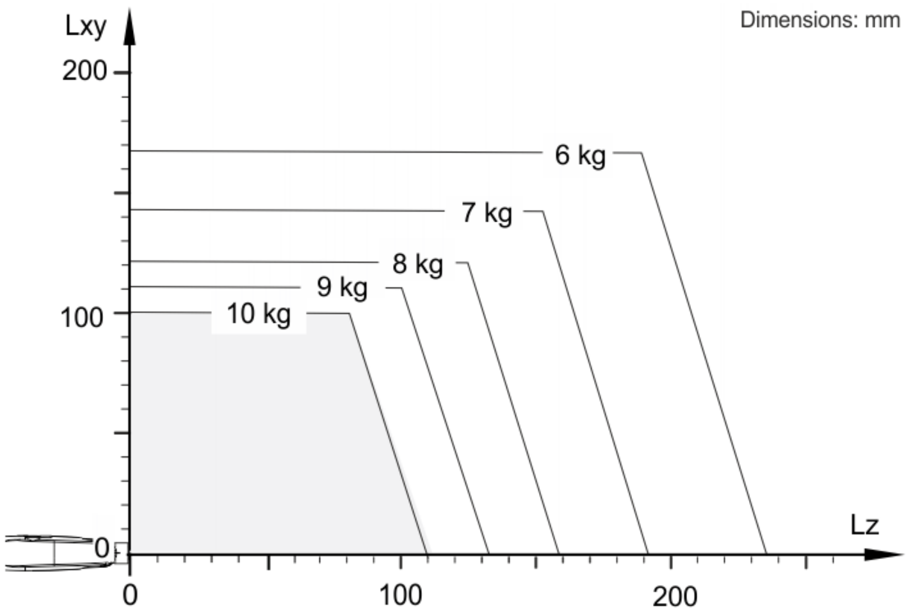


Fig. 4-6: Payload diagram, KR 10 R1420

In-line wrist

In-line wrist type	ZH 6/8/10 kpl.
Mounting flange	see drawing

Mounting flange

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

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.

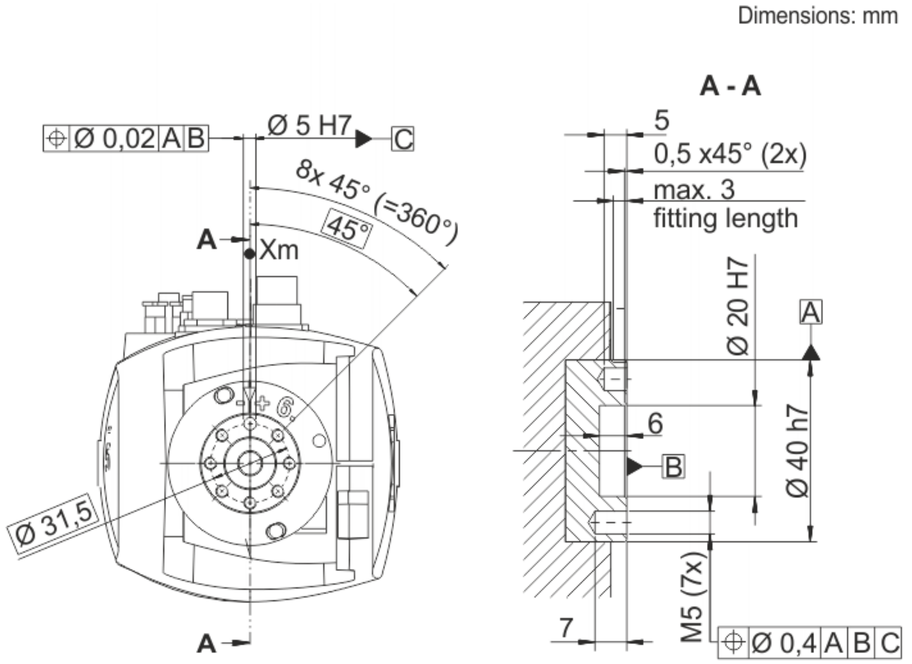


Fig. 4-7: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. 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.

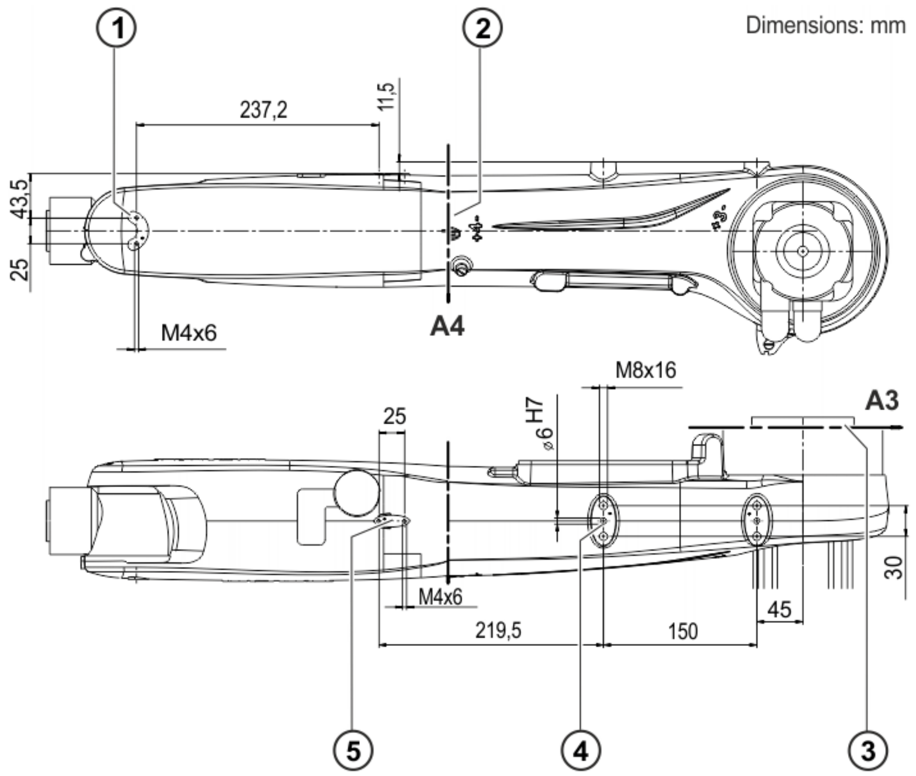


Fig. 4-8: Fastening the supplementary load, arm

1 Mounting surface on IW, energy supply system only
2 Plane of rotation, axis 4
3 Plane of rotation, axis 3

4 Mounting surface on arm
5 Mounting surface on IW, energy supply system only

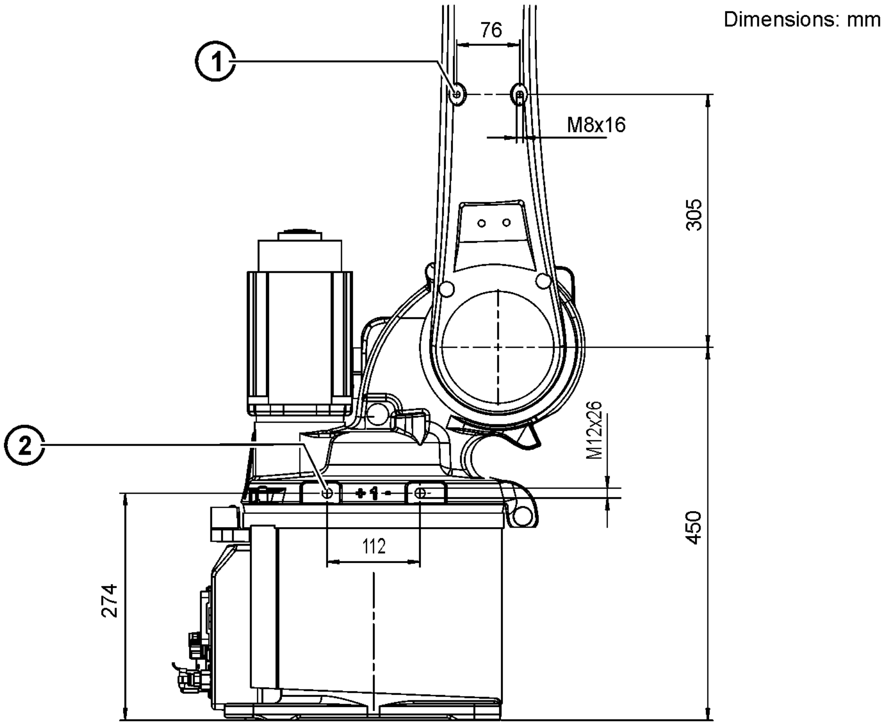


Fig. 4-9: Fastening the supplementary load, link arm/rotating column

1 Mounting surface on link arm
2 Mounting surface on rotating column, both sides

4.2.4 Loads acting on the mounting base KR 10 R1420

Loads acting on the mounting base

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)	2469 N
F(v max)	2599 N
F(h normal)	1114 N
F(h max)	1376 N
M(k normal)	1523 Nm
M(k max)	2040 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for ceiling mounting position	
F(v normal)	2712 N
F(v max)	2794 N
F(h normal)	1282 N
F(h max)	1624 N
M(k normal)	1832 Nm
M(k max)	2329 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm

Foundation loads for wall mounting position	
F(v normal)	800 N
F(v max)	1000 N
F(h normal)	2748 N
F(h max)	2987 N
M(k normal)	2562 Nm
M(k max)	2701 Nm
M(r normal)	947 Nm
M(r max)	1126 Nm

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

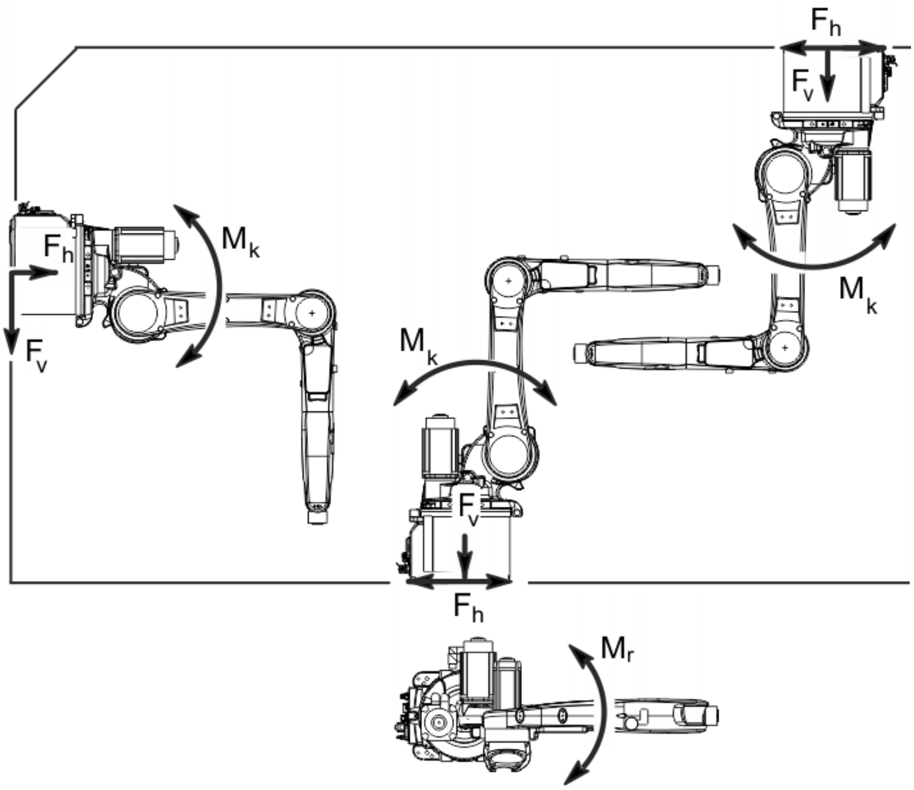


Fig. 4-10: Foundation loads

> **⚠ 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.

4.2.5 Transport dimensions, KR 10 R1420

The transport dimensions for the robots can be noted from the following diagrams (>>> Fig. 4-11). 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. The following diagram shows the dimensions of the robot when it stands on the floor without wooden transport blocks.

Dimensions: mm

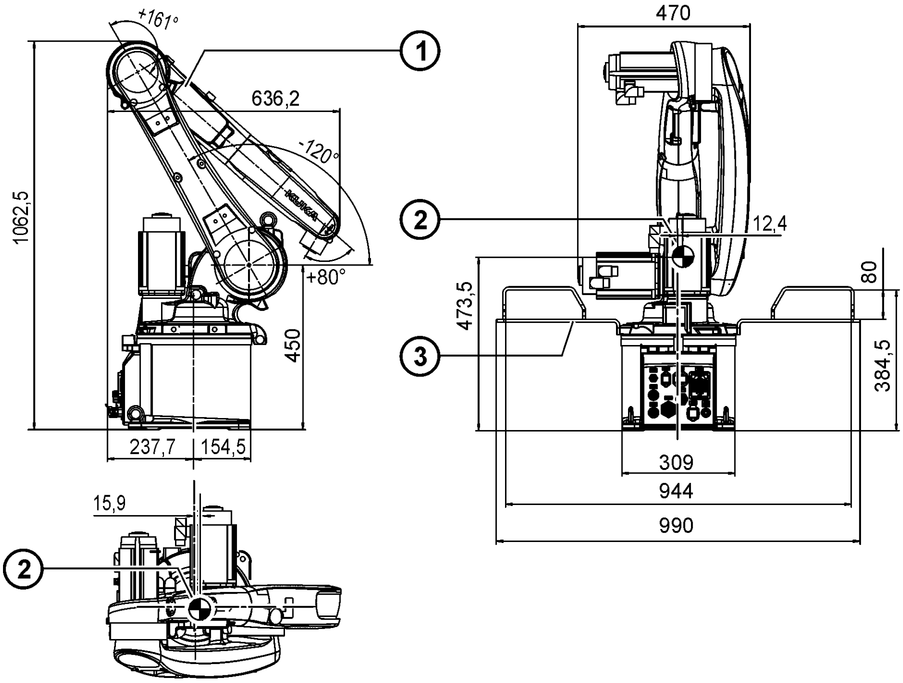


Fig. 4-11: Transport dimensions

1 Robot
2 Center of gravity
3 Fork slots

4.3 Technical data, KR 8 R1620

4.3.1 Basic data, KR 8 R1620

Basic data

	KR 8 R1620
Number of axes	6
Number of controlled axes	6
Volume of working envelope	15.93 m³
Pose repeatability (ISO 9283)	± 0.04 mm
Weight	approx. 165 kg
Rated payload	8 kg
Maximum reach	1620 mm
Protection rating	IP54
Protection rating, in-line wrist	IP54
Sound level	< 75 dB (A)
Mounting position	Floor; Ceiling; Wall
Footprint	333.5 mm x 307 mm
Permissible angle of inclination	-
Default color	Base frame: black (RAL 9005); Moving parts: KUKA orange 2567

	KR 8 R1620
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: #KR8R1620 C4

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3
Ambient temperature	
During operation	5 °C to 45 °C (278 K to 318 K)
During storage/transportation	-20 °C to 60 °C (253 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 4 mm^2 (can be ordered as an option)		M4 ring cable lug at both ends

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

Minimum bending radius	5x D

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

4.3.2 Axis data, KR 8 R1620

Axis data

Motion range	
A1	±170 °
A2	-185 ° / 65 °
A3	-137 ° / 163 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	220 °/s
A2	210 °/s
A3	270 °/s
A4	381 °/s
A5	311 °/s
A6	492 °/s

The direction of motion and the arrangement of the individual axes may be noted from the following diagram.

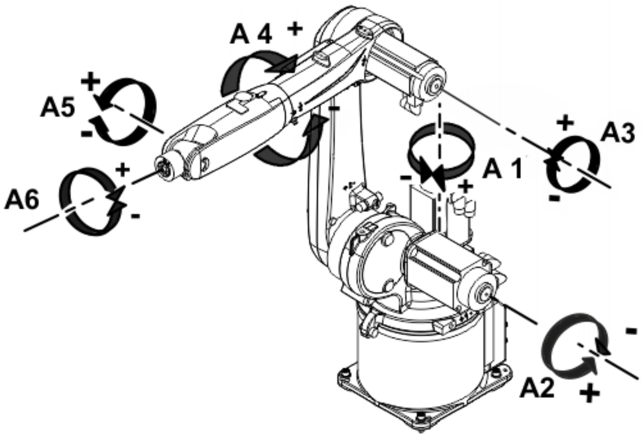


Fig. 4-12: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	38 °
A2	-110 °
A3	110 °
A4	0 °
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.

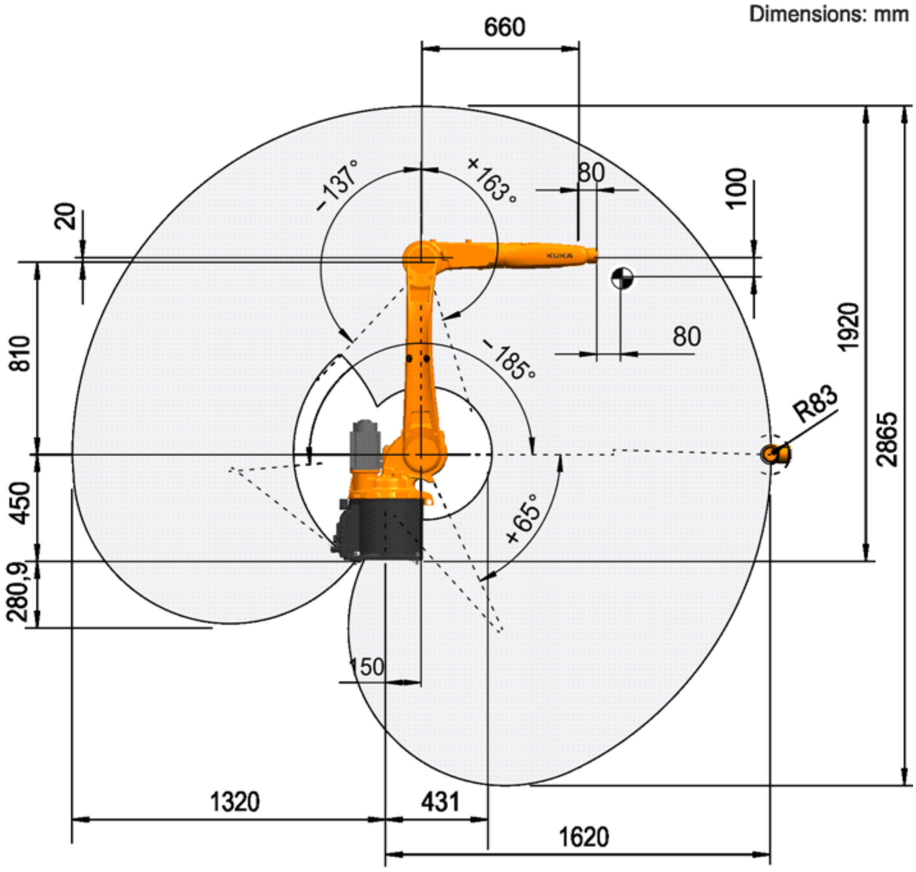


Fig. 4-13: Working envelope, side view, KR 8 R1620

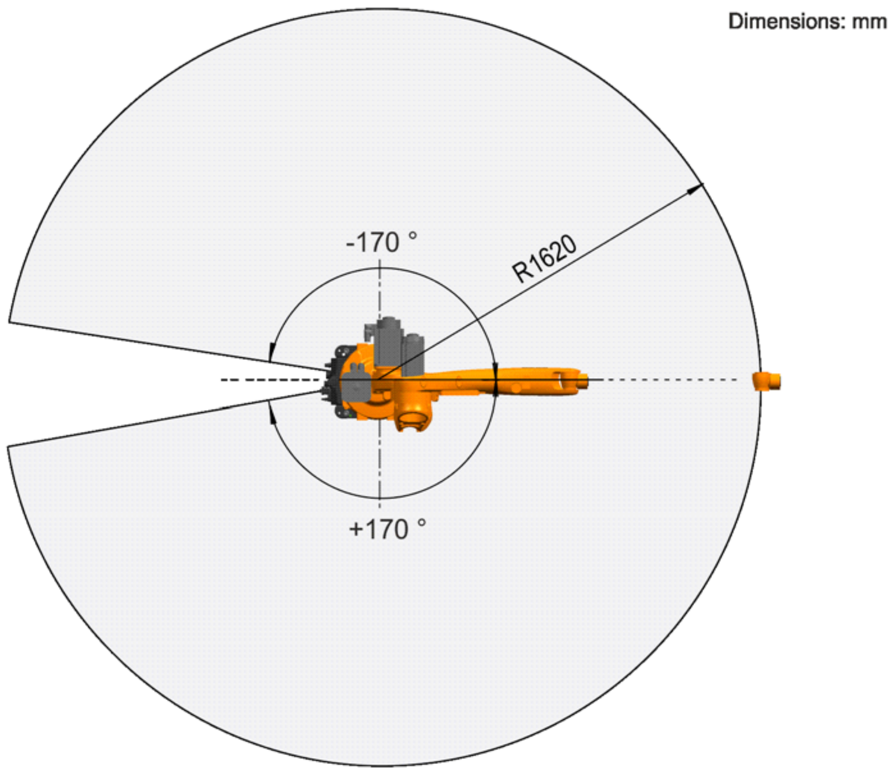


Fig. 4-14: Working envelope, top view, KR 8 R1620

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). This type of installation results in limitations to the range of motion in the plus and minus directions about axis 1. 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. A 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.

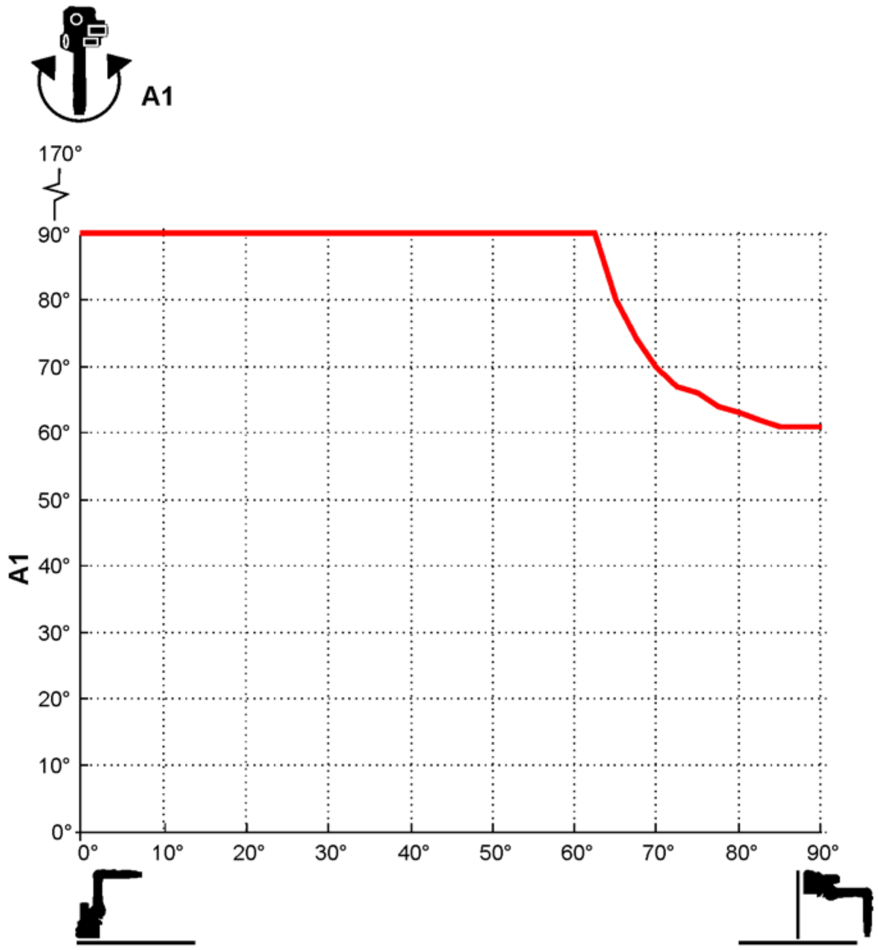


Fig. 4-15: Motion range, axis 1 at an inclined position

4.3.3 Payloads, KR 8 R1620

Payloads

Rated payload	8 kg
Rated mass moment of inertia	0.1 kgm²
Rated total load	18 kg

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	20 kg
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	15 kg
Rated supplementary load, arm	10 kg
Maximum supplementary load, arm	15 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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. Refer to the payload diagram for the nominal distance.

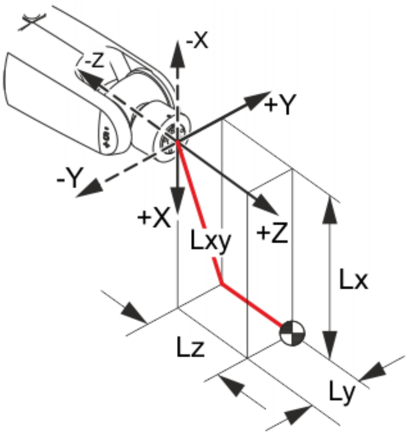


Fig. 4-16: Load center of gravity

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 the KUKA Roboter 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!

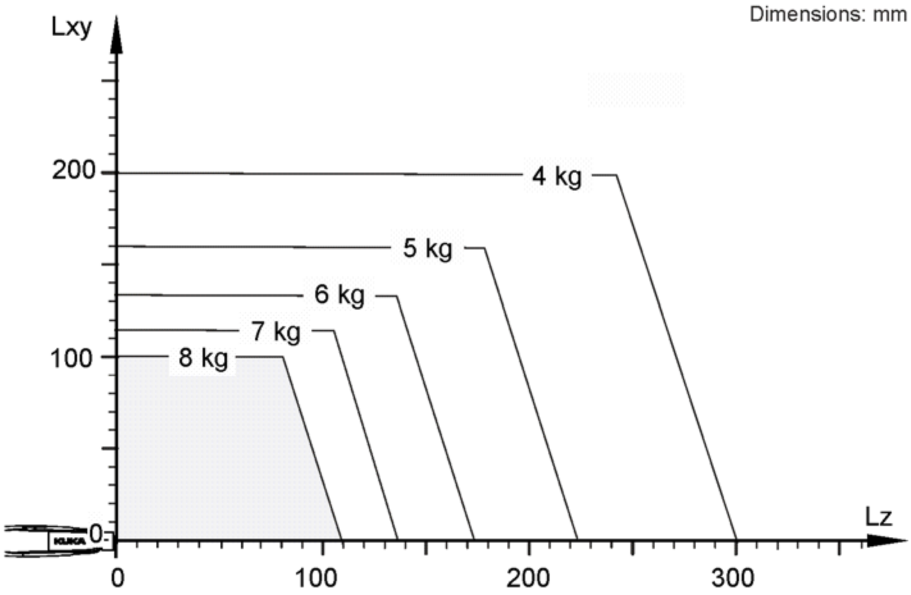


Fig. 4-17: Payload diagram, KR 8 R1620

In-line wrist

In-line wrist type	ZH 6/8/10 kpl.
Mounting flange	see drawing

Mounting flange

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

The mounting flange is depicted (>>> Fig. 4-18) 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.

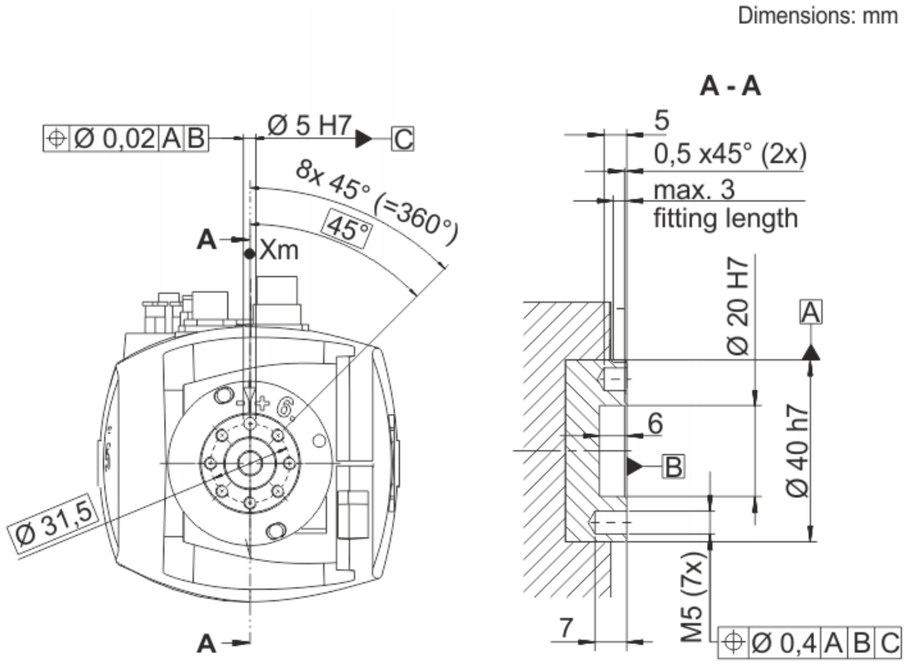


Fig. 4-18: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. 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.

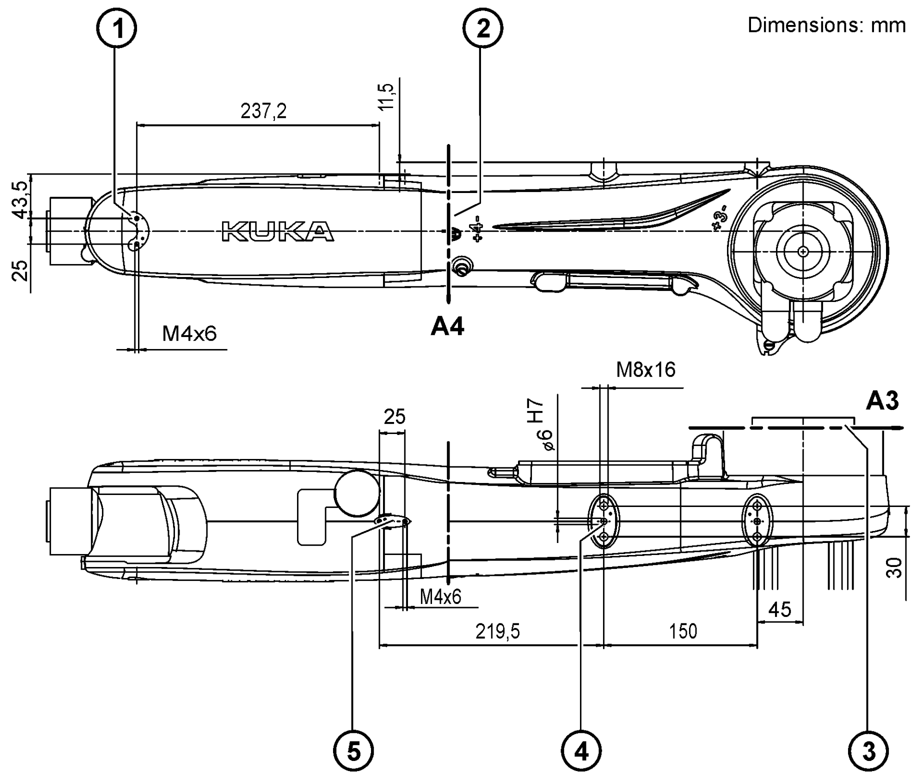


Fig. 4-19: Fastening the supplementary load on the arm

1 Mounting surface on IW, energy supply system only
2 Plane of rotation, axis 4
3 Plane of rotation, axis 3

4 Mounting surface on arm
5 Mounting surface on IW, energy supply system only

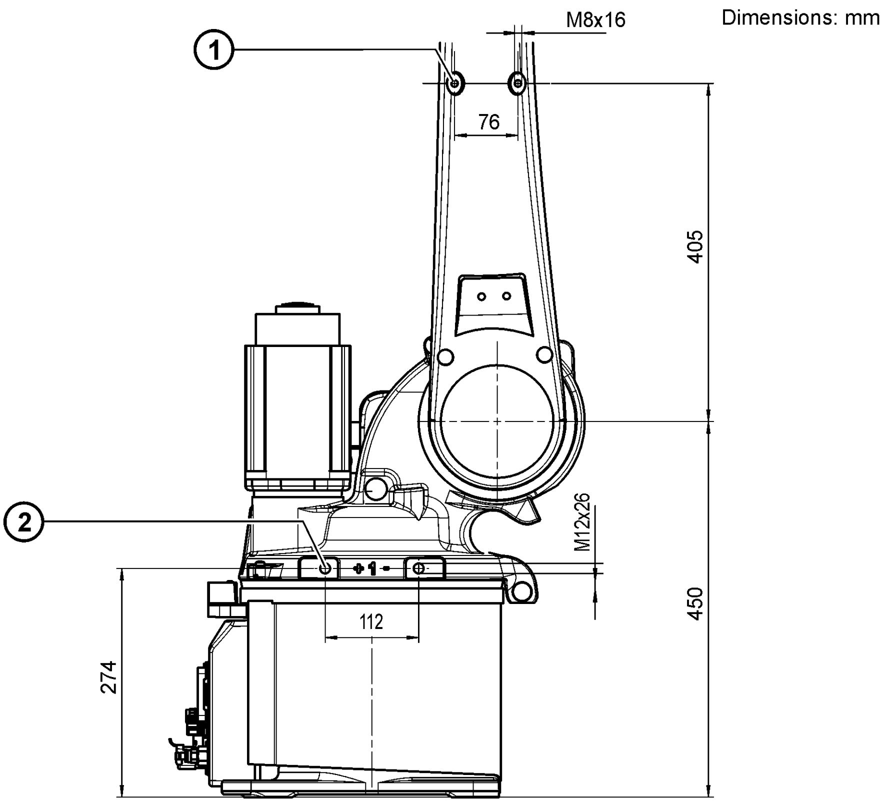


Fig. 4-20: Fastening the supplementary load on the link arm/rotating column

1 Mounting surface on link arm
2 Mounting surface on rotating column, both sides

4.3.4 Loads acting on the mounting base KR 8 R1620

Loads acting on the mounting base

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)	2469 N
F(v max)	2599 N
F(h normal)	1114 N
F(h max)	1376 N
M(k normal)	1523 Nm
M(k max)	2040 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for ceiling mounting position	
F(v normal)	2712 N
F(v max)	2794 N
F(h normal)	1282 N
F(h max)	1624 N
M(k normal)	1832 Nm

M(k max)	2329 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for wall mounting position	
F(v normal)	800 N
F(v max)	1000 N
F(h normal)	2748 N
F(h max)	2987 N
M(k normal)	2562 Nm
M(k max)	2701 Nm
M(r normal)	947 Nm
M(r max)	1126 Nm

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

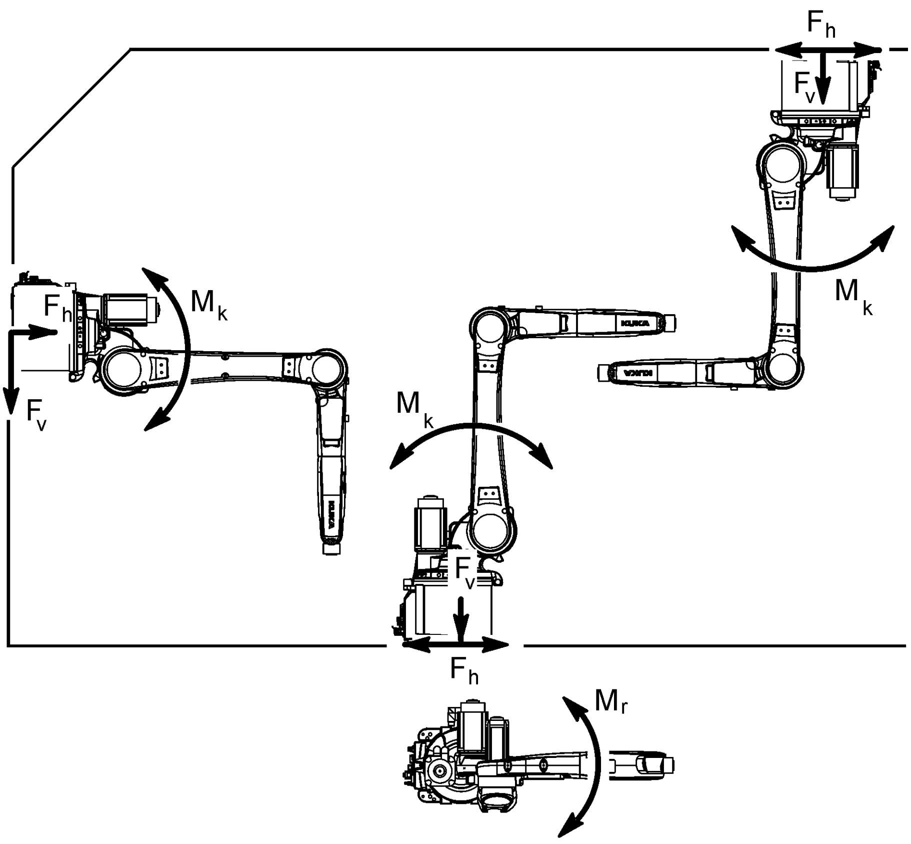


Fig. 4-21: Mounting base loads

> **⚠ 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.

4.3.5 Transport dimensions, KR 8 R1620

The transport dimensions for the robots can be noted from the following diagrams (>>> Fig. 4-22). 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. The following diagram shows the dimensions of the robot when it stands on the floor without wooden transport blocks.

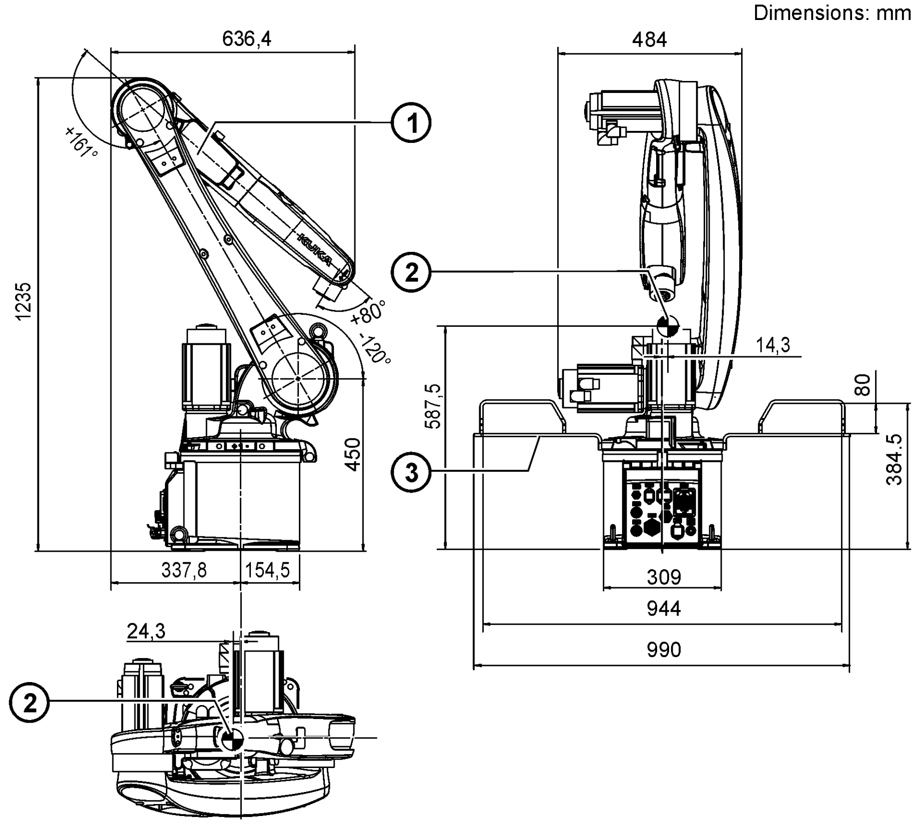


Fig. 4-22: Transport dimensions

1 Robot
2 Center of gravity
3 Fork slots

4.4 Technical data, KR 6 R1820

4.4.1 Basic data, KR 6 R1820

Basic data

	KR 6 R1820
Number of axes	6
Number of controlled axes	6
Volume of working envelope	22.97 m³
Pose repeatability (ISO 9283)	± 0.04 mm
Weight	approx. 168 kg
Rated payload	6 kg
Maximum reach	1820 mm
Protection rating	IP54
Protection rating, in-line wrist	IP54
Sound level	< 75 dB (A)

	KR 6 R1820
Mounting position	Floor; Ceiling; Wall
Footprint	333.5 mm x 307 mm
Permissible angle of inclination	-
Default color	Base frame: black (RAL 9005); Moving parts: KUKA orange 2567
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: #KR6R1820 C4

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3
Ambient temperature	
During operation	5 °C to 45 °C (278 K to 318 K)
During storage/transportation	-20 °C to 60 °C (253 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 4 mm^2 (can be ordered as an option)		M4 ring cable lug at both ends

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

Minimum bending radius	5x D

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

4.4.2 Axis data, KR 6 R1820

Axis data

Motion range	
A1	±170 °
A2	-185 ° / 65 °
A3	-137 ° / 163 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	

A1	220 °/s
A2	210 °/s
A3	270 °/s
A4	381 °/s
A5	311 °/s
A6	492 °/s

The direction of motion and the arrangement of the individual axes may be noted from the following diagram.

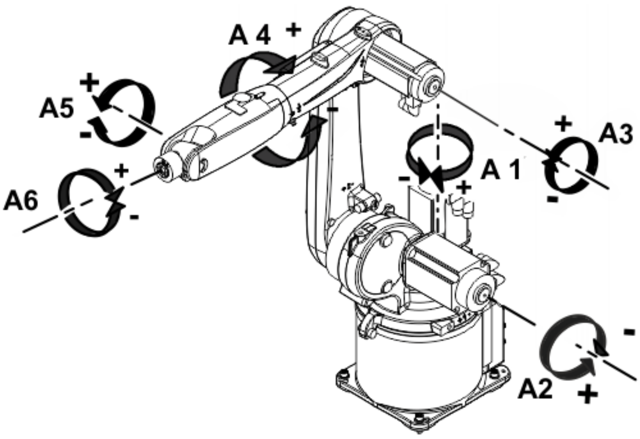


Fig. 4-23: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	38 °
A2	-110 °
A3	110 °
A4	0 °
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.

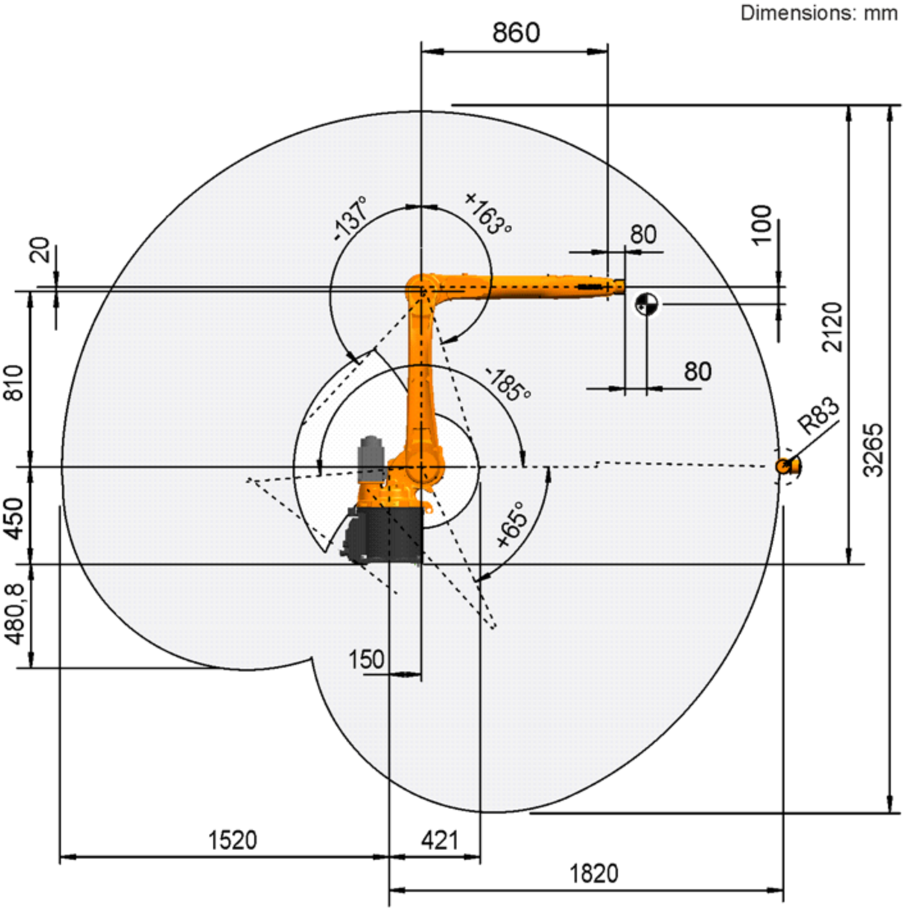


Fig. 4-24: Working envelope, side view, KR 6 R1820

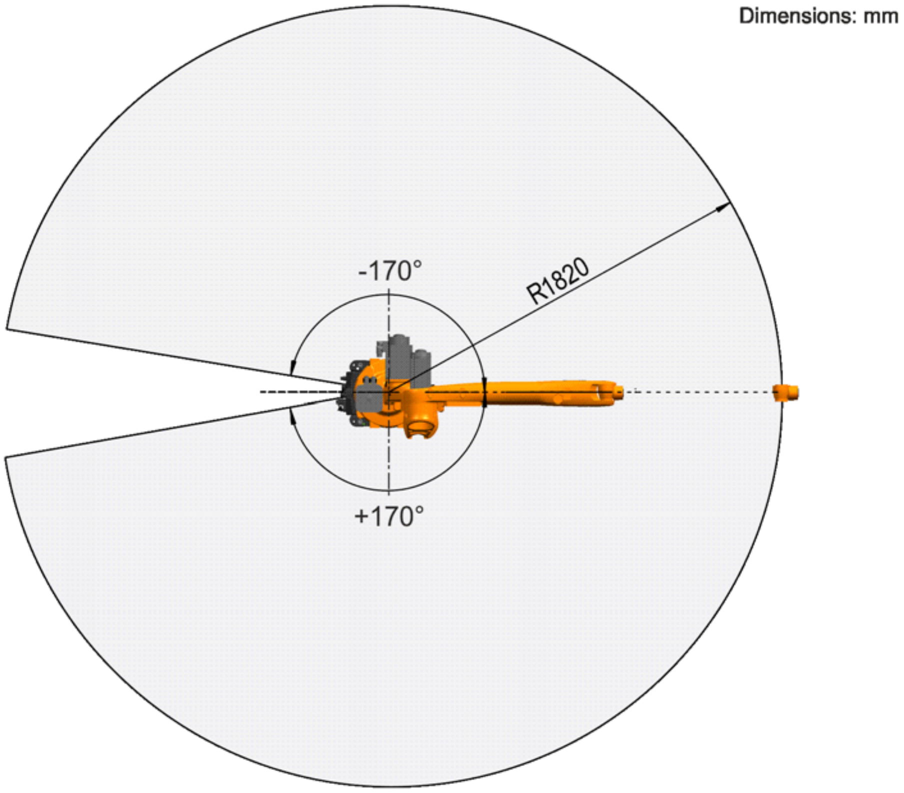


Fig. 4-25: Working envelope, top view, KR 6 R1820

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). This type of installation results in limitations to the range of motion in the plus and minus directions about axis 1. 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. A 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.

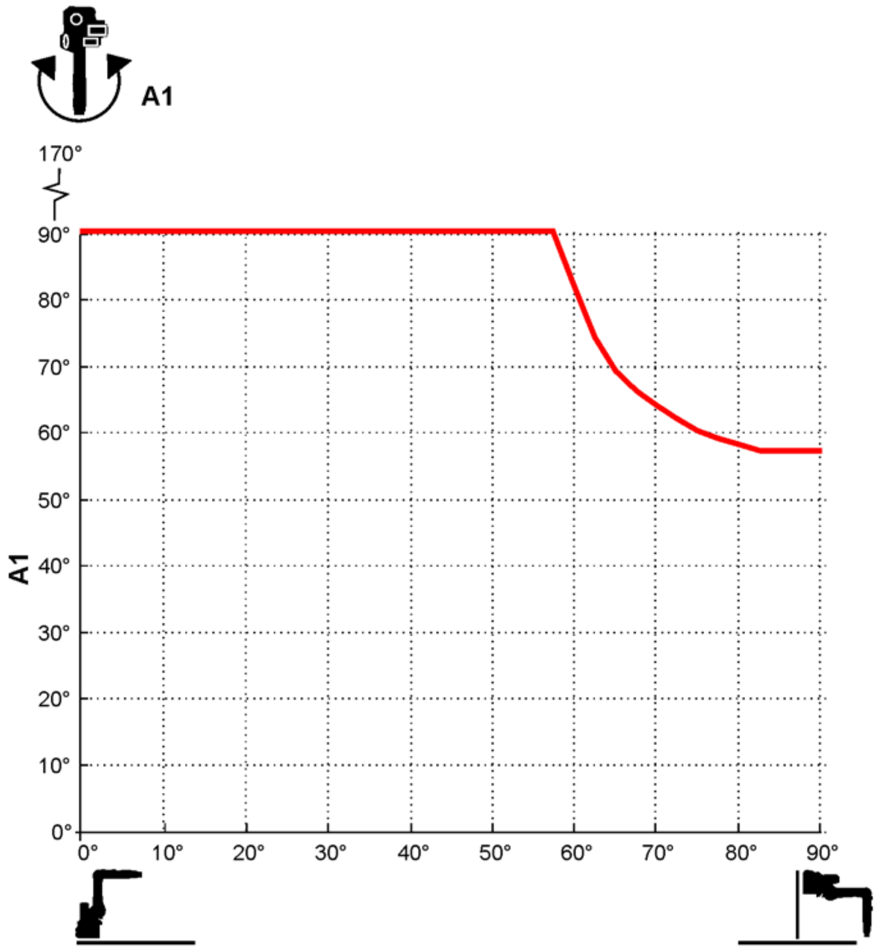


Fig. 4-26: Motion range, axis 1 inclined

4.4.3 Payloads, KR 6 R1820

Payloads

Rated payload	6 kg
Rated mass moment of inertia	0.1 kgm²
Rated total load	16 kg

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	20 kg
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	15 kg
Rated supplementary load, arm	10 kg
Maximum supplementary load, arm	15 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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. Refer to the payload diagram for the nominal distance.

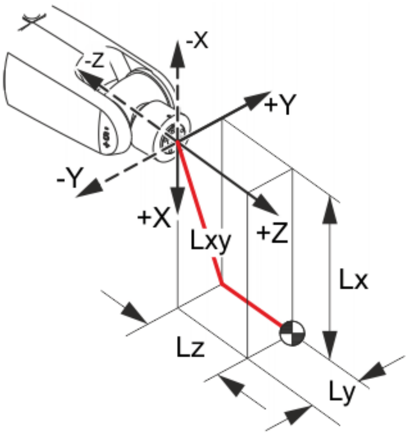


Fig. 4-27: Load center of gravity

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 the KUKA Roboter 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!

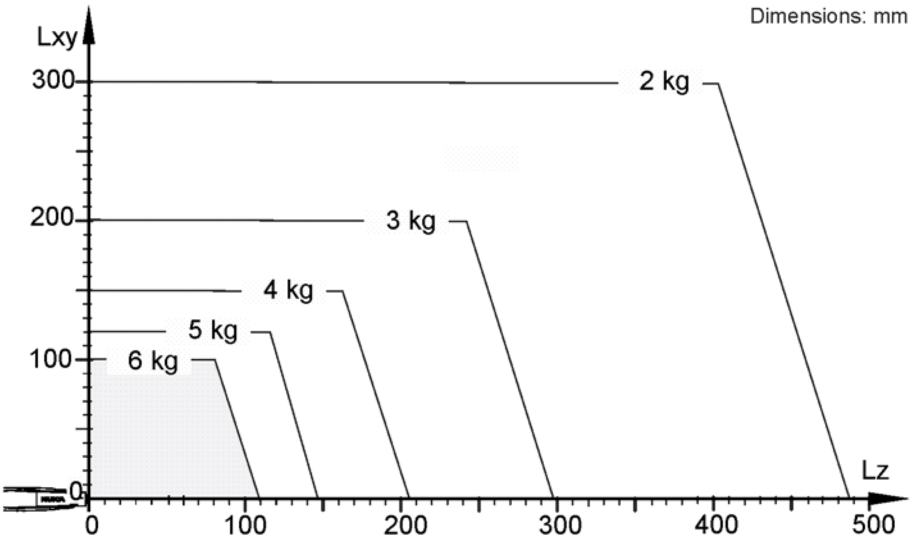


Fig. 4-28: Payload diagram, KR 6 R1820

In-line wrist

In-line wrist type	ZH 6/8/10 kpl.
Mounting flange	see drawing

Mounting flange

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

The mounting flange is depicted (>>> Fig. 4-29) 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.

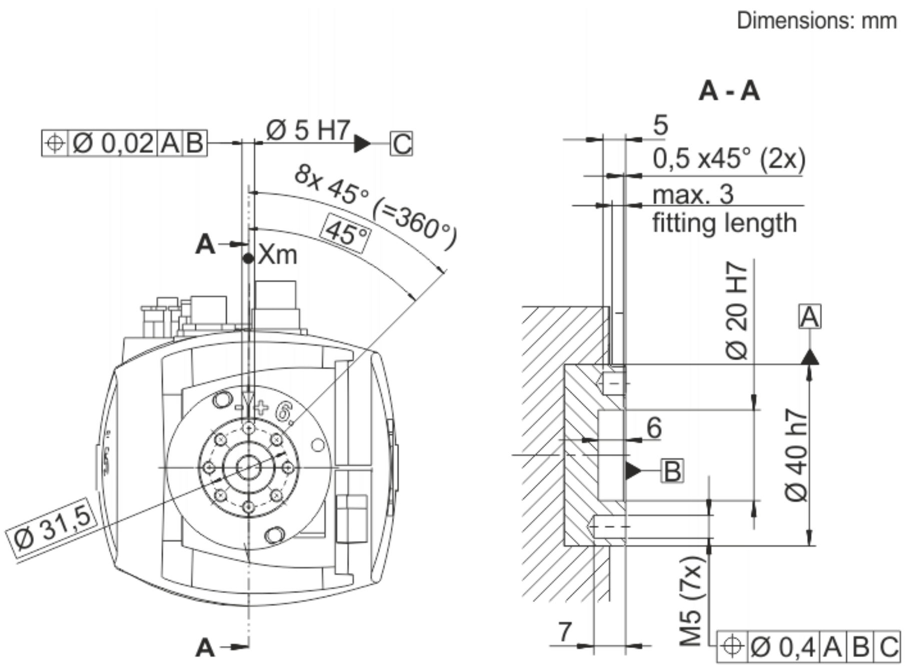


Fig. 4-29: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. 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.

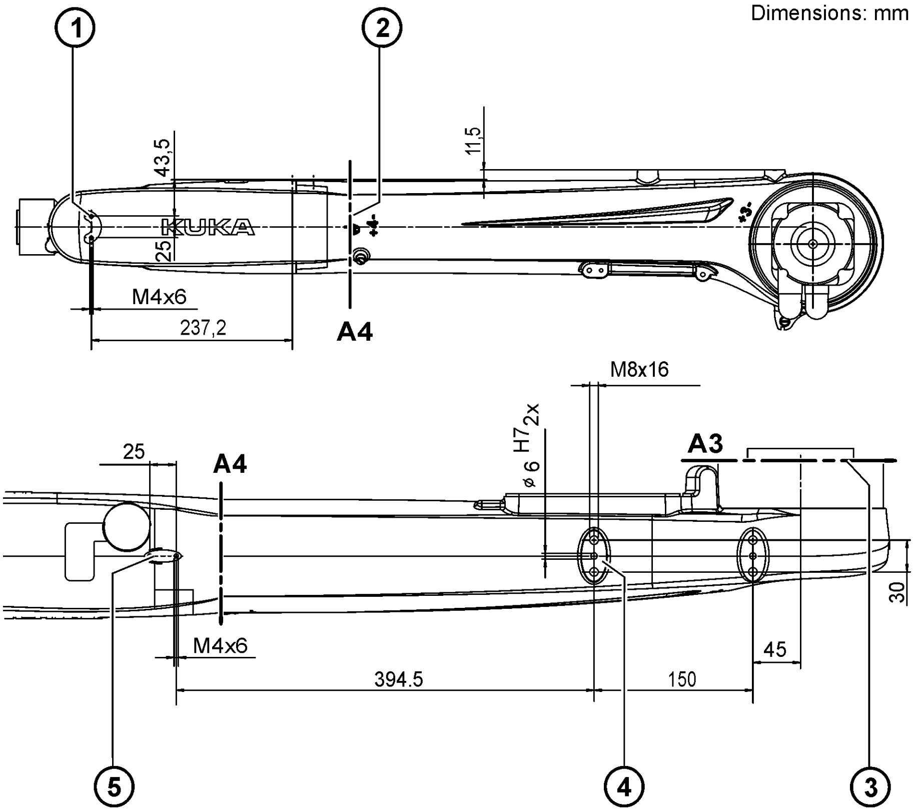


Fig. 4-30: Fastening the supplementary load on the arm

1. Mounting surface on IW, energy supply system only
2. Plane of rotation, axis 4
3. Plane of rotation, axis 3
4. Mounting surface on arm
5. Mounting surface on IW, energy supply system only

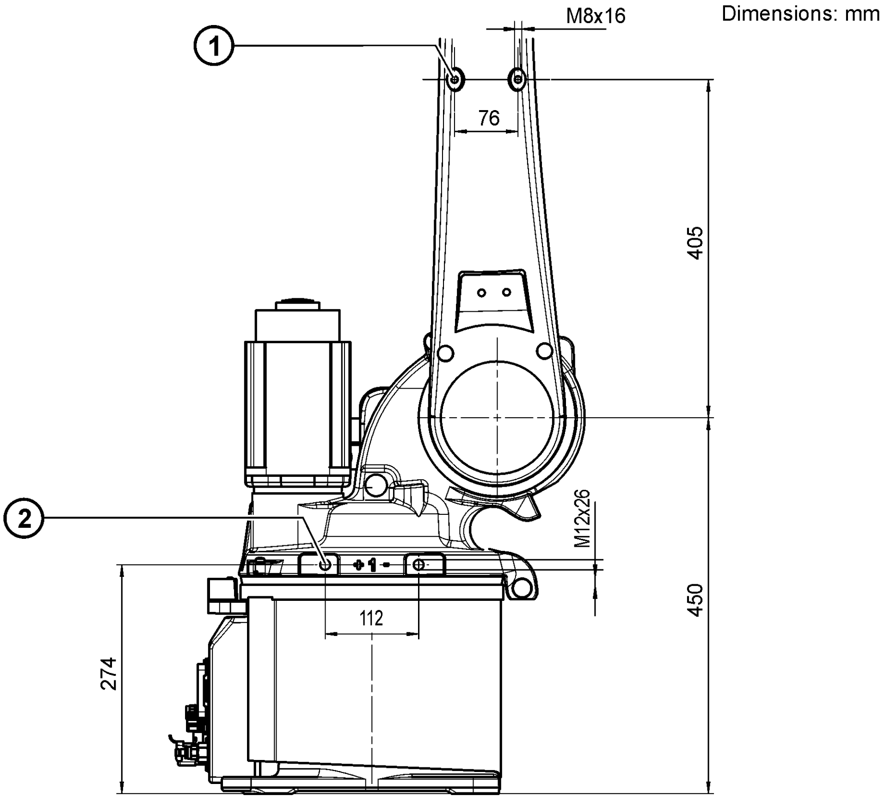


Fig. 4-31: Fastening the supplementary load on the link arm/rotating column

1 Mounting surface on link arm
2 Mounting surface on rotating column, both sides

4.4.4 Loads acting on the mounting base KR 6 R1820

Loads acting on the mounting base

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)	2469 N
F(v max)	2599 N
F(h normal)	1114 N
F(h max)	1376 N
M(k normal)	1523 Nm
M(k max)	2040 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for ceiling mounting position	
F(v normal)	2712 N
F(v max)	2794 N
F(h normal)	1282 N
F(h max)	1624 N
M(k normal)	1832 Nm
M(k max)	2329 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm

Foundation loads for wall mounting position	
F(v normal)	800 N
F(v max)	1000 N
F(h normal)	2748 N
F(h max)	2987 N
M(k normal)	2562 Nm
M(k max)	2701 Nm
M(r normal)	947 Nm
M(r max)	1126 Nm

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

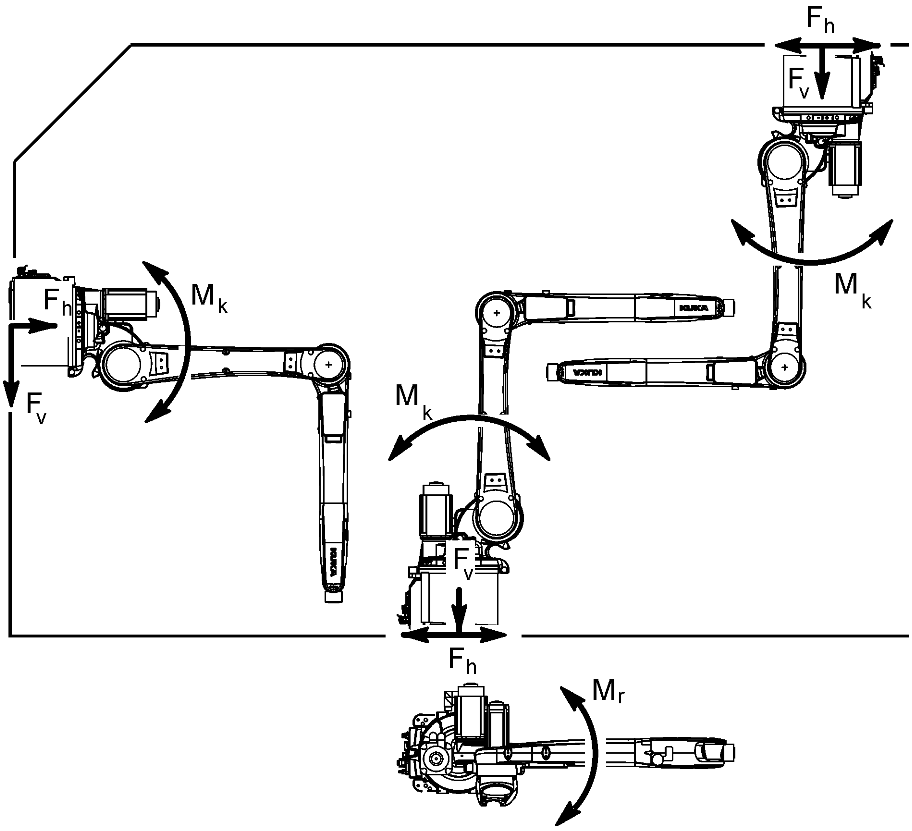


Fig. 4-32: Mounting base loads

> **⚠ 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.

4.4.5 Transport dimensions, KR 6 R1820

The transport dimensions for the robots can be noted from the following diagrams (>>> Fig. 4-33). 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. The following diagram shows the dimensions of the robot when it stands on the floor without wooden transport blocks.

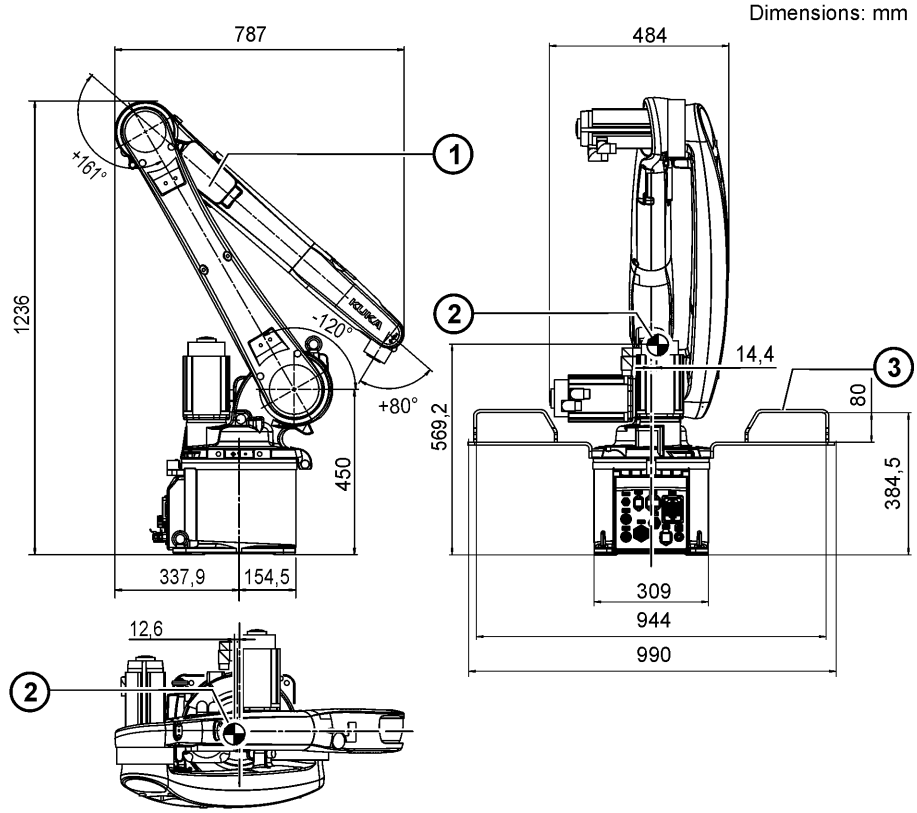


Fig. 4-33: Transport dimensions

1 Robot
2 Center of gravity
3 Fork slots

4.5 Technical data, KR 10 R1420 HP

4.5.1 Basic data, KR 10 R1420 HP

Basic data

	KR 10 R1420 HP
Number of axes	6
Number of controlled axes	6
Volume of working envelope	10.64 m³
Pose repeatability (ISO 9283)	± 0.04 mm
Weight	approx. 160 kg
Rated payload	10 kg
Maximum reach	1420 mm
Protection rating	IP65
Protection rating, in-line wrist	IP67
Sound level	< 75 dB (A)
Mounting position	Floor; Ceiling; Wall
Footprint	333.5 mm x 307 mm
Permissible angle of inclination	-

	KR 10 R1420 HP
Default color	Base frame: black (RAL 9005); Moving parts: KUKA orange 2567
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: #KR10R1420 C4

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3
Ambient temperature	
During operation	5 °C to 45 °C (278 K to 318 K)
During storage/transportation	-20 °C to 60 °C (253 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 4 mm^2 (can be ordered as an option)		M4 ring cable lug at both ends

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

Minimum bending radius	5x D

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

4.5.2 Axis data, KR 10 R1420 HP

Axis data

Motion range	
A1	±170 °
A2	-185 ° / 65 °
A3	-137 ° / 163 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	220 °/s
A2	210 °/s
A3	270 °/s
A4	381 °/s

A5	311 °/s
A6	492 °/s

The direction of motion and the arrangement of the individual axes may be noted from the following diagram.

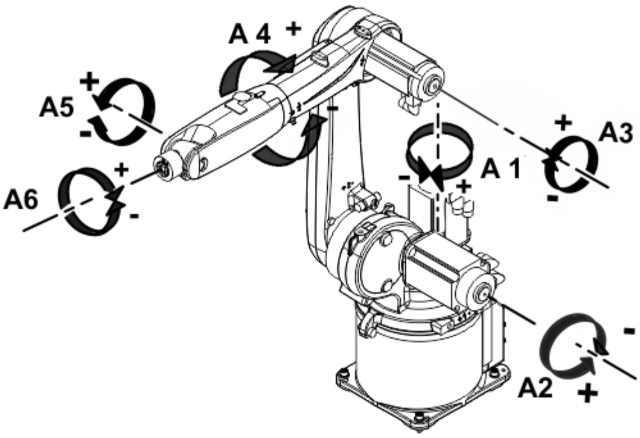


Fig. 4-34: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	38 °
A2	-110 °
A3	110 °
A4	0 °
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.

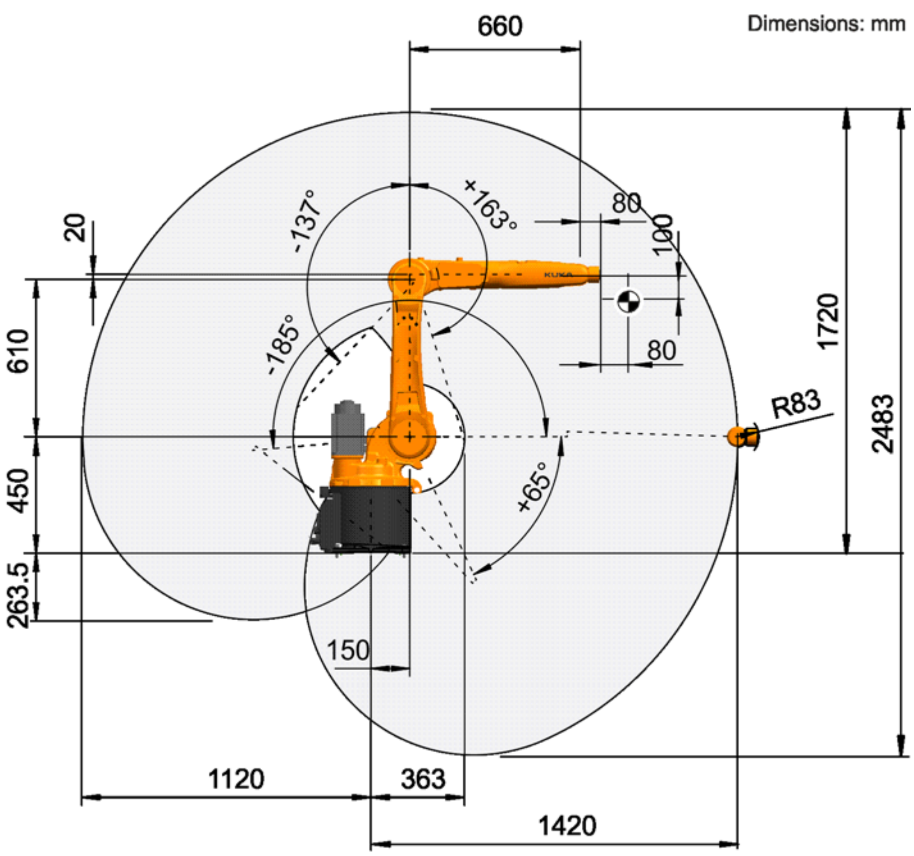


Fig. 4-35: Working envelope, side view, KR 10 R1420 HP

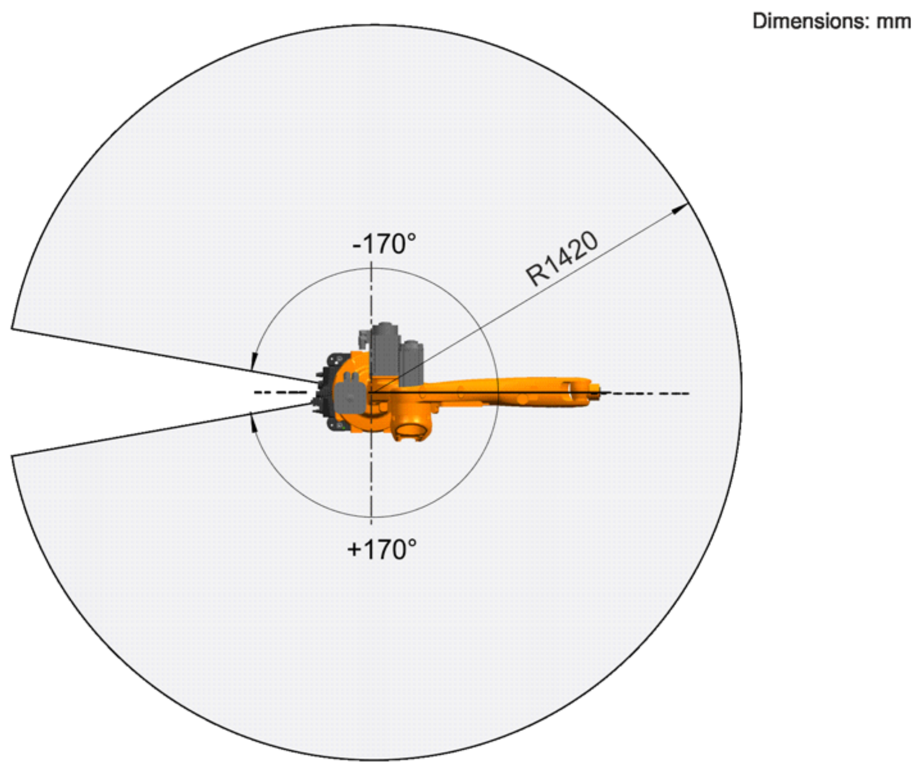


Fig. 4-36: Working envelope, top view, KR 10 R1420 HP

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). This type of installation results in limitations to the range of motion in the plus and minus directions about axis 1. 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. A 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.

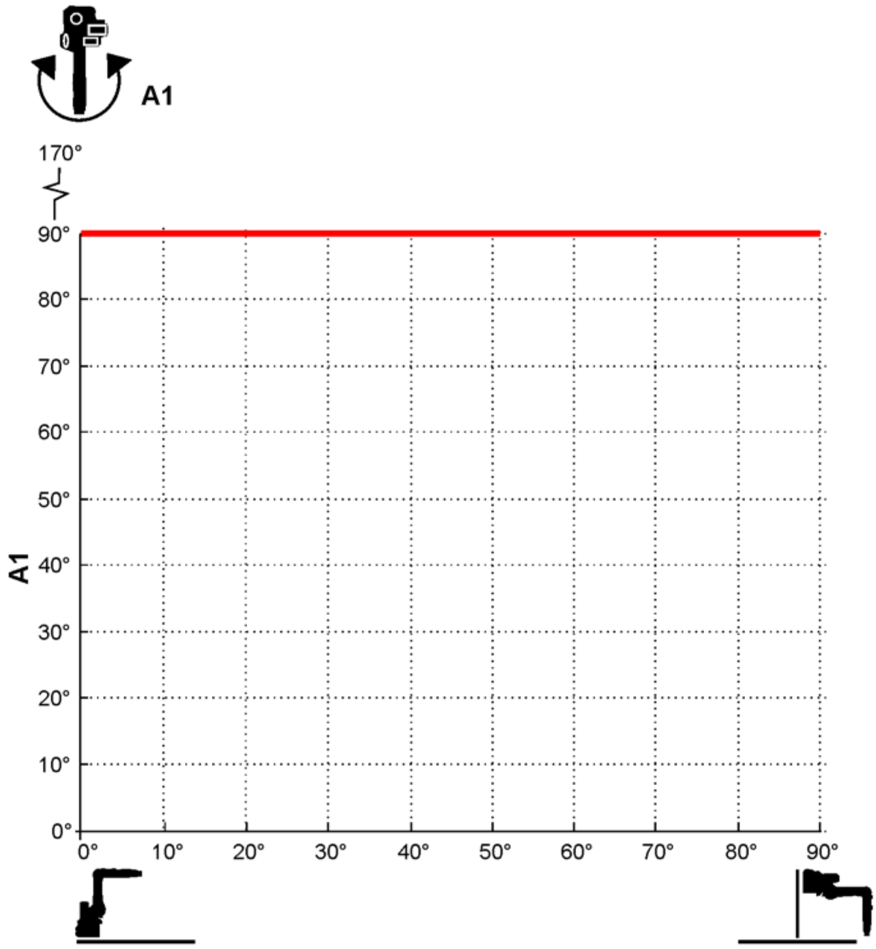


Fig. 4-37: Motion range, axis 1 at an inclined position

4.5.3 Payloads, KR 10 R1420 HP

Payloads

Rated payload	10 kg
Rated mass moment of inertia	0.1 kgm²
Rated total load	20 kg
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	20 kg
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	15 kg
Rated supplementary load, arm	10 kg
Maximum supplementary load, arm	15 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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. Refer to the payload diagram for the nominal distance.

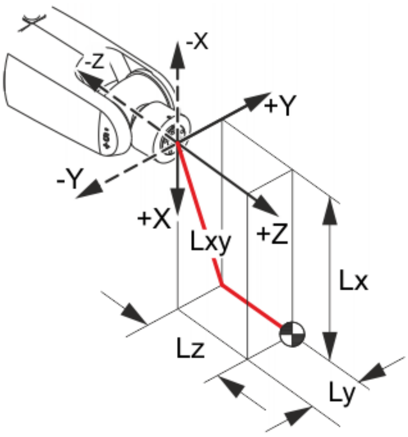


Fig. 4-38: Load center of gravity

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 the KUKA Roboter 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!

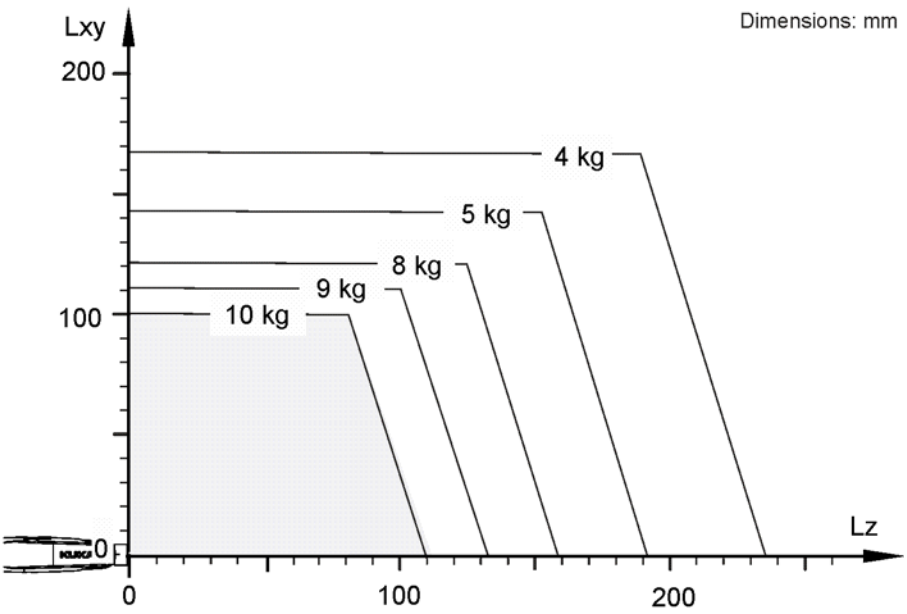


Fig. 4-39: Payload diagram, KR 10 R1420 HP

In-line wrist

In-line wrist type	ZH 6/8/10 HP kpl.
Mounting flange	see drawing

Mounting flange

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

The mounting flange is depicted (>>> Fig. 4-40) 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.

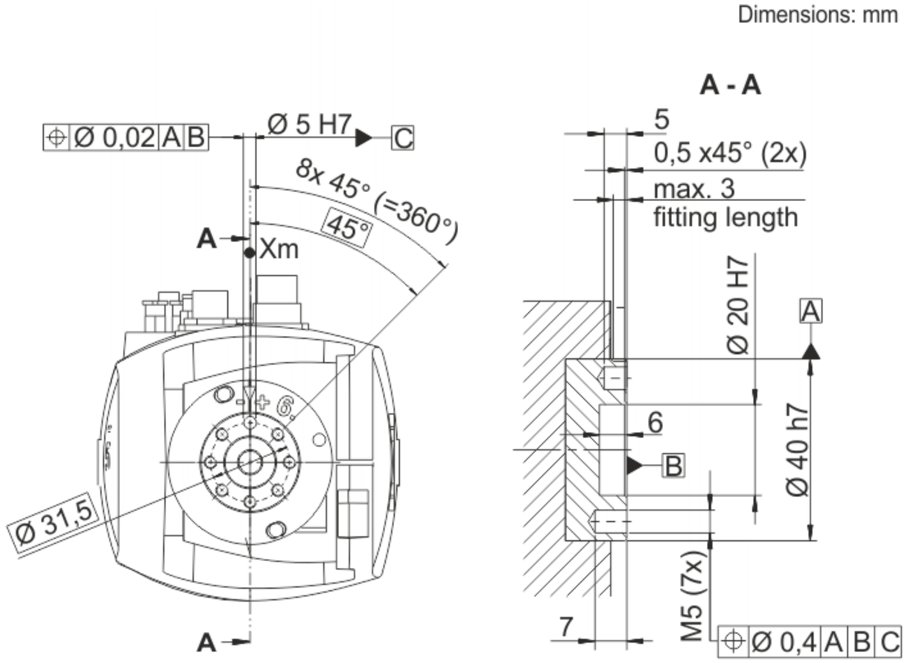


Fig. 4-40: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. 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.

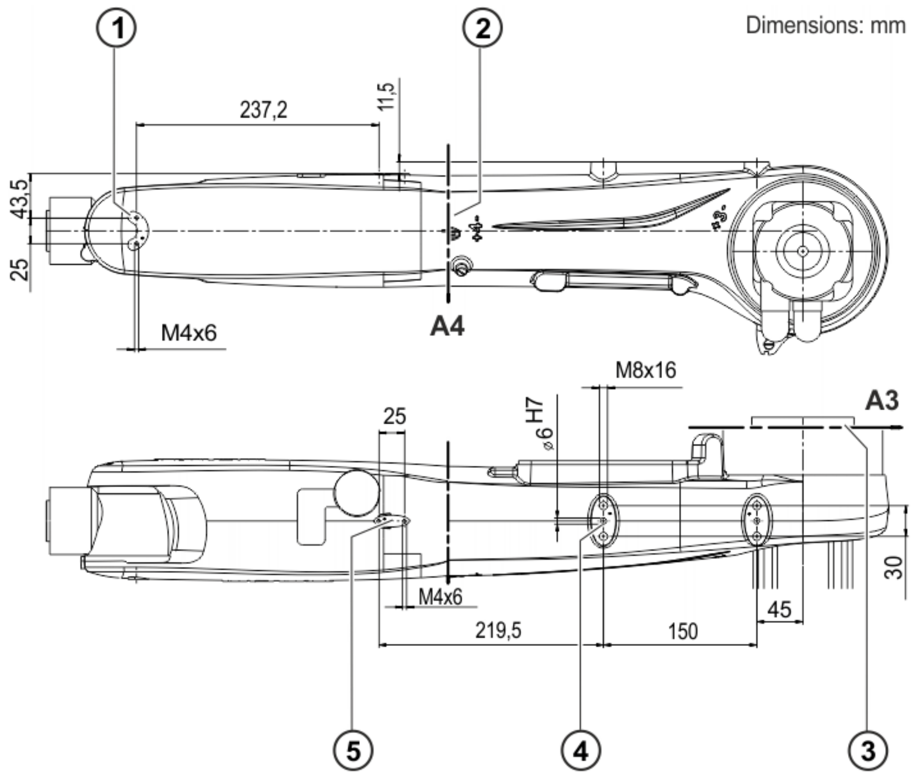


Fig. 4-41: Fastening the supplementary load, arm

1 Mounting surface on IW, energy supply system only
2 Plane of rotation, axis 4
3 Plane of rotation, axis 3

4 Mounting surface on arm
5 Mounting surface on IW, energy supply system only

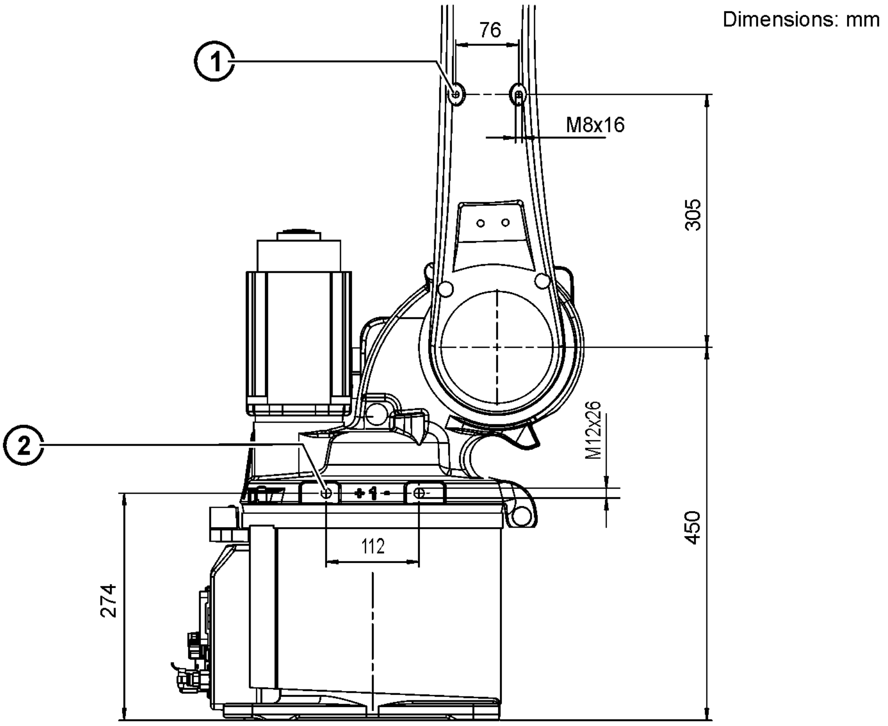


Fig. 4-42: Fastening the supplementary load, link arm/rotating column

1 Mounting surface on link arm
2 Mounting surface on rotating column, both sides

4.5.4 Loads acting on the mounting base KR 10 R1420 HP

Loads acting on the mounting base

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)	2469 N
F(v max)	2599 N
F(h normal)	1114 N
F(h max)	1376 N
M(k normal)	1523 Nm
M(k max)	2040 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for ceiling mounting position	
F(v normal)	2712 N
F(v max)	2794 N
F(h normal)	1282 N
F(h max)	1624 N
M(k normal)	1832 Nm
M(k max)	2329 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm

Foundation loads for wall mounting position	
F(v normal)	800 N
F(v max)	1000 N
F(h normal)	2748 N
F(h max)	2987 N
M(k normal)	2562 Nm
M(k max)	2701 Nm
M(r normal)	947 Nm
M(r max)	1126 Nm

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

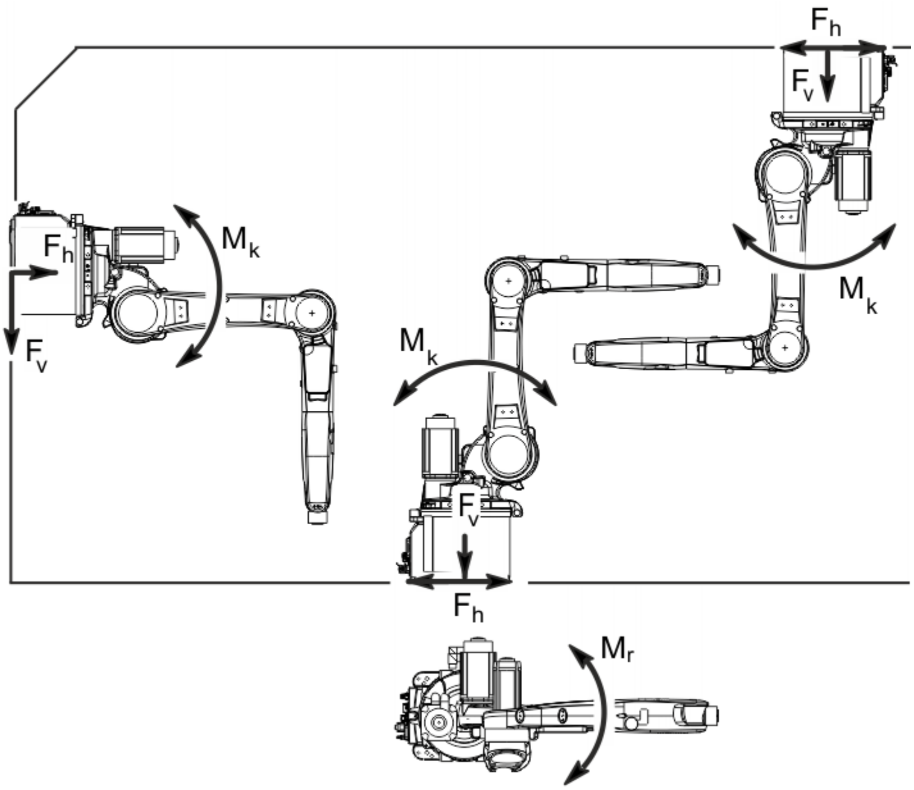


Fig. 4-43: Foundation loads

> **⚠ 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.

4.5.5 Transport dimensions, KR 10 R1420 HP

The transport dimensions for the robots can be noted from the following diagrams (>>> Fig. 4-44). 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. The following diagram shows the dimensions of the robot when it stands on the floor without wooden transport blocks.

Dimensions: mm

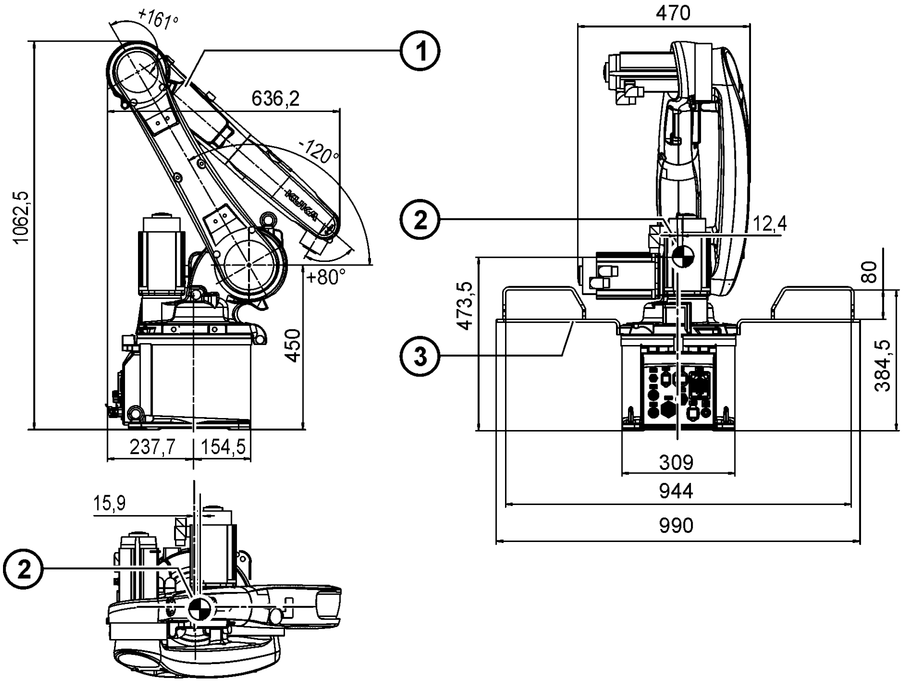


Fig. 4-44: Transport dimensions

1	Robot	3	Fork slots
2	Center of gravity		

4.6 Technical data, KR 8 R1620 HP

4.6.1 Basic data, KR 8 R1620 HP

Basic data

	KR 8 R1620 HP
Number of axes	6
Number of controlled axes	6
Volume of working envelope	15.93 m³
Pose repeatability (ISO 9283)	± 0.04 mm
Weight	approx. 165 kg
Rated payload	8 kg
Maximum reach	1620 mm
Protection rating	IP65
Protection rating, in-line wrist	IP67
Sound level	< 75 dB (A)
Mounting position	Floor; Ceiling; Wall
Footprint	333.5 mm x 307 mm
Permissible angle of inclination	-
Default color	Base frame: black (RAL 9005); Moving parts: KUKA orange 2567

	KR 8 R1620 HP
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: #KR8R1620 C4

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3
Ambient temperature	
During operation	5 °C to 45 °C (278 K to 318 K)
During storage/transportation	-20 °C to 60 °C (253 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 4 mm^2 (can be ordered as an option)		M4 ring cable lug at both ends

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

Minimum bending radius	5x D

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

4.6.2 Axis data, KR 8 R1620 HP

Axis data

Motion range	
A1	±170 °
A2	-185 ° / 65 °
A3	-137 ° / 163 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	
A1	220 °/s
A2	210 °/s
A3	270 °/s
A4	381 °/s
A5	311 °/s
A6	492 °/s

The direction of motion and the arrangement of the individual axes may be noted from the following diagram.

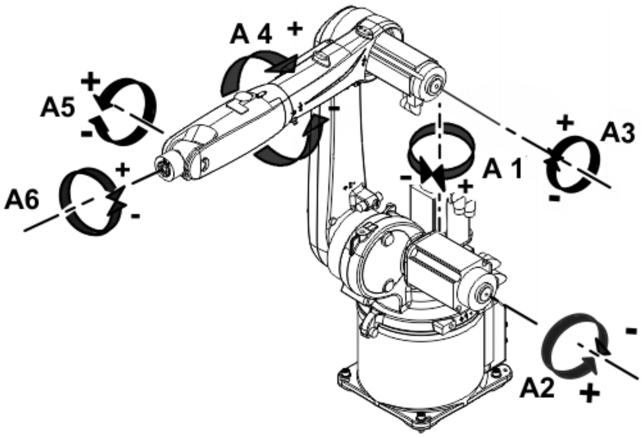


Fig. 4-45: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	38 °
A2	-110 °
A3	110 °
A4	0 °
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.

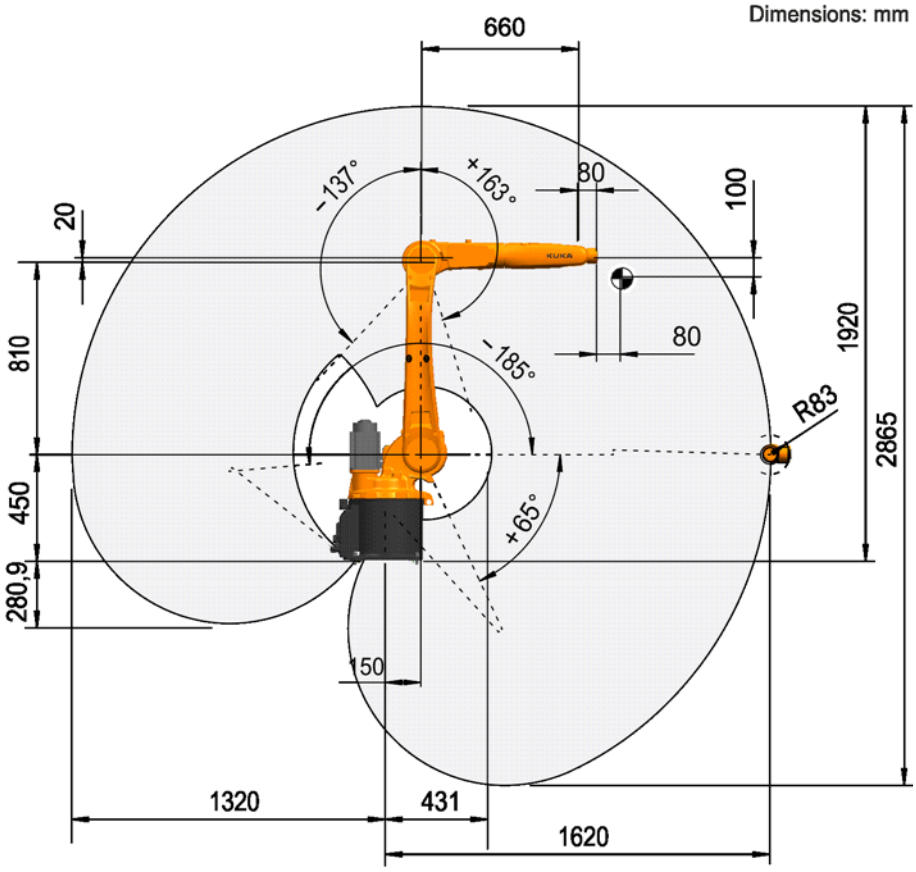


Fig. 4-46: Working envelope, side view, KR 8 R1620 HP

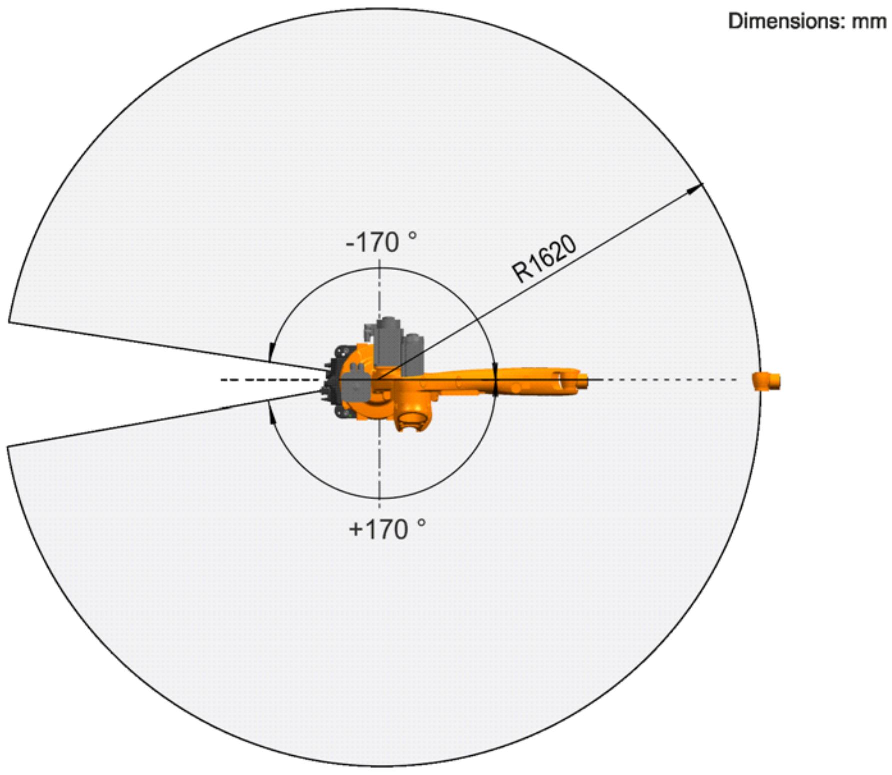


Fig. 4-47: Working envelope, top view, KR 8 R1620 HP

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). This type of installation results in limitations to the range of motion in the plus and minus directions about axis 1. 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. A 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.

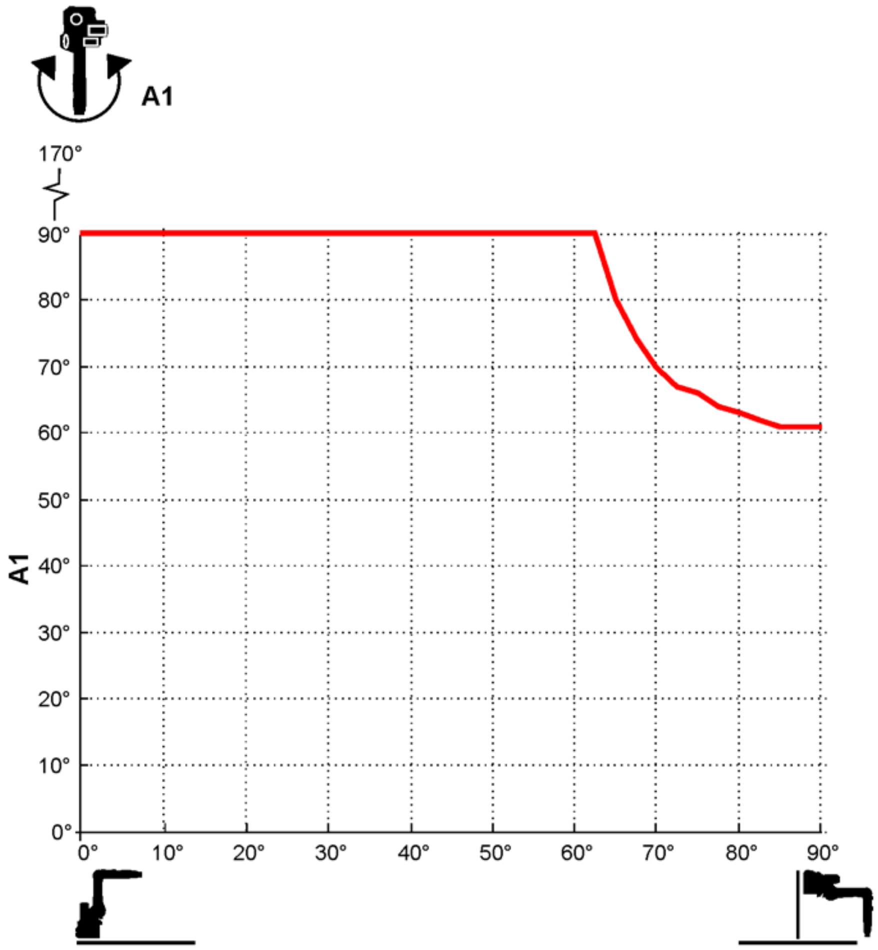


Fig. 4-48: Motion range, axis 1 at an inclined position

4.6.3 Payloads, KR 8 R1620 HP

Payloads

Rated payload	8 kg
Rated mass moment of inertia	0.1 kgm²
Rated total load	18 kg

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	20 kg
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	15 kg
Rated supplementary load, arm	10 kg
Maximum supplementary load, arm	15 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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. Refer to the payload diagram for the nominal distance.

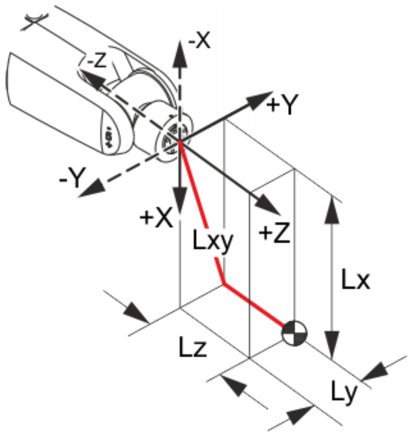


Fig. 4-49: Load center of gravity

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 the KUKA Roboter 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!

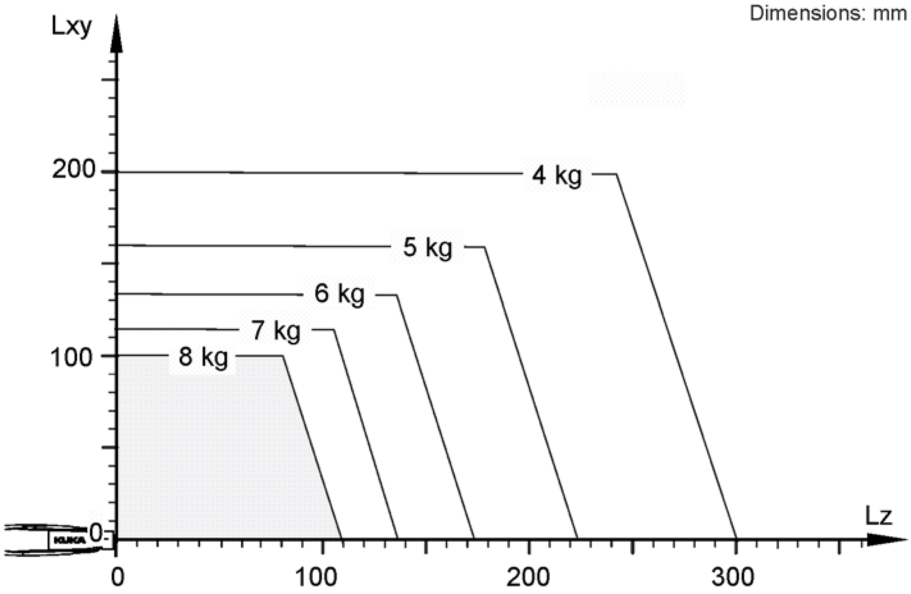


Fig. 4-50: Payload diagram, KR 8 R1620 HP

In-line wrist

In-line wrist type	ZH 6/8/10 HP kpl.
Mounting flange	see drawing

Mounting flange

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

The mounting flange is depicted (>>> Fig. 4-51) 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.

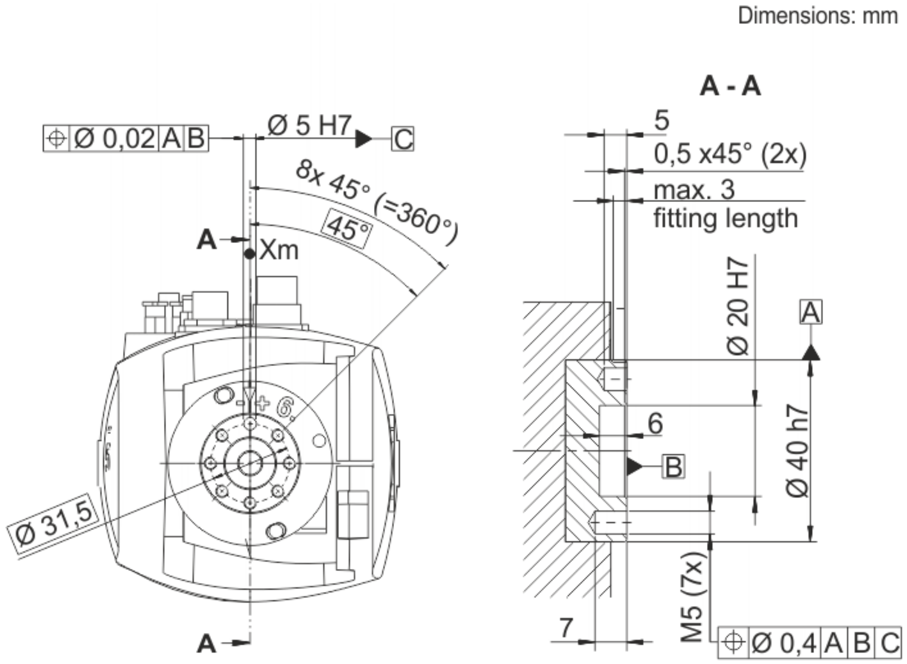


Fig. 4-51: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. 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.

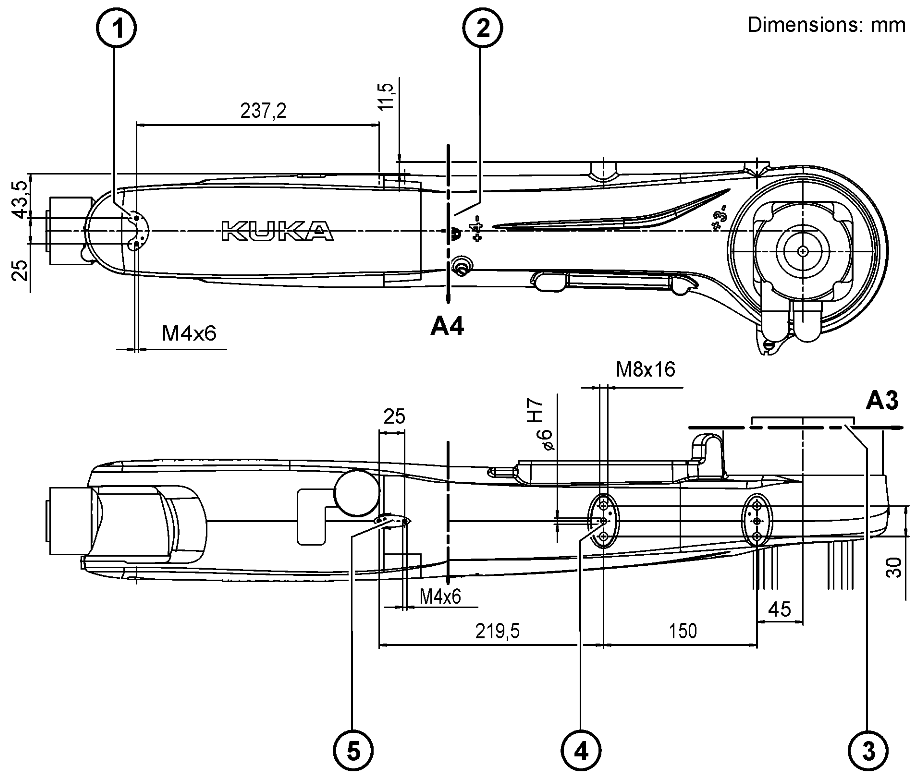


Fig. 4-52: Fastening the supplementary load on the arm

1 Mounting surface on IW, energy supply system only
2 Plane of rotation, axis 4
3 Plane of rotation, axis 3

4 Mounting surface on arm
5 Mounting surface on IW, energy supply system only

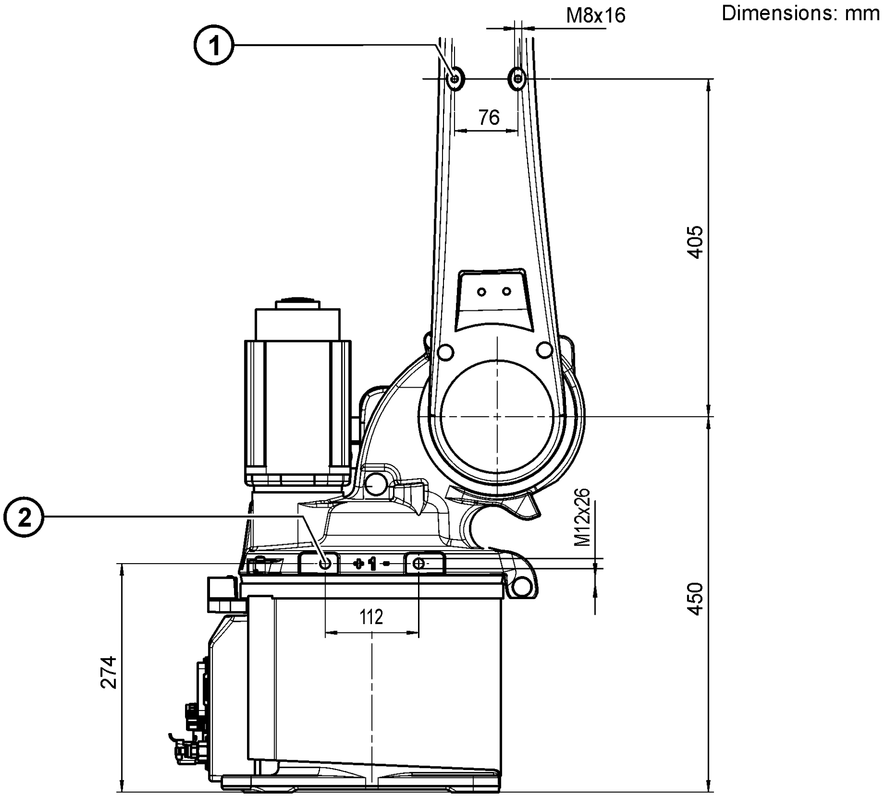


Fig. 4-53: Fastening the supplementary load on the link arm/rotating column

1 Mounting surface on link arm
2 Mounting surface on rotating column, both sides

4.6.4 Loads acting on the mounting base KR 8 R1620 HP

Loads acting on the mounting base

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)	2469 N
F(v max)	2599 N
F(h normal)	1114 N
F(h max)	1376 N
M(k normal)	1523 Nm
M(k max)	2040 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for ceiling mounting position	
F(v normal)	2712 N
F(v max)	2794 N
F(h normal)	1282 N
F(h max)	1624 N
M(k normal)	1832 Nm

M(k max)	2329 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for wall mounting position	
F(v normal)	800 N
F(v max)	1000 N
F(h normal)	2748 N
F(h max)	2987 N
M(k normal)	2562 Nm
M(k max)	2701 Nm
M(r normal)	947 Nm
M(r max)	1126 Nm

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

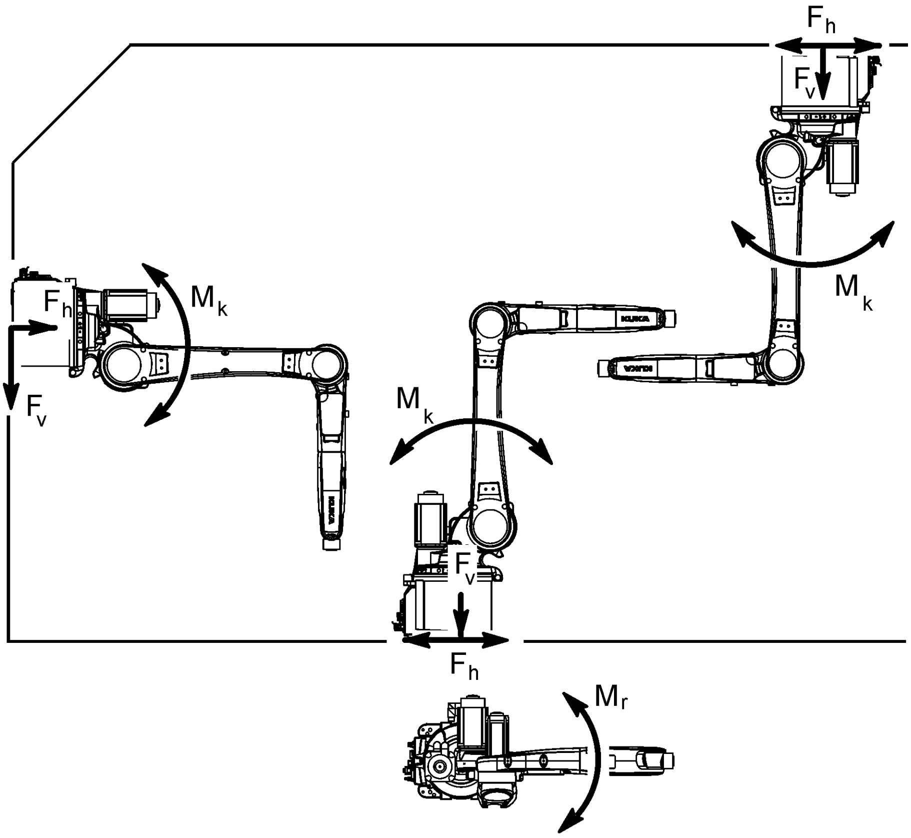


Fig. 4-54: Mounting base loads

⚠ **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.

4.6.5 Transport dimensions, KR 8 R1620 HP

The transport dimensions for the robots can be noted from the following diagrams (>>> Fig. 4-55). 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. The following diagram shows the dimensions of the robot when it stands on the floor without wooden transport blocks.

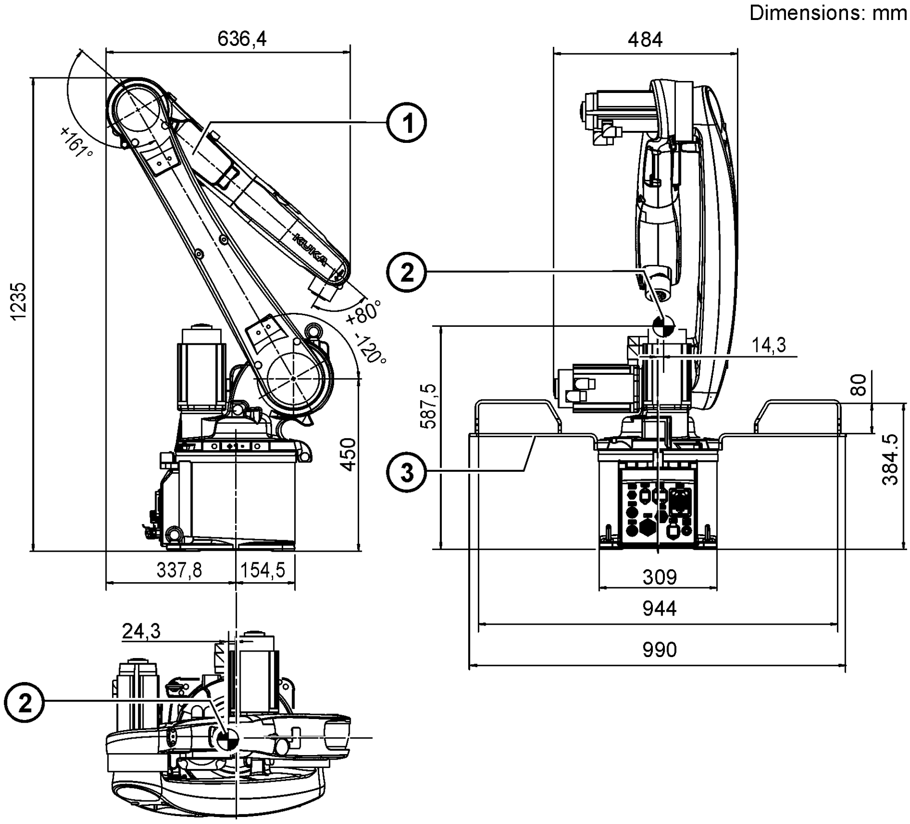


Fig. 4-55: Transport dimensions

1	Robot	3	Fork slots
2	Center of gravity		

4.7 Technical data, KR 6 R1820 HP

4.7.1 Basic data, KR 6 R1820 HP

Basic data

	KR 6 R1820 HP
Number of axes	6
Number of controlled axes	6
Volume of working envelope	22.97 m³
Pose repeatability (ISO 9283)	± 0.04 mm
Weight	approx. 168 kg
Rated payload	6 kg
Maximum reach	1820 mm
Protection rating	IP65
Protection rating, in-line wrist	IP67
Sound level	< 75 dB (A)

	KR 6 R1820 HP
Mounting position	Floor; Ceiling; Wall
Footprint	333.5 mm x 307 mm
Permissible angle of inclination	-
Default color	Base frame: black (RAL 9005); Moving parts: KUKA orange 2567
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: #KR6R1820 C4

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3K3
Ambient temperature	
During operation	5 °C to 45 °C (278 K to 318 K)
During storage/transportation	-20 °C to 60 °C (253 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 4 mm^2 (can be ordered as an option)		M4 ring cable lug at both ends

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

Minimum bending radius	5x D

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

4.7.2 Axis data, KR 6 R1820 HP

Axis data

Motion range	
A1	±170 °
A2	-185 ° / 65 °
A3	-137 ° / 163 °
A4	±185 °
A5	±120 °
A6	±350 °
Speed with rated payload	

A1	220 °/s
A2	210 °/s
A3	270 °/s
A4	381 °/s
A5	311 °/s
A6	492 °/s

The direction of motion and the arrangement of the individual axes may be noted from the following diagram.

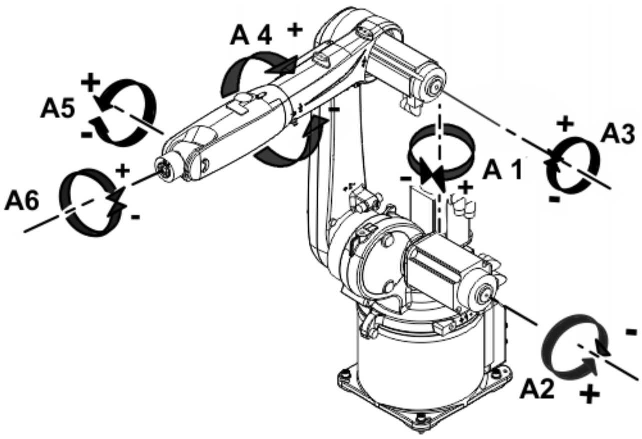


Fig. 4-56: Direction of rotation of robot axes

Mastering positions

Mastering position	
A1	38 °
A2	-110 °
A3	110 °
A4	0 °
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.

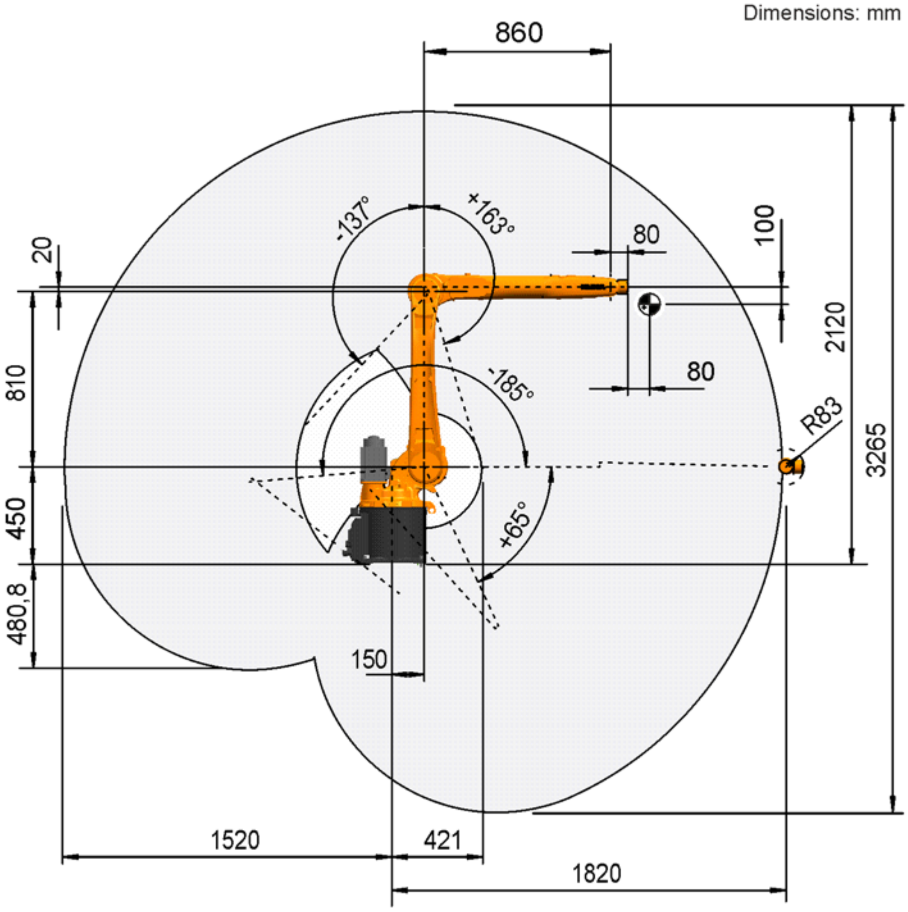


Fig. 4-57: Working envelope, side view, KR 6 R1820 HP

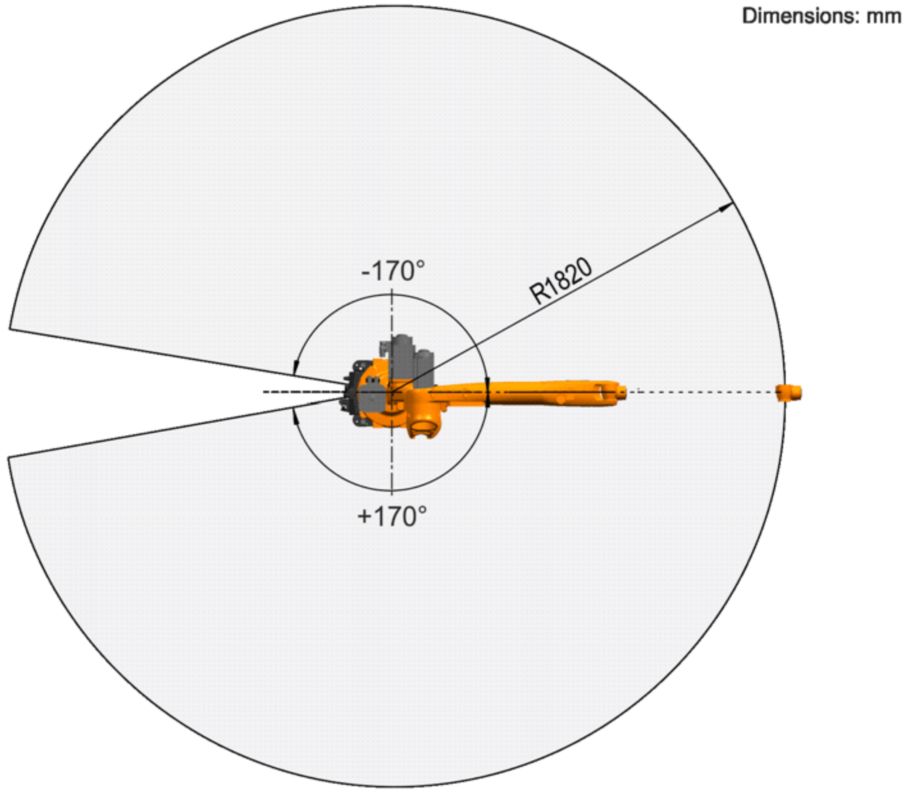


Fig. 4-58: Working envelope, top view, KR 6 R1820 HP

Inclined installation

The robot can installed anywhere from a 0° position (floor) to a 180° position (ceiling). This type of installation results in limitations to the range of motion in the plus and minus directions about axis 1. 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. A 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.

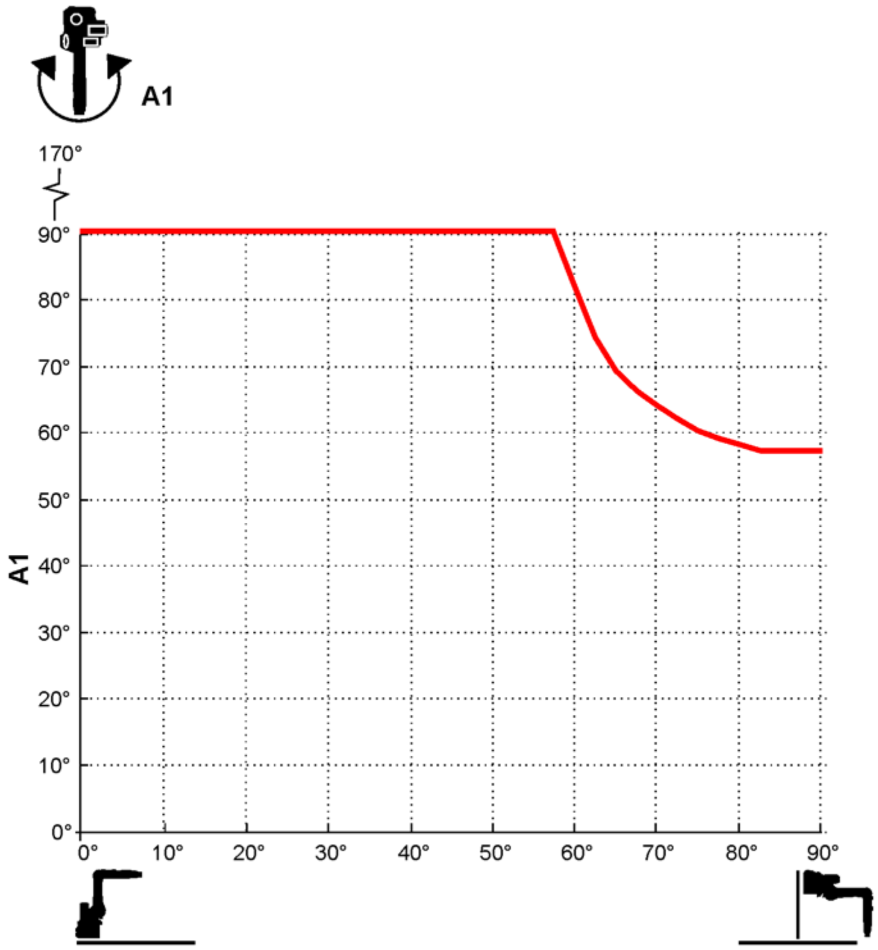


Fig. 4-59: Motion range, axis 1 at an inclined position

4.7.3 Payloads, KR 6 R1820 HP

Payloads

Rated payload	6 kg
Rated mass moment of inertia	0.1 kgm²
Rated total load	16 kg

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	20 kg
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	15 kg
Rated supplementary load, arm	10 kg
Maximum supplementary load, arm	15 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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. Refer to the payload diagram for the nominal distance.

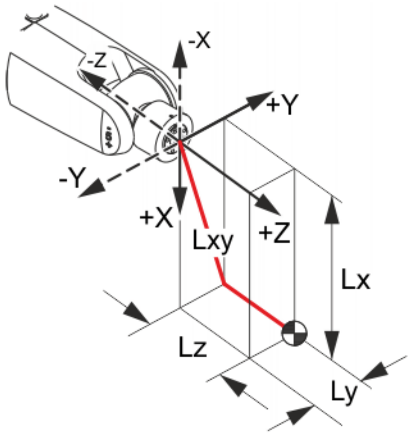


Fig. 4-60: Load center of gravity

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 the KUKA Roboter 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!

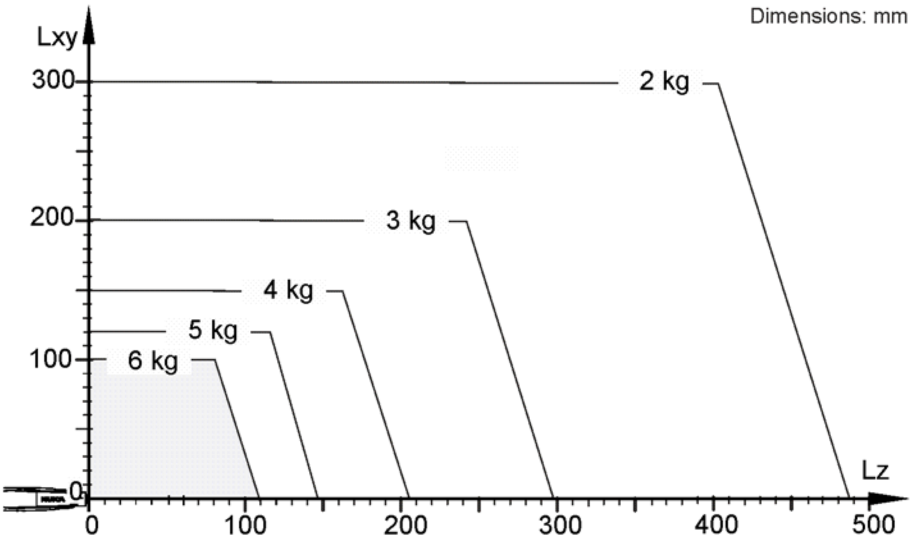


Fig. 4-61: Payload diagram, KR 6 R1820 HP

In-line wrist

In-line wrist type	ZH 6/8/10 kpl.
Mounting flange	see drawing

Mounting flange

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

The mounting flange is depicted (>>> Fig. 4-62) 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.

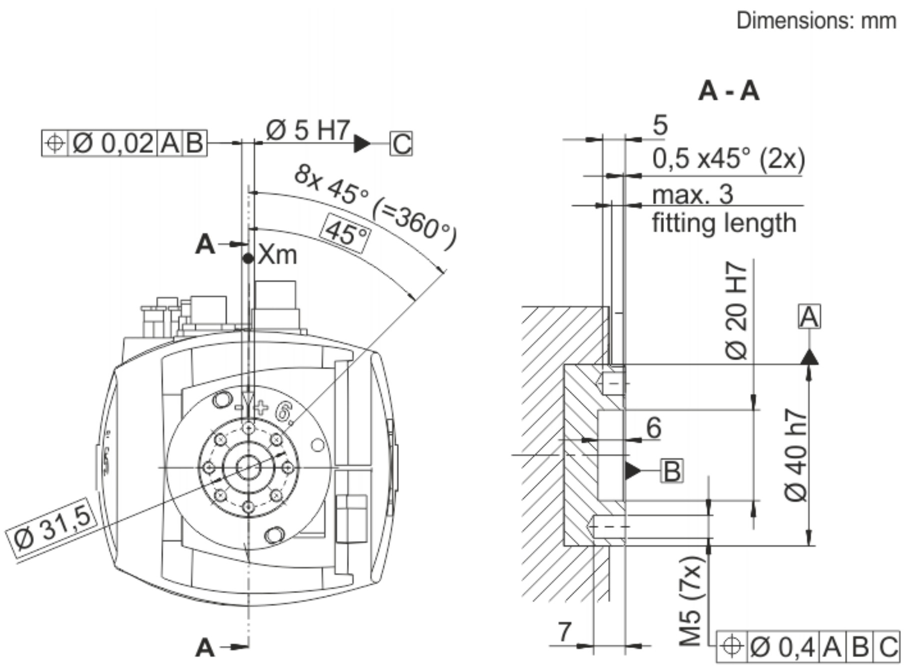


Fig. 4-62: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm, link arm and rotating column. 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.

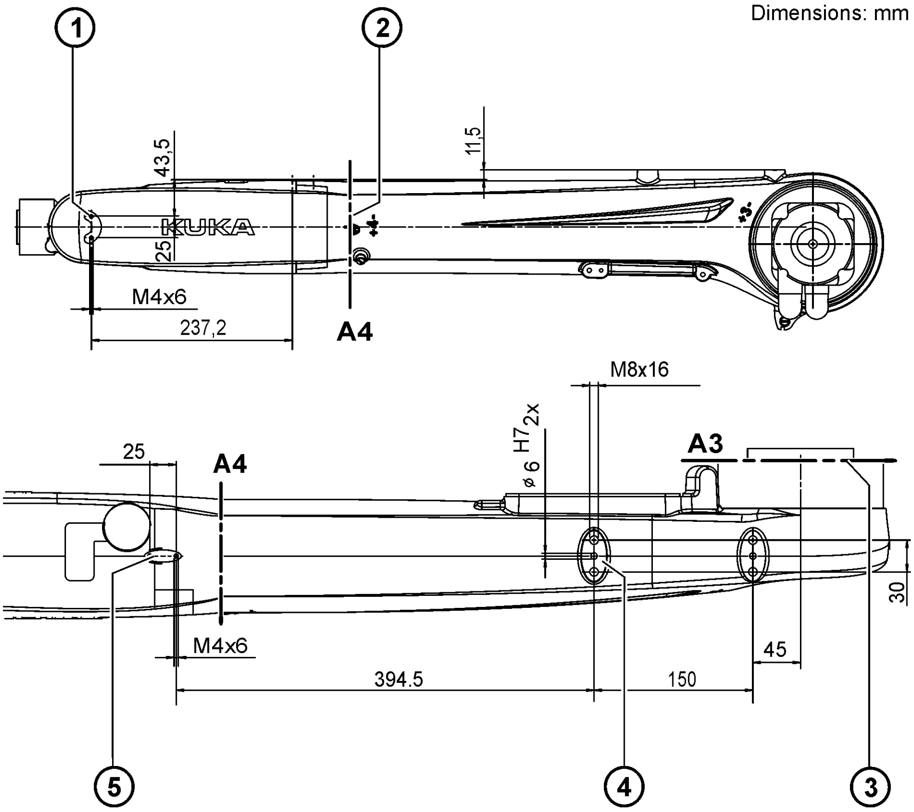


Fig. 4-63: Fastening the supplementary load on the arm

1. Mounting surface on IW, energy supply system only
2. Plane of rotation, axis 4
3. Plane of rotation, axis 3
4. Mounting surface on arm
5. Mounting surface on IW, energy supply system only

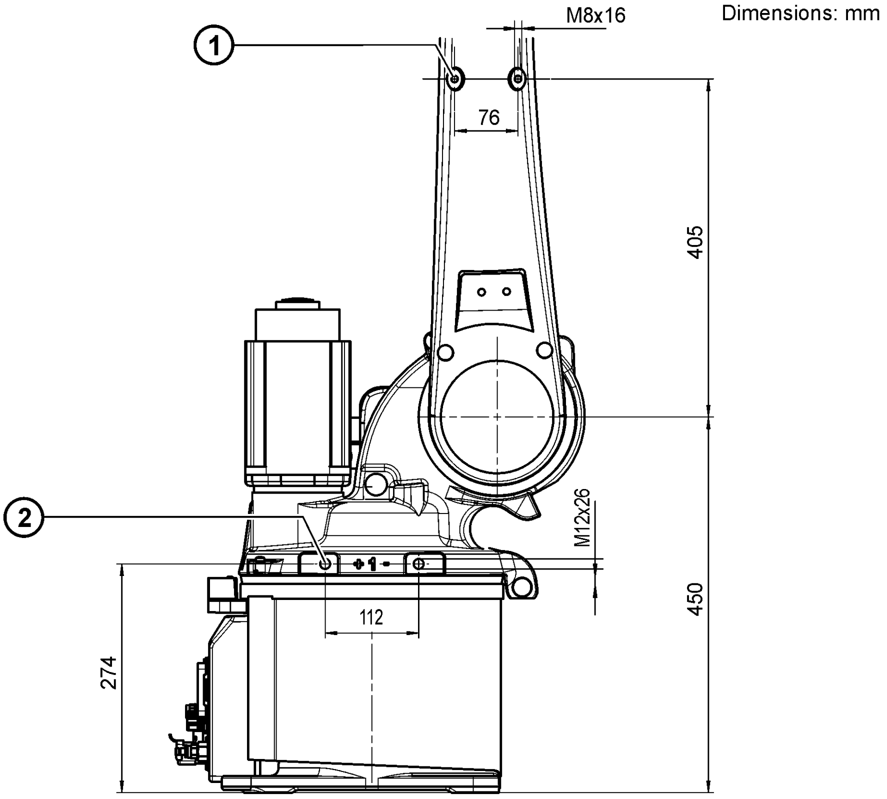


Fig. 4-64: Fastening the supplementary load on the link arm/rotating column

1 Mounting surface on link arm
2 Mounting surface on rotating column, both sides

4.7.4 Loads acting on the mounting base KR 6 R1820 HP

Loads acting on the mounting base

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)	2469 N
F(v max)	2599 N
F(h normal)	1114 N
F(h max)	1376 N
M(k normal)	1523 Nm
M(k max)	2040 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm
Foundation loads for ceiling mounting position	
F(v normal)	2712 N
F(v max)	2794 N
F(h normal)	1282 N
F(h max)	1624 N
M(k normal)	1832 Nm
M(k max)	2329 Nm
M(r normal)	1029 Nm
M(r max)	1149 Nm

Foundation loads for wall mounting position	
F(v normal)	800 N
F(v max)	1000 N
F(h normal)	2748 N
F(h max)	2987 N
M(k normal)	2562 Nm
M(k max)	2701 Nm
M(r normal)	947 Nm
M(r max)	1126 Nm

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

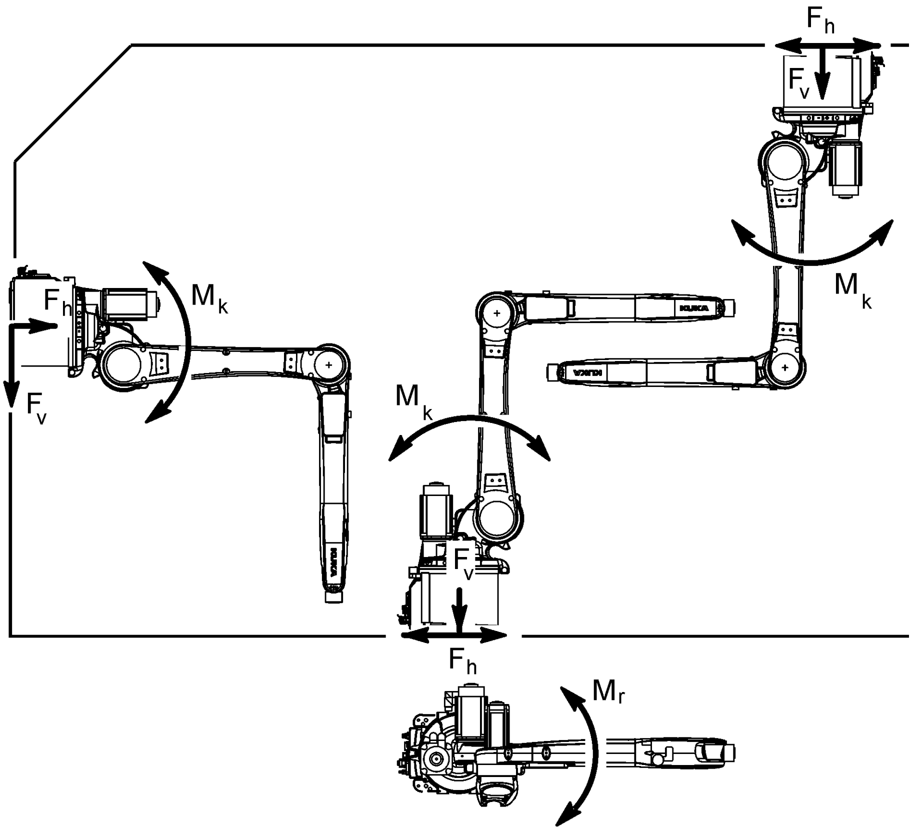


Fig. 4-65: Mounting base loads

> **⚠ 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.

4.7.5 Transport dimensions, KR 6 R1820 HP

The transport dimensions for the robots can be noted from the following diagrams (>>> Fig. 4-66). 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. The following diagram shows the dimensions of the robot when it stands on the floor without wooden transport blocks.

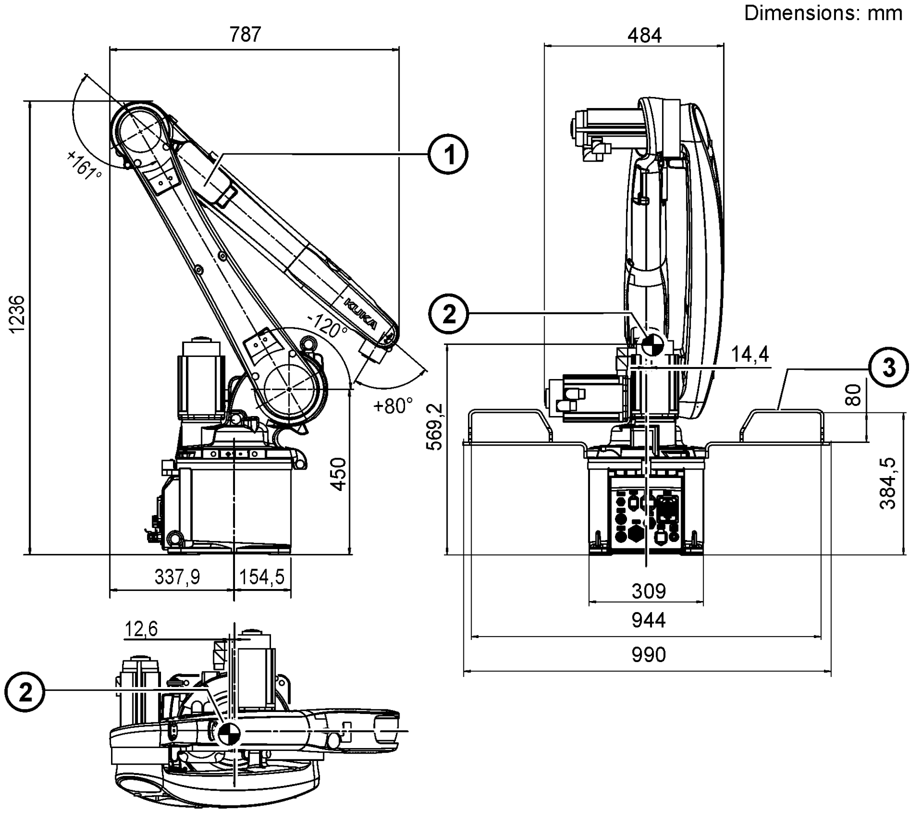


Fig. 4-66: Transport dimensions

1	Robot	3	Fork slots
2	Center of gravity		

4.8 Plates and labels

Plates and labels

The following plates and labels (>>> Fig. 4-67) are attached to the robot. They must not be removed or rendered illegible. Illegible plates and labels must be replaced. The plates and labels depicted here are valid for all robots of this robot model.

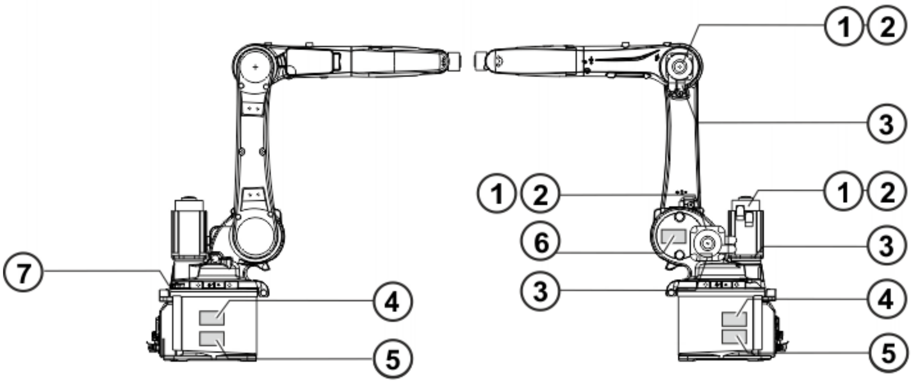
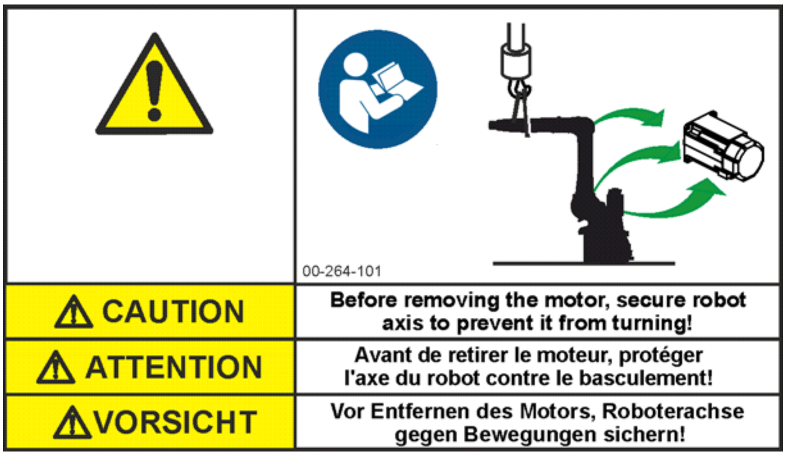
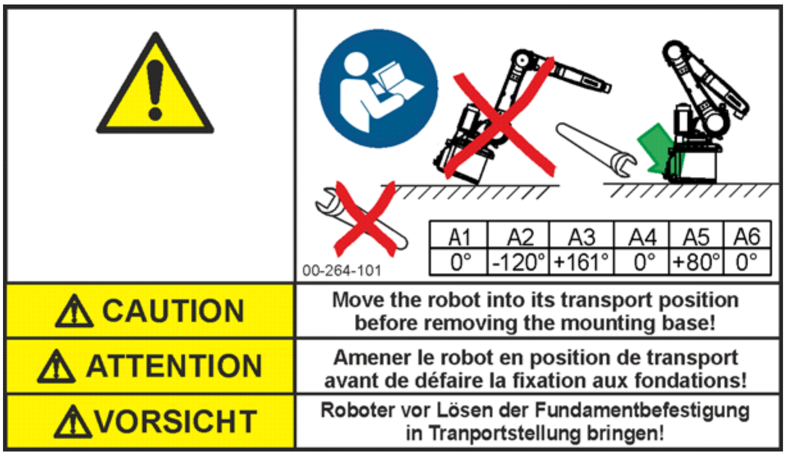
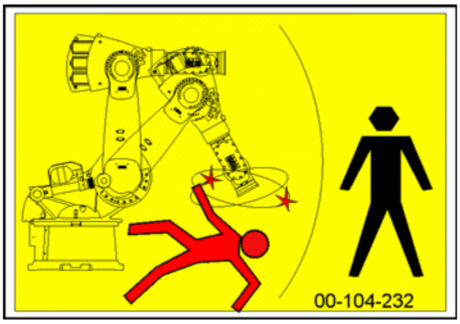
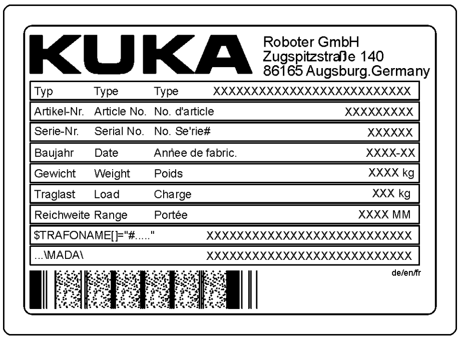
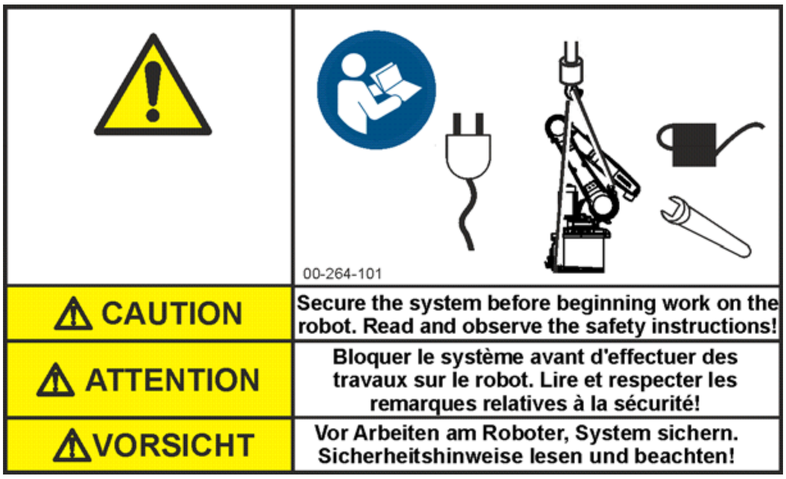


Fig. 4-67: Location of plates and labels

Item	Description
1	 **High voltage** Any improper handling can lead to contact with current-carrying components. Electric shock hazard!
2	 **Hot surface** During operation of the robot, surface temperatures may be reached that could result in burn injuries. Protective gloves must be worn!
3	 **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!
4	 **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!

Item	Description
5	 **Danger zone** Entering the danger zone of the robot is prohibited if the robot is in operation or ready for operation. Risk of injury!
6	 **Identification plate** Content according to Machinery Directive.
7	 **Work on the robot** Before start-up, transportation or maintenance, read and follow the assembly and operating instructions.

4.9 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.

4.10 Stopping distances and times

4.10.1 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.

4.10.2 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. 4-68) 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.

Term	Description
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.

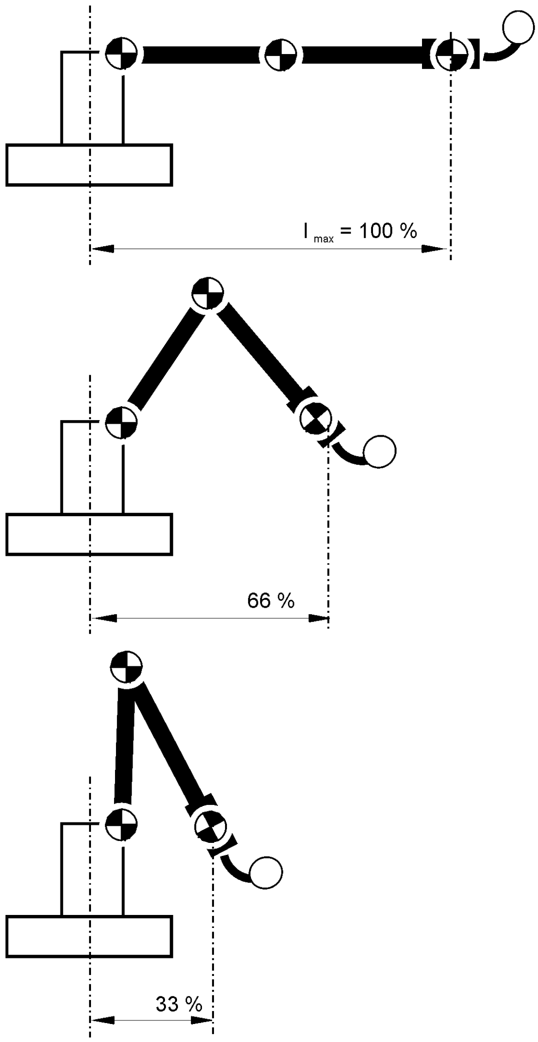


Fig. 4-68: Extension

4.10.3 Stopping distances and times, KR 10 R1420

4.10.3.1 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	41.03	0.31
Axis 2	22.47	0.25
Axis 3	21.11	0.15

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

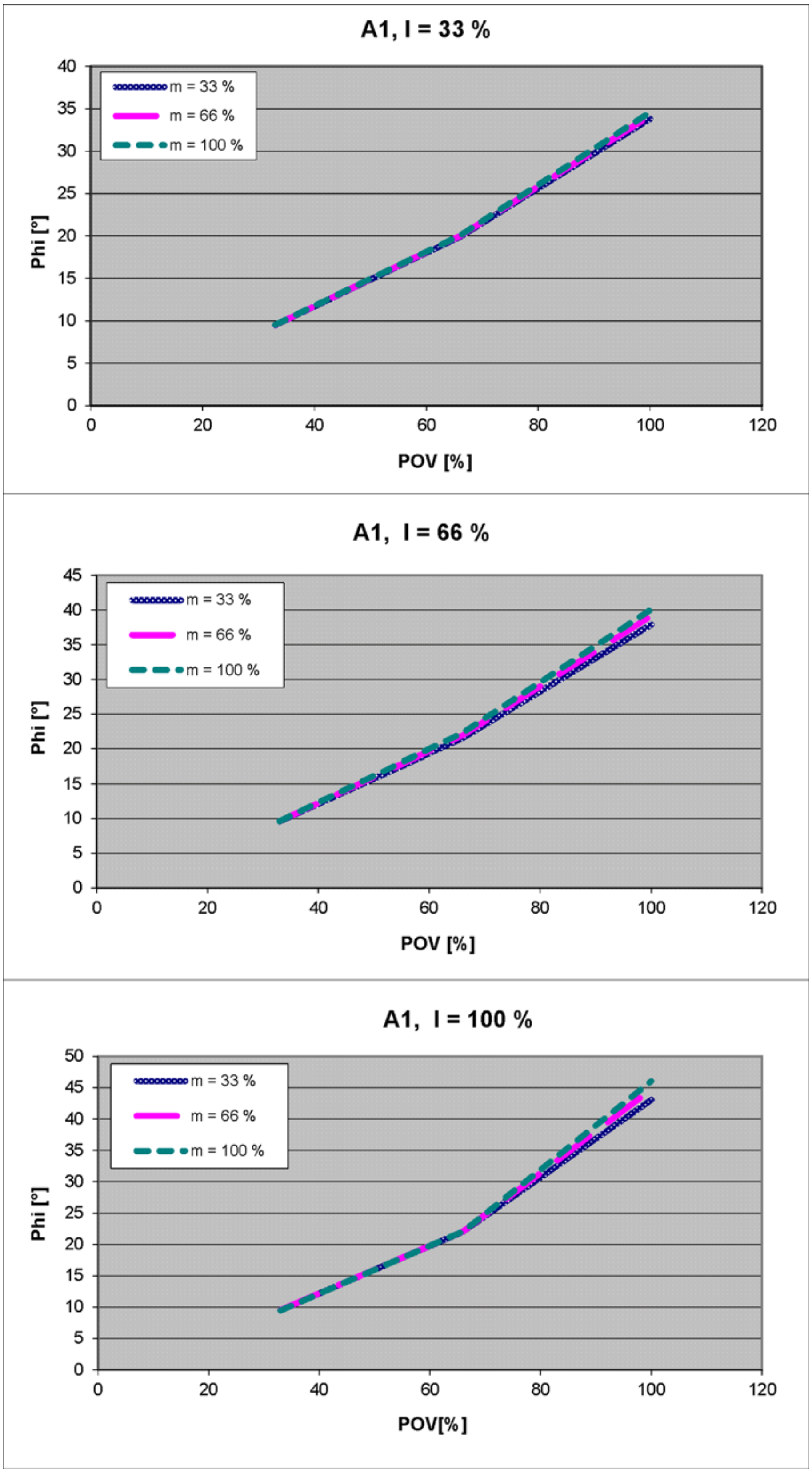


Fig. 4-69: Stopping distances for STOP 1, axis 1

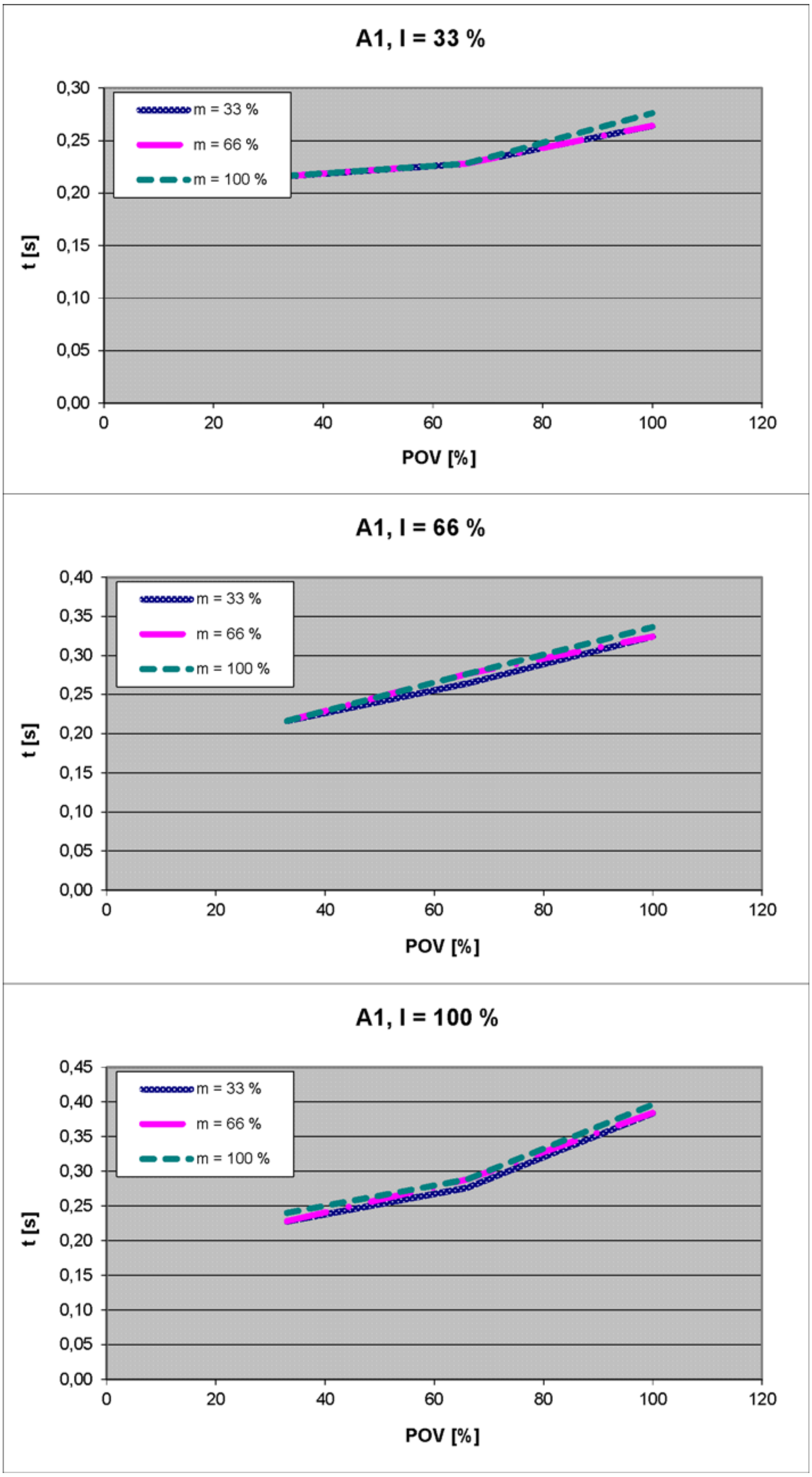


Fig. 4-70: Stopping times for STOP 1, axis 1

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

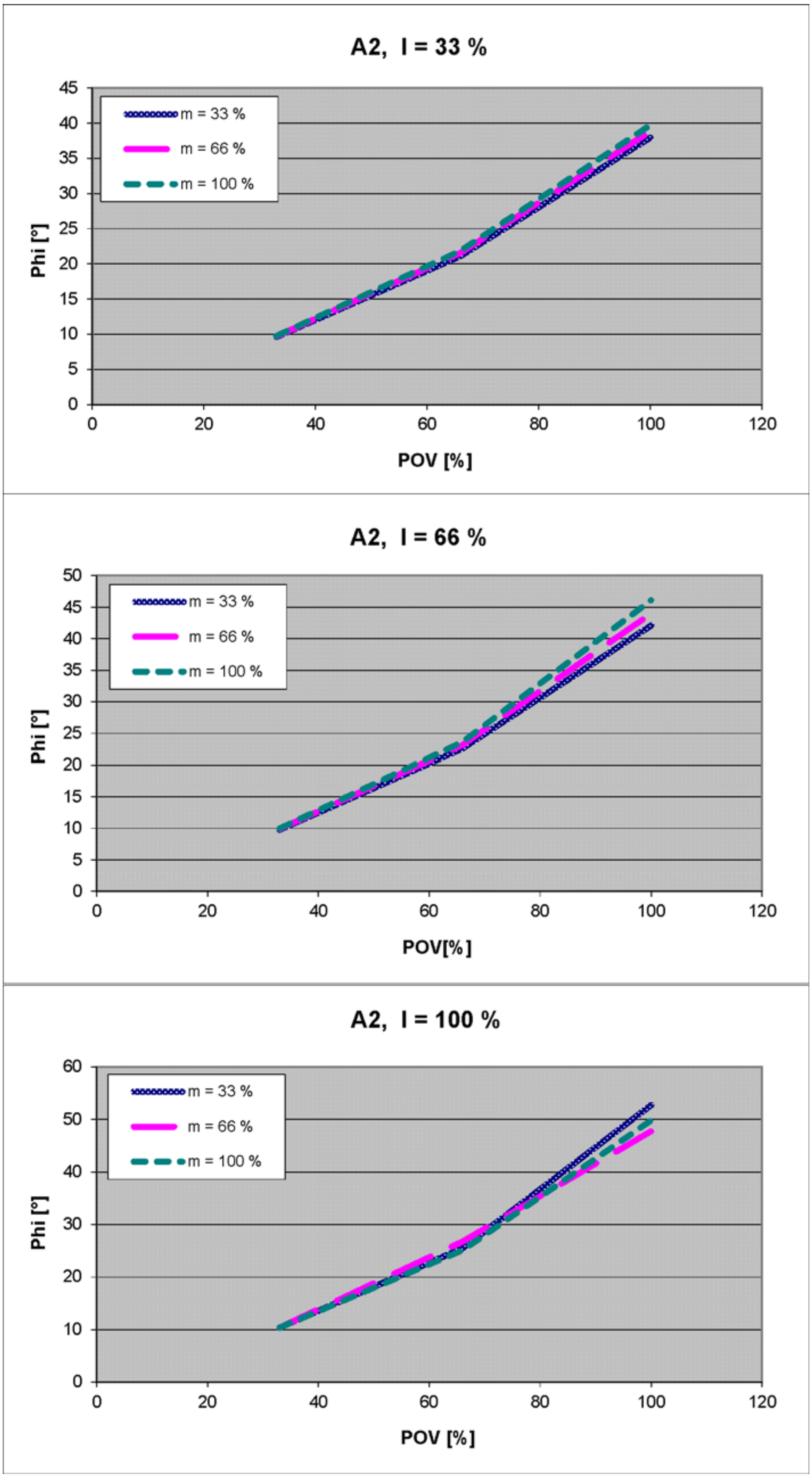


Fig. 4-71: Stopping distances for STOP 1, axis 2

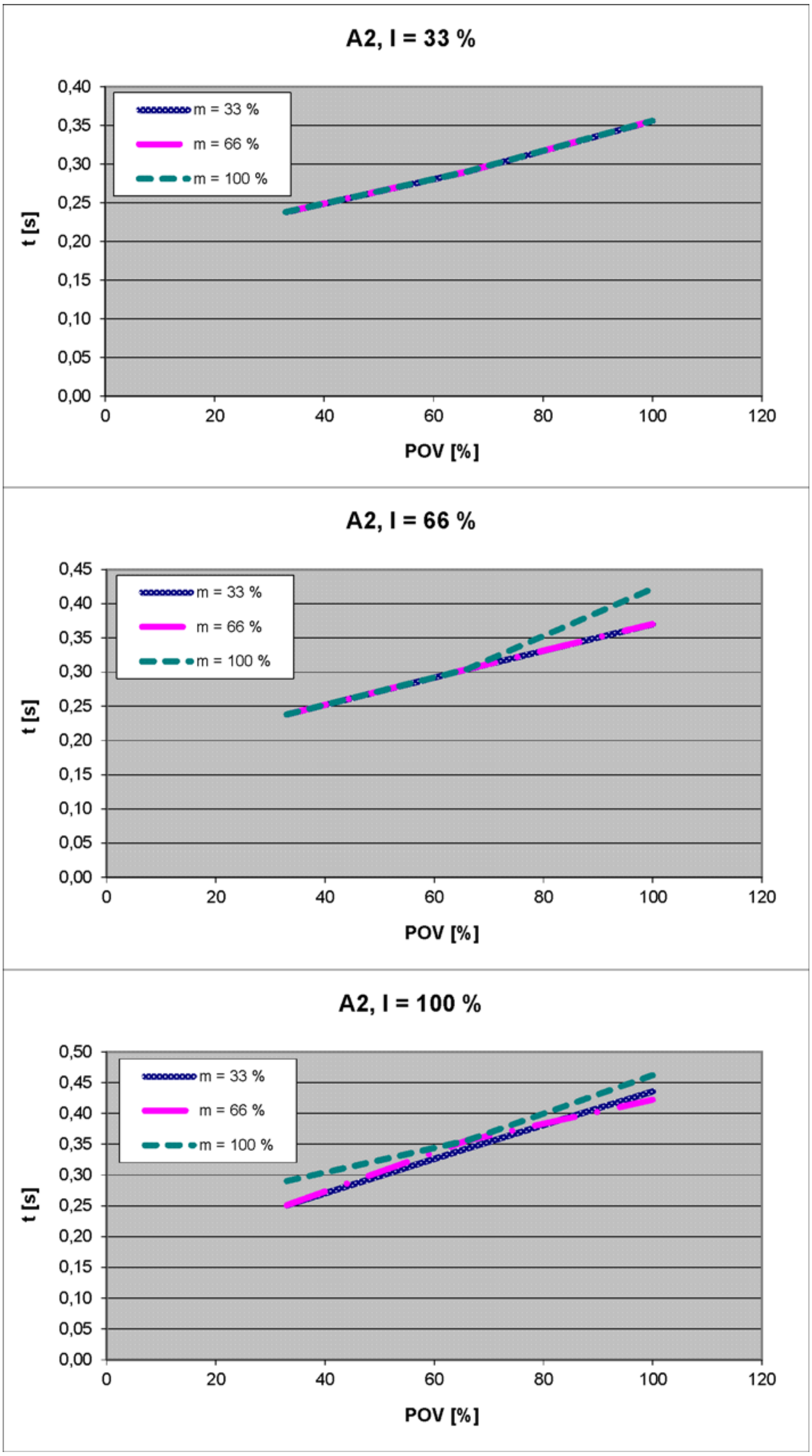


Fig. 4-72: Stopping times for STOP 1, axis 2

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

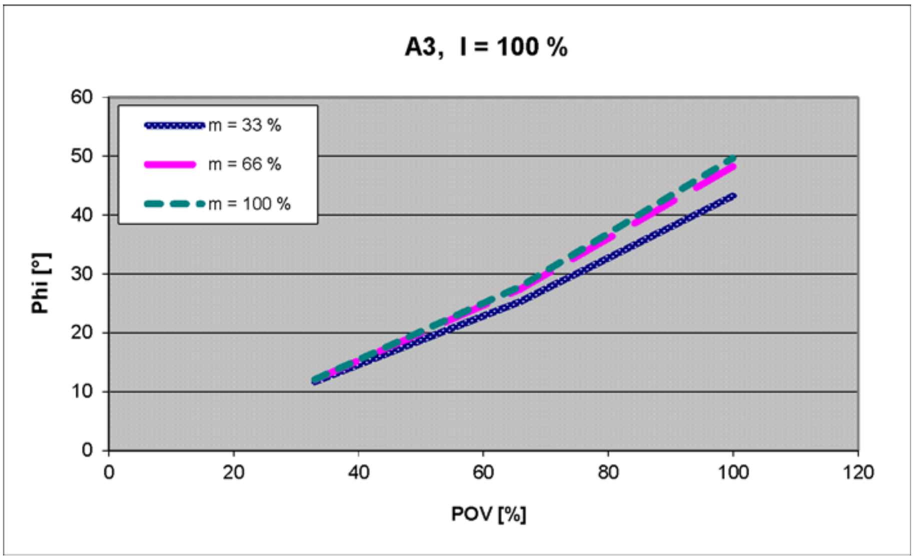


Fig. 4-73: Stopping distances for STOP 1, axis 3

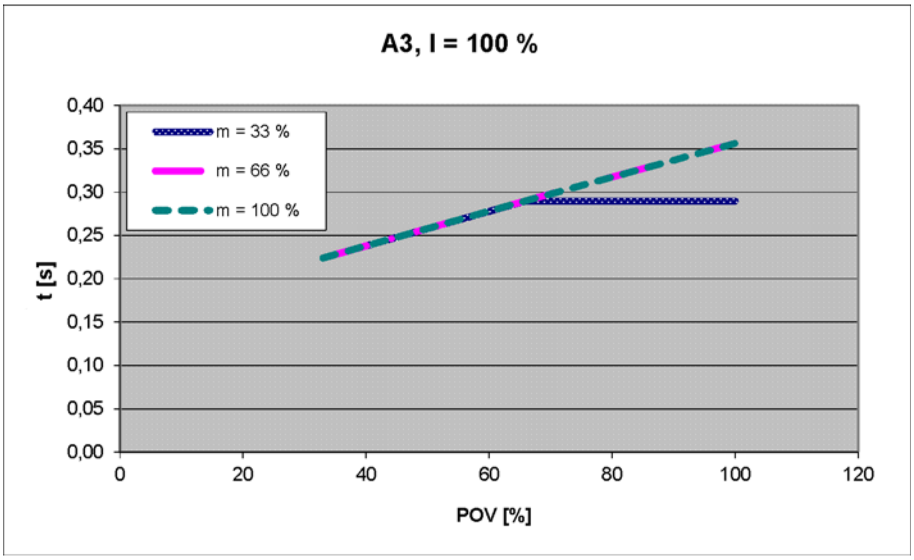


Fig. 4-74: Stopping times for STOP 1, axis 3

4.10.4 Stopping distances and times, KR 8 R1620

4.10.4.1 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	54.21	0.40
Axis 2	48.89	0.40
Axis 3	18.18	0.13

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

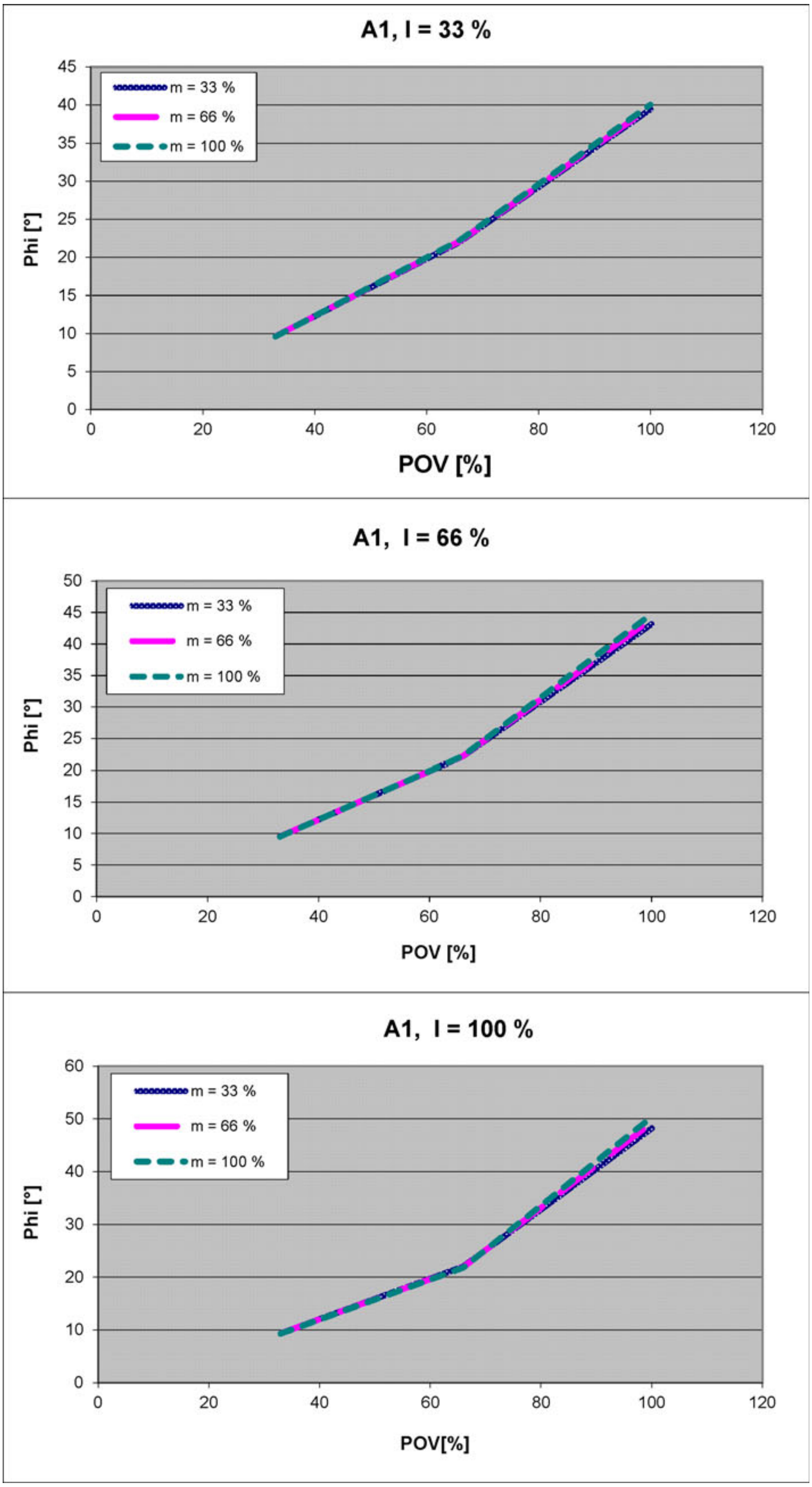


Fig. 4-75: Stopping distances for STOP 1, axis 1

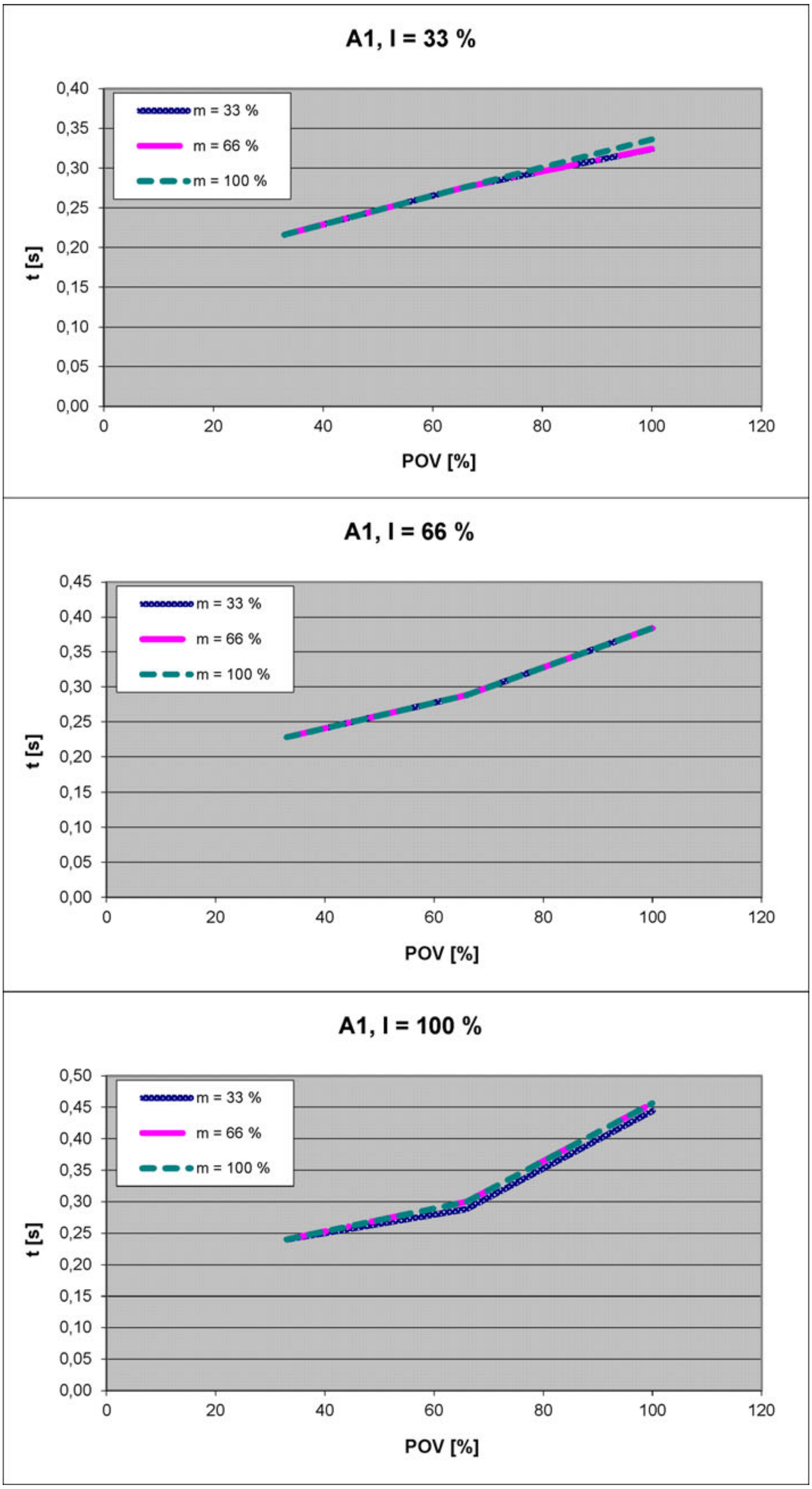


Fig. 4-76: Stopping times for STOP 1, axis 1

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

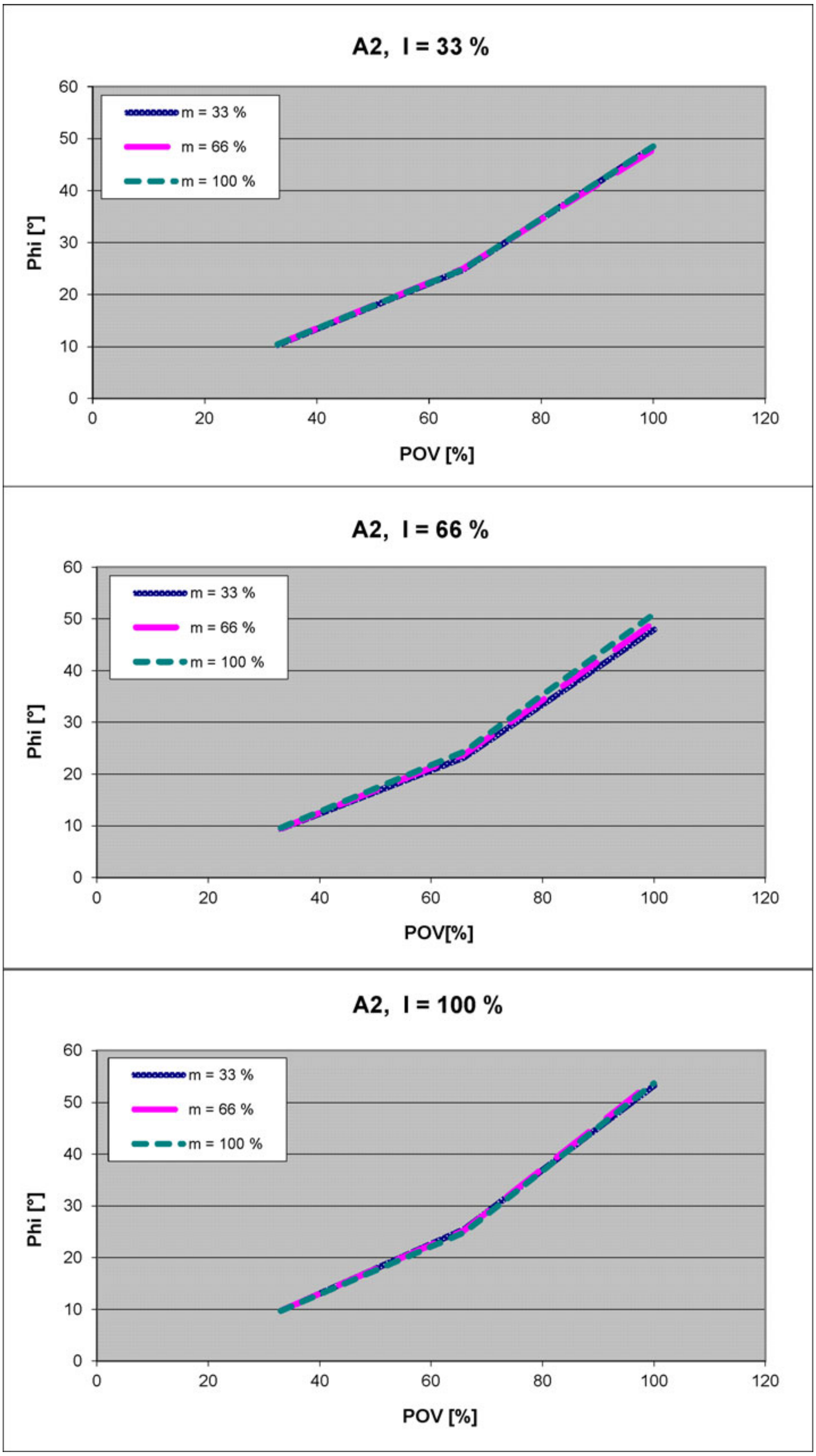


Fig. 4-77: Stopping distances for STOP 1, axis 2

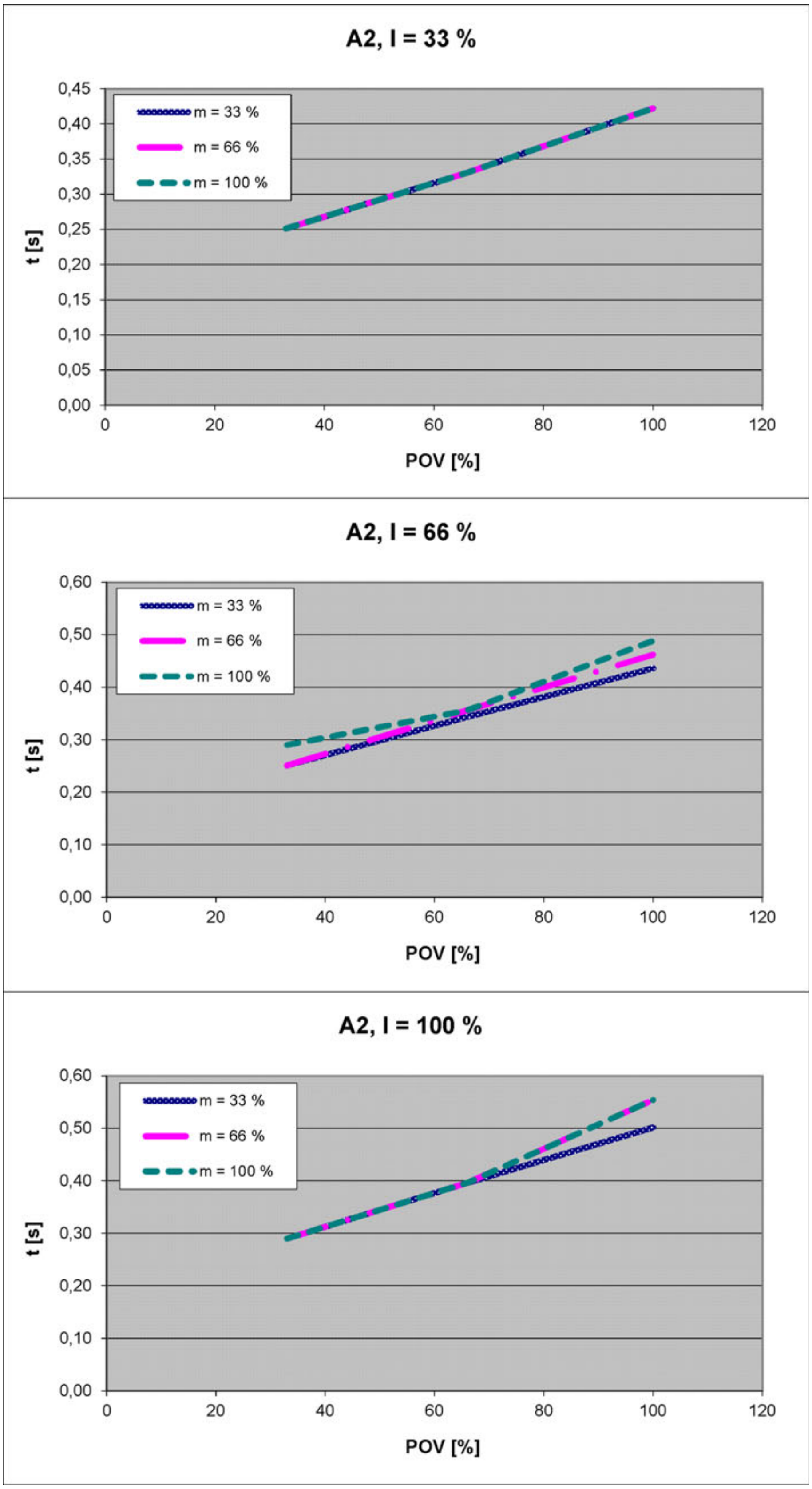


Fig. 4-78: Stopping times for STOP 1, axis 2

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

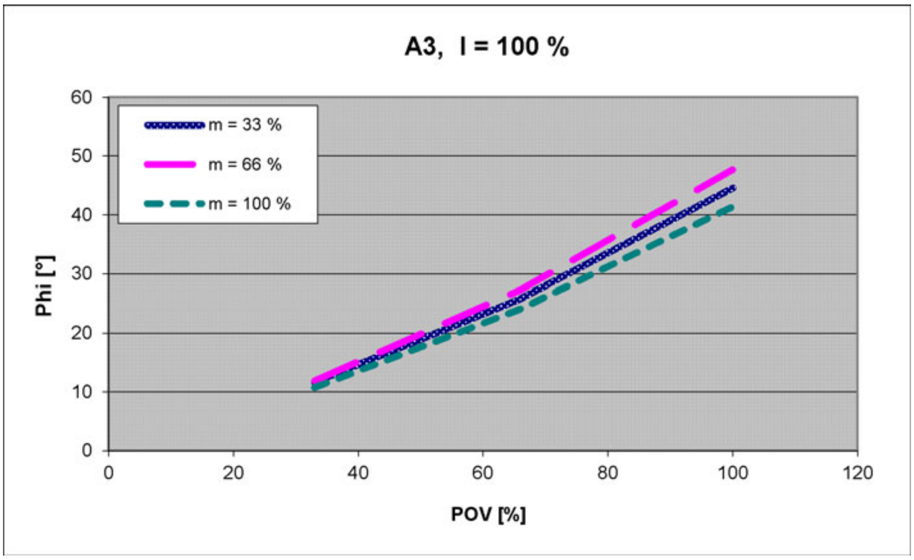


Fig. 4-79: Stopping distances for STOP 1, axis 3

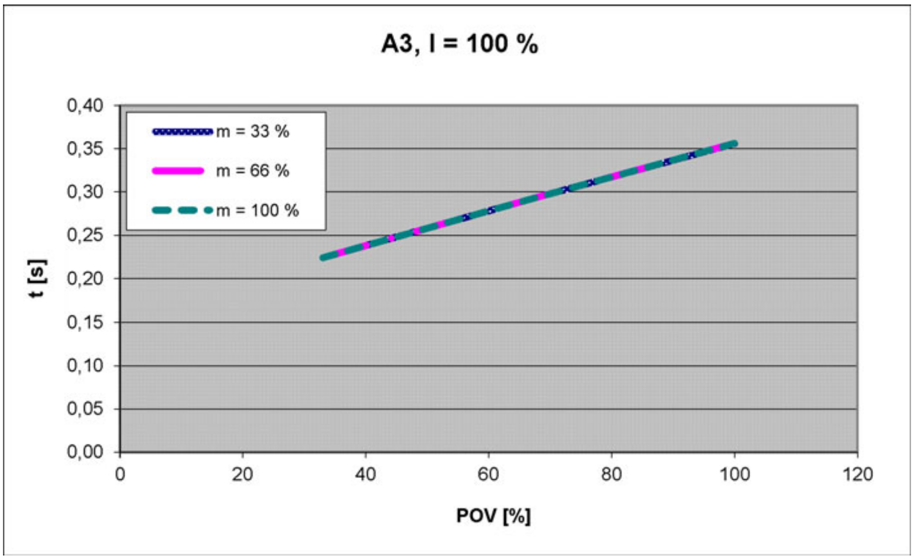


Fig. 4-80: Stopping times for STOP 1, axis 3

4.10.5 Stopping distances and times, KR 6 R1820

4.10.5.1 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	54.05	0.39
Axis 2	47.41	0.39
Axis 3	17.26	0.10

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

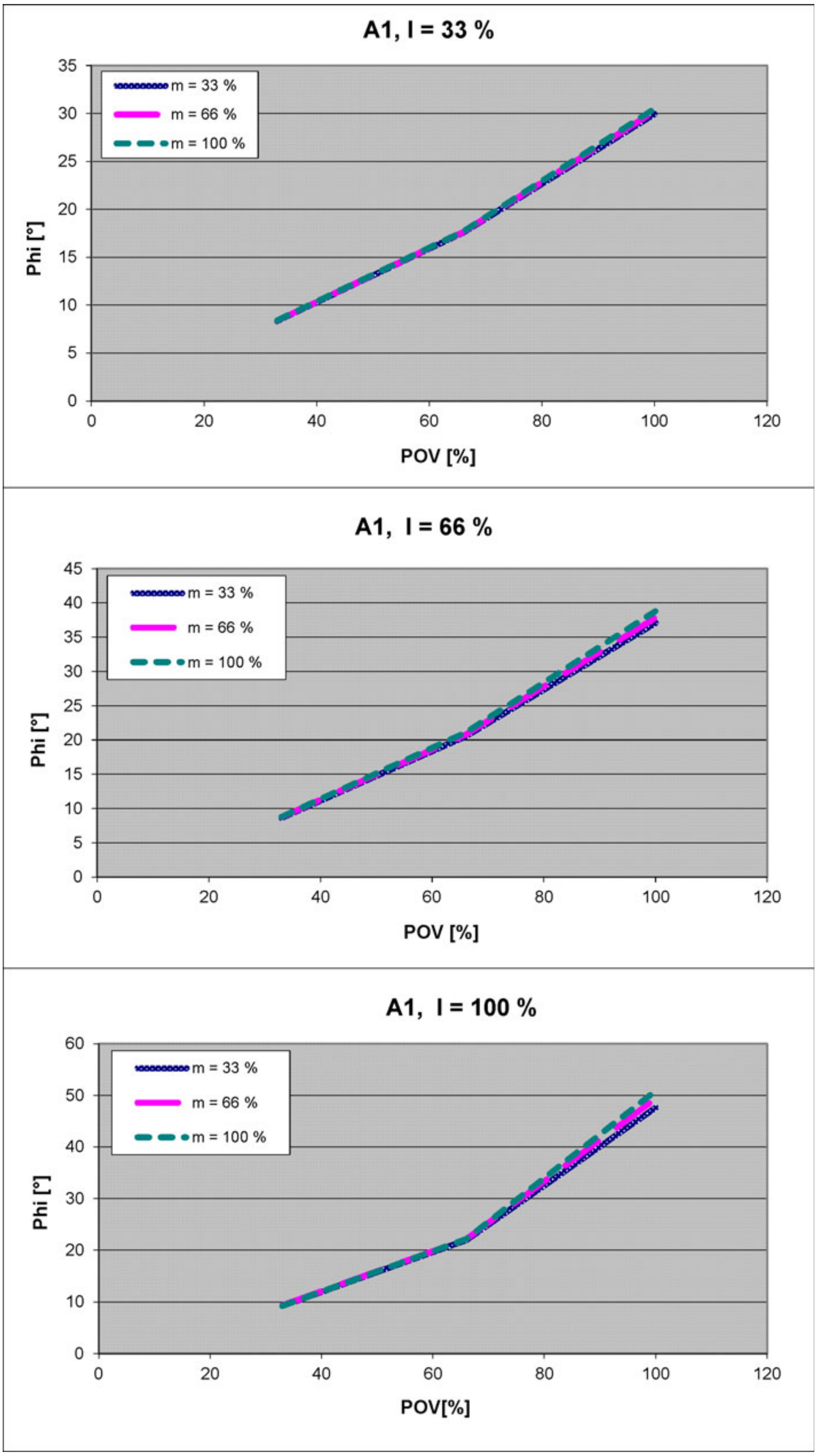


Fig. 4-81: Stopping distances for STOP 1, axis 1

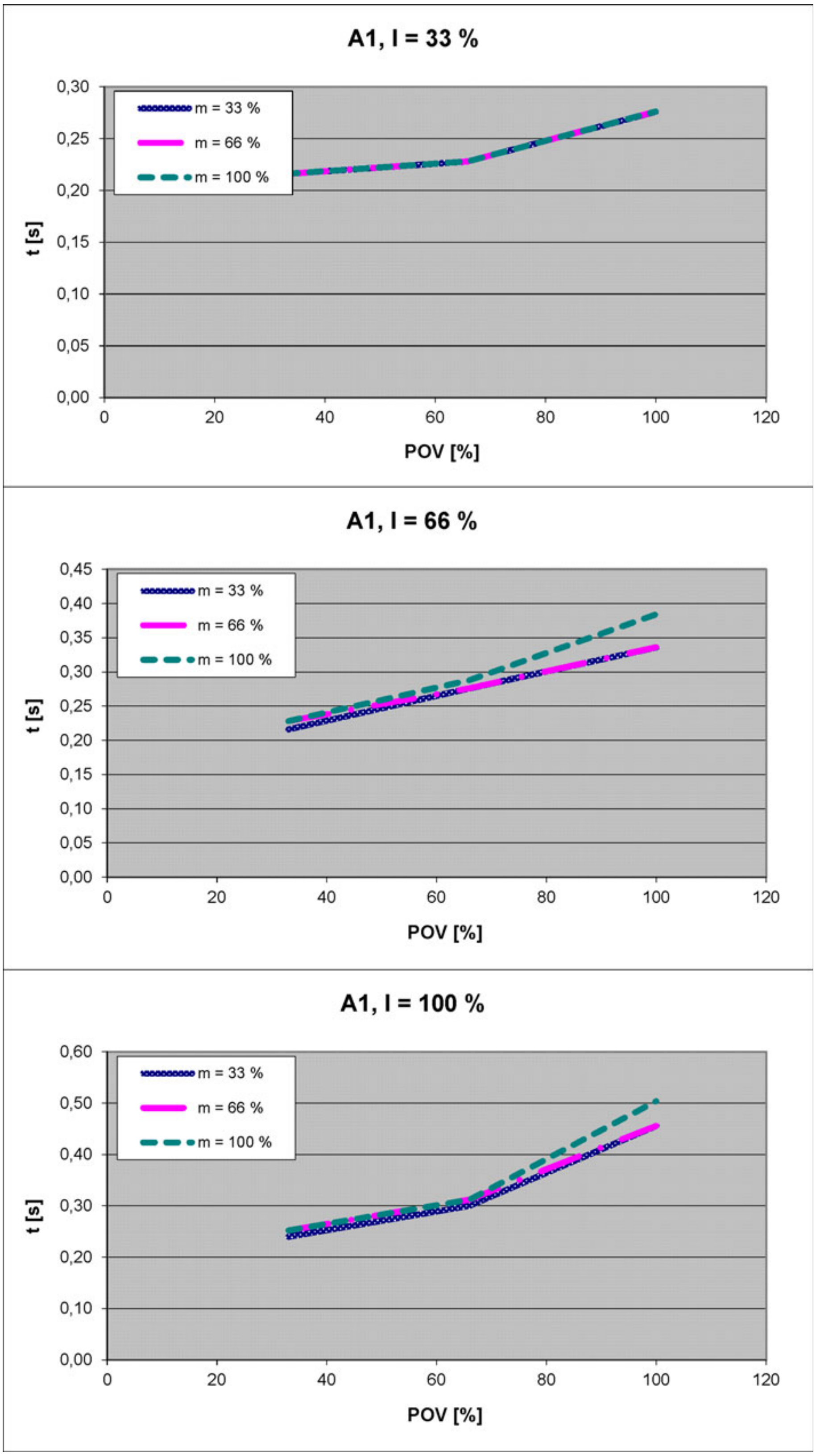


Fig. 4-82: Stopping times for STOP 1, axis 1

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

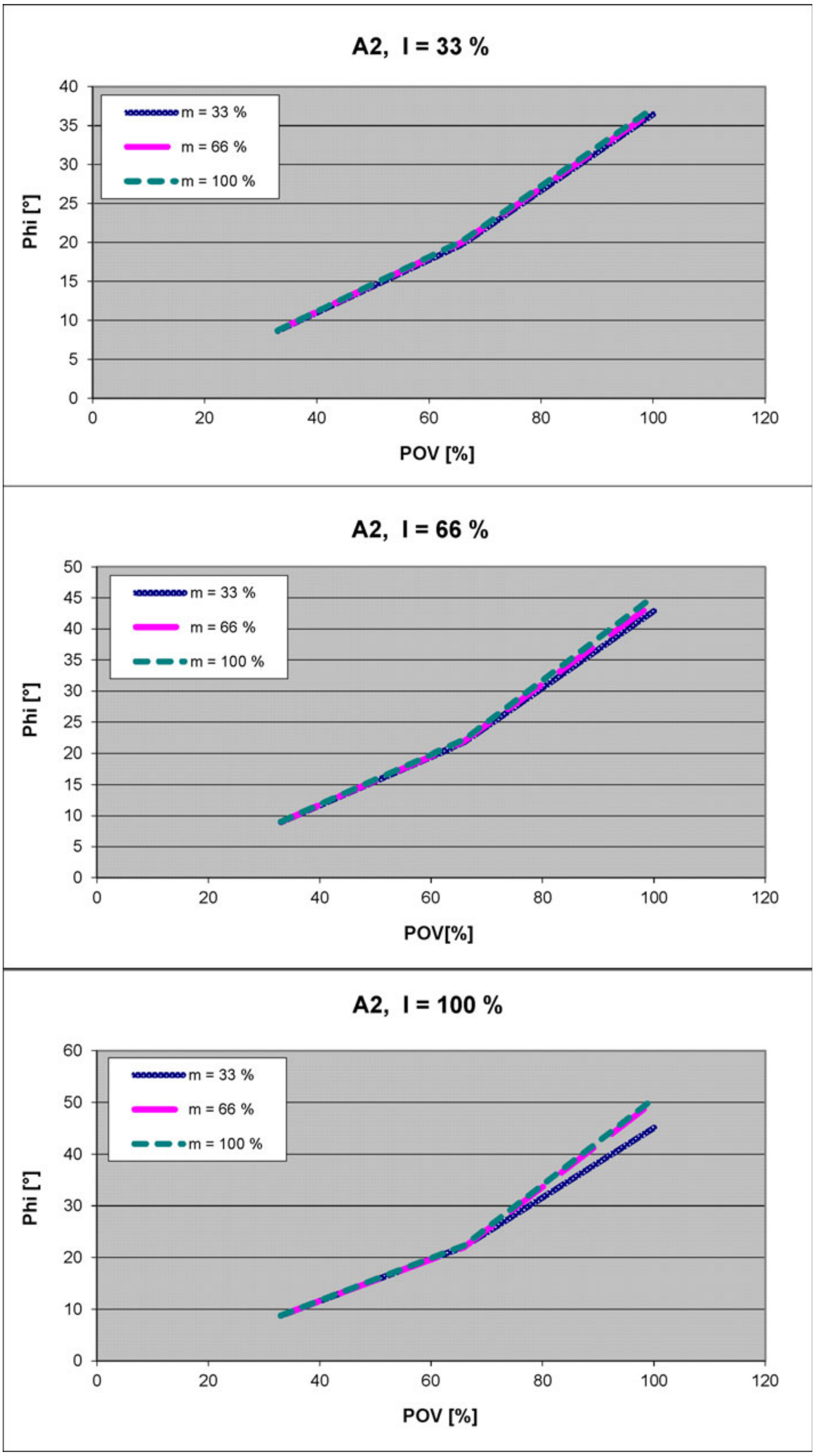


Fig. 4-83: Stopping distances for STOP 1, axis 2

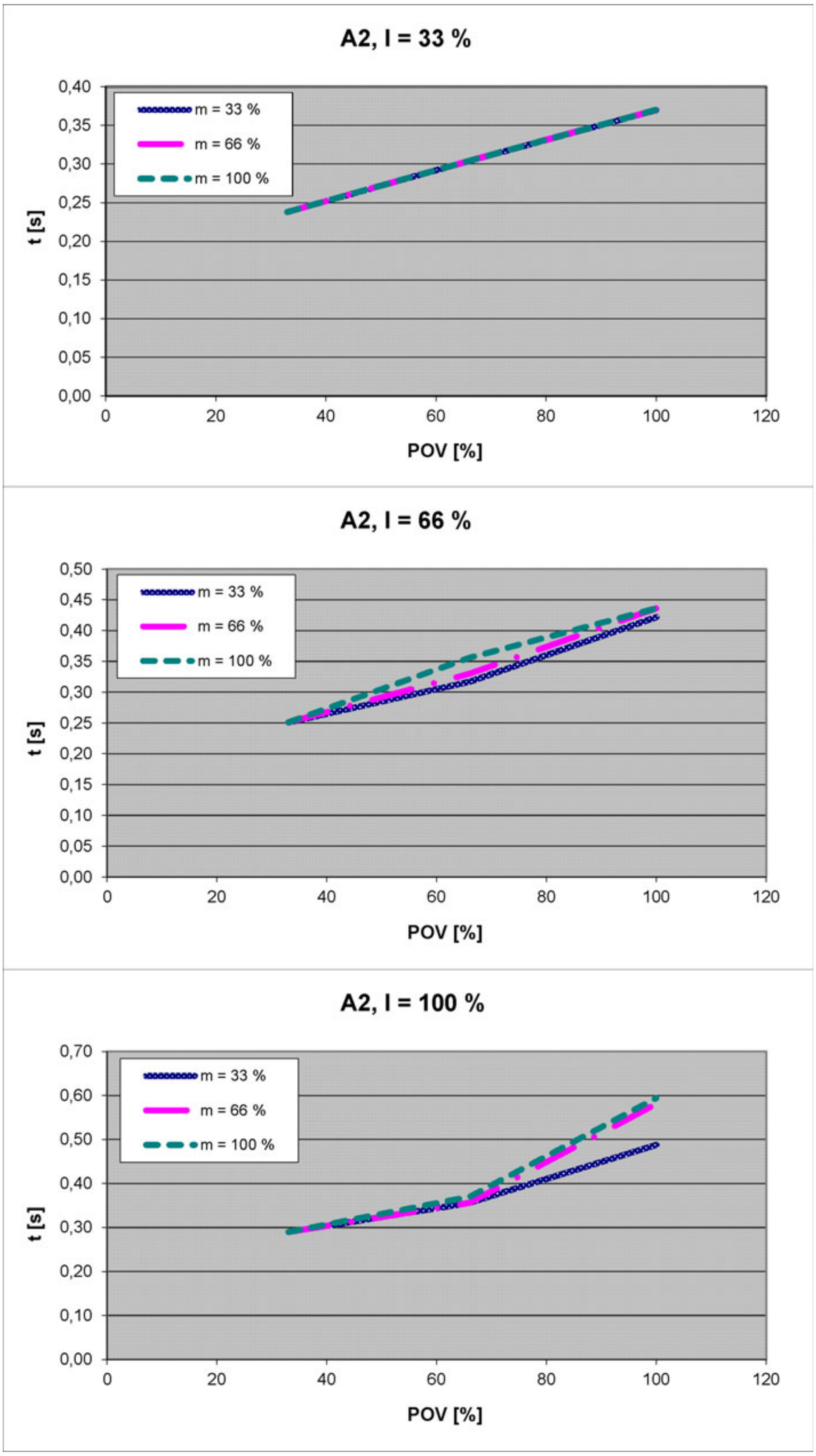


Fig. 4-84: Stopping times for STOP 1, axis 2

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

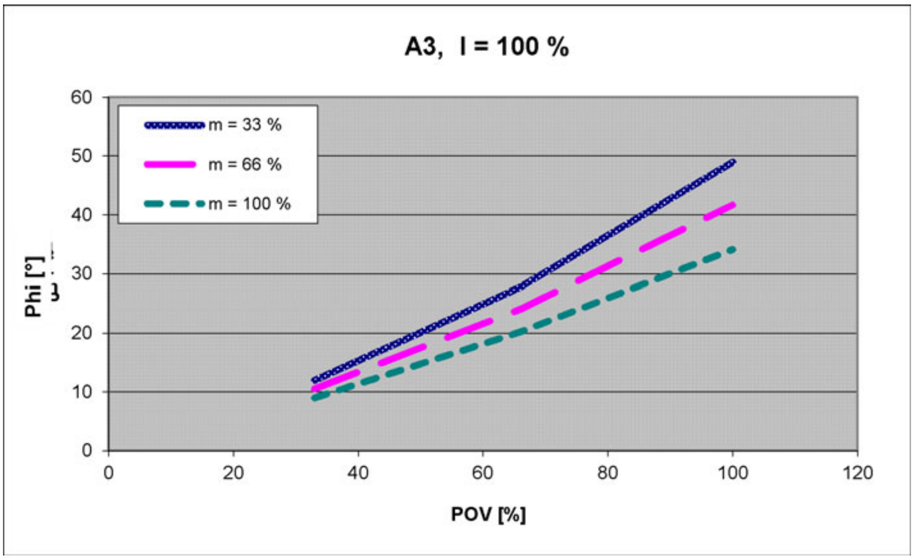


Fig. 4-85: Stopping distances for STOP 1, axis 3

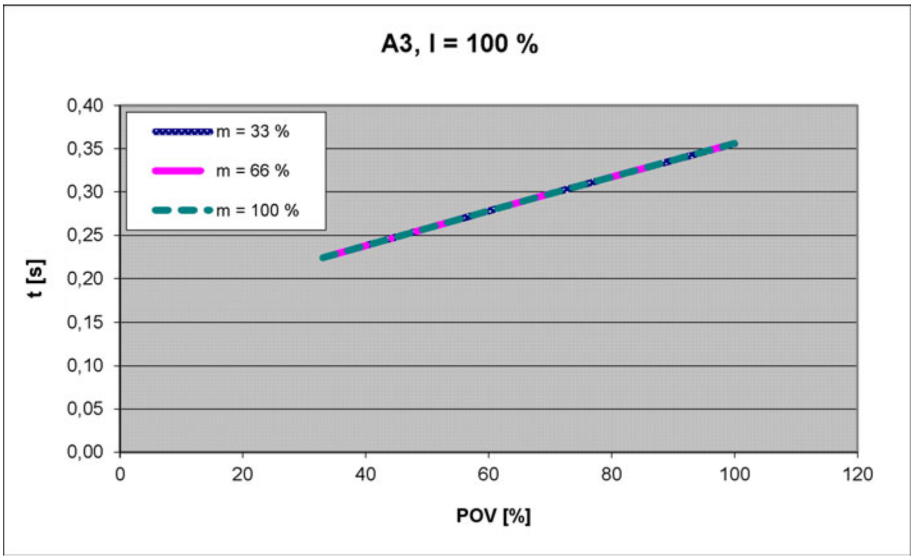


Fig. 4-86: Stopping times for STOP 1, axis 3

4.10.6 Stopping distances and times, KR 10 R1420 HP

4.10.6.1 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	41.03	0.31
Axis 2	22.47	0.25
Axis 3	21.11	0.15

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

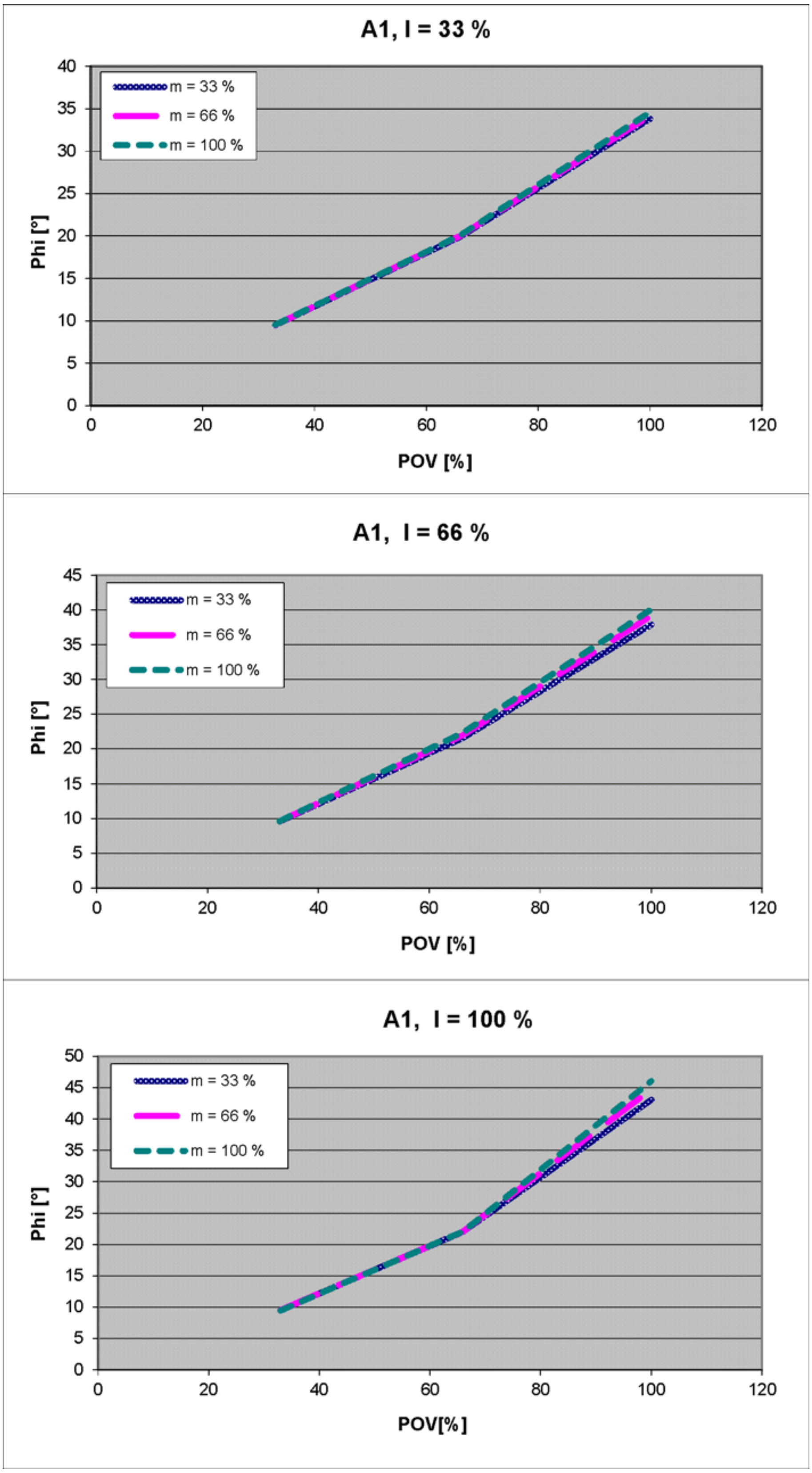


Fig. 4-87: Stopping distances for STOP 1, axis 1

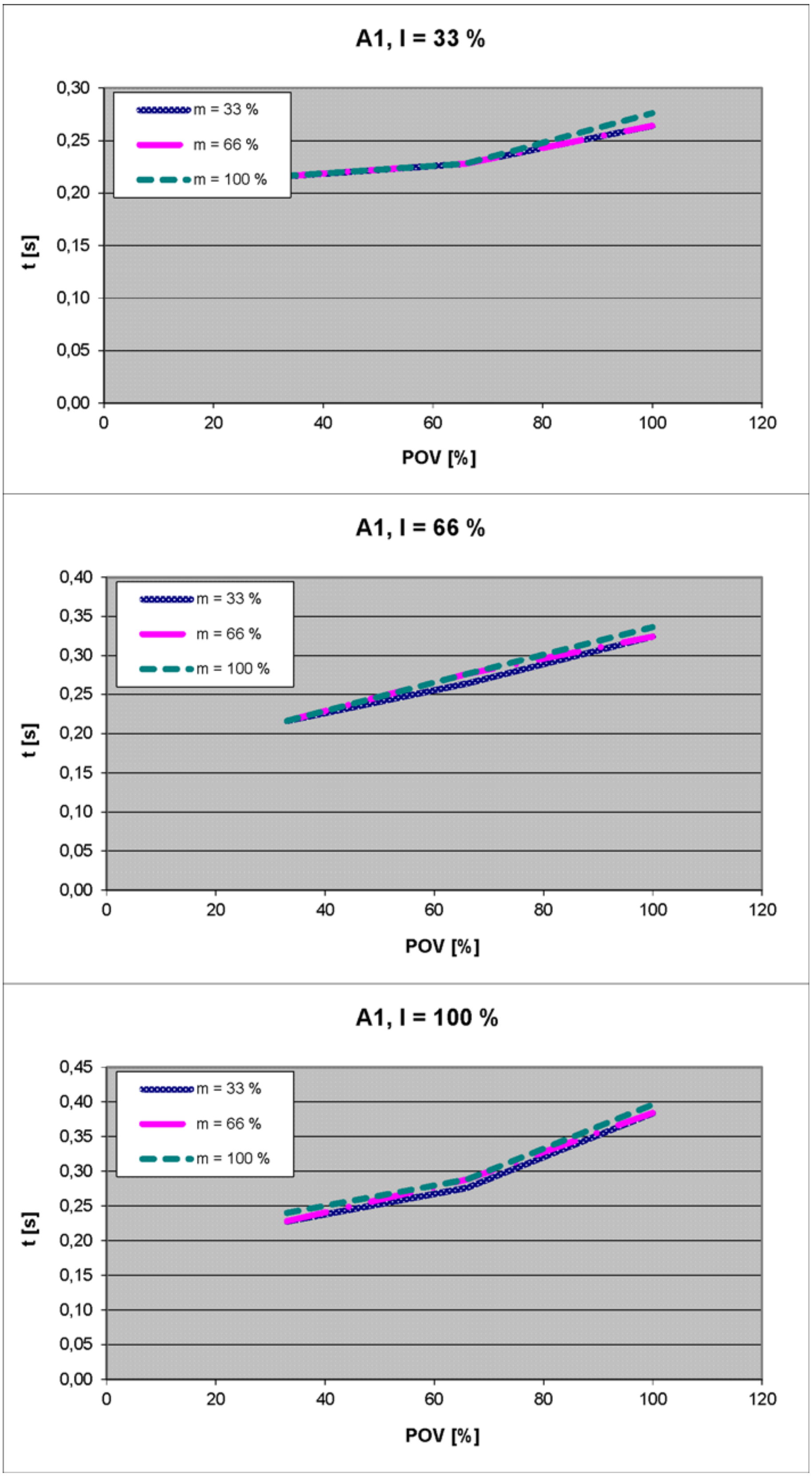


Fig. 4-88: Stopping time for STOP 1, axis 1

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

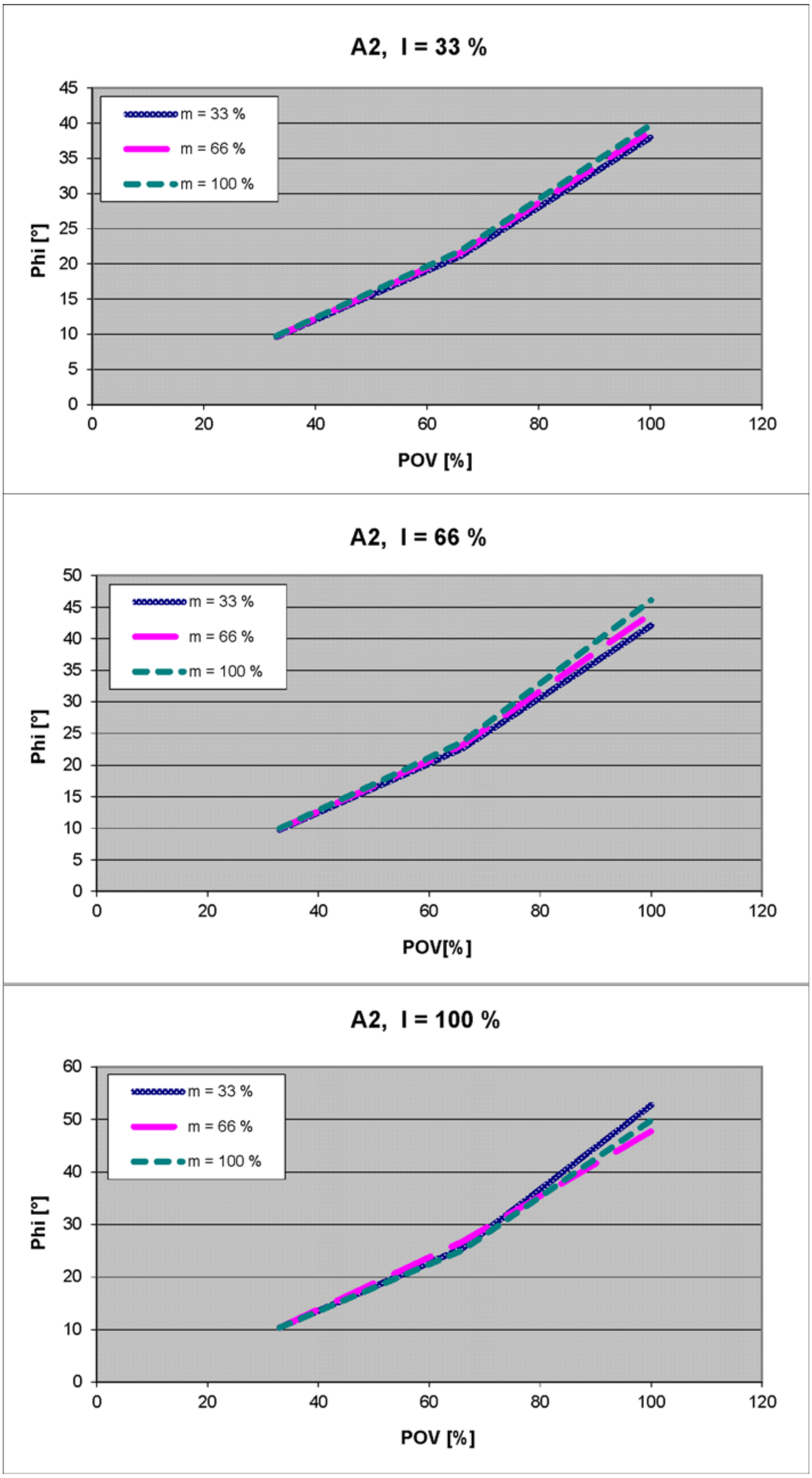


Fig. 4-89: Stopping distances for STOP 1, axis 2

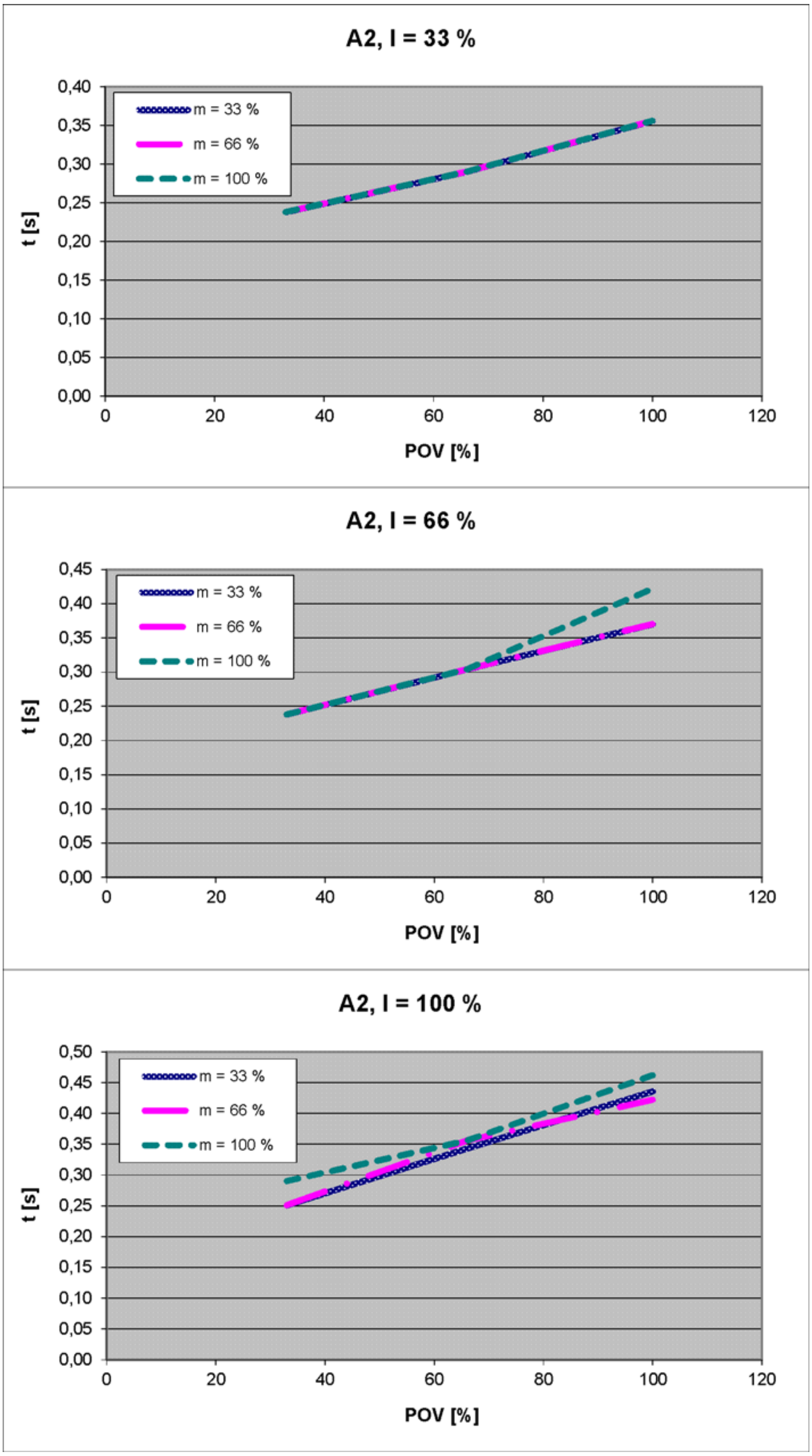


Fig. 4-90: Stopping time for STOP 1, axis 2

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

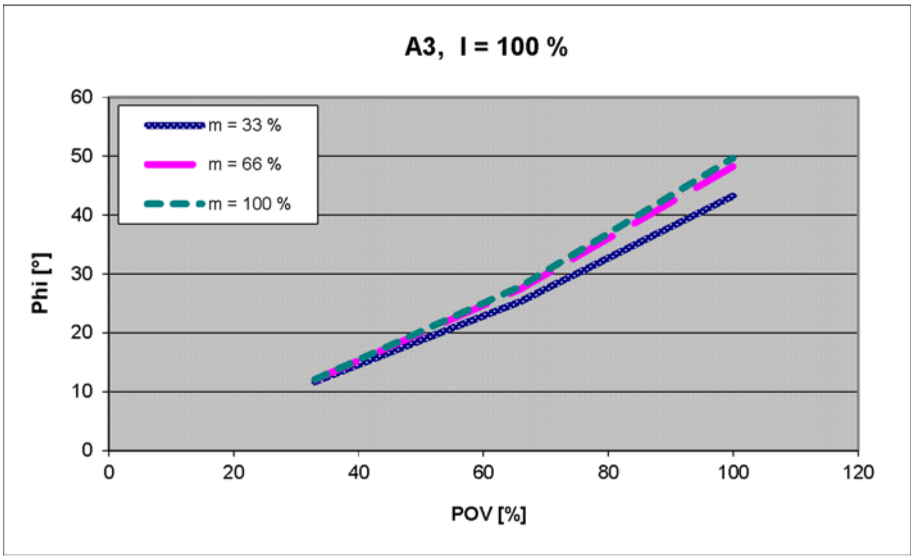


Fig. 4-91: Stopping distances for STOP 1, axis 3

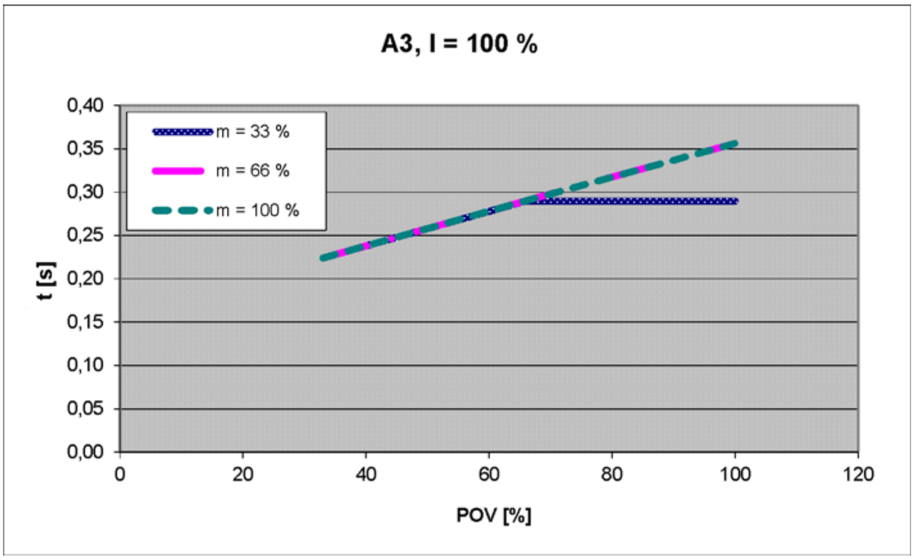


Fig. 4-92: Stopping time for STOP 1, axis 3

4.10.7 Stopping distances and times, KR 8 R1620 HP

4.10.7.1 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	54.21	0.40
Axis 2	48.89	0.40
Axis 3	18.18	0.13

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

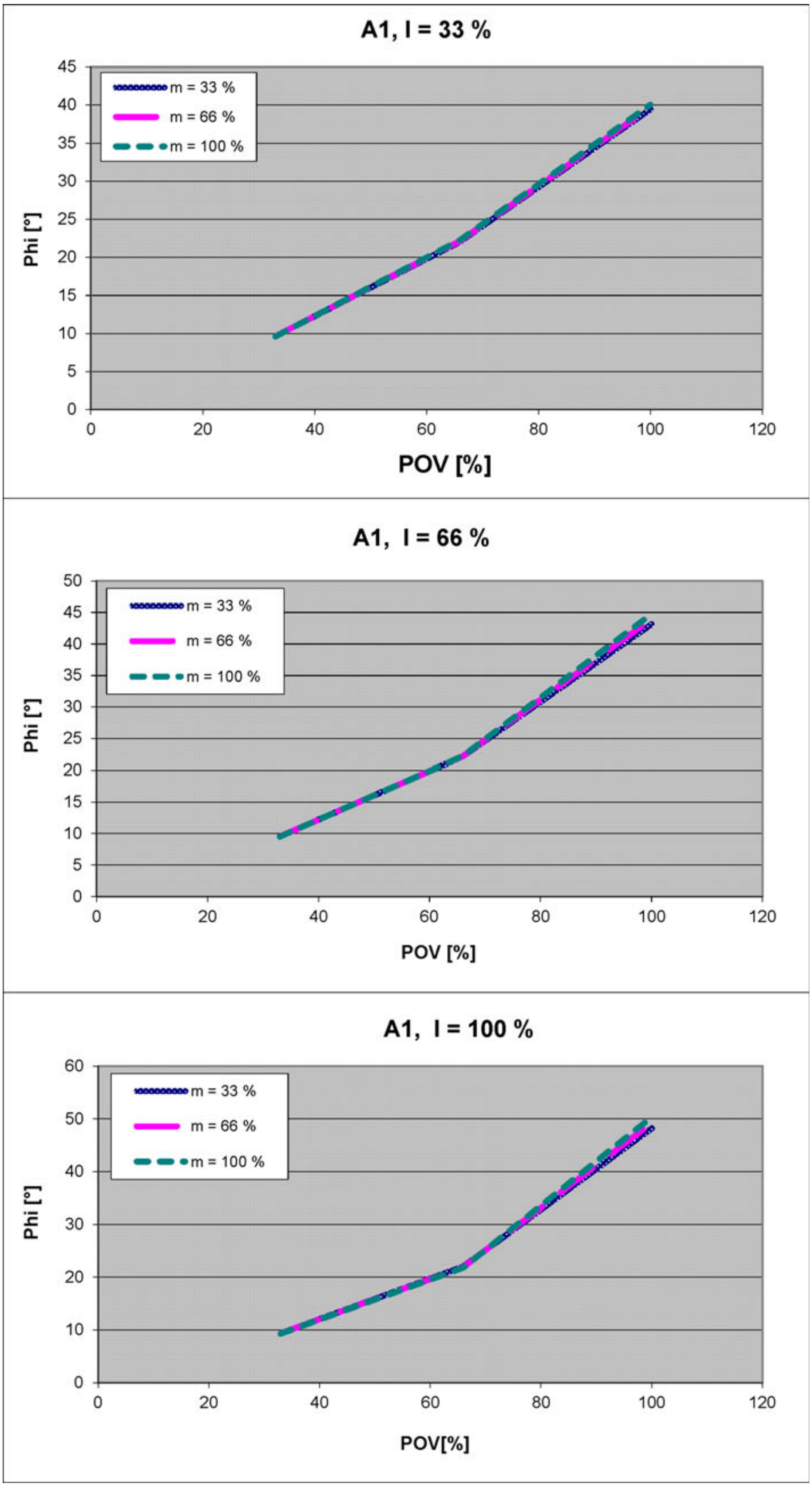


Fig. 4-93: Stopping distances for STOP 1, axis 1

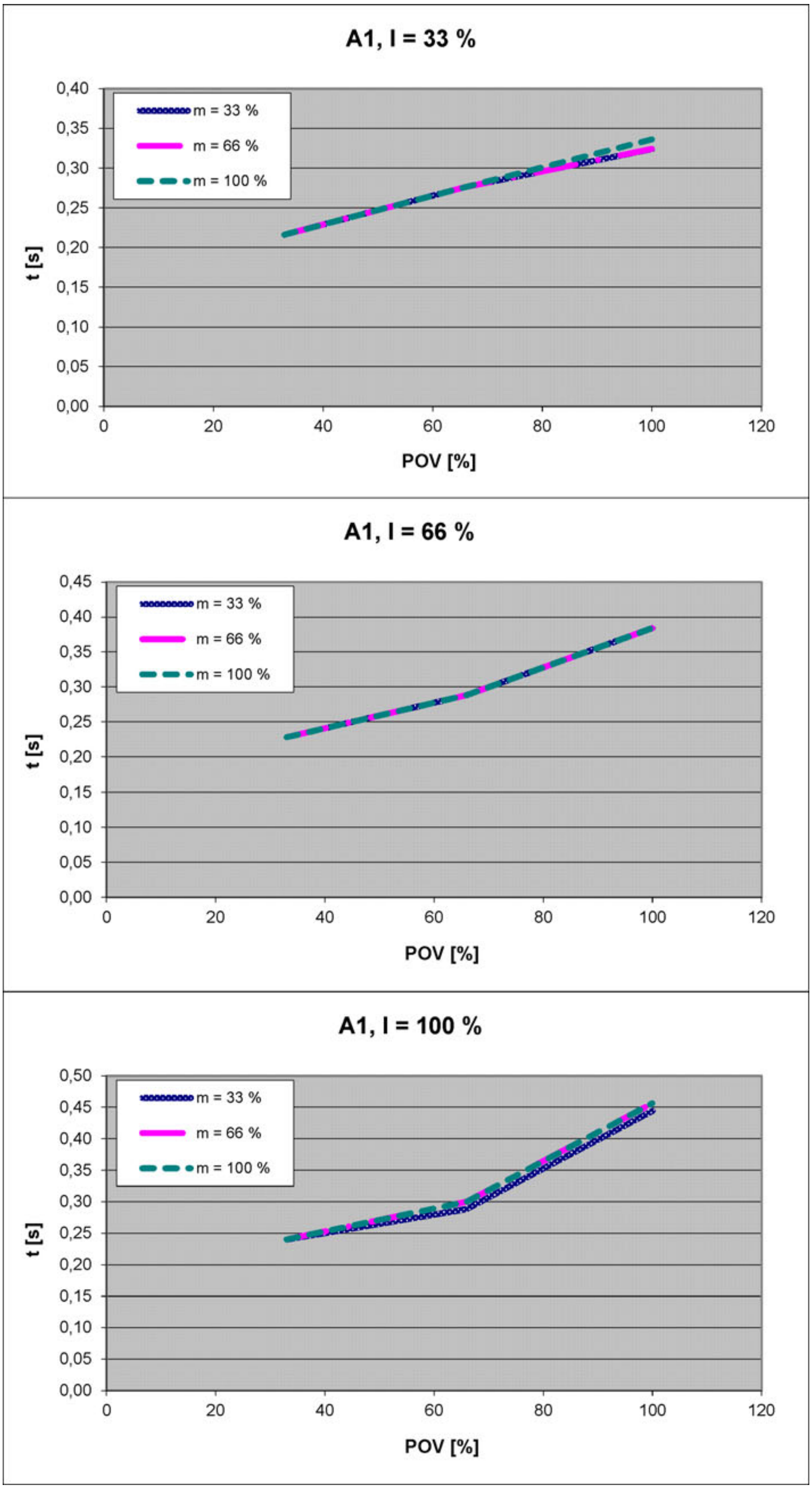


Fig. 4-94: Stopping times for STOP 1, axis 1

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

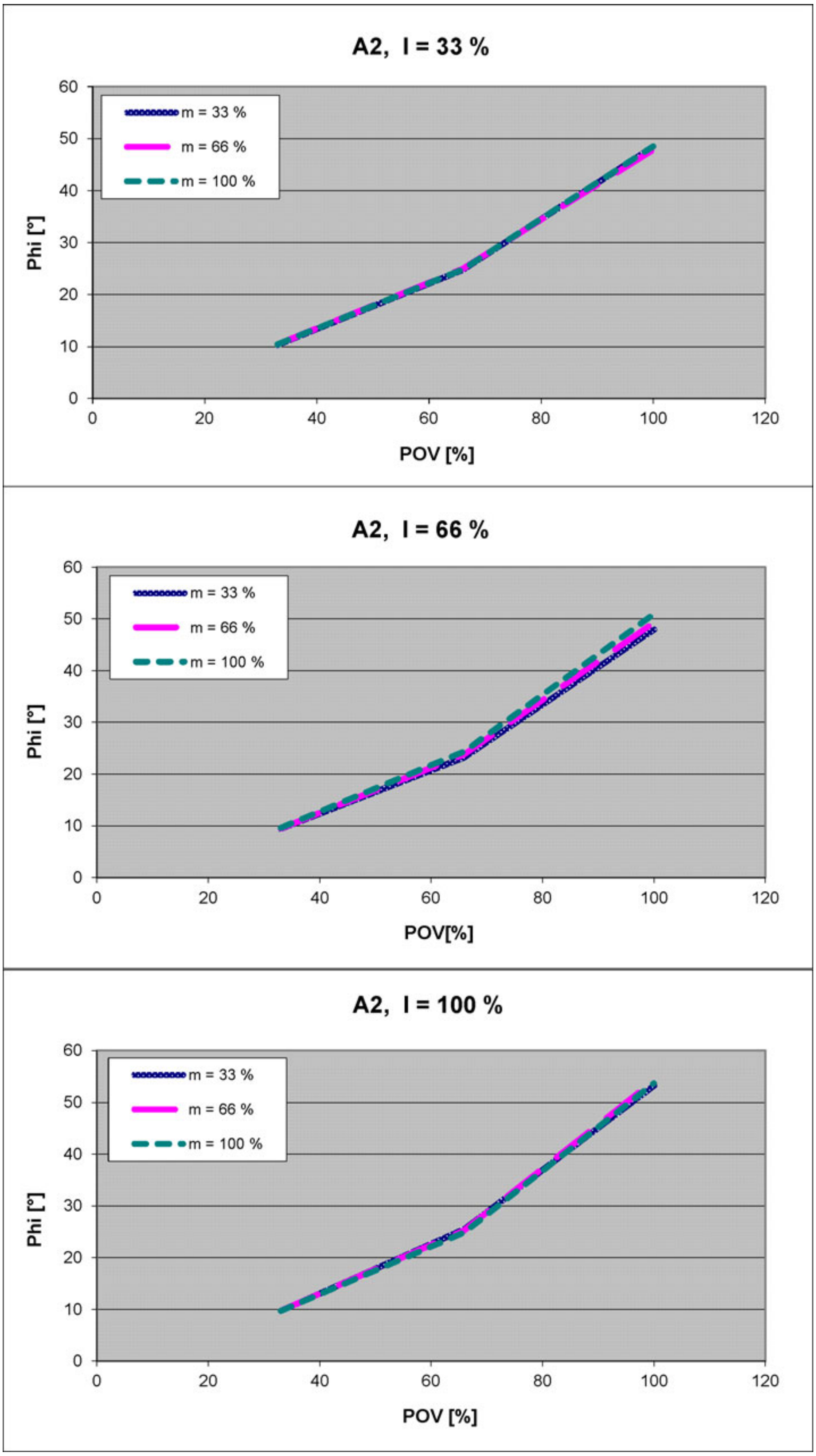


Fig. 4-95: Stopping distances for STOP 1, axis 2

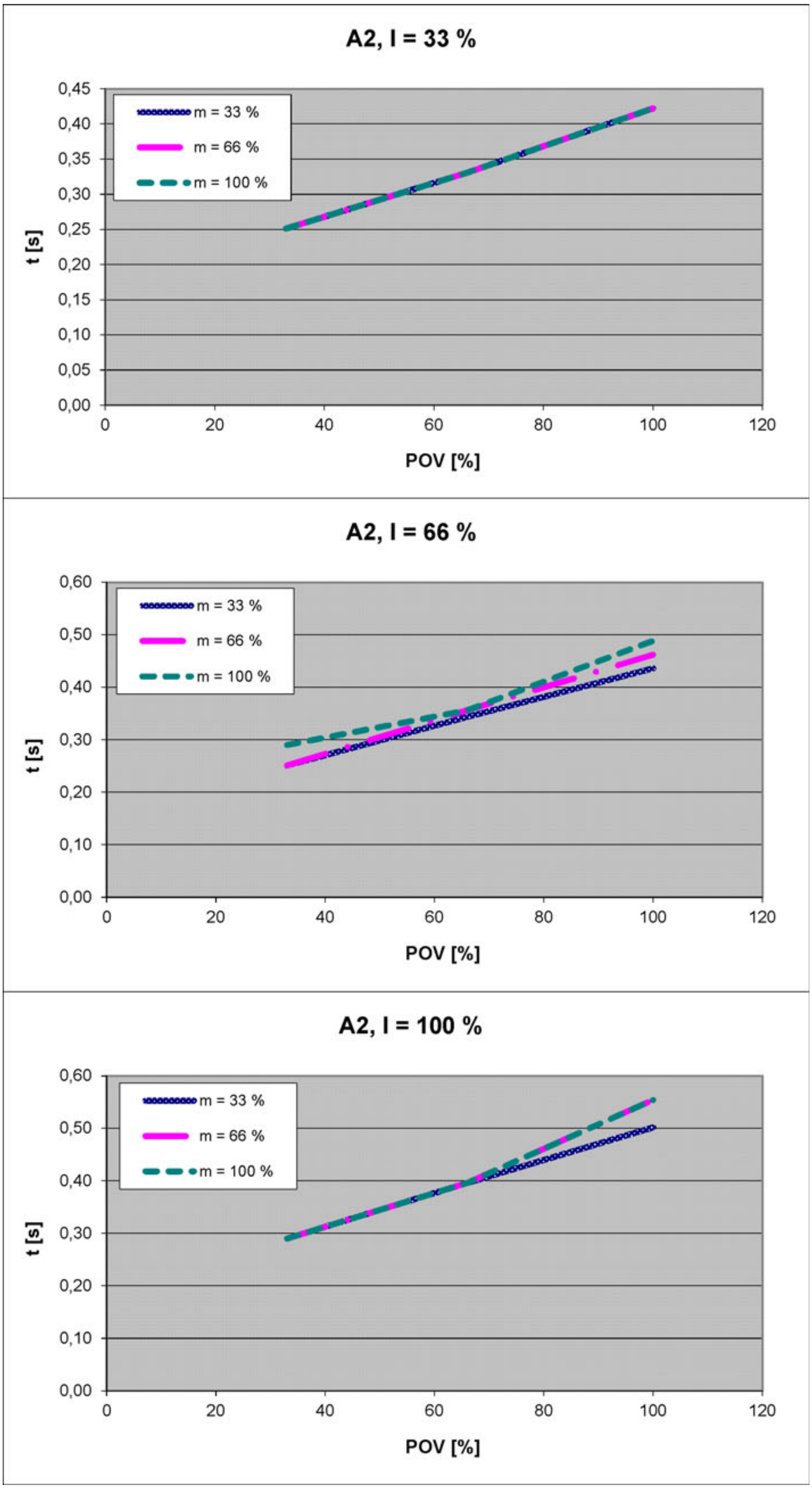


Fig. 4-96: Stopping times for STOP 1, axis 2

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

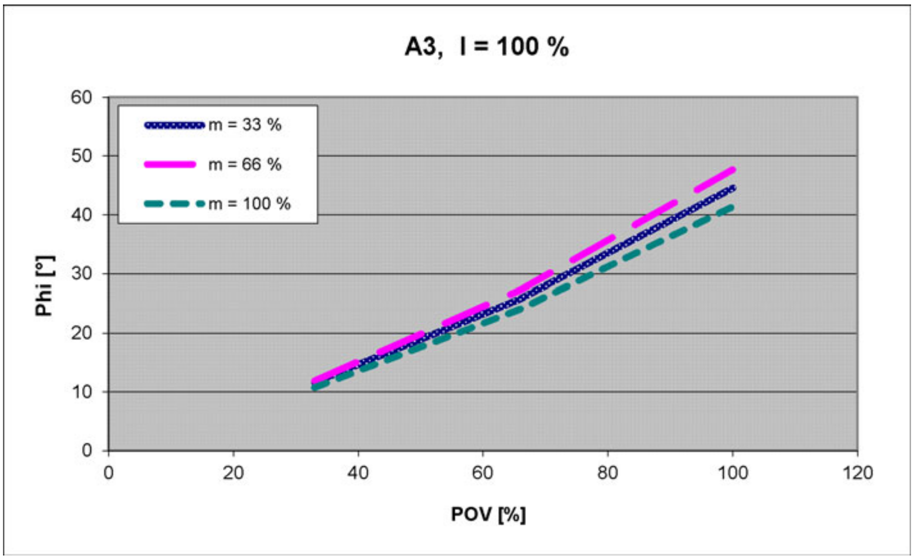


Fig. 4-97: Stopping distances for STOP 1, axis 3

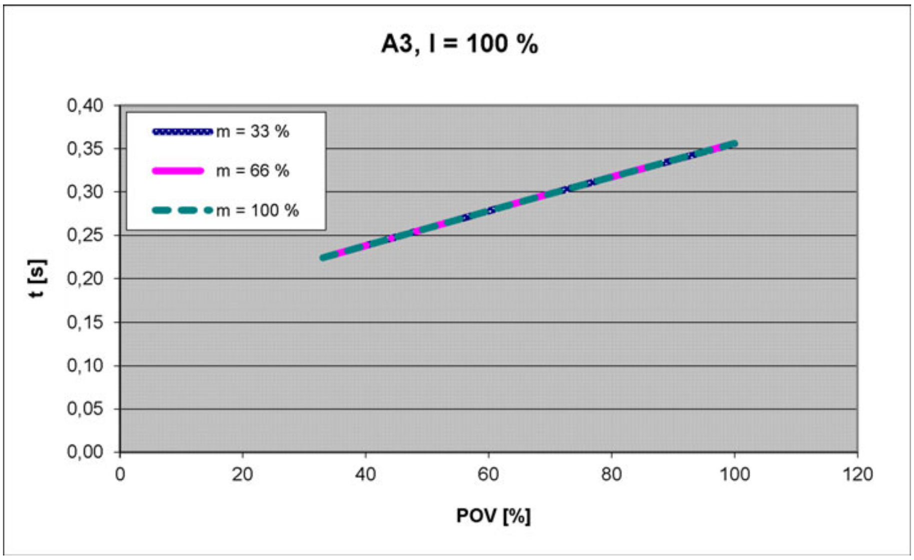


Fig. 4-98: Stopping times for STOP 1, axis 3

4.10.8 Stopping distances and times, KR 6 R1820 HP

4.10.8.1 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	54.05	0.39
Axis 2	47.41	0.39
Axis 3	17.26	0.10

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

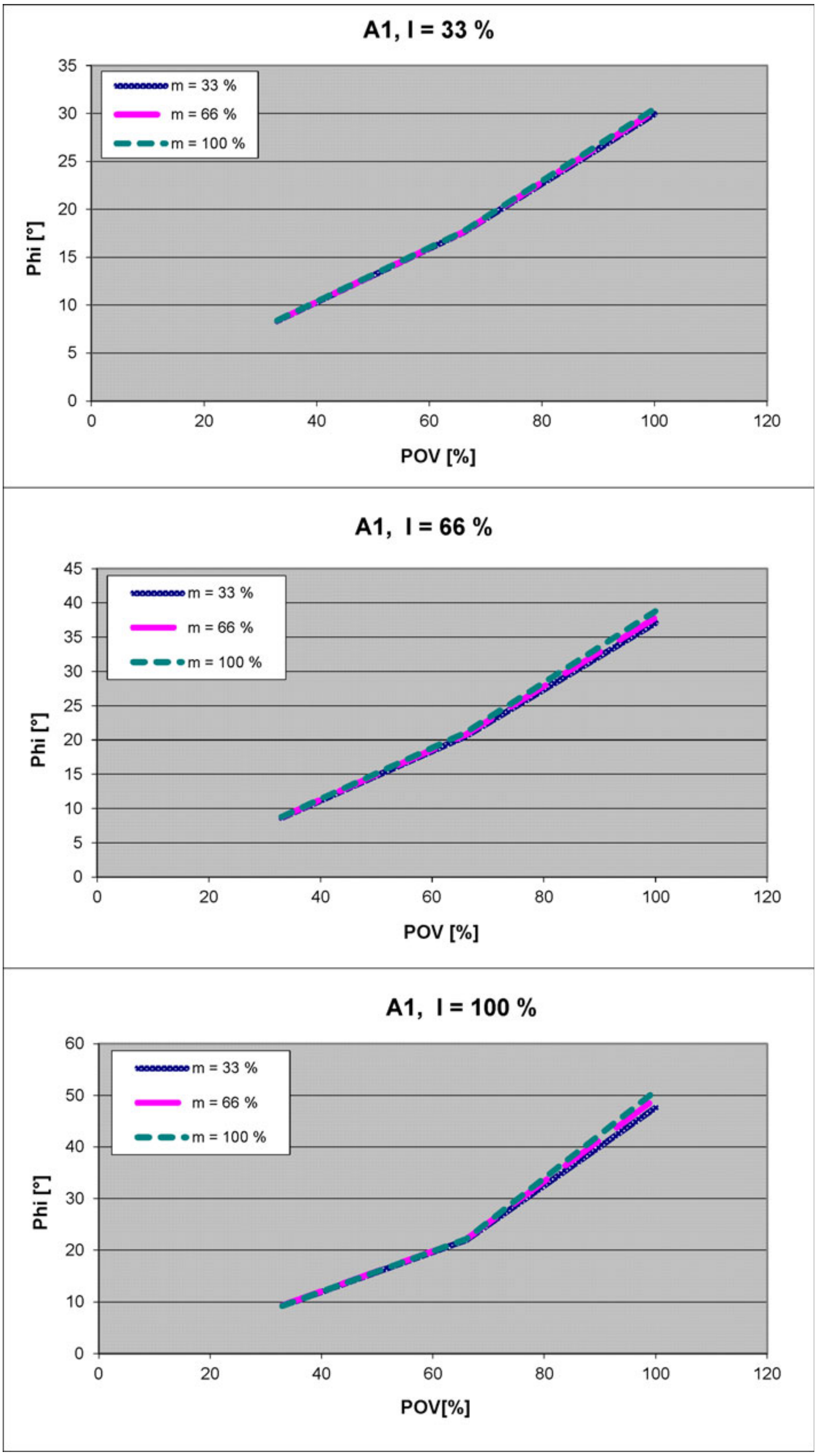


Fig. 4-99: Stopping distances for STOP 1, axis 1

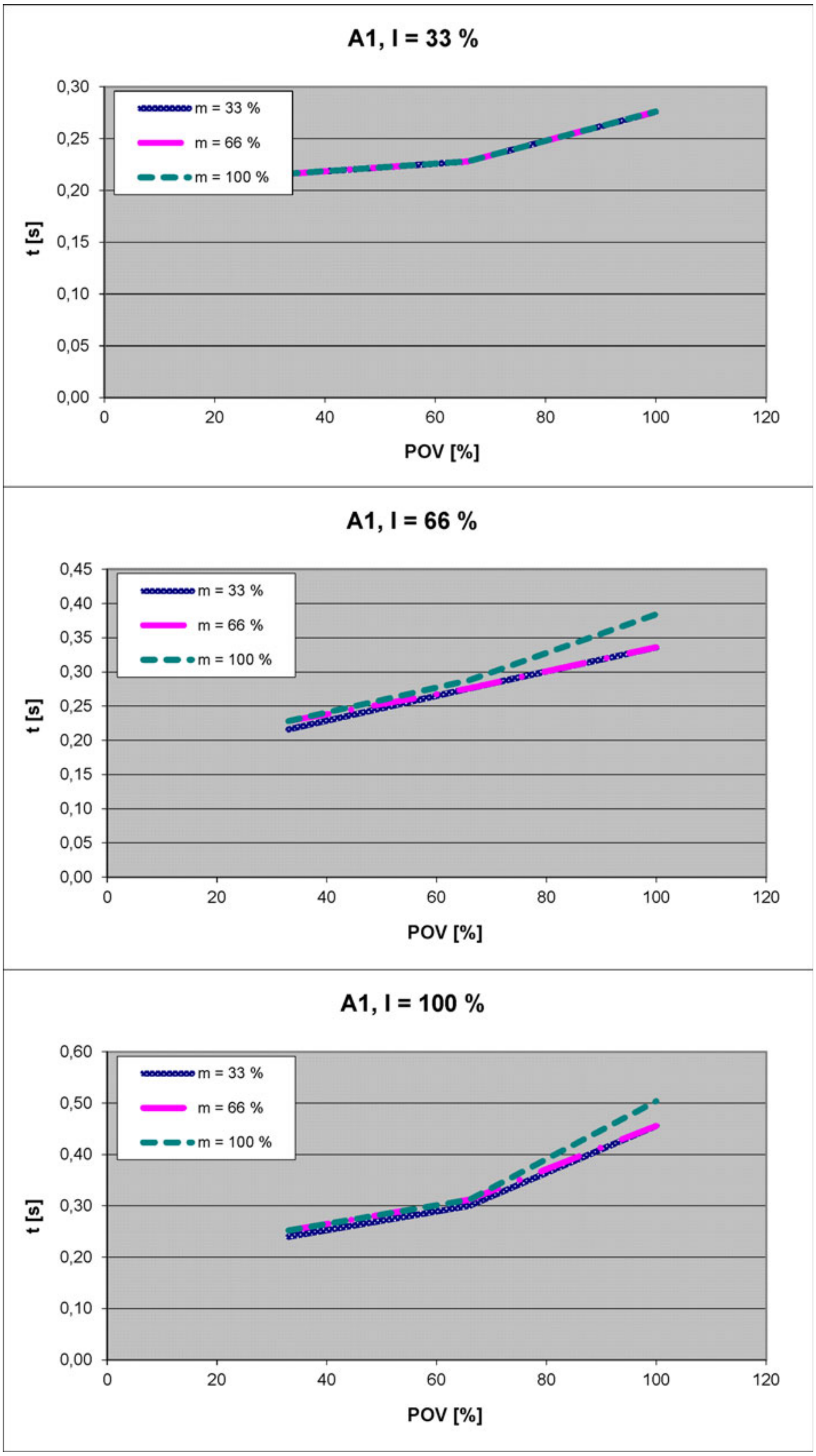


Fig. 4-100: Stopping times for STOP 1, axis 1

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

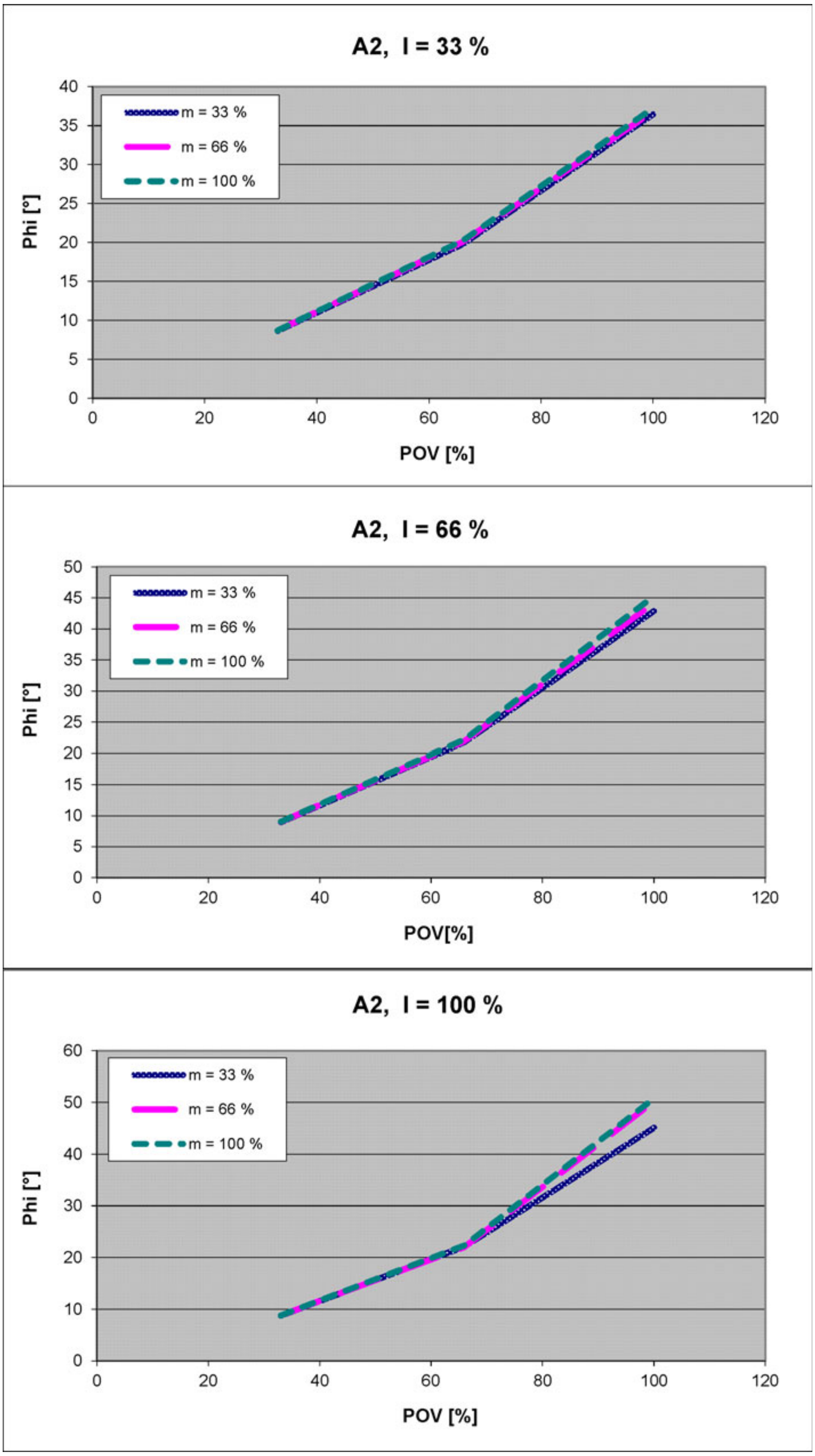


Fig. 4-101: Stopping distances for STOP 1, axis 2

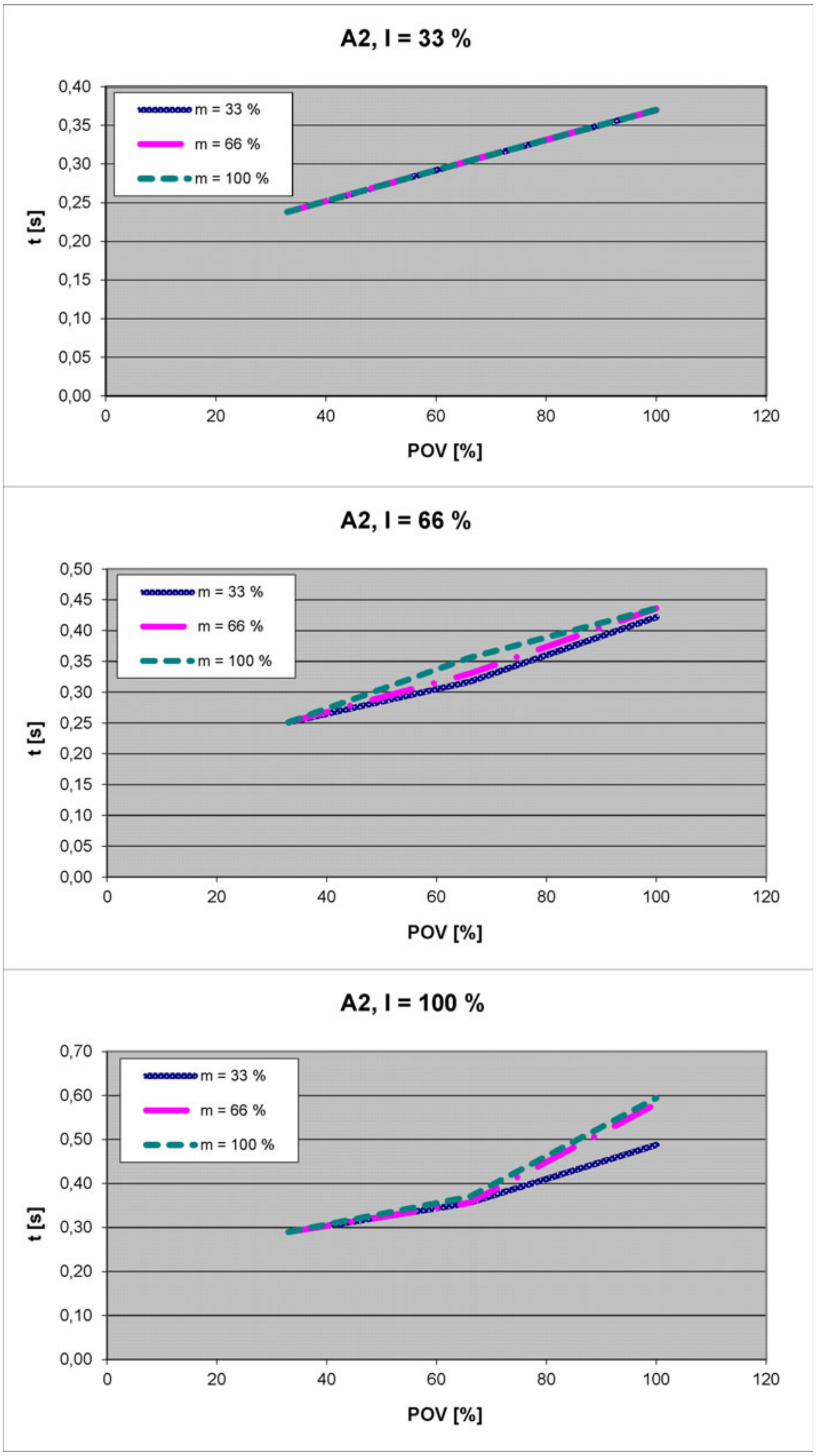


Fig. 4-102: Stopping times for STOP 1, axis 2

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

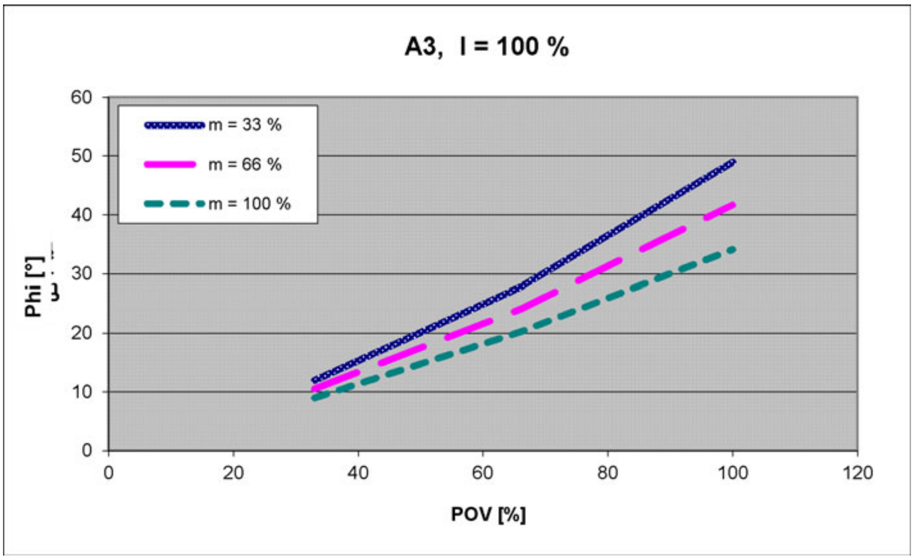


Fig. 4-103: Stopping distances for STOP 1, axis 3

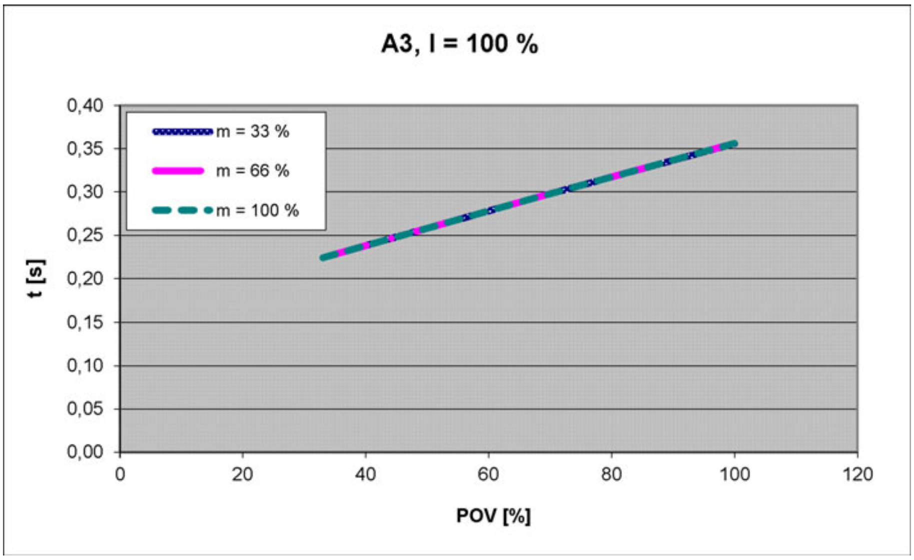


Fig. 4-104: Stopping times for STOP 1, axis 3

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

Safety information cannot be held against KUKA Roboter 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 Roboter GmbH. Additional components (tools, software, etc.), not supplied by KUKA Roboter 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.:

- Transportation of persons and animals
- Use as a climbing aid
- Operation outside the specified operating parameters
- Use in potentially explosive environments
- Operation without additional safeguards
- Outdoor operation
- Underground operation

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 an assessment of conformity.

Declaration of conformity

The system integrator must issue a declaration of conformity for the complete system in accordance with the Machinery Directive. The 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 EC 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 robot 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”
Manipulator	The robot arm and the associated electrical installations
Safety zone	The safety zone is situated outside the danger zone.
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.
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.
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	Motion axis which is not part of the manipulator but which is controlled using the robot 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 declaration of conformity
- Attaching the CE mark
- Creating the operating instructions for the complete system

Operator

The operator must meet the following preconditions:

- The operator must be trained for the work to be carried out.
- Work on the industrial robot 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 range limitation (optional)
- Axis range monitoring (optional)
- 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 axis range limitation, the manipulator can no longer be operated safely. The manipulator must be taken out of operation and KUKA Roboter GmbH must be consulted before it is put back into operation .

5.4.2 Mechanical axis range limitation (optional)

Some manipulators can be fitted with mechanical axis range limitation in axes A1 to A3. The adjustable axis range 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 range 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 range 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 Roboter GmbH.

5.4.3 Axis range monitoring (optional)

Some manipulators can be fitted with dual-channel axis range monitoring systems in main axes A1 to A3. The positioner axes may be fitted with additional axis range monitoring systems. The safety zone for an axis can be adjusted and monitored using an axis range monitoring system. This increases personal safety and protection of the system.

> This option is not available for the KR C4. This option is not available for all robot models. Information on specific robot models can be obtained from KUKA Roboter GmbH.

5.4.4 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 Roboter 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.

5.4.5 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 modifications 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 (tag-out).
- 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 Roboter 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 Roboter 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	Definition	Edition
2006/42/EC	**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)	2006
2014/30/EU	**EMC Directive:** Directive 2014/30/EC of the European Parliament and of the Council of 26 February 2014 on the approximation of the laws of the Member States concerning electromagnetic compatibility	2014
2014/68/EC	**Pressure Equipment Directive**: Directive 2014/68/EC of the European Parliament and of the Council of 15 May 2014 on the approximation of the laws of the Member States concerning pressure equipment (Only applicable for robots with hydropneumatic counterbalancing system.) This directive is valid from the 19/07/2016 on.	2014
97/23/EC	**Pressure Equipment Directive**: Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment (Only applicable for robots with hydropneumatic counterbalancing system.) This directive is valid until 18/07/2016.	1997

EN ISO 13850	**Safety of machinery:** Emergency stop - Principles for design	2008
EN ISO 13849-1	**Safety of machinery:** Safety-related parts of control systems - Part 1: General principles of design	2008
EN ISO 13849-2	**Safety of machinery:** Safety-related parts of control systems - Part 2: Validation	2012
EN ISO 12100	**Safety of machinery:** General principles of design, risk assessment and risk reduction	2010
EN ISO 10218-1	**Industrial robots – Safety requirements** Part 1: Robot **Note:** Content equivalent to **ANSI/RIA R.15.06-2012, Part 1**	2011
EN 614-1 + A1	**Safety of machinery:** Ergonomic design principles - Part 1: Terms and general principles	2009
EN 61000-6-2	**Electromagnetic compatibility (EMC):** Part 6-2: Generic standards; Immunity for industrial environments	2005
EN 61000-6-4 + A1	**Electromagnetic compatibility (EMC):** Part 6-4: Generic standards; Emission standard for industrial environments	2011
EN 60204-1 + A1	**Safety of machinery:** Electrical equipment of machines - Part 1: General requirements	2009

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 Roboter 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 following variant is available:

- Mounting base with centering

This mounting base variant consists of:

- Bedplates
- 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.

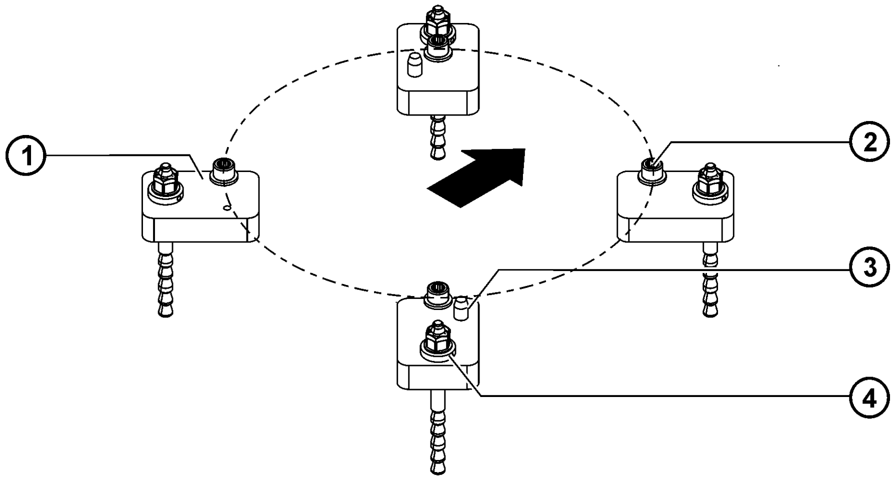


Fig. 6-1: Mounting base

1 Bedplate, 4x
2 Allen screw with conical spring washer, 4x
3 Locating pin, 2x
4 Resin-bonded anchor (chemical anchor), 4x

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 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.

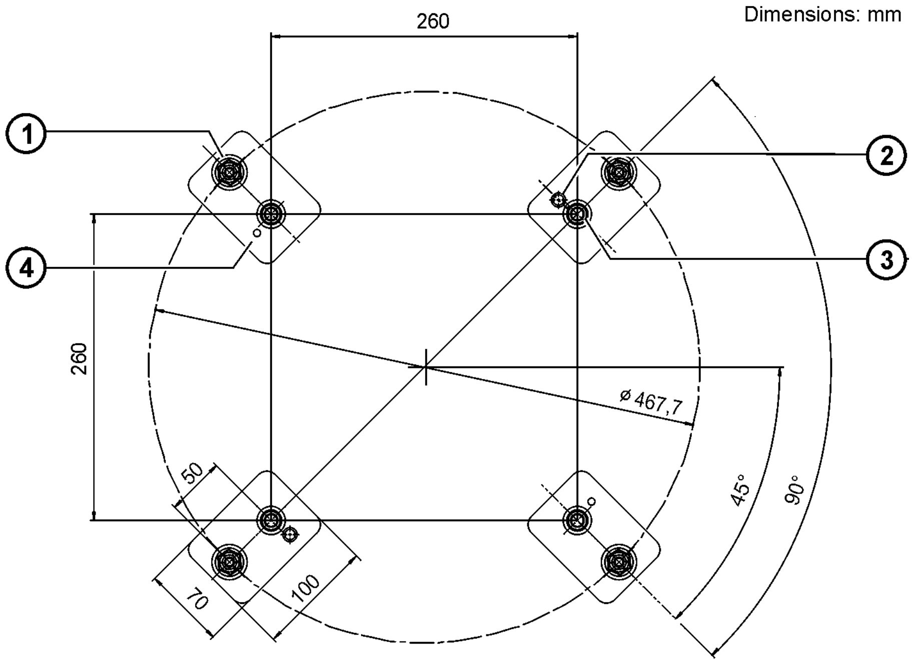


Fig. 6-2: Mounting base, dimensioned drawing

1 Resin-bonded anchor (chemical anchor)
2 Locating pin

3 Allen screw
4 Bedplate

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). The specified foundation dimensions refer to the safe transmission of the foundation loads into the foundation and not to the stability of the foundation.

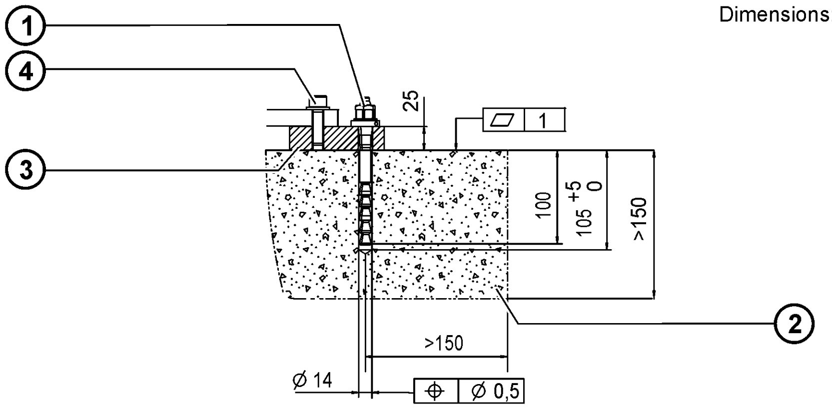


Fig. 6-3: Cross-section of foundations

1	Chemical anchors	3	Bedplate
2	Concrete foundation	4	Allen screw

6.3 Machine frame mounting

Description

The machine frame mounting (>>> Fig. 6-4) with centering is used for installing the robot on a steel structure provided by the customer or on the carriage of a KUKA linear unit. The mounting surface for the robot must be machined and of an appropriate quality. The robot is fastened to the machine frame mounting option using 4 Allen screws. Two support pins are used for centering.

The steel structure used by the customer must be designed in such a way that the forces generated (mounting base load, maximum load (>>> 4 "Technical data" Page 15)) are safely transmitted via the screw connection and the necessary stiffness is ensured. The specified surface values and tightening torques must be observed.

The following values must be taken into consideration in the design:

- Bolt force: Fs = 62 kN
- Stripping safety: The material of the substructure must be selected so that the stripping safety is ensured (e.g. S355J2G3).

The machine frame mounting assembly consists of:

- Locating pin
- Allen screws

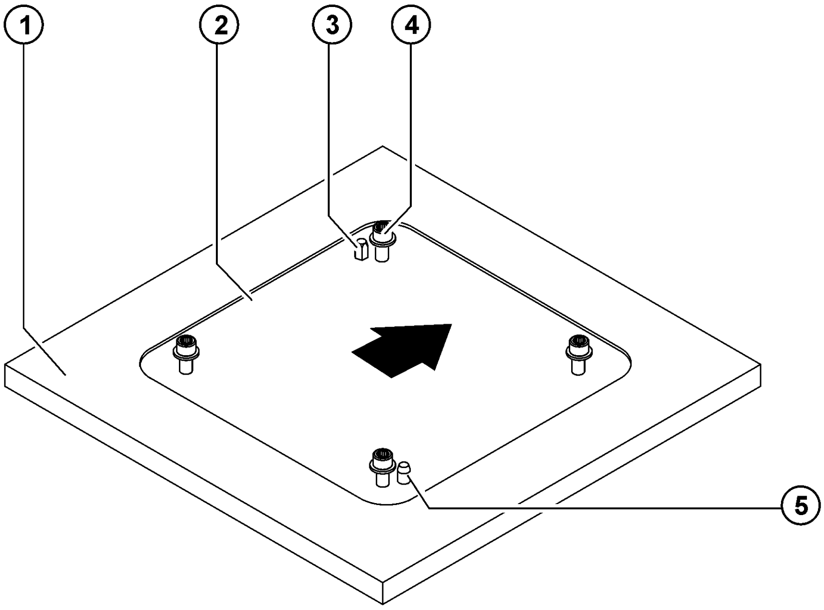


Fig. 6-4: Machine frame mounting

1 Machine frame
2 Mounting surface, machined
3 Locating pin, flat-sided
4 Allen screw
5 Locating pin, round

Dimensioned drawing

The following diagram contains all the necessary information that must be observed when preparing the mounting surface and the holes (>>> Fig. 6-5).

Dimensions: mm

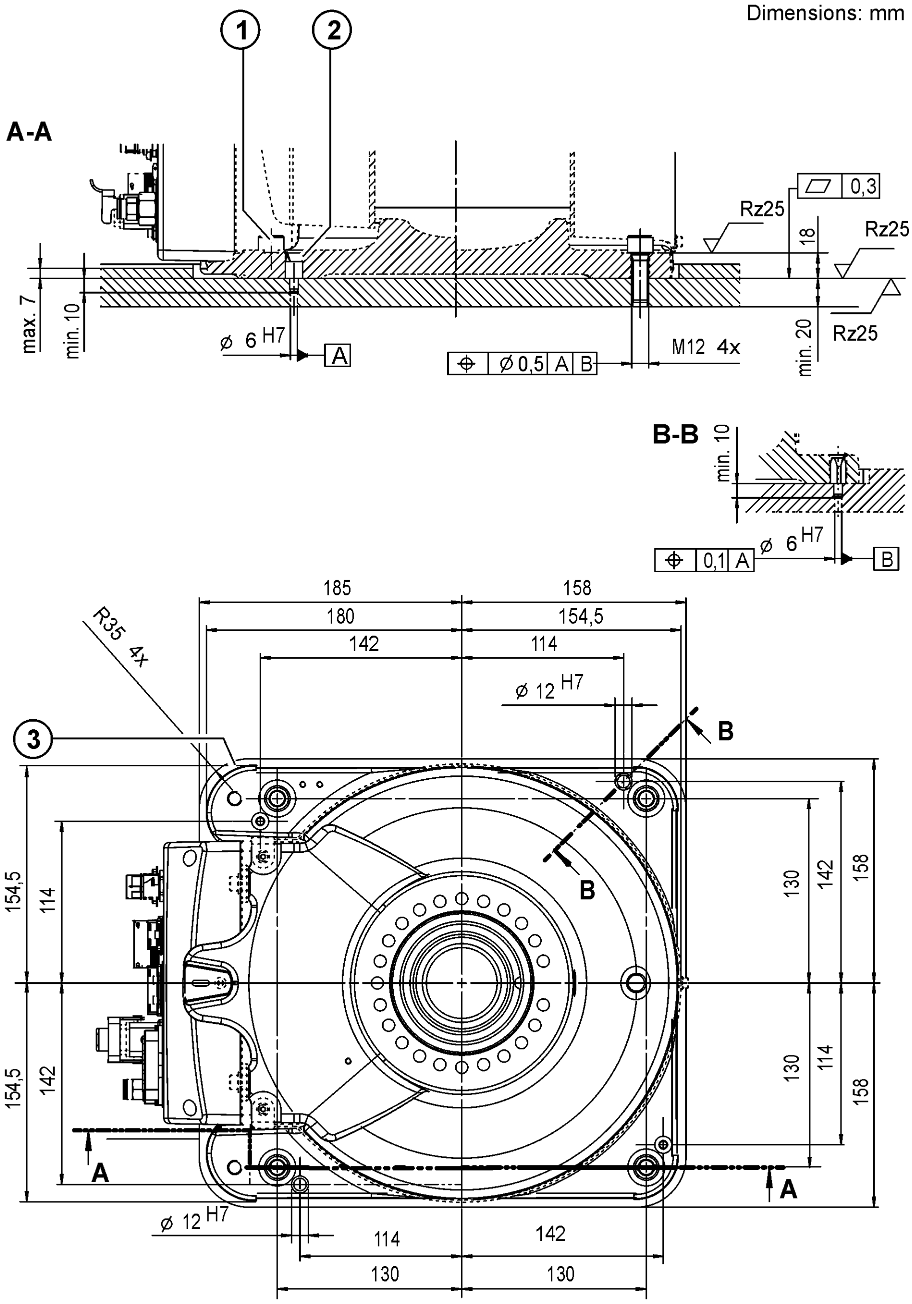


Fig. 6-5: Machine frame mounting, dimensioned drawing

1 Allen screw
2 Locating pin
3 Mounting surface, machined

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 to the robot junction boxes with connectors. Connection to the controller is always the same, irrespective of the controller variant.

The following diagram provides an overview of the available connecting cables (>>> Fig. 6-6).

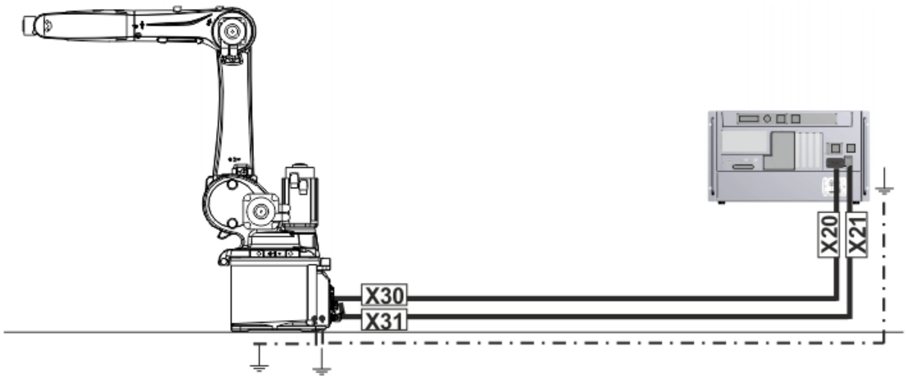


Fig. 6-6: Connecting cables, overview

The following connecting cables are available and can be used irrespective of the cable set in the robot:

- Motor cable, X20 - X30
- Data cable X21 - X31
- Ground conductor (optional)

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. A second ground conductor must additionally be installed between the robot and the system. 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 75 mm for motor cables and 45 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 343 K (+70 °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 for energy supply systems

The robot can be equipped with an integrated energy supply system between axis 1 and axis 3 and a second energy supply system between axis 3 and axis 6. The A1 interface required for this is located on the rear of the base frame, the A3 interface is located on the side of the arm. Depending on the application, the interfaces differ in design and scope. They can be equipped e.g. with connections for cables and hoses. Detailed information about the energy supply A3-A6, e.g. the connector pin allocation, threaded unions, etc., can be found in separate documentation.

Interface A1

The interfaces A1 on the base frame are illustrated below for robots with the following cable sets:

- Standard cable set

- Multibus cable set
- ProfiNet cable set

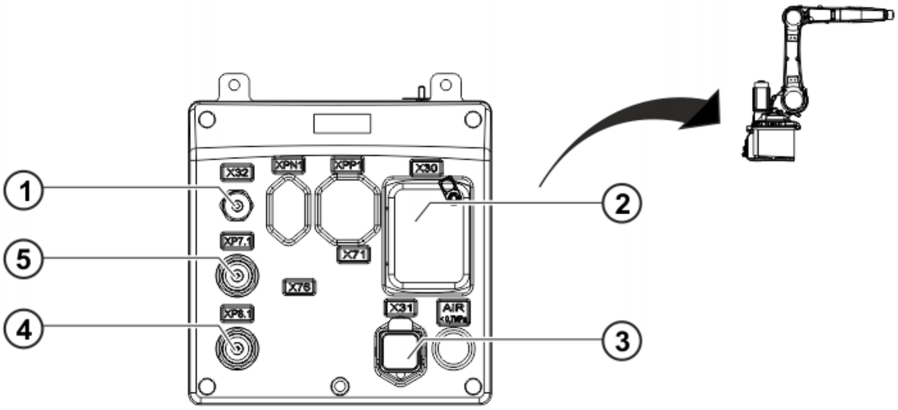


Fig. 6-7: Interface A1, standard cable set

1	Mastering cable X32	4	External axis XP8.1
2	Motor cable X30	5	External axis XP7.1
3	Data cable X31		

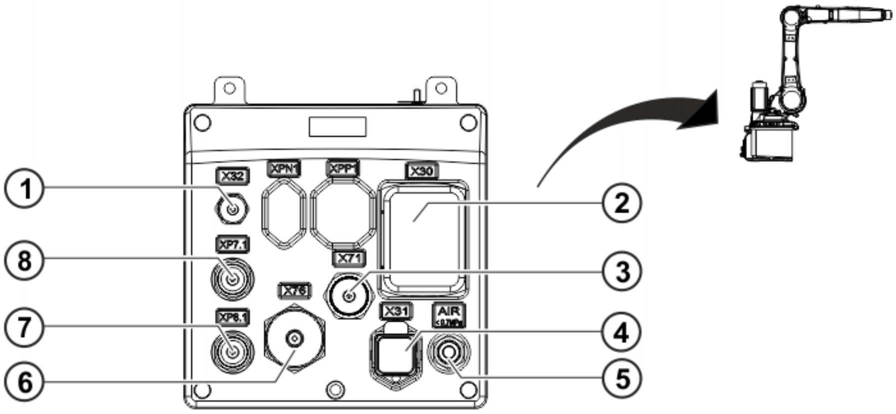


Fig. 6-8: Interface A1, Multibus cable set

1	Mastering cable X32	5	Air line
2	Motor cable X30	6	Control cable X76
3	Multibus cable X71	7	External axis XP8.1
4	Data cable X31	8	External axis XP7.1

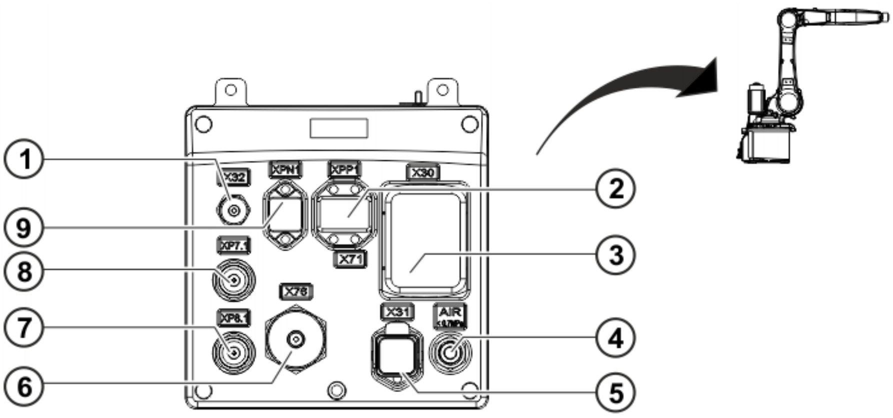


Fig. 6-9: Interface A1, ProfiNet cable set

1	Mastering cable X32	6	Control cable X76
2	Power supply XPP1	7	External axis XP8.1
3	Motor cable X30	8	External axis XP7.1
4	Air line	9	ProfiNet cable XPN1
5	Data cable X31		

Interface A3

Interface A3 is located on the arm. The incoming cables and hoses from the internal energy supply system are grouped together here at a single interface. The following interfaces are available, depending on the equipment (cable set).

- Multibus
- ProfiNet

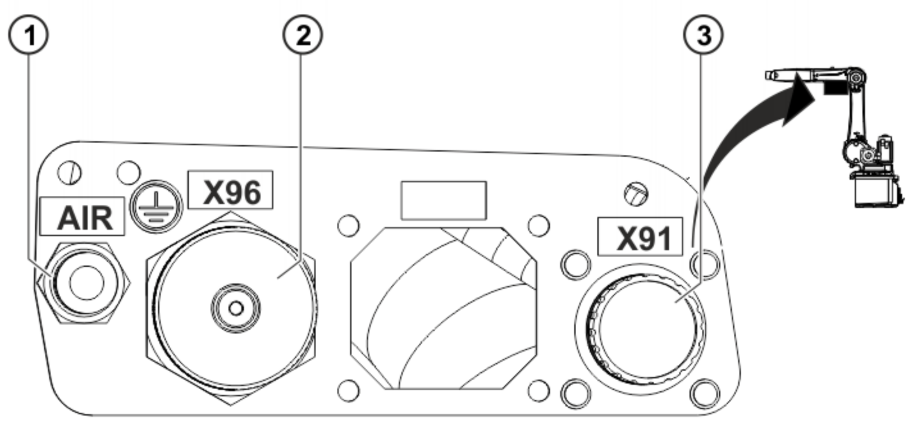


Fig. 6-10: Interface A3, Multibus cable set

1	Air line	3	Multibus cable X91
2	Control cable X96		

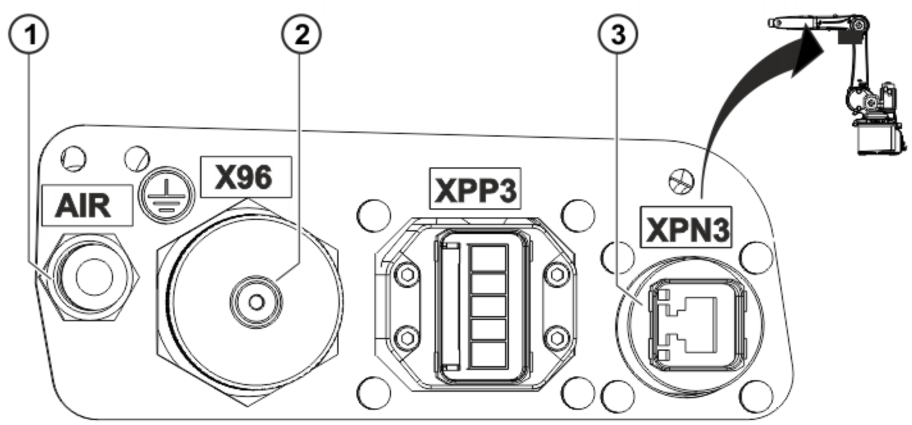


Fig. 6-11: Interface A3, ProfiNet cable set

1	Air line	3	Power supply XPP3
2	Control cable X96	4	ProfiNet cable XPN3

6.5 Internal energy supply system

The robot can be equipped with an internal energy supply system. The corresponding cables are integrated into the relevant cable set. Variants for:

- Multibus
- ProfiNet

are available.

The available cables and hoses are shown below.

Hose line

Nominal size	8 mm Internal diameter, 5 mm
Material	PU
Connection	Plug-in connection 8 mm
Color	natural
Rated pressure $_{max.}$	0.8 MPa (8 bar) at 293 K (+20 °C)
Minimum bending radius	10x outer diameter
Ambient temperature	253 K to 333 K (-20 °C to +60 °C)

Multibus cable, X71-X91

Configuration a	2x (2x 0.25 mm^2), shielded; IBS 2x (2x 0.34 mm^2), shielded; CAN 2x 0.34 mm^2/2x 0.29 mm^2, shielded; Profibus 2x (2x 1 mm^2) 24 V/0 V supply 1x 1 mm^2, ground conductor (GNYE)
Configuration b	2x (2x 0.25 mm^2), shielded; IBS 1x (4x 0.34 mm^2), shielded; CAN 2x 0.34 mm^2, shielded; Profibus 1x (4x 1 mm^2), 24 V/0 V supply 1x 1 mm^2, ground conductor (GNYE)
Rated voltage	30 V DC
Current	EN 60204-1 (derating factors must be taken into account)
Connection A1	Bus coupling, SpeedTEC-ready, 17-pole, E-part, male
Connection A3	Bus coupling, SpeedTEC-ready, 17-pole, P-part, female

Connect X71	Pin	Shield Multibus a	Shield Multibus b	Wire a	Wire b	Shield Multibus a	Shield Multibus b	Pin	Connect X91	Signal designation
	7			YE	YE				7	IBS D0
	8			GN	GN				8	IBS $\overline{D0}$
	9			GY	GY				9	IBS D1
	10			PK	PK				10	IBS $\overline{D1}$
	11			GN	GN				11	Profi A
	6			RD	RD				6	Profi B
	17			RD	YE				17	CAN
	12			BU	GN				12	CAN
	13			WH	WH				13	CAN high
	14			BU	BN				14	CAN low
	2			BU	BU				2	US2 0V
	3			BN	BN				3	US2 24V
	1			BK	BK				1	US1 0V
	4			RD	RD				4	US1 24V
	5			GNYE	GNYE				5	PE
	15								15	n.c.
	16								16	n.c.
Housing									Connector housing	

Fig. 6-12: Multibus cable, X71-X91

ProfiNet cable, XPN1 - XPN3

Configuration	2x (2x AWG22), shielded
Rated voltage	30 V AC/DC
Current	EN 60204-1 (derating factors must be taken into account)
Connection A1	RJ45 insert for PNT housing
Connection A3	Coupling, round, HAN Push Pull RJ45 AWG22/23

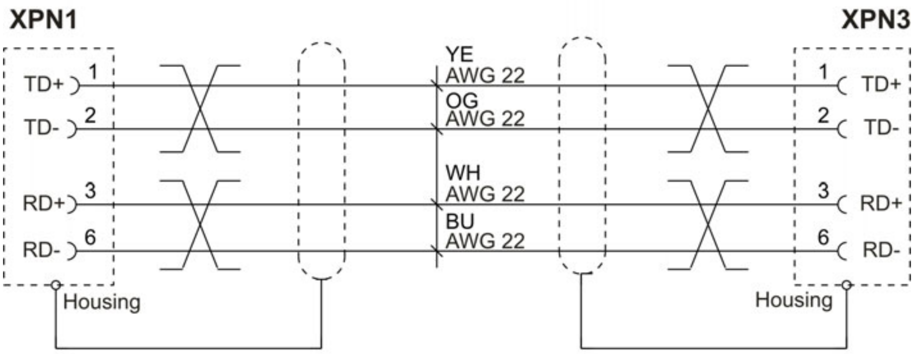


Fig. 6-13: ProfiNet cable, XPN1 - XPN3

Power supply, XPP1 - XPP3

Configuration	5x 1.5 mm^2
Rated voltage	24 V AC/DC
Current	EN 60204-1 (derating factors must be taken into account)
Connection A1	HAN PushPull Power L connector insert
Connection A3	HAN PushPull L Power coupling

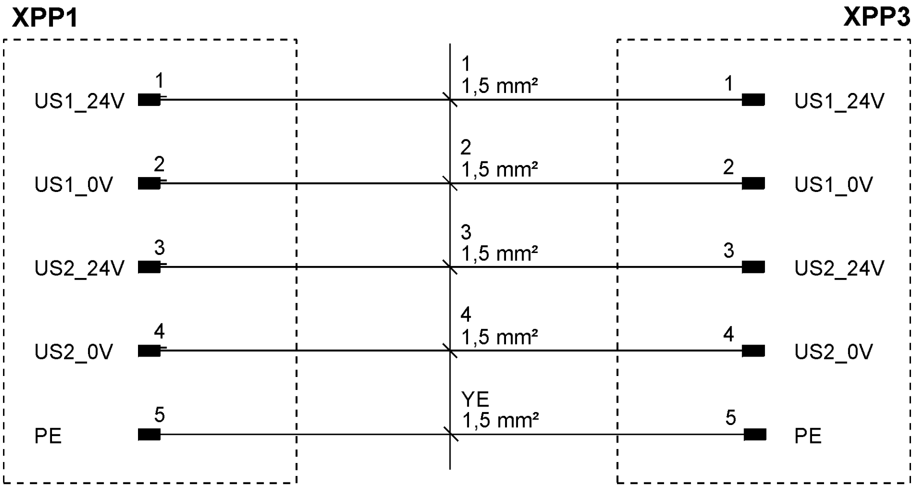


Fig. 6-14: Power supply, XPP1 - XPP3

Control cable, X76 - X96

Configuration	25x 0.25 mm^2
Rated voltage	300 V AC/DC
Current	EN 60204-1 (derating factors must be taken into account)
Connection A1	Built-in connector, male, 28 pins
Connection A3	Built-in connector, female, 28 pins

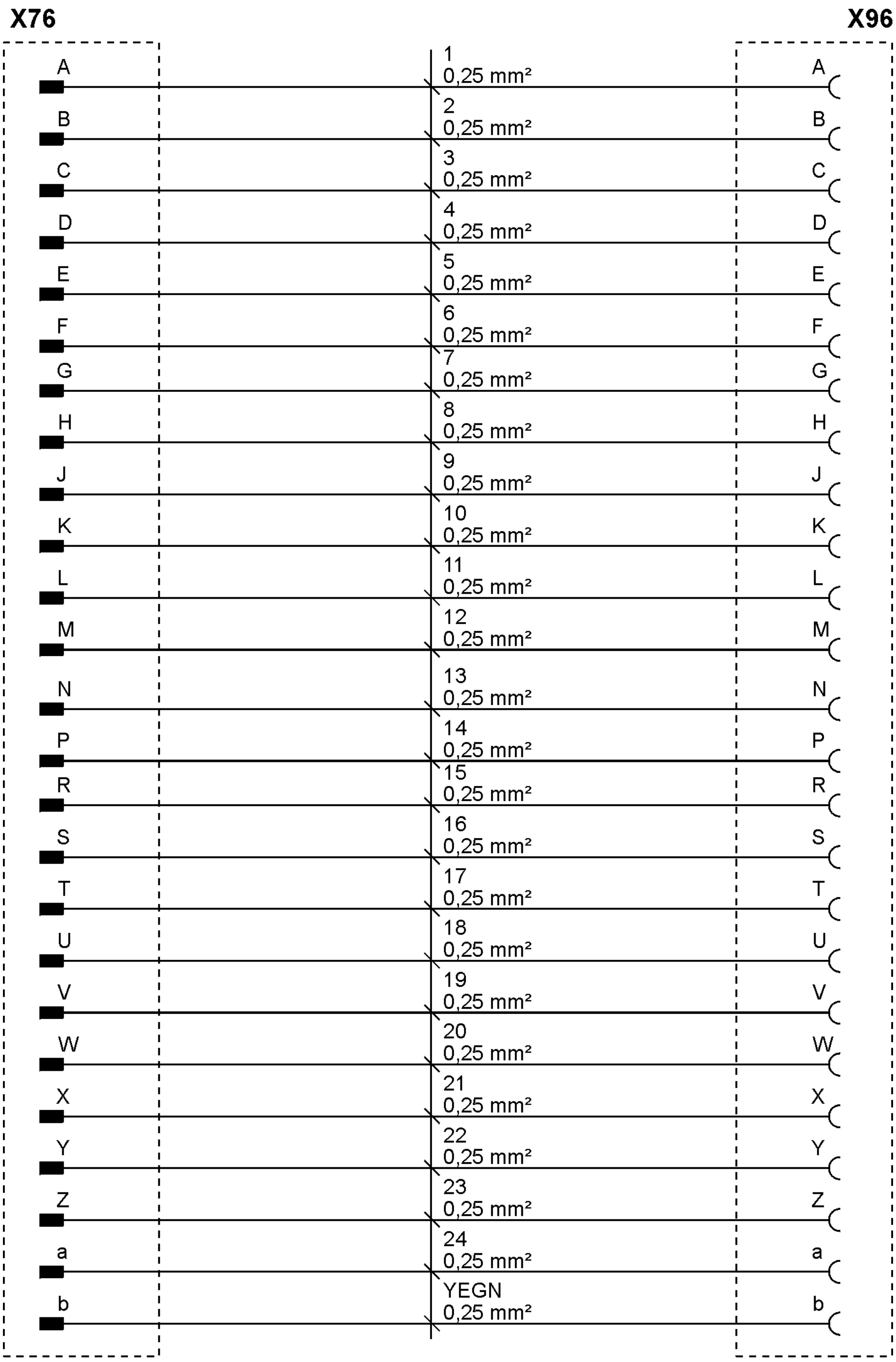


Fig. 6-15: Control cable, X76 - X96

7 Transportation

7.1 Transporting the robot

Move the robot into its transport position (>>> Fig. 7-1) 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 in position. 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 rust or glue on contact surfaces.

Transport position

The transport position is the same for all robots of this model. The robot is in the transport position when the axes are in the following positions:

Axis	A1	A2	A3	A4	A5	A6
Angle	0º	-120º	+161º	0º	+80º	0º

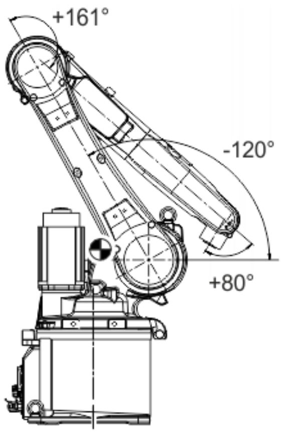


Fig. 7-1: Transport position

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.

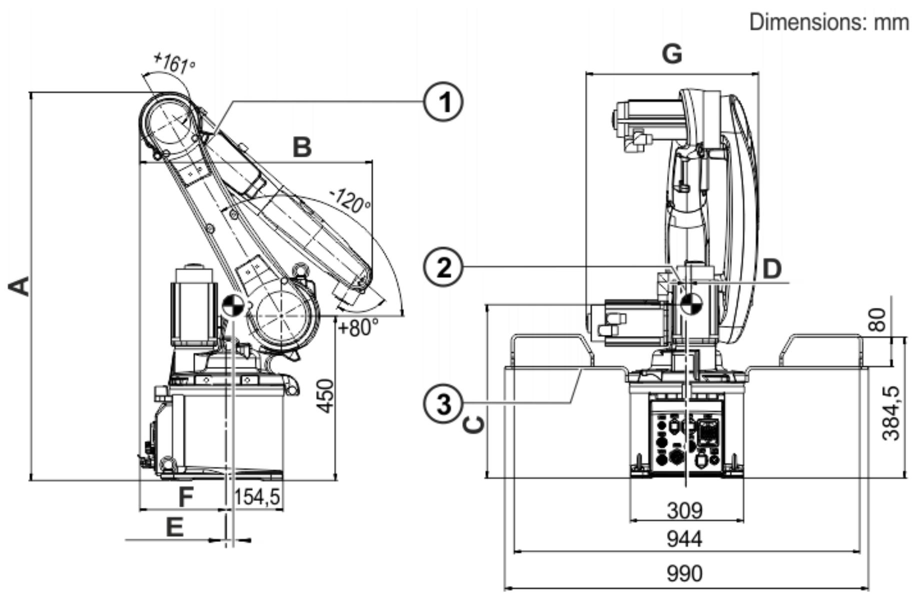


Fig. 7-2: Transport dimensions

1 Robot
2 Center of gravity
3 Fork slots

Transport dimensions and centers of gravity

Robot	A	B	C	D	E	F	E
KR 10 R1420	1062.5	636.2	473.5	12.4	15.9	238	470
KR 8 R1620	1235	636.4	587.5	14.3	-24.3	338	484
KR 6 R1820	1236	787	569.2	14.4	-12.6	338	484

Transportation

The floor-mounted robot is transported using a crane or fork lift truck. The ceiling-mounted robot in its installation position can only be transported outside the transport frame using a fork lift truck. In the transport frame, transportation with fork lift truck or crane is possible.

⚠ 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.

Transportation by fork lift truck

For transport by fork lift truck (>>> Fig. 7-3), the fork slots must be properly and fully installed.

The robot must be in the transport position.

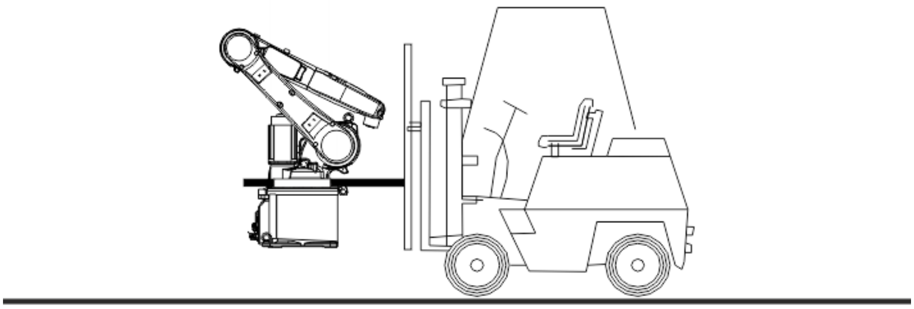


Fig. 7-3: Transportation by fork lift truck

Transportation using lifting tackle

The floor-mounted robot can be transported using a crane and lifting tackle (>>> Fig. 7-4). For this, it must be in the transport position. The lifting tackle is attached to eyebolts that are screwed into the rotating column and into the base frame. All ropes of the lifting tackle must be long enough and must be routed in such a way that the robot is not damaged. Installed tools and pieces of equipment can cause undesirable shifts in the center of gravity. These must therefore be removed if necessary.

The eyebolts must be removed from the rotating column after transportation.

⚠ 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!

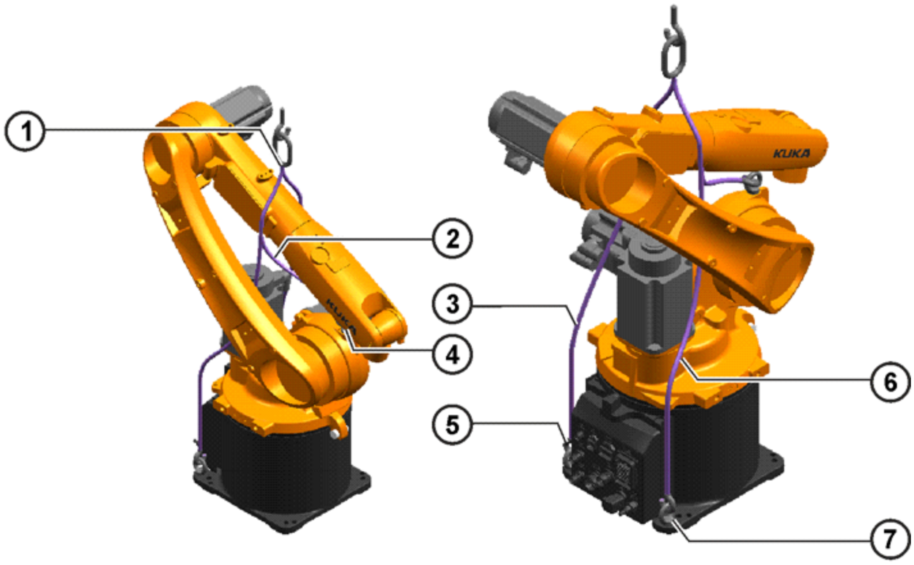


Fig. 7-4: Transportation by crane

1	Lifting tackle assembly
2	Leg G1
3	Leg G3
4	M10 eyebolt, rotating column, front
5	M10 eyebolt, base frame, left
6	Leg G2
7	M10 eyebolt, base frame, right

8 Options

8.1 Release device (optional)

Description

The release device can be used to move the manipulator manually after an accident or malfunction. The release device can be used for the motors of axes A1 to A3. It cannot be used for axes A4 to A6, as these motors are not accessible. It is only for use in exceptional circumstances and emergencies (e.g. for freeing people).

The release device is mounted on the base frame of the manipulator. This assembly also includes a ratchet and a set of plates with one plate for each motor. The plate specifies the direction of rotation for the ratchet and shows the corresponding direction of motion of the manipulator.

9 KUKA Service

9.1 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

9.2 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. (Agency)
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 Roboter GmbH Zugspitzstr. 140 86165 Augsburg Germany Tel. +49 821 797-1926 Fax +49 821 797-41 1926 Hotline.robotics.de@kuka.com www.kuka-roboter.de

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 Robotics 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 Robotics Japan K.K.
YBP Technical Center
134 Godo-cho, Hodogaya-ku
Yokohama, Kanagawa
240 0005
Japan
Tel. +81 45 744 7691
Fax +81 45 744 7696
info@kuka.co.jp

Canada

KUKA Robotics Canada Ltd.
6710 Maritz Drive - Unit 4
Mississauga
L5W 0A1
Ontario
Canada
Tel. +1 905 670-8600
Fax +1 905 670-8604
info@kukarobotics.com
www.kuka-robotics.com/canada

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 Roboter CEE GmbH Gruberstraße 2-4 4020 Linz Austria Tel. +43 7 32 78 47 52 Fax +43 7 32 79 38 80 office@kuka-roboter.at www.kuka.at

Poland	KUKA Roboter Austria GmbH 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-roboter.de
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 Robotics RUS Werbnaja ul. 8A 107143 Moskau Russia Tel. +7 495 781-31-20 Fax +7 495 781-31-19 info@kuka-robotics.ru www.kuka-robotics.ru
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 Schweiz AG Industriestr. 9 5432 Neuenhof Switzerland Tel. +41 44 74490-90 Fax +41 44 74490-91 info@kuka-roboter.ch www.kuka-roboter.ch

Spain	KUKA Robots IBÉRICA, S.A. Pol. Industrial Torrent de la Pastera Carrer del Bages s/n 08800 Vilanova i la Geltrú (Barcelona) Spain Tel. +34 93 8142-353 Fax +34 93 8142-950 comercial@kukarob.es www.kuka.es
South Africa	Jendamark Automation LTD (Agency) 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 Robot Automation Taiwan Co., Ltd. No. 249 Pujong Road Jungli City, Taoyuan County 320 Taiwan, R. O. C. Tel. +886 3 4331988 Fax +886 3 4331948 info@kuka.com.tw www.kuka.com.tw
Thailand	KUKA Robot Automation (M)SdnBhd Thailand Office c/o Maccall System Co. Ltd. 49/9-10 Soi Kingkaew 30 Kingkaew Road Tt. Rachatheva, A. Bangpli Samutprakarn 10540 Thailand Tel. +66 2 7502737 Fax +66 2 6612355 atika@ji-net.com www.kuka-roboter.de
Czech Republic	KUKA Roboter Austria GmbH Organisation Tschechien und Slowakei Sezemická 2757/2 193 00 Praha Horní Počernice Czech Republic Tel. +420 22 62 12 27 2 Fax +420 22 62 12 27 0 support@kuka.cz

Hungary

KUKA Robotics Hungaria 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
info@kukarobotics.com
www.kukarobotics.com

UK

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

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