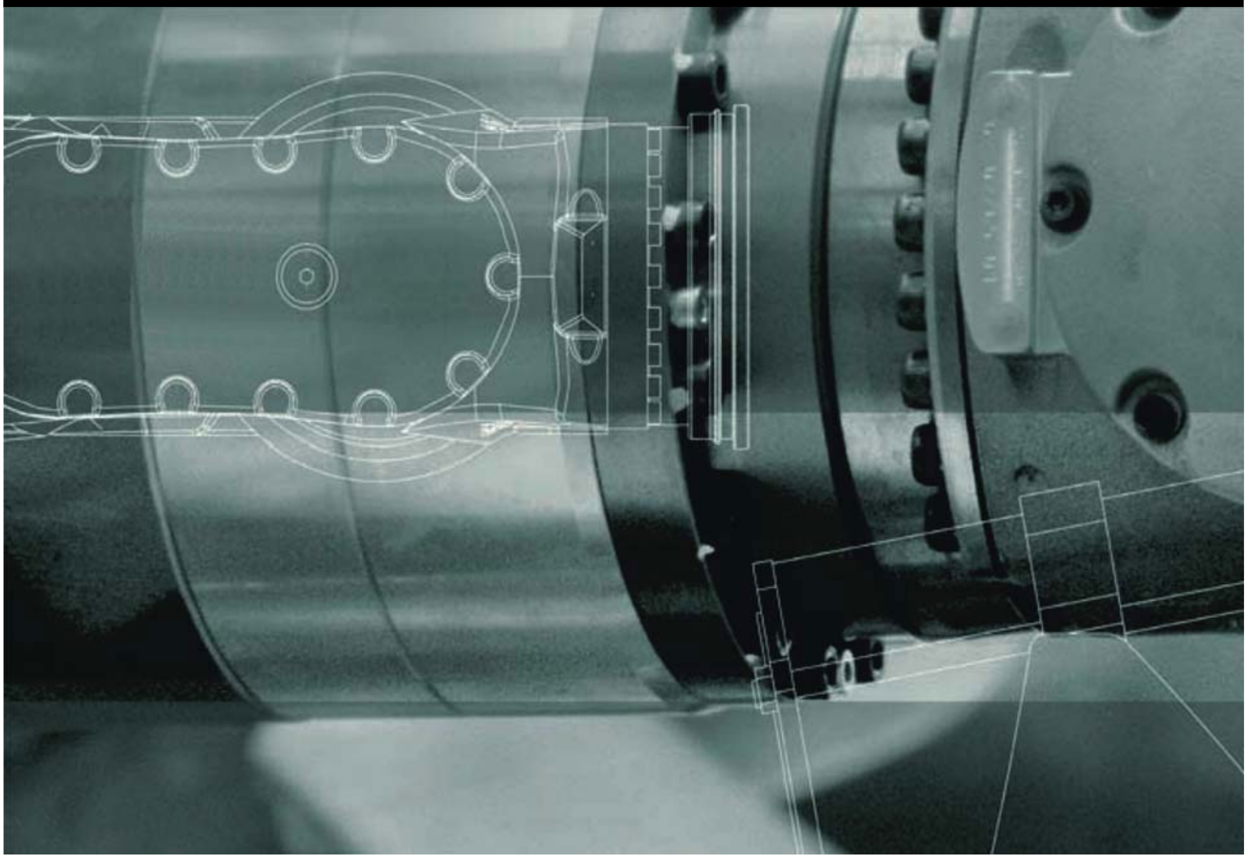
Robots

KUKA Deutschland GmbH

KR AGILUS sixx HM-SC

Operating Instructions



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

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

Subject to technical alterations without an effect on the function.

KIM-PS5-DOC

Translation of the original documentation

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Version:	BA KR AGILUS sixx HM-SC V4

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 The following procedure must be followed exactly!

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

Notices

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

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

1.3 Terms used

Term	Description
EDS cool	Electronic Data Storage (memory card), extended temperature range
HM	Hygienic Machine

Term	Description
MEMD	Micro Electronic Mastering Device
KL	KUKA linear unit
RDC cool	Resolver Digital Converter (KR C4) with extended temperature range
SC	Special Connection
smartPAD	The smartPAD teach pendant has all the operator control and display functions required for operating and programming the industrial robot.

2 Purpose

2.1 Target group

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

- Advanced knowledge of mechanical engineering
- Advanced knowledge of electrical 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 used for:

- Handling tools and fixtures
- Processing and transferring components or products
- Handling and packaging pharmaceutical products

It is employed in the food environment (primary area) and may only be used under the specified climatic 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
- Operation outside the specified operating parameters
- Direct contact with foodstuffs by parts of the manipulator
- Use in a medical environment
- Use in a potentially explosive area
- Use in radioactive environments
- Operation without additional safeguards
- Outdoor operation
- Operation in underground mining

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

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

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

3 Product description

3.1 Overview of the robot system

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

- KR 6 R700 sixx HM-SC
- KR 6 R900 sixx HM-SC
- KR 10 R900 sixx HM-SC
- KR 10 R1100 sixx HM-SC

An industrial robot of this type comprises the following components:

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

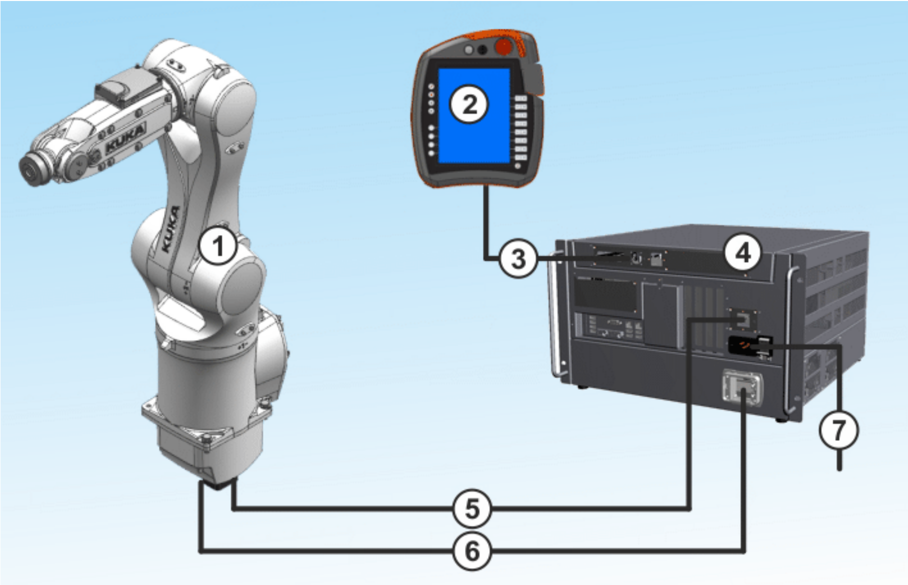


Fig. 3-1: Example of an industrial robot

1 Manipulator
2 smartPAD control panel
3 Connecting cable, smartPAD
4 Robot controller
5 Connecting cable, data cable
6 Connecting cable, motor cable
7 Device connection cable

3.2 Description of the manipulator

Overview

The manipulator is a 6-axis jointed-arm manipulator made of cast light alloy. Each axis is fitted with a brake. All motor units and current-carrying cables are protected against dirt and moisture beneath screwed-on cover plates.

The robot consists of the following principal components:

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

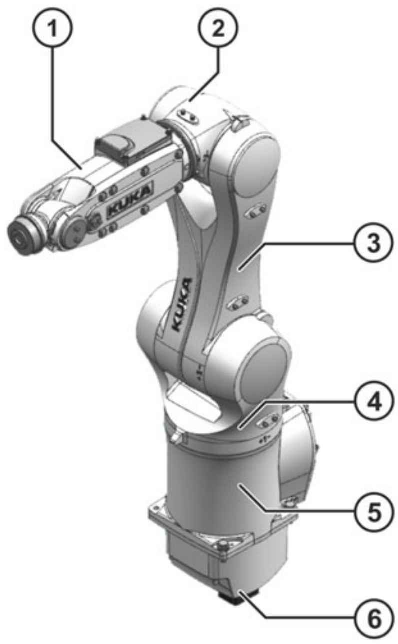


Fig. 3-2: Principal components

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

In-line wrist A4, A5, A6

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

There are three 5/2-way solenoid valves and a CAT5 data cable in the in-line wrist that can be used for controlling tools.

The in-line wrist also accommodates the 10-contact circular connector of the wrist I/O cable and interface A4 for the energy supply system. The interface is factory-closed with a sealed cover.

Arm A3

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

Link arm A2

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

Rotating column A1

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

Base frame

The base frame is the base of the robot. Interface A1 is located on the underside of the base frame. It constitutes the interface for the connecting cables between the manipulator and the controller, the energy supply system and the pressurization unit.

Electrical installations

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

> **NOTICE** When exchanging the “cool” components, it must be ensured that only “cool” components are reinstalled. Failure to do so is liable to result in irregular motion characteristics and malfunctions!

Options

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

The following options are also available:

- Cleaning collars A4 and A5
  (>>> 12.1 "Cleaning collars A4 and A6 (optional)" Page 237)
- Cable set
  (>>> 12.2 "Cable set (optional)" Page 237)
- SC frame
  (>>> 12.3 "SC frame (optional)" Page 241)
- PURGE option A
  (>>> 12.4 "PURGE option A" Page 242)
- PURGE option B
  (>>> 12.5 "PURGE option B" Page 242)

4 Technical data

4.1 Technical data, overview

The technical data can be found in the following sections:

Robot	Technical data
KR 6 sixx HM	
KR 6 R700 sixx HM-SC	■ Technical data (>>> 4.2 "Technical data, KR 6 R700 sixx HM-SC" Page 18) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.3 "Stopping distances and times KR 6 R700 sixx HM-SC and KR 6 R700 sixx C-HM-SC" Page 125)
KR 6 R700 sixx W-HM-SC	■ Technical data (>>> 4.3 "Technical data, KR 6 R700 sixx W-HM-SC" Page 26) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.4 "Stopping distances and times, KR 6 R700 sixx W-HM-SC" Page 130)
KR 6 R700 sixx C-HM-SC	■ Technical data (>>> 4.4 "Technical data, KR 6 R700 sixx C-HM-SC" Page 34) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.3 "Stopping distances and times KR 6 R700 sixx HM-SC and KR 6 R700 sixx C-HM-SC" Page 125)
KR 6 R900 sixx HM-SC	■ Technical data (>>> 4.5 "Technical data, KR 6 R900 sixx HM-SC" Page 42) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.5 "Stopping distances and times KR 6 R900 sixx HM-SC and KR 6 R900 sixx C-HM-SC" Page 136)

Robot	Technical data
KR 6 sixx HM	
KR 6 R900 sixx W-HM-SC	■ Technical data (>>> 4.6 "Technical data, KR 6 R900 sixx W-HM-SC" Page 51) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.6 "Stopping distances and times, KR 6 R900 sixx W-HM-SC" Page 142)
KR 6 R900 sixx C-HM-SC	■ Technical data (>>> 4.7 "Technical data, KR 6 R900 sixx C-HM-SC" Page 59) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.5 "Stopping distances and times KR 6 R900 sixx HM-SC and KR 6 R900 sixx C-HM-SC" Page 136)

Robot	Technical data
KR 10 sixx HM	
KR 10 R900 sixx HM-SC	■ Technical data (>>> 4.8 "Technical data, KR 10 R900 sixx HM-SC" Page 67) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.7 "Stopping distances and times, KR 10 R900 sixx HM-SC and KR 10 R1100 sixx HM-SC" Page 148)
KR 10 R900 sixx W-HM-SC	■ Technical data (>>> 4.9 "Technical data, KR 10 R900 sixx W-HM-SC" Page 76) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.8 "Stopping distances and times KR 10 R900 sixx W-HM-SC and KR 10 R1100 sixx W-HM-SC" Page 154)

Robot	Technical data
KR 10 sixx HM	
KR 10 R900 sixx C-HM-SC	■ Technical data (>>> 4.10 "Technical data, KR 10 R900 sixx C-HM-SC" Page 84) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.7 "Stopping distances and times, KR 10 R900 sixx HM-SC and KR 10 R1100 sixx HM-SC" Page 148)
KR 10 R1100 sixx HM-SC	■ Technical data (>>> 4.11 "Technical data, KR 10 R1100 sixx HM-SC" Page 92) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.7 "Stopping distances and times, KR 10 R900 sixx HM-SC and KR 10 R1100 sixx HM-SC" Page 148)
KR 10 R1100 sixx W-HM-SC	■ Technical data (>>> 4.12 "Technical data, KR 10 R1100 sixx W-HM-SC" Page 101) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.8 "Stopping distances and times KR 10 R900 sixx W-HM-SC and KR 10 R1100 sixx W-HM-SC" Page 154)
KR 10 R1100 sixx C-HM-SC	■ Technical data (>>> 4.13 "Technical data, KR 10 R1100 sixx C-HM-SC" Page 109) ■ Supplementary loads (>>> 4.14.2 "Supplementary load, reach R900" Page 119) ■ Plates and labels (>>> 4.15 "Plates and labels" Page 121) ■ Stopping distances and times (>>> 4.17.7 "Stopping distances and times, KR 10 R900 sixx HM-SC and KR 10 R1100 sixx HM-SC" Page 148)

4.2 Technical data, KR 6 R700 sixx HM-SC

4.2.1 Basic data, KR 6 R700 sixx HM-SC

Basic data

Designation	KR 6 R700 sixx HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	1.3 m^3
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 60 kg
Rated payload	3 kg
Maximum total load	6 kg
Maximum reach	706.7 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Floor
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R700 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion

- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.2.2 Axis data, KR 6 R700 sixx HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	381 °/s
A5	327 °/s
A6	518 °/s

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

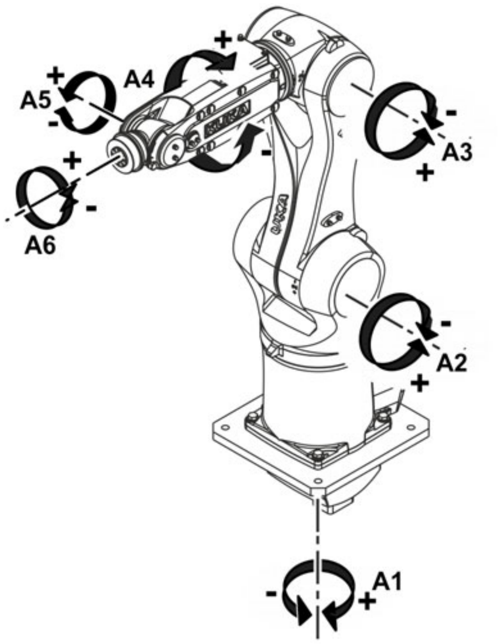


Fig. 4-1: Direction of rotation of robot axes

Mastering position

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

Working envelope

The following diagrams (>>> Fig. 4-2) and (>>> Fig. 4-3) show the load center of gravity and the shape and size of the working envelope.

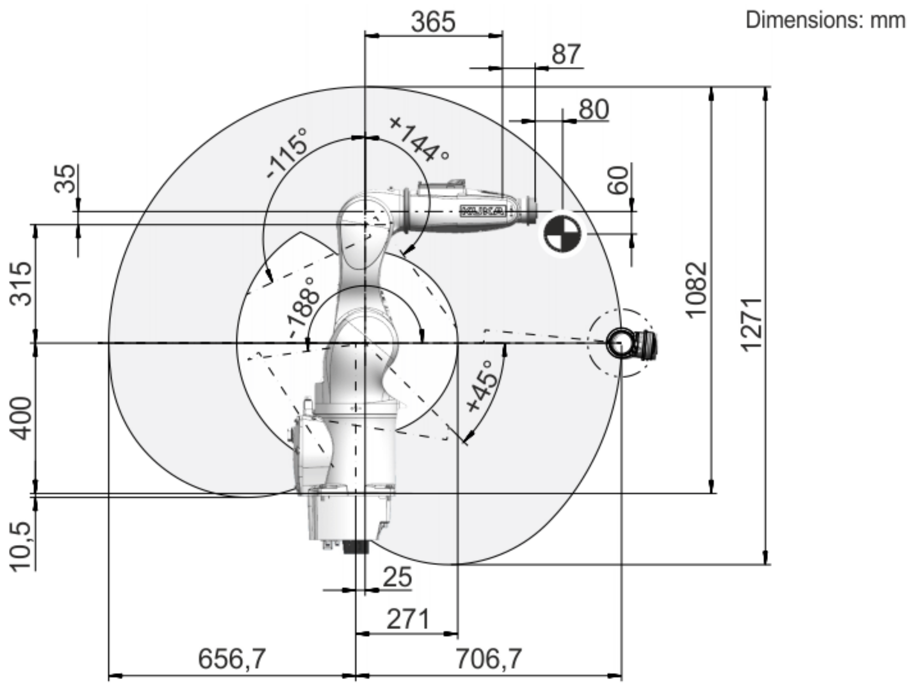


Fig. 4-2: KR 6 R700 sixx HM-SC, working envelope, side view

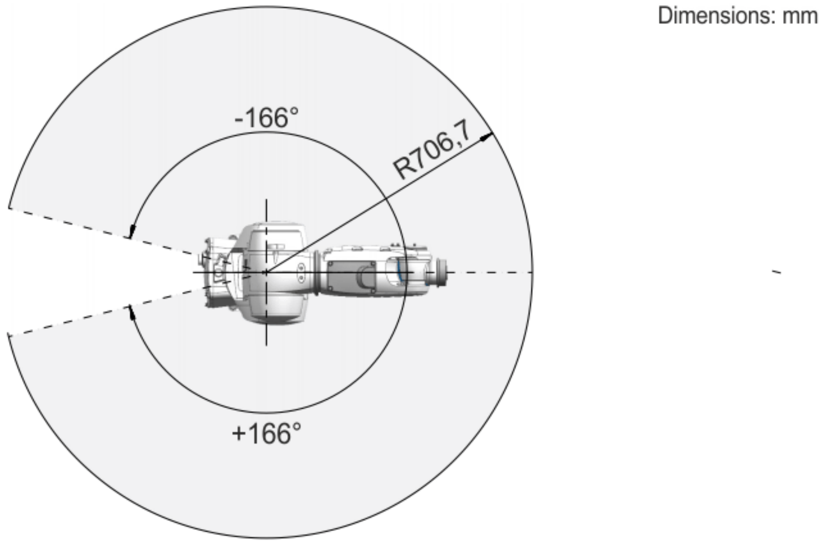


Fig. 4-3: KR 6 R700 sixx HM-SC, working envelope, top view

Distance to flange The distance to the flange varies according to the position of the robot (>>> Fig. 4-4).

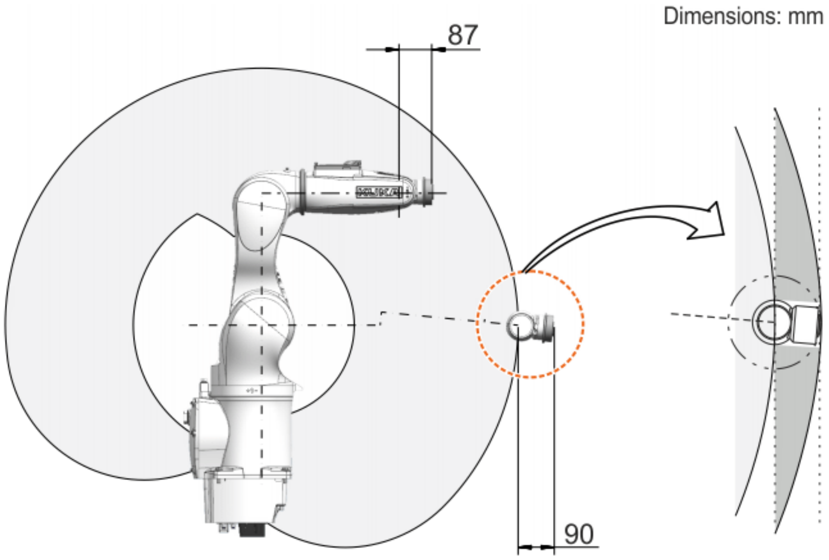


Fig. 4-4: Distance to flange, KR 6 R700 sixx HM-SC (with W and C variants)

4.2.3 Payloads, KR 6 R700 sixx HM-SC

Payloads

Rated payload	3 kg
Maximum payload	6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-

Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	6 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

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

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.

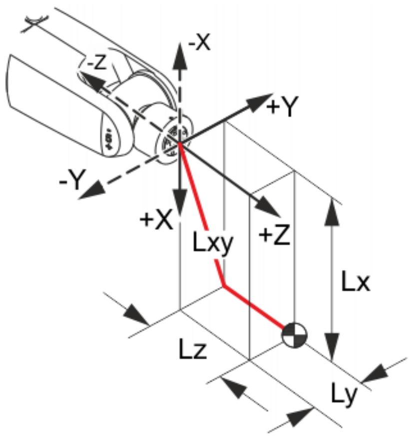


Fig. 4-5: Load center of gravity

Payload diagram

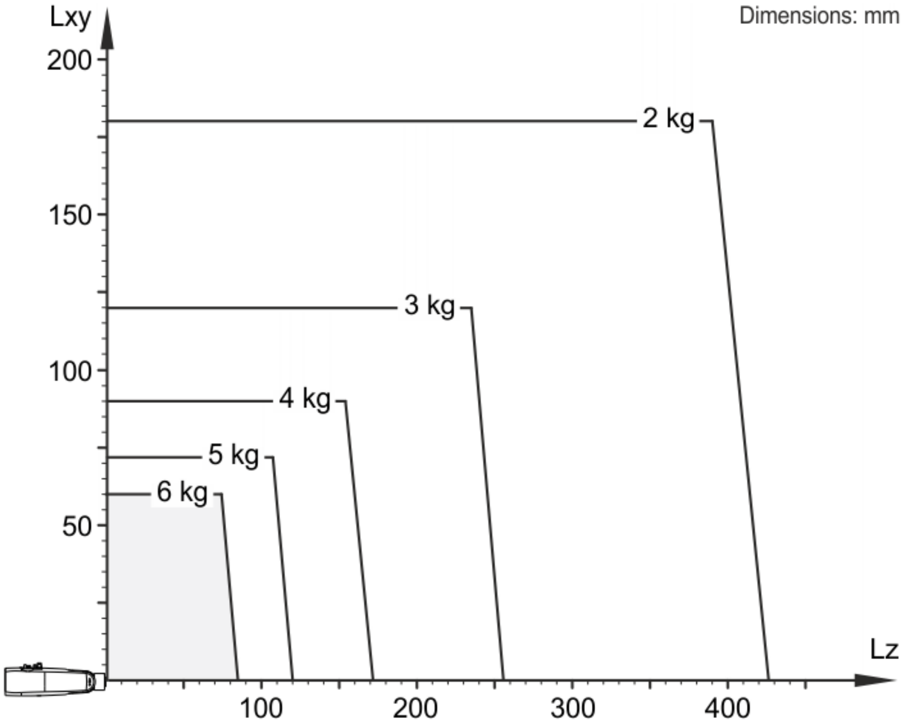


Fig. 4-6: KR 6 R700 sixx HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 6 R700 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5^{H7}
Standard	See diagram. (>>> Fig. 4-7)

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

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

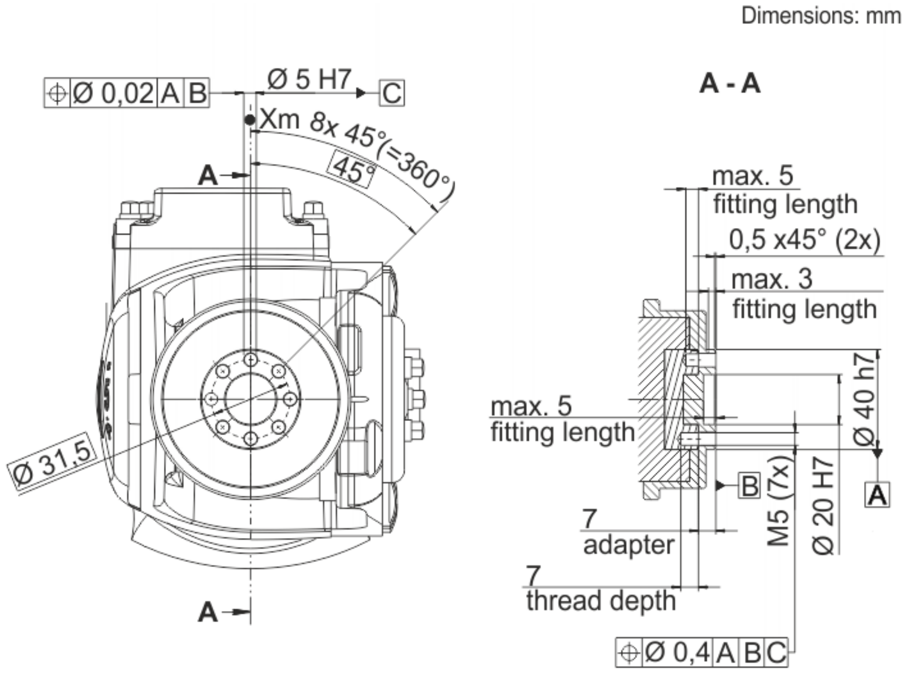


Fig. 4-7: Mounting flange

Flange loads

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

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

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

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

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

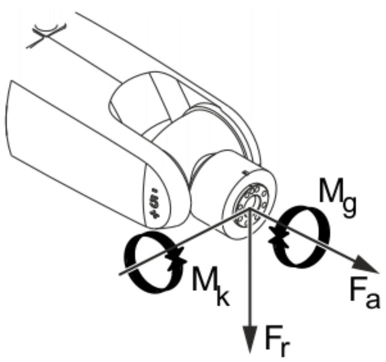


Fig. 4-8: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.2.4 Loads acting on the foundation, KR 6 R700 sixx HM-SC

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

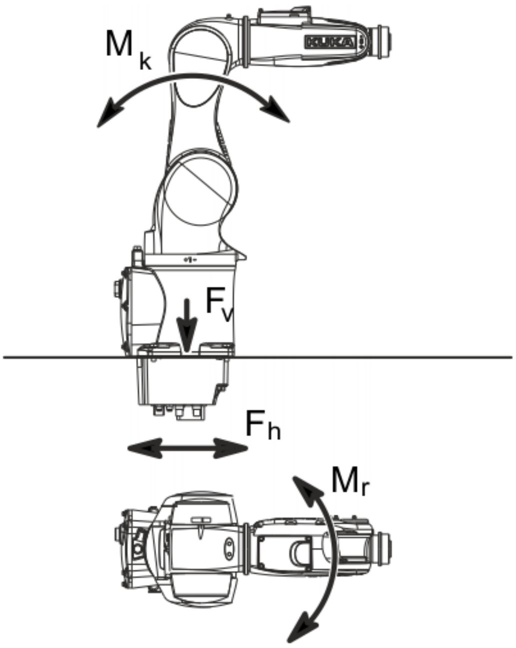


Fig. 4-9: Loads acting on the foundation, floor mounting

Vertical force F(v)	
F(v normal)	944 N
F(v max)	1285 N
Horizontal force F(h)	
F(h normal)	617 N
F(h max)	1032 N
Tilting moment M(k)	
M(k normal)	602 Nm
M(k max)	595 Nm
Torque about axis 1 M(r)	
M(r normal)	342 Nm
M(r max)	741 Nm

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

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

4.3 Technical data, KR 6 R700 sixx W-HM-SC

4.3.1 Basic data, KR 6 R700 sixx W-HM-SC

Basic data

Designation	KR 6 R700 sixx W-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	1.3 m^3
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 60 kg
Rated payload	3 kg
Maximum total load	6 kg
Maximum reach	706.7 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Wall
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R700 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.3.2 Axis data, KR 6 R700 sixx W-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °

A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	381 °/s
A5	327 °/s
A6	518 °/s

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

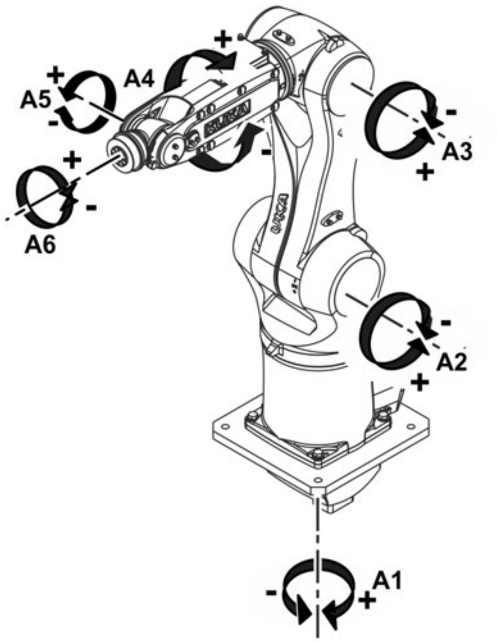


Fig. 4-10: Direction of rotation of robot axes

Mastering position

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

Working envelope

The following diagrams (>>> Fig. 4-11) and (>>> Fig. 4-12) show the load center of gravity and the shape and size of the working envelope.

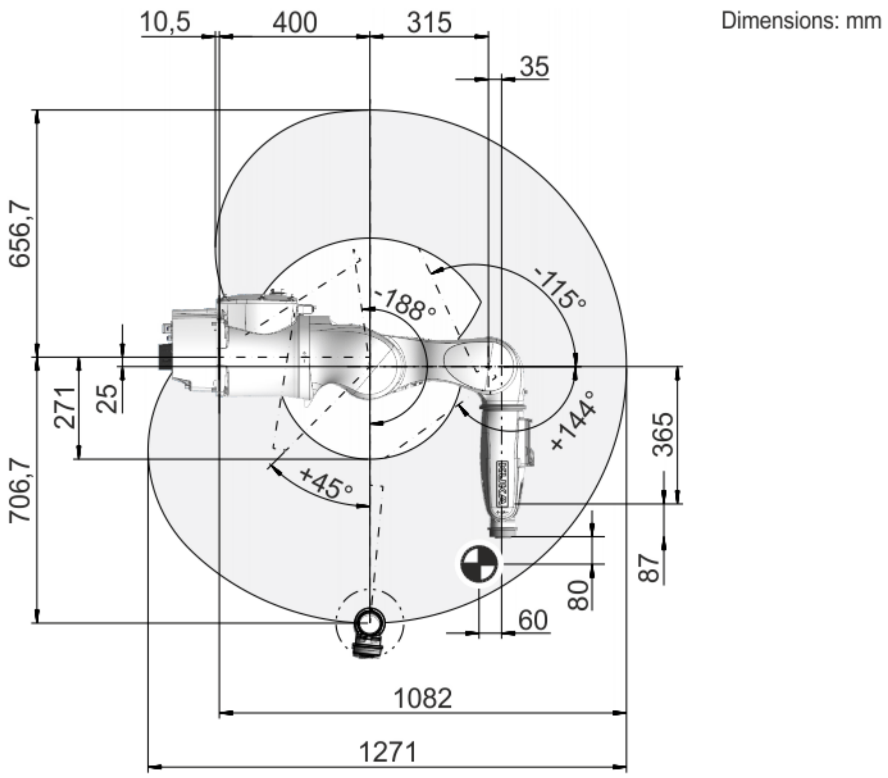


Fig. 4-11: KR 6 R700 sixx W-HM-SC, working envelope, side view

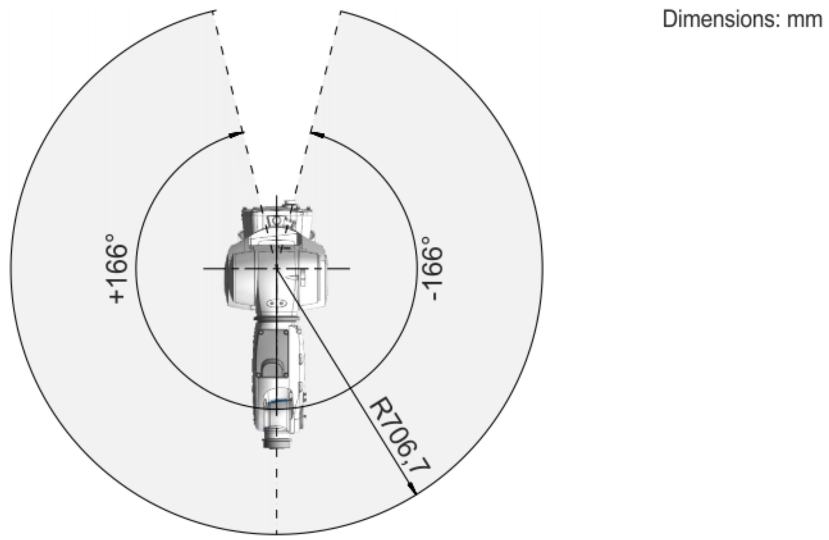


Fig. 4-12: KR 6 R700 sixx W-HM-SC, working envelope, top view

Distance to flange The distance to the flange varies according to the position of the robot (>>> Fig. 4-13).

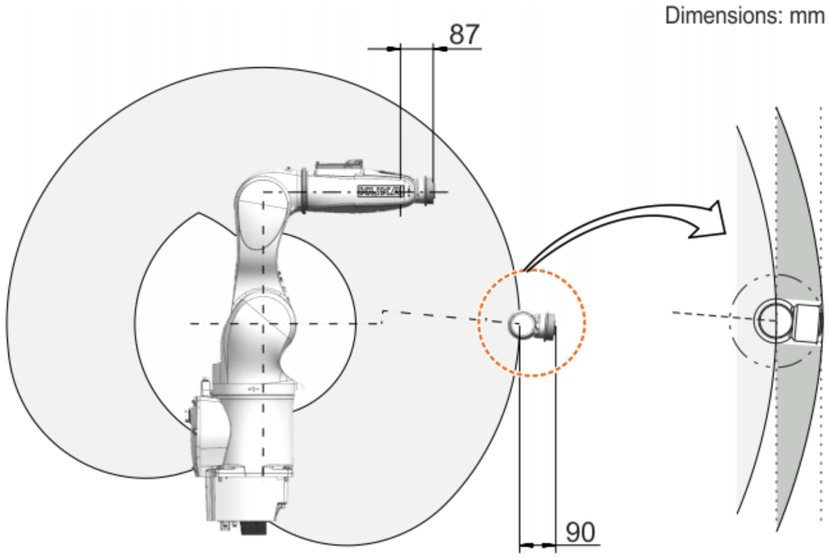


Fig. 4-13: Distance to flange, KR 6 R700 sixx HM-SC (with W and C variants)

4.3.3 Payloads, KR 6 R700 sixx W-HM-SC

Payloads

Rated payload	3 kg
Maximum payload	6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	6 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

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

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.

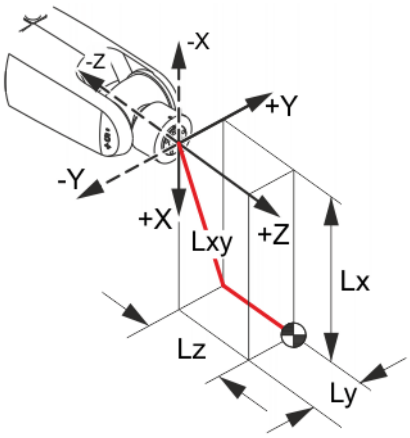


Fig. 4-14: Load center of gravity

Payload diagram

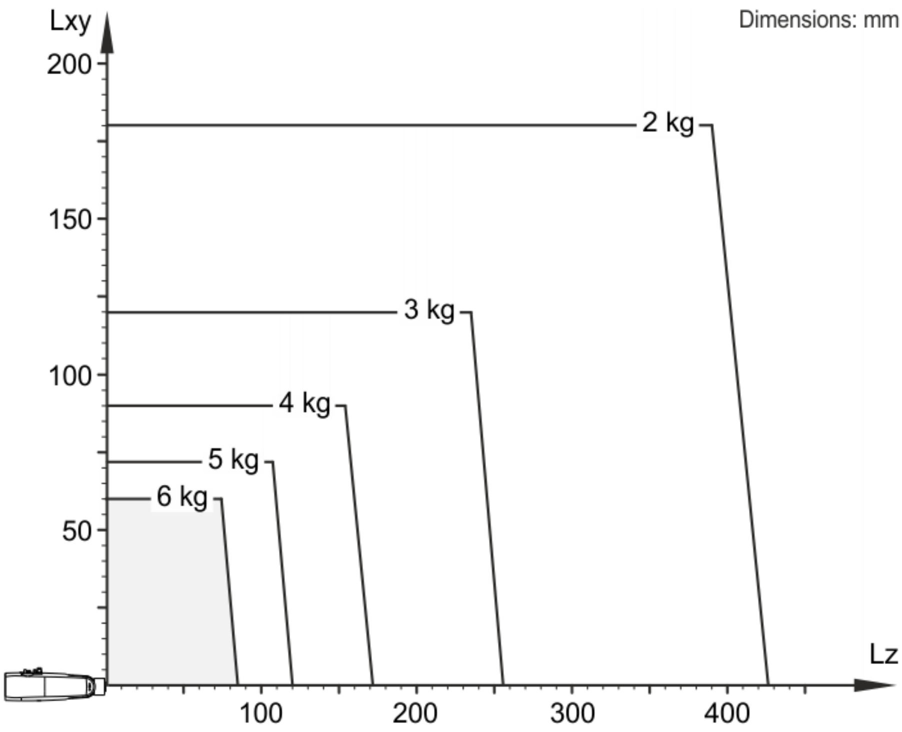


Fig. 4-15: KR 6 R700 sixx W-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 6 R700 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80

Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 H7
Standard	See diagram. (>>> Fig. 4-16)

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

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

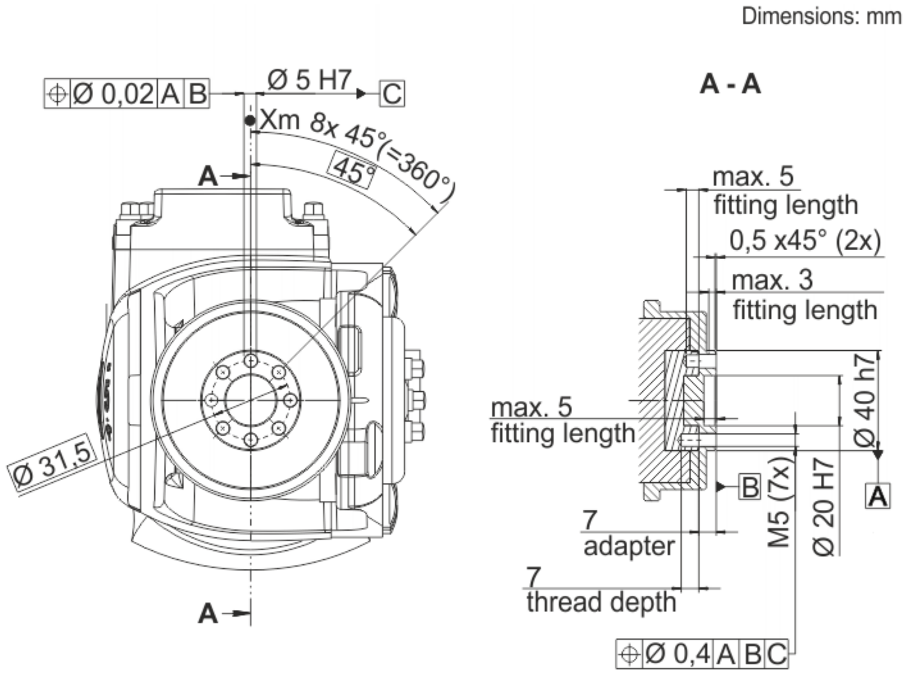


Fig. 4-16: Mounting flange

Flange loads

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

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

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

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

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

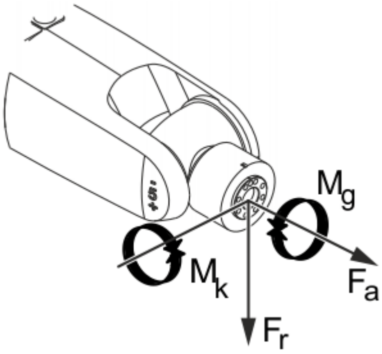


Fig. 4-17: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.3.4 Loads acting on the foundation, KR 6 R700 sixx W-HM-SC

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

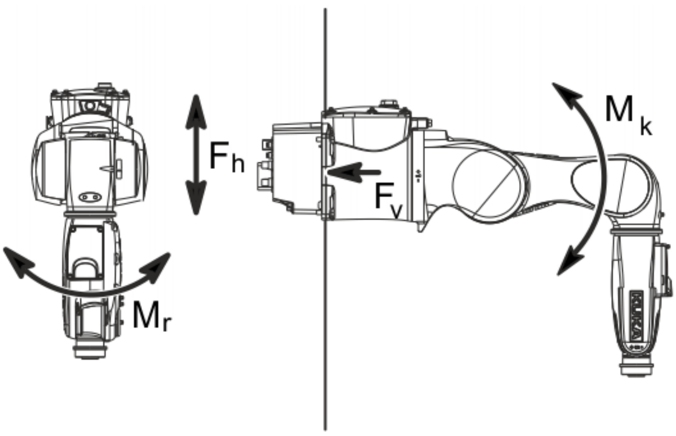


Fig. 4-18: Loads acting on the foundation, wall mounting

Vertical force F(v)	
F(v normal)	415 N
F(v max)	775 N
Horizontal force F(h)	

F(h normal)	1125 N
F(h max)	1488 N
Tilting moment M(k)	
M(k normal)	742 Nm
M(k max)	1142 Nm
Torque about axis 1 M(r)	
M(r normal)	307 Nm
M(r max)	654 Nm

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

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

4.4 Technical data, KR 6 R700 sixx C-HM-SC

4.4.1 Basic data, KR 6 R700 sixx C-HM-SC

Basic data

Designation	KR 6 R700 sixx C-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	1.3 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 60 kg
Rated payload	3 kg
Maximum total load	6 kg
Maximum reach	706.7 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Ceiling
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 6 R700 sixx C-HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R700 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.4.2 Axis data, KR 6 R700 sixx C-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	381 °/s
A5	327 °/s
A6	518 °/s

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

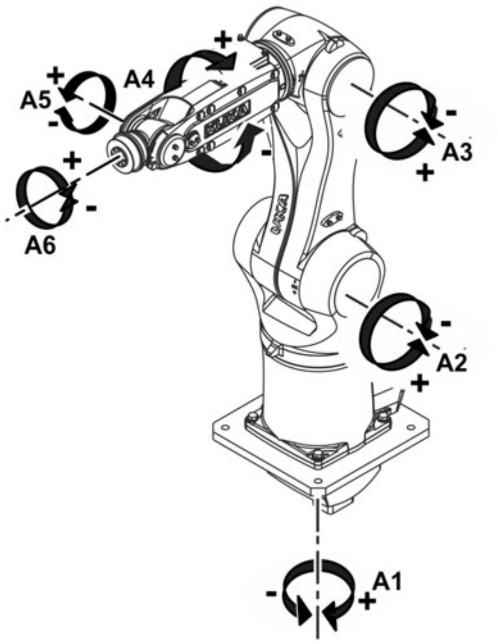


Fig. 4-19: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Working envelope

The following diagrams (>>> Fig. 4-20) and (>>> Fig. 4-21) show the load center of gravity and the shape and size of the working envelope.

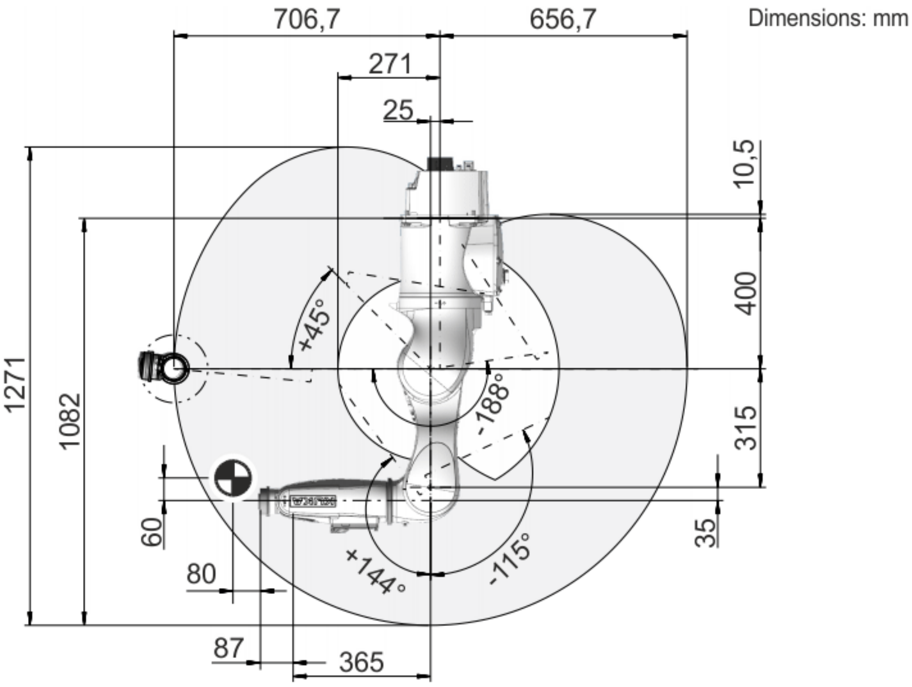


Fig. 4-20: KR 6 R700 sixx C-HM-SC, working envelope, side view

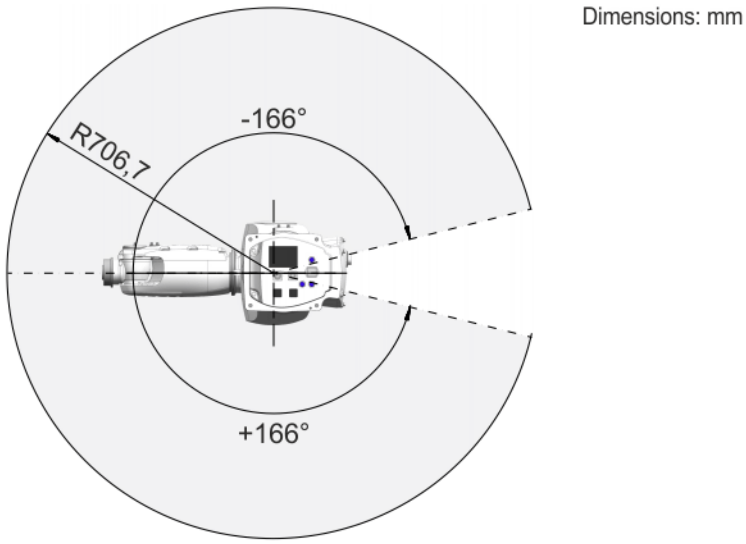


Fig. 4-21: KR 6 R700 sixx C-HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-22).

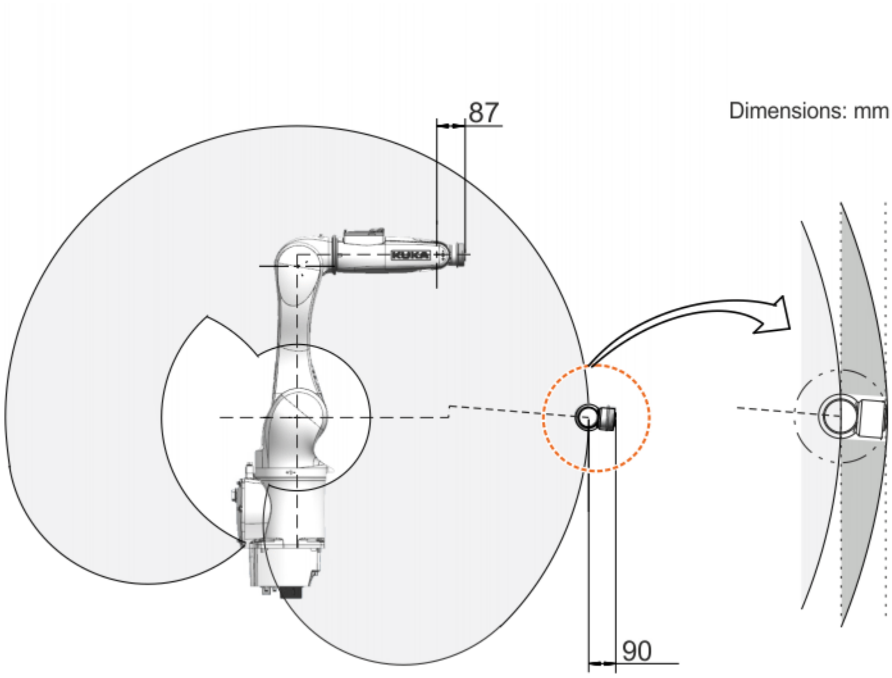


Fig. 4-22: Distance to flange, KR 6 R900 sixx HM-SC (with W and C variants)

4.4.3 Payloads, KR 6 R700 sixx C-HM-SC

Payloads

Rated payload	3 kg
Maximum payload	6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	6 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

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

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.

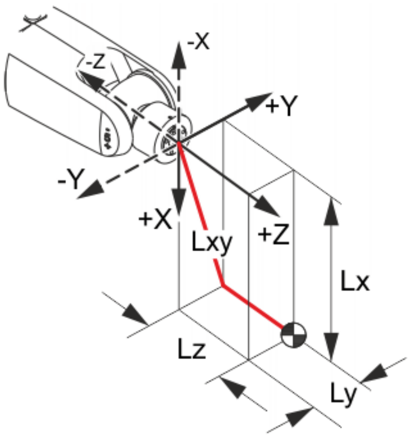


Fig. 4-23: Load center of gravity

Payload diagram

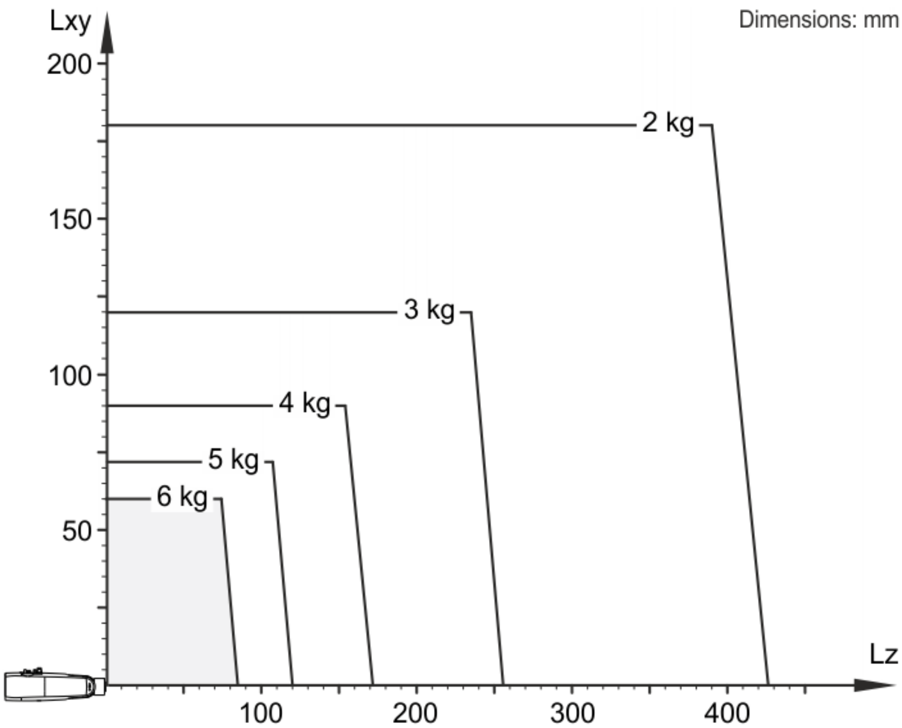


Fig. 4-24: KR 6 R700 sixx C-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 6 R700 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80

Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 ^{H7}
Standard	See diagram. (>>> Fig. 4-25)

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

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

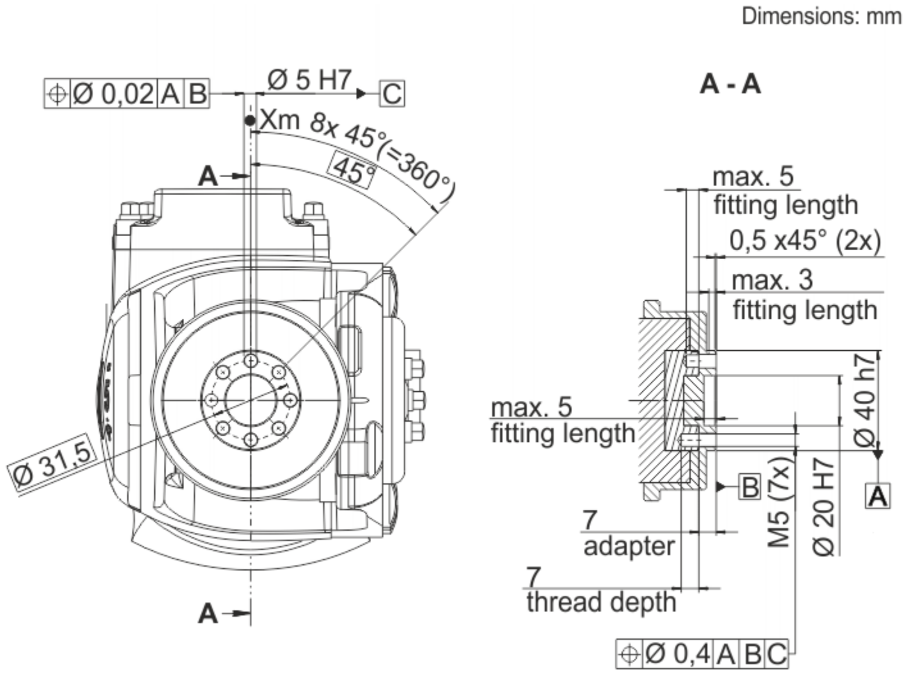


Fig. 4-25: Mounting flange

Flange loads

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

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

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

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

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

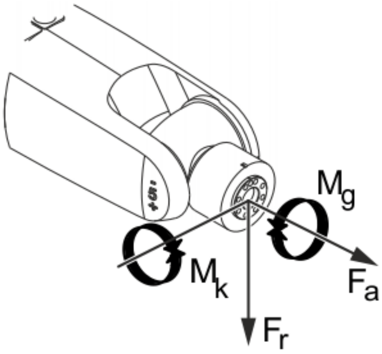


Fig. 4-26: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.4.4 Loads acting on the foundation, KR 6 R700 sixx C-HM-SC

Foundation loads

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

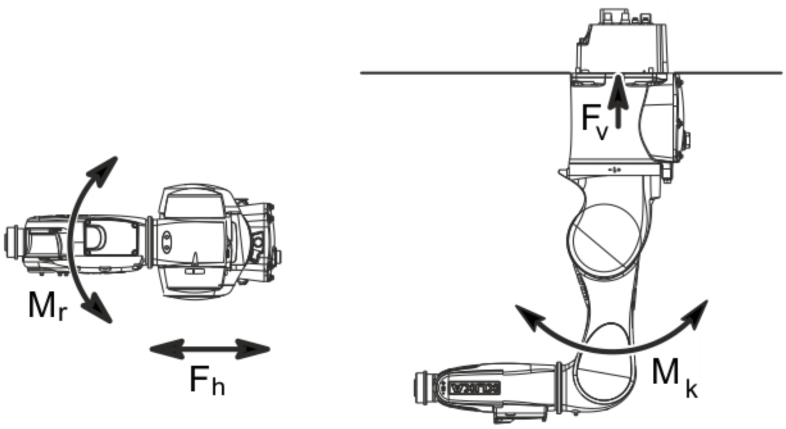


Fig. 4-27: Loads acting on the foundation, ceiling mounting

Vertical force F(v)	
F(v normal)	1015 N
F(v max)	1258 N

Horizontal force F(h)	
F(h normal)	622 N
F(h max)	1013 N
Tilting moment M(k)	
M(k normal)	582 Nm
M(k max)	953 Nm
Torque about axis 1 M(r)	
M(r normal)	358 Nm
M(r max)	776 Nm

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

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

4.5 Technical data, KR 6 R900 sixx HM-SC

4.5.1 Basic data, KR 6 R900 sixx HM-SC

Basic data

Designation	KR 6 R900 sixx HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.73 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 62 kg
Rated payload	3 kg
Maximum total load	6 kg
Maximum reach	901.5 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Floor
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 6 R900 sixx HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R900 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.5.2 Axis data, KR 6 R900 sixx HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	381 °/s
A5	327 °/s
A6	518 °/s

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

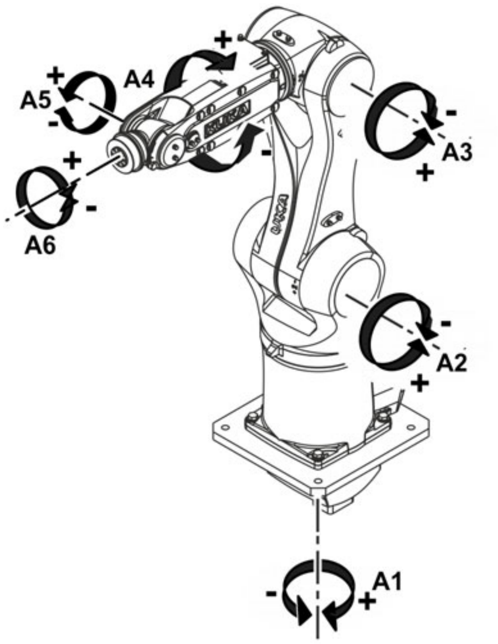


Fig. 4-28: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Workspace

The following diagrams (>>> Fig. 4-29) and (>>> Fig. 4-30) show the load center of gravity, shape and size of the working envelope.

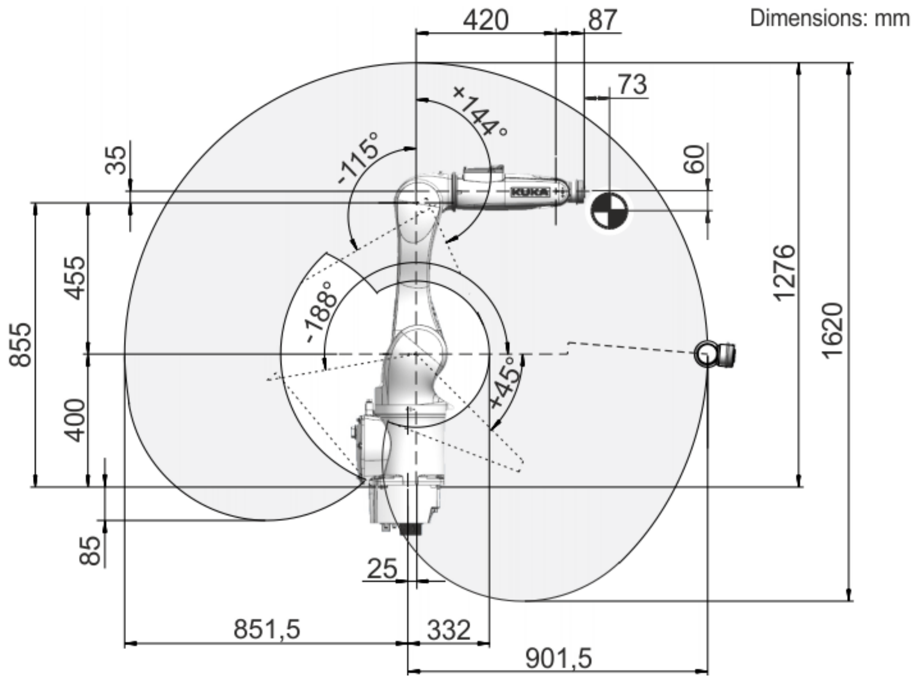


Fig. 4-29: KR 6 R900 sixx HM-SC, working envelope, side view

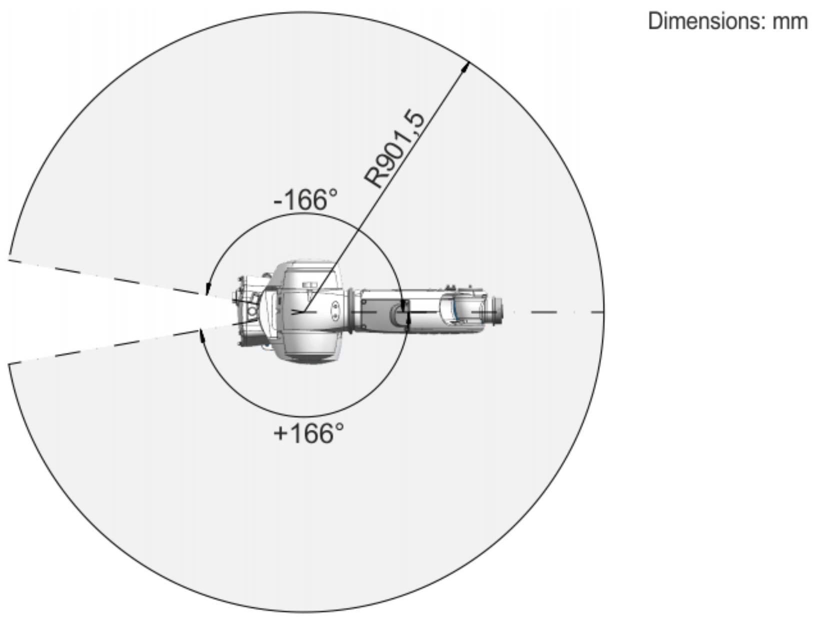


Fig. 4-30: KR 6 R900 sixx HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-31).

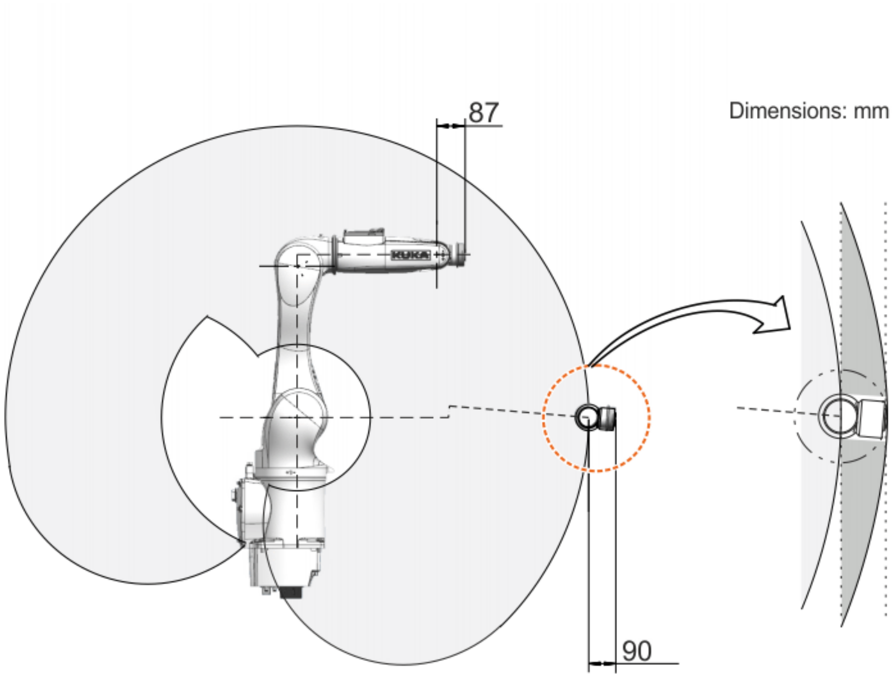


Fig. 4-31: Distance to flange, KR 6 R900 sixx HM-SC (with W and C variants)

4.5.3 Payloads, KR 6 R900 sixx HM-SC

Payloads

Rated payload	3 kg
Maximum payload	6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	6 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

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

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.

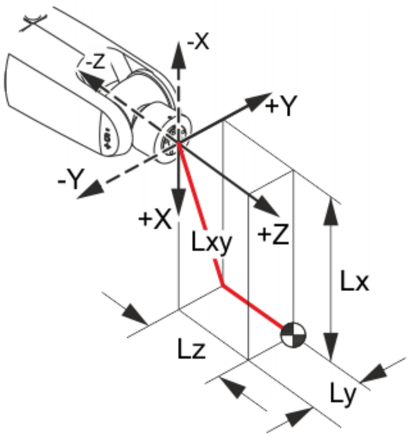


Fig. 4-32: Load center of gravity

Payload diagram

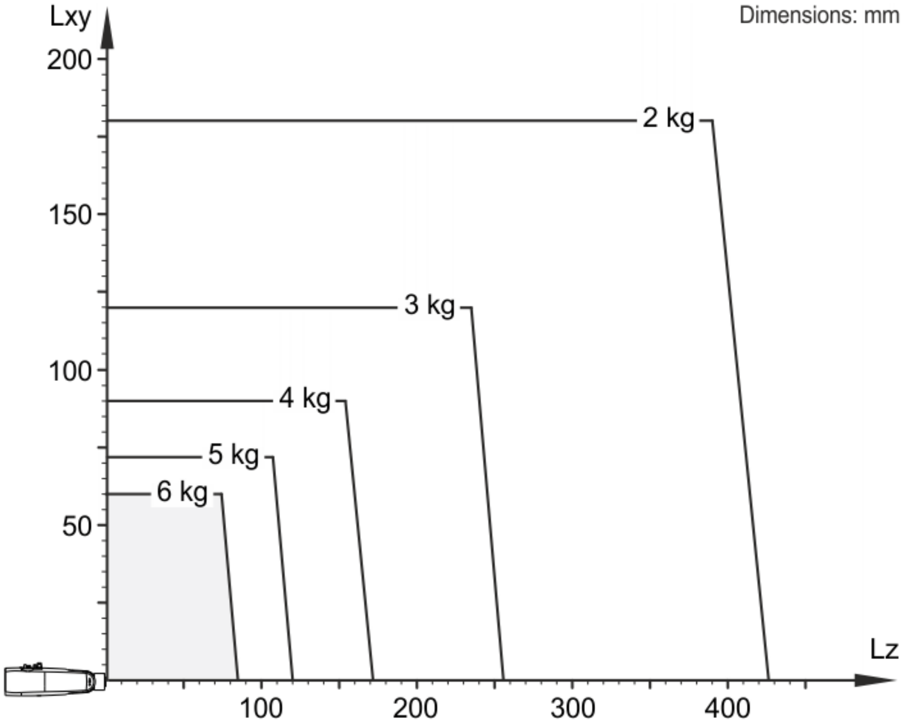


Fig. 4-33: KR 6 R900 sixx HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 6 R900 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80

Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 ^{H7}
Standard	See diagram. (>>> Fig. 4-34)

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

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

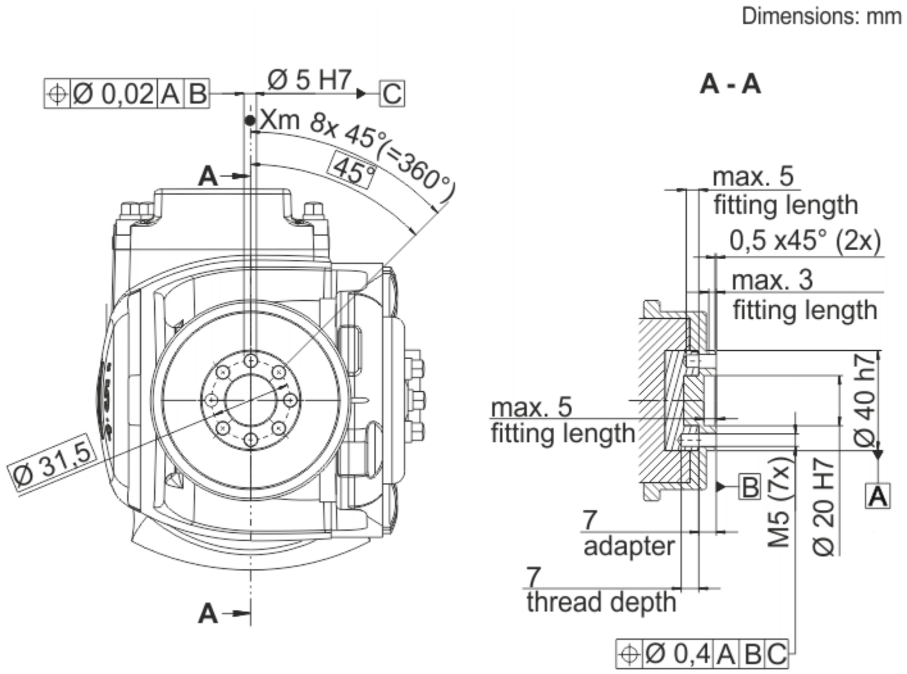


Fig. 4-34: Mounting flange

Flange loads

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

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

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

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

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

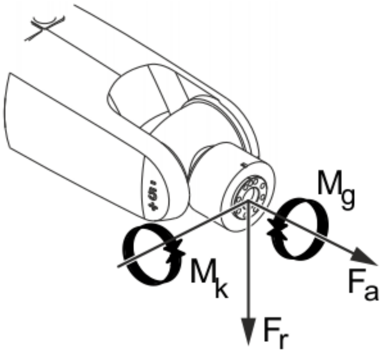


Fig. 4-35: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.5.4 Loads acting on the foundation, KR 6 R900 sixx HM-SC

Foundation loads

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

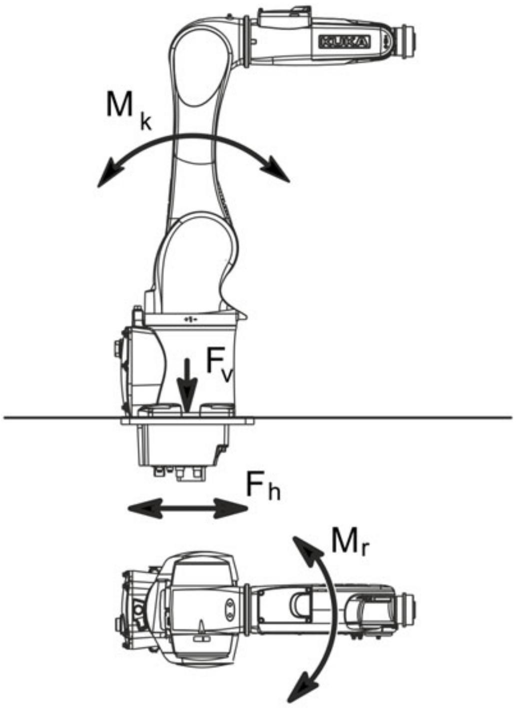


Fig. 4-36: Loads acting on the foundation, floor mounting

Vertical force F(v)	
F(v normal)	944 N
F(v max)	1285 N
Horizontal force F(h)	
F(h normal)	617 N
F(h max)	1032 N
Tilting moment M(k)	
M(k normal)	602 Nm
M(k max)	595 Nm
Torque about axis 1 M(r)	
M(r normal)	342 Nm
M(r max)	741 Nm

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

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 Technical data, KR 6 R900 sixx W-HM-SC

4.6.1 Basic data, KR 6 R900 sixx W-HM-SC

Basic data

Designation	KR 6 R900 sixx W-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.73 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 62 kg
Rated payload	3 kg
Maximum total load	6 kg
Maximum reach	901.5 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Wall
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R900 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion

- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.6.2 Axis data, KR 6 R900 sixx W-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	381 °/s
A5	327 °/s
A6	518 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-37).

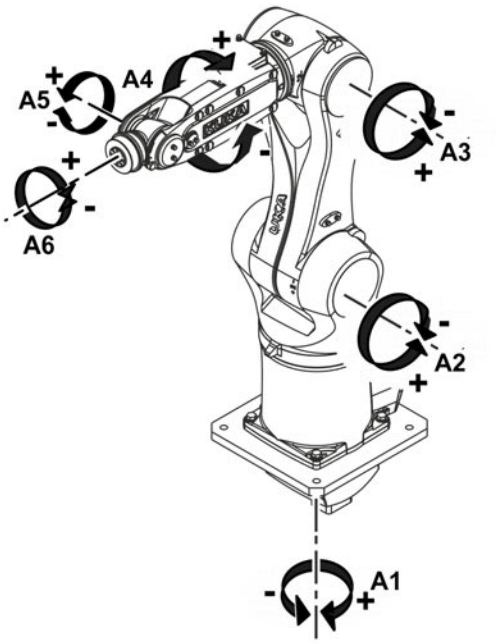


Fig. 4-37: Direction of rotation of robot axes

Mastering position

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

Working envelope

The following diagrams (>>> Fig. 4-38) and (>>> Fig. 4-39) show the load center of gravity and the shape and size of the working envelope.

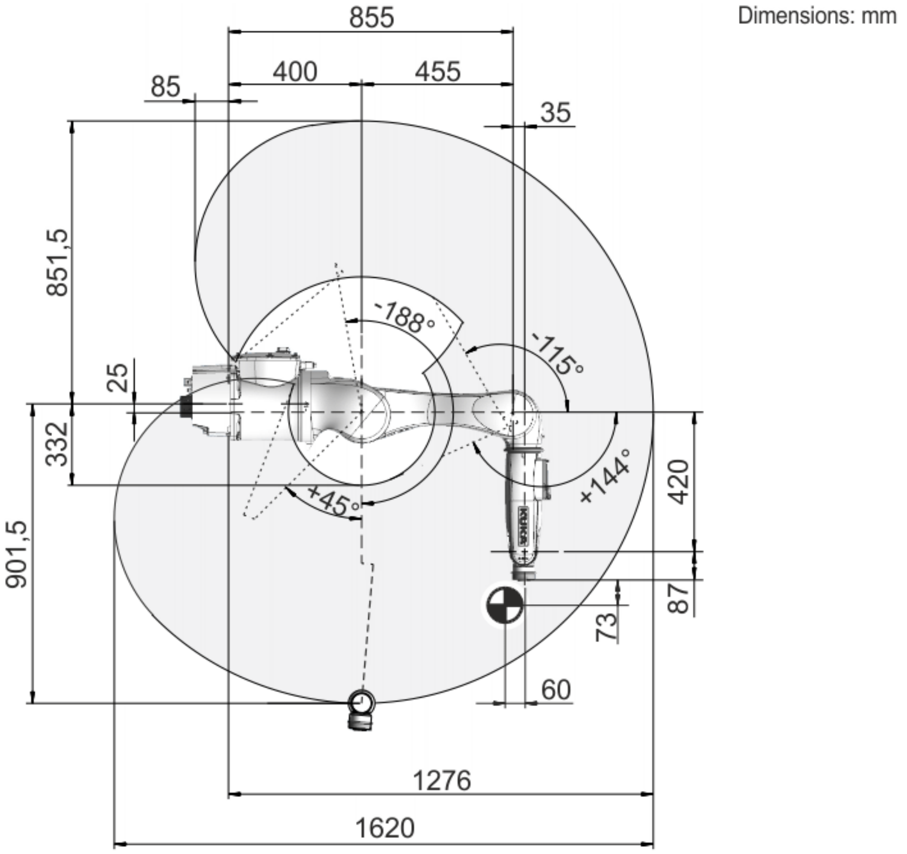


Fig. 4-38: KR 6 R900 sixx W-HM-SC, working envelope, side view

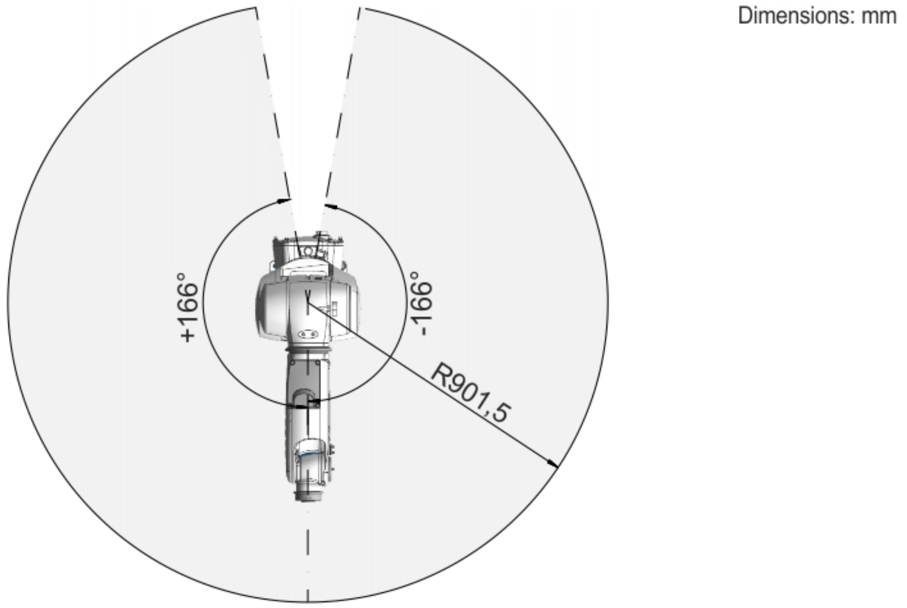


Fig. 4-39: KR 6 R900 sixx W-HM-SC, working envelope, top view

Distance to flange The distance to the flange varies according to the position of the robot (>>> Fig. 4-40).

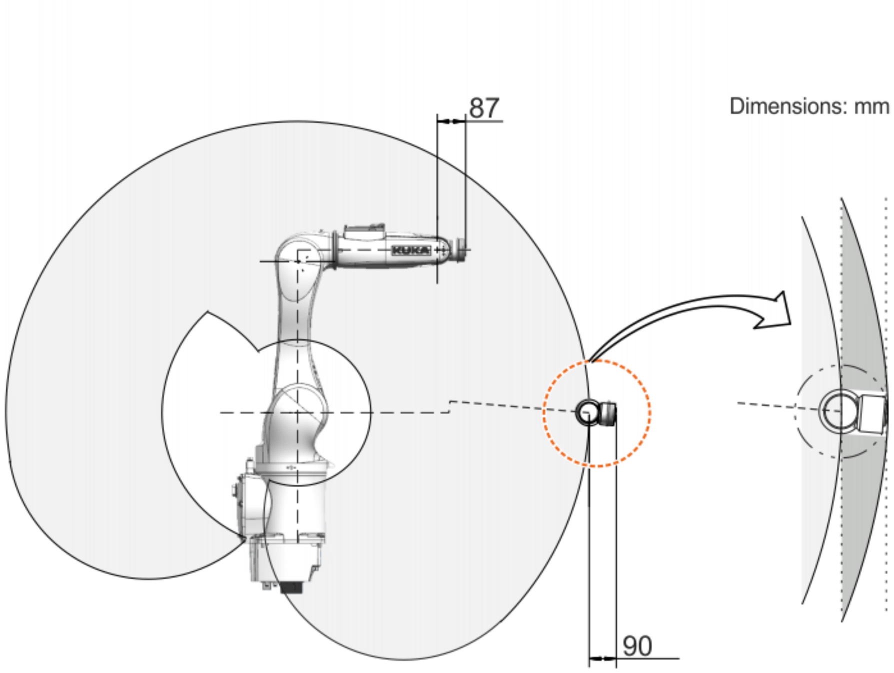


Fig. 4-40: Distance to flange, KR 6 R900 sixx HM-SC (with W and C variants)

4.6.3 Payloads, KR 6 R900 sixx W-HM-SC

Payloads

Rated payload	3 kg
Maximum payload	6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	6 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

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

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.

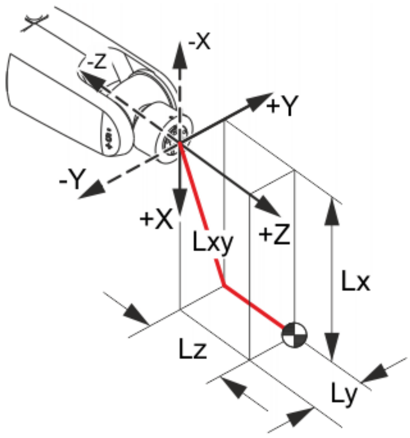


Fig. 4-41: Load center of gravity

Payload diagram

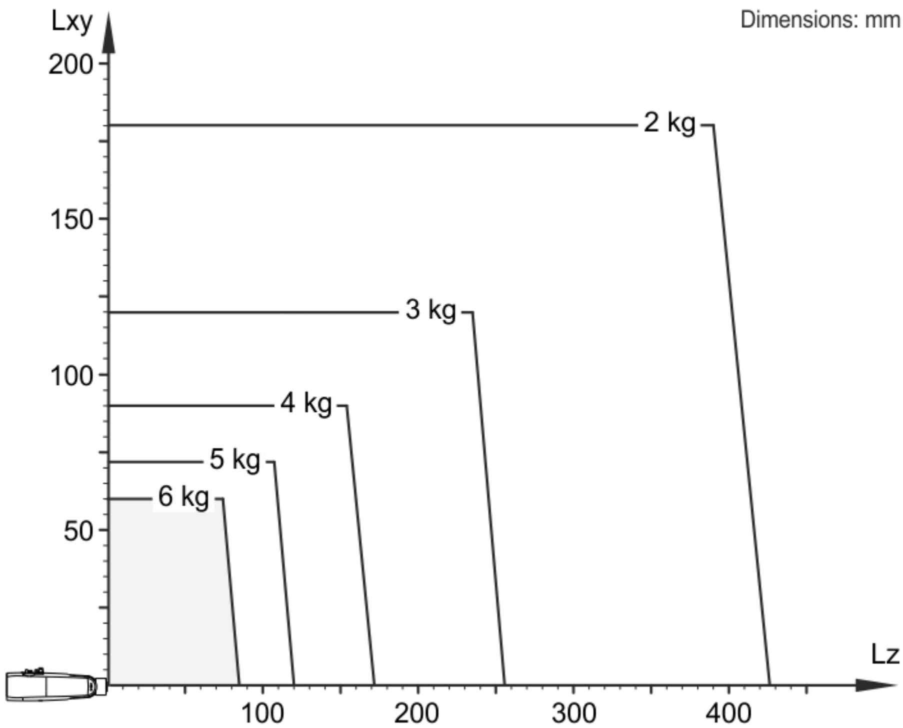


Fig. 4-42: KR 6 R900 sixx W-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 6 R900 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80

Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 H7
Standard	See diagram. (>>> Fig. 4-43)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-43) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

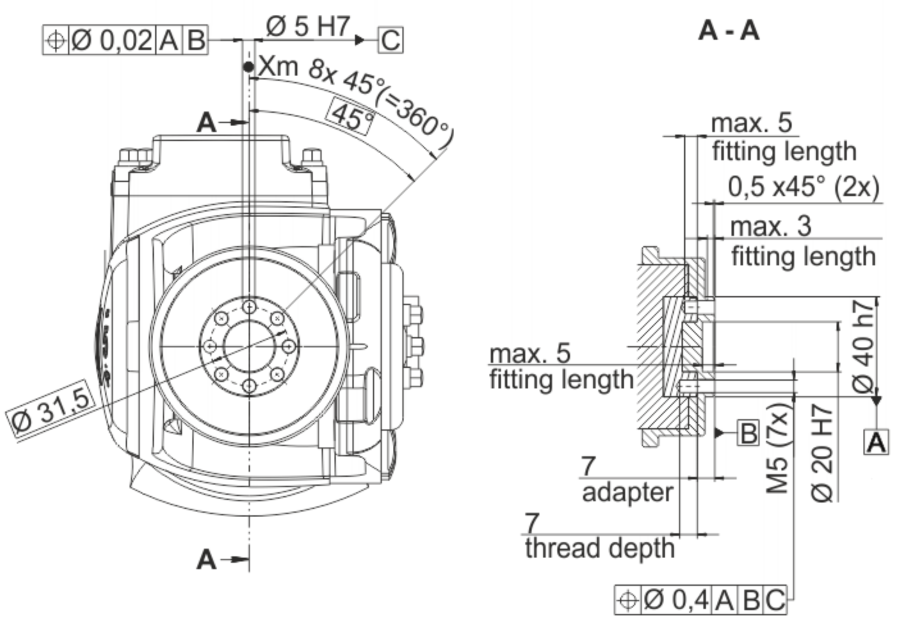


Fig. 4-43: Mounting flange

Flange loads

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

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

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

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

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

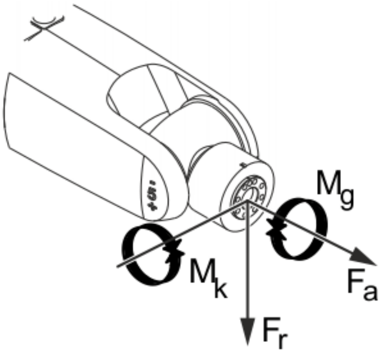


Fig. 4-44: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.6.4 Loads acting on the foundation, KR 6 R900 sixx W-HM-SC

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

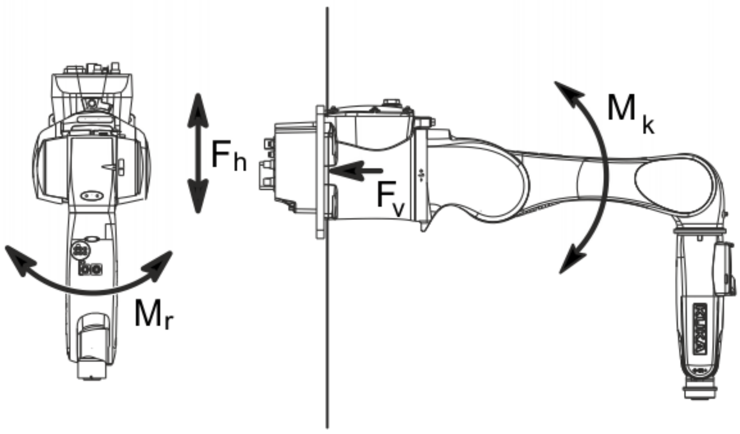


Fig. 4-45: Loads acting on the foundation, wall mounting

Vertical force F(v)	
F(v normal)	415 N
F(v max)	775 N

Horizontal force F(h)	
F(h normal)	1125 N
F(h max)	1488 N
Tilting moment M(k)	
M(k normal)	742 Nm
M(k max)	1142 Nm
Torque about axis 1 M(r)	
M(r normal)	307 Nm
M(r max)	654 Nm

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

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 Technical data, KR 6 R900 sixx C-HM-SC

4.7.1 Basic data, KR 6 R900 sixx C-HM-SC

Basic data

Designation	KR 6 R900 sixx C-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.73 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 62 kg
Rated payload	3 kg
Maximum total load	6 kg
Maximum reach	901.5 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Ceiling
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 6 R900 sixx C-HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR6R900 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.7.2 Axis data, KR 6 R900 sixx C-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	360 °/s
A2	300 °/s
A3	360 °/s
A4	381 °/s
A5	327 °/s
A6	518 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-46).

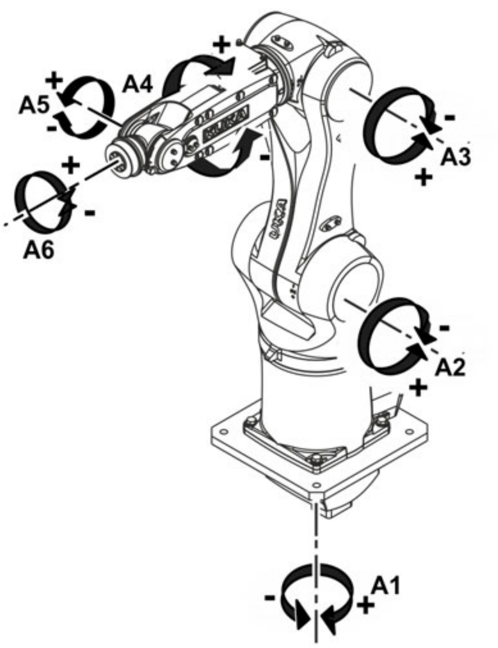


Fig. 4-46: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Workspace

The following diagrams (>>> Fig. 4-47) and (>>> Fig. 4-48) show the load center of gravity, shape and size of the working envelope.

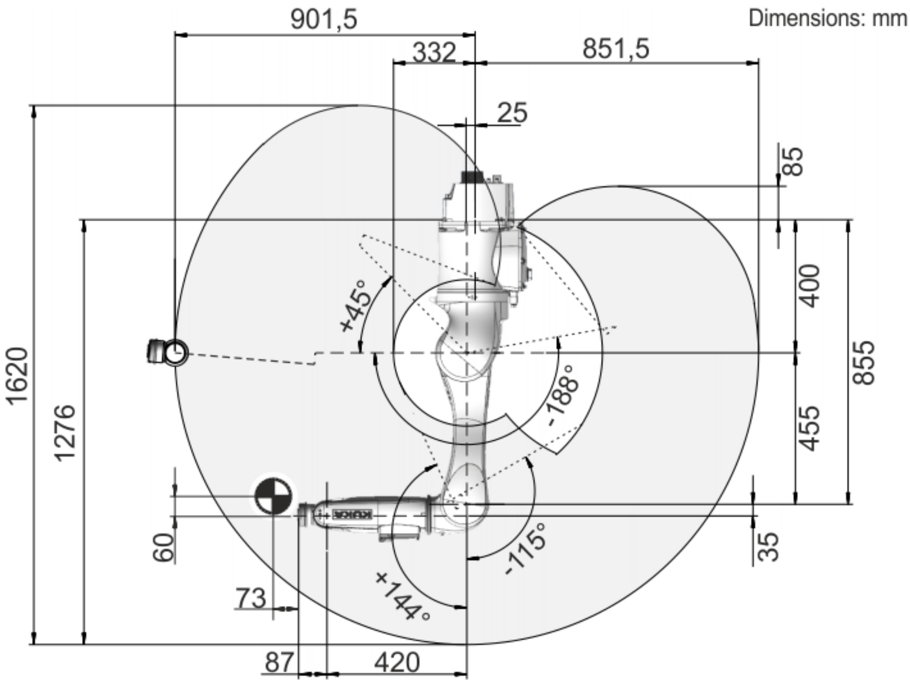


Fig. 4-47: KR 6 R900 sixx C-HM-SC, working envelope, side view

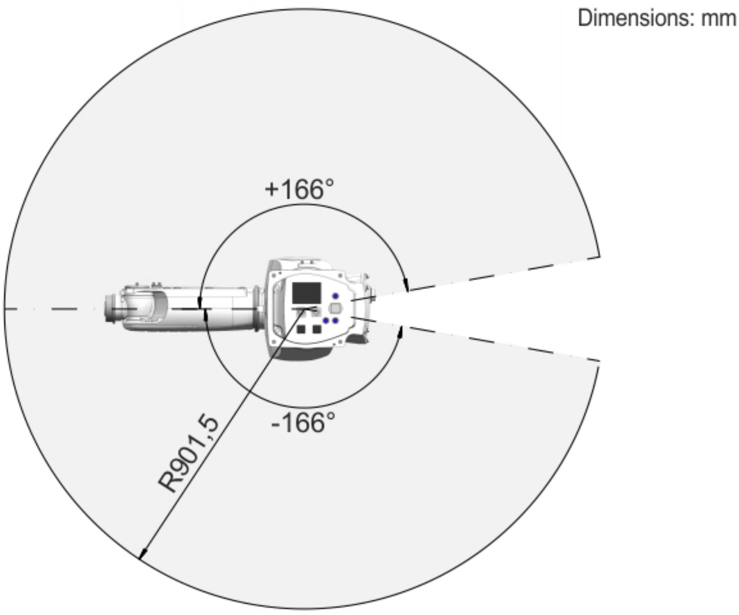


Fig. 4-48: KR 6 R900 sixx C-HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-49).

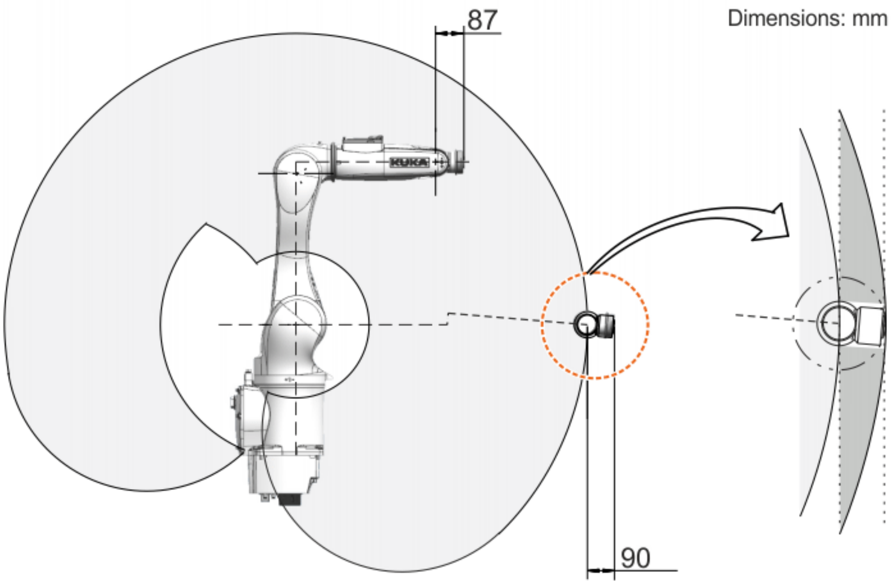


Fig. 4-49: Distance to flange, KR 6 R900 sixx HM-SC (with W and C variants)

4.7.3 Payloads, KR 6 R900 sixx C-HM-SC

Payloads

Rated payload	3 kg
Maximum payload	6 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	6 kg
Nominal distance to load center of gravity	
Lxy	60 mm
Lz	80 mm

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

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.

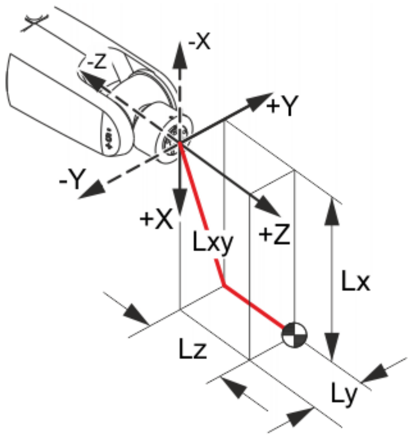


Fig. 4-50: Load center of gravity

Payload diagram

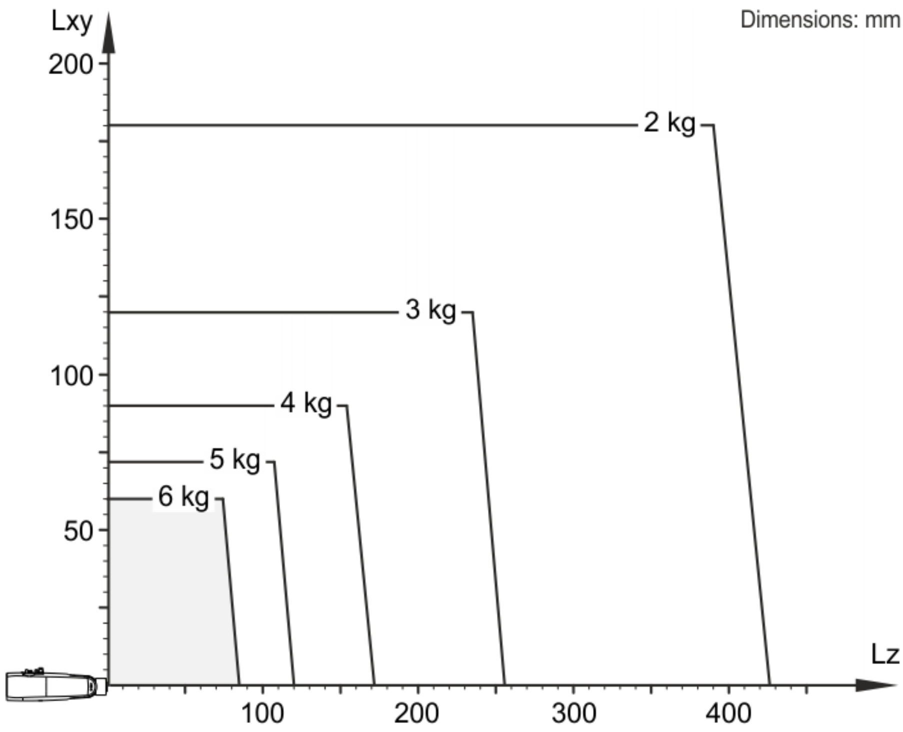


Fig. 4-51: KR 6 R900 sixx C-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 6 R900 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80

Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 ^{H7}
Standard	See diagram. (>>> Fig. 4-52)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-52) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

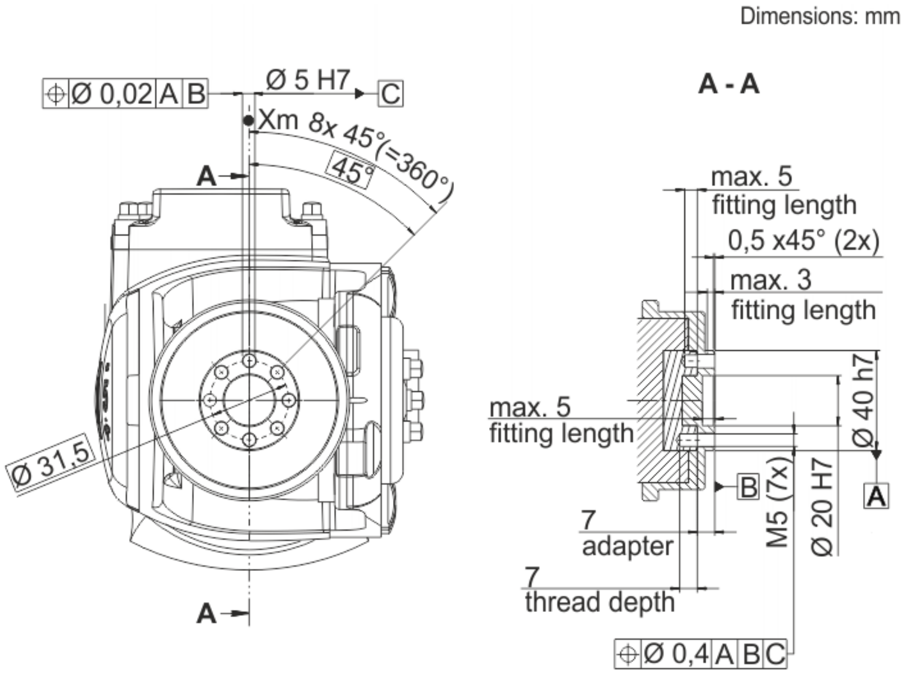


Fig. 4-52: Mounting flange

Flange loads

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

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

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

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

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

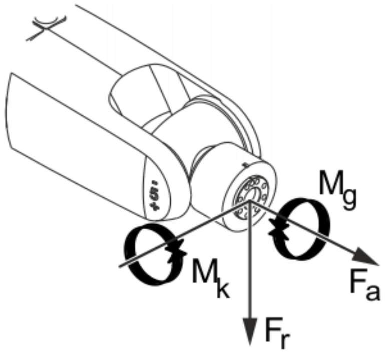


Fig. 4-53: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.7.4 Loads acting on the foundation, KR 6 R900 sixx C-HM-SC

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

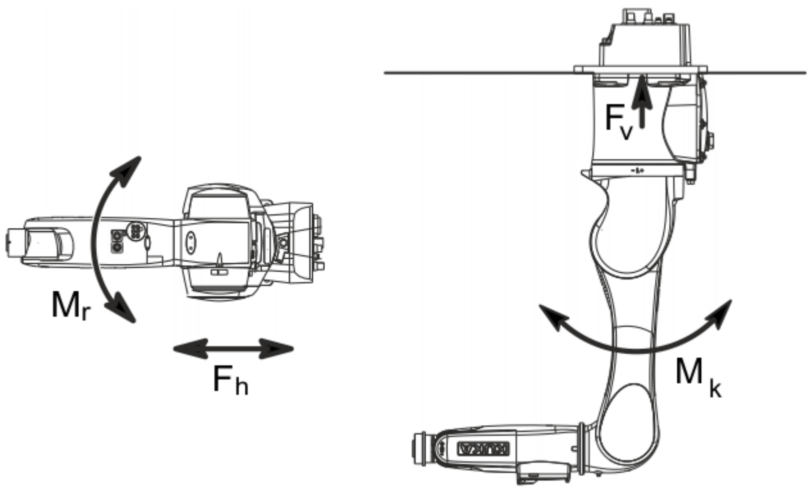


Fig. 4-54: Loads acting on the foundation, ceiling mounting

Vertical force F(v)	
F(v normal)	1015 N
F(v max)	1258 N

Horizontal force F(h)	
F(h normal)	622 N
F(h max)	1013 N
Tilting moment M(k)	
M(k normal)	582 Nm
M(k max)	953 Nm
Torque about axis 1 M(r)	
M(r normal)	358 Nm
M(r max)	776 Nm

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

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.

4.8 Technical data, KR 10 R900 sixx HM-SC

4.8.1 Basic data, KR 10 R900 sixx HM-SC

Basic data

Designation	KR 10 R900 sixx HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.73 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 62 kg
Rated payload	5 kg
Maximum total load	10 kg
Maximum reach	901.5 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Floor
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 10 R900 sixx HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R900 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	40 °C to 60 °C (313 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.8.2 Axis data, KR 10 R900 sixx HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	225 °/s
A4	381 °/s
A5	262 °/s
A6	414 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-55).

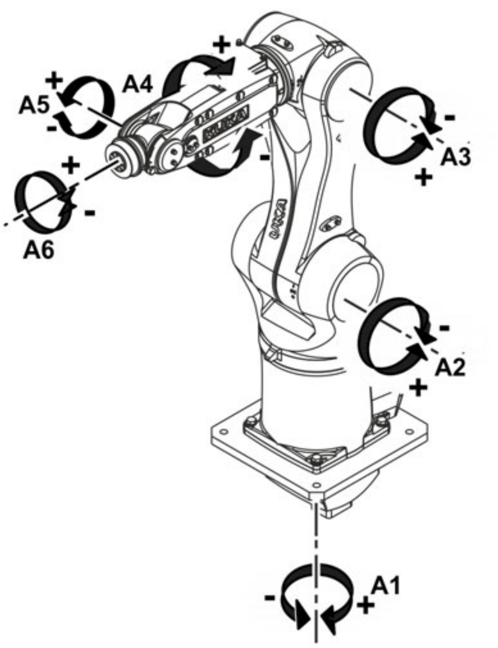


Fig. 4-55: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Workspace

The following diagrams (>>> Fig. 4-56) and (>>> Fig. 4-57) show the load center of gravity, shape and size of the working envelope.

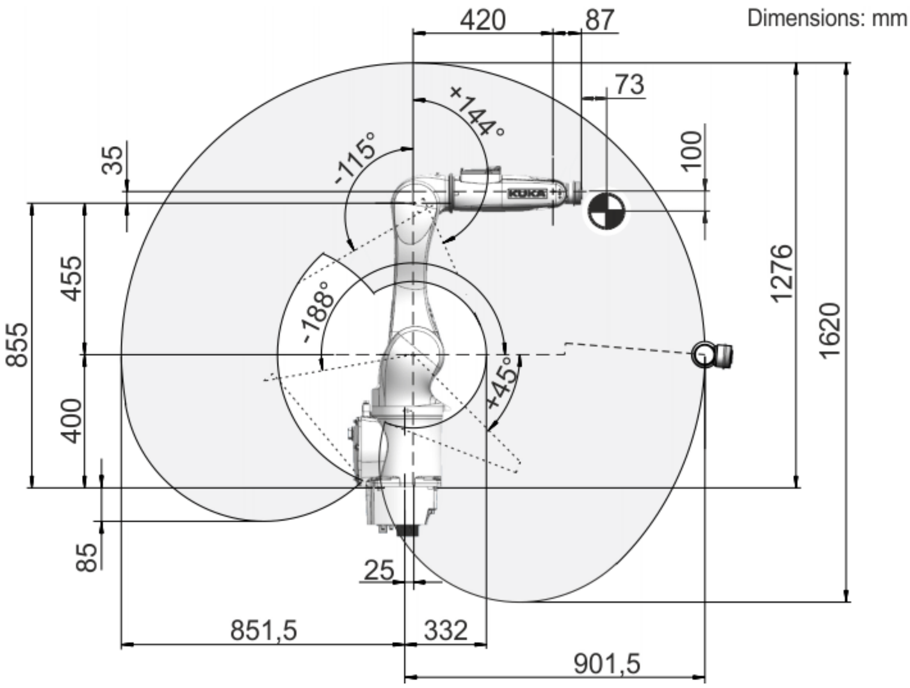


Fig. 4-56: KR 10 R900 sixx HM-SC, working envelope, side view

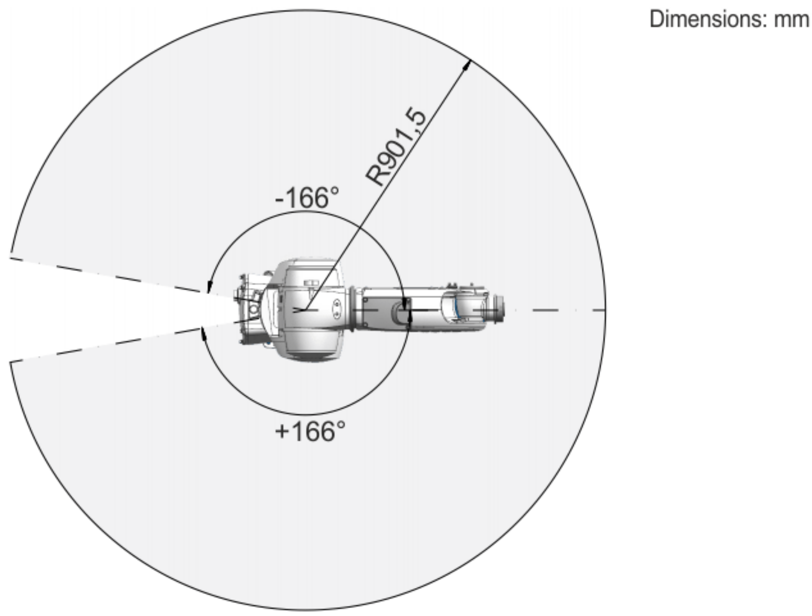


Fig. 4-57: KR 10 R900 sixx HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-58).

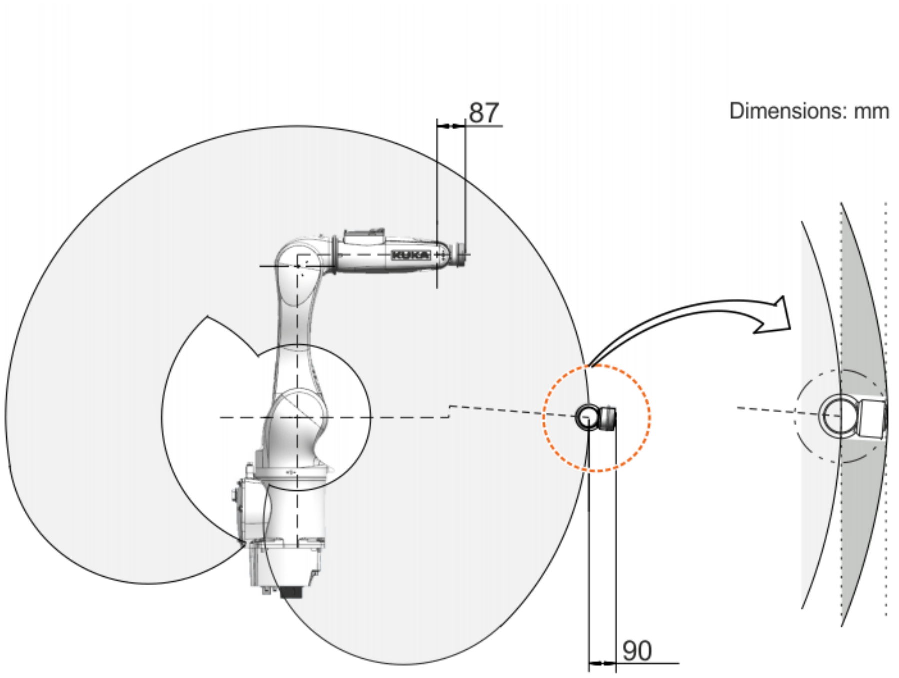


Fig. 4-58: Distance to flange, KR 10 R900 sixx HM-SC (with W and C variants)

4.8.3 Payloads, KR 10 R900 sixx HM-SC

Payloads

Rated payload	5 kg
Maximum payload	10 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	10 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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

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.

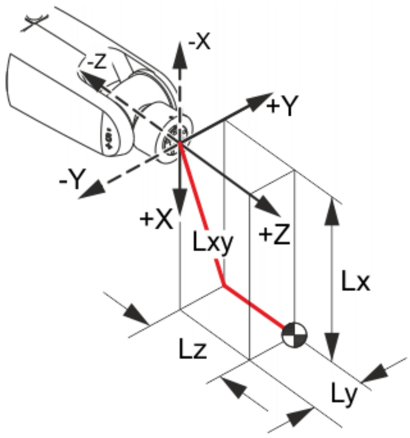


Fig. 4-59: Load center of gravity

Payload diagram

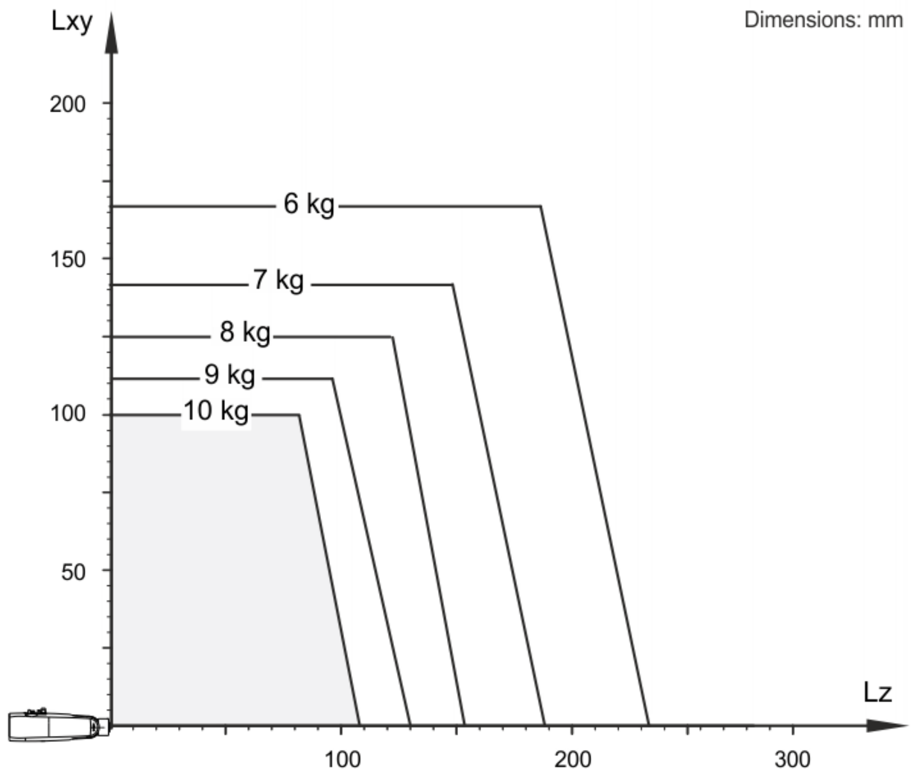


Fig. 4-60: KR 10 R900 sixx HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 10 R900 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 H7
Standard	See diagram. (>>> Fig. 4-61)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-61) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

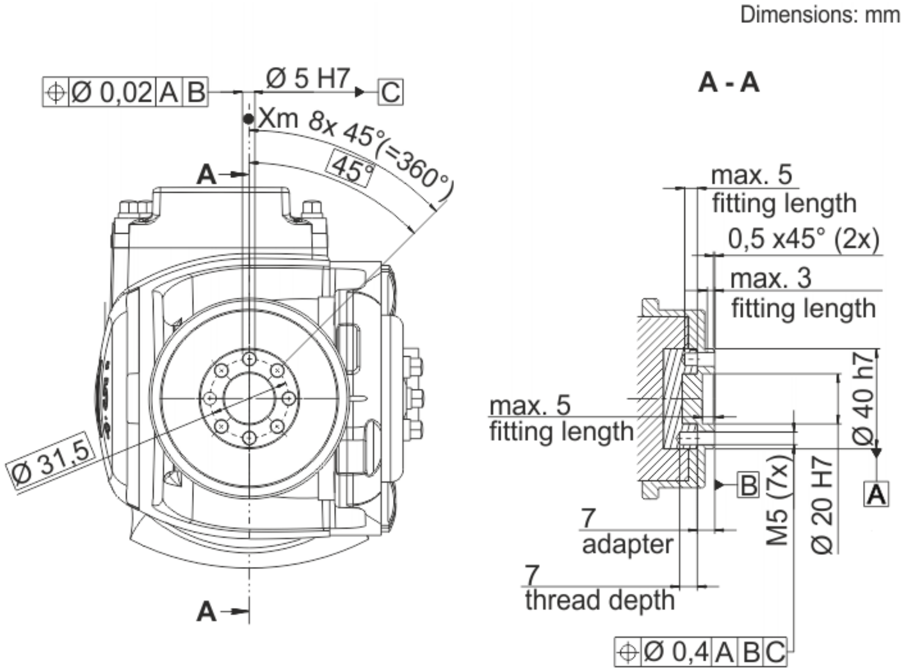


Fig. 4-61: Mounting flange

Flange loads

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

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

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

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

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

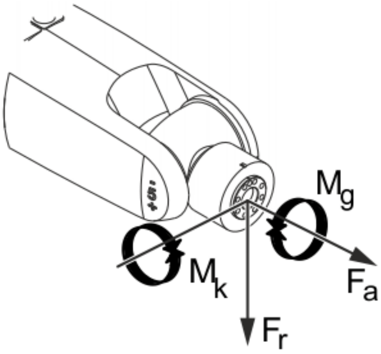


Fig. 4-62: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.8.4 Loads acting on the foundation, KR 10 R900 sixx HM-SC

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

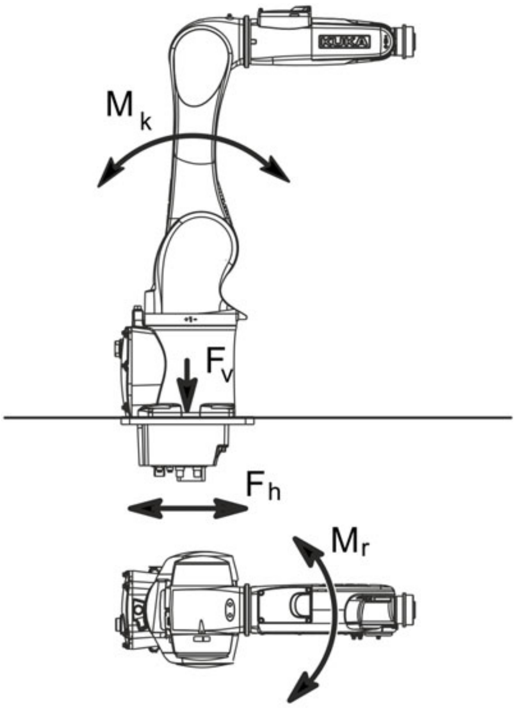


Fig. 4-63: Loads acting on the foundation, floor mounting

Vertical force F(v)	
F(v normal)	944 N
F(v max)	1285 N
Horizontal force F(h)	
F(h normal)	617 N
F(h max)	1032 N
Tilting moment M(k)	
M(k normal)	602 Nm
M(k max)	595 Nm
Torque about axis 1 M(r)	
M(r normal)	342 Nm
M(r max)	741 Nm

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

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.

4.9 Technical data, KR 10 R900 sixx W-HM-SC

4.9.1 Basic data, KR 10 R900 sixx W-HM-SC

Basic data

Designation	KR 10 R900 sixx W-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.73 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 62 kg
Rated payload	5 kg
Maximum total load	10 kg
Maximum reach	901.5 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Wall
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R900 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	40 °C to 60 °C (313 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion

- Acidic or alkaline environments
- Vacuum applications

> **NOTICE** If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.9.2 Axis data, KR 10 R900 sixx W-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	225 °/s
A4	381 °/s
A5	262 °/s
A6	414 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-64).

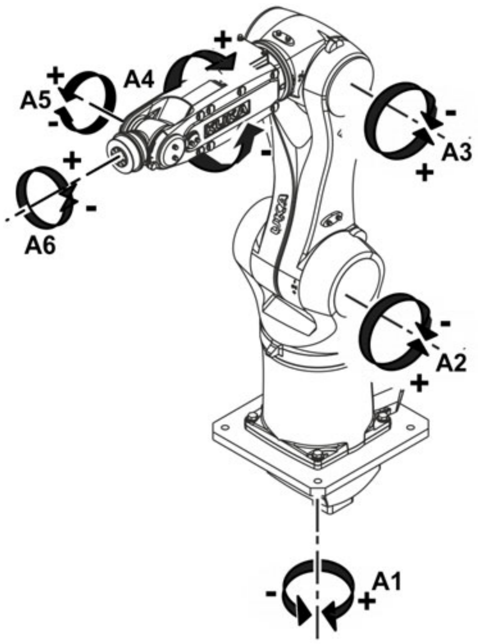


Fig. 4-64: Direction of rotation of robot axes

Mastering position

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

Workspace

The following diagrams (>>> Fig. 4-65) and (>>> Fig. 4-66) show the load center of gravity, shape and size of the working envelope.

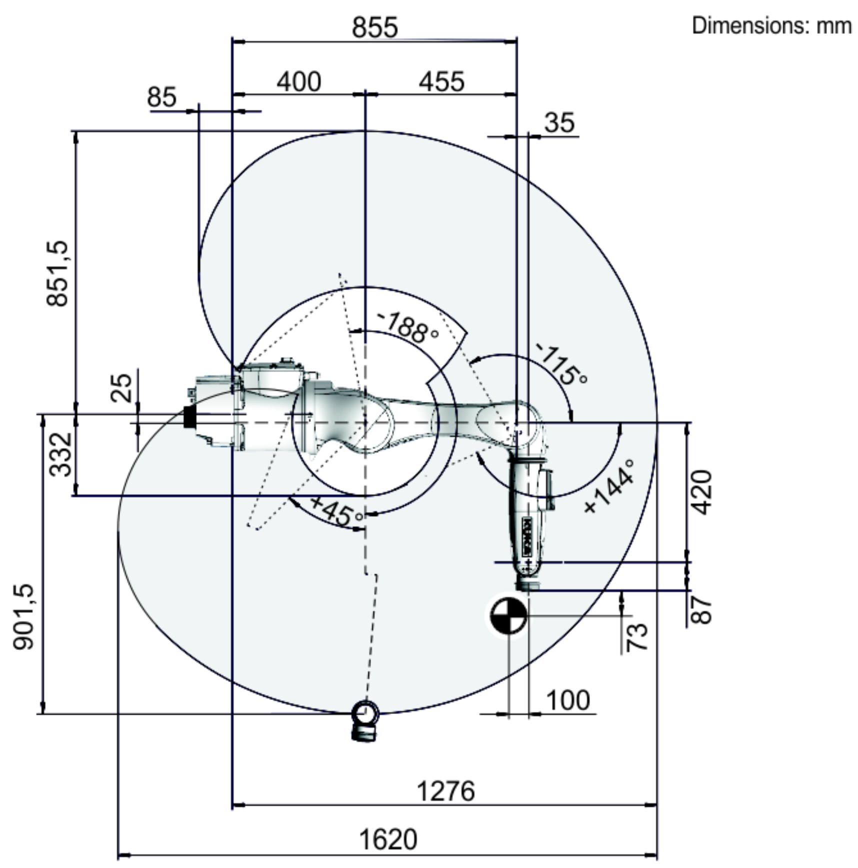


Fig. 4-65: KR 10 R900 sixx W-HM-SC, working envelope, side view

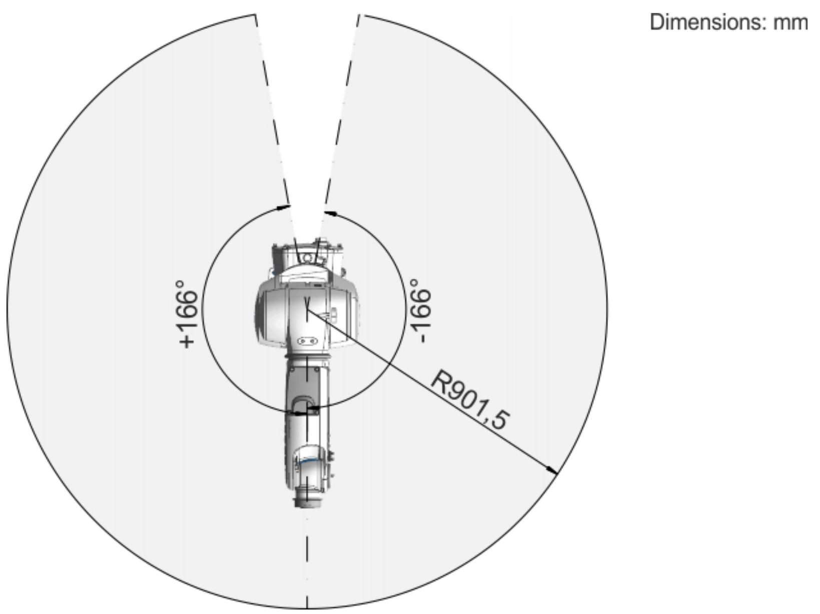


Fig. 4-66: KR 10 R900 sixx W-HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-67).

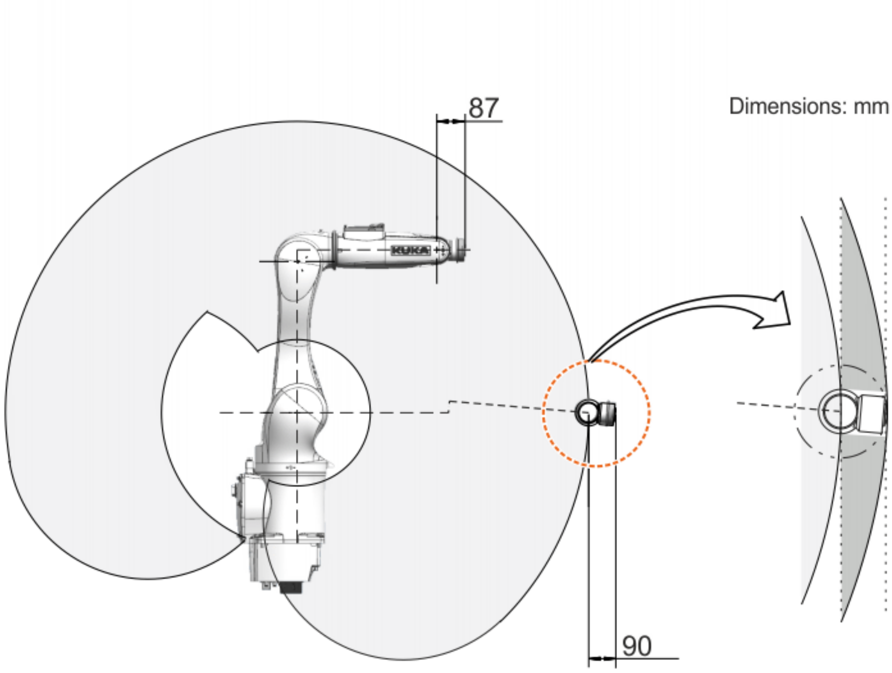


Fig. 4-67: Distance to flange, KR 10 R900 sixx HM-SC (with W and C variants)

4.9.3 Payloads, KR 10 R900 sixx W-HM-SC

Payloads

Rated payload	5 kg
Maximum payload	10 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	10 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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

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.

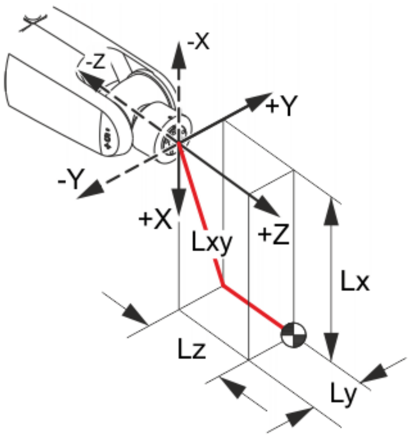


Fig. 4-68: Load center of gravity

Payload diagram

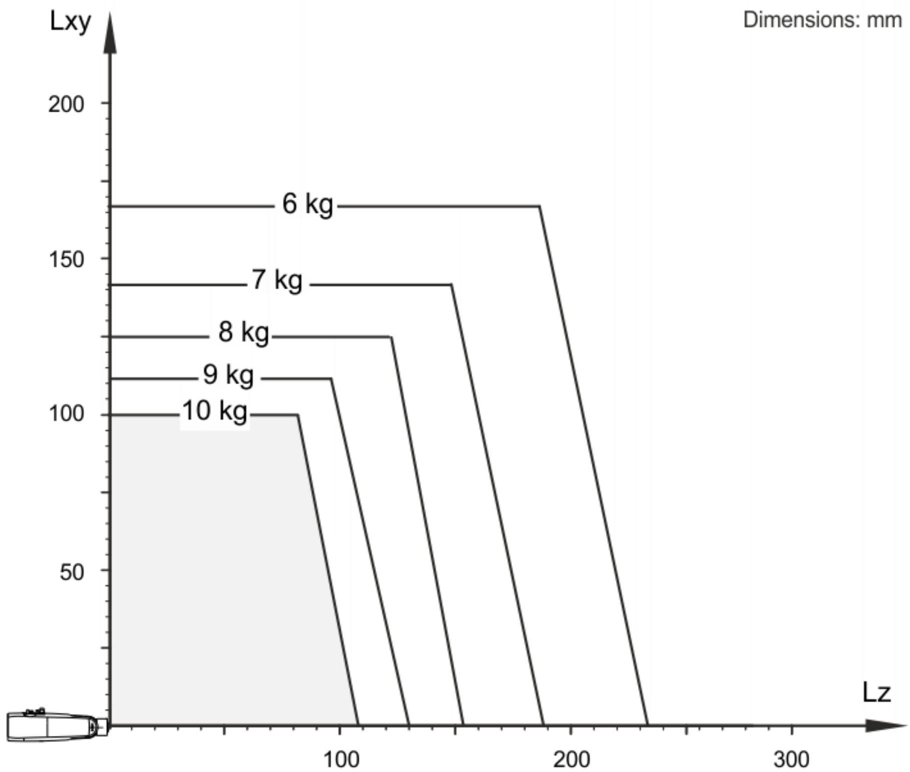


Fig. 4-69: KR 10 R900 sixx W-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 10 R900 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 H7
Standard	See diagram. (>>> Fig. 4-70)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-70) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

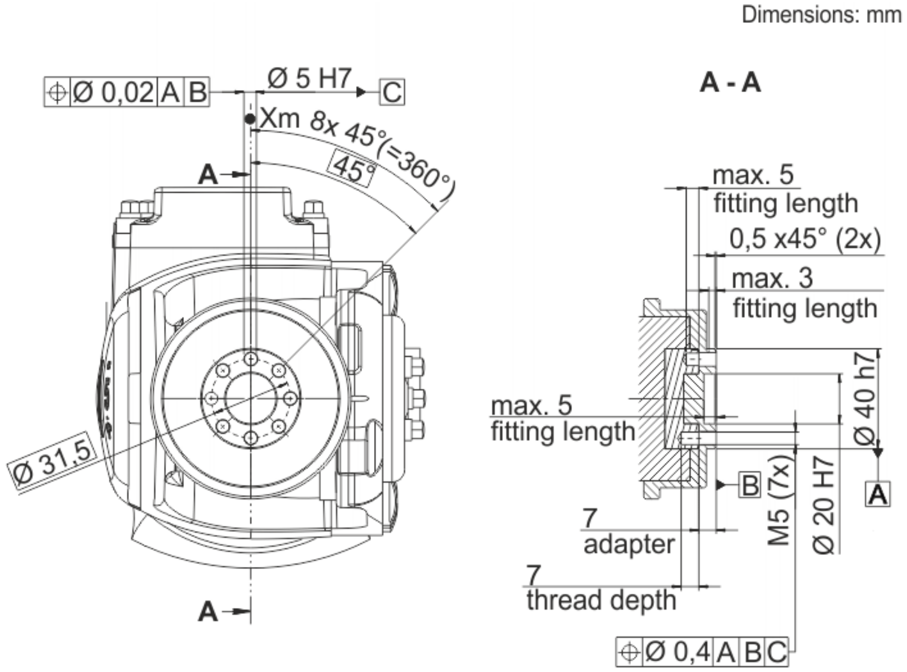


Fig. 4-70: Mounting flange

Flange loads

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

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

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

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

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

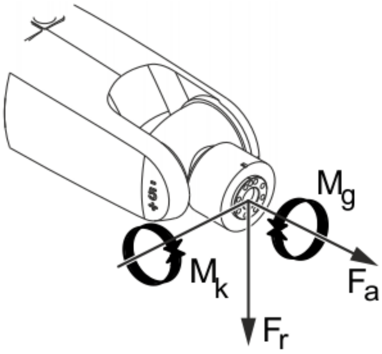


Fig. 4-71: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.9.4 Loads acting on the foundation, KR 10 R900 sixx W-HM-SC

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

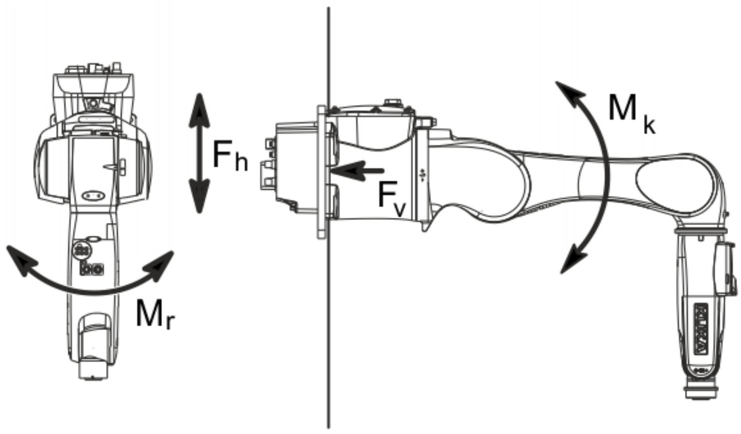


Fig. 4-72: Loads acting on the foundation, wall mounting

Vertical force F(v)	
F(v normal)	415 N
F(v max)	775 N

Horizontal force F(h)	
F(h normal)	1125 N
F(h max)	1488 N
Tilting moment M(k)	
M(k normal)	742 Nm
M(k max)	1142 Nm
Torque about axis 1 M(r)	
M(r normal)	307 Nm
M(r max)	654 Nm

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

⚠ 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.

4.10 Technical data, KR 10 R900 sixx C-HM-SC

4.10.1 Basic data, KR 10 R900 sixx C-HM-SC

Basic data

Designation	KR 10 R900 sixx C-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	2.73 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 62 kg
Rated payload	5 kg
Maximum total load	10 kg
Maximum reach	901.5 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Ceiling
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 10 R900 sixx C-HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R900 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	40 °C to 60 °C (313 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.10.2 Axis data, KR 10 R900 sixx C-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-115 ° / 144 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	225 °/s
A4	381 °/s
A5	262 °/s
A6	414 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-73).

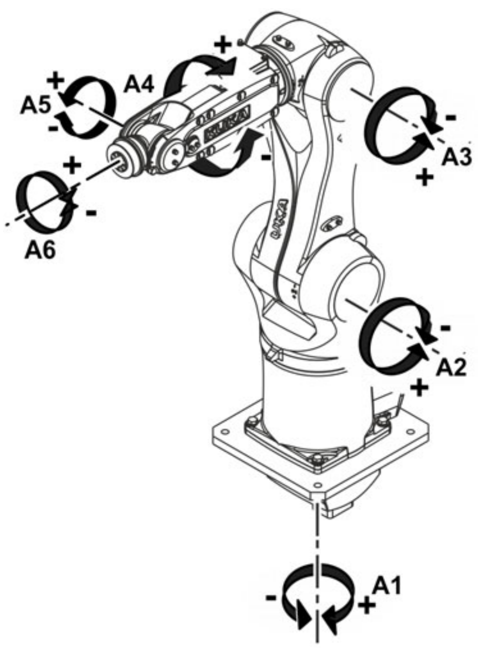


Fig. 4-73: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Workspace

The following diagrams (>>> Fig. 4-74) and (>>> Fig. 4-75) show the load center of gravity, shape and size of the working envelope.

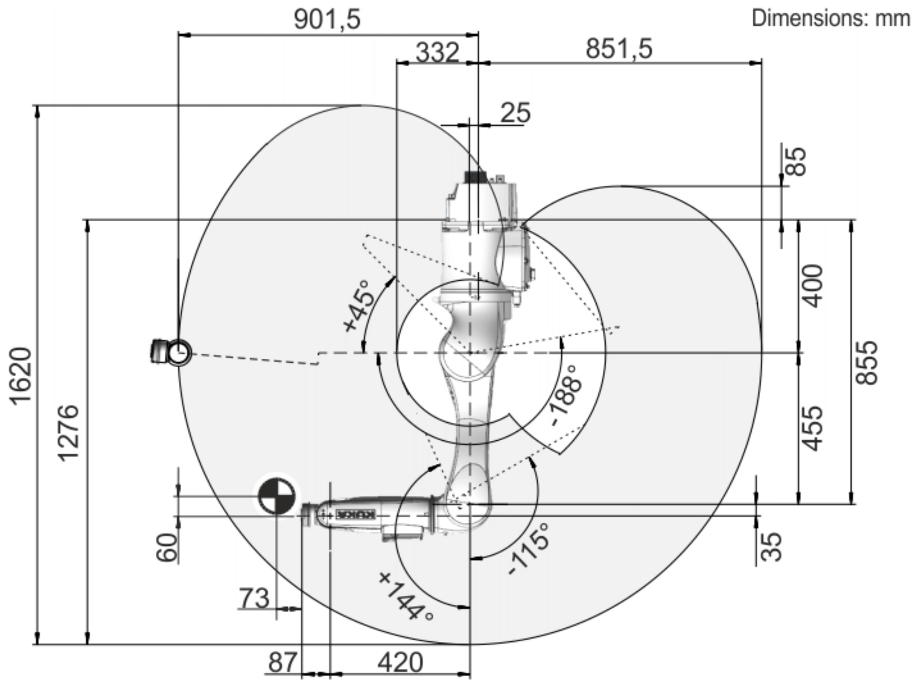


Fig. 4-74: KR 10 R900 sixx C-HM-SC, working envelope, side view

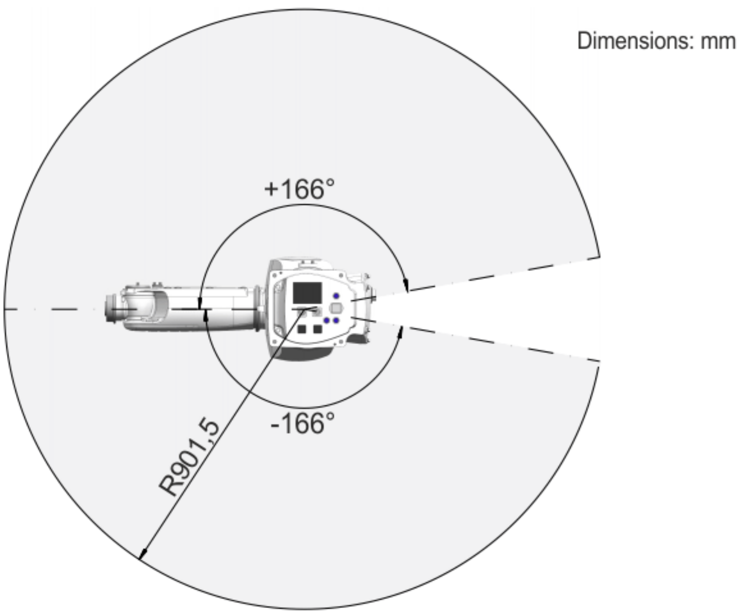


Fig. 4-75: KR 10 R900 sixx C-HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-76).

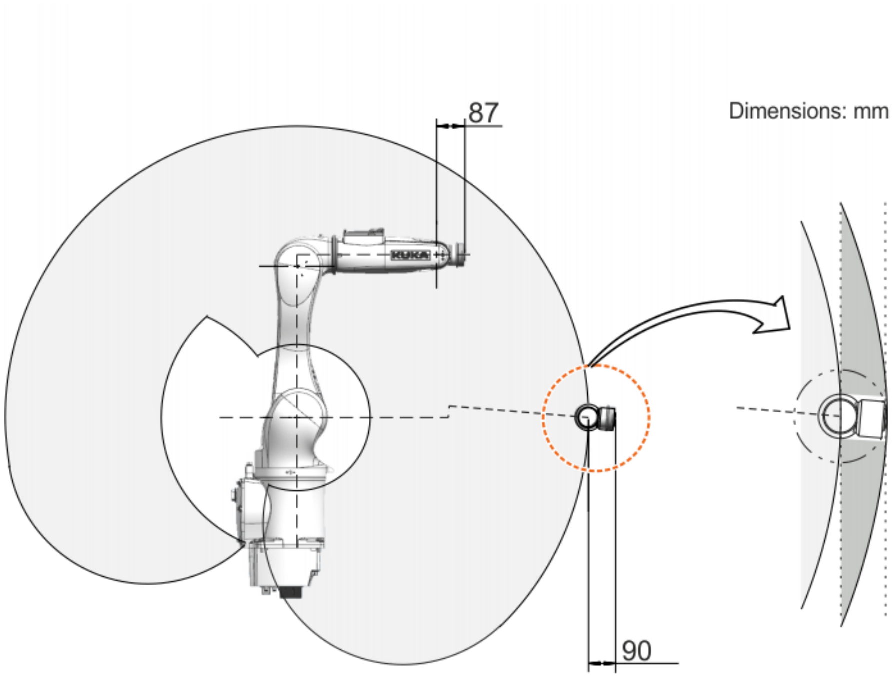


Fig. 4-76: Distance to flange, KR 10 R900 sixx HM-SC (with W and C variants)

4.10.3 Payloads, KR 10 R900 sixx C-HM-SC

Payloads

Rated payload	5 kg
Maximum payload	10 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	10 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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

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.

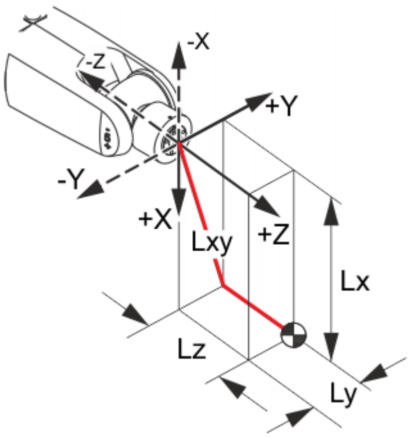


Fig. 4-77: Load center of gravity

Payload diagram

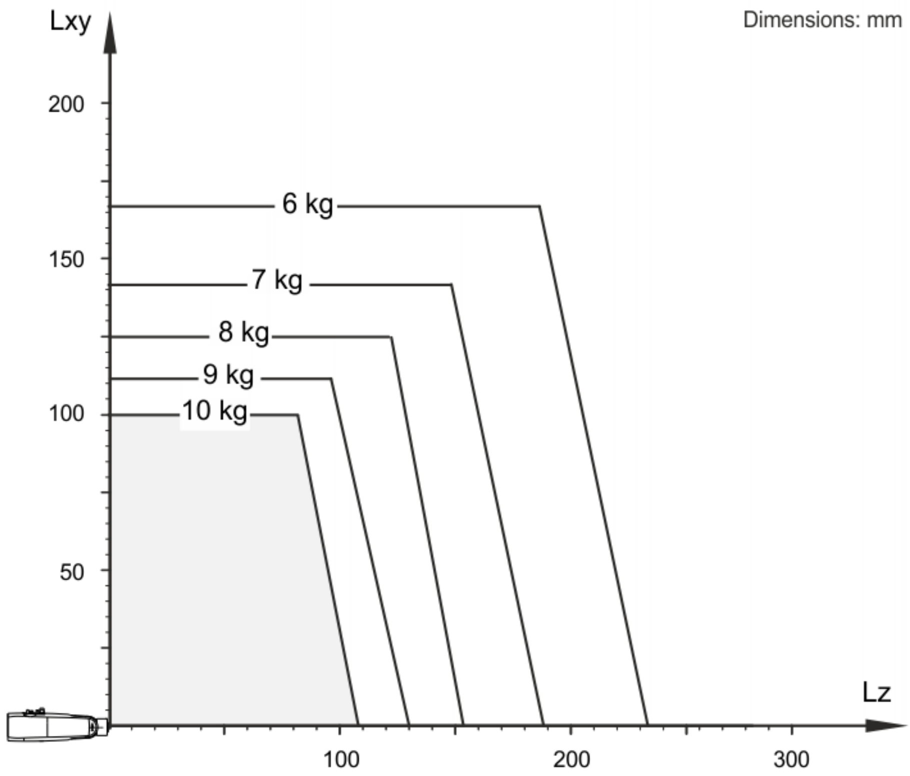


Fig. 4-78: KR 10 R900 sixx C-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 10 R900 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 H7
Standard	See diagram. (>>> Fig. 4-79)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-79) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

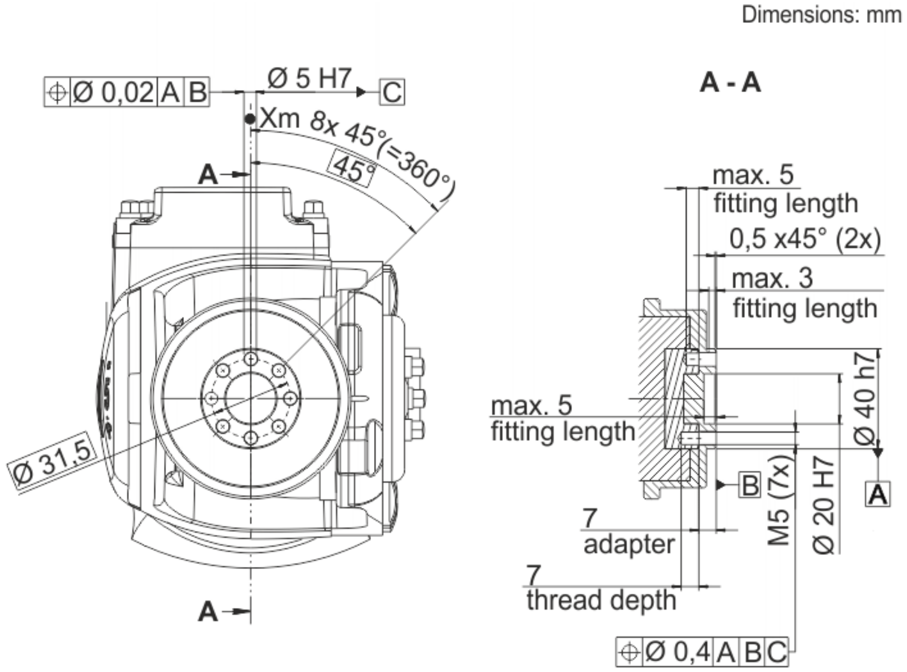


Fig. 4-79: Mounting flange

Flange loads

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

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

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

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

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

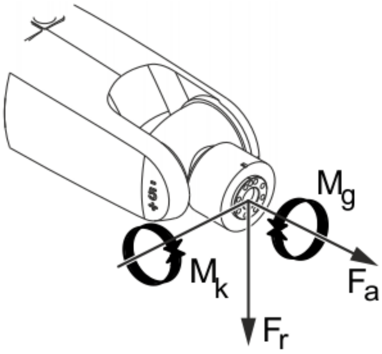


Fig. 4-80: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.10.4 Loads acting on the foundation, KR 10 R900 sixx C-HM-SC

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

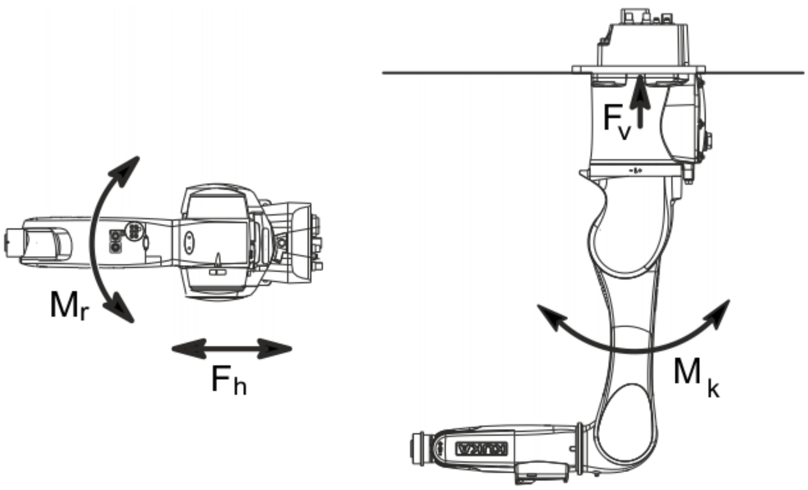


Fig. 4-81: Loads acting on the foundation, ceiling mounting

Vertical force F(v)	
F(v normal)	1015 N
F(v max)	1258 N

Horizontal force F(h)	
F(h normal)	622 N
F(h max)	1013 N
Tilting moment M(k)	
M(k normal)	582 Nm
M(k max)	953 Nm
Torque about axis 1 M(r)	
M(r normal)	358 Nm
M(r max)	776 Nm

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

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.

4.11 Technical data, KR 10 R1100 sixx HM-SC

4.11.1 Basic data, KR 10 R1100 sixx HM-SC

Basic data

Designation	KR 10 R1100 sixx HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	5.14 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 64 kg
Rated payload	5 kg
Maximum total load	10 kg
Maximum reach	1101 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Floor
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 10 R1100 sixx HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R1100 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.11.2 Axis data, KR 10 R1100 sixx HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-116 ° / 153 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	225 °/s
A4	381 °/s
A5	262 °/s
A6	414 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-82).

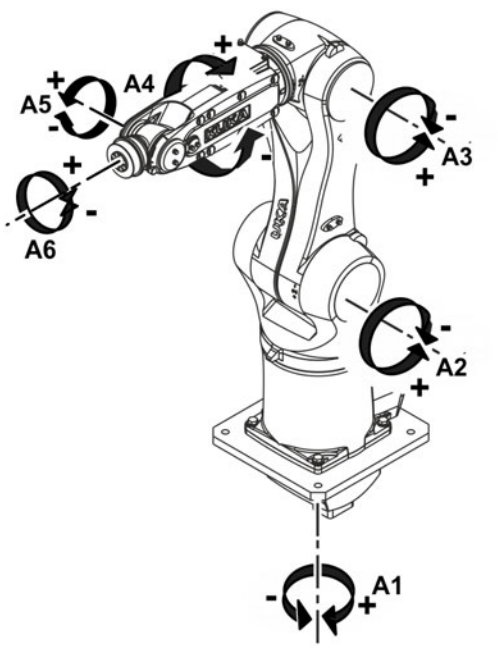


Fig. 4-82: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Working envelope

The following diagrams (>>> Fig. 4-83) and (>>> Fig. 4-84) show the load center of gravity and the shape and size of the working envelope.

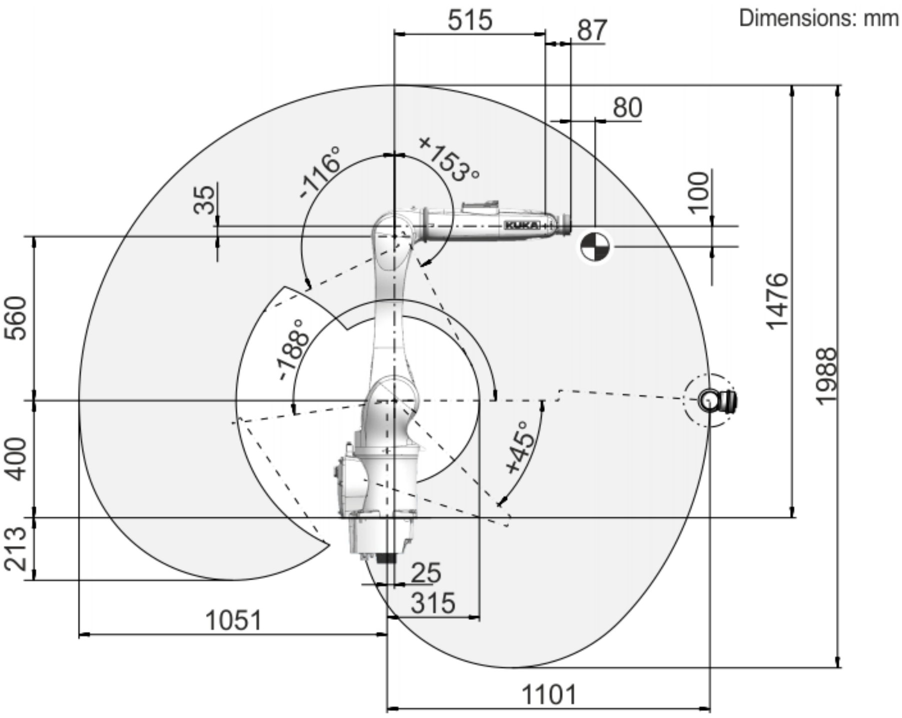


Fig. 4-83: KR 10 R1100 sixx HM-SC, working envelope, side view

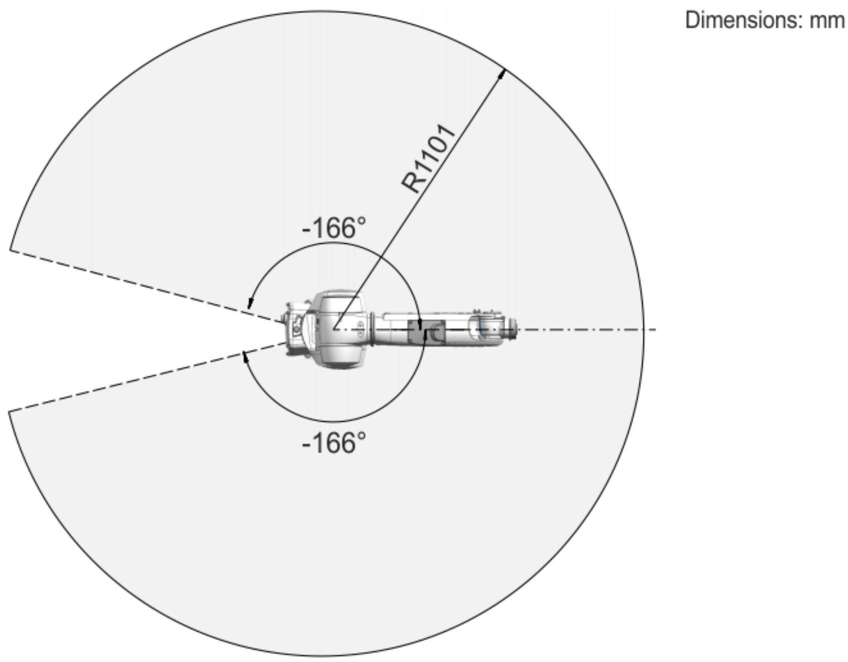


Fig. 4-84: KR 10 R1100 sixx HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-85).

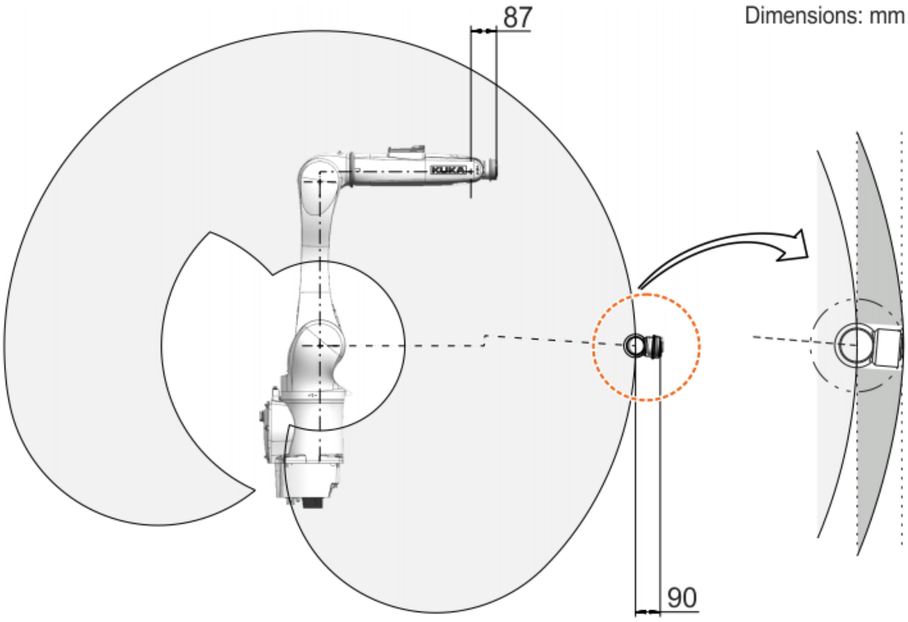


Fig. 4-85: Distance to flange, KR 10 R1100 sixx HM-SC (with W and C variants)

4.11.3 Payloads, KR 10 R1100 sixx HM-SC

Payloads

Rated payload	5 kg
Maximum payload	10 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	10 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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

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.

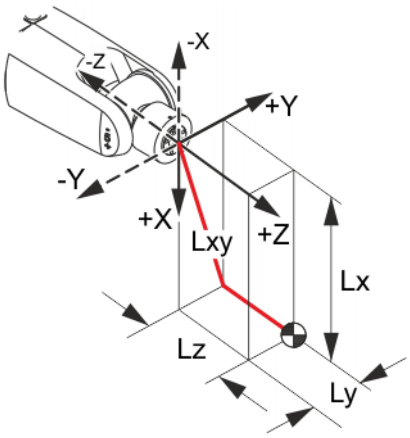


Fig. 4-86: Load center of gravity

Payload diagram

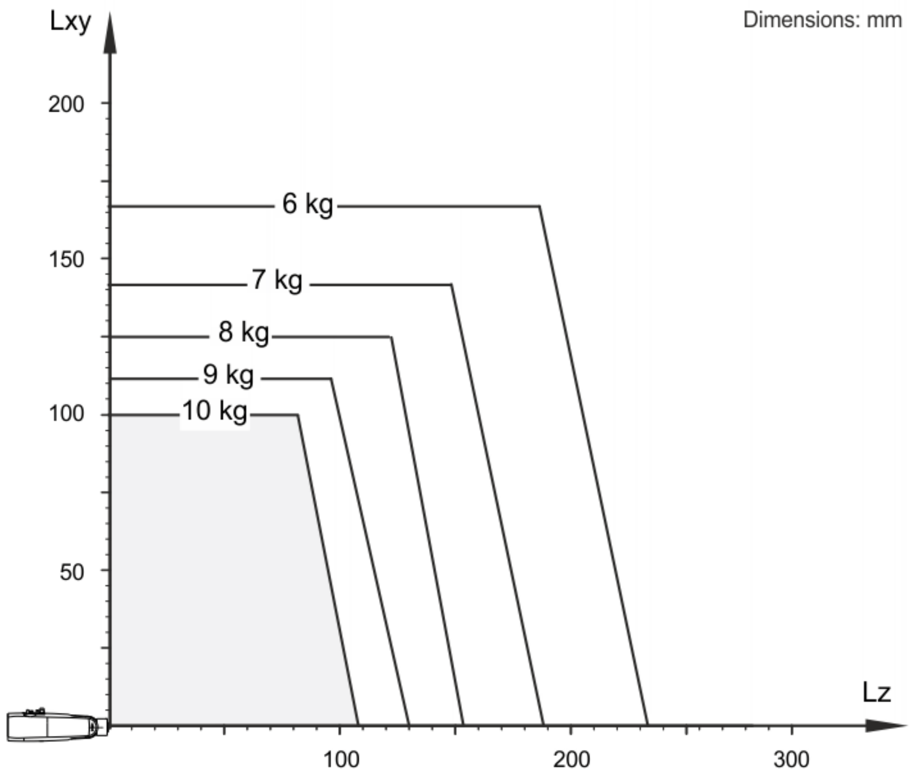


Fig. 4-87: KR 10 R1100 sixx HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 10 R1100 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5^{H7}
Standard	See diagram. (>>> Fig. 4-88)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-88) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

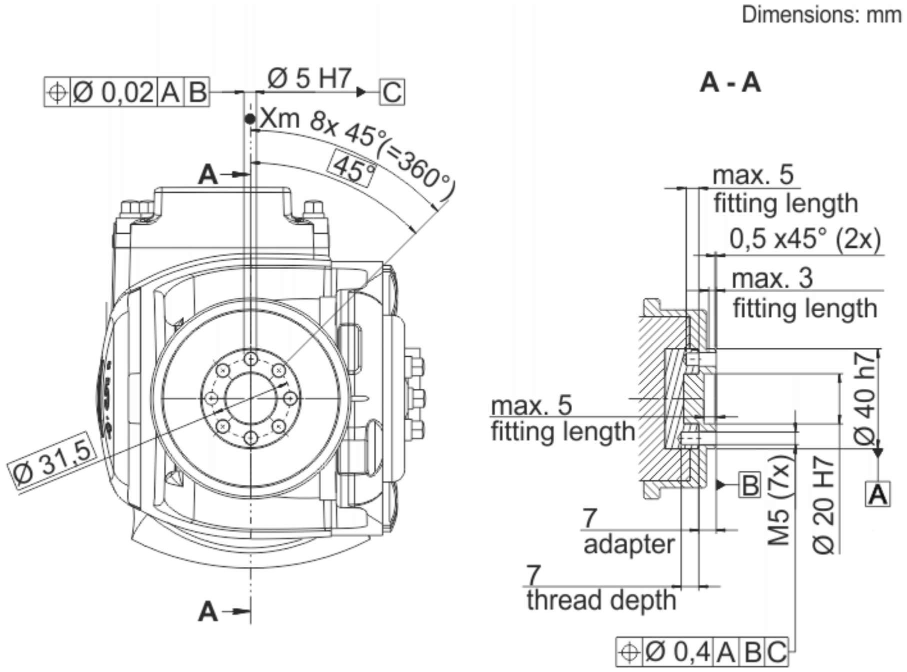


Fig. 4-88: Mounting flange

Flange loads

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

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

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

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

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

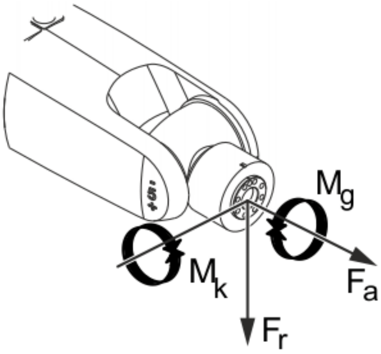


Fig. 4-89: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.11.4 Loads acting on the foundation, KR 10 R1100 sixx HM-SC

Foundation loads

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

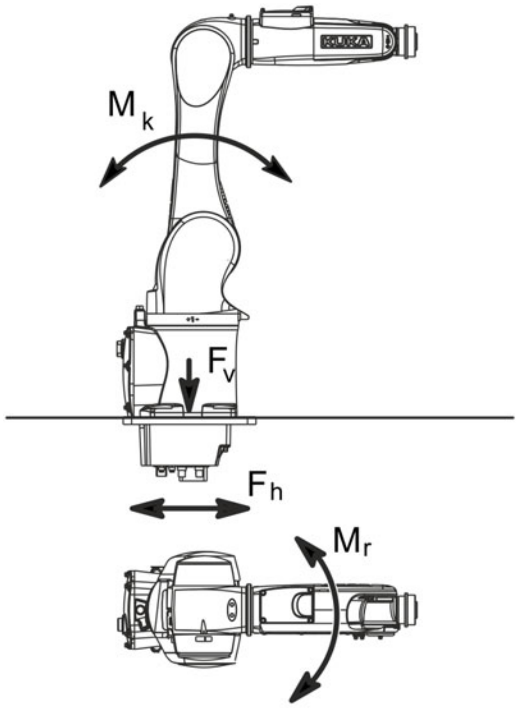


Fig. 4-90: Loads acting on the foundation, floor mounting

Vertical force F(v)	
F(v normal)	944 N
F(v max)	1285 N
Horizontal force F(h)	
F(h normal)	617 N
F(h max)	1032 N
Tilting moment M(k)	
M(k normal)	602 Nm
M(k max)	595 Nm
Torque about axis 1 M(r)	
M(r normal)	342 Nm
M(r max)	741 Nm

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

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.

4.12 Technical data, KR 10 R1100 sixx W-HM-SC

4.12.1 Basic data, KR 10 R1100 sixx W-HM-SC

Basic data

Designation	KR 10 R1100 sixx W-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	5.14 m^3
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 64 kg
Rated payload	5 kg
Maximum total load	10 kg
Maximum reach	1101 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Wall
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R1100 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion

- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.12.2 Axis data, KR 10 R1100 sixx W-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-116 ° / 153 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	225 °/s
A4	381 °/s
A5	262 °/s
A6	414 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-91).

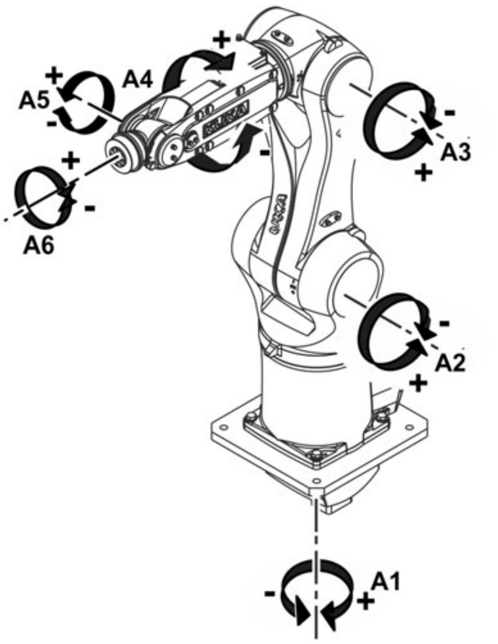


Fig. 4-91: Direction of rotation of robot axes

Mastering position

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

Working envelope

The following diagrams (>>> Fig. 4-92) and (>>> Fig. 4-93) show the load center of gravity and the shape and size of the working envelope.

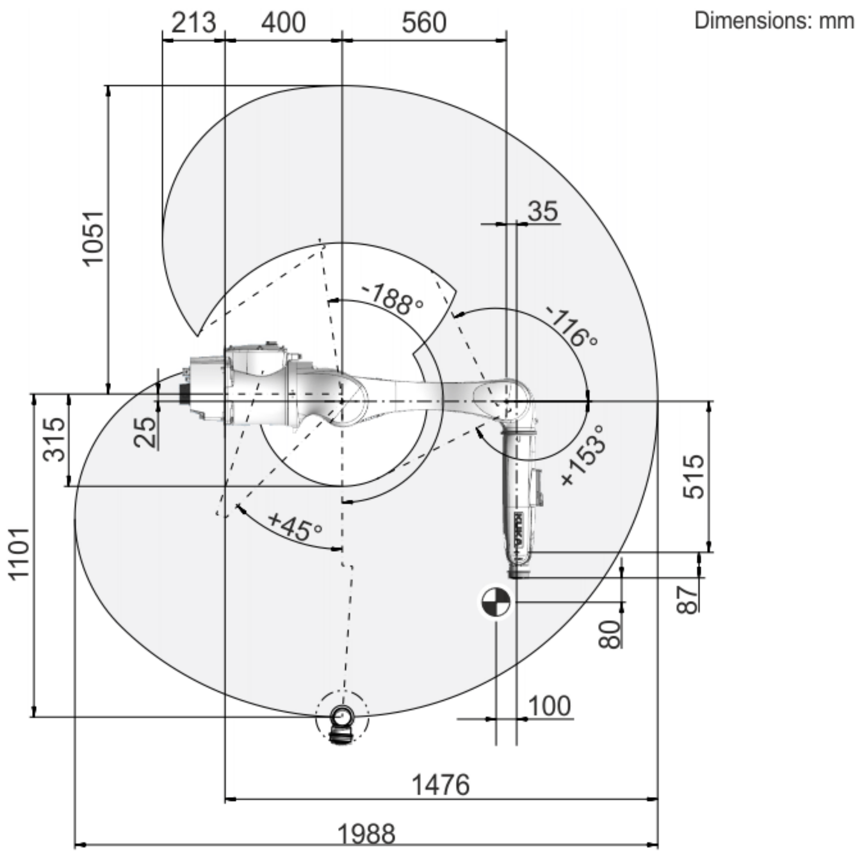


Fig. 4-92: KR 10 R1100 sixx W-HM-SC, working envelope, side view

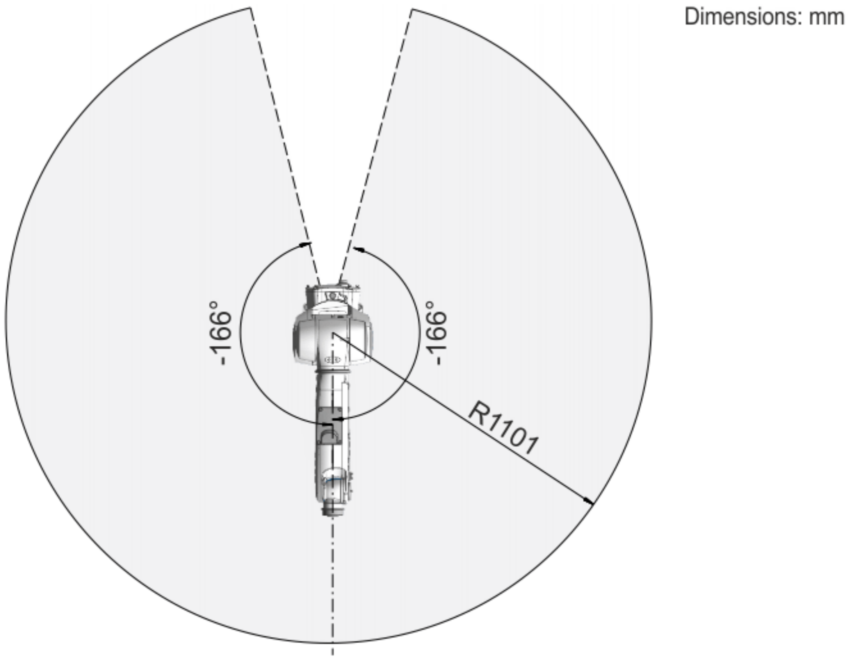


Fig. 4-93: KR 10 R1100 sixx W-HM-SC, working envelope, top view

Distance to flange The distance to the flange varies according to the position of the robot (>>> Fig. 4-94).

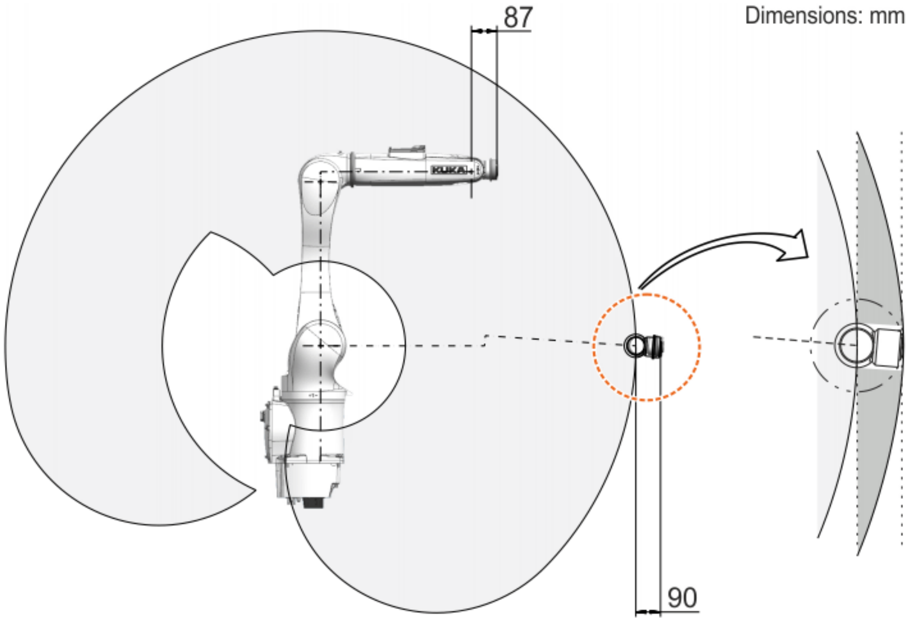


Fig. 4-94: Distance to flange, KR 10 R1100 sixx HM-SC (with W and C variants)

4.12.3 Payloads, KR 10 R1100 sixx W-HM-SC

Payloads

Rated payload	5 kg
Maximum payload	10 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	10 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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

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.

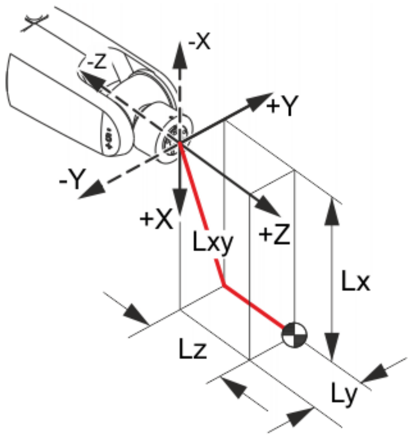


Fig. 4-95: Load center of gravity

Payload diagram

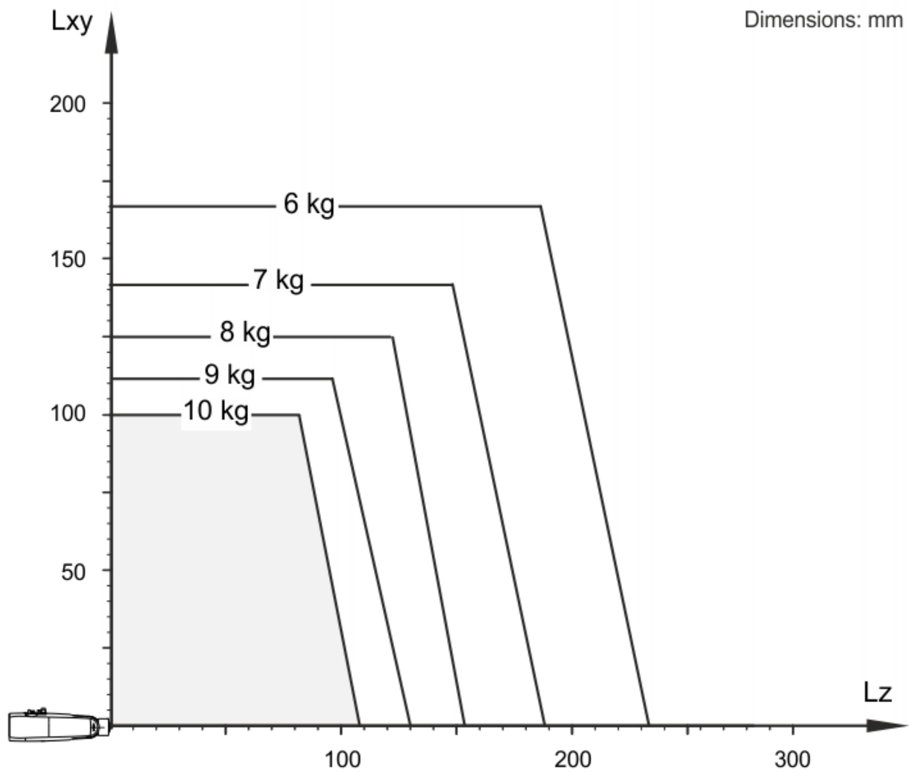


Fig. 4-96: KR 10 R1100 sixx W-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 10 R1100 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5^{H7}
Standard	See diagram. (>>> Fig. 4-97)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-97) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

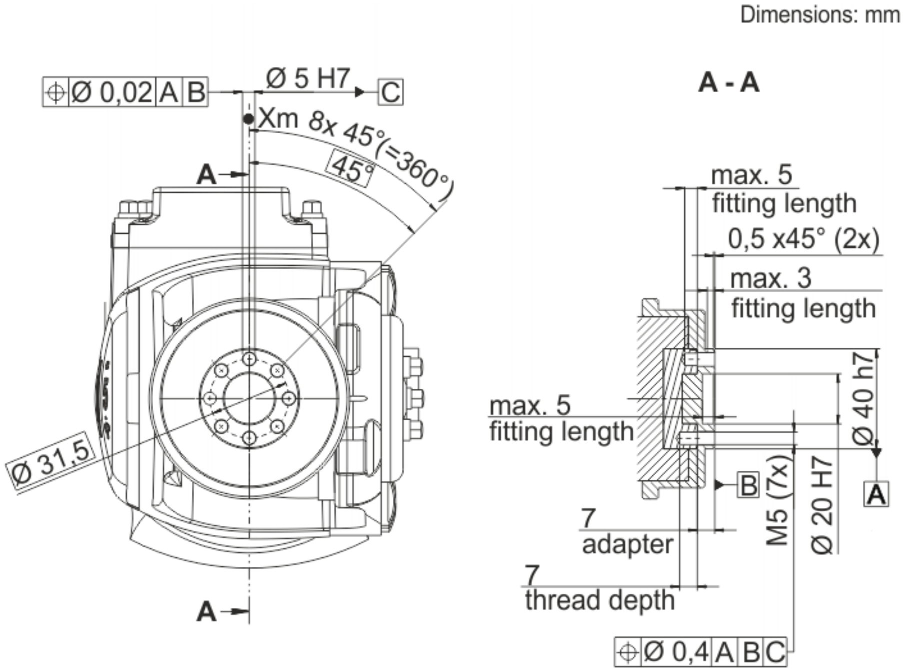


Fig. 4-97: Mounting flange

Flange loads

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

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

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

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

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

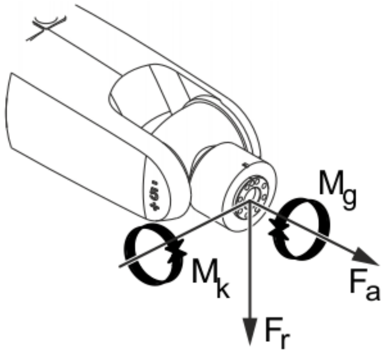


Fig. 4-98: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.12.4 Loads acting on the foundation, KR 10 R1100 sixx W-HM-SC

Foundation loads

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

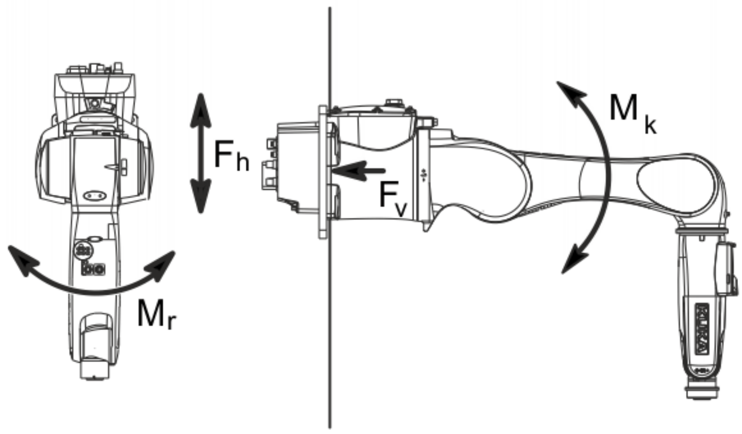


Fig. 4-99: Loads acting on the foundation, wall mounting

Vertical force F(v)	
F(v normal)	415 N
F(v max)	775 N

Horizontal force F(h)	
F(h normal)	1125 N
F(h max)	1488 N
Tilting moment M(k)	
M(k normal)	742 Nm
M(k max)	1142 Nm
Torque about axis 1 M(r)	
M(r normal)	307 Nm
M(r max)	654 Nm

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

⚠ 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.

4.13 Technical data, KR 10 R1100 sixx C-HM-SC

4.13.1 Basic data, KR 10 R1100 sixx C-HM-SC

Basic data

Designation	KR 10 R1100 sixx C-HM-SC
Number of axes	6
Number of controlled axes	6
Volume of working envelope	5.14 m³
Pose repeatability (ISO 9283)	± 0.03 mm
Weight	approx. 64 kg
Rated payload	5 kg
Maximum total load	10 kg
Maximum reach	1101 mm
Protection rating (IEC 60529)	IP65 / IP67
Protection rating, in-line wrist (IEC 60529)	IP65 / IP67
Sound level	< 70 dB (A)
Mounting position	Ceiling
Footprint	320 mm x 320 mm
Hole pattern: mounting surface for kinematic system	C246
Permissible angle of inclination	-
Default color	Base frame: traffic white (RAL 9016); Moving parts: traffic white (RAL 9016)

Designation	KR 10 R1100 sixx C-HM-SC
Controller	KR C4 smallsize-2; KR C4 compact
Transformation name	KR C4: KR10R1100 HM C4SR 400

Overpressure in the robot	0.03 MPa (0.3 bar)
Compressed air	Oil-free, dry, filtered in accordance with: ISO 8573.1-1, 1.2 to 16.2
Air consumption	0.1 m^3/h
Air line connection	Plug-in connection for hose, standard outside diameter 6 mm

Ambient conditions

Humidity class (EN 60204)	-
Classification of environmental conditions (EN 60721-3-3)	3B2; 3Z10
Ambient temperature	
During operation	0 °C to 35 °C (273 K to 308 K)
During storage/transportation	-40 °C to 60 °C (233 K to 333 K)

If the hygiene risk assessment is performed in accordance with EN ISO 14159, it is to be assumed that the manipulator conforms to the criteria of hygiene level 1.

The manipulator may not be used under the following ambient conditions:

- High-pressure component washing systems
- Continuous submersion
- Acidic or alkaline environments
- Vacuum applications

NOTICE If the manipulator is exposed to high-velocity fluids, particles and/or compressed air, it must be protected against direct exposure to these.

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
Data cable CAT5 (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor, equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

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

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

4.13.2 Axis data, KR 10 R1100 sixx C-HM-SC

Axis data

Motion range	
A1	±166 °
A2	-188 ° / 45 °
A3	-116 ° / 153 °
A4	±185 °
A5	±110 °
A6	±350 °
Speed with rated payload	
A1	300 °/s
A2	225 °/s
A3	225 °/s
A4	381 °/s
A5	262 °/s
A6	414 °/s

The direction of motion and the arrangement of the individual axes may be noted from the diagram (>>> Fig. 4-100).

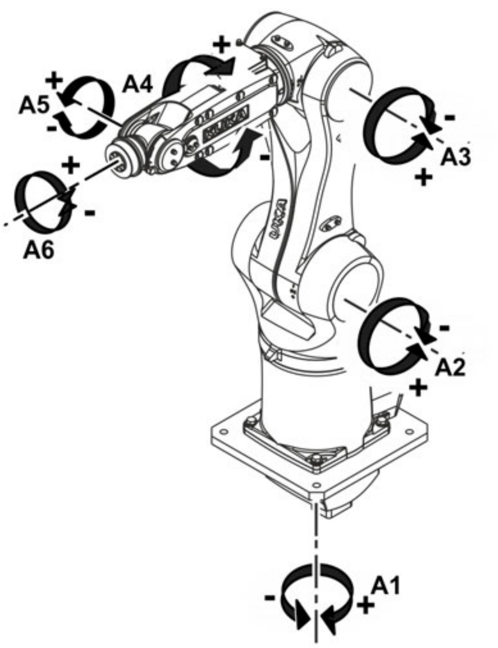


Fig. 4-100: Direction of rotation of robot axes

Mastering position

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

A5	0 °
A6	0 °

Working envelope

The following diagrams (>>> Fig. 4-101) and (>>> Fig. 4-102) show the load center of gravity and the shape and size of the working envelope.

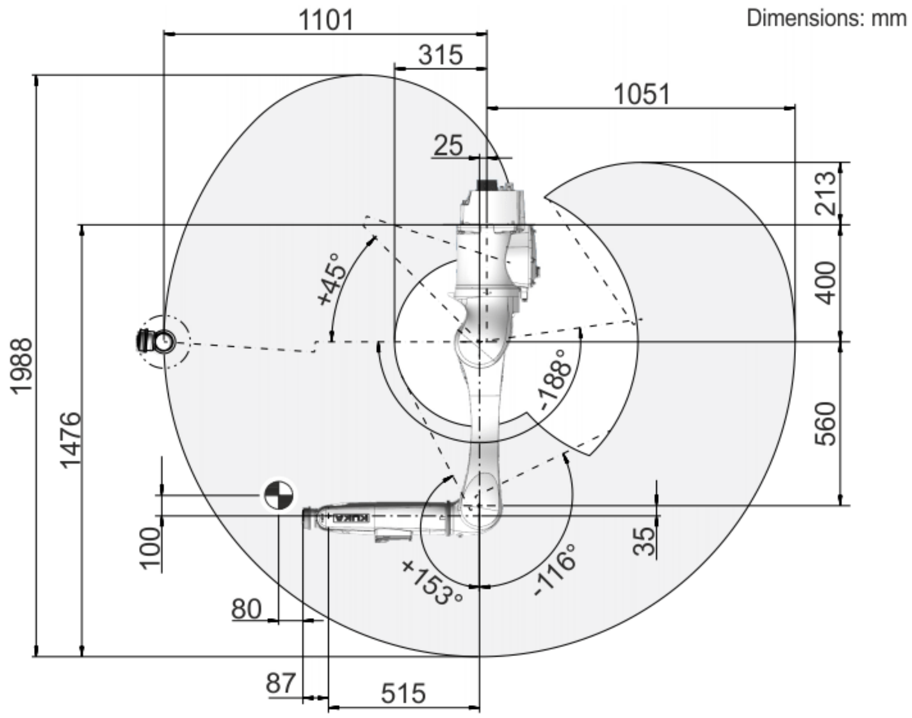


Fig. 4-101: KR 10 R1100 sixx C-HM-SC, working envelope, side view

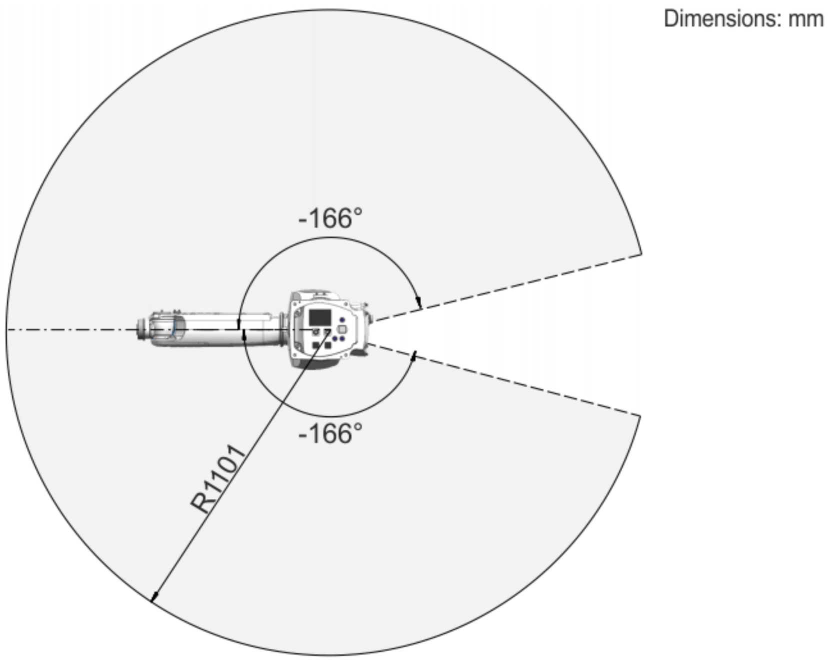


Fig. 4-102: KR 10 R1100 sixx C-HM-SC, working envelope, top view

Distance to flange

The distance to the flange varies according to the position of the robot (>>> Fig. 4-103).

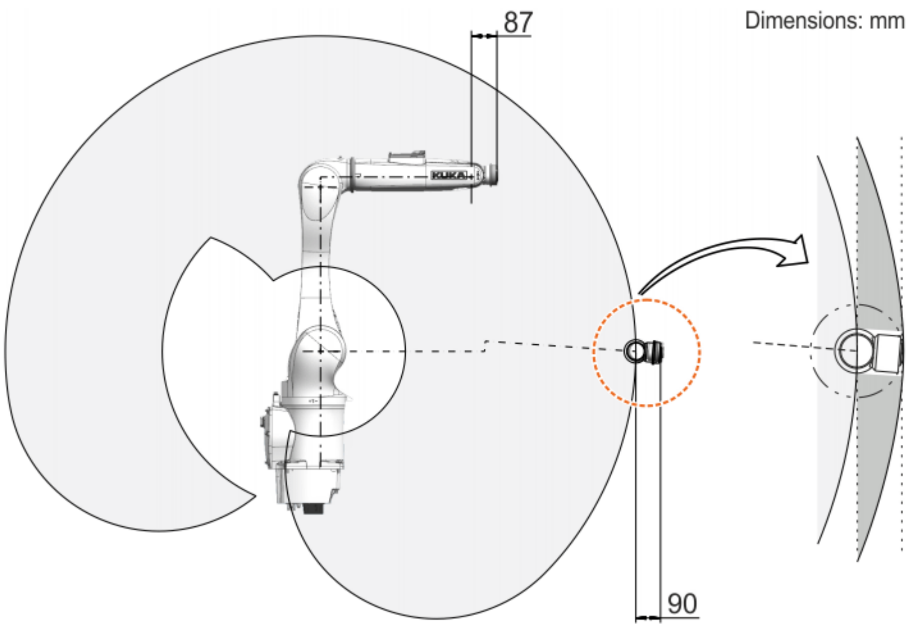


Fig. 4-103: Distance to flange, KR 10 R1100 sixx HM-SC (with W and C variants)

4.13.3 Payloads, KR 10 R1100 sixx C-HM-SC

Payloads

Rated payload	5 kg
Maximum payload	10 kg
Rated mass moment of inertia	0.045 kgm²
Rated supplementary load, base frame	0 kg
Maximum supplementary load, base frame	-
Rated supplementary load, rotating column	0 kg
Maximum supplementary load, rotating column	-
Rated supplementary load, link arm	0 kg
Maximum supplementary load, link arm	-
Rated supplementary load, arm	0 kg
Maximum supplementary load, arm	-
Maximum total load	10 kg
Nominal distance to load center of gravity	
Lxy	100 mm
Lz	80 mm

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

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.

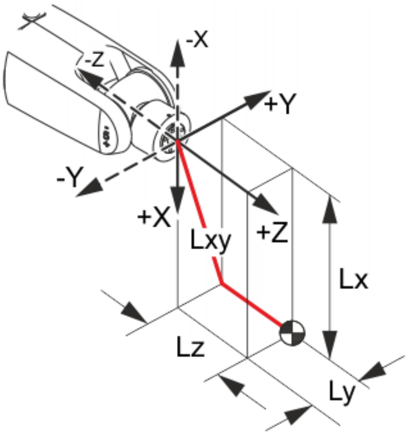


Fig. 4-104: Load center of gravity

Payload diagram

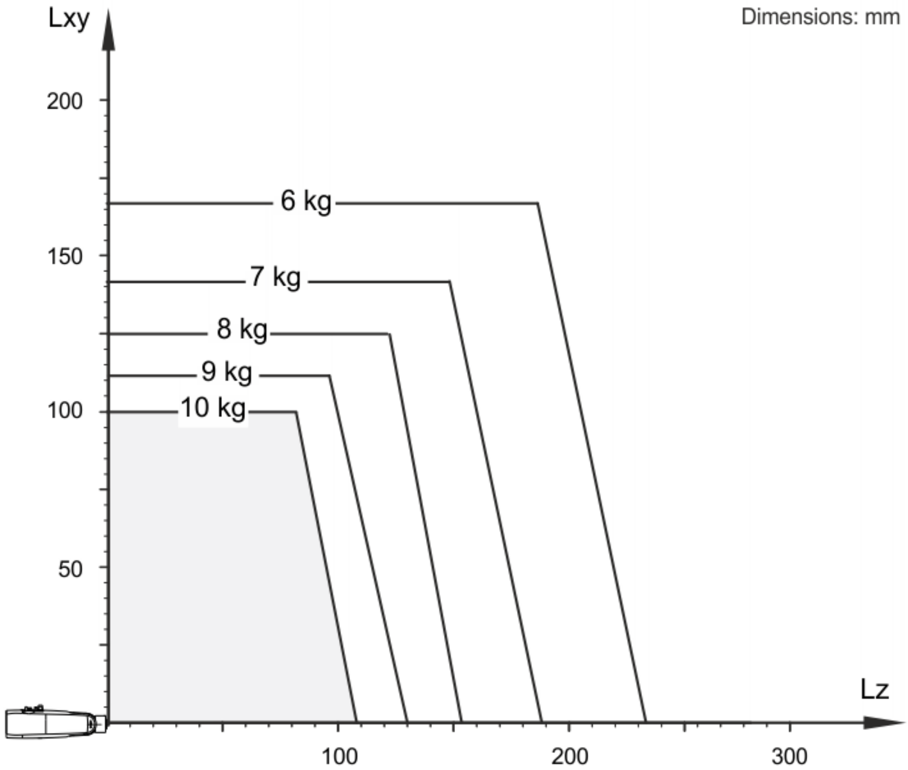


Fig. 4-105: KR 10 R1100 sixx C-HM-SC, payload diagram

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

Mounting flange

In-line wrist type	ZH 10 R1100 HM
Mounting flange	see drawing

Mounting flange (hole circle)	31.5 mm
Screw grade	A4-80
Screw size	M5
Number of fastening screws	7
Clamping length	min. 1.5 x nominal diameter
Depth of engagement	min. 5.5 mm, max. 7 mm
Locating element	5 H7
Standard	See diagram. (>>> Fig. 4-106)

The mounting flange is depicted with axis 6 in the zero position (>>> Fig. 4-106) The symbol X_m indicates the position of the locating element in the zero position.

When planning the tool fastening, it must be ensured that the positioning is carried out in the mounting flange. The adapter offers no possibility for positioning.

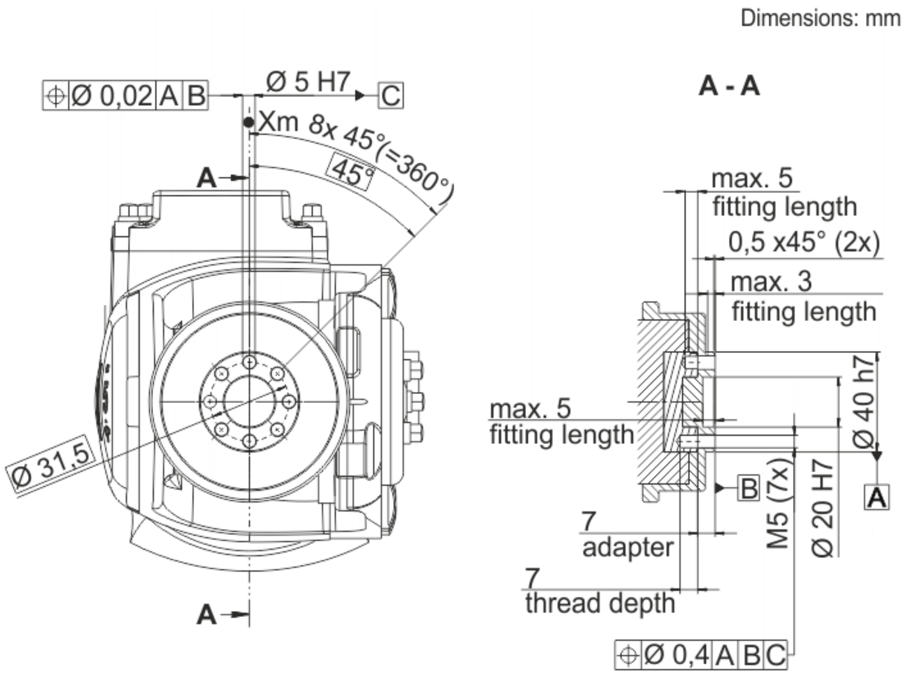


Fig. 4-106: Mounting flange

Flange loads

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

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

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

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

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

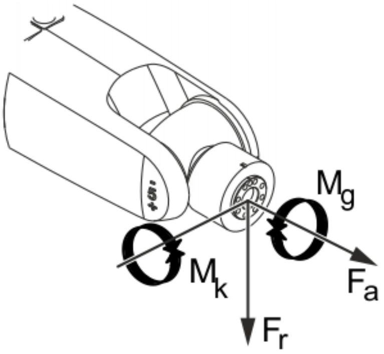


Fig. 4-107: Flange loads

Flange loads during operation	
F(a)	187 N
F(r)	318 N
M(k)	29 Nm
M(g)	25 Nm
Flange loads in the case of EMERGENCY STOP	
F(a)	412 N
F(r)	524 N
M(k)	65 Nm
M(g)	51 Nm

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

4.13.4 Loads acting on the foundation, KR 10 R1100 sixx C-HM-SC

Foundation loads

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

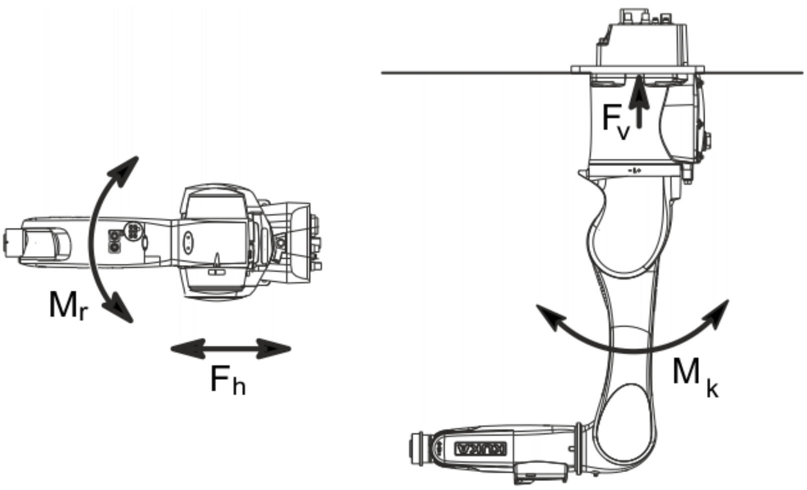


Fig. 4-108: Loads acting on the foundation, ceiling mounting

Vertical force F(v)	
F(v normal)	1015 N
F(v max)	1258 N

Horizontal force F(h)	
F(h normal)	622 N
F(h max)	1013 N
Tilting moment M(k)	
M(k normal)	582 Nm
M(k max)	953 Nm
Torque about axis 1 M(r)	
M(r normal)	358 Nm
M(r max)	776 Nm

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

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.

4.14 Supplementary load

The robot can carry supplementary loads on the arm, on the in-line wrist, on the link arm and on the rotating column. The fastening holes on the arm, link arm and rotating column are used for fastening the covers or external energy supply systems. Parts of the energy supply system (e.g. holders for compressed air hose) are fastened to the in-line wrist using the fastening holes. When mounting the supplementary loads, be careful to observe the maximum permissible total load. The dimensions and positions of the installation options can be seen in the following diagram.

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

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

Robot	Description
■ KR 6 R700 sixx HM-SC ■ KR 6 R700 sixx W-HM-SC ■ KR 6 R700 sixx C-HM-SC	(>>> 4.14.1 "Supplementary load, reach R700" Page 118)

Robot	Description
■ KR 6 R900 sixx HM-SC ■ KR 6 R900 sixx W-HM-SC ■ KR 6 R900 sixx C-HM-SC ■ KR 10 R900 sixx HM-SC ■ KR 10 R900 sixx W-HM-SC ■ KR 10 R900 sixx C-HM-SC	(>>> 4.14.2 "Supplementary load, reach R900" Page 119)
■ KR 10 R1100 sixx HM-SC ■ KR 10 R1100 sixx W-HM-SC ■ KR 10 R1100 sixx C-HM-SC	(>>> 4.14.3 "Supplementary load, reach R1100" Page 120)

4.14.1 Supplementary load, reach R700

The following diagrams (>>> Fig. 4-109) and (>>> Fig. 4-110) show the dimensions and position of the installation options on the arm, in-line wrist, link arm and rotating column.

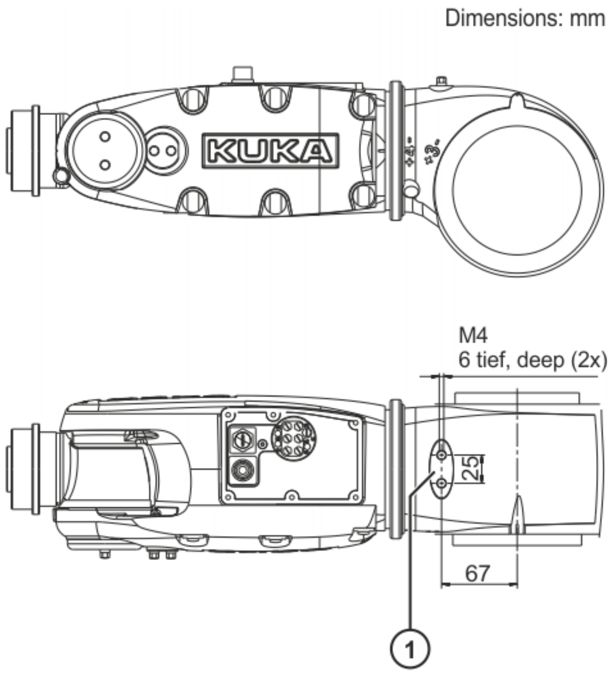


Fig. 4-109: Supplementary load on arm and in-line wrist

1 Support bracket for supplementary load

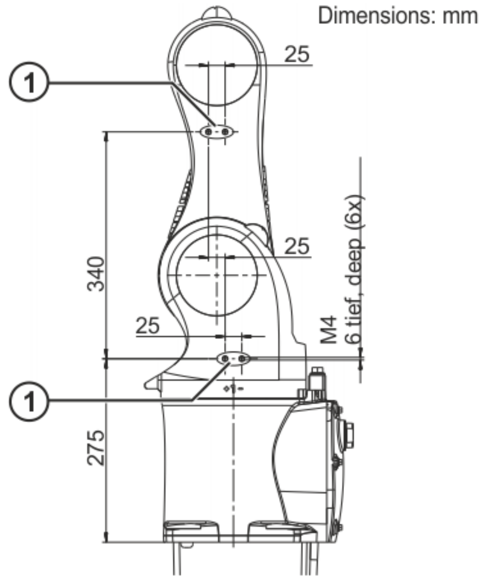


Fig. 4-110: Supplementary load on link arm and rotating column

1 Support bracket for supplementary load

4.14.2 Supplementary load, reach R900

The following diagrams (>>> Fig. 4-111) and (>>> Fig. 4-112) show the dimensions and position of the installation options on the arm, in-line wrist, link arm and rotating column.

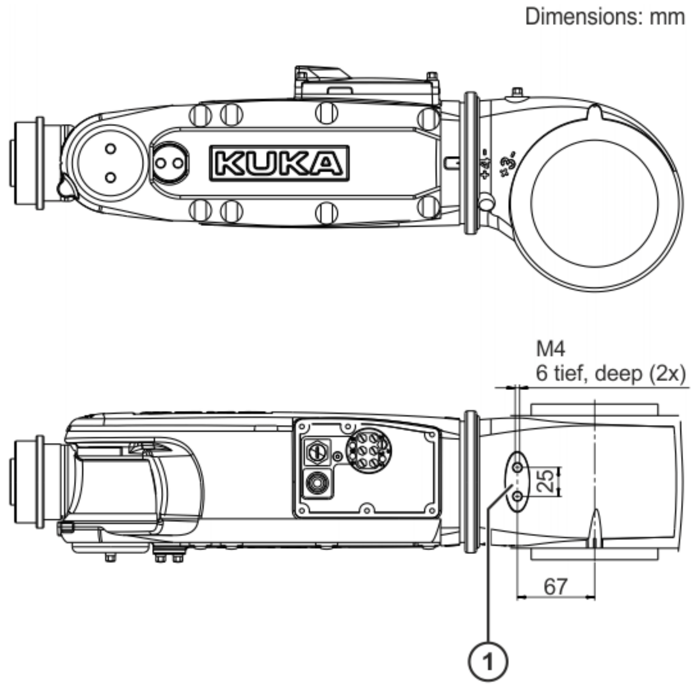


Fig. 4-111: Supplementary load on arm and in-line wrist

1 Support bracket for supplementary load

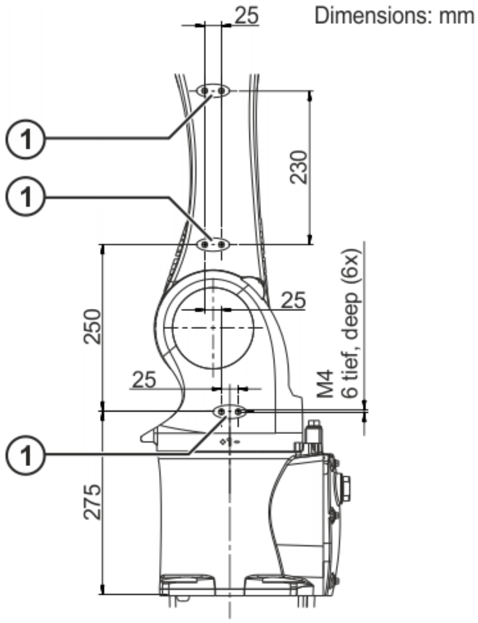


Fig. 4-112: Supplementary load on link arm and rotating column

1 Support bracket for supplementary load

4.14.3 Supplementary load, reach R1100

The following diagrams (>>> Fig. 4-113) and (>>> Fig. 4-114) show the dimensions and position of the installation options on the arm, in-line wrist, link arm and rotating column.

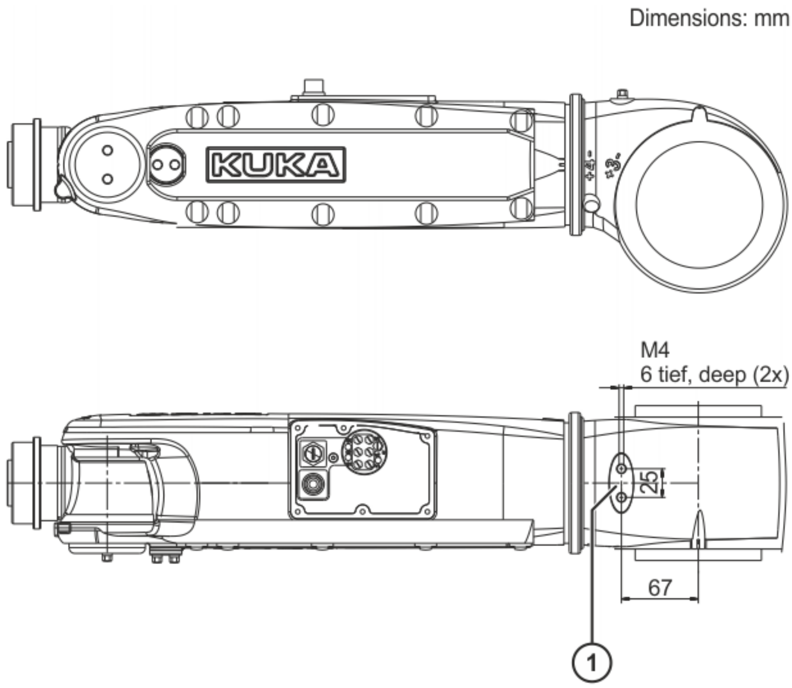


Fig. 4-113: Supplementary load on arm and in-line wrist

1 Support bracket for supplementary load

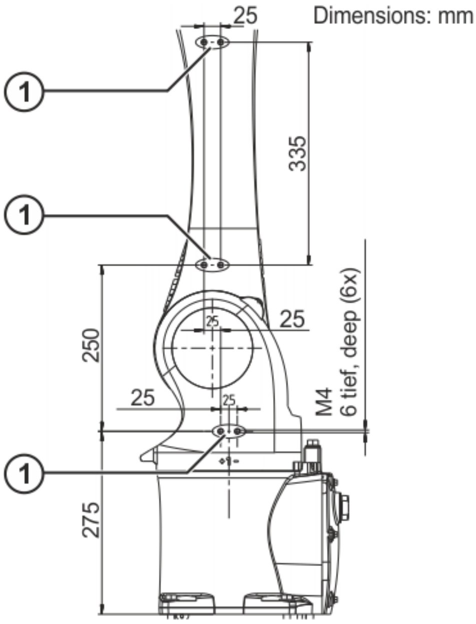


Fig. 4-114: Supplementary load on link arm and rotating column

1 Support bracket for supplementary load

4.15 Plates and labels

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

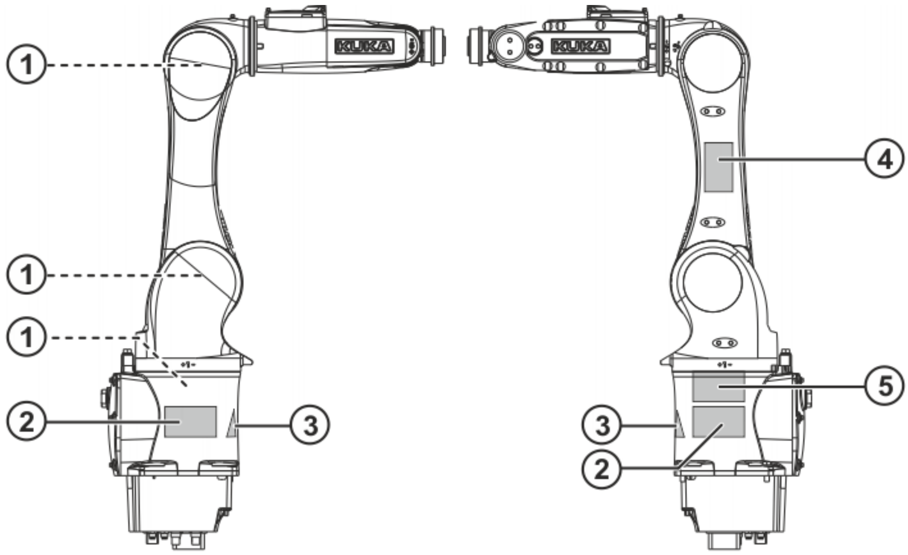
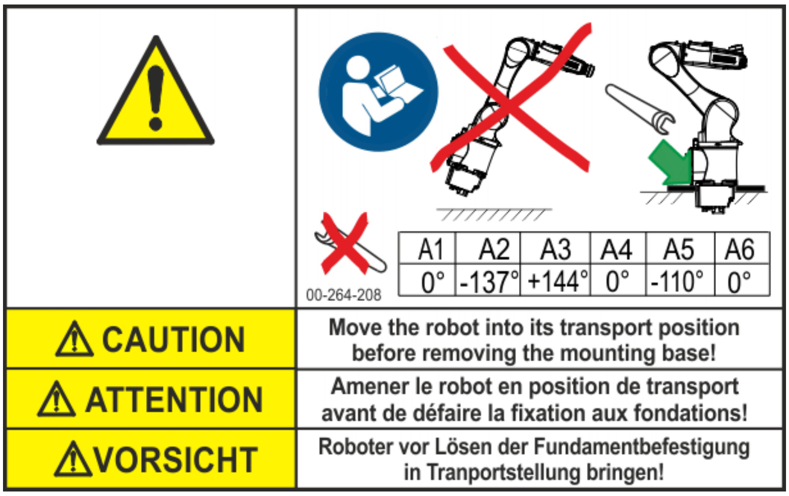
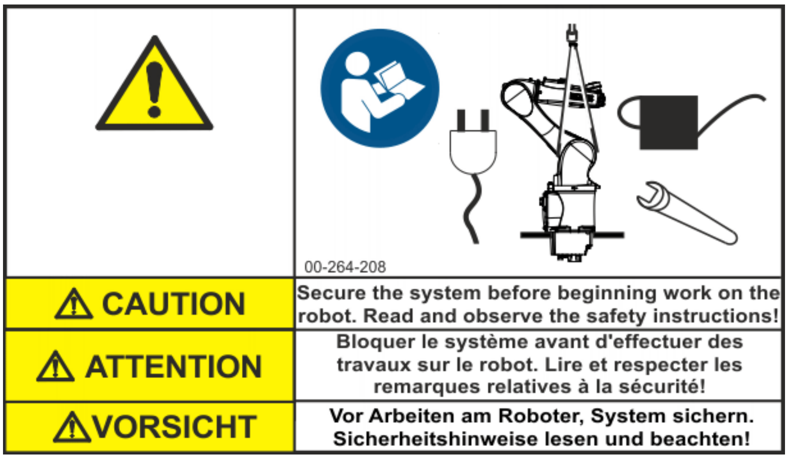
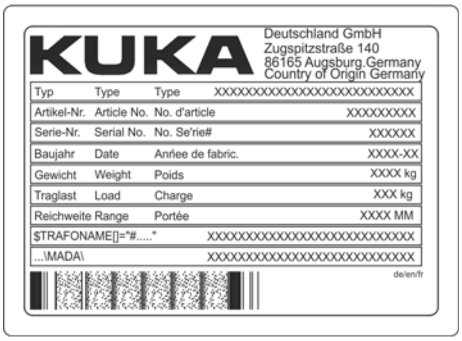


Fig. 4-115: Plates and labels

Item	Description
1	 **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!
2	 **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!
3	 **Danger zone** Entering the danger zone of the robot is prohibited if the robot is in operation or ready for operation. Risk of injury!

Item	Description
4	 **Work on the robot** Before start-up, transportation or maintenance, read and follow the assembly and operating instructions.
5	 **Identification plate** Content according to Machinery Directive.

4.16 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.

4.17 Stopping distances and times

4.17.1 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.

4.17.2 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. 4-116) between axis 1 and the intersection of axes 4 and 5. With parallelogram robots, the distance between axis 1 and the intersection of axis 6 and the mounting flange.
KCP	KUKA Control Panel Teach pendant for the KR C2/KR C2 edition2005 The KCP has all the operator control and display functions required for operating and programming the industrial robot.
smartPAD	Teach pendant for the KR C4 The smartPAD has all the operator control and display functions required for operating and programming the industrial robot.

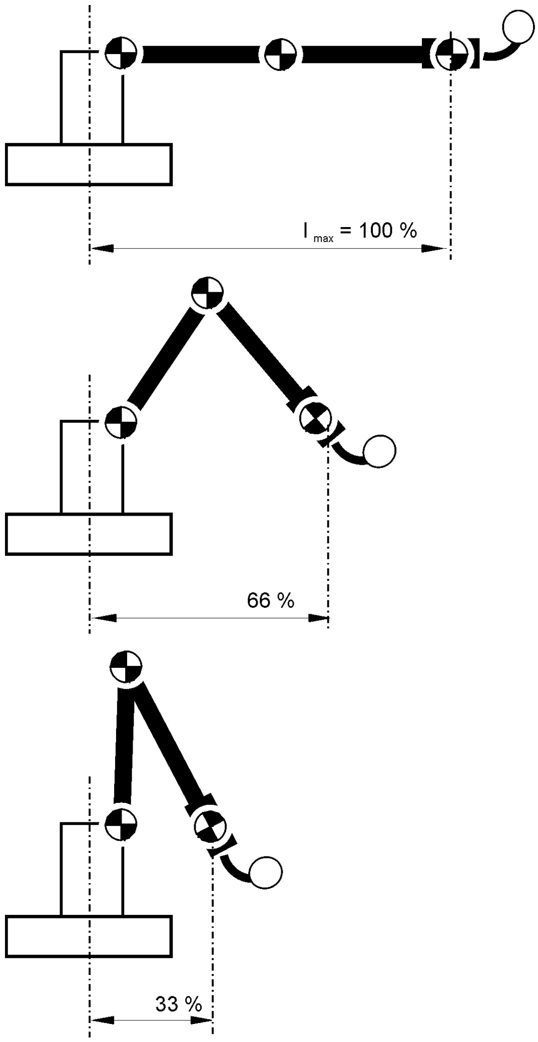


Fig. 4-116: Extension

4.17.3 Stopping distances and times KR 6 R700 sixx HM-SC and KR 6 R700 sixx C-HM-SC

The following values are valid for the following robot:

- KR 6 R700 sixx HM-SC
- KR 6 R700 sixx C-HM-SC

4.17.3.1 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	133.67	0.494
Axis 2	122.43	0.556
Axis 3	79.29	0.371

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

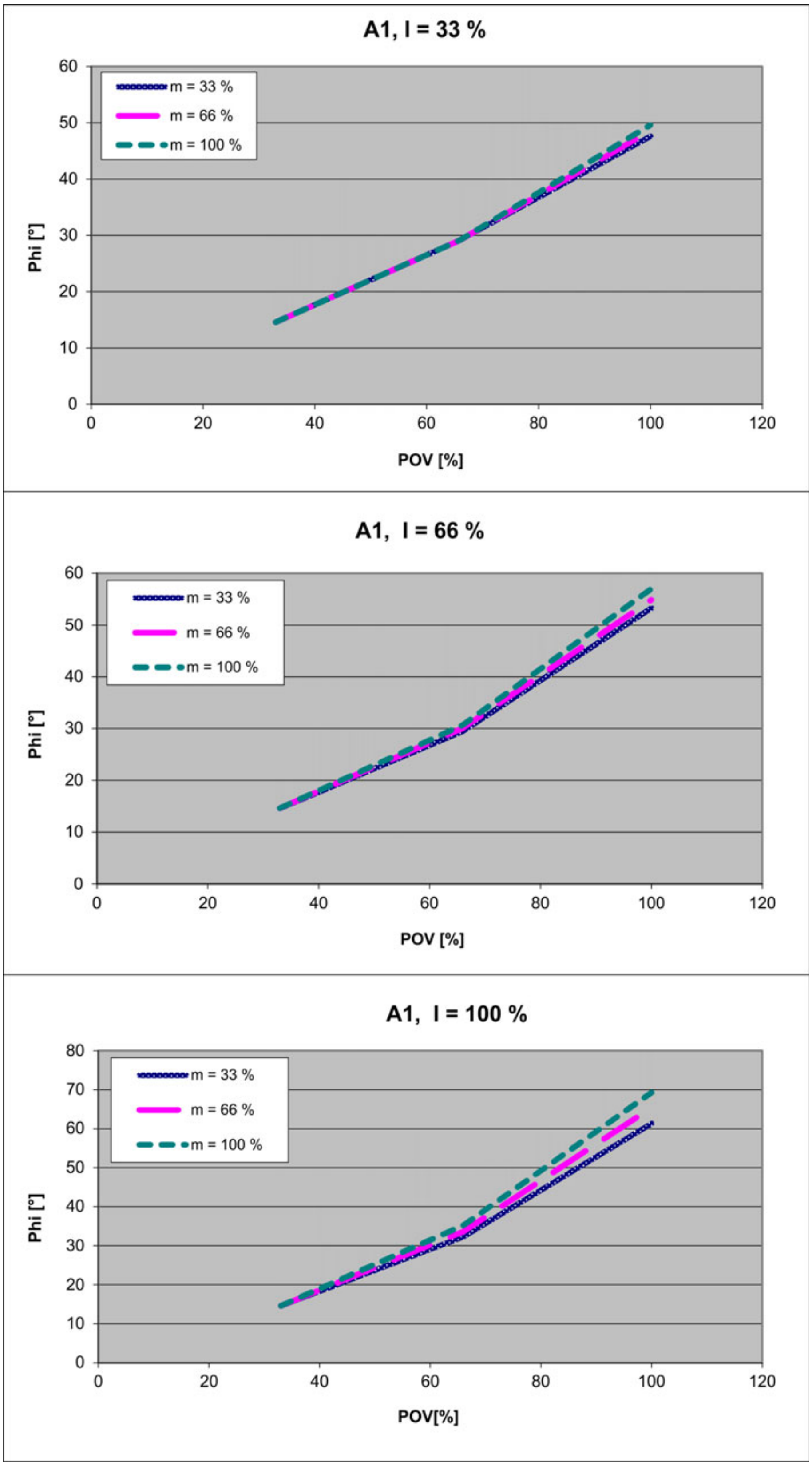


Fig. 4-117: Stopping distances for STOP 1, axis 1

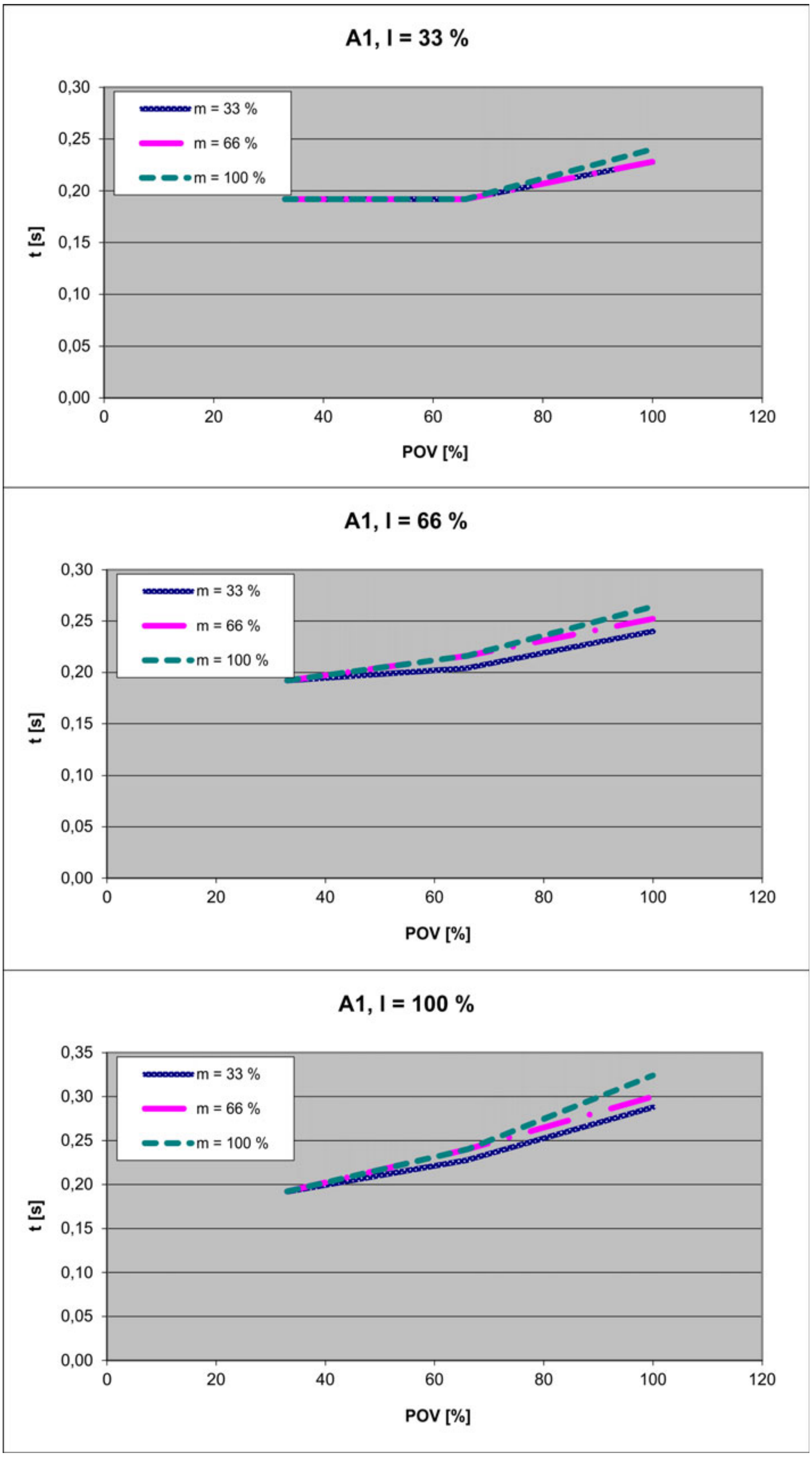


Fig. 4-118: Stopping times for STOP 1, axis 1

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

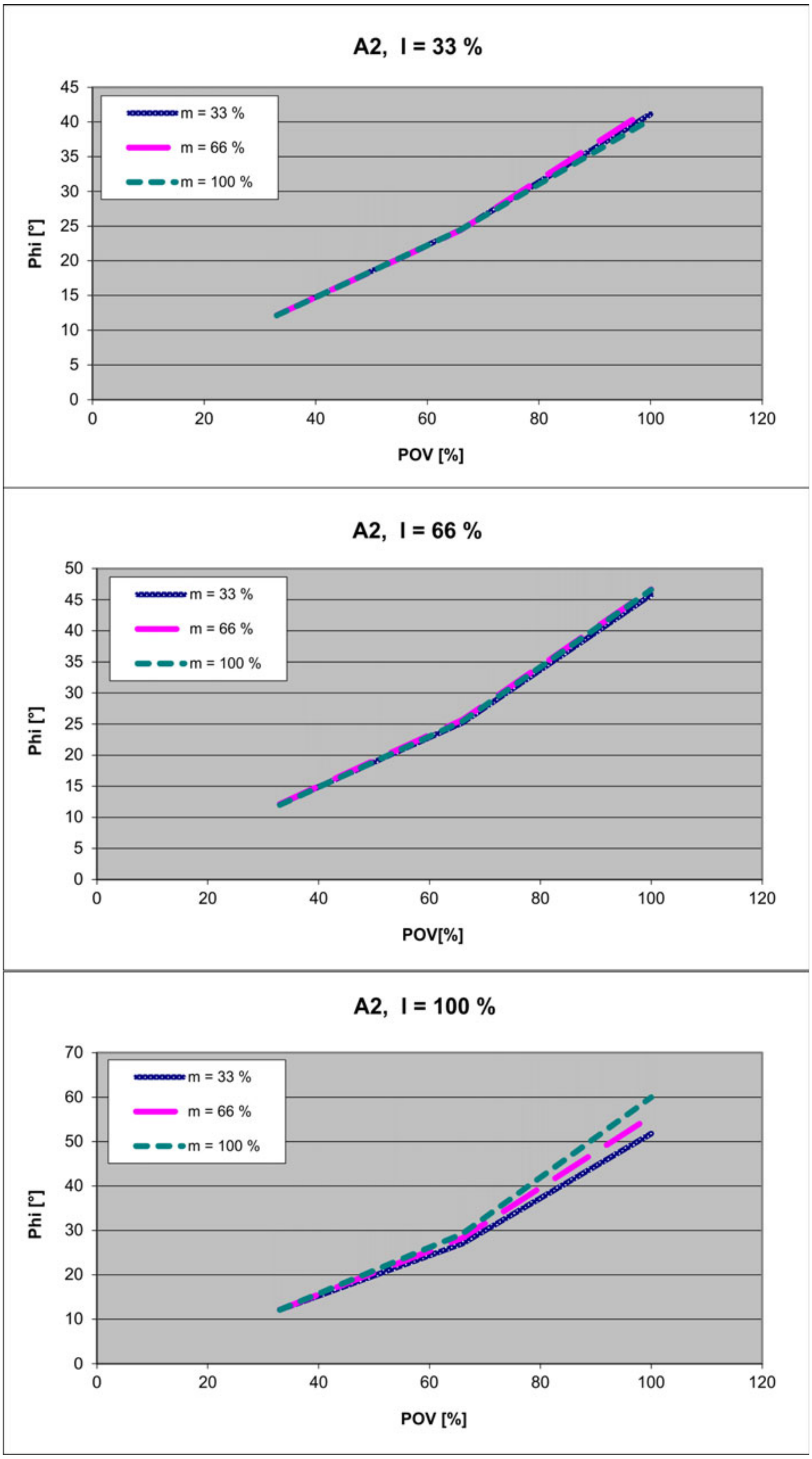


Fig. 4-119: Stopping distances for STOP 1, axis 2

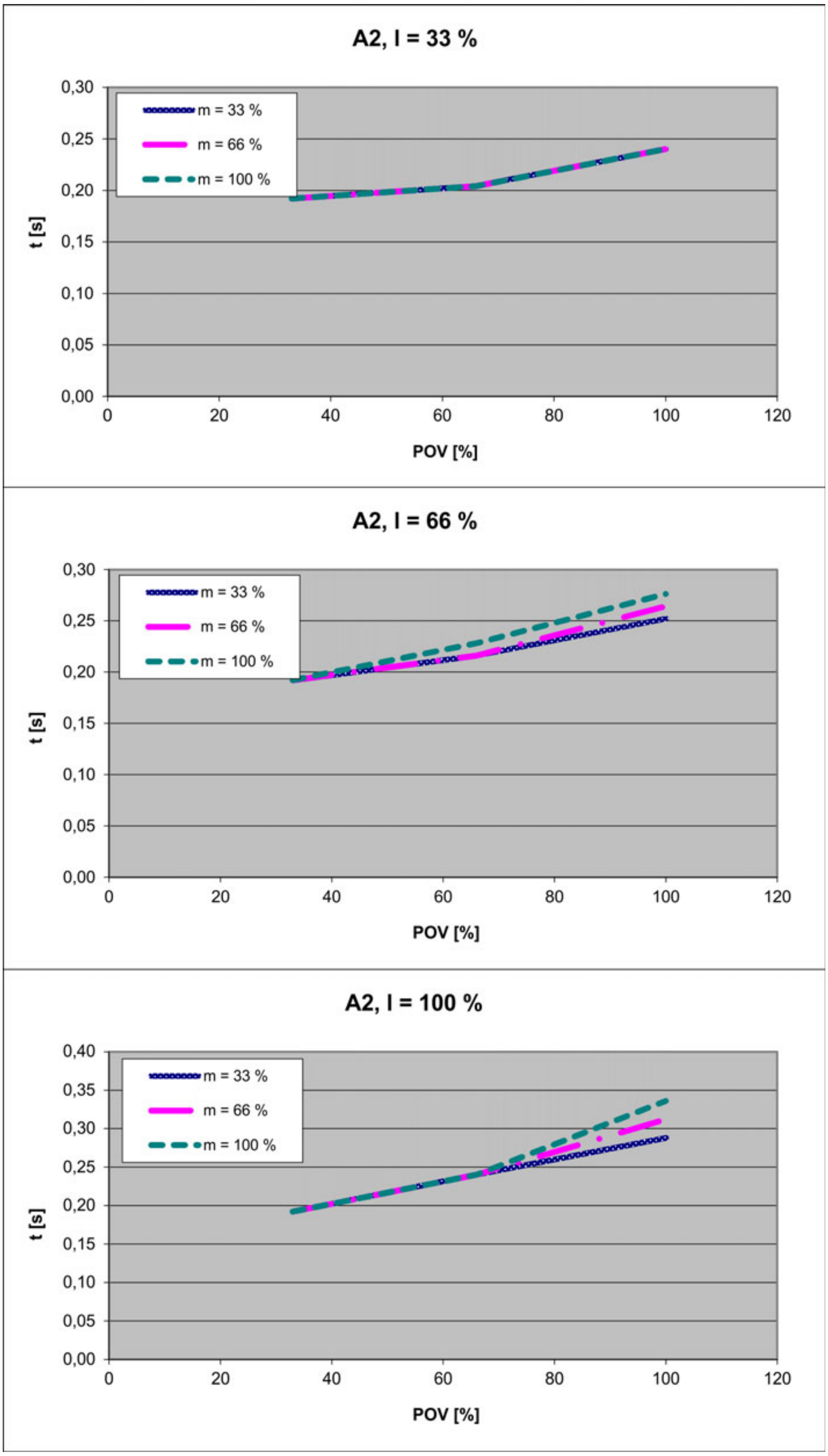


Fig. 4-120: Stopping times for STOP 1, axis 2

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

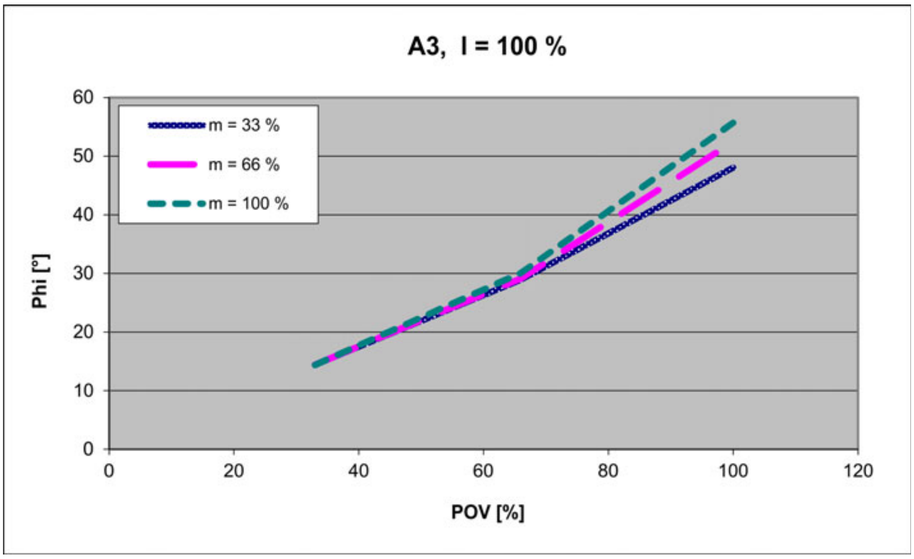


Fig. 4-121: Stopping distances for STOP 1, axis 3

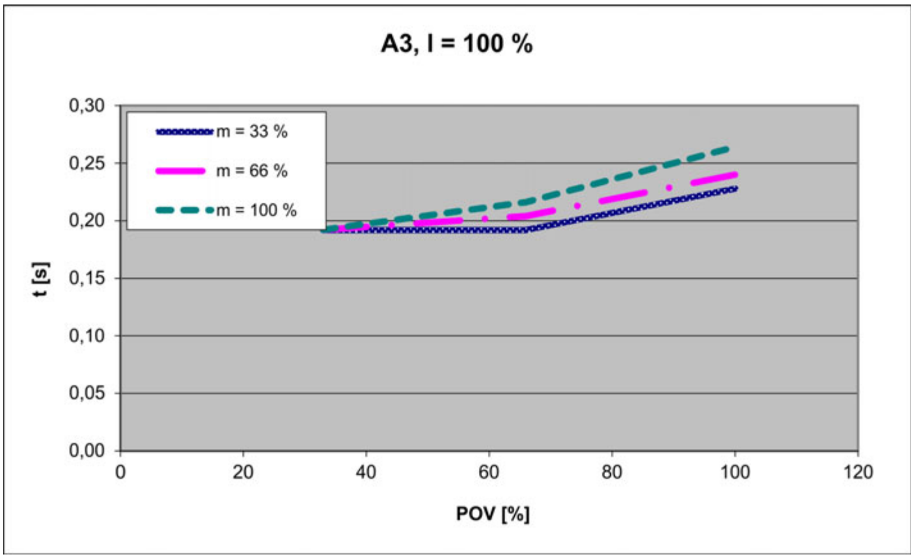


Fig. 4-122: Stopping times for STOP 1, axis 3

4.17.4 Stopping distances and times, KR 6 R700 sixx W-HM-SC

The following values are valid for the following robot:

- KR 6 R700 sixx W-HM-SC

4.17.4.1 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	182.04	0.665
Axis 2	68.31	0.377
Axis 3	63.48	0.379

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

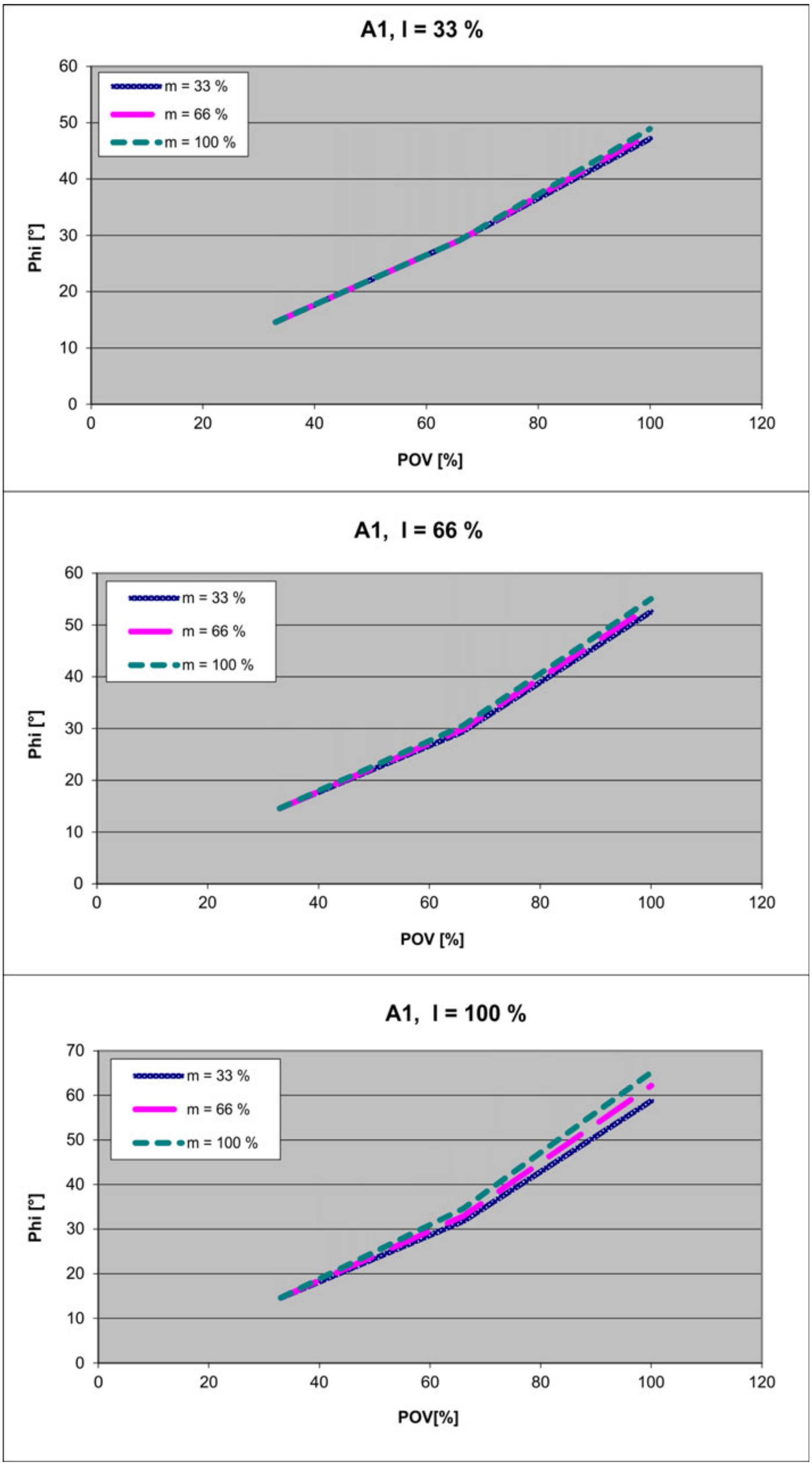


Fig. 4-123: Stopping distances for STOP 1, axis 1

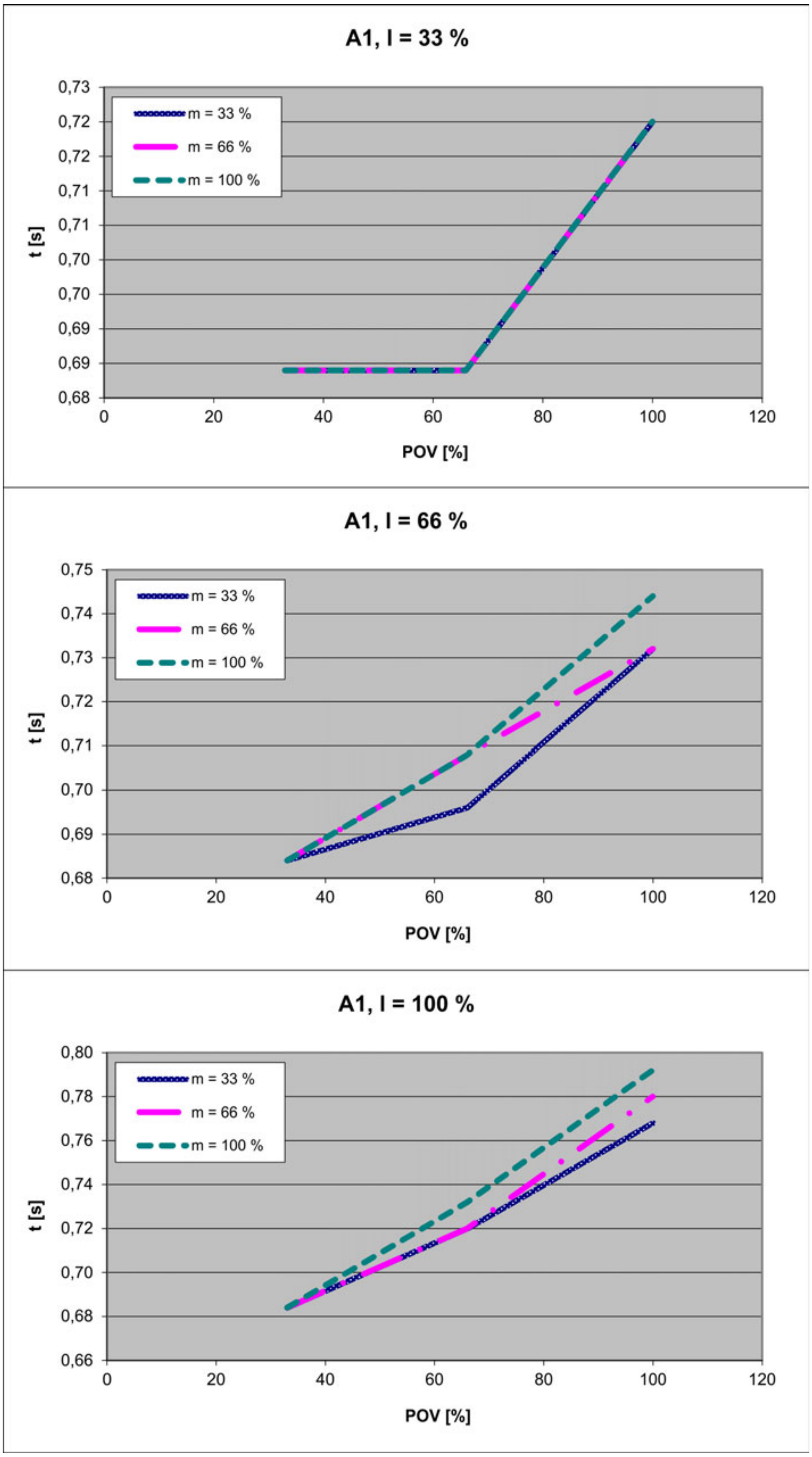


Fig. 4-124: Stopping times for STOP 1, axis 1

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

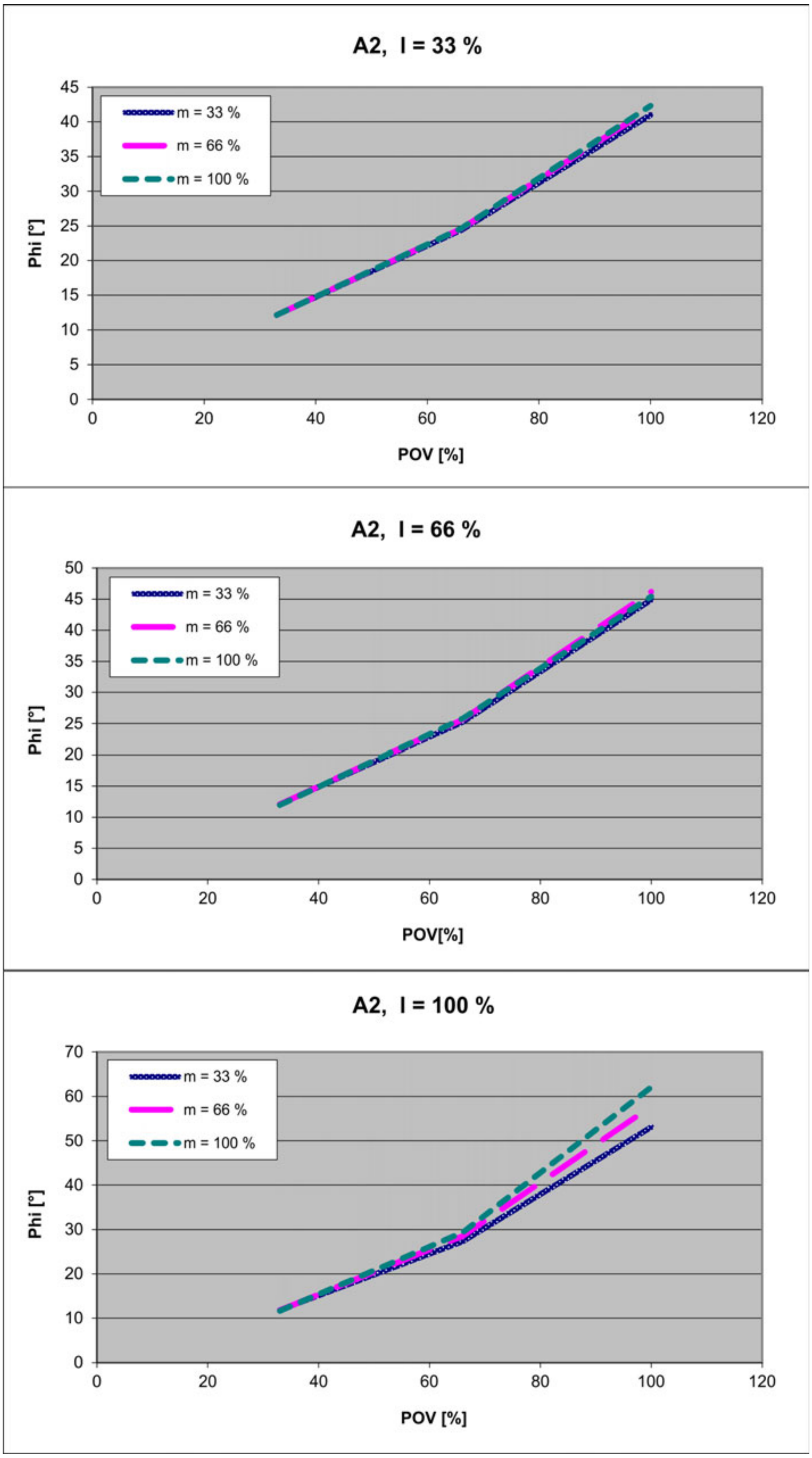


Fig. 4-125: Stopping distances for STOP 1, axis 1

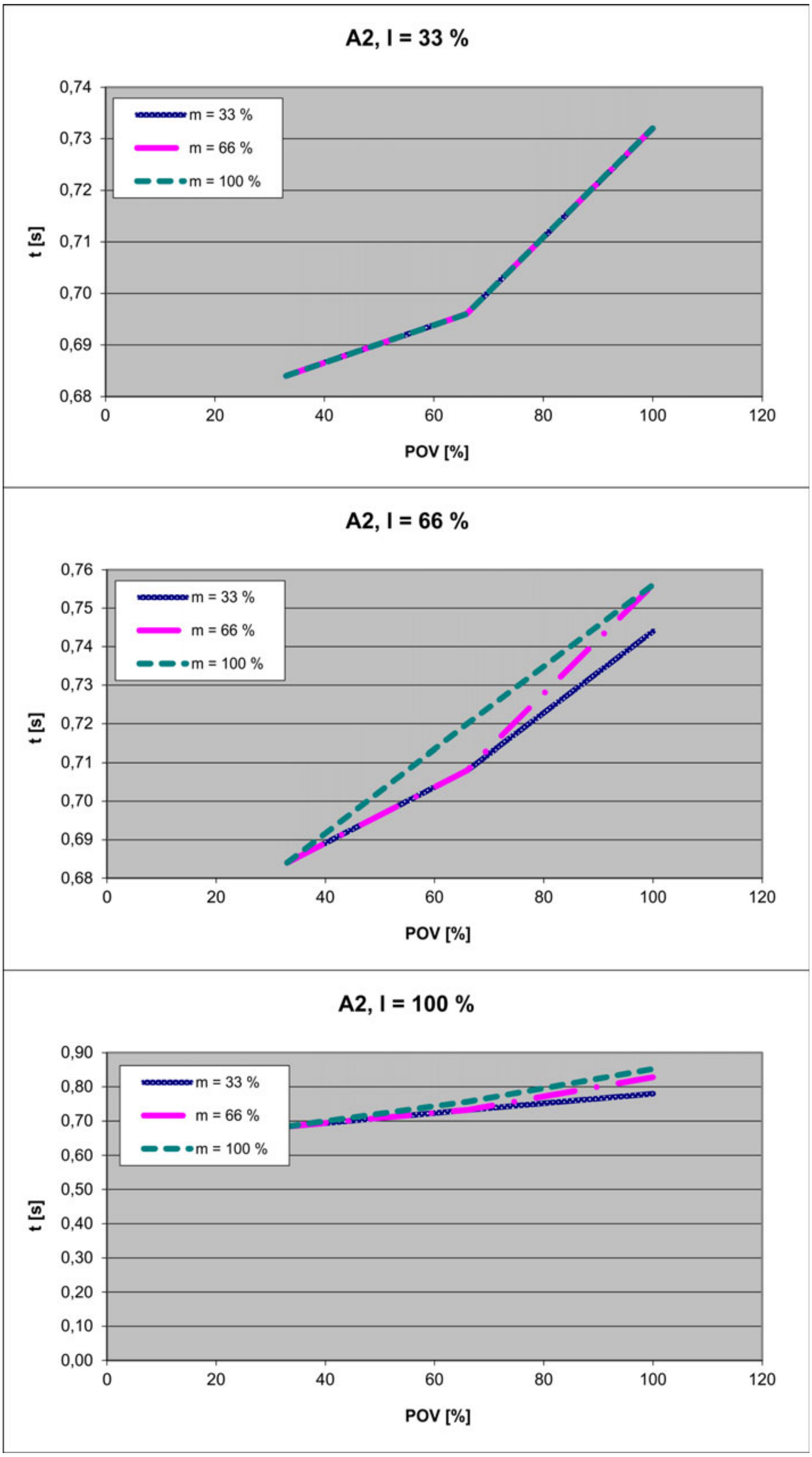


Fig. 4-126: Stopping times for STOP 1, axis 1

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

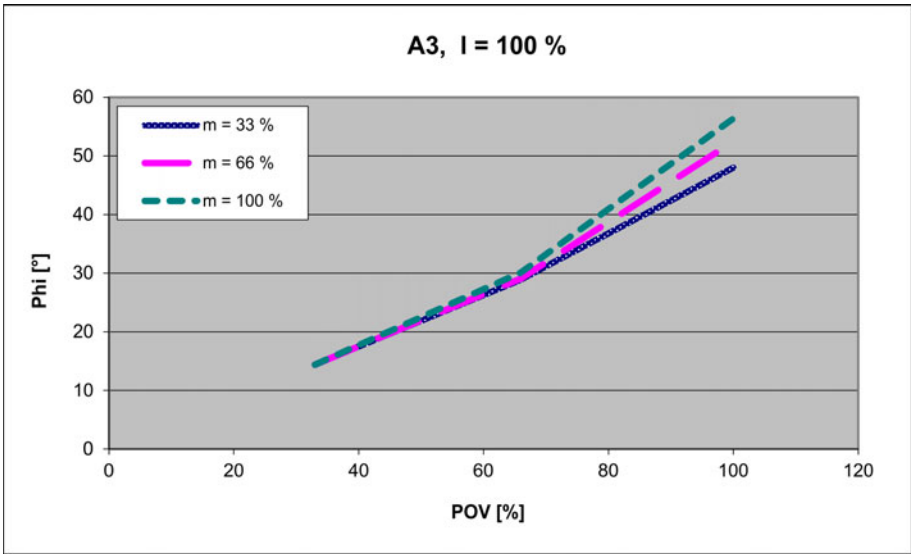


Fig. 4-127: Stopping distances for STOP 1, axis 1

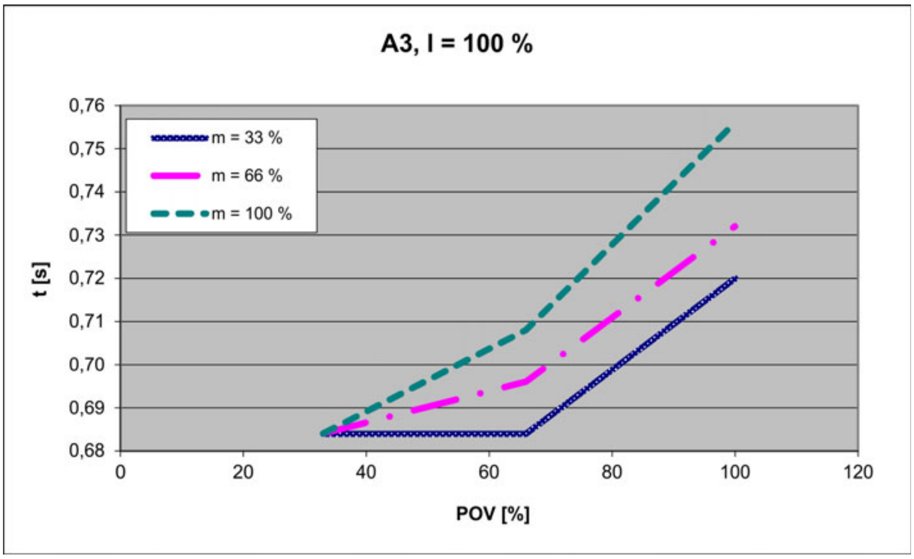


Fig. 4-128: Stopping times for STOP 1, axis 1

4.17.5 Stopping distances and times KR 6 R900 sixx HM-SC and KR 6 R900 sixx C-HM-SC

The following values are valid for the following robot:

- KR 6 R900 sixx HM-SC
- KR 6 R900 sixx C-HM-SC

4.17.5.1 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	113.59	0.507
Axis 2	126.76	0.684
Axis 3	68.10	0.370

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

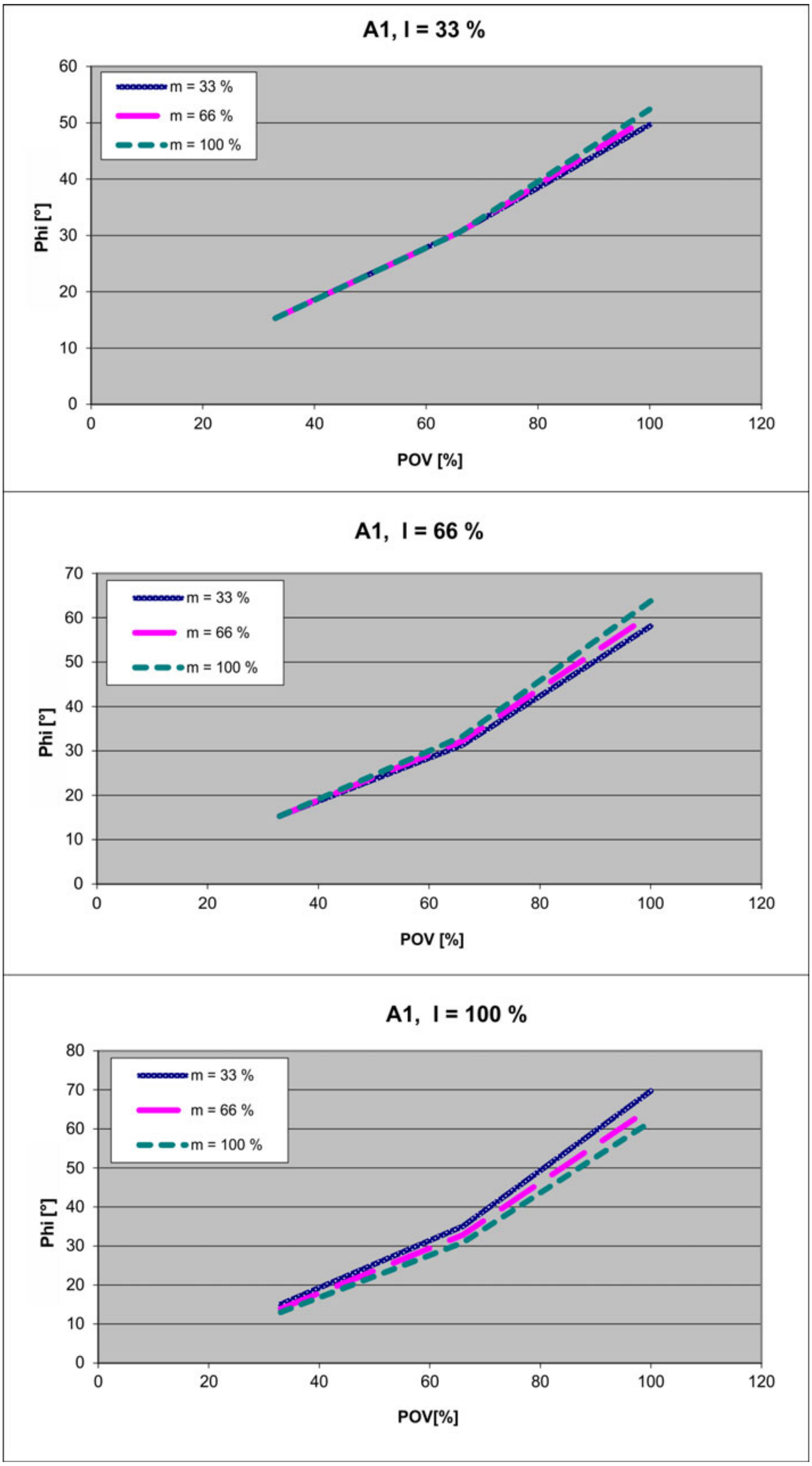


Fig. 4-129: Stopping distances for STOP 1, axis 1

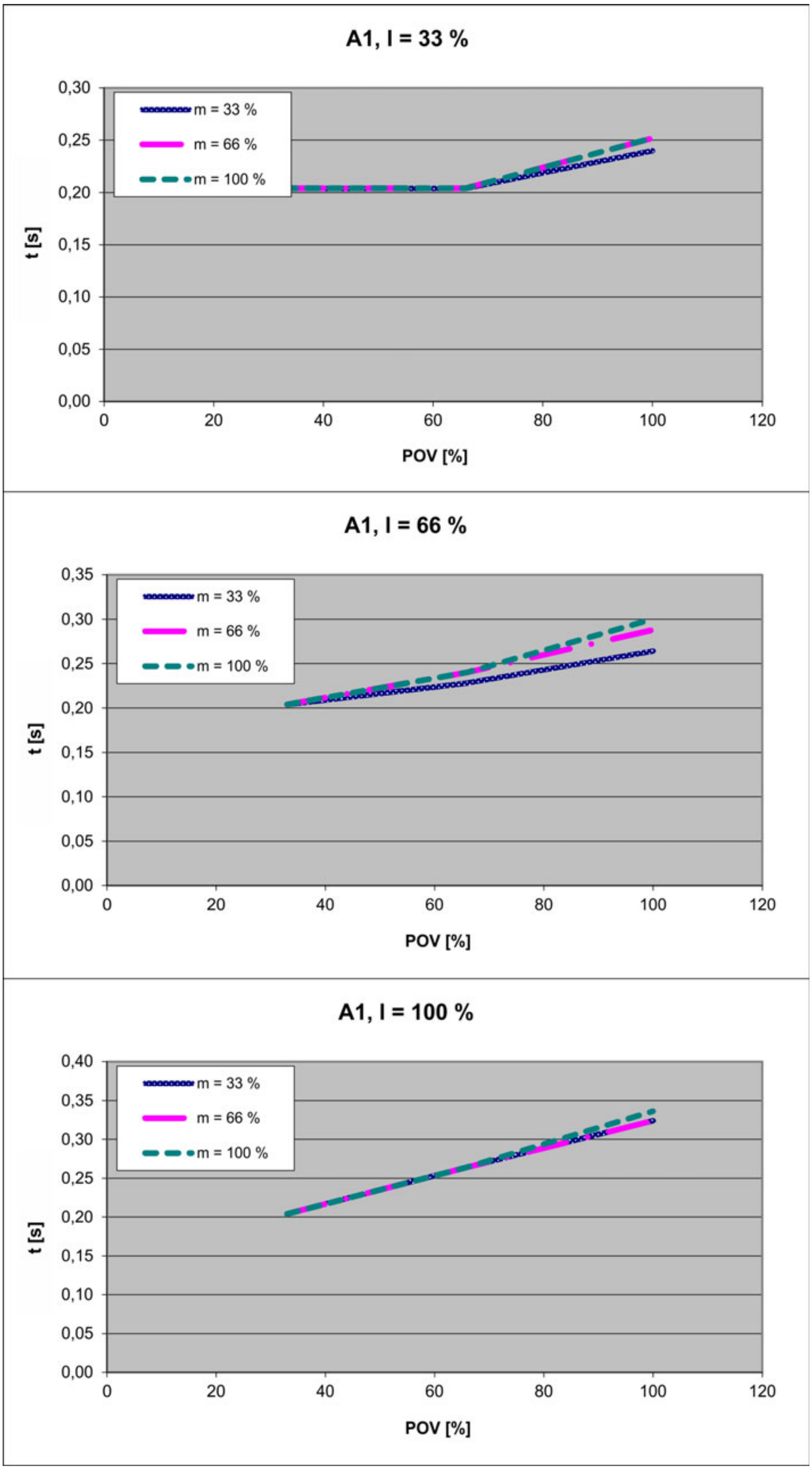


Fig. 4-130: Stopping times for STOP 1, axis 1

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

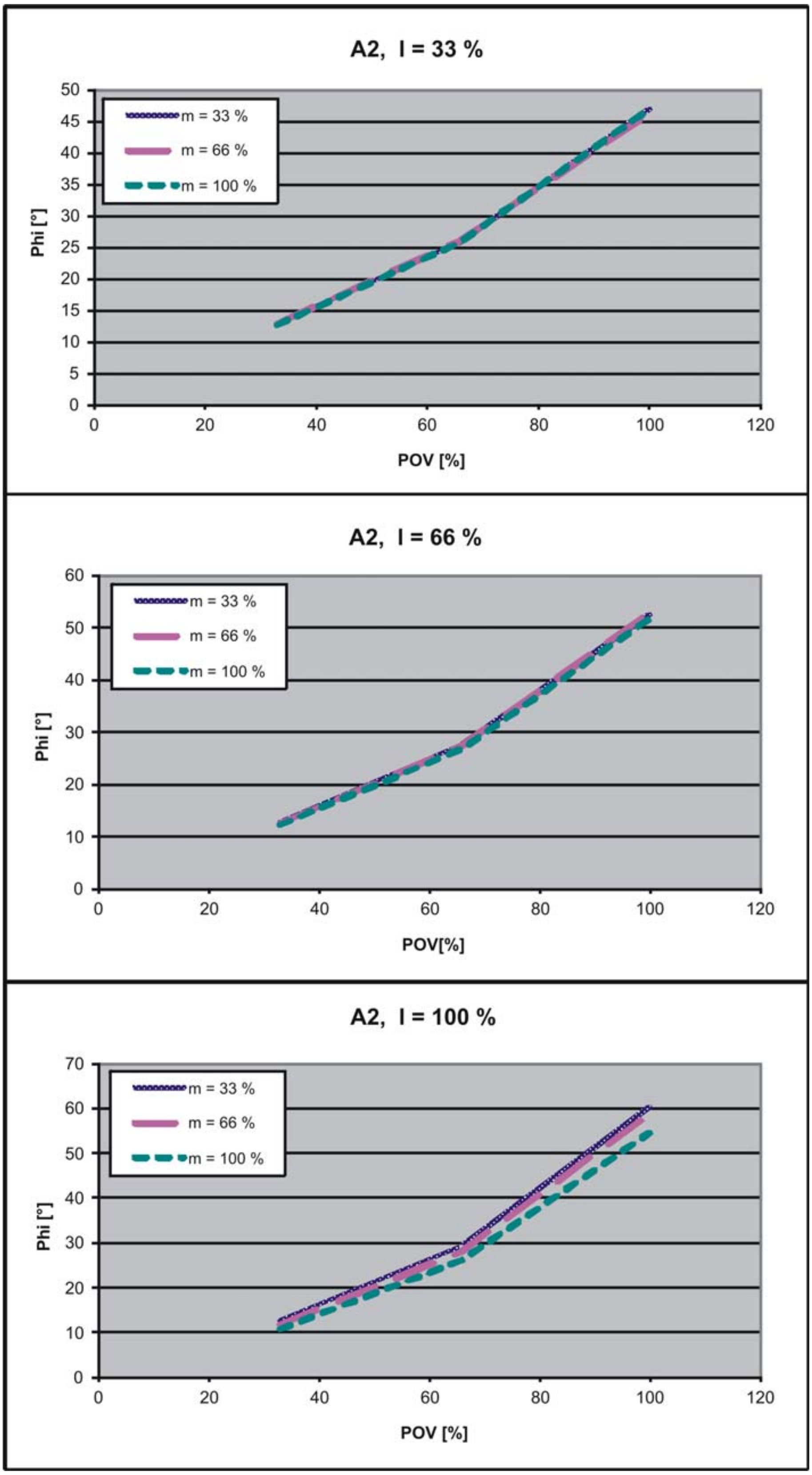


Fig. 4-131: Stopping distances for STOP 1, axis 2

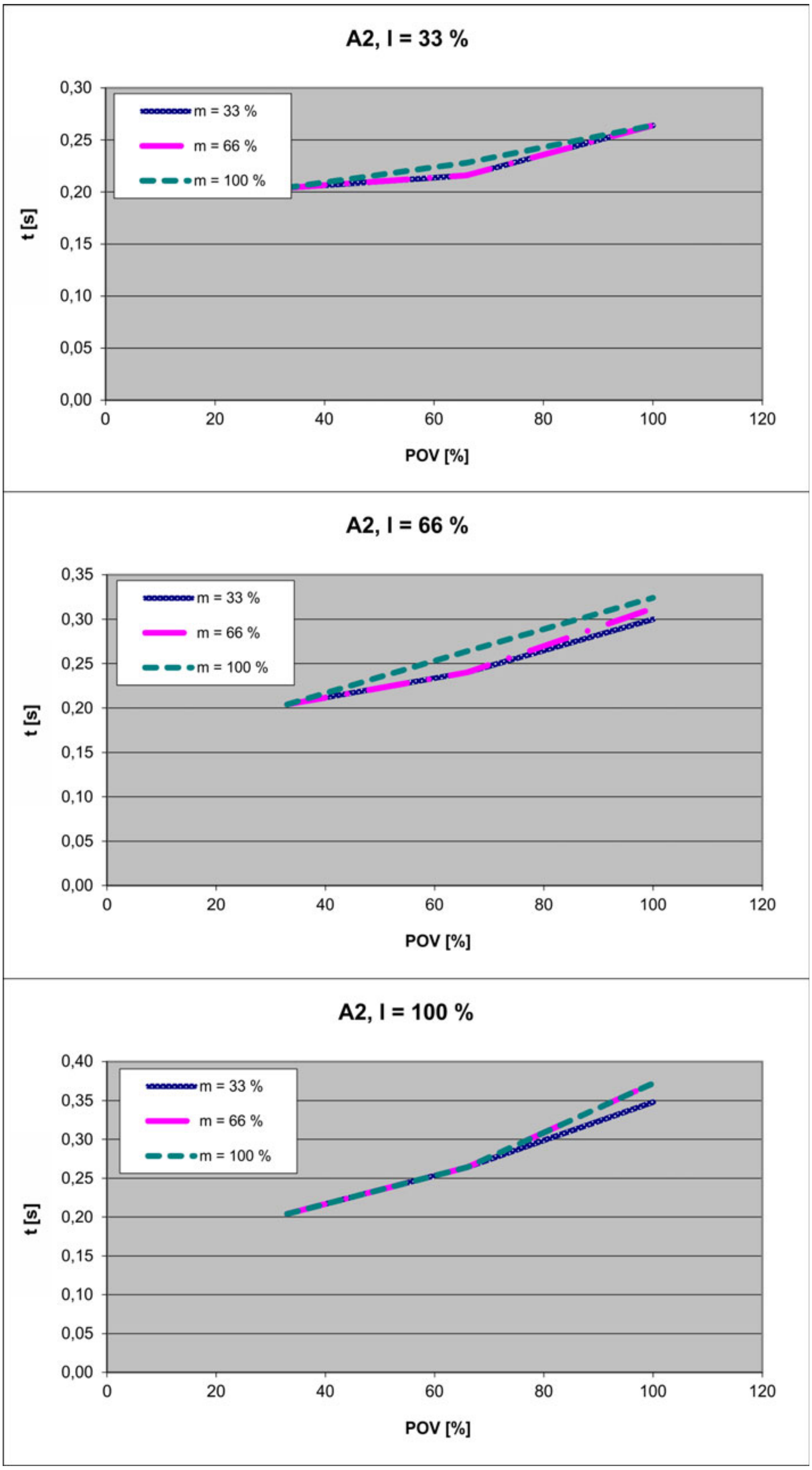


Fig. 4-132: Stopping times for STOP 1, axis 2

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

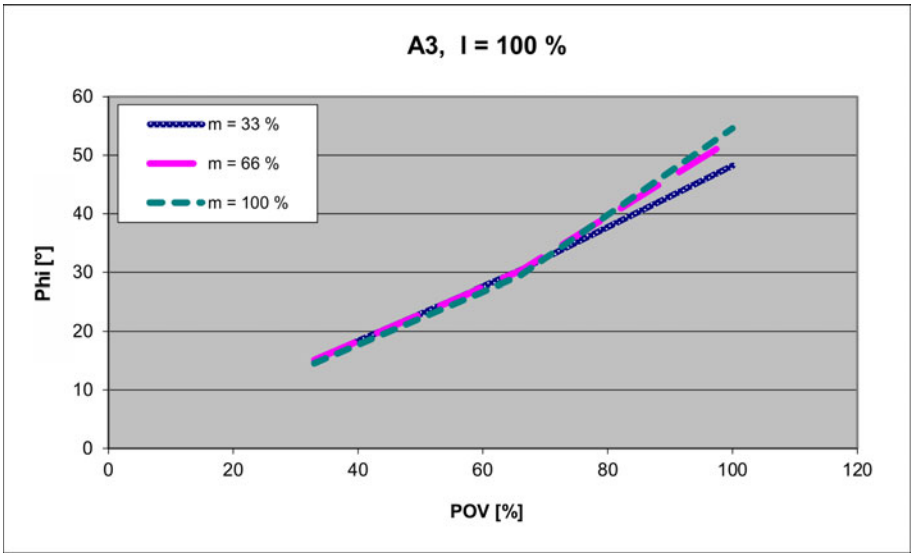


Fig. 4-133: Stopping distances for STOP 1, axis 3

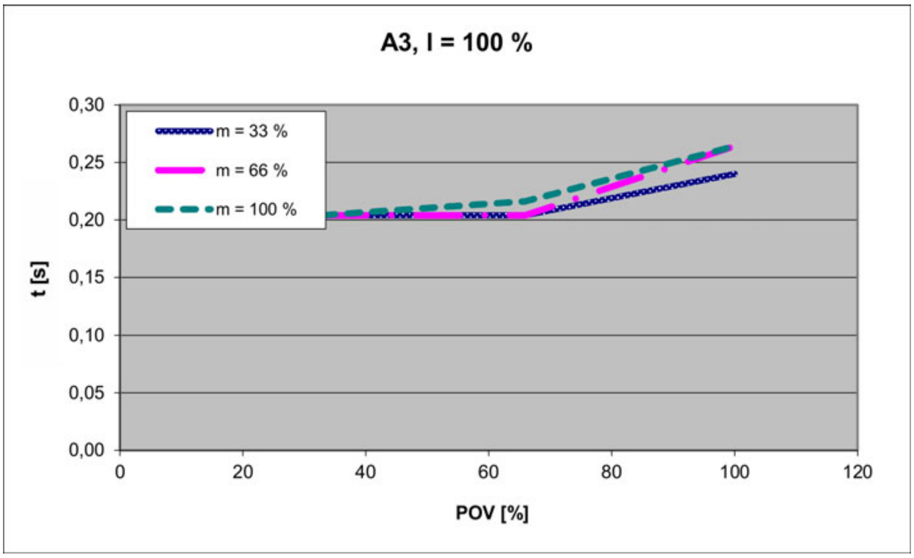


Fig. 4-134: Stopping times for STOP 1, axis 3

4.17.6 Stopping distances and times, KR 6 R900 sixx W-HM-SC

The following values are valid for the following robot:

- KR 6 R900 sixx W-HM-SC

4.17.6.1 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	163.11	0.745
Axis 2	67.78	0.404
Axis 3	60.96	0.387

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

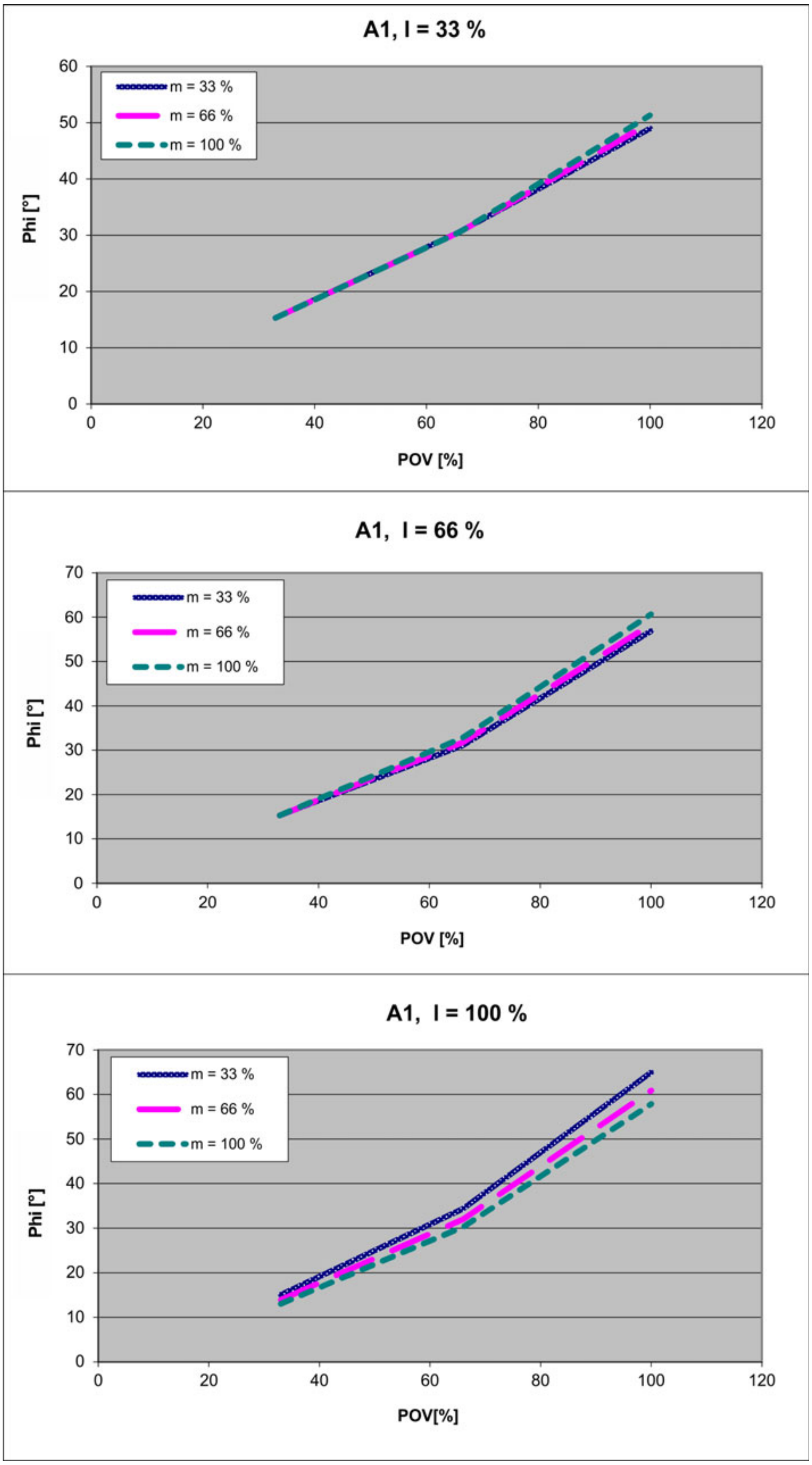


Fig. 4-135: Stopping distances for STOP 1, axis 1

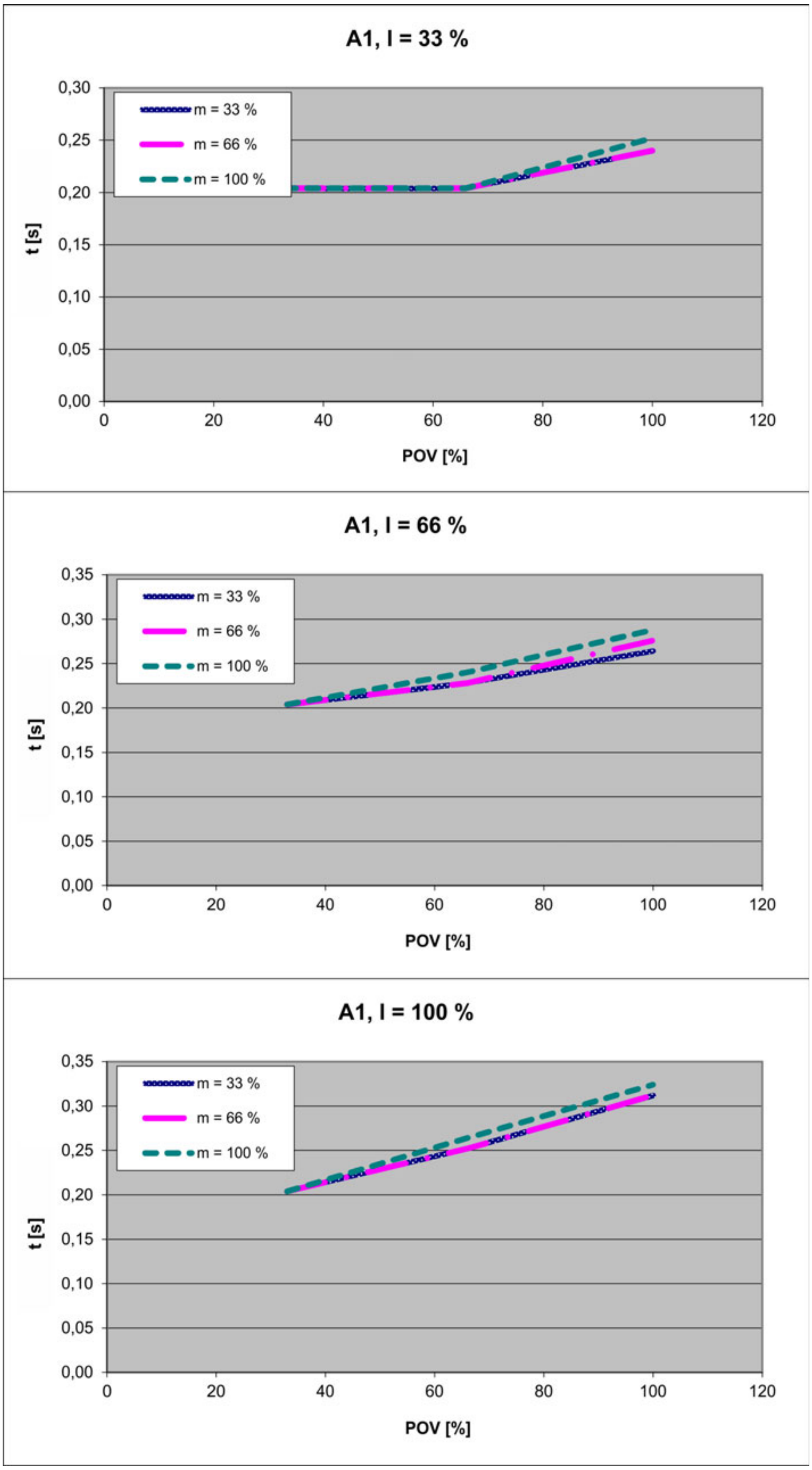


Fig. 4-136: Stopping times for STOP 1, axis 1

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

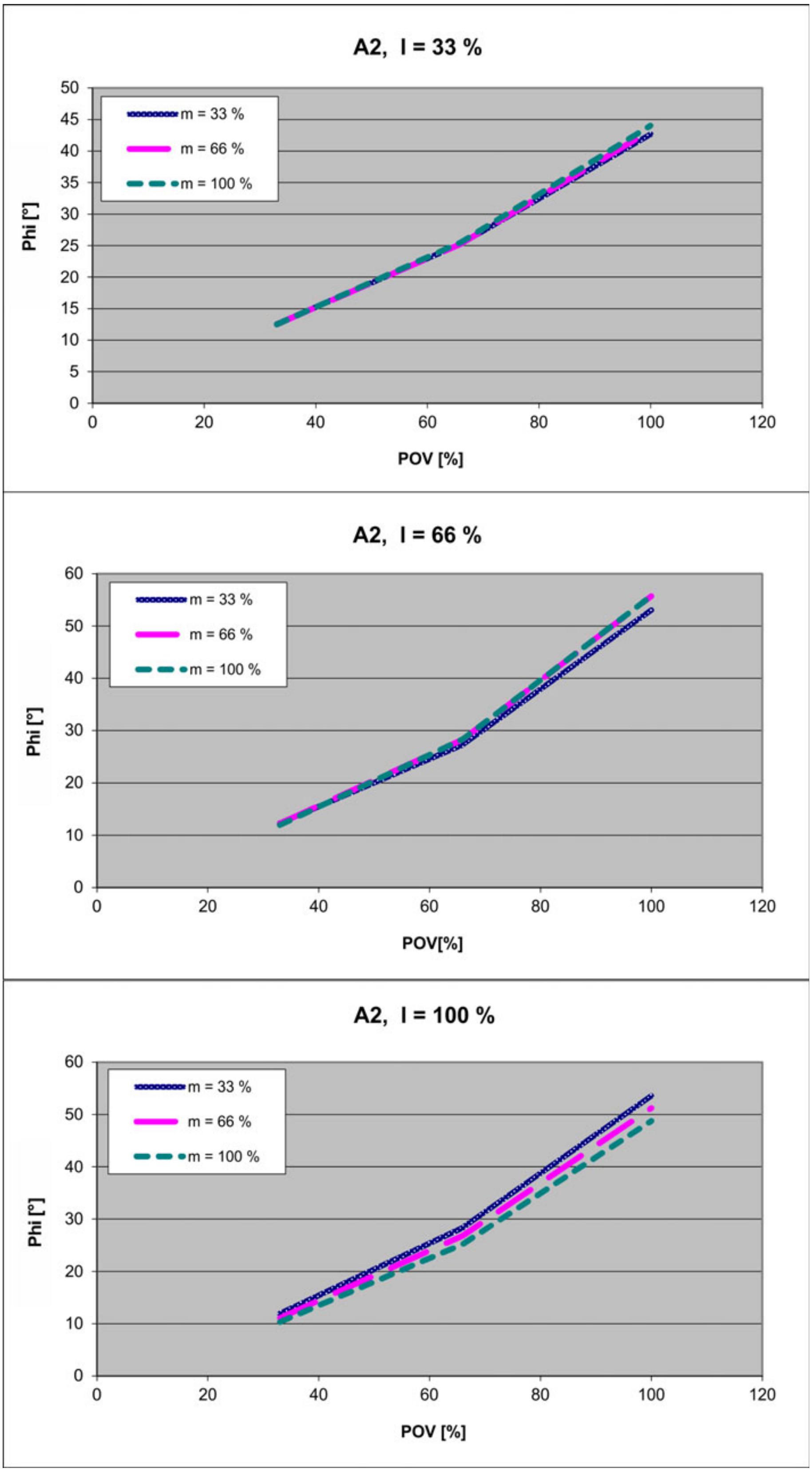


Fig. 4-137: Stopping distances for STOP 1, axis 2

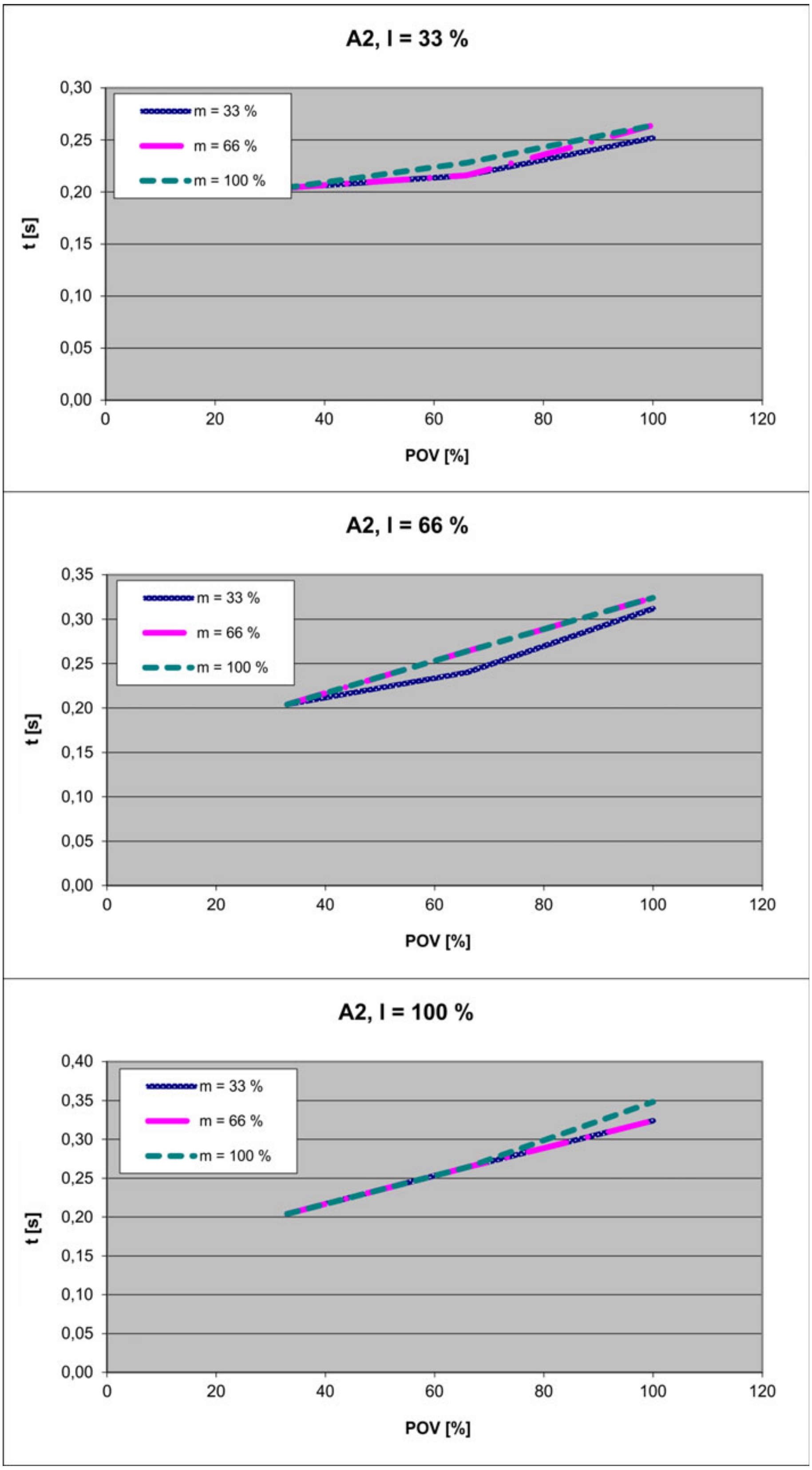


Fig. 4-138: Stopping times for STOP 1, axis 2

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

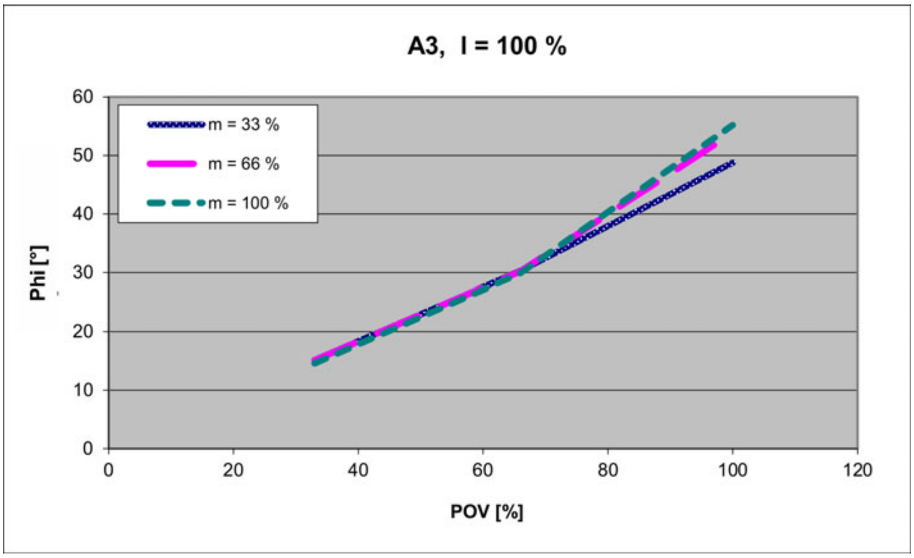


Fig. 4-139: Stopping distances for STOP 1, axis 3

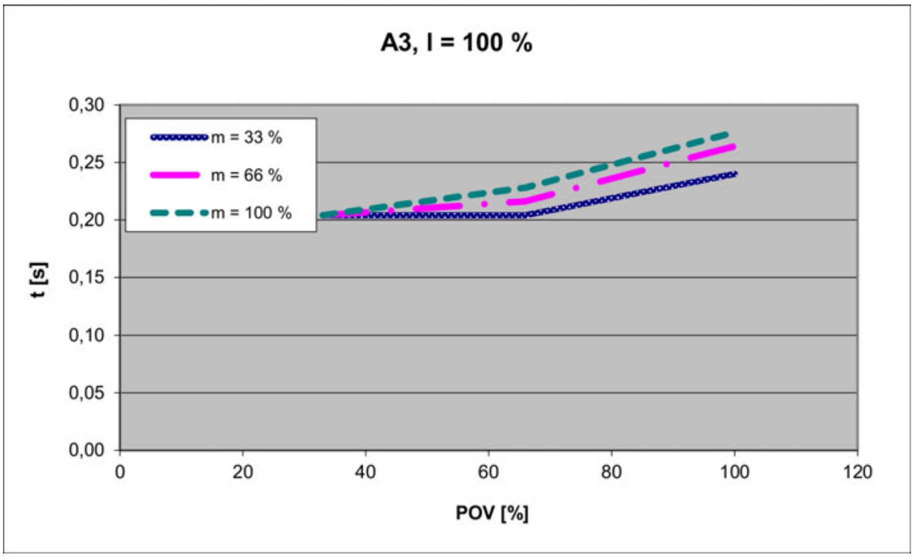


Fig. 4-140: Stopping times for STOP 1, axis 3

4.17.7 Stopping distances and times, KR 10 R900 sixx HM-SC and KR 10 R1100 sixx HM-SC

The following values are valid for the following robot:

- KR 10 R900 sixx HM-SC
- KR 10 R900 sixx C-HM-SC
- KR 10 R1100 sixx HM-SC
- KR 10 R1100 sixx C-HM-SC

4.17.7.1 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	106.21	0.536
Axis 2	96.06	0.647
Axis 3	46.99	0.373

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

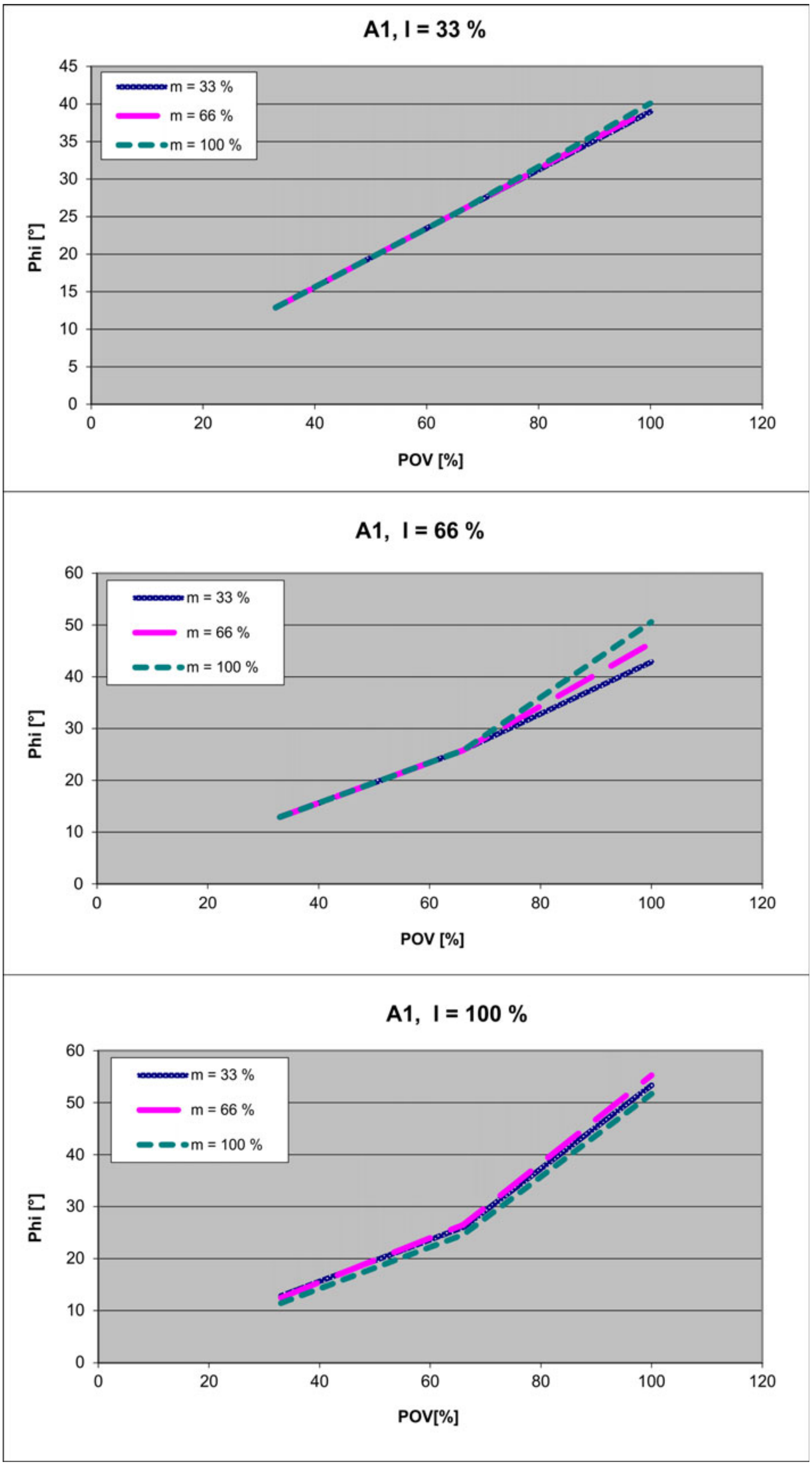


Fig. 4-141: Stopping distances for STOP 1, axis 1

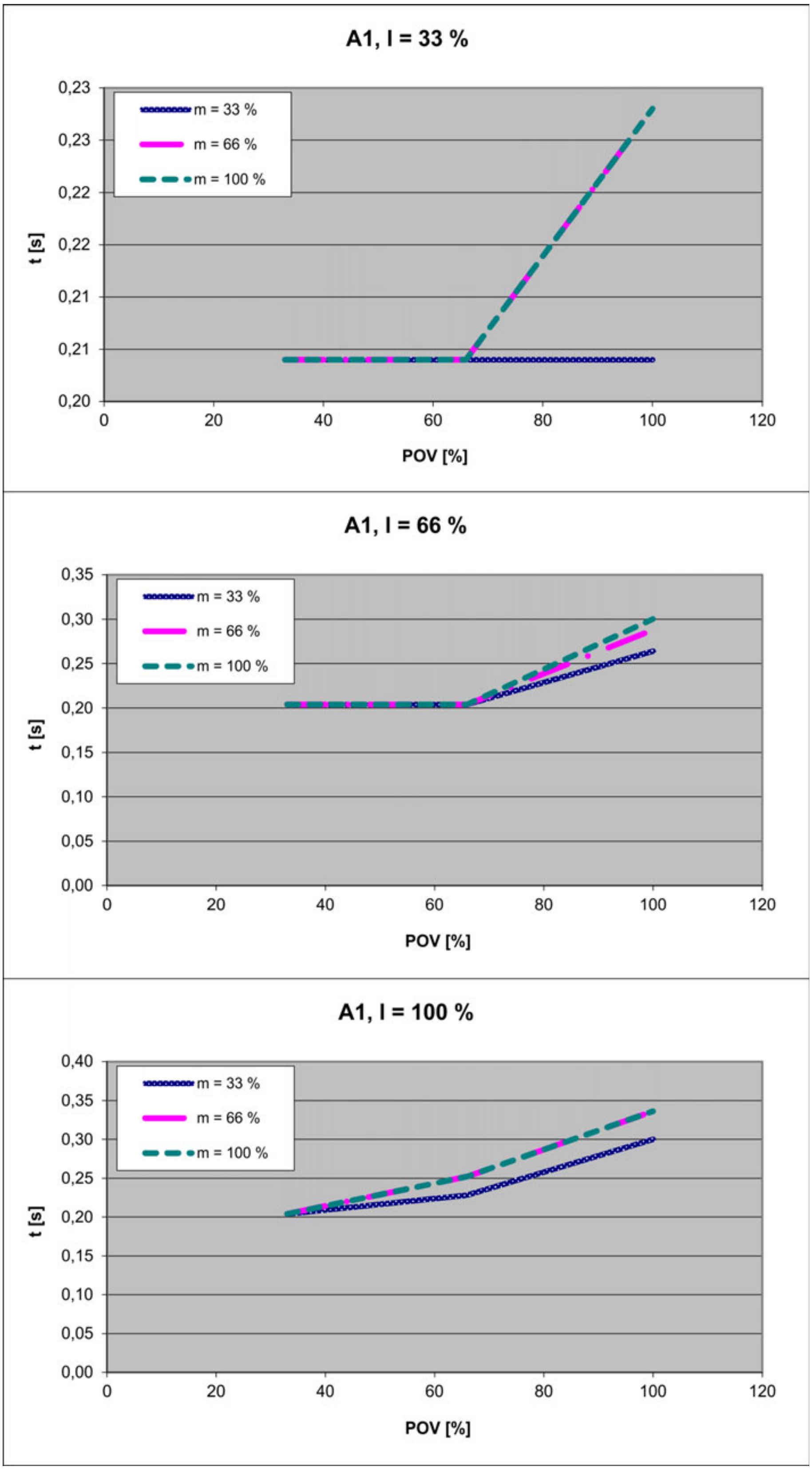


Fig. 4-142: Stopping times for STOP 1, axis 1

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

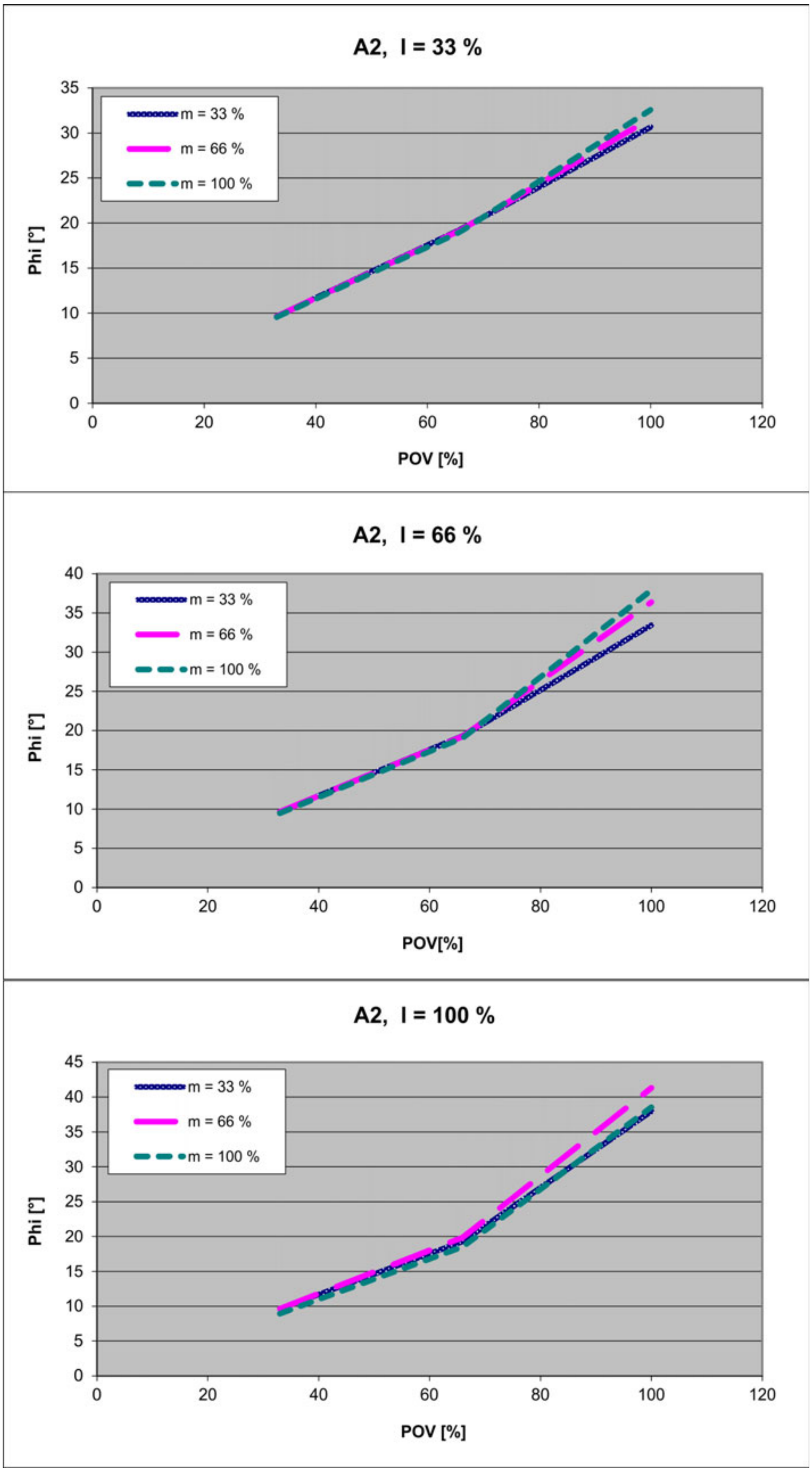


Fig. 4-143: Stopping distances for STOP 1, axis 2

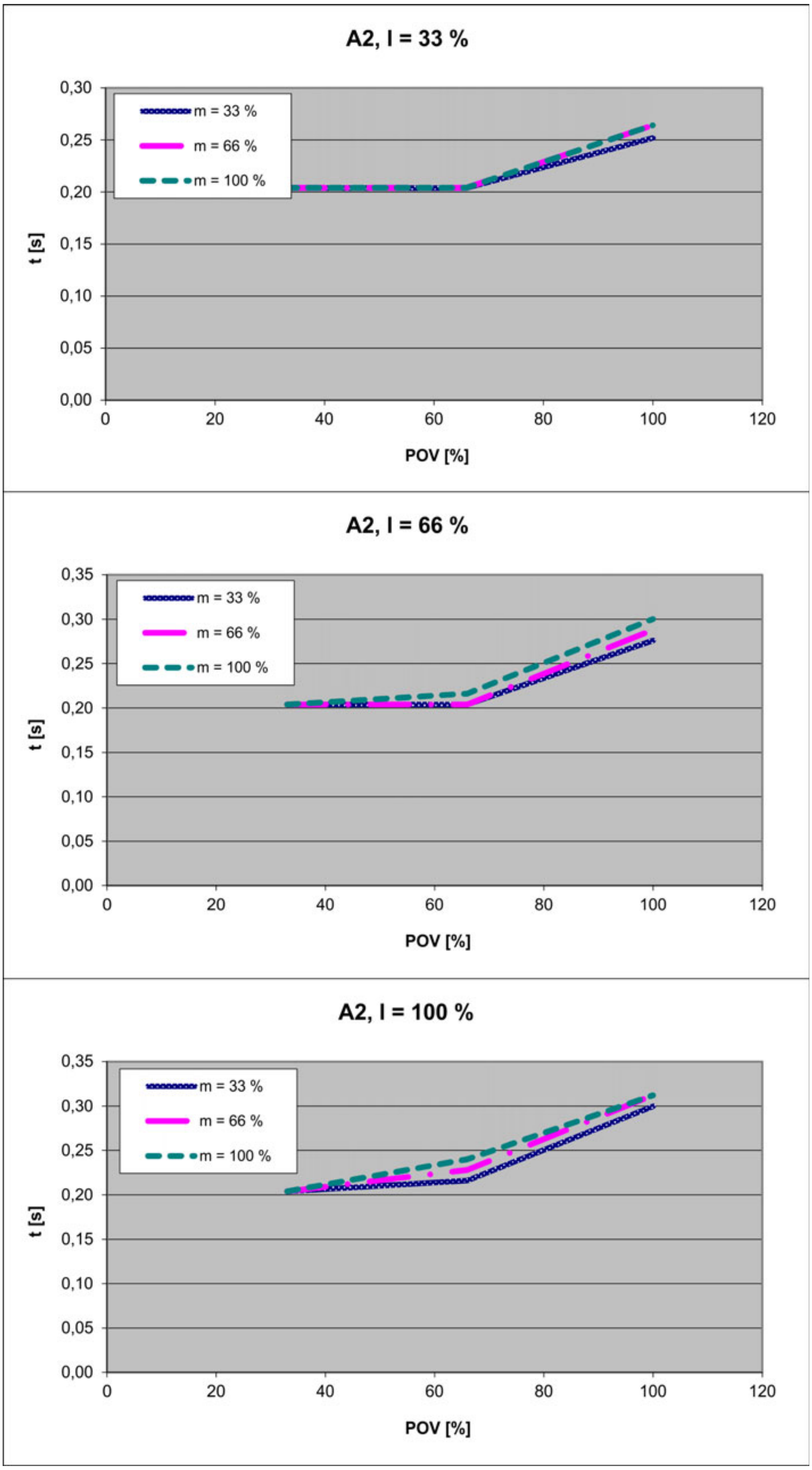


Fig. 4-144: Stopping times for STOP 1, axis 2

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

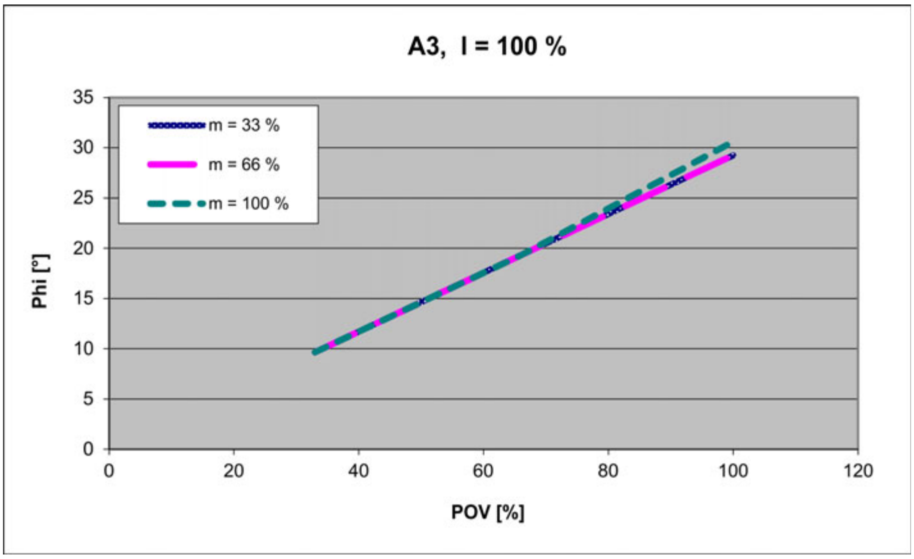


Fig. 4-145: Stopping distances for STOP 1, axis 3

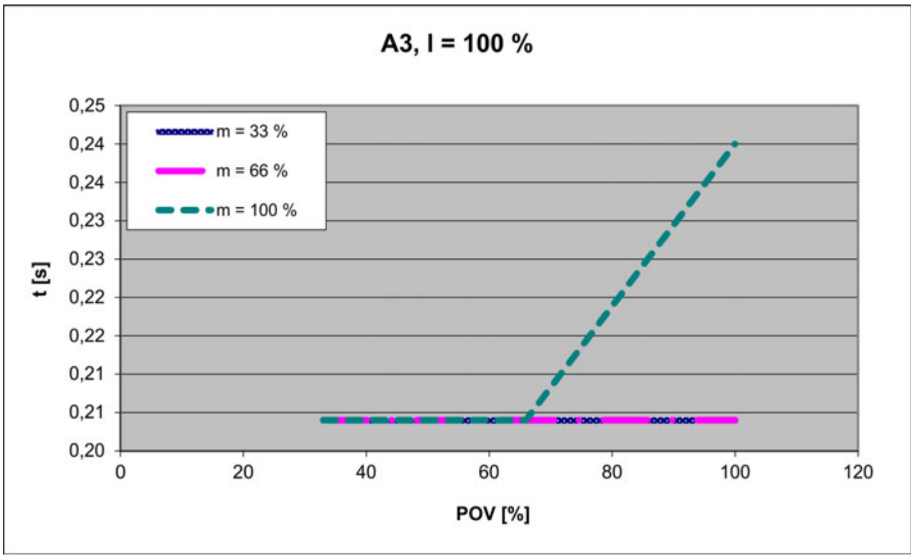


Fig. 4-146: Stopping times for STOP 1, axis 3

4.17.8 Stopping distances and times KR 10 R900 sixx W-HM-SC and KR 10 R1100 sixx W-HM-SC

The following values are valid for the following robot:

- KR 10 R900 sixx W-HM-SC
- KR 10 R1100 sixx W-HM-SC

4.17.8.1 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	163.11	0.745
Axis 2	67.78	0.404
Axis 3	60.96	0.387

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

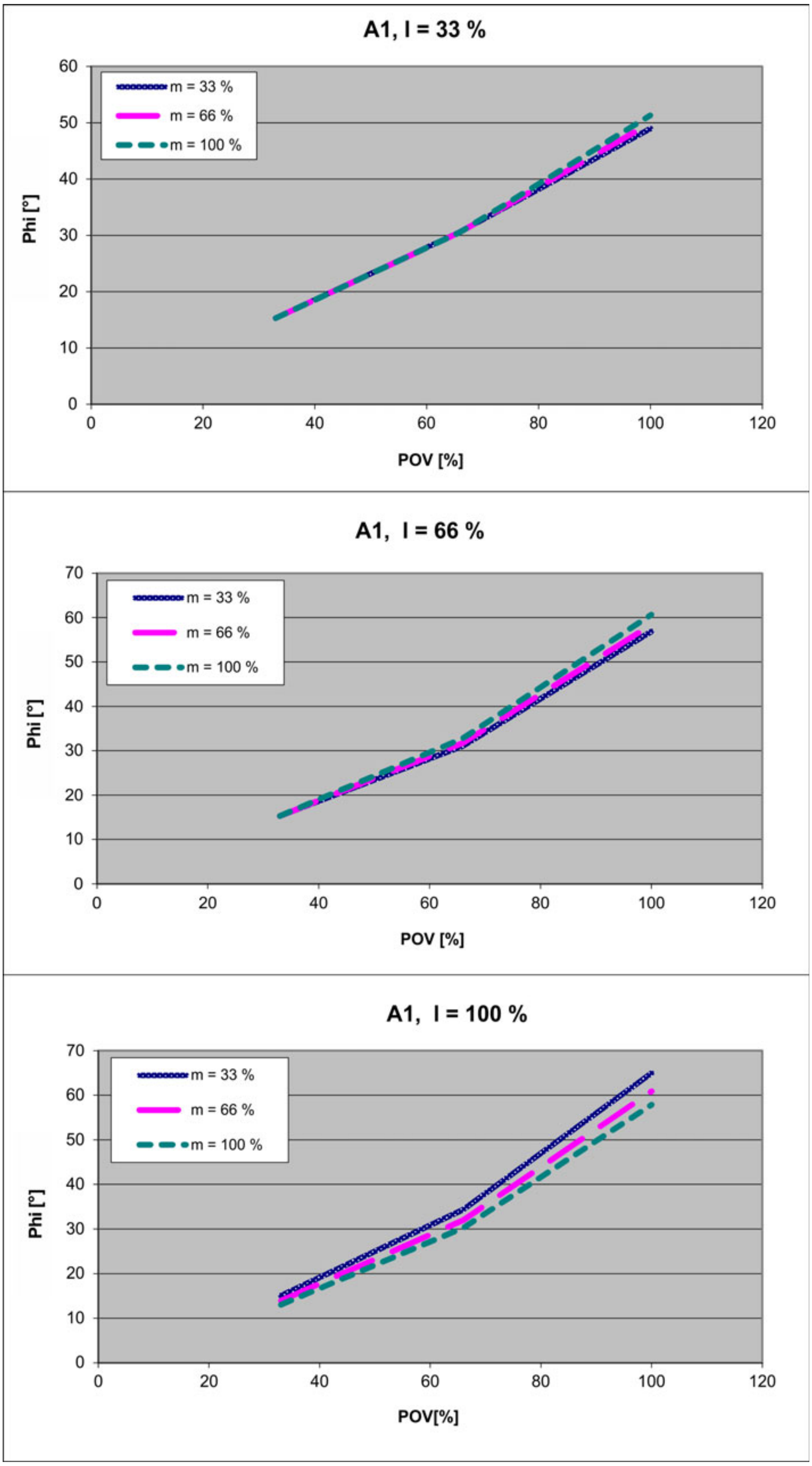


Fig. 4-147: Stopping distances for STOP 1, axis 1

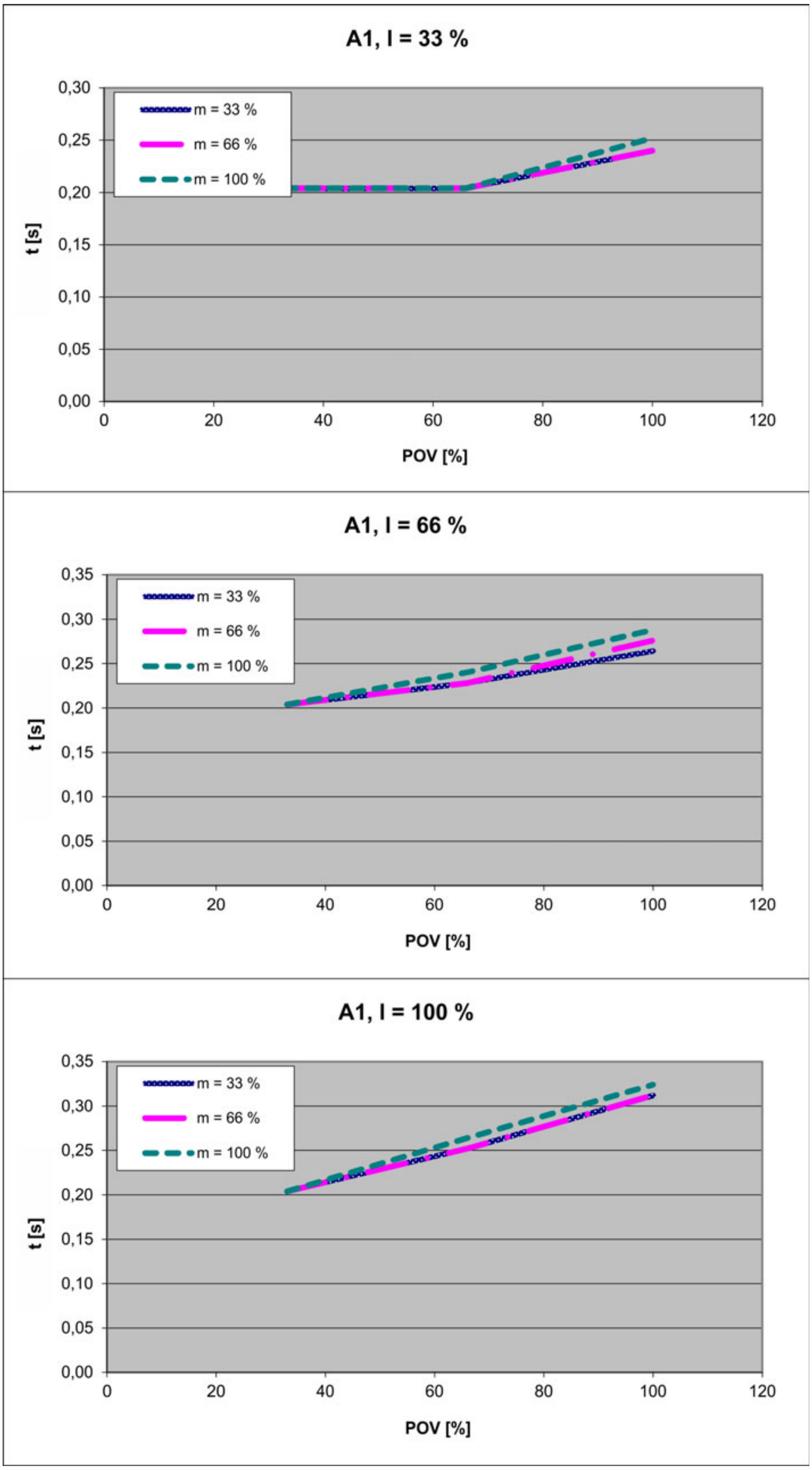


Fig. 4-148: Stopping times for STOP 1, axis 1

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

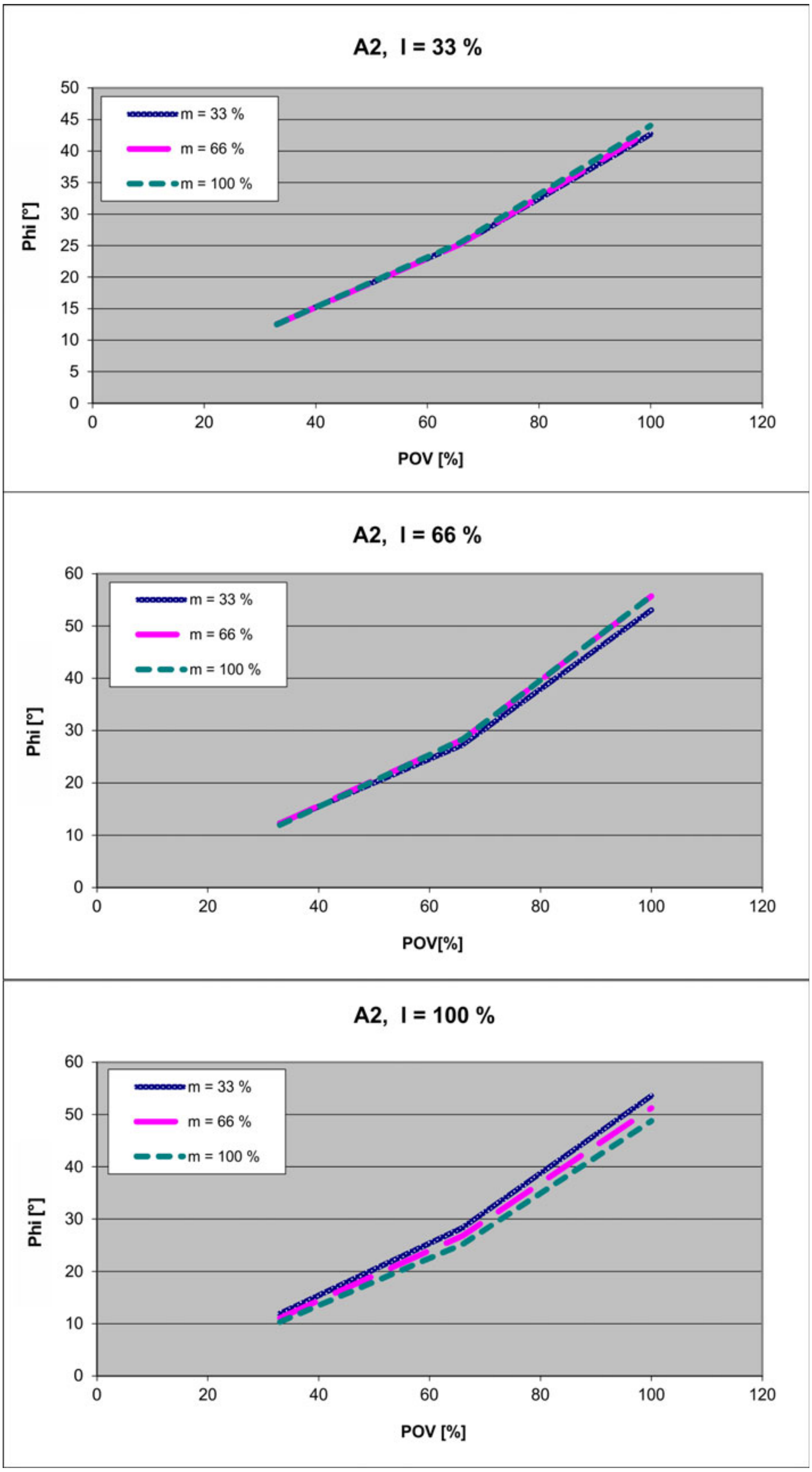


Fig. 4-149: Stopping distances for STOP 1, axis 2

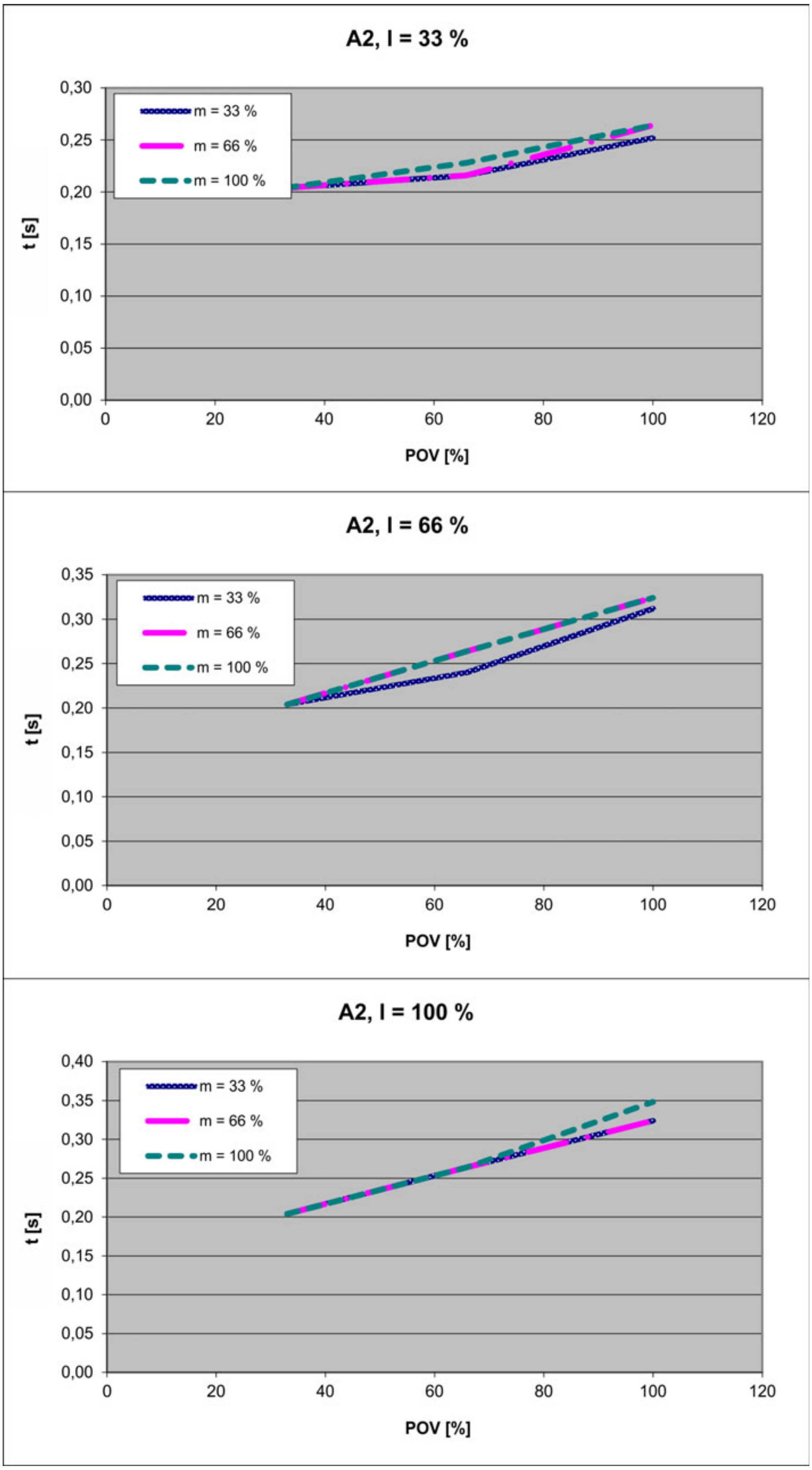


Fig. 4-150: Stopping times for STOP 1, axis 2

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

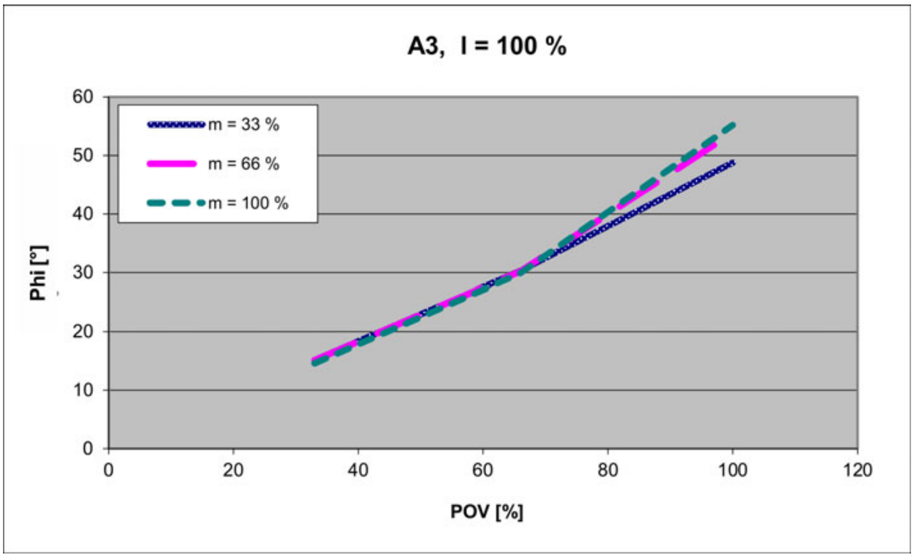


Fig. 4-151: Stopping distances for STOP 1, axis 3

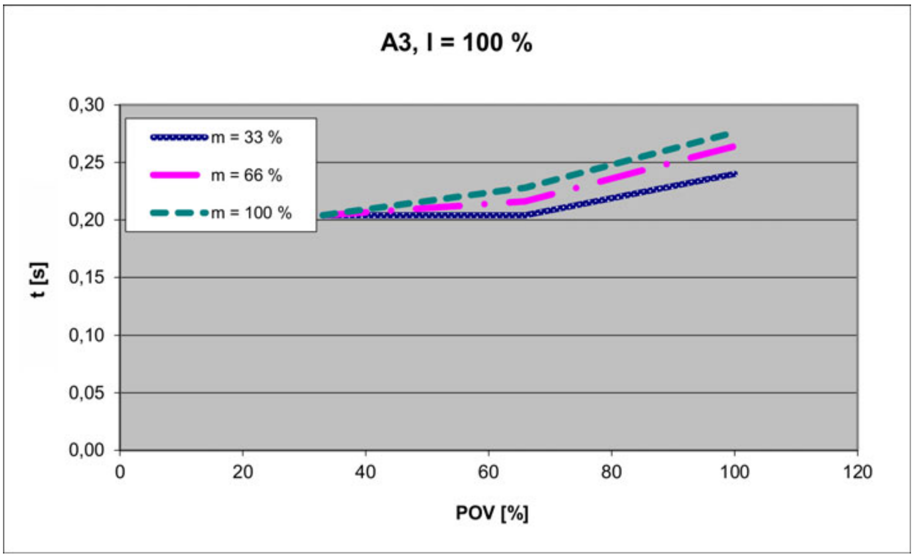


Fig. 4-152: Stopping times for STOP 1, axis 3

5 Safety

5.1 General

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

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

5.1.1 Liability

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

Components of the industrial robot:

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

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

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

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

Safety information

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

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

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

5.1.2 Intended use of the industrial robot

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

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

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

Misuse

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

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

5.1.3 EC declaration of conformity and declaration of incorporation

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

- The industrial robot is integrated into a complete system.

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

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

EC declaration of conformity

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

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

Declaration of incorporation

The partly completed machinery is supplied with a declaration of incorporation in accordance with Annex II B of the 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 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.
Safety options	Generic term for options which make it possible to configure additional safe monitoring functions in addition to the standard safety functions. Example: SafeOperation
smartPAD	Teach pendant for the KR C4 The smartPAD has all the operator control and display functions required for operating and programming the industrial robot.
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	Axis of motion that does not belong to the manipulator, yet is controlled with the same controller. e.g. KUKA linear unit, turn-tilt table, Posiflex

5.2 Personnel

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

- User
- Personnel

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

User

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

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

Personnel

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

Personnel includes:

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

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

System integrator

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

The system integrator is responsible for the following tasks:

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

Operators

The operator must meet the following preconditions:

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

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

5.3 Workspace, safety zone and danger zone

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

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

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

5.4 Overview of protective equipment

The protective equipment of the mechanical component may include:

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

Not all equipment is relevant for every mechanical component.

5.4.1 Mechanical end stops

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

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

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

5.4.2 Mechanical axis limitation (optional)

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

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

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

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

5.4.3 Options for moving the manipulator without drive energy

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

Description

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

- Release device (optional)

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

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

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

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

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

5.4.4 Labeling on the industrial robot

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

Labeling on the industrial robot consists of:

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

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

5.5 Safety measures

5.5.1 General safety measures

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

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

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

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

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

KCP/smartPAD

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

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

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

External keyboard, external mouse

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

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

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

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

Modifications

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

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

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

Faults

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

- Switch off the robot controller and secure it (e.g. with a padlock) to prevent unauthorized persons from switching it on again.
- Indicate the fault by means of a label with a corresponding warning (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 Deutschland GmbH, are integrated into the industrial robot, the user is responsible for ensuring that these components do not adversely affect or disable safety functions.

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

Function test

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

It must be ensured that:

- The industrial robot is correctly installed and fastened in accordance with the specifications in the documentation.
- There is no damage to the robot that could be attributed to external forces. Example: Dents or abrasion that could be caused by an impact or collision.

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

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

5.5.4 Manual mode

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

- Jog mode
- Teaching
- Programming
- Program verification

The following must be taken into consideration in manual mode:

- If the drives are not required, they must be switched off to prevent the manipulator or the external axes (optional) from being moved unintentionally.

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

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

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

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

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

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

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

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

5.5.5 Automatic mode

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

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

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

5.5.6 Maintenance and repair

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

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

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

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

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

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

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

Robot controller

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

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

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

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

Counterbalancing system

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

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

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

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

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

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

Hazardous substances

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

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

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

5.5.7 Decommissioning, storage and disposal

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

5.6 Applied norms and regulations

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

EN 614-1:2006+A1:2009	**Safety of machinery:** Ergonomic design principles - Part 1: Terms and general principles
EN 61000-6-2:2005	**Electromagnetic compatibility (EMC):** Part 6-2: Generic standards; Immunity for industrial environments
EN 61000-6-4:2007 + A1:2011	**Electromagnetic compatibility (EMC):** Part 6-4: Generic standards; Emission standard for industrial environments
EN 60204-1:2006/A1:2009	**Safety of machinery:** Electrical equipment of machines - Part 1: General requirements

6 Planning

6.1 Information for planning

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

- Continuous operation near temperature limits or in abrasive environments
- Continuous operation in wet and abrasive environments
- Operation in aggressive chemical environments
- Operation in the immediate vicinity of cooling lubricant spray, waterjets or compressed air
- 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

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

If a robot is started in low ambient temperatures, this results in increased friction in the gear unit. This can cause the motor current of an axis (or of more than one axis) to reach its maximum value. To prevent this, the manipulator must be warmed up.

> Further information about warm-up is contained in the operating and programming instructions for the KUKA System Software (KSS).

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 Outstanding residual risks in accordance with the requirements of EN ISO 14159

The user must carry out a hygiene risk assessment in order to minimize the occurrence and effects of residual risks. Residual risks can arise from the following aspects, for example. A workplace risk assessment must be carried out.

Residual risk due to the manipulator

- Leakage of lubricants (lubricants are food-approved)
- Abrasion of seals (seals are food-approved)
- Loss of small parts (e.g. screws), flakes of paint
- Loss of functionality due to corrosion damage, e.g. on structural components, seals and electrical system

  Use of the cable set (optional) is recommended to protect the electrical connections on interface A1 (>>> 12.2 "Cable set (optional)" Page 237).

Residual risk due to contamination from production and cleaning

- Product residue, e.g. food, pharmaceutical products

- Residues from chemical cleaning

Residual risk from system safety

- No hazards that go beyond the known risks of robot operation

6.3 Hole pattern for fastening

For fastening the robot, the substructure must be prepared with a hole pattern and an aperture for interface A1.

The following diagrams show the dimensions of the hole pattern and the requirements on the substructure as well as the dimensions of the required aperture. The substructure must additionally meet the following requirements:

- Material thickness: min. 20 mm
- Machining depth: max. 3 mm

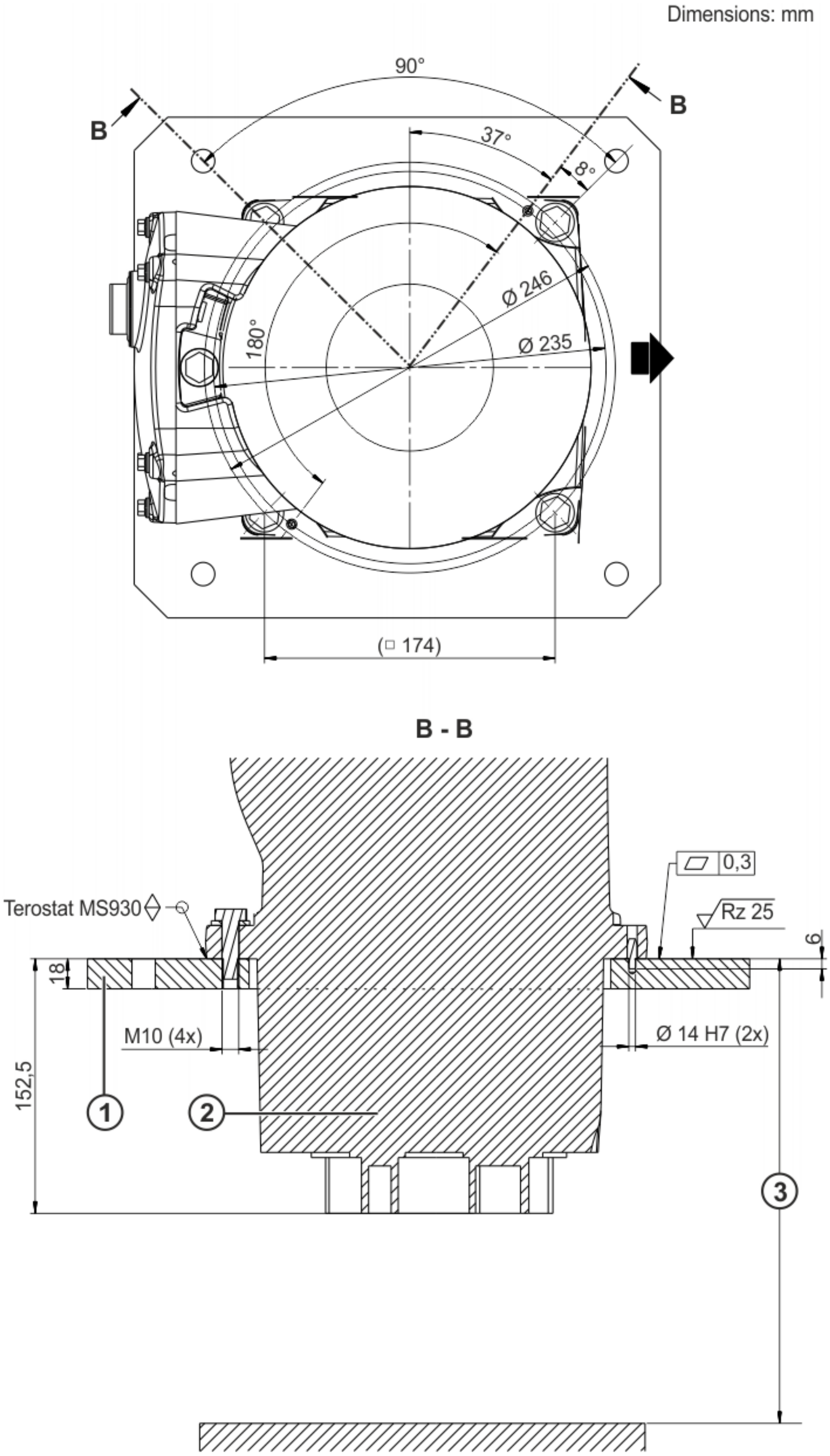


Fig. 6-1: Hole pattern for fastening

1 Substructure
2 Interface A1
3 Using standard connecting cables: 296 mm

Using the optional cable set: 595 mm

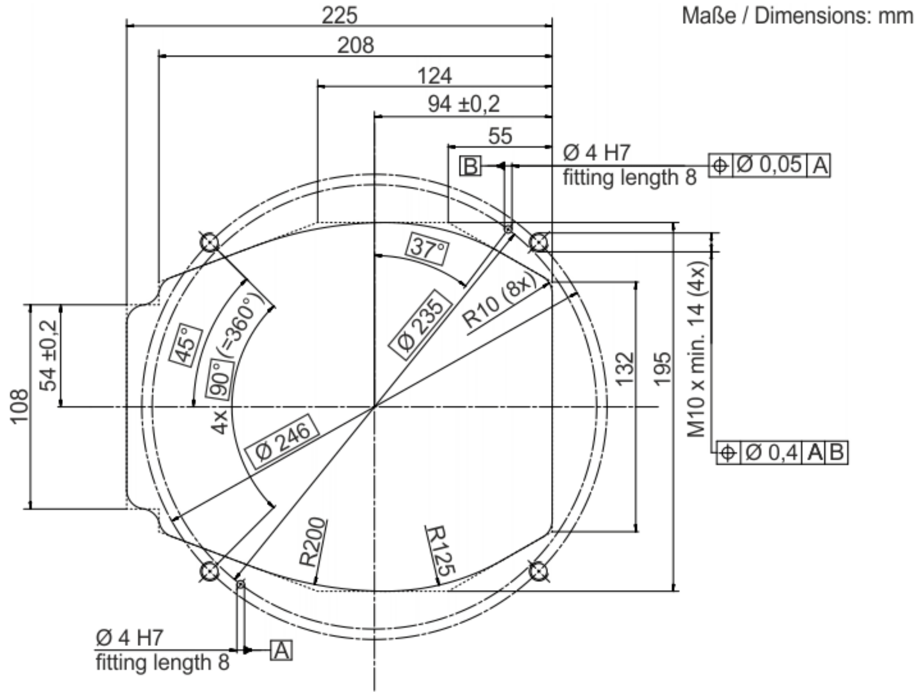


Fig. 6-2: Dimensions of aperture

6.4 Machine frame mounting

Description

The machine frame mounting assembly is used when the robot is fastened on a substructure or a booster frame (pedestal). It must be ensured that the substructure is able to withstand safely the forces occurring during operation (foundation loads). The following diagram contains all the necessary information that must be observed when preparing the mounting surface .

The machine frame mounting assembly consists of:

- Locating pin
- Hexagon bolts with USIT rings

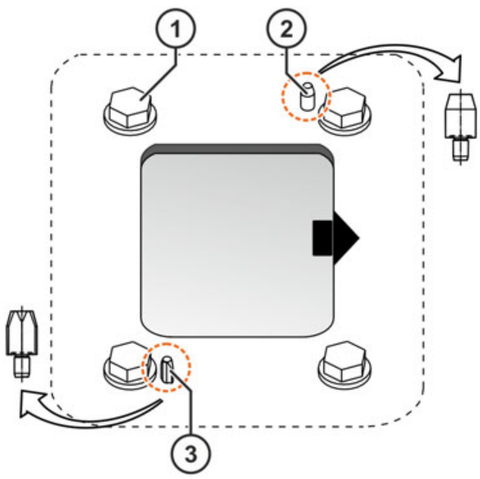


Fig. 6-3: Machine frame mounting

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

Dimensioned drawing

The following illustration (>>> Fig. 6-4) provides all the necessary information on machine frame mounting, together with the required foundation data.

Dimensions: mm

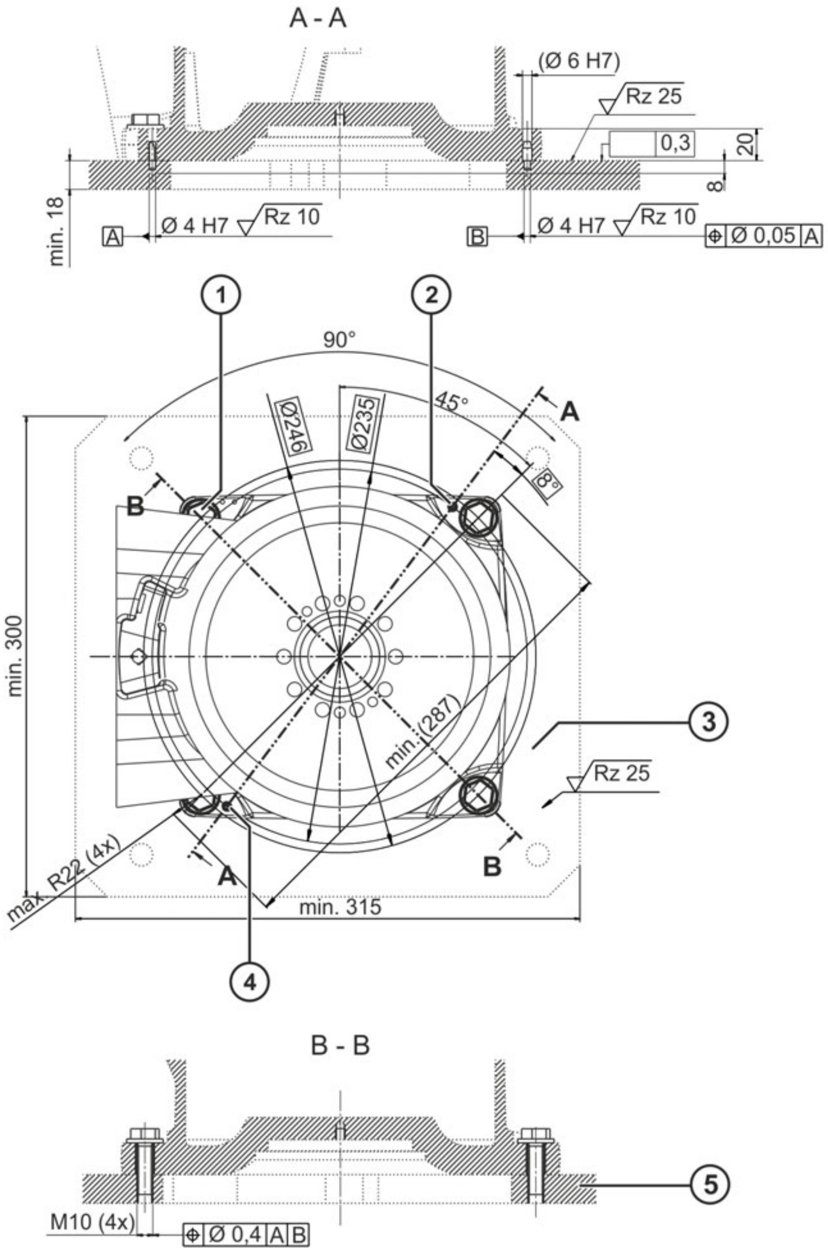


Fig. 6-4: Machine frame mounting – schematic representation

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

6.5 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. The set of connecting cables comprises:

- Motor cable
- Data cable
- CAT5 data cable (optional)

- Connecting cable, external axes A7 and A8 (optional)
- Ground conductor (optional)

Depending on the specification of the robot, various connecting cables are used. The standard cable length is 4 m. Cable lengths of 1 m, 7 m, 15 m and 25 m are available as an option. 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 cables must also be taken into account.

> ⚠ For the connecting cables, a ground conductor is always required to provide a low-resistance connection between the robot and the control cabinet in accordance with DIN EN 60204. The ground conductor is not part of the scope of supply and can be ordered as an option. The connection must be made by the customer. The tapped holes for connecting the ground conductor are located on the base frame of the robot.

If the robot arm and the control cabinet are to be installed in separate areas, an optional cable set is available. This consists of a dress package, a connection plate and a protective circuit (>>> 12.2 "Cable set (optional)" Page 237).

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

- The bending radius for fixed routing must not be less than 50 mm for motor cables and 30 mm for control cables.
- Protect cables against exposure to mechanical stress.
- Route the cables without mechanical stress – no tensile forces on the connectors
- Cables are only to be installed indoors.
- Observe the permissible temperature range (fixed installation) of 263 K (-10 °C) to 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 A1

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

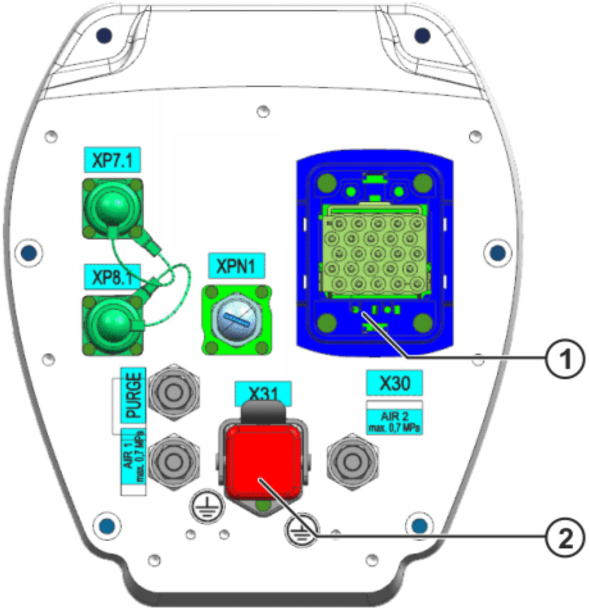


Fig. 6-5: Interface A1

1 Motor cable connection X30
2 Data cable connection X31

6.6 Customer interfaces

Interface A1 Interface A1 is located on the underside of the base frame.

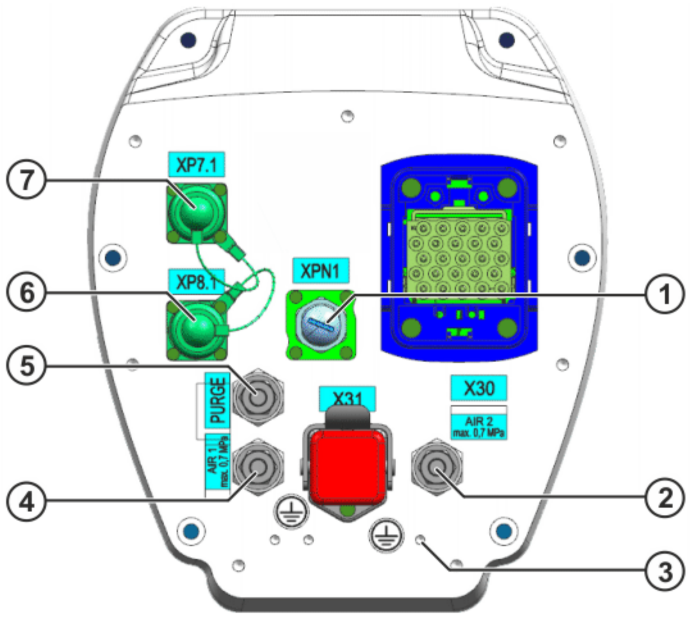


Fig. 6-6: Customer interface A1

1 CAT5 data cable connection XPN1
2 Air line connection AIR2

Outside diameter: 6 mm

3 Ground conductor connection
4 Air line connection AIR1

Outside diameter: 6 mm

5 Pressurization connection

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

6 Connection for external axis A8 (XP8.1)
7 Connection for external axis A7 (XP7.1)

Connection X32 Connection X32 for the MEMD is located beneath a cover at the rear of the base frame.

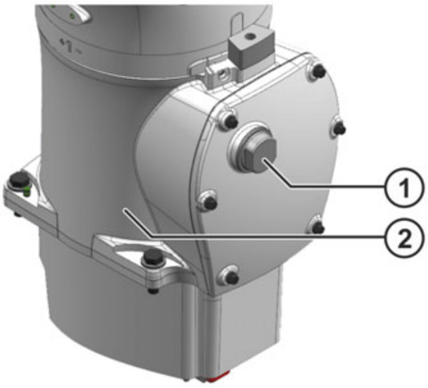


Fig. 6-7: Connection X32

1	Connection MEMD X32	2	Base frame

Interface A4

Interface A4 is located on top of the in-line wrist. When using this interface, it must be ensured that the connectors and connections are protected against penetration of liquids and chemicals.

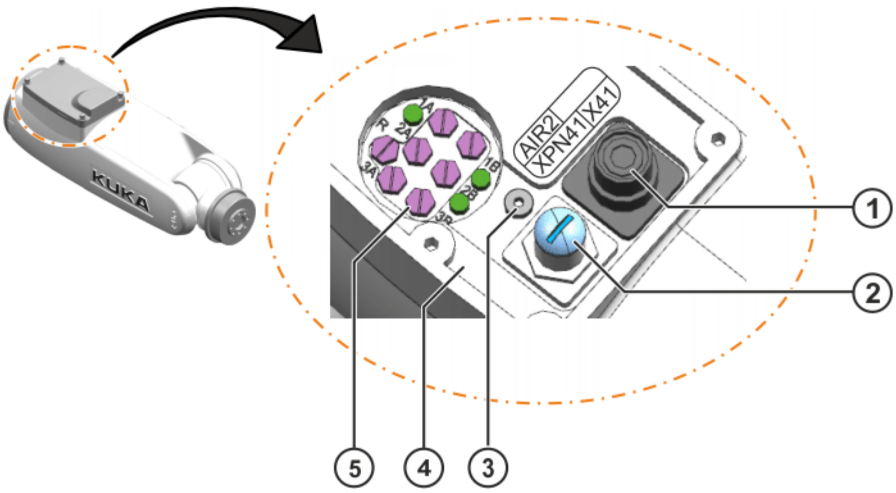


Fig. 6-8: Interface A4, example

1	Connection X41	4	In-line wrist
2	Connection XPN41	5	Air connections
3	Air line AIR2		

The following diagram shows the dimensions of interface A4 (>>> Fig. 6-9).

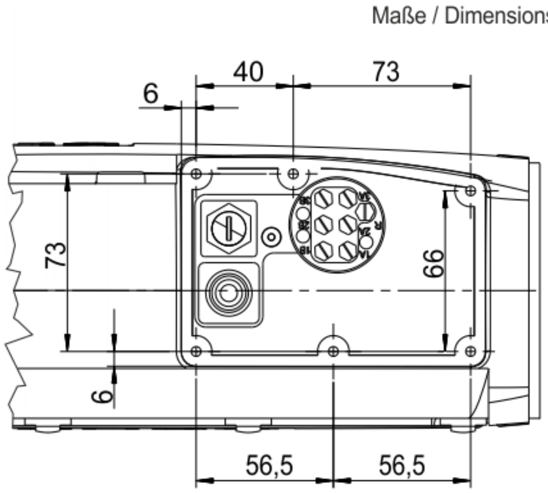


Fig. 6-9: Dimensions of interface A4

The optional connector bypack is required for use of the air connections. This option contains a silencer and several plug-in couplings (>>> Fig. 6-10).

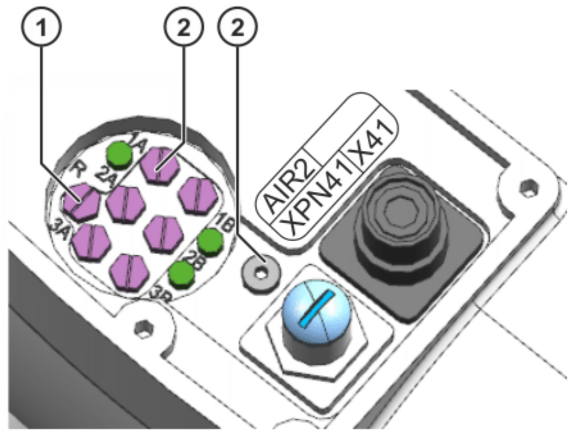


Fig. 6-10: Connections for connector bypack option

1 Silencer
2 Push-in fitting

The robot has three bistable 5/2-way solenoid valves integrated into the in-line wrist. The valve unit is activated via the internal energy supply system:

Designation	Limit values
Valve type	5/2-way solenoid valve
Max. pressure	7 bar
Switching frequency	10 Hz
Operating temperature	+5 °C to +45 °C (278 K to 318 K)
Threaded union	M5
Medium	Air, oil-free, dry, filtered according to: ISO 8573.1-1, 1.2 to 16.2 Degree of filtration: max. 5 µm
Operating voltage	24 V DC
Current	25 mA

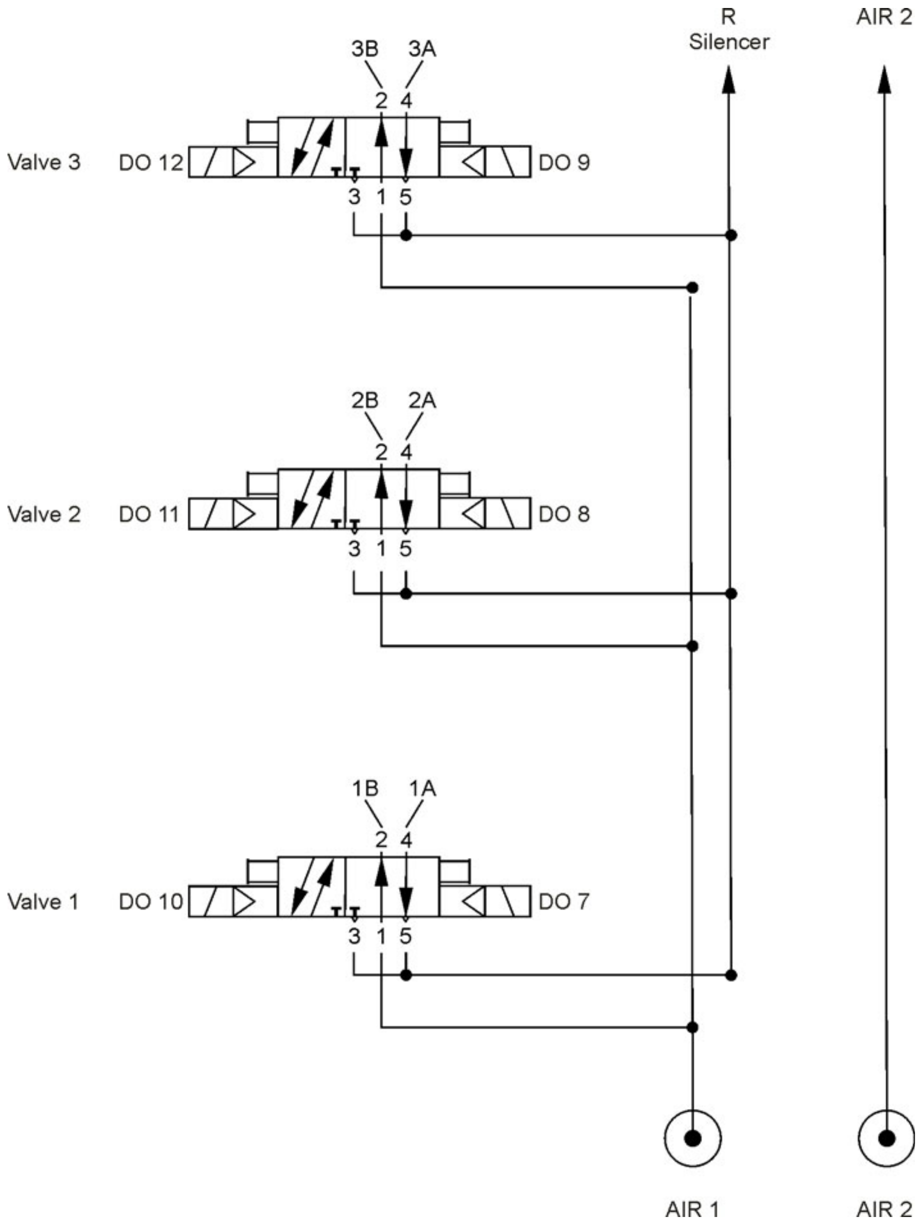


Fig. 6-11: Valve diagram

Valve activation

Designation		Values
Digital outputs (for valve activation)		6 (DO7 to DO12): ■ Valve 1: DO7/DO10 ■ Valve 2: DO8/DO11 ■ Valve 3: DO9/DO12 not short-circuit proof
	Rated voltage	24 V DC (-15%/+20%)
	Output current	max. 25 mA

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

Connection X41

Designation		Values
Digital outputs (for customer interface X41)		2 (DO13, DO14) short-circuit proof
	Rated voltage	24 V DC (-15%/+20%)
	Output current	max. 0.5 A
	Short-circuit current	max. 2 A
	Load type	Ohmic, inductive Lamp load
Digital inputs (for customer interface X41)		6 (DI1 to DI6)
	Signal voltage “0”	-3 V … +5 V EN 61131-2, type 3
	Signal voltage “1”	15 V … 30 V EN 61131-2, type 3
	Input current	typically 3 mA EN 61131-2, type 3
	Input filter	typically 0.3 ms
Power supply		24 V / 3 A

A 615springtec® connector, 12-pole EMC enclosure E-part from Intercontec is required for connection X41.

When using the power supply, the customer must protect this against overload and short-circuit with a 3 A fuse downstream of connector X41.

For the connector bypack option, the pin assignments on the connector insert are to be noted.

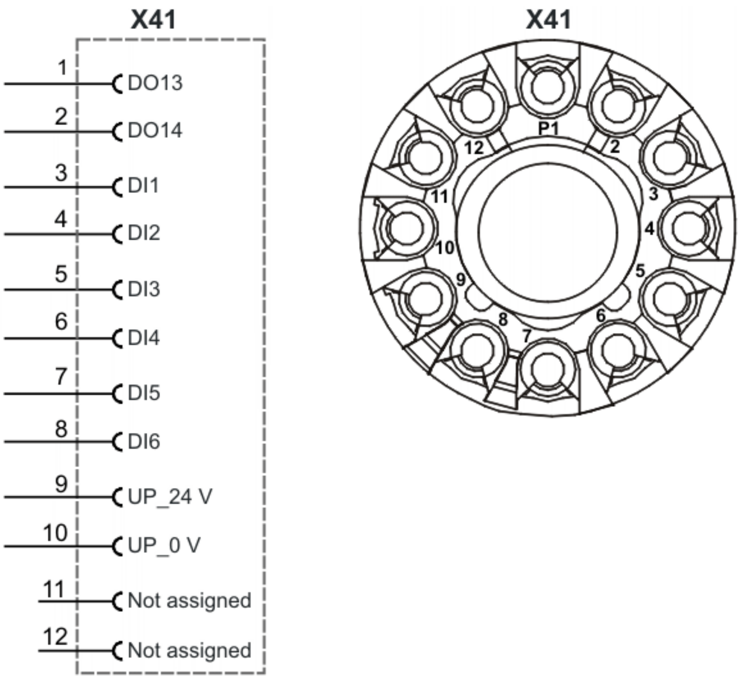


Fig. 6-12: Wiring diagram, connection X41

Connection XPN41

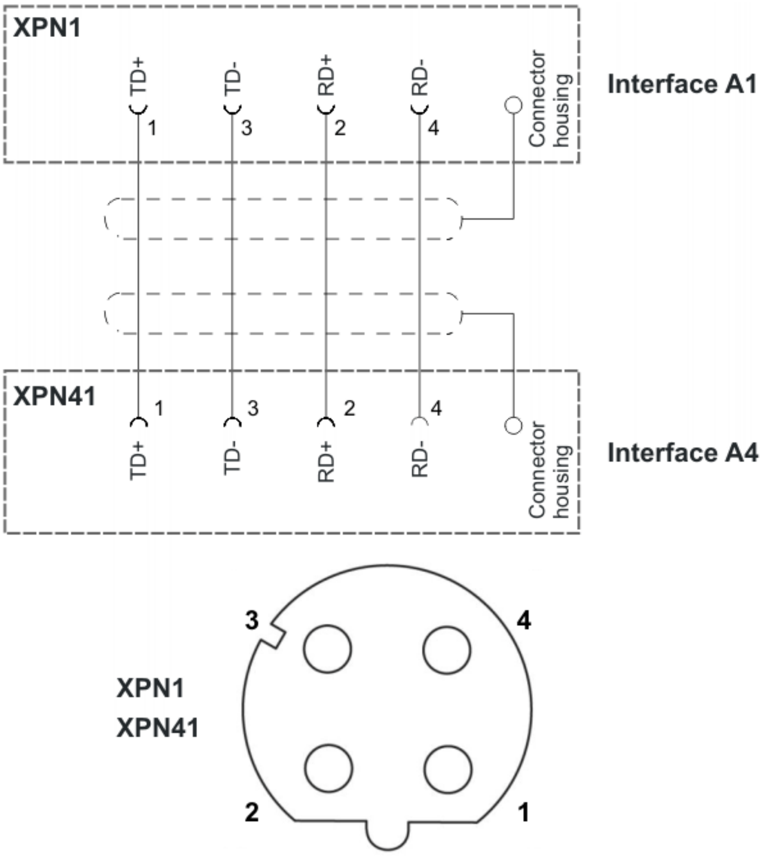


Fig. 6-13: Wiring diagram, connection XPN41

A SAISM-4/8S-M12 4P D-ZF connector from Weidmüller is required for connection XPN41.

Connection AIR2

Customer-specific air connection with the following values:

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

7 Transportation

7.1 Transporting the manipulator

Description

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

Transport position

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

Axis	A1	A2	A3	A4	A5	A6
Angle	0°	-137°	+144°	0º	-110º	0º

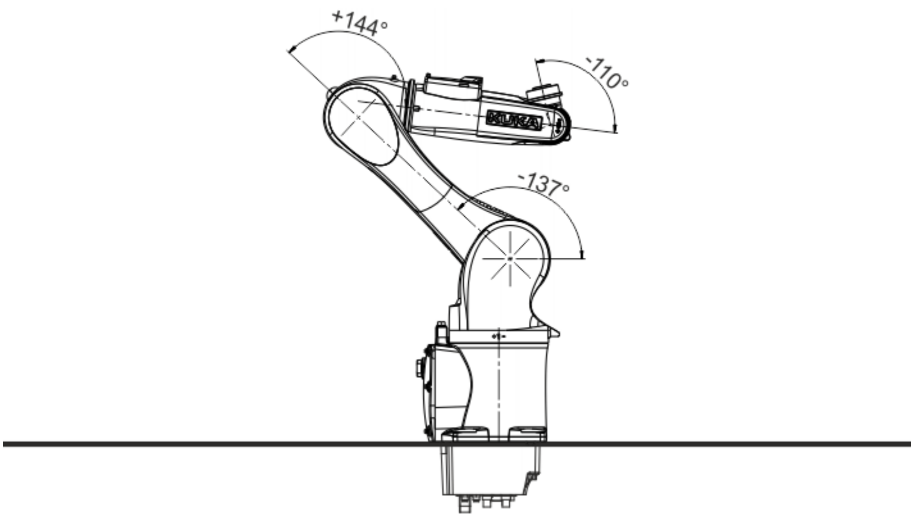


Fig. 7-1: Transport position

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.

The following transport dimensions (>>> Fig. 7-2) are valid for the robots:

- KR 6 R700 sixx HM-SC
- KR 6 R700 sixx W-HM-SC
- KR 6 R700 sixx C-HM-SC

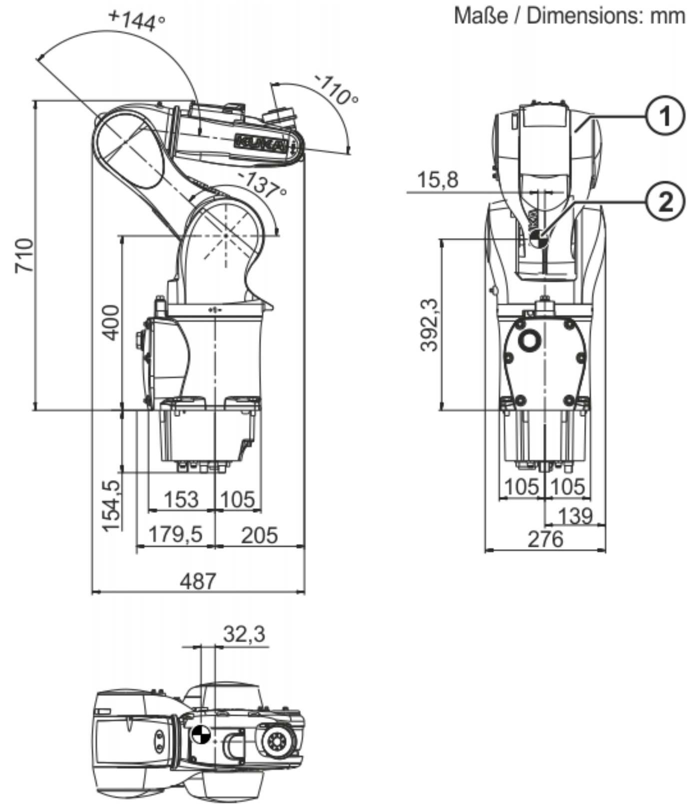


Fig. 7-2: Transport dimensions, R700

1	Robot	2	Center of gravity

The following transport dimensions (>>> Fig. 7-3) are valid for the robots:

- KR 6 R900 sixx HM-SC
- KR 6 R900 sixx W-HM-SC
- KR 6 R900 sixx C-HM-SC
- KR 10 R900 sixx HM-SC
- KR 10 R900 sixx W-HM-SC
- KR 10 R900 sixx C-HM-SC

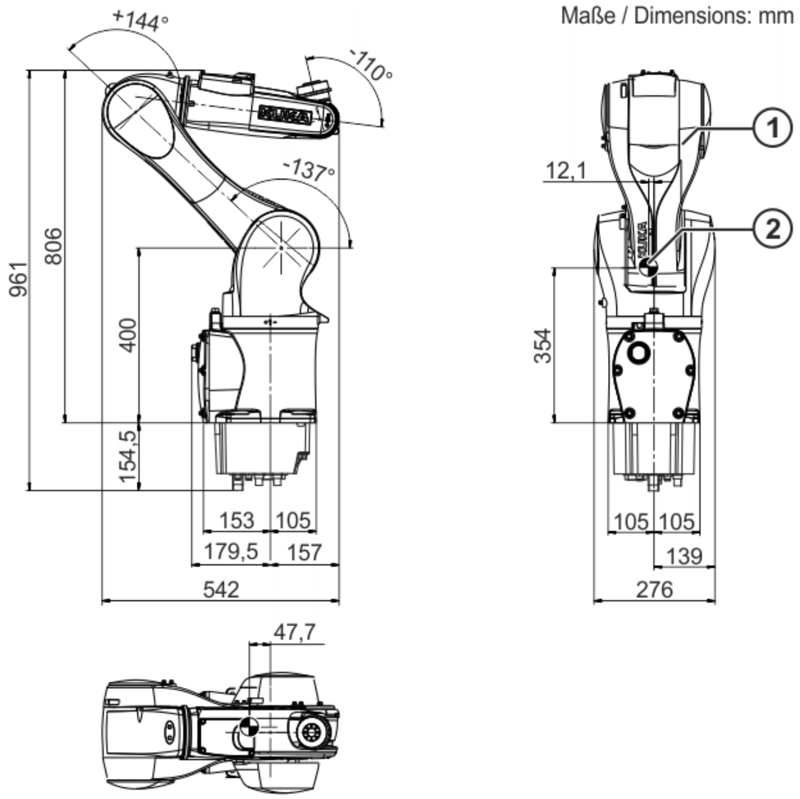


Fig. 7-3: Transport dimensions, R900

1	Robot	2	Center of gravity

The following transport dimensions (>>> Fig. 7-4) are valid for the robots:

- KR 10 R1100 sixx HM-SC
- KR 10 R1100 sixx W-HM-SC
- KR 10 R1100 sixx C-HM-SC

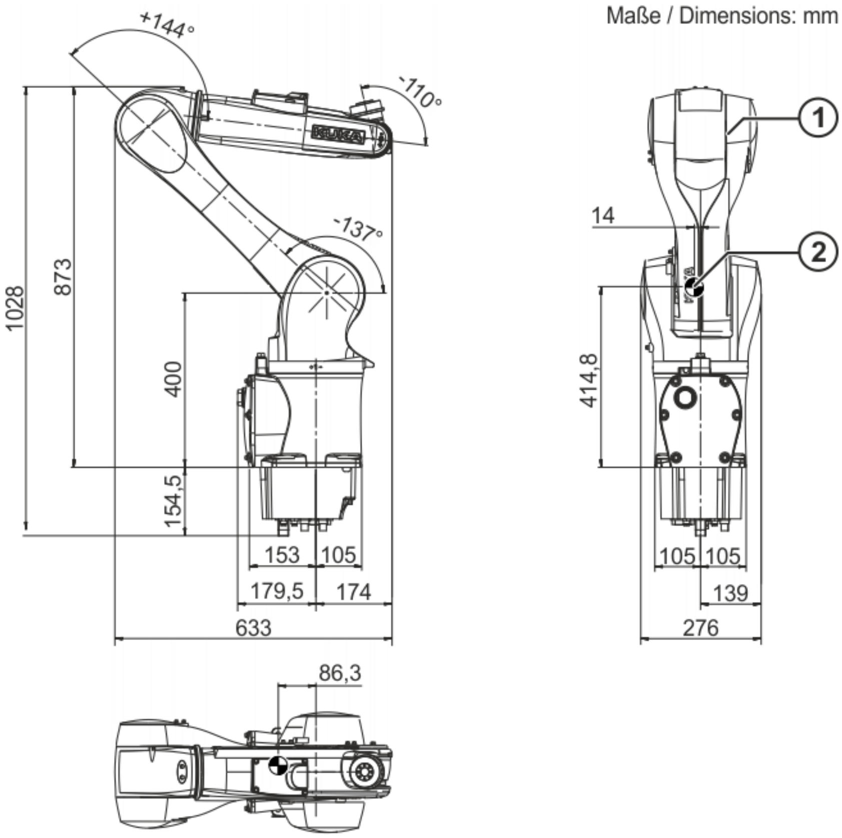


Fig. 7-4: Transport dimensions, R1100

1	Robot	2	Center of gravity

Transportation with round sling

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

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

> ⚠ **WARNING** The robot may tip during transportation. Risk of personal injury and damage to property.
> If the robot is being transported using round slings, 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!

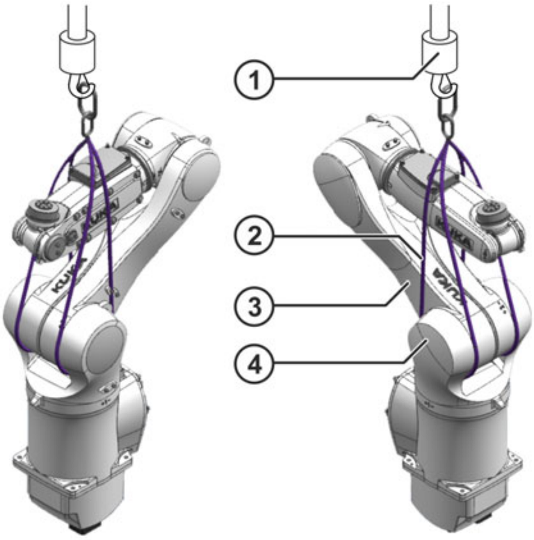


Fig. 7-5: Transportation with round slings

1	Crane	3	Link arm
2	Round sling	4	Rotating column

8 Start-up and recommissioning

CAUTION For screwed connections, the fastening screws (standard, strength class 8.8) are to be tightened with the tightening torques specified in the appendix (>>> 13 "Appendix" Page 245). Tightening torques deviating from these values are specified directly.
The specified screw sizes and strength classes are those valid at the copy deadline. The specifications contained in the Parts Catalog are, however, always to be taken as the most up-to-date information.
Screws of strength class 10.9 and higher may only be tightened once with the rated tightening torque. When the screws are first slackened they must be replaced with new ones.

8.1 Installing the machine frame mounting assembly

Description The machine frame mounting is used for installing robots on a steel structure prepared by the customer.

Precondition

- The mounting surface has been prepared as shown in the diagram .
- The substructure has been checked for sufficient safety.
- The machine frame mounting assembly is complete.

Procedure

1. Clean the mounting surface of the robot (>>> Fig. 8-1).
2. Check the hole pattern.
3. Insert 2 locating pins into the hole pattern.
4. Provide 4 M10x35-A2-70 hexagon bolts with USIT rings.

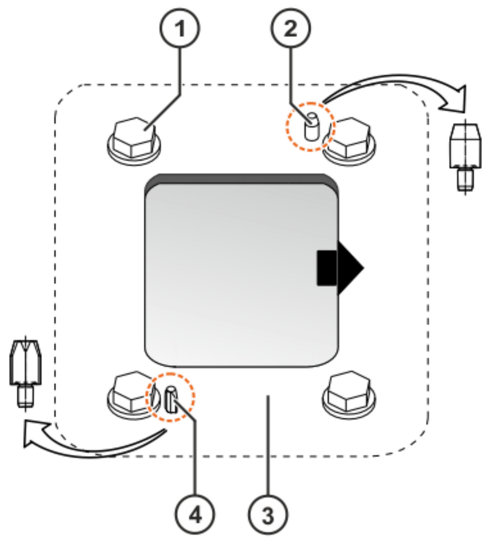


Fig. 8-1: Installing the machine frame mounting assembly

1 M10x35-8.8 hexagon bolt (4x)
2 Locating pin, cylindrical
3 Mounting surface
4 Locating pin, flat-sided

The mounting base is now ready for the robot to be installed.

8.2 Installing a floor-mounted robot

Description This description is valid for the installation of floor-mounted robots.

Fastening is carried out using 4 hexagon bolts with USIT rings. A cylindrical stepped pin and a flat-sided locating pin are provided to ensure correct positioning.

The installation and start-up of the robot controller, the tools mounted and the applications are not described here.

NOTICE The robot may only be operated with a functioning compressed air supply. The compressed air must be oil-free, dry and filtered. Damage to property may otherwise result.

⚠ CAUTION During start-up and recommissioning, compliance with the requirements of the hygiene level cannot be assured. Before the manipulator is put into operation, cleaning must be carried out in accordance with the requirements of the application.

Precondition

- The substructure is prepared for installation (hole pattern and aperture) (>>> 6.3 "Hole pattern for fastening" Page 176).
- The installation site is accessible with a crane.
- Any tools or other system components which would hinder the work have been removed.
- The robot is in the transport position.
- The connecting cables and ground conductors are routed to the robot and installed.
- There is a compressed air supply to the robot.
- Interface A1 must be accessible after fastening.

Procedure

1. Check that the locating pins are undamaged and fitted securely (>>> Fig. 8-2).
2. Bring the robot to the installation site with the crane.
3. Carefully position the robot vertically in the substructure and carefully set it down on the mounting surface. Ensure that an entirely vertical position is maintained in order to prevent damage to the locating pins.
4. Insert 4 M10x35-A2-70 hexagon bolts with USIT rings.
5. Tighten 4 M10x35-A2-70 hexagon bolts with the torque wrench in diagonally opposite sequence. Increase the tightening torque in several stages.
6. If necessary, the robot base can be sealed on the substructure by applying sealant (e.g. Terostat MS930) around its circumference.
7. Remove the round slings.
8. Connect motor cable X30 and data cable X31.

   When connecting the motor cable connectors, it must be ensured that the connectors on the controller and on the robot are locked correctly. Correct locking is indicated by an audible click. It is indicated optically by the fact that the red rings on each of the locking buttons are not visible and are pushed in completely.
9. Connect the PURGE compressed air line with max. 0.3 bar.
10. Connect the ground conductor between the robot controller and the robot to the ground conductor connection.
11. Connect the ground conductor between the system component and the robot to the ground conductor connection.
12. Check the equipotential bonding in accordance with VDE 0100 and EN 60204-1.

Further information is contained in the operating and assembly instructions of the robot controller.

13. Mount tooling, if present.
14. Retighten the 4 M10x35-A2-70 hexagon bolts with a torque wrench after 100 hours of operation.

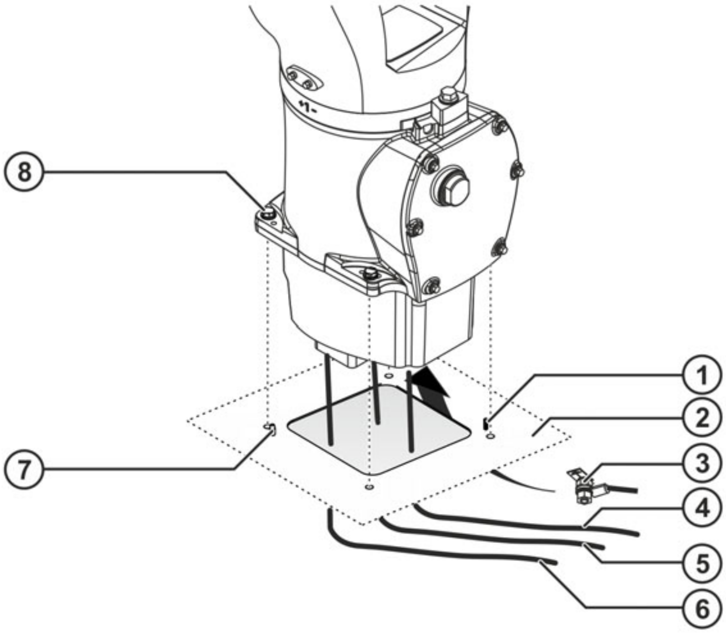


Fig. 8-2: Installing a floor-mounted robot

1	Locating pin, flat-sided	5	Data cable
2	Substructure	6	Motor cable
3	Ground conductor	7	Locating pin, cylindrical
4	Compressed air line	8	Hexagon bolt

Put the robot into operation in accordance with the “Start-up” chapter of the operating and programming instructions for the System Software and/or the assembly instructions or operating instructions for the robot controller.

NOTICE Incorrectly adjusted pressure regulators or operation with no pressure regulator may result in damage to the robot. For this reason, the robot may only be operated with a correctly adjusted pressure regulator and with the compressed air supply connected.

8.3 Installing a wall-mounted robot

Description

This description is valid for the installation of wall-mounted robots with the mounting variant “Machine frame mounting”. For installation on the wall, the robot must be fastened to the Load Lifting Attachment. The robot is fastened to the wall using the Load Lifting Attachment. The Load Lifting Attachment must then be removed.

The SC frame (optional) (>>> 12.3 "SC frame (optional)" Page 241) is available to facilitate fastening of the Load Lifting Attachment.

The installation and start-up of the robot controller, the tools mounted and the applications are not described here.

NOTICE The robot may only be operated with a functioning compressed air supply. The compressed air must be oil-free, dry and filtered. Damage to property may otherwise result.

CAUTION During start-up and recommissioning, compliance with the requirements of the hygiene level cannot be assured. Before the manipulator is put into operation, cleaning must be carried out in accordance with the requirements of the application.

Precondition

- The substructure is prepared for installation (hole pattern and aperture) (>>> 6.3 "Hole pattern for fastening" Page 176).
- The installation site is accessible with a crane.
- Any tools or other system components which would hinder the work have been removed.
- The robot is in the transport position.
- The connecting cables and ground conductors are routed to the robot and installed.
- There is a compressed air supply to the robot.
- Interface A1 must be accessible after fastening.

Procedure

1. Move the robot to the installation site with the crane and set it down on a suitable support (e.g. SC frame (>>> 12.3 "SC frame (optional)" Page 241)). Ensure that interface A1 is not damaged.
2. Carefully push the Load Lifting Attachment onto the base frame of the robot from the front (>>> Fig. 8-3).
3. Remove the round slings.
4. Fasten the robot to the front of the Load Lifting Attachment with 2 M12x30 Allen screws and washers; M_A = 40.0 Nm.

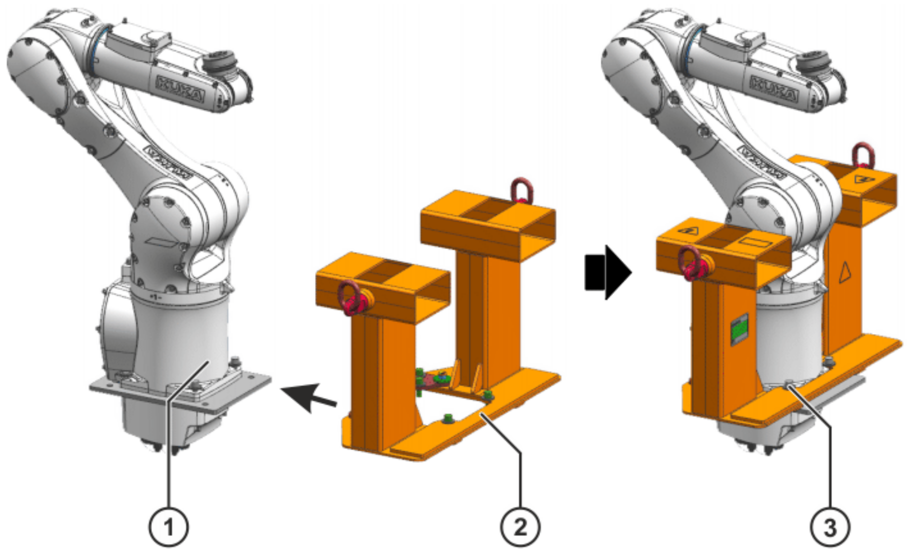


Fig. 8-3: Pushing on the Load Lifting Attachment and fastening it at the front

1	Base frame
2	Load Lifting Attachment
3	M12x30 Allen screw (front)

5. Position swivel holders on base frame (>>> Fig. 8-4).
6. Fasten the swivel holders to the rear of the base frame with 2 M12x30 Allen screws and washers; M_A = 40.0 Nm.
7. Lock the swivel holders to the Load Lifting Attachment with 2 M12x30 Allen screws and washers.

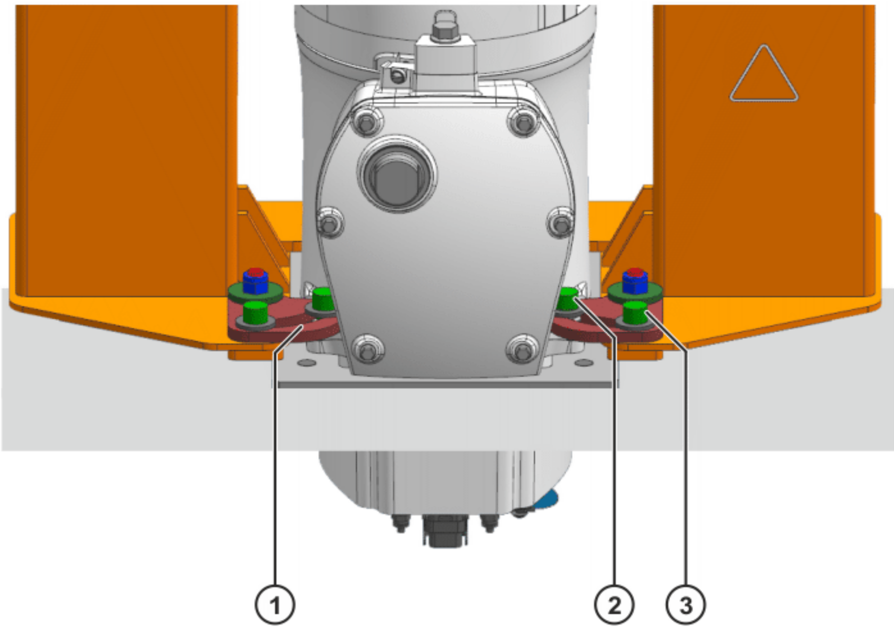


Fig. 8-4: Positioning and fastening the swivel holders

1	Swivel holder
2	M12x30 Allen screw (rear)
3	M12x30 Allen screw (locking screw)

8. Attach round slings to the 2 rotating swivel eyebolts on the Load Lifting Attachment and to the crane.
9. Person 1:

   Slowly and carefully lift the robot with the crane.

   Person 2:

   Secure the robot against toppling during the lifting operation.

⚠ WARNING Ensure that the robot does not topple during the lifting operation. Serious injuries and damage to property may otherwise result.

10. Slowly rotate the robot through 90°. The arm must point downward.
11. Lift the Load Lifting Attachment with a fork lift truck (>>> Fig. 8-5).

    The fork lift truck must remain in the fork slots of the Load Lifting Attachment during installation in order to prevent slipping.

NOTICE When picking up the Load Lifting Attachment with the fork lift truck, the width of the fork slots (140 mm) must be taken into consideration. Damage to property may otherwise result.

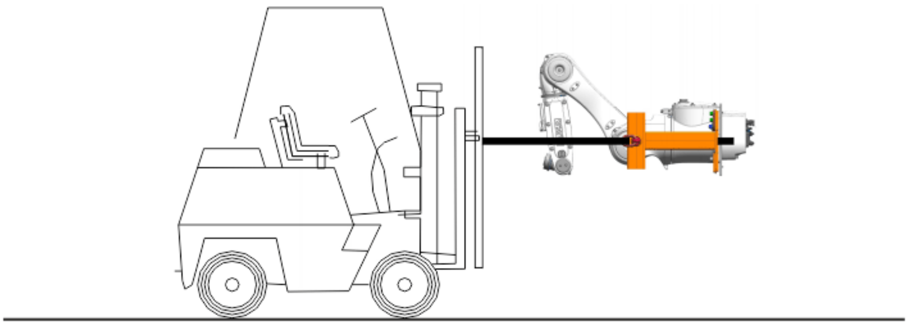


Fig. 8-5: Lifting the Load Lifting Attachment with a fork lift truck

12. Position the robot on the wall using the fork lift truck. Ensure that an entirely horizontal position is maintained in order to prevent damage to the pins.
13. Unscrew 2 M12x30 Allen screws (top Allen screws) and washers from the top of the base frame (>>> Fig. 8-6).
14. Unscrew 2 M12x30 Allen screws (locking screws) and washers from the Load Lifting Attachment.

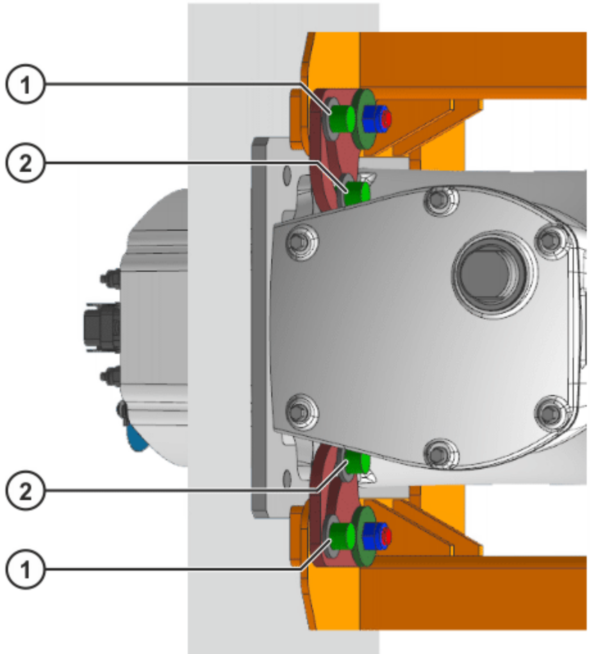


Fig. 8-6: Removing the top screws

1 M12x30 Allen screw (top)
2 M12x30 Allen screw (locking screw)

15. Rotate the swivel holders outwards (>>> Fig. 8-7).
16. Fasten the robot to the wall with 2 M10x35-A2-70 hexagon bolts (top hexagon bolts) and USIT rings at the top.

    Tighten the hexagon bolts alternately with the torque wrench. Gradually increase the tightening torque to 30.5 Nm.

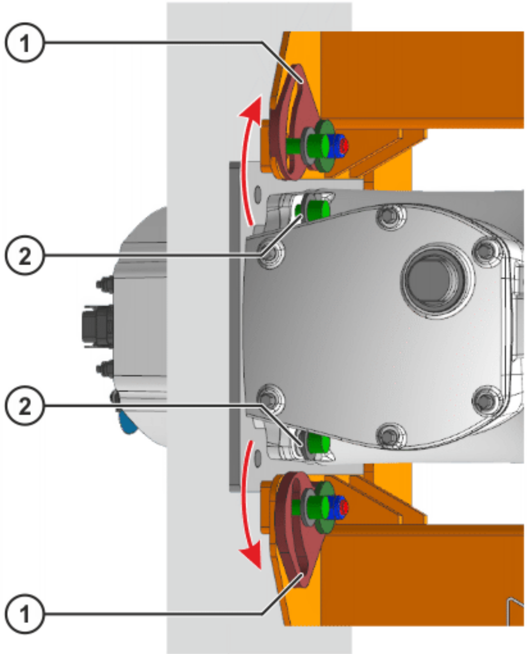


Fig. 8-7: Rotating the swivel holders outwards

1 Swivel holder
2 M10x35-A2-70 hexagon bolt (top)

17. Unscrew 2 M12x30 Allen screws (bottom Allen screws) and washers from the bottom of the base frame.
18. Carefully separate the Load Lifting Attachment from the bottom of the base frame with the fork lift truck.
19. Fasten the robot to the wall with 2 M10x35-A2-70 hexagon bolts and USIT rings on the bottom of the base frame.

    Tighten the hexagon bolts alternately with the torque wrench. Gradually increase the tightening torque to 30.5 Nm.
20. If necessary, the robot base can be sealed on the substructure by applying sealant (e.g. Terostat MS930) around its circumference.
21. Connect motor cable X30 and data cable X31 (>>> Fig. 8-8).

    When connecting the motor cable connectors, it must be ensured that the connectors on the controller and on the robot are locked correctly. Correct locking is indicated by an audible click. It is indicated optically by the fact that the red rings on each of the locking buttons are not visible and are pushed in completely.
22. Connect the ground conductor between the robot controller and the robot to the ground conductor connection.

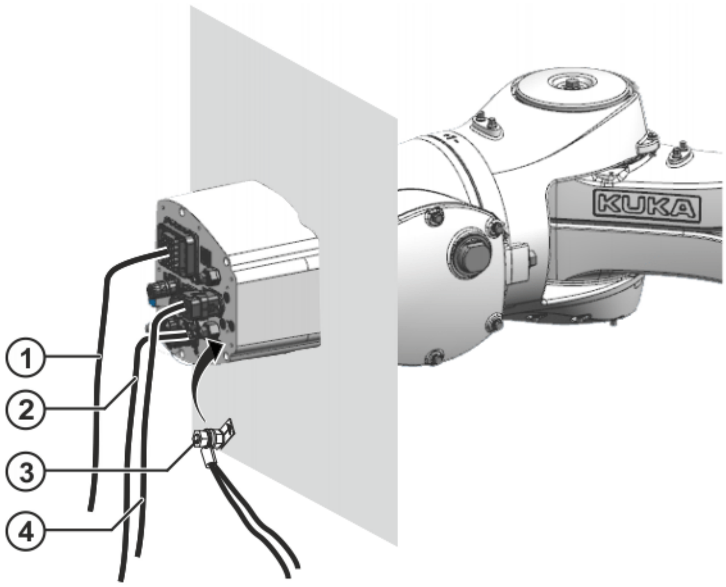


Fig. 8-8: Connecting the supply lines

1	Motor cable	3	Ground conductor
2	Compressed air line	4	Data cable

23. Check the equipotential bonding in accordance with VDE 0100 and EN 60204-1.

Further information is contained in the operating and assembly instructions of the robot controller.

24. Connect the ground conductor between the system component and the robot to the ground conductor connection.
25. Mount tooling, if present.
26. Retighten the 4 hexagon bolts with a torque wrench after 100 hours of operation.

Put the robot into operation in accordance with the “Start-up” chapter of the operating and programming instructions for the System Software and/or the assembly instructions or operating instructions for the robot controller.

NOTICE Incorrectly adjusted pressure regulators or operation with no pressure regulator may result in damage to the robot. For this reason, the robot may only be operated with a correctly adjusted pressure regulator and with the compressed air supply connected.

8.4 Installing a ceiling-mounted robot

Description

This description is valid for the installation of ceiling-mounted robots. The mounting base or machine frame mounting assembly is used for this purpose. For installation on the ceiling, the robot must be fastened to the Load Lifting Attachment. The robot is fastened to the ceiling using the Load Lifting Attachment. The Load Lifting Attachment must then be removed.

The SC frame (optional) (>>> 12.3 "SC frame (optional)" Page 241) is available to facilitate fastening of the Load Lifting Attachment.

The installation and start-up of the robot controller, the tools mounted and the applications are not described here.

NOTICE The robot may only be operated with a functioning compressed air supply. The compressed air must be oil-free, dry and filtered. Damage to property may otherwise result.

⚠ CAUTION During start-up and recommissioning, compliance with the requirements of the hygiene level cannot be assured. Before the manipulator is put into operation, cleaning must be carried out in accordance with the requirements of the application.

Precondition

- The substructure is prepared for installation (hole pattern and aperture) (>>> 6.3 "Hole pattern for fastening" Page 176).
- The installation site is accessible with a crane.
- Any tools or other system components which would hinder the work have been removed.
- The robot is in the transport position.
- The connecting cables and ground conductors are routed to the robot and installed.
- There is a compressed air supply to the robot.
- Interface A1 must be accessible after fastening.

Procedure

1. Move the robot to the installation site with the crane and set it down on a suitable support (e.g. SC frame (>>> 12.3 "SC frame (optional)" Page 241)). Ensure that interface A1 is not damaged.
2. Carefully push the Load Lifting Attachment onto the base frame of the robot from the front (>>> Fig. 8-9).
3. Remove the round slings.
4. Fasten the robot to the front of the Load Lifting Attachment with 2 M12x30 Allen screws and washers; M_A = 40.0 Nm.

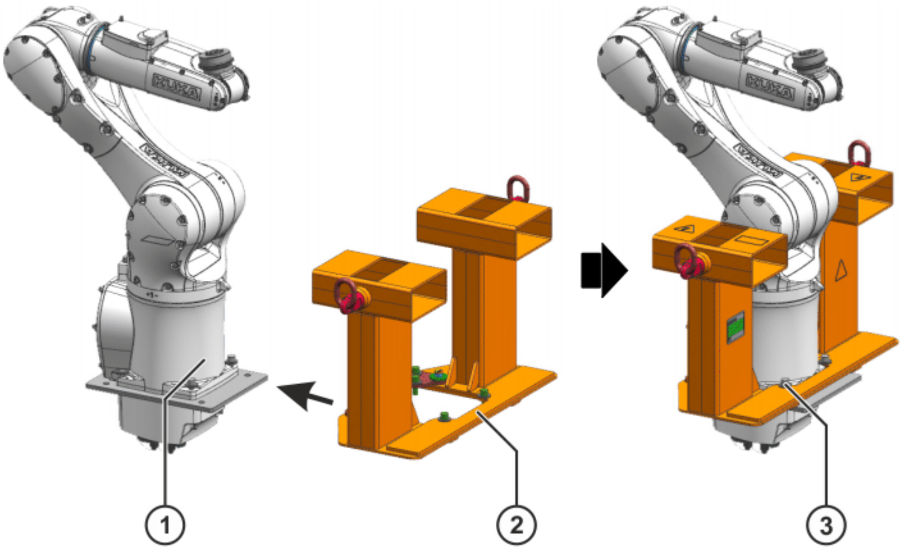


Fig. 8-9: Pushing on the Load Lifting Attachment and fastening it at the front

1 Base frame
2 Load Lifting Attachment
3 M12x30 Allen screw (front)

5. Position swivel holders on base frame (>>> Fig. 8-10).
6. Fasten the swivel holders to the rear of the base frame with 2 M12x30 Allen screws and washers; M_A = 40.0 Nm.

7. Lock the swivel holders to the Load Lifting Attachment with 2 M12x30 Allen screws and washers.

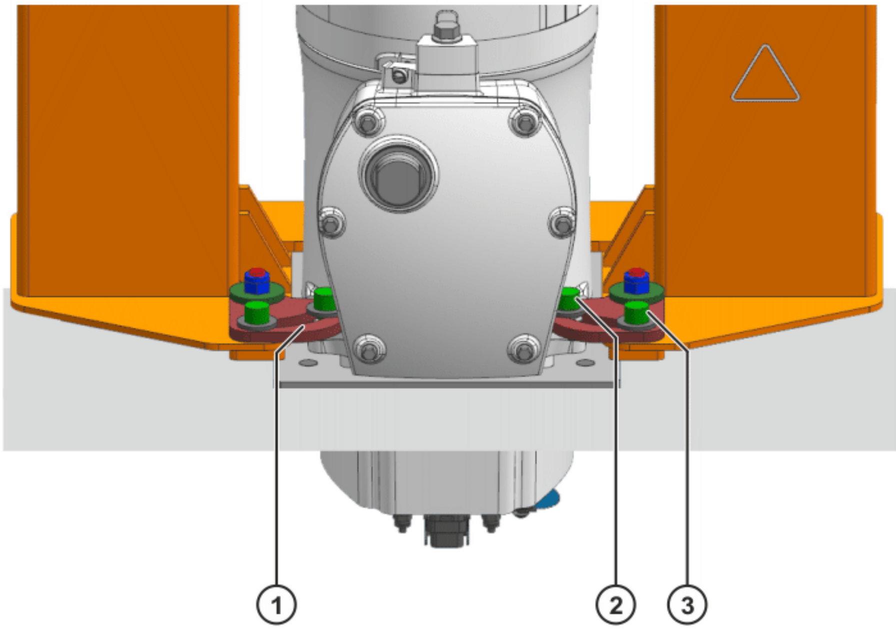


Fig. 8-10: Positioning and fastening the swivel holders

1	Swivel holder
2	M12x30 Allen screw (rear)
3	M12x30 Allen screw (locking screw)

8. Attach round slings to the 2 rotating swivel eyebolts on the Load Lifting Attachment and to the crane.
9. Person 1:

   Slowly and carefully lift the robot with the crane.

   Person 2:

   Secure the robot against toppling during the lifting operation.

> **⚠ WARNING** Ensure that the robot does not topple during the lifting operation. Serious injuries and damage to property may otherwise result.

10. Slowly rotate the robot through 180° and lower it.
11. Lift the Load Lifting Attachment with a fork lift truck (>>> Fig. 8-11).

    The fork lift truck must remain in the fork slots of the Load Lifting Attachment during installation in order to prevent slipping.

> **NOTICE** When picking up the Load Lifting Attachment with the fork lift truck, the width of the fork slots (140 mm) must be taken into consideration. Damage to property may otherwise result.

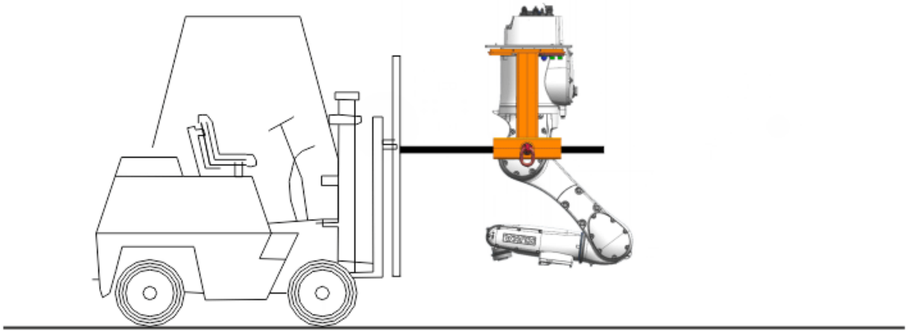


Fig. 8-11: Lifting the Load Lifting Attachment with a fork lift truck

12. Position the robot on the ceiling using the fork lift truck. Ensure that an entirely vertical position is maintained in order to prevent damage to the pins.
13. Unscrew 2 M12x30 Allen screws (rear Allen screws) and washers from the rear of the base frame (>>> Fig. 8-12).
14. Unscrew 2 M12x30 Allen screws (locking screws) and washers from the Load Lifting Attachment.

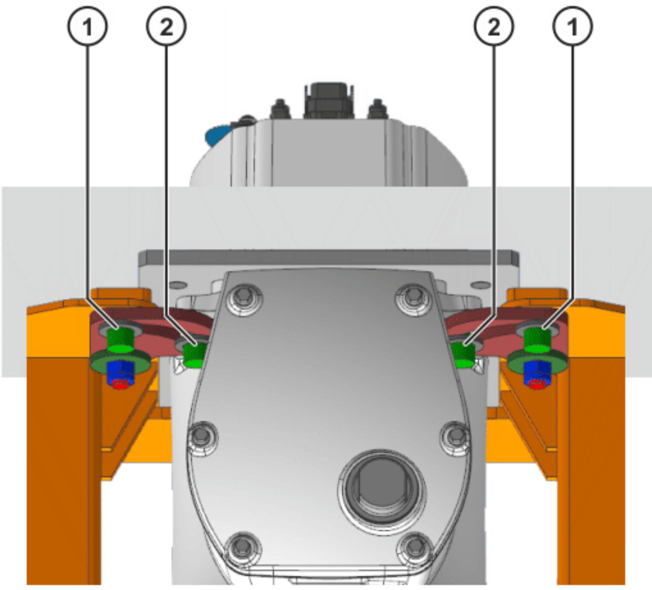


Fig. 8-12: Removing screws from the rear

1 M12x30 Allen screw (rear)
2 M12x30 Allen screw (locking screw)

15. Rotate the swivel holders outwards (>>> Fig. 8-13).
16. Fasten the robot to the ceiling with 2 M10x35-A2-70 hexagon bolts (rear hexagon bolts) and USIT rings at the back.

    Tighten the hexagon bolts alternately with the torque wrench. Gradually increase the tightening torque to 30.5 Nm.

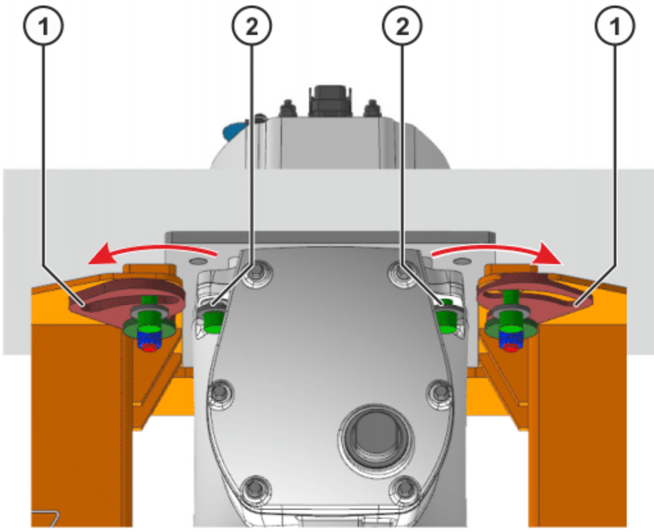


Fig. 8-13: Rotating the swivel holders outwards

1 Swivel holder
2 M10x35-A2-70 hexagon bolt (back)

17. Unscrew 2 M12x30 Allen screws (front Allen screws) and washers from the front of the base frame.
18. Carefully push the Load Lifting Attachment down from the back of the base frame with the fork lift truck.
19. Fasten the robot to the ceiling with 2 M10x35-A2-70 hexagon bolts and USIT rings on the front of the base frame.

    Tighten the hexagon bolts alternately with the torque wrench. Gradually increase the tightening torque to 30.5 Nm.
20. If necessary, the robot base can be sealed on the substructure by applying sealant (e.g. Terostat MS930) around its circumference.
21. Connect motor cable X30 and data cable X31 (>>> Fig. 8-14).

    When connecting the motor cable connectors, it must be ensured that the connectors on the controller and on the robot are locked correctly. Correct locking is indicated by an audible click. It is indicated optically by the fact that the red rings on each of the locking buttons are not visible and are pushed in completely.
22. Connect the ground conductor between the robot controller and the robot to the ground conductor connection.

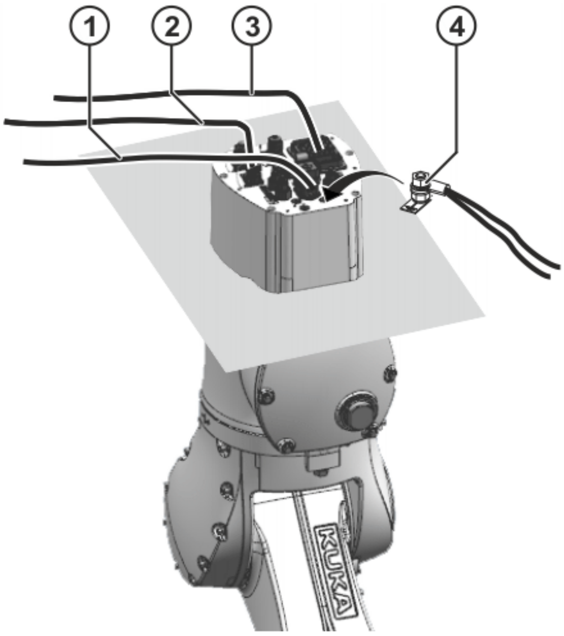


Fig. 8-14: Connecting the supply lines

1	Data cable	3	Motor cable
2	Compressed air line	4	Ground conductor

23. Check the equipotential bonding in accordance with VDE 0100 and EN 60204-1.

> Further information is contained in the operating and assembly instructions of the robot controller.

24. Connect the ground conductor between the system component and the robot to the ground conductor connection.
25. Mount tooling, if present.
26. Retighten the 4 M10x35-A2-70 hexagon bolts with a torque wrench after 100 hours of operation.

Put the robot into operation in accordance with the "Start-up" chapter of the operating and programming instructions for the System Software and/or the assembly instructions or operating instructions for the robot controller.

> **NOTICE** Incorrectly adjusted pressure regulators or operation with no pressure regulator may result in damage to the robot. For this reason, the robot may only be operated with a correctly adjusted pressure regulator and with the compressed air supply connected.

8.5 Description of the connecting cables

Configuration

The connecting cables are used to transfer power and signals between the robot controller and the robot.

The connecting cables comprise:

- Motor cable
- Data cable
- CAT5 data cable (optional)
- Connecting cable, external axes A7 and A8 (optional)
- Ground conductor (optional)

Interface

For connection of the connecting cables between the robot controller and the robot, the following connectors are available at the interfaces:

Cable designation	Connector designation robot controller - robot	Interface with robot
Motor cable	X20 - X30	Han Yellock 30
Data cable	X21 - X31	Han Q12
CAT5 data cable (can be ordered as an option)	X65/X66 - XPN1	M12 connector
Connecting cable, external axes A7 and A8 (can be ordered as an option)	XP7 - XP7.1 XP8 - XP8.1	Connector M17 in each case
Ground conductor / equipotential bonding (can be ordered as an option)		M4 ring cable lug

Only resolvers can be connected to the connections XP7.1 and XP8.1.

For the connecting cables, a ground conductor is always required to provide a low-resistance connection between the robot and the control cabinet in accordance with DIN EN 60204. The ground conductor is not part of the scope of supply and can be ordered as an option. The connection must be made by the customer. The tapped holes for connecting the ground conductor are located on interface A1 of the robot.

Standard connecting cable

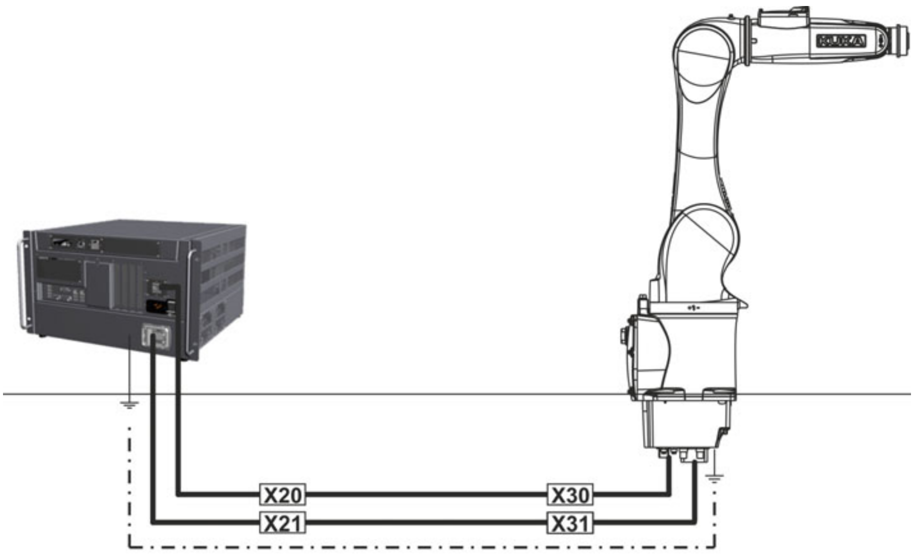


Fig. 8-15: Connecting cables, overview

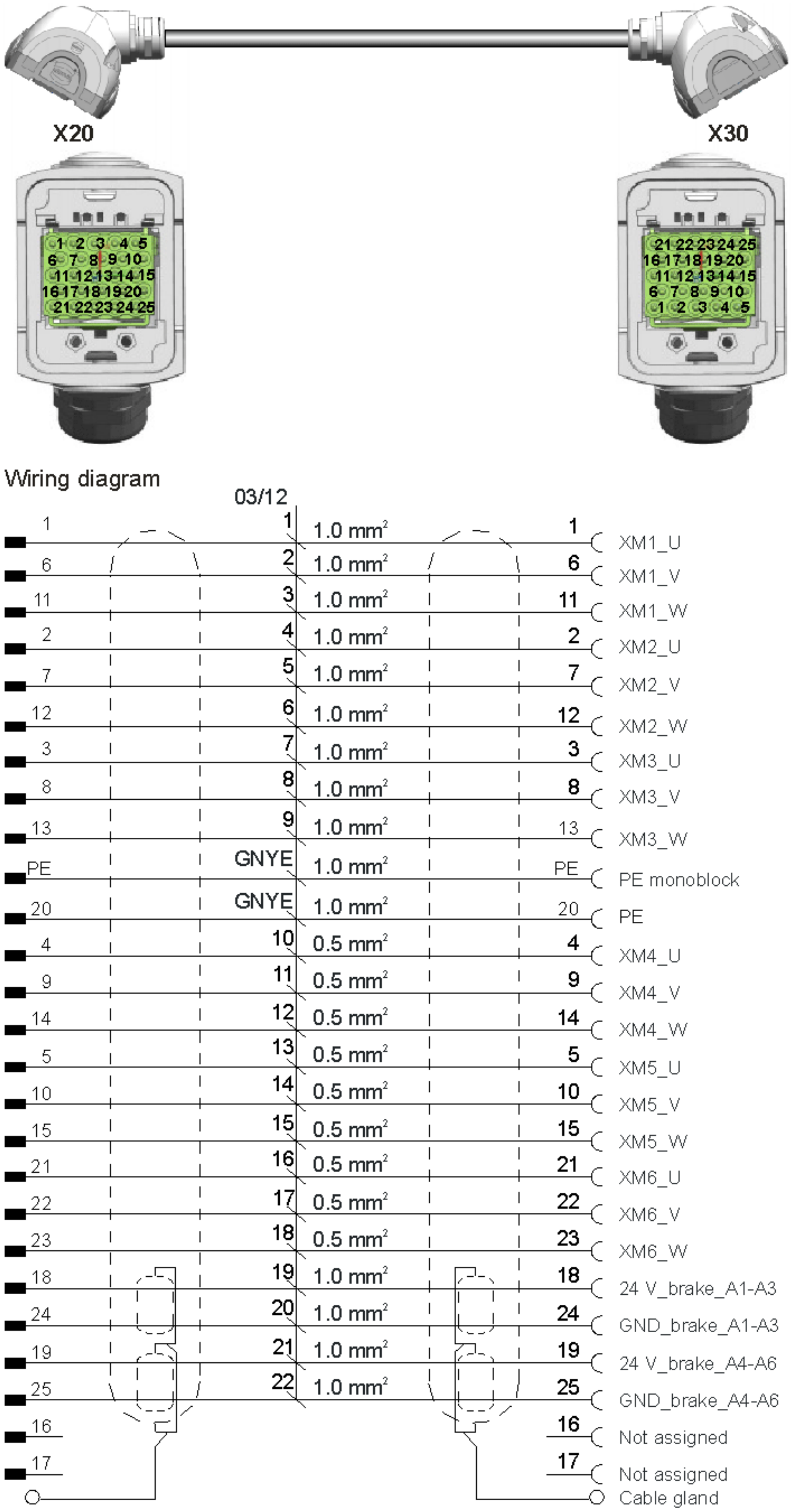


Fig. 8-16: Connecting cable, motor cable, X20 - X30

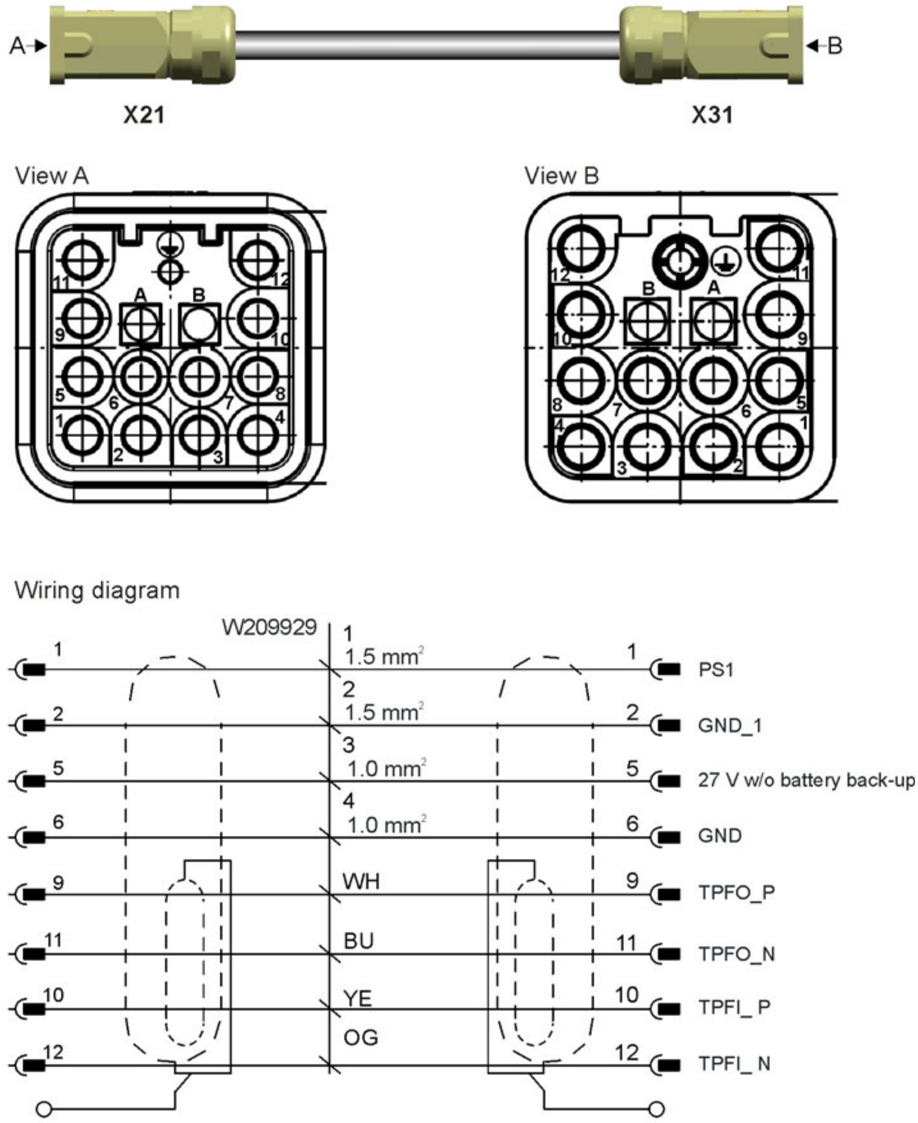


Fig. 8-17: Connecting cable, data cable X21 - X31

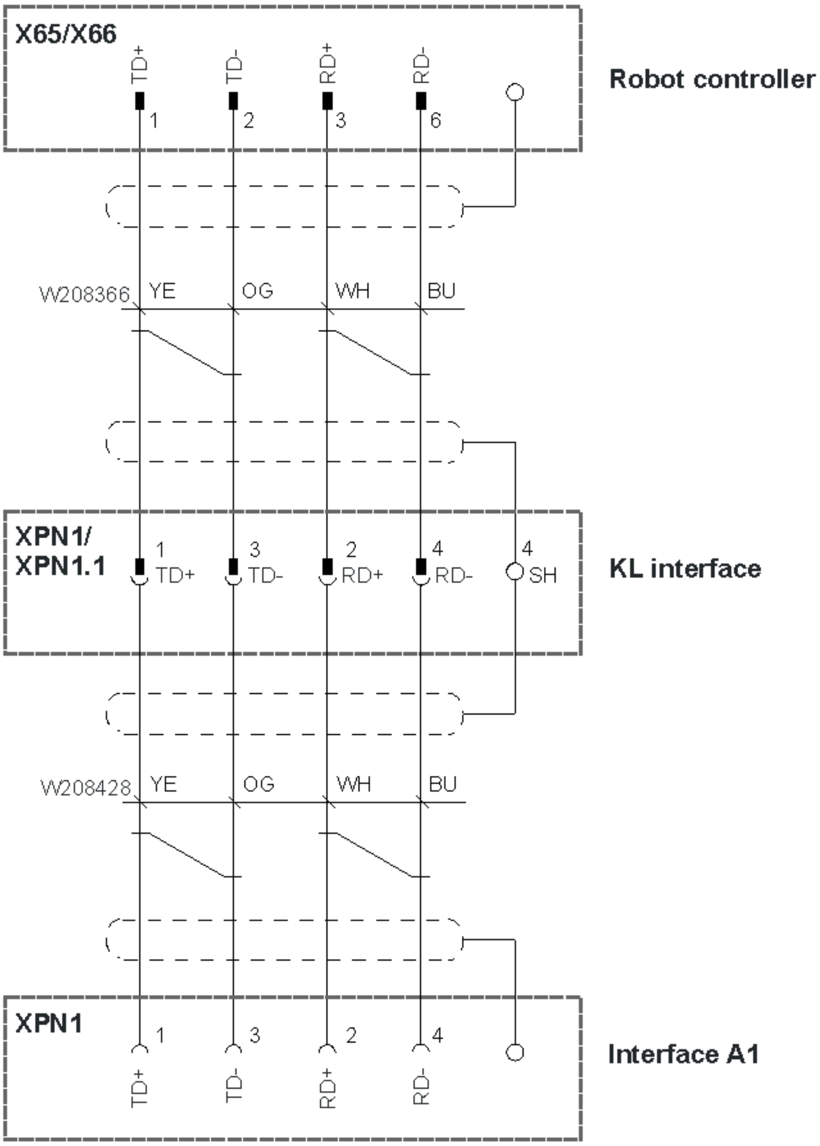


Fig. 8-18: Connecting cable, data cable CAT5 X65/X66 - XPN1

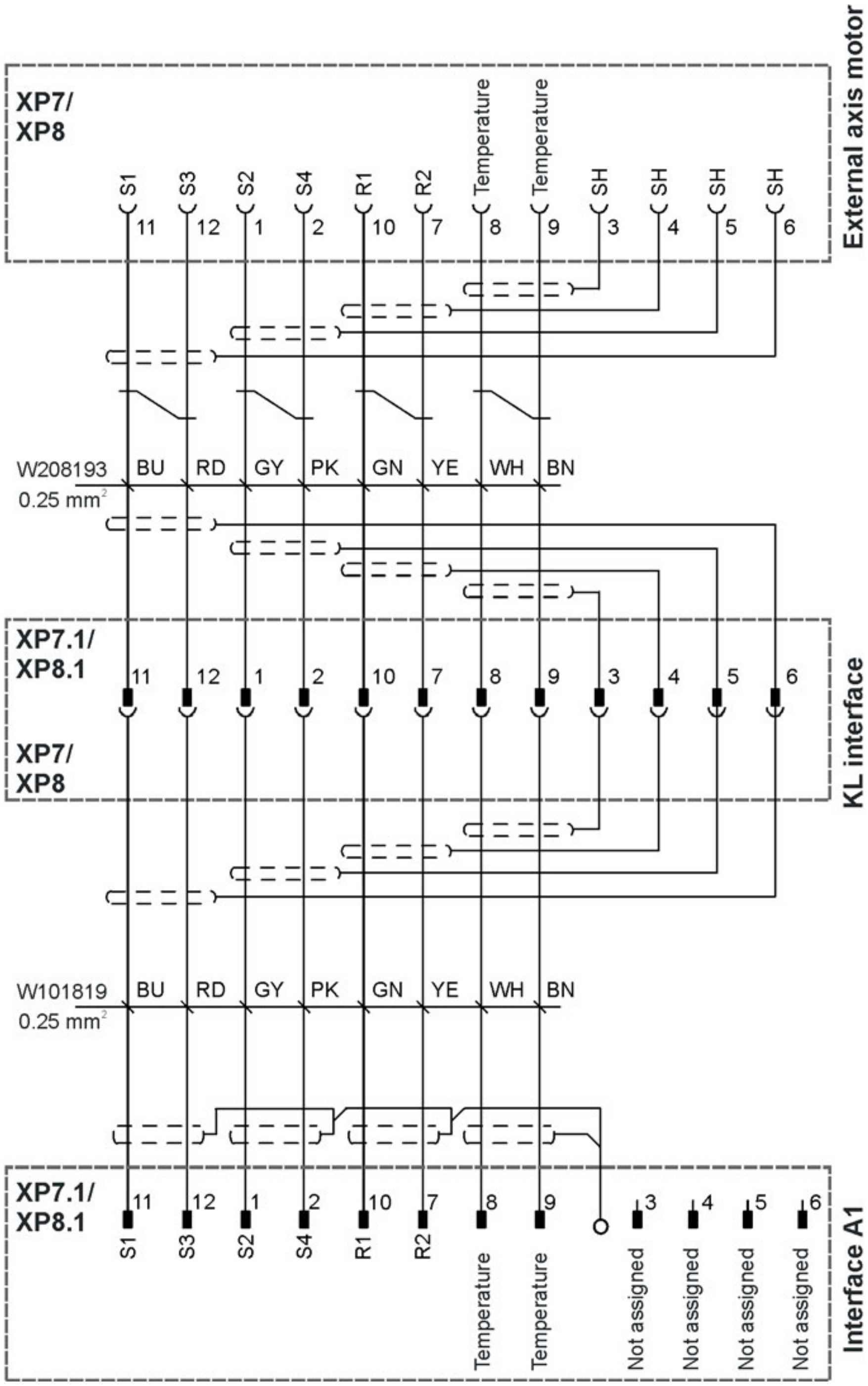


Fig. 8-19: Connecting cable, external axes A7 and A8

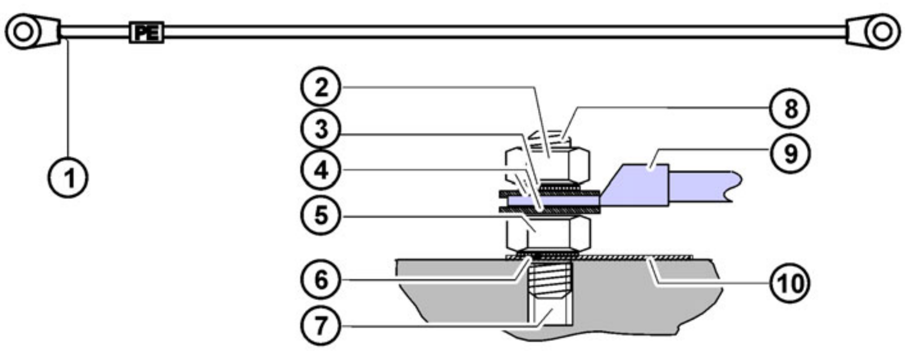


Fig. 8-20: Connecting cable, ground conductor

1	Ground conductor	6	Conical spring washer
2	Hexagon nut	7	Robot
3	Conical spring washer	8	Setscrew, M4
4	2x plain washer	9	Ground conductor connection M4 ring cable lug
5	Hexagon nut	10	Ground sign

8.6 Mastering A6

Description

Before mastering A6, the adapter must be removed from the mounting flange. Only then is the line mark on the mounting flange visible.

Precondition

- No tool or fixture on the in-line wrist

> **⚠ WARNING** Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot, the robot must be secured by activating the EMERGENCY STOP device.
> Warn all persons concerned before starting to put it back into operation.

Procedure

1. Unscrew the M3 domed cap nut from the adapter.
2. Remove the sealing washer that comes free.
3. Carefully pull the adapter including seal off the mounting flange.
   During removal, the seal remains in the adapter.
4. Carry out mastering.

> **i** Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

5. Carefully push the adapter including seal onto the mounting flange and position it. Ensure that the seal is not damaged.

> **NOTICE** In order to ensure that the protection classification is met after mastering, the seal must be functional and the compressed air supply active.

6. Fit the sealing washer on the M3 domed cap nut and fasten the adapter; M_A = 0.8 Nm.

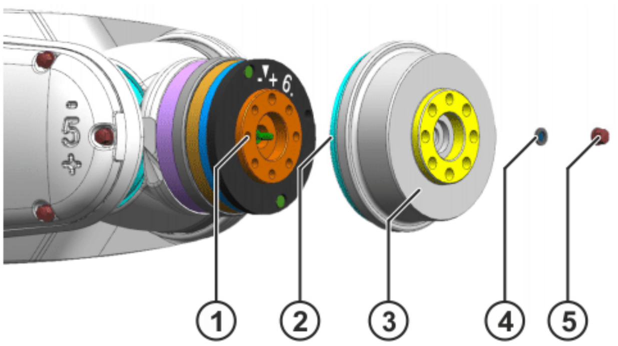


Fig. 8-21: Mastering A6

1	Mounting flange	4	Sealing washer
2	Seal	5	Domed cap nut
3	Adapter		

8.7 Moving the manipulator without drive energy

Description

The brake release device (optional) an be used for moving the manipulator after an accident or malfunction without drive energy.

This option is only for use in exceptional circumstances and emergencies, e.g. for freeing people.

Precondition

- The robot controller must be switched off and secured (e.g. with a padlock) to prevent unauthorized persons from switching it on again.

Procedure

⚠ WARNING Use of the brake release device may result in unexpected robot motions, especially sagging of the axes. During use of the brake release device, attention must be paid to motion of this kind in order to be able to prevent physical injuries or damage to property. Standing under moving axes is not permitted.

SAFETY INSTRUCTIONS The following procedure must be followed exactly!

1. Unplug motor cable X30 on the robot.
2. Plug connector X20 into the brake release device and connector X30 into the robot.
3. Plug connector X1 of the hand-held device into the brake release device.
4. Select the brakes to be released (main axes, wrist axes) via the selection switch on the brake release device.
5. Press the button on the hand-held device.

   The brakes of the main axes or wrist axes are released and the robot can be moved manually.

Further information about the brake release device can be found in the documentation for the brake release device.

9 Maintenance

> **⚠ CAUTION** For screwed connections, the fastening screws (standard, strength class 8.8) are to be tightened with the tightening torques specified in the appendix (>>> 13 "Appendix" Page 245).
> Tightening torques deviating from these values are specified directly.
> The specified screw sizes and strength classes are those valid at the copy deadline. The specifications contained in the Parts Catalog are, however, always to be taken as the most up-to-date information.
> Screws of strength class 10.9 and higher may only be tightened once with the rated tightening torque. When the screws are first slackened they must be replaced with new ones.

9.1 Maintenance overview

Description

The table provides an overview of the maintenance work (maintenance intervals, activities, lubrication work) and required lubricants applicable to this robot.

The maintenance intervals given in the table are valid for the operating conditions specified in the technical data. KUKA Deutschland GmbH must be consulted in the case of discrepancies!

> **i** Further information can be found in the section “Information for planning” (>>> 6.1 "Information for planning" Page 175).

Precondition

- The maintenance points must be freely accessible.
- Remove the tools and any additional items of equipment if they impede maintenance work.

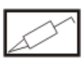
> **⚠ WARNING** Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot, the robot must be secured by activating the EMERGENCY STOP device.
> Warn all persons concerned before starting to put it back into operation.

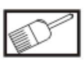
9.1.1 Maintenance table

Maintenance symbols

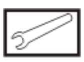
> **i** The overview may contain maintenance symbols that are not relevant for the maintenance work on this product. The maintenance illustrations provide an overview of the relevant maintenance work.

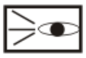

Oil change

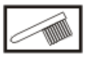

Lubricate with grease gun

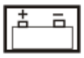

Lubricate with brush


Lubricate with spray grease

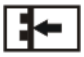

Tighten screw/nut

 Check component, visual inspection

 Clean component

 Exchange battery

 Exchanging the toothed belt

 Check toothed belt tension

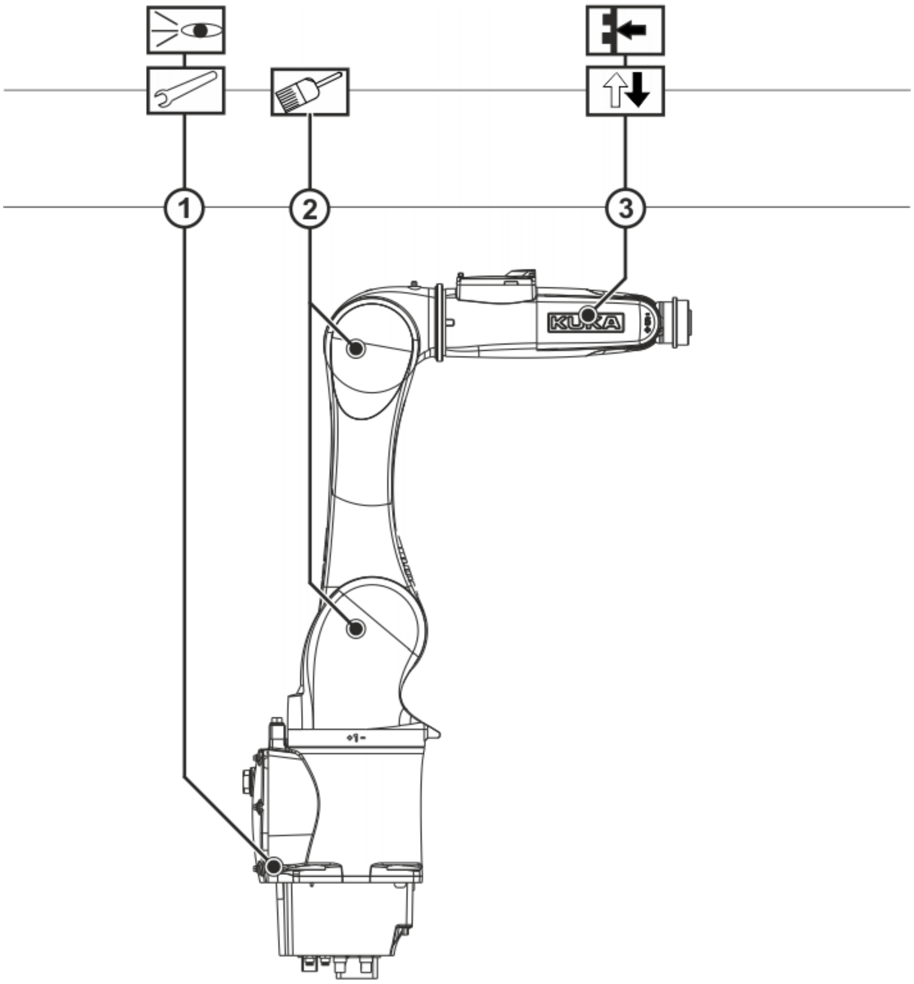


Fig. 9-1: Maintenance work

Interval	Item	Activity	Lubricant
100 h*	1	Check the tightening torque of the 4 holding-down bolts on the mounting base. M_A = 30.5 Nm * Once only, after initial start-up or recommissioning.	-
1 year	1	If using a mounting base, check the tightening torque of the 4 holding-down bolts. M_A = 45 Nm	-

Interval	Item	Activity	Lubricant
5,000 h or 1 year at the latest	2	Grease the inside of covers A2 and A3. (>>> 9.2 "Greasing the inside of covers A2 and A3" Page 215)	Klüberfood NH1 34-401 grease 00-286-279 10 g
5,000 h or 1 year at the latest	3	Exchange toothed belts on A5 and A6. (>>> 9.3 "Exchanging the toothed belts" Page 216)	-

9.2 Greasing the inside of covers A2 and A3

Description

The inside of the covers must be greased.

Precondition

- Arm and in-line wrist are horizontal.

> **⚠ WARNING** Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot, the robot must be secured by activating the EMERGENCY STOP device.
> Warn all persons concerned before starting to put it back into operation.

> **⚠ 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.

Procedure

1. Remove the following hexagon screws and USIT rings from cover A2 and take off cover A2 together with the seal (>>> Fig. 9-2):
   - 3 M4x16-A2-70 hexagon screws
   - 2 M4x25-A2-70 hexagon screws
   - 5 M4x35-A2-70 hexagon screws
2. Remove 7 M3x10 cap screws and sealing washers from cover A3 and take off cover A3 together with the seal.

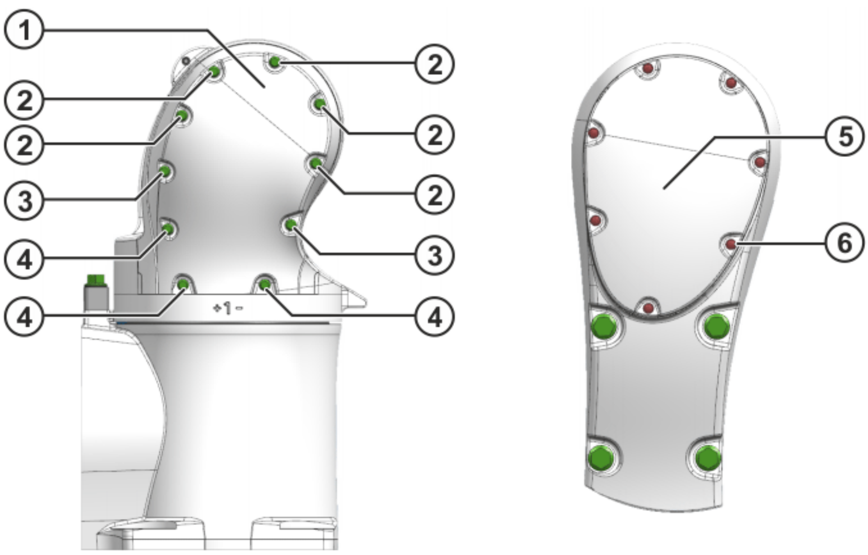


Fig. 9-2: Removing covers A2 and A3

1 Cover A2
2 M4x35-A2-70 hexagon screws
3 M4x25-A2-70 hexagon screws
4 M4x16-A2-70 hexagon screws
5 Cover A3
6 M3x10 cap screw

3. Remove the seals from the covers and dispose of them in accordance with the pertinent regulations.
4. Clean the sealing surfaces of the cover and housing and check them for damage. In the case of damage, inform KUKA Service.
5. Grease the inside of both covers with Klüberfood NH1 34-4.
6. Mount a new seal in each cover.

In order to ensure that the protection classification is met after maintenance and repair work, the seal must be functional and the compressed air supply active.

7. Fit cover A2 and fasten it with the following new hexagon screws and new USIT rings:
   - Tighten 3 M4x16-A2-70 hexagon screws; tightening torque M_A= 1.9 Nm.
   - Tighten 2 M4x25-A2-70 hexagon screws; tightening torque M_A= 1.9 Nm.
   - Tighten 5 M4x35-A2-70 hexagon screws; tightening torque M_A= 1.9 Nm.
8. Fit cover A3 and fasten it with 7 new M3x10 cap screws and new sealing washers; tightening torque M_A = 0.8 Nm.

9.3 Exchanging the toothed belts

Description

The toothed belts of axes 5 and 6 may only be removed and installed together.

Precondition

- The arm is in the horizontal position.
- The wrist axes are in their zero positions.
- No tools are installed on axis 6.

⚠ WARNING Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot, the robot must be secured by activating the EMERGENCY STOP device.
Warn all persons concerned before starting to put it back into operation.

⚠ CAUTION If the toothed belt is removed and installed immediately after the robot has stopped operating, surface temperatures are likely to be high and could result in burn injuries; there is also a risk of hands and fingers being pinched or crushed.
Protective gloves must be worn.

Procedure

1. Remove 7 M3x10 cap screws and sealing washers from the cover and take off the cover together with the seal (>>> Fig. 9-3).

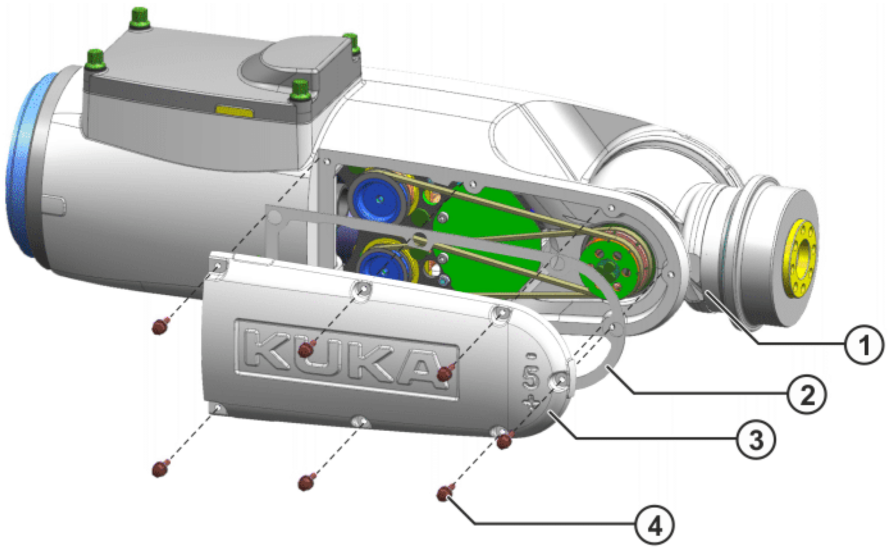


Fig. 9-3: Removing the cover from the in-line wrist – example

1	In-line wrist	3	Cover
2	Seal	4	Cap screw

2. Slacken 2 M4x10-10.9 fillister head screws on motor A5 and motor A6. (>>> Fig. 9-4)
3. Take the old toothed belts A5 and A6 off the pulleys.

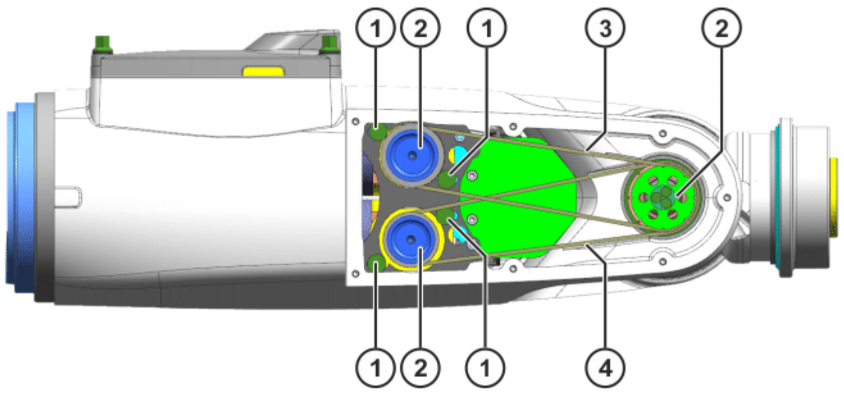


Fig. 9-4: Removing the toothed belt – example

1	Fillister head screw	3	Toothed belt A5
2	Toothed belt pulley	4	Toothed belt A6

4. Fit new toothed belts A5 and A6 in the in-line wrist. Ensure that the toothed belts mesh properly with the toothed belt pinions (>>> Fig. 9-5).

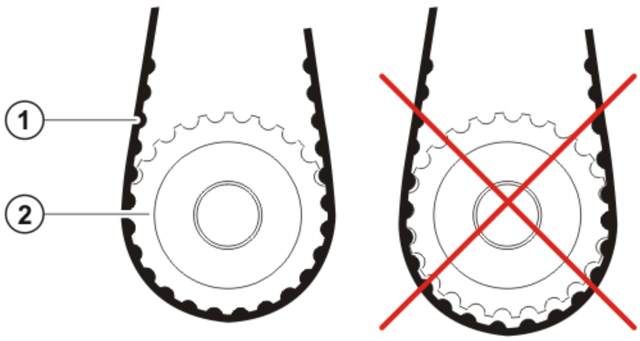


Fig. 9-5: Toothed belt and toothed belt pinion

1 Toothed belt 2 Toothed belt pinion

5. Measure and adjust the toothed belt tension.
   (>>> 10.1 "Measuring and adjusting the toothed belt tension" Page 223)
6. Clean the sealing surfaces of the cover and housing and check them for damage. In the case of damage, inform KUKA Service.
7. Insert a new seal into the cover.

> In order to ensure that the protection classification is met after maintenance and repair work, the seal must be functional and the compressed air supply active.

8. Fit cover and fasten it with 7 new M3x10 cap screws and new sealing washers; tightening torque M_A = 0.8 Nm.
9. To perform mastering, remove the mounting flange A6.
   (>>> 8.6 "Mastering A6" Page 211)
10. Carry out mastering of axes 5 and 6.

> Detailed information about mastering is contained in the operating and programming instructions for end users or system integrators.

9.4 Cleaning the robot

Description

The following cleaning recommendations assume typical impurities found in the foodstuffs industry, e.g. fats, proteins, mono-, di- and polysaccharides, and microorganisms. Special areas of application and usage of the robot can necessitate additional measures and changes to the cleaning intervals. In this case, KUKA Deutschland GmbH must be consulted.

Remove foodstuffs and sensitive system components from the working envelope of the robot. Move the robot so that all points are easily accessible, e.g. vertical stretch or cannon position. Remove any tools and equipment that would impede the work.

	A1	A2	A3	A4	A5	A6
Vertical position	0°	-90°	0°	0°	0°	0°
Cannon position	0°	-90°	+90°	0°	0°	0°

Cleaning agents with the following base substances are suitable for cleaning the robot arm, provided that the maximum permissible concentrations are observed.

Base substances	Max. concentration
Formalin	37%
Ammonia	25%
Hydrogen peroxide	30%
Isopropanol	100%
Ethanol	99.5%

The following cleaning agents are recommended for cleaning, provided that the maximum permissible concentrations are observed. It must be ensured that a maximum duration of exposure of 1 hour and a cleaning temperature of 40 °C (313 K) are not exceeded.

Cleaning agents	Max. concentration
JohnsonDiversey Shureclean Plus (neutral)	2%
Elma Clean 100 (mildly alkaline)	5%
Microbac food (mildly alkaline)	5%
Desifor forte (mildly alkaline)	5%

NOTICE The instructions of the respective manufacturer must be observed. Damage to property may otherwise result.

The robot can be cleaned manually (>>> 9.4.1 "Manual cleaning" Page 220) and/or by means of high-pressure water cleaning (>>> 9.4.2 "High-pressure water cleaning" Page 220). After every cleaning operation, the gaps between the joints of the robot must be cleaned separately using a soft brush with rounded bristles (>>> Fig. 9-6).

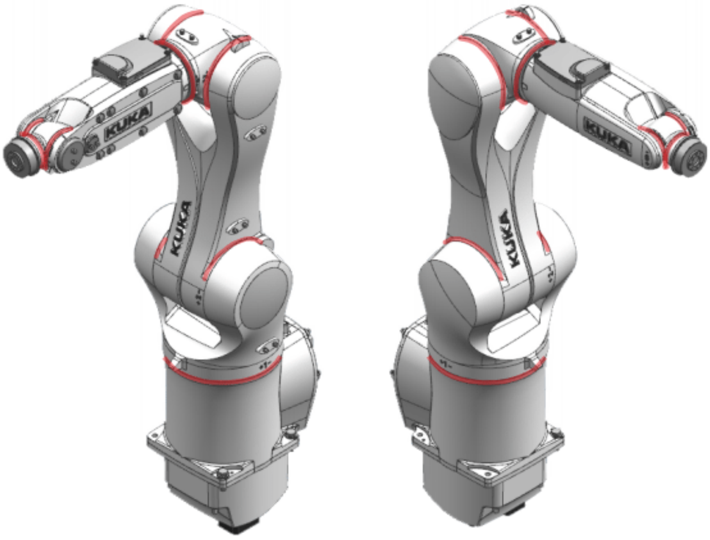


Fig. 9-6: Gaps between joints on robot (marked in red)

Carry out the pre-rinse procedure from top to bottom. Neutral cleaning agents are to be used for preference. Cleaning agents that contain chlorine, are strongly acidic or strongly alkaline must not be used. After each cleaning interval, rinse down thoroughly with water until all the cleaning agents have been removed and then dry with a cloth. It must be ensured that no water or cleaning agents enter the electrical system components.

⚠ **WARNING** Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot, the robot must be secured by activating the EMERGENCY STOP device.
Warn all persons concerned before starting to put it back into operation.

NOTICE The robot may only be operated with a functioning compressed air supply. The compressed air must be oil-free, dry and filtered. Damage to property may otherwise result.

9.4.1 Manual cleaning

Procedure

1. Shut down the robot.
2. If necessary, stop adjacent system components and lock them.
   Compressed air supply must remain active.
3. Clean the robot with a cloth and a neutral cleaning agent, e.g. Shureclean Plus, with a concentration of 2%.
4. Rinse the robot, fully remove all cleaning agents from the robot and dry with a cloth.
5. Remove cleaning agents and equipment from the workspace of the robot.
6. Dispose of cleaning agents in accordance with the pertinent regulations.
7. Replace any damaged or illegible plates and covers.
8. Put back in place any enclosures that have been removed.
9. Only put fully functional robots and systems back into operation.

9.4.2 High-pressure water cleaning

The following must be taken into consideration for high-pressure water cleaning:

- Static and dynamic seals on the robot must not be directly pressurized.
- The distance between the cleaning nozzles and the robot must be at least 0.5 m.
- Maximum permissible water pressure: 120 bar with flat spray nozzle
- Use flat spray nozzle with min. 45° spray angle.
- Maximum permissible delivery rate of the cleaning device: 600 l/h
- The distance between the cleaning nozzles and the robot must be at least 0.5 m.
- Use soft brushes with rounded bristles for the removal of heavier contamination.
- Recommendation: Low-pressure foaming devices

Optional cleaning collars for A4 and A6 are available for high-pressure water cleaning (>>> 12.1 "Cleaning collars A4 and A6 (optional)" Page 237).

Procedure

1. Shut down the robot.
2. If necessary, stop adjacent system components and lock them.
   Compressed air supply must remain active.
3. Fasten cleaning collars A4 and A6 (optional) (>>> 12.1 "Cleaning collars A4 and A6 (optional)" Page 237).
4. Perform high-pressure water cleaning.
5. Remove cleaning collars A4 and A6 (optional) again and clean them after use.
6. Clean seals A4 and A6 using a soft brush with rounded bristles.

7. Rinse the robot, fully remove all cleaning agents from the robot and dry with a cloth.
8. Remove cleaning agents and equipment from the workspace of the robot.
9. Dispose of cleaning agents in accordance with the pertinent regulations.
10. Replace any damaged or illegible plates and covers.
11. Put back in place any enclosures that have been removed.
12. Only put fully functional robots and systems back into operation.

10 Repair

> **⚠ CAUTION** For screwed connections, the fastening screws (standard, strength class 8.8) are to be tightened with the tightening torques specified in the appendix (>>> 13 "Appendix" Page 245). Tightening torques deviating from these values are specified directly.
> The specified screw sizes and strength classes are those valid at the copy deadline. The specifications contained in the Parts Catalog are, however, always to be taken as the most up-to-date information.
> Screws of strength class 10.9 and higher may only be tightened once with the rated tightening torque. When the screws are first slackened they must be replaced with new ones.

10.1 Measuring and adjusting the toothed belt tension

Description

The toothed belt tension on A5 and A6 is measured and adjusted in the same way. The following description deals with the toothed belt tension for A5.

Precondition

- Axis 5 is horizontal.
- No tools are installed on axis 6.

> **⚠ WARNING** Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot, the robot must be secured by activating the EMERGENCY STOP device.
> Warn all persons concerned before starting to put it back into operation.

> **⚠ CAUTION** If the toothed belt tension is measured and adjusted immediately after the robot has stopped operating, surface temperatures are likely to be high and could result in burn injuries. Protective gloves must be worn.

Procedure

1. Remove 7 M3x10-A2-70 cap screws from the cover and take off the cover (>>> Fig. 10-1).

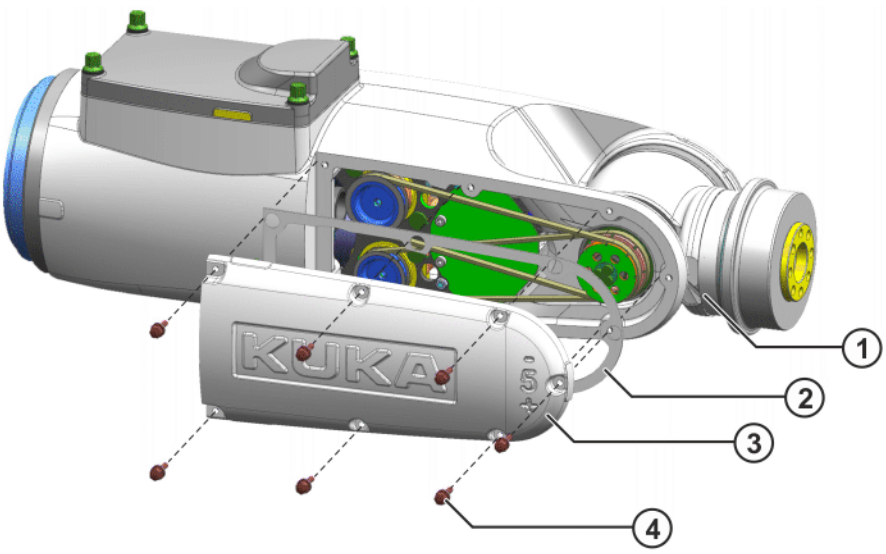


Fig. 10-1: Removing the cover from the in-line wrist – example

1	In-line wrist	3	Cover
2	Seal	4	Cap screw

2. Slacken 2 M4x10-10.9 fillister head screws on motor A5 (>>> Fig. 10-2).
3. Insert a suitable tool (e.g. screwdriver) into the corresponding aperture in the motor mount and carefully press motor A5 to the left in order to tension toothed belt A5.

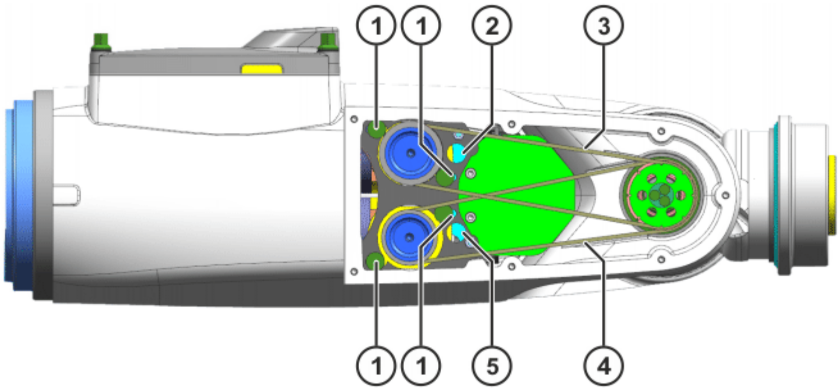


Fig. 10-2: Tensioning the toothed belt – example

1	Fillister head screw	4	Toothed belt A6
2	Aperture in motor mount A5	5	Aperture in motor mount A6
3	Toothed belt A5		

4. Lightly tighten 2 M4x10-10.9 fillister head screws on motor A5.
5. Switch on the belt tension measuring device (>>> Fig. 10-3).
6. Pluck toothed belt A5 and hold the sensor near its center at a distance of 2 to 3 mm from the vibrating toothed belt. Read the measurement on the belt tension measuring device.

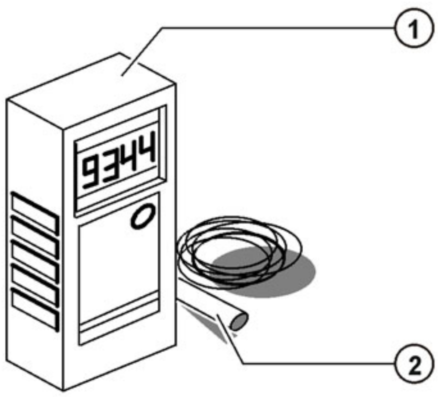


Fig. 10-3: Belt tension measuring device

1	Belt tension measuring device
2	Sensor

Toothed belt tension

In-line wrist	Axis	Toothed belt	Frequency
IW 6 R700	5	AT3/267	305 ±5 Hz
	6		
IW 6/10 R900	5	AT3/351	205 ±5 Hz
	6		
IW 10 R1100	5	AT3/351	205 ±5 Hz
	6		

7. Tighten 2 M4x10-10.9 fillister head screws on motor A5; tightening torque M_A= 1.9 Nm.
8. Put the robot into operation and move A5 in both directions.
9. Secure the robot by pressing the E-STOP device.
10. Measure the tension of the toothed belt again.

    If the value obtained does not correspond to the value in the table, repeat steps 2 to 10.
11. Carry out steps 2 to 10 for toothed belt A6.
12. Clean the sealing surfaces of the cover and housing and check them for damage. In the case of damage, inform KUKA Service.
13. Insert a new seal into the cover.

> In order to ensure that the protection classification is met after maintenance and repair work, the seal must be functional and the compressed air supply active.

14. Mount the cover and fasten it with 7 new M3x10-A2-70 cap screws; tightening torque M_A = 0.8 Nm.
15. Check for leaks and insert new seals if required.

11 Decommissioning, storage and disposal

> ⚠ **CAUTION** For screwed connections, the fastening screws (standard, strength class 8.8) are to be tightened with the tightening torques specified in the appendix (>>> 13 "Appendix" Page 245). Tightening torques deviating from these values are specified directly.
> The specified screw sizes and strength classes are those valid at the copy deadline. The specifications contained in the Parts Catalog are, however, always to be taken as the most up-to-date information.
> Screws of strength class 10.9 and higher may only be tightened once with the rated tightening torque. When the screws are first slackened they must be replaced with new ones.

11.1 Decommissioning, floor-mounted robot

Description

This section describes all the work required for decommissioning the robot if the robot is to be removed from the system. After decommissioning, it is prepared for storage or for transportation to a different location.

Following its removal, the robot can be transported by means of round slings and a crane (>>> 7 "Transportation" Page 187).

Precondition

- The removal site is accessible for transportation with a crane.
- There is no hazard posed by system components.

> ⚠ **WARNING** When carrying out the following work, the robot must be moved several times between the individual work steps.
> While work is being carried out on the robot, it must always be secured by activating the EMERGENCY STOP device.
> Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot that is switched on, the robot must only be moved at reduced velocity. It must be possible to stop the robot at any time by activating an EMERGENCY STOP device. Operation must be limited to what is absolutely necessary.
> Warn all persons concerned before switching on and moving the robot.

Procedure

1. Secure the robot.
2. Remove tools and equipment.
3. Put the robot into operation and move it into the transport position .

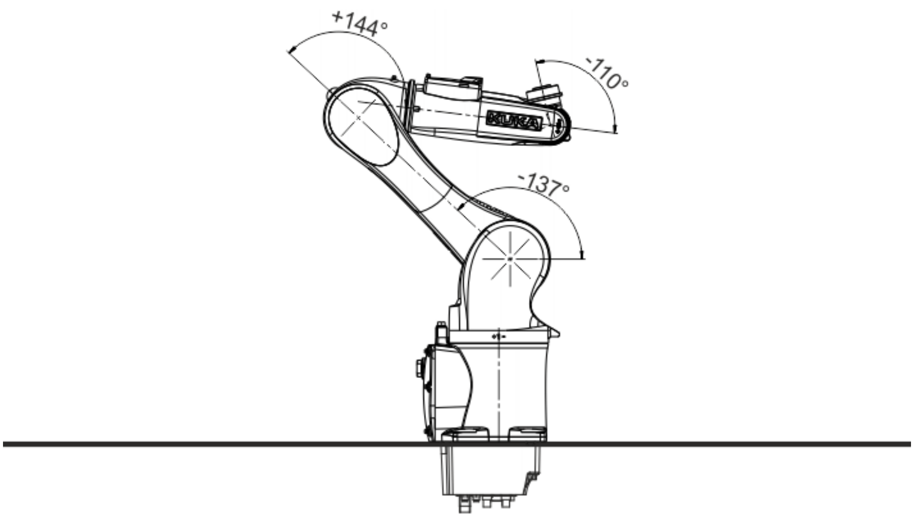


Fig. 11-1: Transport position

4. Secure the robot by activating the E-STOP device and then shut down the robot (>>> Fig. 11-2).
5. Release and unplug all peripheral connections.
6. Release and unplug the motor cable and data cable connectors.
7. Release and unplug the compressed air connector.
8. Release and unplug the ground conductor.
9. Attach the round slings.
10. Unscrew and remove the 4 hexagon bolts and USIT rings.
11. Lift the robot vertically off the mounting surface and transport it away.

    Take care not to damage the two locating pins when lifting.

> **⚠ CAUTION** If the robot is caught on the mounting surface, it may come free abruptly, endangering persons and property.
> The robot must stand loosely on the mounting surface; completely remove all fastening materials and any adhesives.

12. Prepare the robot for storage.

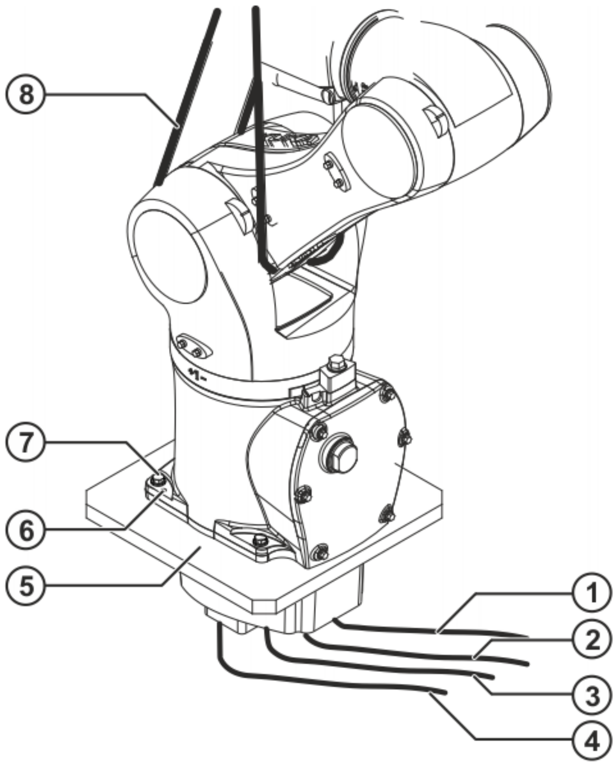


Fig. 11-2: Removing a floor-mounted robot

1	Ground conductor	5	Mounting surface
2	Compressed air line	6	Locating pin
3	Data cable	7	Hexagon bolt
4	Motor cable	8	Round sling

11.2 Decommissioning, wall-mounted robot

Description

This section describes all the work required for decommissioning the wall-mounted robot if the robot is to be removed from the system. After decommissioning, it is prepared for storage or for transportation to a different location.

Precondition

- The removal site is accessible with a crane and fork lift truck.
- There is no hazard posed by system components.

> **⚠ WARNING** When carrying out the following work, the robot must be moved several times between the individual work steps.
> While work is being carried out on the robot, it must always be secured by activating the EMERGENCY STOP device.
> Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot that is switched on, the robot must only be moved at reduced velocity. It must be possible to stop the robot at any time by activating an EMERGENCY STOP device. Operation must be limited to what is absolutely necessary.
> Warn all persons concerned before switching on and moving the robot.

Procedure

1. Secure the robot.
2. Remove tools and equipment.
3. Put the robot into operation and move it into the transport position .

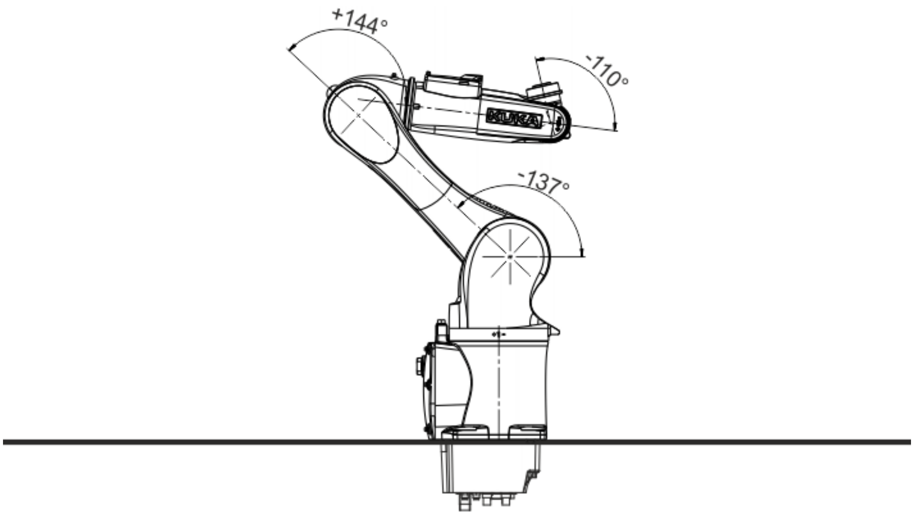


Fig. 11-3: Transport position

4. Secure the robot by activating the E-STOP device and then shut down the robot.
5. Release and unplug all peripheral connections.
6. Release and unplug the motor cable and data cable connectors.
7. Release and unplug the compressed air connector.
8. Release and unplug the ground conductor.
9. Rotate the Load Lifting Attachment so that it can be screwed to the wall-mounted machine.
10. Lift the Load Lifting Attachment with a fork lift truck.

    The fork lift truck must remain in the fork slots of the Load Lifting Attachment during removal in order to prevent slipping.

> **NOTICE** When picking up the Load Lifting Attachment with the fork lift truck, the width of the fork slots (140 mm) must be taken into consideration. Damage to property may otherwise result.

11. Unscrew 2 M10x35-A2-70 hexagon bolts (bottom hexagon bolts) and USIT rings from the bottom of the base frame.
12. Carefully push the Load Lifting Attachment onto the base frame of the robot from underneath (>>> Fig. 11-4).
13. Fasten the robot to the Load Lifting Attachment from underneath with 2 M12x30 Allen screws (bottom Allen screws) and washers; M_A = 40 Nm.

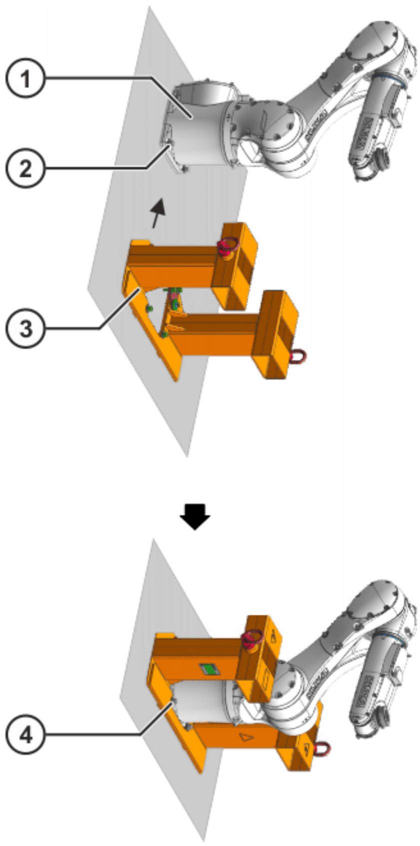


Fig. 11-4: Fastening the Load Lifting Attachment to the robot

1 Base frame
2 M10x35-A2-70 hexagon bolt (bottom)
3 Load Lifting Attachment
4 M12x30 Allen screw (bottom)

14. Unscrew 2 M10x35-A2-70 hexagon bolts (top hexagon bolts) and USIT rings from the top of the base frame.
15. Position swivel holders on base frame (>>> Fig. 11-5).
16. Fasten the swivel holders to the top of the base frame with 2 M12x30 Allen screws and washers; M_A = 40 Nm.
17. Lock the swivel holders to the Load Lifting Attachment with 2 M12x30 Allen screws (locking screws) and washers.

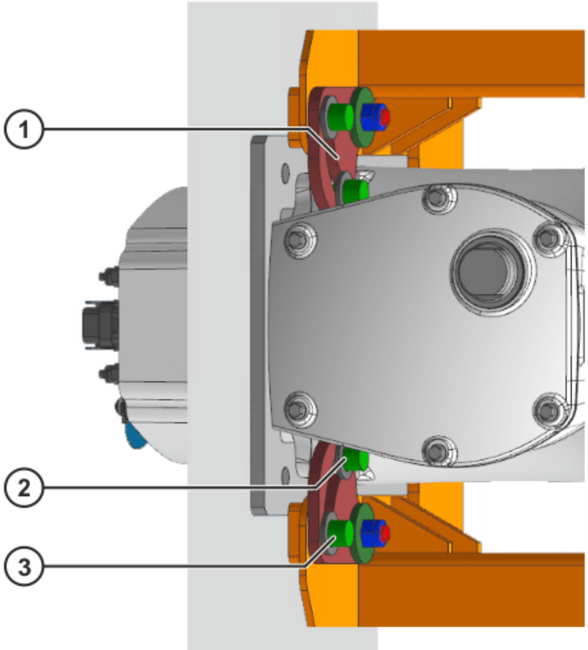


Fig. 11-5: Positioning and fastening the swivel holders

1 Swivel holder
2 M12x30 Allen screw (top)
3 M12x30 Allen screw (locking screw)

18. Slowly move the robot away from the wall with a fork lift truck.
19. Attach round slings to the 2 rotating swivel eyebolts on the Load Lifting Attachment and to the crane.
20. Move the fork lift truck slowly and carefully out of the fork slots of the Load Lifting Attachment.
21. Person 1:

    Slowly and carefully lower the robot with the crane.

    Person 2:

    Secure the robot against toppling during the lowering operation.

⚠ **WARNING** Ensure that the robot does not topple during the lowering operation. Serious injuries and damage to property may otherwise result.

22. Slowly turn the robot through 90° and set it down on a suitable support (e.g. SC frame (>>> 12.3 "SC frame (optional)" Page 241)). Ensure that interface A1 is not damaged.
23. Unscrew 4 M12x30 Allen screws and washers from the Load Lifting Attachment.
24. Unscrew 2 M12x30 Allen screws and washers from the swivel holders.
25. Rotate the swivel holders outwards.
26. Carefully push the Load Lifting Attachment down from the back of the base frame.
27. Prepare the robot for storage.

11.3 Decommissioning, ceiling-mounted robot

Description

This section describes all the work required for decommissioning the ceiling-mounted robot if the robot is to be removed from the system. After decommissioning, it is prepared for storage or for transportation to a different location.

Precondition

- The removal site is accessible with a crane and fork lift truck.
- There is no hazard posed by system components.

> ⚠ **WARNING** When carrying out the following work, the robot must be moved several times between the individual work steps.
> While work is being carried out on the robot, it must always be secured by activating the EMERGENCY STOP device.
> Unintentional robot motions can cause injuries and damage to property. If work is carried out on an operational robot that is switched on, the robot must only be moved at reduced velocity. It must be possible to stop the robot at any time by activating an EMERGENCY STOP device. Operation must be limited to what is absolutely necessary.
> Warn all persons concerned before switching on and moving the robot.

Procedure

1. Secure the robot.
2. Remove tools and equipment.
3. Put the robot into operation and move it into the transport position .

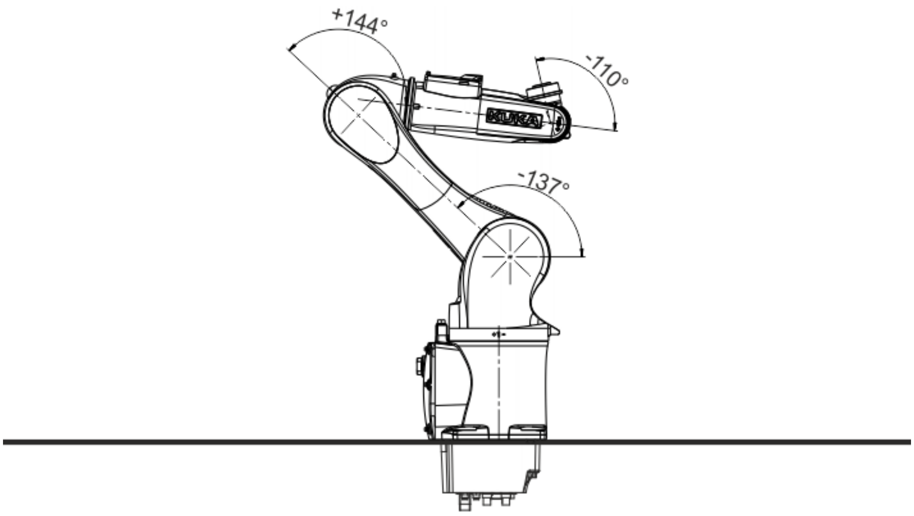


Fig. 11-6: Transport position

4. Secure the robot by activating the E-STOP device and then shut down the robot.
5. Release and unplug all peripheral connections.
6. Release and unplug the motor cable and data cable connectors.
7. Release and unplug the compressed air connector.
8. Release and unplug the ground conductor.
9. Rotate the Load Lifting Attachment so that it can be screwed to the ceiling-mounted machine.
10. Lift the Load Lifting Attachment with a fork lift truck.

    The fork lift truck must remain in the fork slots of the Load Lifting Attachment during removal in order to prevent slipping.

> **NOTICE** When picking up the Load Lifting Attachment with the fork lift truck, the width of the fork slots (140 mm) must be taken into consideration. Damage to property may otherwise result.

11. Unscrew 2 M10x35-A2-70 hexagon bolts (front hexagon bolts) and USIT rings from the front of the base frame.
12. Carefully push the Load Lifting Attachment onto the base frame of the robot from the front (>>> Fig. 11-7).
13. Fasten the robot to the front of the Load Lifting Attachment with 2 M12x30 Allen screws (front Allen screws) and washers; M_A = 40 Nm.

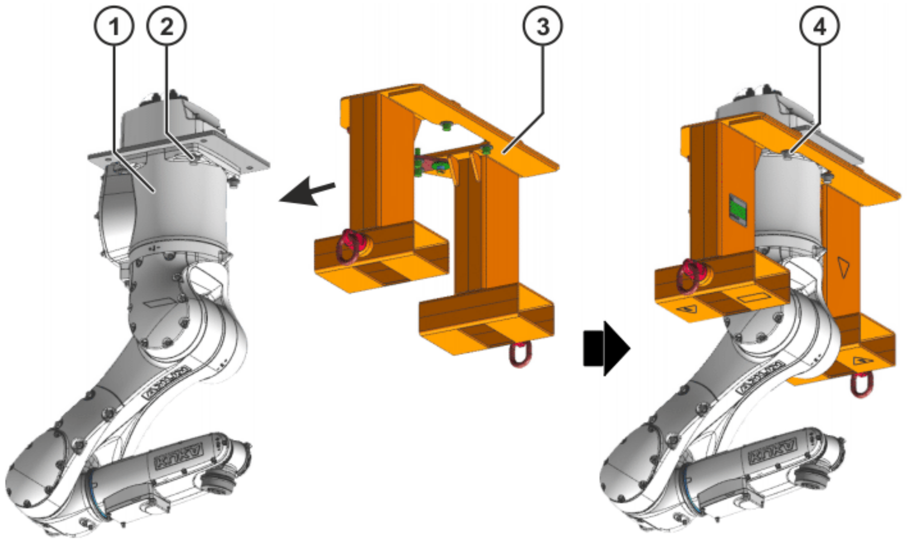


Fig. 11-7: Fastening the Load Lifting Attachment to the robot

1 Base frame
2 M10x35-A2-70 hexagon bolt (front)
3 Load Lifting Attachment
4 M12x30 Allen screw (front) and washer

14. Unscrew 2 M10x35-A2-70 hexagon bolts (rear hexagon bolts) and USIT rings from the back of the base frame.
15. Position swivel holders on base frame (>>> Fig. 11-8).
16. Fasten the swivel holders to the rear of the base frame with 2 M12x30 Allen screws and washers; M_A = 40 Nm.
17. Lock the swivel holders on the Load Lifting Attachment with 2 M12x30 Allen screws.

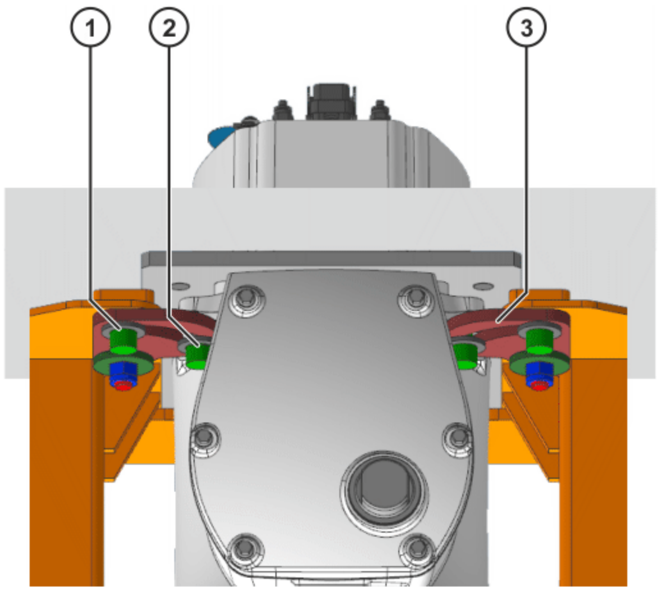


Fig. 11-8: Positioning and fastening the swivel holders

1 M12x30 Allen screw (locking screw)
2 M12x30 Allen screw (rear)
3 Swivel holder

18. Slowly lower the robot with a fork lift truck.

19. Attach round slings to the 2 rotating swivel eyebolts on the Load Lifting Attachment and to the crane.
20. Move the fork lift truck slowly and carefully out of the fork slots of the Load Lifting Attachment.
21. Person 1:

    Slowly and carefully lift the robot with the crane.

    Person 2:

    Secure the robot against toppling during the lifting operation.

⚠ WARNING Ensure that the robot does not topple during the lifting operation. Serious injuries and damage to property may otherwise result.

22. Slowly turn the robot through 180° and set it down on a suitable support (e.g. SC frame (>>> 12.3 "SC frame (optional)" Page 241)). Ensure that interface A1 is not damaged.
23. Unscrew 4 M12x30 Allen screws (front and rear) and washers from the Load Lifting Attachment.
24. Unscrew 2 M12x30 Allen screws (locking screws) and washers from the swivel holders.
25. Rotate the swivel holders outwards.
26. Carefully push the Load Lifting Attachment down from the back of the base frame.
27. Prepare the robot for storage.

11.4 Storage

Description

If the robot is being put into storage, the following points must be observed. In the case of a longer break in production, the cleaned robot must be protected against corrosion.

- The robot must be cleaned.

  (>>> 9.4 "Cleaning the robot" Page 218)
- The place of storage must be as dry and dust-free as possible.
- Avoid temperature fluctuations.
- Avoid wind and drafts.
- Avoid condensation.
- Use appropriate coverings that cannot detach themselves and which can withstand the expected environmental conditions.
- Do not leave any loose parts on the robot, especially ones that might knock against other parts.
- Do not leave the robot exposed to direct sunlight while in storage.
- Observe and comply with the permissible temperature ranges for storage.
- Select a storage location in which the packaging materials cannot be damaged.
- Corrosion protection: lightly oil metal parts.

Procedure

1. Remove tools and equipment.
2. Remove the robot.
3. Clean and dry the robot. No dirt or cleaning agent residue may remain on or in the robot.
4. Perform a visual inspection of the robot.
5. Remove any foreign bodies.
6. Remove any corrosion.

7. Attach all covers to the robot and check that the seals are correctly in place.
8. Seal off electrical connections with suitable covers.
9. Seal hose connections by suitable means.
10. Cover the robot with plastic film and seal it at the base frame against dust.

    If necessary, add a desiccant beneath the sheeting.

11.5 Disposal

When the manipulator reaches the end of its useful life, it can be removed from the system and dismantled, and the materials can be disposed of properly by type.

The following table provides an overview of the materials used in the manipulator. All plastic components are marked with a material designation and must be disposed of accordingly.

Material	**Subassembly, component**	**Additional information**
Metals		
Cast aluminum	Rotating column, arm, link arm, wrist, base frame	
Copper	Cables, wires	
Steel	Gear units, screws, washers	
Electrical components		
	Electronic components, such as RDC, EDS, etc.	Dispose of as electrical scrap without disassembling
	Motors	Dispose of motors without dismantling them.
Plastics		
FKM	Seals	
Plastic	Panels, covers	
NBR	Shaft seals, O-rings	
PUR	Cable sheaths	
PU	Hoses	
Auxiliary substances and consumables		
Lubricating grease	Gear units	Berusynth 32 H1
Lubricating grease	Cover, cabling	Klüberfood NH1 34-401
Lubricant	Gear units	Berulub FG-H 2 SL

Up-to-date safety data sheets must be requested from the manufacturers of auxiliary and operating materials (>>> 13.3 "Auxiliary and operating materials used" Page 246).

12 Options

12.1 Cleaning collars A4 and A6 (optional)

To prevent the seals of A4 and A6 from being damaged during high-pressure water cleaning, they can be protected with a cleaning collar. A cleaning collar consists of 2 shells connected by two clips.

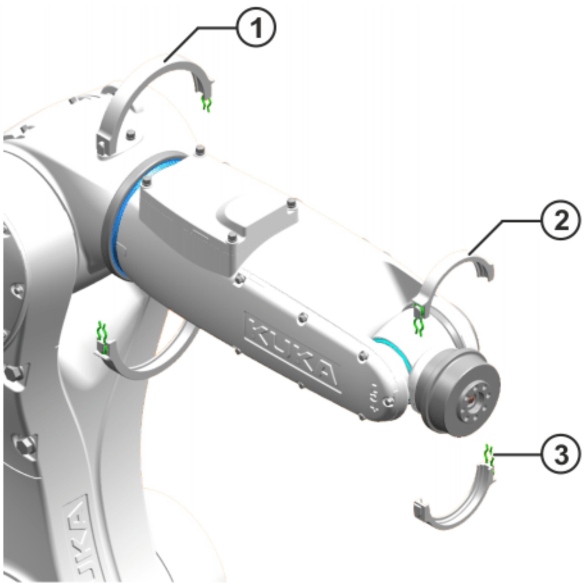


Fig. 12-1: Cleaning collars A4 and A6 (optional)

1	Cleaning collar A4	3	Clip
2	Cleaning collar A6		

12.2 Cable set (optional)

Using this cable set, the robot arm and the control cabinet can be installed in two separate areas. For routing the cable set, an appropriate opening in the partition between the two areas must be provided.

The cable set consists of a dress package, a connection plate and a protective circuit.

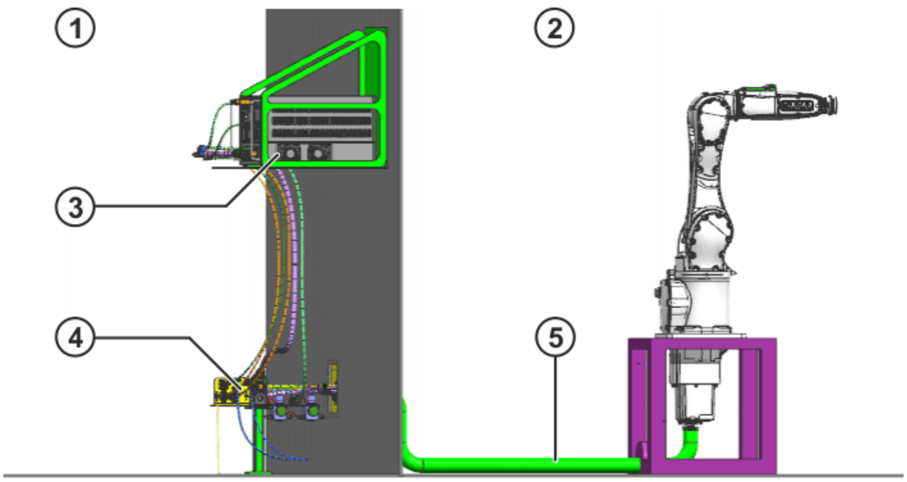


Fig. 12-2: Cable set (optional)

1	Protected space	4	Connection plate
2	Hygiene area	5	Dress package
3	Control cabinet		

Opening

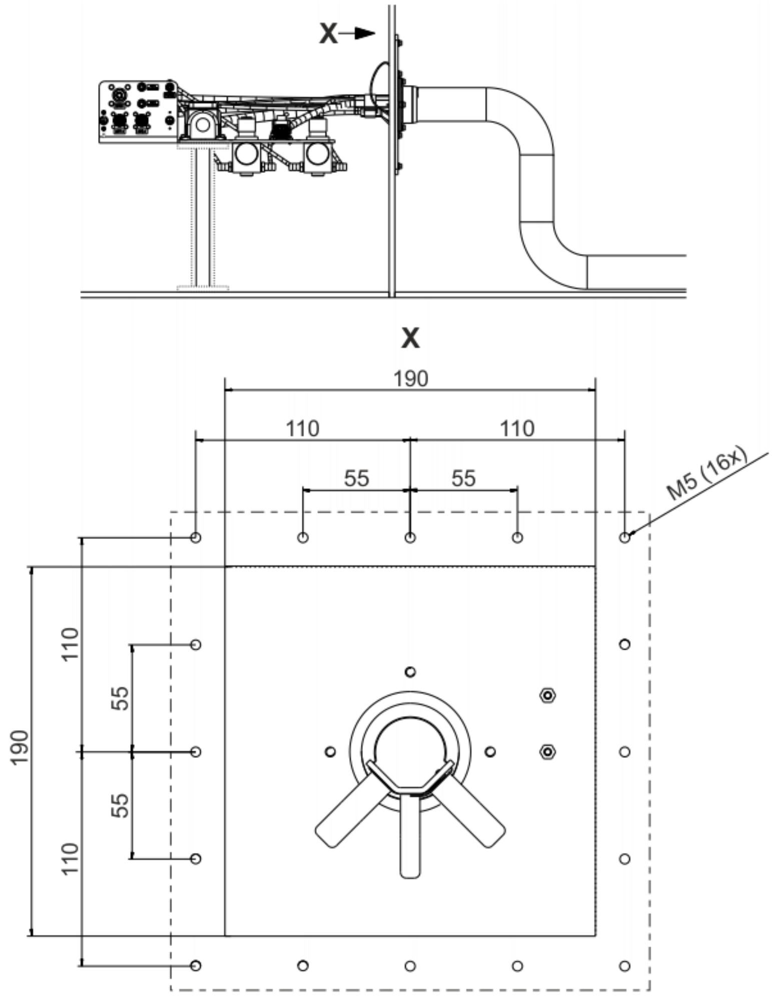


Fig. 12-3: Cable set (optional)

Dress package

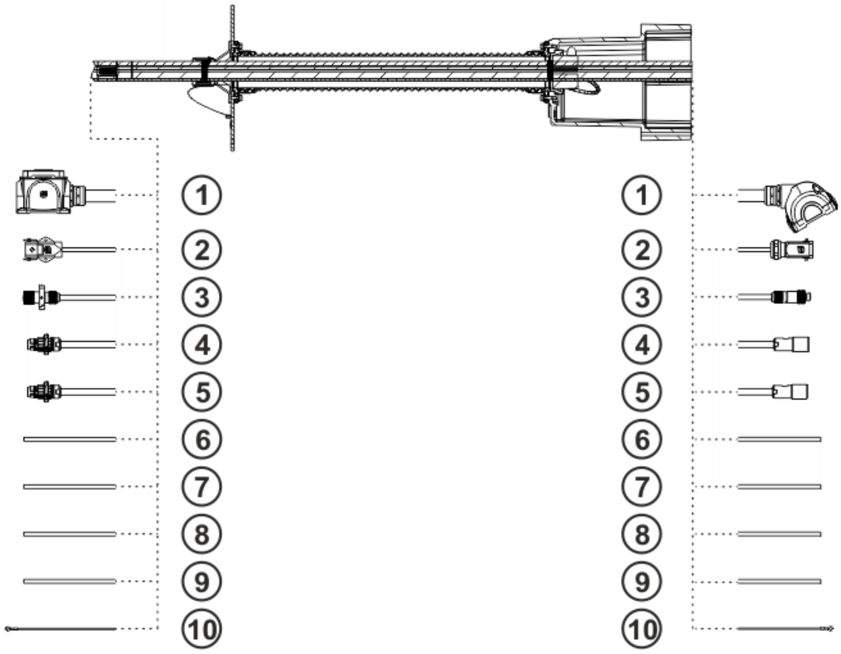


Fig. 12-4: Dress package

1	Motor cable X30.1 - X30
2	Data cable X31.1 - X31
3	Data cable CAT5 XPN1.1 - XPN1
4	External axis A7 XP7.1.1 - XP7.1
5	External axis A8 XP8.1.1 - XP8.1
6	Air line AIR1 - AIR
7	Air line AIR2 - AIR
8	Ventilation PURGE - PURGE
9	Ventilation PURGE - PURGE
10	Ground conductor

Connection plate

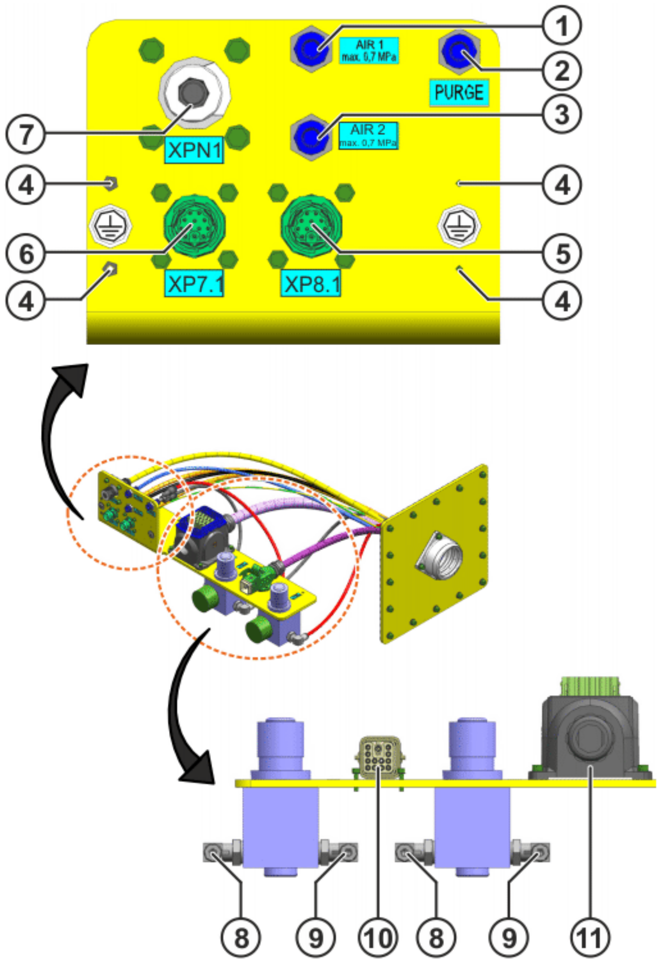


Fig. 12-5: Connection plate

1 Air line connection AIR1

Outside diameter: 6 mm

2 Pressurization connection

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

3 Air line connection AIR2

Outside diameter: 6 mm

4 Ground conductor connection
5 Connection for external axis A8 (XP8.1)
6 Connection for external axis A7 (XP7.1)
7 CAT5 data cable connection XPN1
8 Ventilation connection OUT
9 Ventilation connection IN
10 Data cable connection X31
11 Motor cable connection X30

Protective circuit

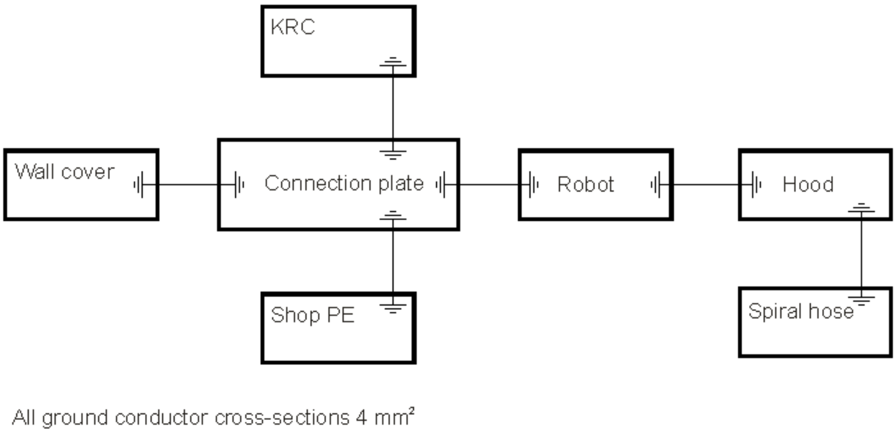


Fig. 12-6: Wiring diagram, protective circuit

12.3 SC frame (optional)

Description

The SC frame with plastic support facilitates fastening of the Load Lifting Attachment to the robot for wall and ceiling mounting.

Precondition

- The robot is in the transport position.

Procedure

1. Carefully lower the robot vertically onto the plastic support of the frame.
2. Fasten the robot with 4 M10x35-8.8 Allen screws.
3. Fasten the Load Lifting Attachment.
4. Remove 4 M10x35-8.8 Allen screws.
5. Perform wall or ceiling mounting.

   (>>> 8.3 "Installing a wall-mounted robot" Page 195) (>>> 8.4 "Installing a ceiling-mounted robot" Page 200)

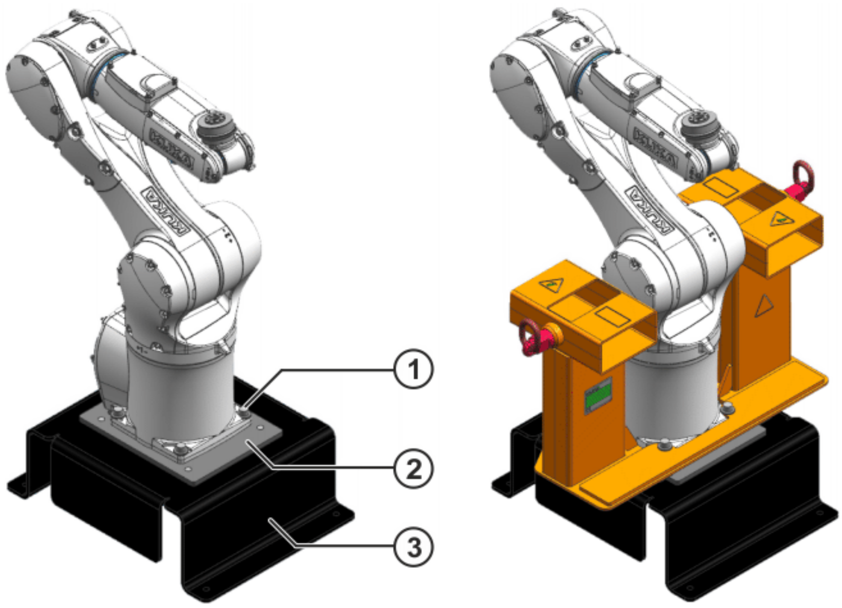


Fig. 12-7: Robot on SC frame

1	Allen screws	3	SC frame
2	Plastic support		

CAUTION The SC frame serves merely to simplify installation of the Load Lifting Attachment. The robot must not be operated with the SC frame. Injuries or damage to property may result.

12.4 PURGE option A

Compressed air preparation system PURGE option A consists of a service unit and a pressure regulator unit. The service unit prepares the compressed air so that it contains no dirt particles, water or chemical contamination. The pressure regulator unit limits the operating pressure of the system and compensates for pressure fluctuations.

A compressed air supply with 1 to 12 bar can be connected to the service unit.

The compressed air preparation system is not suitable for installation in a hygiene area.

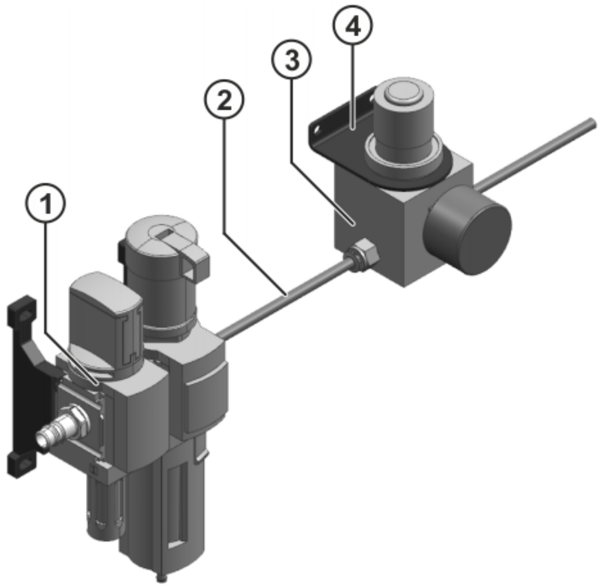


Fig. 12-8: PURGE option A

1	Service unit	3	Pressure regulator unit
2	Compressed air hose	4	Holder

12.5 PURGE option B

Compressed air preparation system PURGE option B consists of a pressure regulator unit that limits the operating pressure of the system and compensates for pressure fluctuations.

The compressed air preparation system is not suitable for installation in a hygiene area.

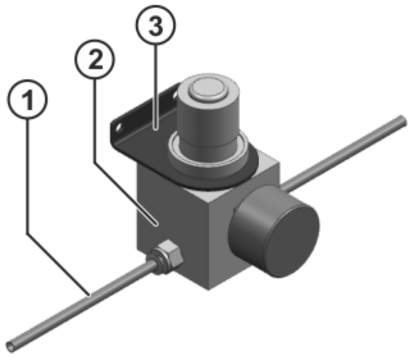


Fig. 12-9: PURGE option B

1	Compressed air hose	3	Holder
2	Pressure regulator unit		

13 Appendix

13.1 Tightening torques

Tightening torques

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

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

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

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

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

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

13.2 Tightening torque for stainless steel screws

Tightening torques for stainless steel screws

The tightening torques (Nm) specified here are valid for stainless steel screws and nuts where no other specifications are given.

The specified values are valid for lightly oiled screws and nuts.

Screw size	Stainless steel A4-80	Stainless steel A2-70 and A4-70	Stainless steel A2-50
M3	1.0	0.8	0.4
M4	2.4	1.9	0.9
M5	4.8	3.8	1.9
M6	8.0	6.4	3.1
M8	19.5	15.5	7.5
M10	38.5	30.5	15.0
M12	66.0	52.0	25.5
M14	106.0	84.0	41.0
M16	165.0	130.0	64.0
M20	320.0	253.0	125.0
M24	557.0	441.0	217.0
M30	1107.0	876.0	--

13.3 Auxiliary and operating materials used

Product designation	Use	Manufacturer designation/Address
Berusynth 32 H1	Lubricating grease	**CARL BECHEM GMBH** Weststrasse 120 D-58089 Hagen Germany
Klüberfood NH1 34-401	Lubricating grease	**Klüber Lubrication München AG** Geisenhausenerstr. 7 D-81379 München Germany
Berulub FG-H 2 SL	Lubricating grease	**CARL BECHEM GmbH** Weststrasse 120 D-58089 Hagen Germany

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

14 KUKA Service

14.1 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

14.2 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)
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Tel. +54 3564 421033
Fax +54 3564 428877
ventas@costantini-sa.com

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Port Melbourne VIC 3207
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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
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