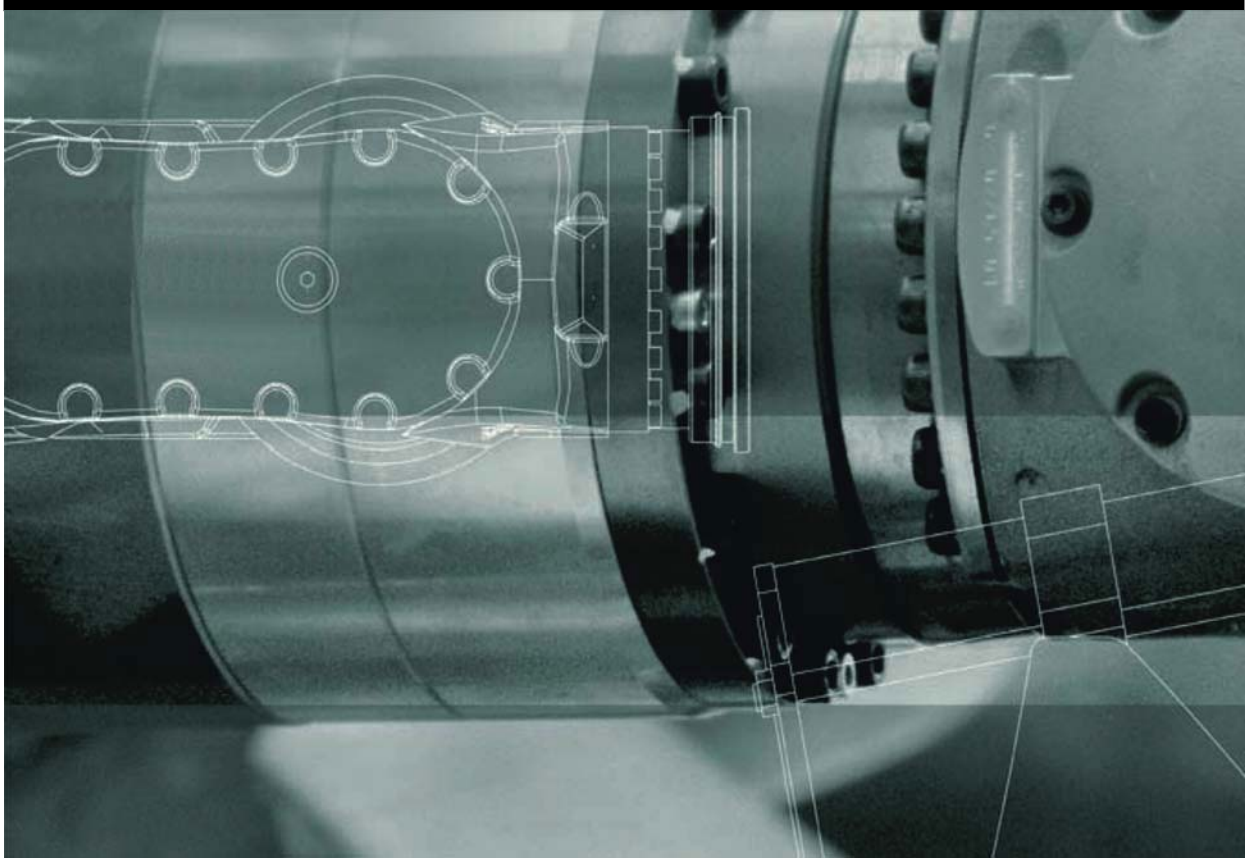
KUKA

Robots

KUKA Roboter GmbH

KR 60 L30 JET

Specification



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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.

Translation of the original documentation

KIM-PS5-DOC

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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 KUKA System Software
- Documentation relating to options and accessories
- Parts catalog on storage medium

Each of these sets of instructions is a separate document.

1.2 Representation of warnings and notes

Safety

These warnings are relevant to safety and **must** be observed.

DANGER	These warnings mean that it is certain or highly probable that death or severe injuries **will** occur, if no precautions are taken.
WARNING	These warnings mean that death or severe injuries **may** occur, if no precautions are taken.
CAUTION	These warnings mean that minor injuries **may** occur, if no precautions are taken.
NOTICE	These warnings mean that damage to property **may** occur, if no precautions are taken.
	These warnings contain references to safety-relevant information or general safety measures. These warnings do not refer to individual hazards or individual precautionary measures.

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

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

Notes

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

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

2 Purpose

2.1 Target group

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

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

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

2.2 Intended use

Use

- Handling of tools or fixtures for processing or transferring components or products. Use is only permitted under the specified environmental conditions.

Misuse

Any use or application deviating from the intended use is deemed to be impermissible misuse; examples of such misuse include:

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

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

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

This robot system can be operated with a KR C2 or KR C4 controller. The manipulator must be equipped with the corresponding electrical installations, however. This documentation is valid for both variants. The robot system is depicted with the KR C2, but attention is drawn to the differences.

A KR 30, 60 JET robot system (>>> Fig. 3-1) consists of the following components:

- JET TRACK axis module
- KR 30, 60 JET ROBOT
- Robot controller
- Connecting cables
- KCP teach pendant
- Software
- Options, accessories

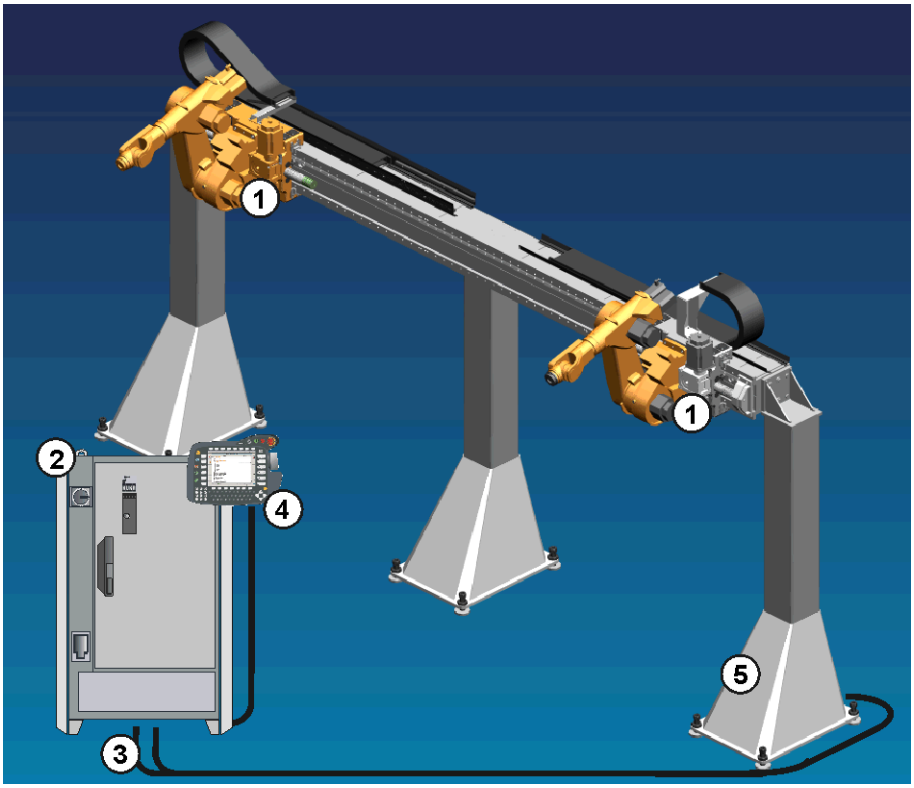

Fig. 3-1: KR 30, 60 JET, example of a robot system

1	KR 30, 60 JET ROBOT	4	Teach pendant (KCP)
2	KR C2 robot controller	5	JET TRACK axis module
3	Connecting cables		

3.2 Description of the robot

Overview

The mechanical system of this robot consists of the main elements KR 30, 60 JET ROBOT and the JET TRACK axis module. Both main elements are modular in design and can be assembled in a wide range of different configurations in accordance with the requirements of the user and the needs of the specific task.

JET TRACK axis module

The axis module (>>> Fig. 3-2) consists of the following principal components:

- Columns
- Beam
- Carriage

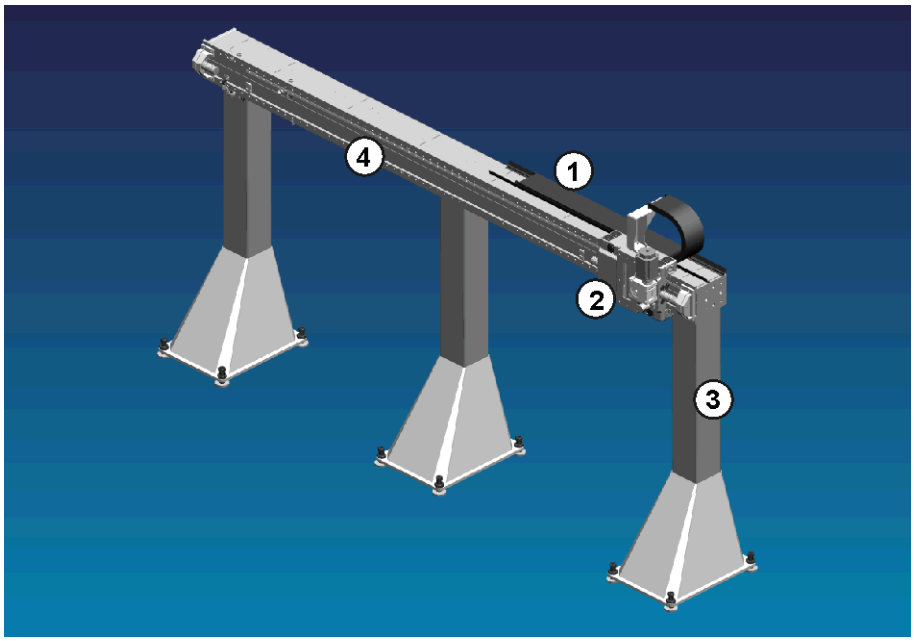

Fig. 3-2: Main assemblies of the KR 30, 60 JET TRACK

1	Energy supply chain	3	Column
2	Carriage	4	Beam

Columns

The axis module can be assembled from the following column variants (3):

- End column, bottom
- End column, side
- Intermediate column, rear-mounted, bottom
- Intermediate column, front-mounted, bottom
- Intermediate column, bottom

The columns (3) are available in steps of 200 mm from a minimum column height of 1,600 mm up to a maximum column height of 4,800 mm. The column variants used depend on the mounting arrangement of the carriage.

The columns are anchored and welded to the foundation. 4 leveling elements are provided on the base plates of each column.

Beam

There are 2 variants of the beam (1) available. They differ in the position of the tracks and racks, which may be mounted on the side or on the bottom. The beam is screwed to the columns and also supports the energy supply chain for the robot. Depending on the length of travel, the beam may be a single piece or composed of several pieces. Multiple-piece beams are screwed together during assembly. Travel lengths from 400 mm to 30,000 mm are possible in gradations of 400 mm.

Carriage

The carriage (2) constitutes axis 1 of the robot. It is mounted on the tracks of the beam and driven by the motor and gear unit. The KR 30, 60 JET ROBOT is mounted on the carriage. The tracks and racks are lubricated automatically by a central lubrication system. The driver for the energy supply chain is also fastened to the carriage.

JET ROBOT arm

The robot arm (>>> Fig. 3-3) consists of the following principal components:

- In-line wrist
- Arm
- Link arm
- Rotating column
- Electrical installations (KR C2, KR C4)

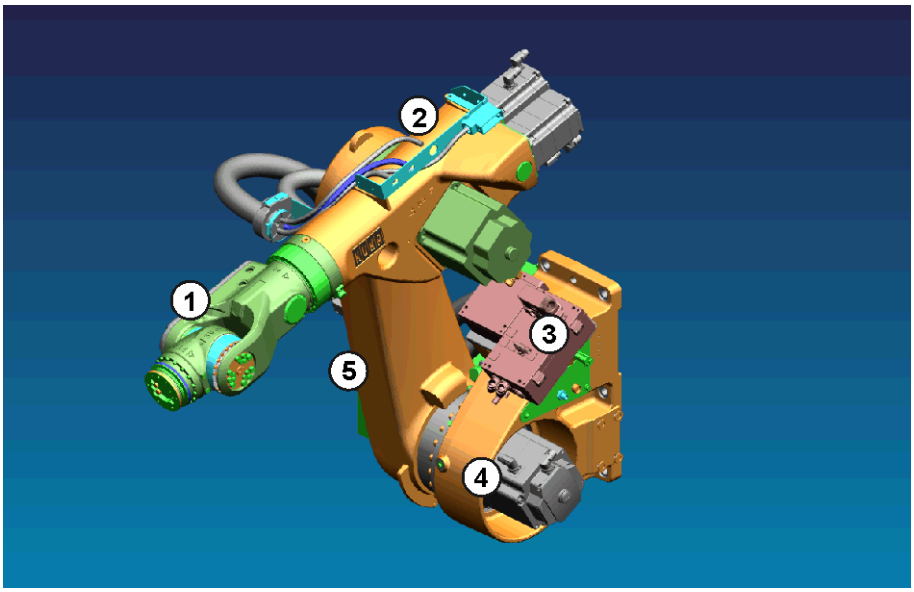

Fig. 3-3: Main assemblies of the KR 30, 60 JET ROBOT

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

In-line wrist

The robot (>>> Fig. 3-3) is fitted with a 3-axis in-line wrist (1). The in-line wrist contains axes 4, 5 and 6. For attaching end effectors (tools), the in-line wrist has a mounting flange.

Arm

The arm (2) is the link between the in-line wrist and the link arm. It houses the motors of the wrist axes A 4, A 5 and A 6. The drive for the arm comes from motor A 3 via the gear unit between the arm and the link arm. The maximum permissible swivel angle is mechanically limited by a stop for each direction, plus and minus. The accompanying plastic buffers are attached to the arm. The arm also houses the motor of axis 3.

Link arm

The link arm (5) is the assembly located between the arm and the rotating column. It consists of the link arm body and the gear units and bearings for axes 2 and 3.

Rotating column

The rotating column (4) forms the interface with the carriage of the axis module. It is screwed to the carriage. The rotating column also supports the link arm. On both sides of the rotating column there are four holes for the fastening screws of the fork slots or the transport frame. The robot junction boxes for the robot's electrical equipment are also mounted on the rotating column.

Electrical installations

The electrical installations assembly comprises the entire cabling for the control and supply of the motors. The electrical installations are described in the operating instructions, in Chapter . Depending on the controller, the manipulator is equipped with electrical installations (cable set) for KR C2 or KR C4.

4 Technical data

4.1 Basic data

Basic data

Type	KR 60 L30 JET ROBOT
Number of axes	5 in the robot
Volume of working envelope	9.0 m^2
Repeatability (ISO 9283)	±0.06 mm
Working envelope reference point	Intersection of axes 4 and 5
Weight	approx. 479 kg
Principal dynamic loads	see Loads acting on the foundation (>>> 4.4 "Loads acting on the mounting base" Page 19)
Protection classification of the robot	IP 64 ready for operation, with connecting cables plugged in (according to EN 60529)
Protection classification of the in-line wrist	IP 65
Sound level	< 75 dB (A) outside the working envelope
Mounting position	inverted, side-mounted
Surface finish, paintwork	Moving parts: orange (RAL 2003, KUKA)

Ambient temperature

Operation	283 K to 328 K (+10 °C to +55 °C)
Operation with Safe RDC	283 K to 323 K (+10 °C to +50 °C)
Storage and transportation	233 K to 333 K (-40 °C to +60 °C)
Start-up	283 K to 288 K (+10 °C to +15 °C) At these temperatures the robot may have to be warmed up before normal operation. Other temperature limits available on request.
Humidity rating	DIN EN 60721-3-3, Class 3K3

The maintenance intervals and the specified service life are based on typical gear unit temperatures and axis motions. If special functions or applications result in atypical gear unit temperatures or axis motions, this can lead to increased wear. In this case, the maintenance intervals or service life may be shortened. If you have any questions, please contact KUKA Customer Support.

Connecting cables

Cable designation	Connector designation	Interface with robot
Motor cable	X20 - X30	Harting connectors at both ends
Data cable	X21 - X31	Harting connectors at both ends
Data cable, SafeRobot	X21.1 - X41	Harting connectors at both ends

Cable lengths	
Standard	7 m, 15 m, 25 m, 35 m
with RoboTeam	7 m, 15 m, 25 m, 35 m
with SafeRobot	7 m, 15 m, 25 m, 35 m

For detailed specifications of the connecting cables, see .

For connecting cables longer than 25 m an additional ground conductor is provided and must be installed.

For operation with KR C4, a ground conductor is always required, which can be ordered separately as an option.

The cable length between the robot controller and the robot junction box must not exceed 50 m. The cable lengths in the energy supply chain must therefore also be taken into account.

4.2 Axis data

Axis data

Axis	Range of motion, software-limited	Speed with rated payload
1	see Order-specific technical data	3.2 m/s
2	0° to -180°	120 °/s
3	+158° to -120°	166 °/s
4	+/-350°	260 °/s
5	+/-119°	245 °/s
6	+/-350°	322 °/s

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

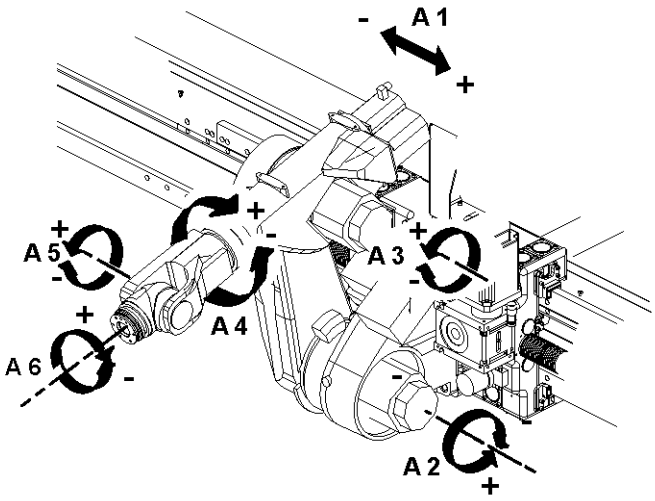

Fig. 4-1: Direction of rotation of robot axes

The diagram shows the shape and size of the working envelope.

Working envelope

The reference point for the working envelope (>>> Fig. 4-2) is the intersection of axes 4 and 5.

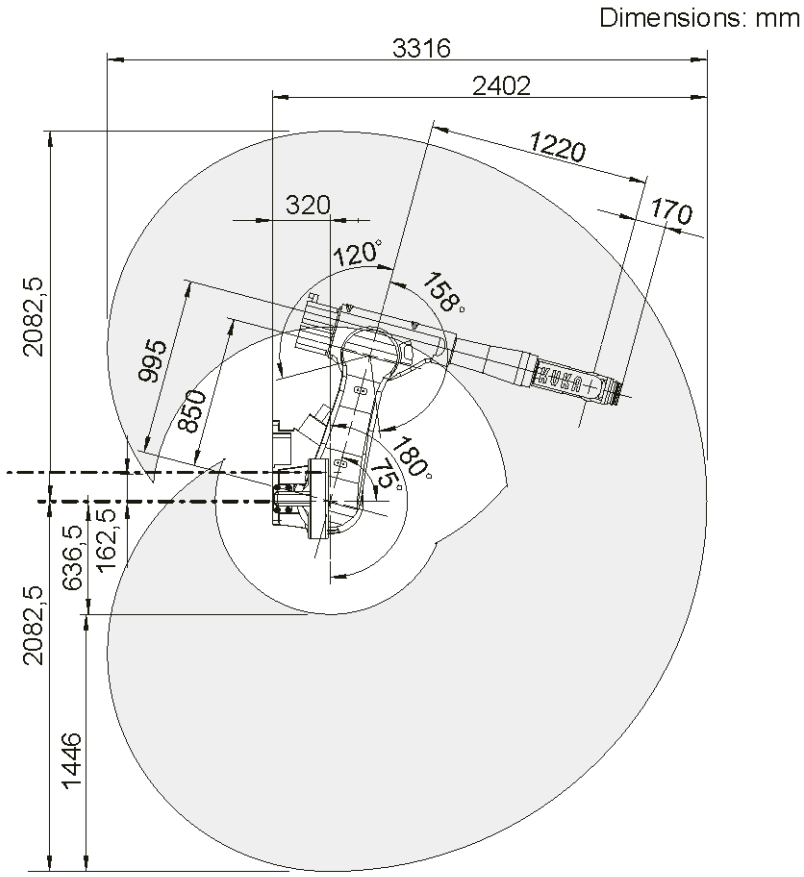

Fig. 4-2: Working envelope for KR 60 L30 JET ROBOT

Reference plane

The reference plane (>>> Fig. 4-3) for the working envelope of the robot is axis 2 (2). With side mounting, it is offset 162.5 mm below the center (3) of the beam. With inverted mounting, the offset is 162.5 mm to the rear. Specifications of the column height (4) refer to the floor and to the center of the carriage in the case of side mounting, and to the bolt-on surface of the carriage in the case of inverted mounting.

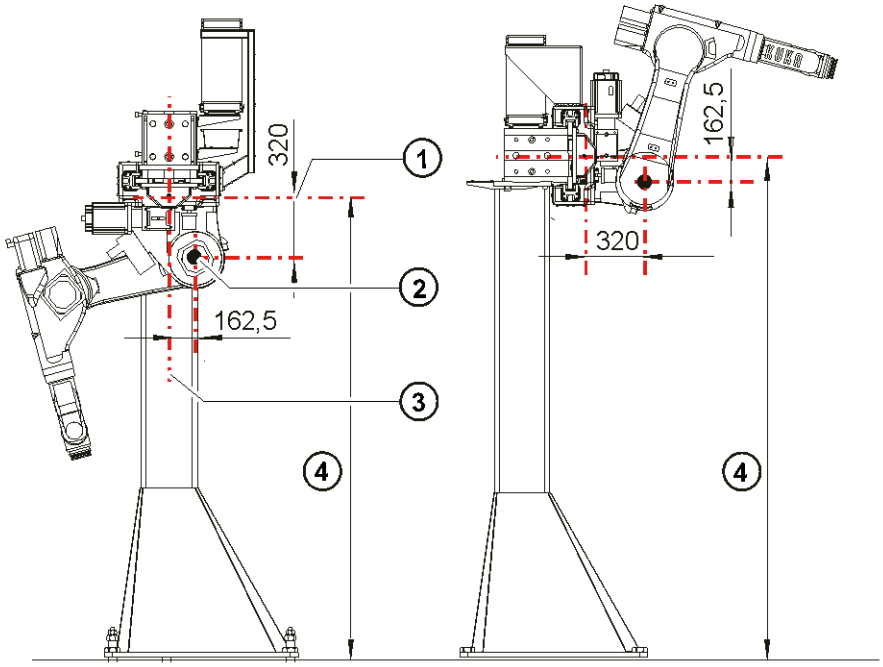

Fig. 4-3: Reference plane

4.3 Payloads

Payloads

Robot	KR 60 L30 JET ROBOT
In-line wrist	IW 30, 45, 60
Rated payload	30 kg
Distance of the load center of gravity L_z (vertical)	180 mm
Distance of the load center of gravity L_{xy} (horizontal)	150 mm
Permissible moment of inertia	9.0 kgm^2
Max. total load	65 kg
Supplementary load, arm	35 kg
Supplementary load, link arm	None
Supplementary load, rotating column	None

Load center of gravity P

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.

Payload diagram

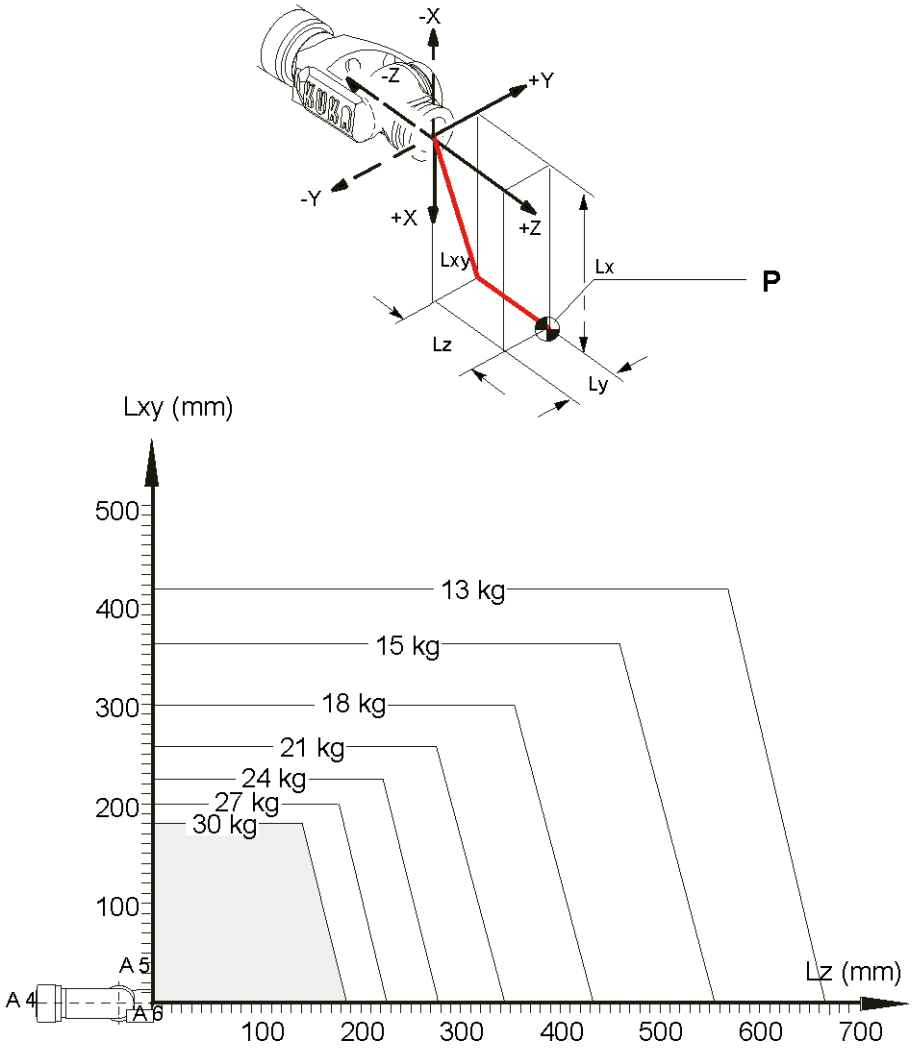

Fig. 4-4: Payload diagram for KR 60 L30 JET ROBOT

NOTICE This loading curve corresponds to the maximum load capacity. Both values (payload and mass moment of inertia) must be checked in all cases. Exceeding this capacity will reduce the service life of the robot and overload the motors and the gears; in any such case the KUKA Roboter GmbH must be consulted beforehand.
The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with 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

Mounting flange	DIN/ISO 9409-1-A100
Screw grade	10.9
Screw size	M8
Grip length	1.5 x nominal diameter
Depth of engagement	min. 12 mm, max. 14 mm
Locating element	8 ^{H7}

The mounting flange is depicted (>>> Fig. 4-5) with axes 4 and 6 in the zero position. The symbol X_m indicates the position of the locating element (bushing) in the zero position.

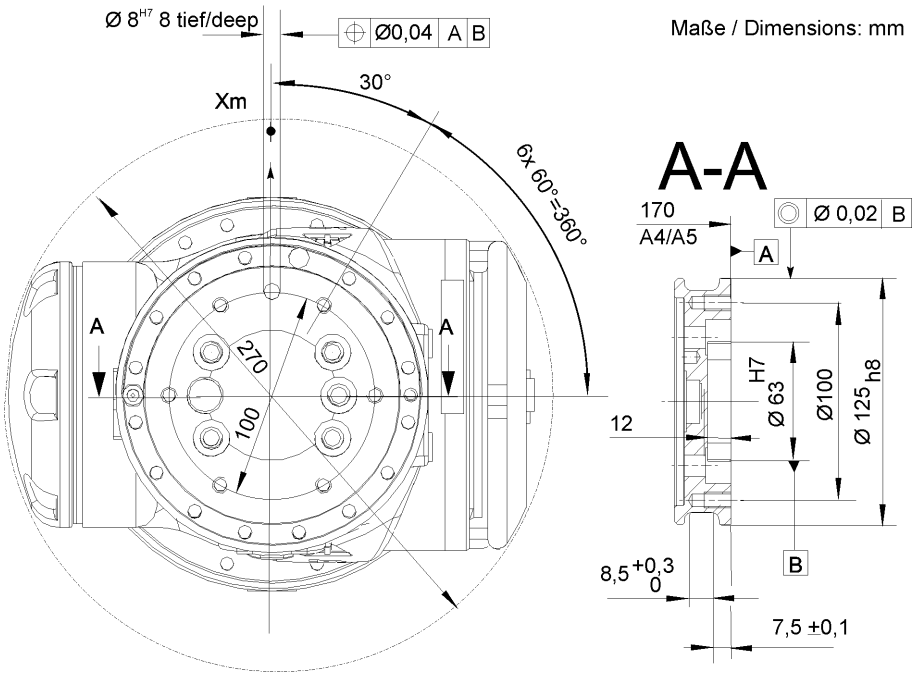

Fig. 4-5: Mounting flange

Supplementary load

The robot can carry supplementary loads on the arm. 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 diagram.

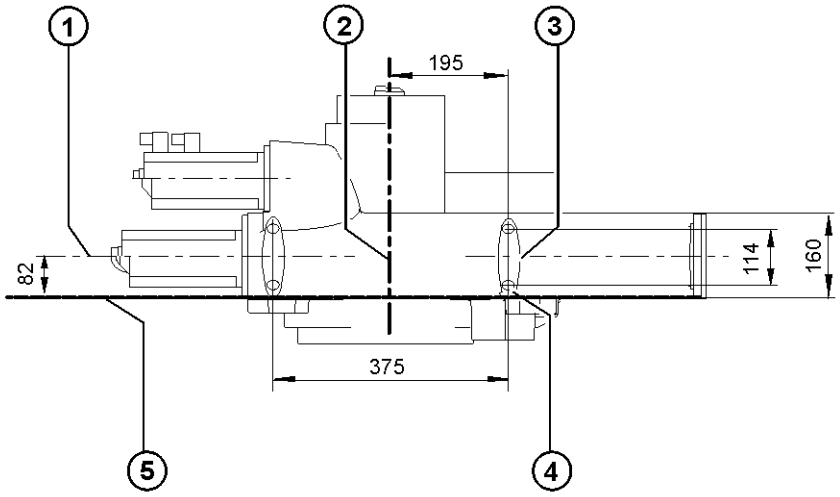

Fig. 4-6: Supplementary load on arm

1	Center of mounts for supplementary load	4	M8 hole, 16 deep
2	Axis 3	5	Interference contour for supplementary load
3	Mounting surface for supplementary load		

4.4 Loads acting on the mounting base

Loads acting on the mounting base

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

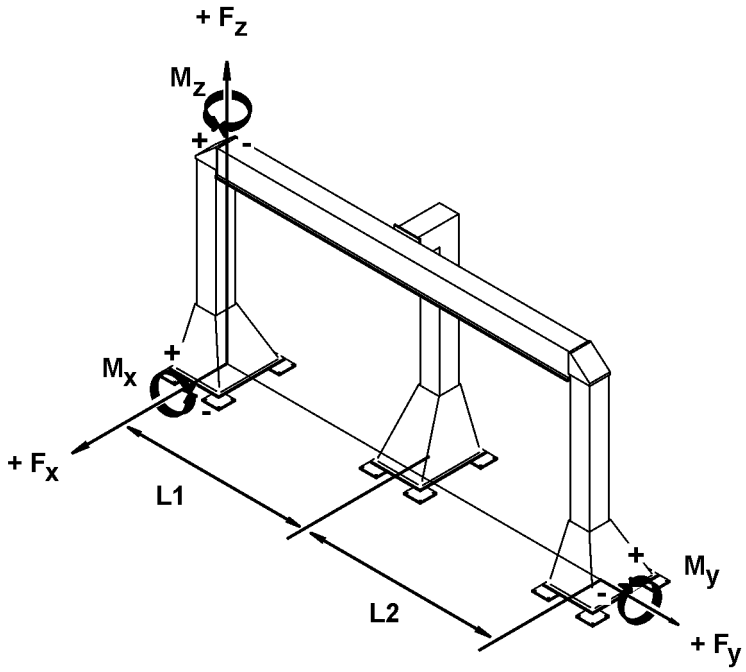

Fig. 4-7: Loads acting on the foundation

NOTICE The mounting base loads specified in the table are the maximum loads that may occur. They must be referred to when dimensioning the mounting bases and must be adhered to for safety reasons.
The supplementary loads on the rotating column are not taken into consideration in the calculation of the foundation load. These supplementary loads must be taken into consideration for F_x.

Inverted mounting position

Intermediate columns must be installed with axis module lengths of 7.6 m or longer. The number of intermediate columns depends on the length of the gantry. The following tables give the maximum permissible distance between columns.

Column spacing with one carriage

	L1	L2 - L5
2 columns	7.6 m	---
3 - 6 columns	7.6 m	5.6 m

Column spacing with two carriages

	L1	L2 - L11
2 columns	6.4 m	---
3 - 12 columns	6.4 m	2.4 m

Type of load	Force/torque/mass	
	1 carriage	2 carriages
F_z = vertical force	$-F_{zmax}$ = -30,000 N $+F_{zmax}$ = -5,000 N	$-F_{zmax}$ = -35,000 N $+F_{zmax}$ = -10,000 N
F_x = horizontal force	$-F_{xmax}$ = -7,500 N $+F_{xmax}$ = 7,500 N	$-F_{xmax}$ = -12,500 N $+F_{xmax}$ = 12,500 N
F_y = horizontal force	$-F_{ymax}$ = -15,000 N $+F_{ymax}$ = 15,000 N	$-F_{ymax}$ = -27,500 N $+F_{ymax}$ = 27,500 N
M_z = tilting moment	$-M_{zmax}$ = -2,500 Nm $+M_{zmax}$ = 2,500 Nm	$-M_{zmax}$ = -2,500 Nm $+M_{zmax}$ = 2,500 Nm
M_x = torque	$-M_{xmax}$ = -25,000 Nm $+M_{xmax}$ = 25,000 Nm	$-M_{xmax}$ = -50,000 Nm $+M_{xmax}$ = 50,000 Nm
M_y = torque	$-M_{ymax}$ = -10,000 Nm $+M_{ymax}$ = 10,000 Nm	$-M_{ymax}$ = -17,500 Nm $+M_{ymax}$ = 17,500 Nm
Weight of JET TRACK		
Weight of robot		
Total load for foundation load		

Side mounting position

Intermediate columns must be installed with axis module lengths of 7.6 m or longer. The number of intermediate columns depends on the length of the gantry. The following tables give the maximum permissible distance between columns.

Column spacing with one carriage

	L1	L2 - L5
2 columns	7.6 m	---
3 - 6 columns	7.6 m	6 m

Column spacing with two carriages

	L1	L2 - L6
2 columns	6.4 m	---
3 - 7 columns	6.4 m	4.8 m

Type of load	Force/torque/mass	
	1 carriage	2 carriages
F_z = vertical force	$-F_{zmax}$ = -35,000 N $+F_{zmax}$ = -7,500 N	$-F_{zmax}$ = -40,000 N $+F_{zmax}$ = -5,000 N
F_x = horizontal force	$-F_{xmax}$ = -7,500 N $+F_{xmax}$ = 7,500 N	$-F_{xmax}$ = -12,500 N $+F_{xmax}$ = 12,500 N
F_y = horizontal force	$-F_{ymax}$ = -15,000 N $+F_{ymax}$ = 15,000 N	$-F_{ymax}$ = -27,500 N $+F_{ymax}$ = 27,500 N
M_z = tilting moment	$-M_{zmax}$ = -5,000 Nm $+M_{zmax}$ = 5,000 Nm	$-M_{zmax}$ = -5,000 Nm $+M_{zmax}$ = 5,000 Nm

Type of load	Force/torque/mass	
	1 carriage	2 carriages
M_x = torque	$-M_{xmax}$ = -25,000 Nm $+M_{xmax}$ = 25,000 Nm	$-M_{xmax}$ = -50,000 Nm $+M_{xmax}$ = 50,000 Nm
M_y = torque	$-M_{ymax}$ = -5,000 Nm $+M_{ymax}$ = 20,000 Nm	$-M_{ymax}$ = -10,000 Nm $+M_{ymax}$ = 40,000 Nm
Weight of JET TRACK		
Weight of robot		
Total load for foundation load		

4.5 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.

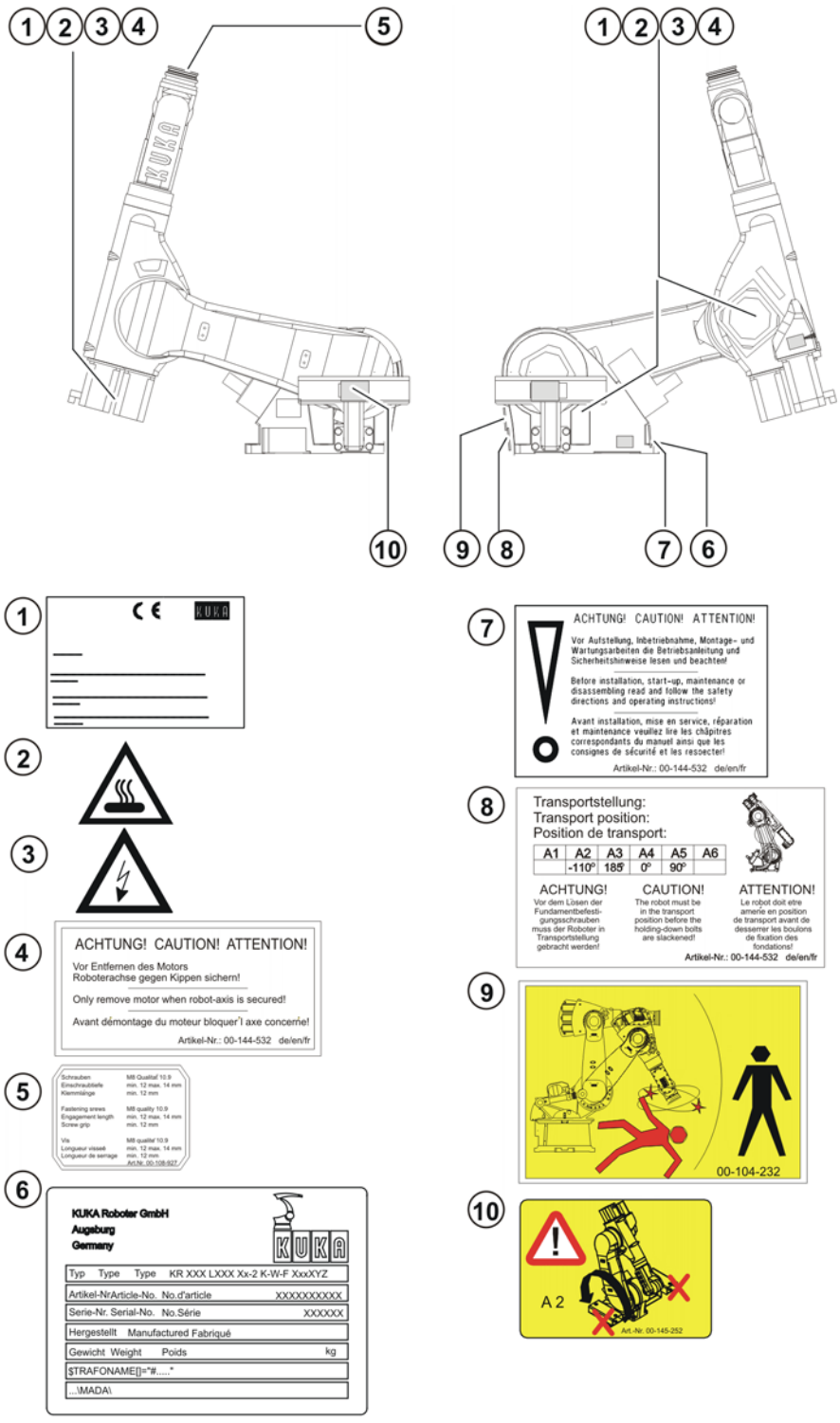

Fig. 4-8: Plates and labels

5 Safety

5.1 General

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

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

5.1.1 Liability

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

Components of the industrial robot:

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

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

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

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

Safety information

Safety information cannot be held against KUKA Roboter GmbH. Even if all safety instructions are followed, this is not a guarantee that the industrial robot will not cause personal injuries or material damage.

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

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

5.1.2 Intended use of the industrial robot

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

Further information is contained in the “Purpose” chapter of the operating instructions or assembly instructions of the industrial robot.

Using the industrial robot for any other or additional purpose is considered impermissible misuse. The manufacturer cannot be held liable for any damage resulting from such use. The risk lies entirely with the user.

Operating the industrial robot and its options within the limits of its intended use also involves observance of 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 impermissible misuse. This includes e.g.:

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

5.1.3 EC declaration of conformity and declaration of incorporation

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

- The industrial robot is integrated into a complete system.

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

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

Declaration of conformity

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

The robot controller is CE certified under the EMC Directive and the Low Voltage Directive.

Declaration of incorporation

The industrial robot as 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 remains impermissible 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.

The declaration of incorporation, together with its annexes, remains with the system integrator as an integral part of the technical documentation of the complete machinery.

5.1.4 Terms used

Term	Description
Axis range	Range of each axis, in degrees or millimeters, within which it may move. The axis range must be defined for each axis.
Stopping distance	Stopping distance = reaction distance + braking distance The stopping distance is part of the danger zone.
Workspace	The manipulator is allowed to move within its workspace. The workspace is derived from the individual axis ranges.
Operator (User)	The user of the industrial robot can be the management, employer or delegated person responsible for use of the industrial robot.
Danger zone	The danger zone consists of the workspace and the stopping distances.
Service life	The service life of a safety-relevant component begins at the time of delivery of the component to the customer. The service life is not affected by whether the component is used in a robot controller or elsewhere or not, as safety-relevant components are also subject to ageing during storage.
KCP	The KCP (KUKA Control Panel) teach pendant has all the operator control and display functions required for operating and programming the industrial robot. The KCP variant for the KR C4 is called KUKA smartPAD. The general term “KCP”, however, is generally used in this documentation.
KUKA smartPAD	See KCP
Manipulator	The robot arm and the associated electrical installations
Safety zone	The safety zone is situated outside the danger zone.
Stop category 0	The drives are deactivated immediately and the brakes are applied. The manipulator and any external axes (optional) perform path-oriented braking. **Note:** This stop category is called STOP 0 in this document.
Stop category 1	The manipulator and any external axes (optional) perform path-maintaining braking. The drives are deactivated after 1 s and the brakes are applied. **Note:** This stop category is called STOP 1 in this document.
Stop category 2	The drives are not deactivated and the brakes are not applied. The manipulator and any external axes (optional) are braked with a normal braking ramp. **Note:** This stop category is called STOP 2 in this document.
System integrator (plant integrator)	System integrators are people who safely integrate the industrial robot into a complete system and commission it.
T1	Test mode, Manual Reduced Velocity (<= 250 mm/s)
T2	Test mode, Manual High Velocity (> 250 mm/s permissible)
External axis	Motion axis which is not part of the manipulator but which is controlled using the robot controller, e.g. KUKA linear unit, turn-tilt table, Posiflex.

5.2 Personnel

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

- User
- Personnel

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

User

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

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

Personnel

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

Personnel includes:

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

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

System integrator

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

The system integrator is responsible for the following tasks:

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

Operator

The operator must meet the following preconditions:

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

Example

The tasks can be distributed as shown in the following table.

Tasks	Operator	Programmer	System integrator
Switch robot controller on/off	x	x	x
Start program	x	x	x
Select program	x	x	x
Select operating mode	x	x	x
Calibration (tool, base)		x	x
Master the manipulator		x	x
Configuration		x	x
Programming		x	x
Start-up			x
Maintenance			x
Repair			x
Shutting down			x
Transportation			x

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.

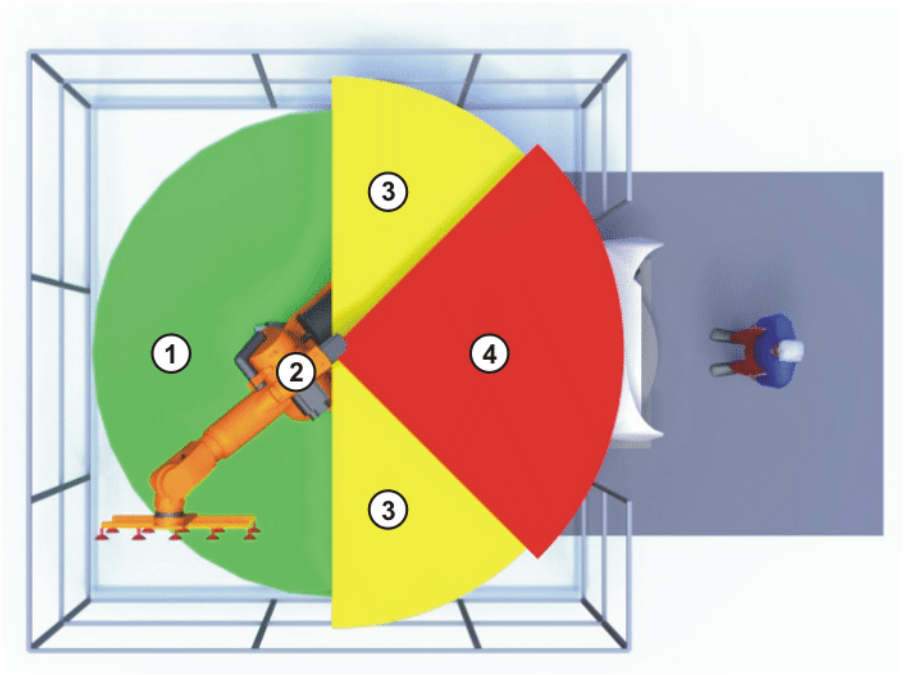

Fig. 5-1: Example of axis range A1

1	Workspace	3	Stopping distance
2	Manipulator	4	Safety zone

5.4 Overview of protective equipment

The protective equipment of the mechanical component may include:

- Mechanical end stops
- Mechanical axis range limitation (optional)
- Axis range monitoring (optional)
- Release device (optional)
- Labeling of danger areas

Not all equipment is relevant for every mechanical component.

5.4.1 Mechanical end stops

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

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

⚠ WARNING If the manipulator or an external axis hits an obstruction or a mechanical end stop or axis range limitation, this can result in material damage to the industrial robot. The manipulator must be taken out of operation and KUKA Roboter GmbH must be consulted before it is put back into operation (>>> 8 "KUKA Service" Page 45).

5.4.2 Mechanical axis range limitation (optional)

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

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

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

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

5.4.3 Axis range monitoring (optional)

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

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

5.4.4 Options for moving the manipulator without drive energy

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

Description

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

- Release device (optional)

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

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

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

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

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

5.4.5 Labeling on the industrial robot

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

Labeling on the industrial robot consists of:

- Identification plates
- Warning labels
- 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. 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 serious 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

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

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

⚠ WARNING The operator must ensure that decoupled KCPs 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 must not be used as long as an external keyboard and/or external mouse are connected.

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

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.

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 circuits must also be tested.

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

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

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.

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.

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

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

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

Function test

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

It must be ensured that:

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

Machine data

It must be ensured that the rating plate on the robot controller has the same machine data as those entered in the declaration of incorporation. The machine data on the rating plate of the manipulator and the external axes (optional) must be entered during start-up.

⚠ WARNING The industrial robot must not be moved if incorrect machine data are loaded. Death, severe injuries or considerable damage to property may otherwise result. The correct machine data must be loaded.

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
- Teach
- 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 Manual Reduced Velocity.
- 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 systems 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.

⚠ WARNING 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 by unauthorized personnel. The incoming power cable must be deenergized. The robot controller and mains supply lead must then be checked to ensure that it is deenergized.
If the KR C4 or VKR C4 robot controller is used:
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 in the case of the drives of the new generation. Parts remain energized. Death or severe injuries may result.

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

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

Robot controller

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

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

Voltages in excess of 50 V (up to 600 V) can be present in various components for several minutes after the robot controller has been switched off! To prevent

life-threatening injuries, no work may be carried out on the industrial robot in this time.

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

Counterbalancing system

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

The hydropneumatic and gas cylinder counterbalancing systems are pressure equipment and, as such, are subject to obligatory equipment monitoring. Depending on the robot variant, the counterbalancing systems correspond to category 0, II or III, fluid group 2, 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 that our customers regularly request up-to-date safety data sheets from the manufacturers of hazardous substances.

5.5.7 Decommissioning, storage and disposal

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

5.6 Applied norms and regulations

Name	Definition	Edition
2006/42/EC	Machinery Directive: Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)	2006
2004/108/EC	EMC Directive: Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC	2004

Name	Definition	Edition
97/23/EC	Pressure Equipment Directive: Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment (Only applicable for robots with hydropneumatic counterbalancing system.)	1997
EN ISO 13850	Safety of machinery: Emergency stop - Principles for design	2008
EN ISO 13849-1	Safety of machinery: Safety-related parts of control systems - Part 1: General principles of design	2008
EN ISO 13849-2	Safety of machinery: Safety-related parts of control systems - Part 2: Validation	2008
EN ISO 12100	Safety of machinery: General principles of design, risk assessment and risk reduction	2010
EN ISO 10218-1	Industrial robots: Safety	2011
EN 614-1	Safety of machinery: Ergonomic design principles - Part 1: Terms and general principles	2006
EN 61000-6-2	Electromagnetic compatibility (EMC): Part 6-2: Generic standards; Immunity for industrial environments	2005
EN 61000-6-4	Electromagnetic compatibility (EMC): Part 6-4: Generic standards; Emission standard for industrial environments	2007
EN 60204-1	Safety of machinery: Electrical equipment of machines - Part 1: General requirements	2006

6 Planning

6.1 Mounting base

Description

The mounting base is used for fastening the KR 30, 60 JET robot to a concrete foundation. Adjustable leveling elements are used for aligning the columns.

There are 2 variants of the mounting base:

- Mounting base with bedplates
- Mounting base

Fastening to mounting base with bedplates

The mounting base with bedplates (>>> Fig. 6-1) consists of:

- Leveling screw (2)
- Baseplate (6)
- Bedplate (5)
- Resin-bonded anchors (4)
- Fasteners (1)

The leveling screws (2) are screwed through the columns (3) and and are supported by the foundation via the baseplates (6) and the bedplates (5). The bedplates are anchored to the foundation. After alignment of the robot, the components are fastened together with screws and welded to the bedplate.

This mounting base requires a level and smooth surface on a concrete foundation with adequate load bearing capacity. The minimum dimensions must be observed.

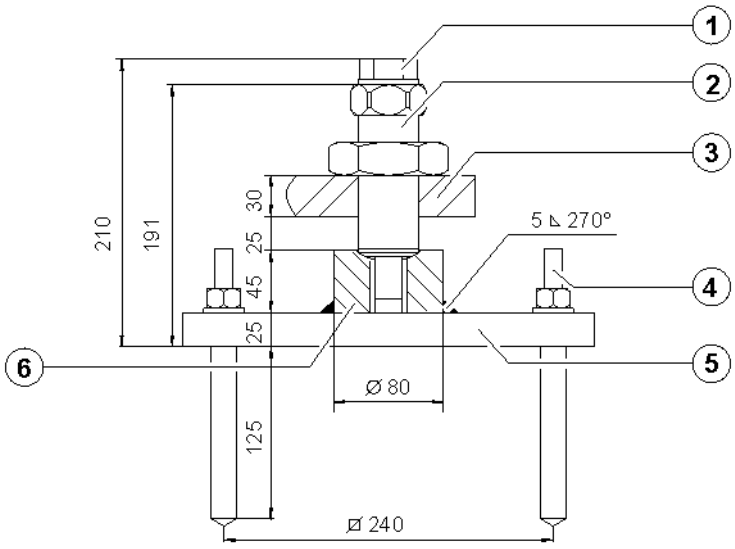

Fig. 6-1: Mounting base with bedplates

1	Fasteners	4	Resin-bonded anchor
2	Leveling screw	5	Bedplate
3	Column	6	Baseplate

Dimensioned drawing

The following illustration (>>> Fig. 6-2) provides all the necessary information on the mounting base with bedplate, together with the required foundation data. To ensure that the anchor forces are safely transmitted to the foundation, the specified dimensions for the concrete foundation must be observed. The position of the individual foundations is order-specific; the necessary dimensions can be found in the section Order-specific Technical Data.

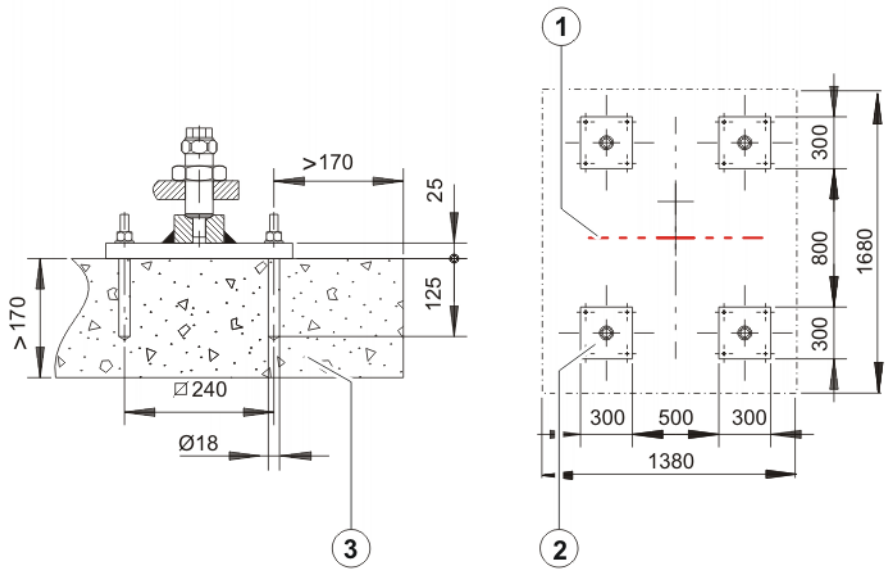

Fig. 6-2: Mounting base with bedplate, dimensioned drawing

1 Center of foundation
2 Bedplate
3 Concrete foundation

Fastening to mounting base

The mounting base (>>> Fig. 6-3) consists of:

- Leveling screw (2)
- Baseplate (5)
- Resin-bonded anchors (4)
- Fasteners (1)

The leveling screws (2) are screwed through the columns (3). They are supported via the baseplates (5) on the foundation. After alignment of the gantry, the components are fastened together with screws and the leveling screws are welded to the foundation.

This mounting base requires a level and smooth surface on a concrete foundation with adequate load bearing capacity. The minimum dimensions must be observed.

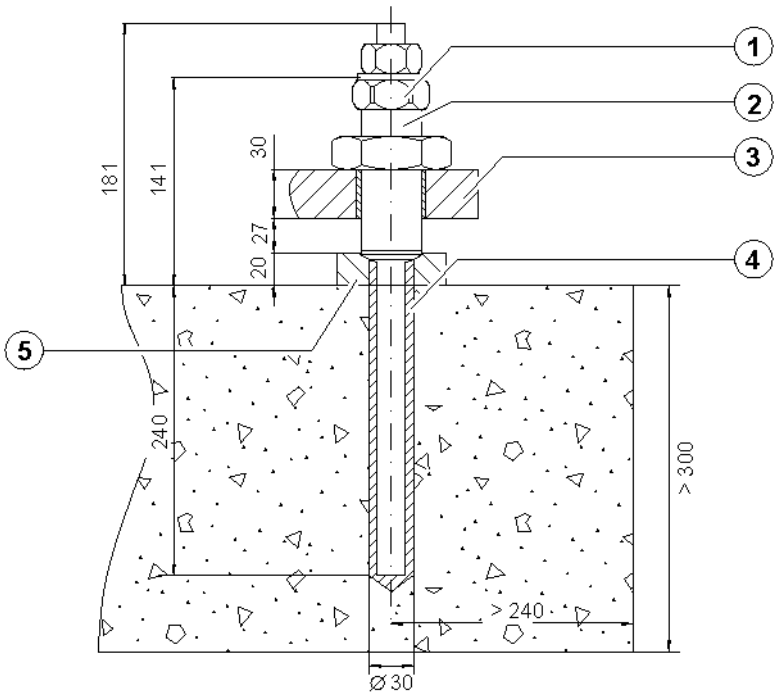

Fig. 6-3: Mounting base on the concrete foundation

1	Fasteners	4	Resin-bonded anchor
2	Leveling screw	5	Baseplate
3	Column		

Dimensioned drawing

The following illustration (>>> Fig. 6-4) provides all the necessary information on the mounting base, together with the required foundation data. To ensure that the anchor forces are safely transmitted to the foundation, the specified dimensions for the concrete foundation must be observed. The position of the individual foundations is order-specific; the necessary dimensions can be found in the section Order-specific Technical Data.

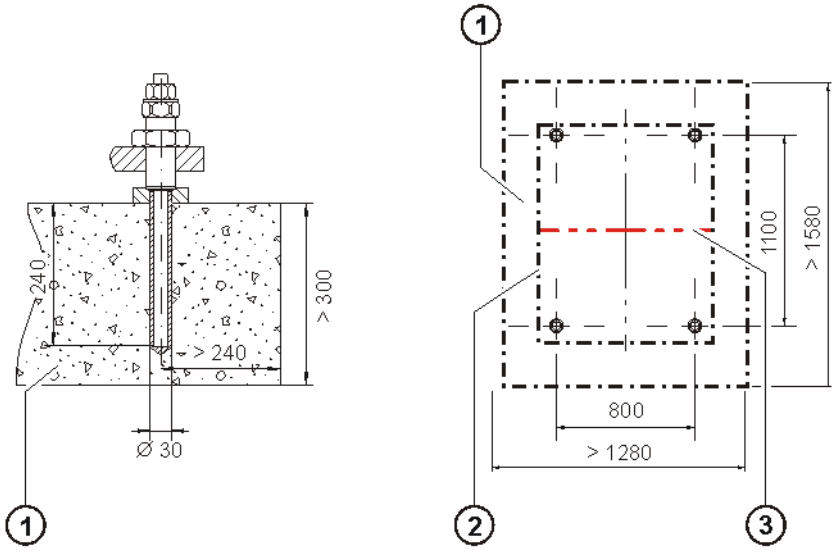

Fig. 6-4: Mounting base, dimensioned drawing

1	Concrete foundation
2	Column
3	Center of foundation

Grade of concrete for foundations

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

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

6.2 Connecting cables and interfaces

Description

The connecting cables comprise all the cables for transferring energy and signals between the robot controller and the JET TRACK (axis module). They are connected by means of connectors to the robot controller and to the connector plate on the energy supply chain of the axis module. The cables between the connector plate and the robot are part of the energy supply chain. Depending on the specific application, the energy supply chain may also contain further cables and hoses.

Depending on the specification of the robot, the following variants are used:

- Connecting cables, standard (KR C2)
- Connecting cables for RoboTeam robots
- Connecting cables for SafeRobot
- Connecting cables for KR C4

If the length of the connecting cables is greater than 25 m, a separate ground conductor must be connected between the axis module and the robot controller. With KR C4, the ground conductor is always required and can be ordered as an option.

Detailed information about wiring diagrams, connector pin allocations and connector designations can be found in section or .

Interface for energy supply system

The KR 30, 60 JET ROBOT can be equipped with an energy supply system for axis 1 to axis 3. The necessary interface – interface A 3 on the arm – is situated on the left-hand side of the robot. The interface is equipped with connections for cables and hoses depending on the application. Detailed information on the connector pin allocation, threaded unions, etc. is given in separate documentation.

7 Transportation

7.1 Transportation

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 in position. Before the robot is lifted, it must be ensured that it is free from obstructions. Remove all transport safeguards, such as nails and screws, in advance. First remove any rust or glue on contact surfaces.

Transport position

The robot is in the transport position when the axes are in the following positions:

Axis	A 1	A 2	A 3	A 4	A 5	A 6
Angle		-110°	+158°	0°	+90°	0°

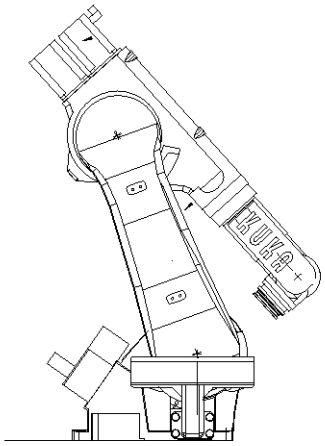

Fig. 7-1: Transport position

Transport dimensions

The transport dimensions for the robot (1) can be noted from the following figure. The position of the center of gravity (3) and the weight vary according to the specific configuration. The specified dimensions refer to the robot without equipment or transport frame.

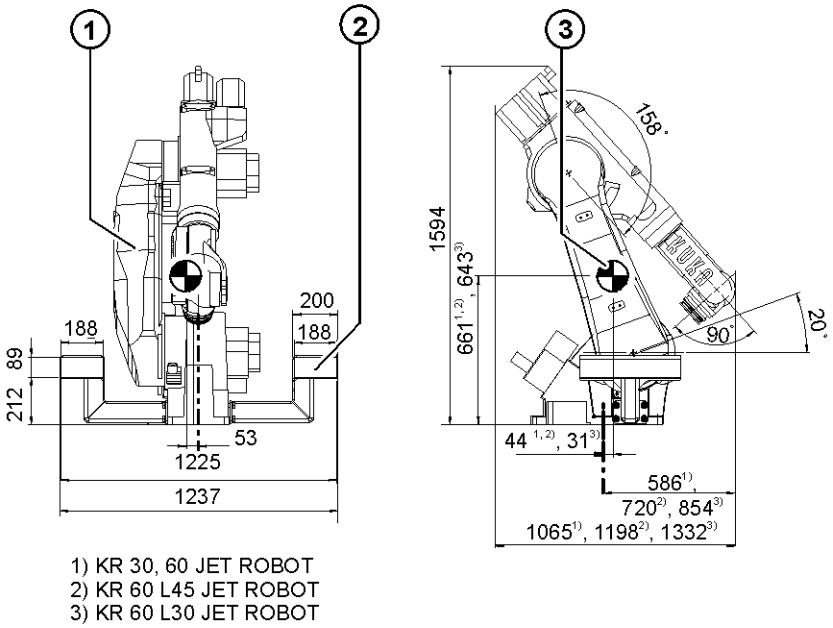

Fig. 7-2: Transport dimensions

1 Robot
2 Fork slots
3 Center of gravity

The fork slots (2) must be installed for transport.

Transportation

The robot can be transported by fork lift truck or using lifting tackle. The fork slots must be properly and fully installed.

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

Transportation by fork lift truck

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

NOTICE Avoid excessive loading of the fork slots through undue inward or outward movement of hydraulically adjustable forks of the fork lift truck. Failure to do so may result in material damage.

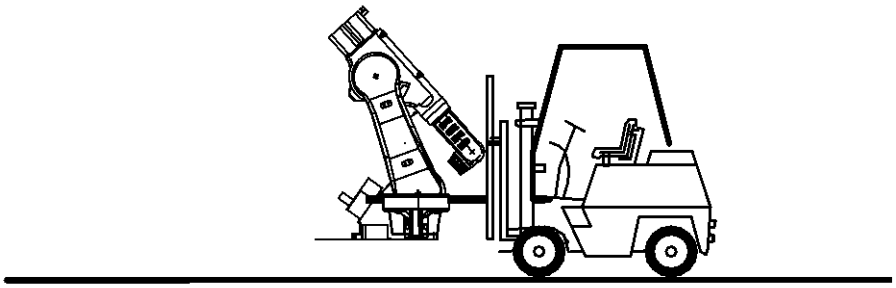

Fig. 7-3: Transport with a fork lift truck

Transportation using lifting tackle

The robot (>>> Fig. 7-4) (2) can be transported using lifting tackle (1). The robot must be in the transport position. The lifting tackle is attached with hooks (3) to the fork slots (4) screwed to the rotating column. All ropes must be long enough and must be routed in such a way that the robot is not damaged. Additional securing measures (5) can be used to prevent the robot from toppling during transportation. Installed tools and pieces of equipment can cause undesirable shifts in the center of gravity, which must be taken into account during transportation.

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

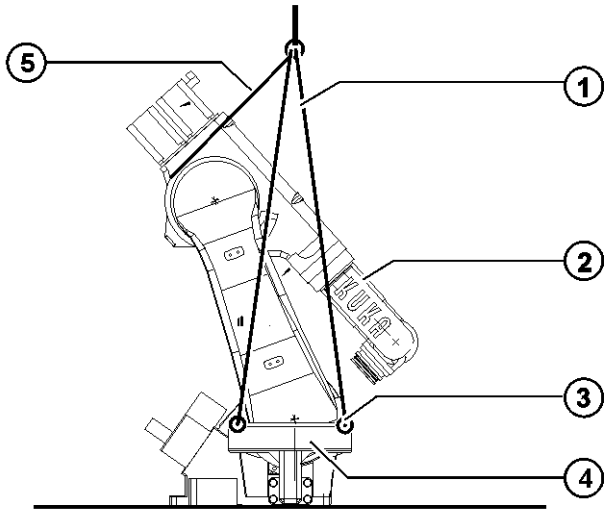

Fig. 7-4: Lifting tackle

1	Lifting tackle	3	Eyebolt
2	Robot	4	Fork slots

Transportation with transport frame

For installation on the wall or ceiling, the robot is transported in a corresponding transport frame (>>> Fig. 7-5) (1), (2). For this the robot must be brought into the transport position before installation in the transport frame. The transport frame can be picked up with a fork lift truck or using lifting tackle (4 ropes). The center of gravity (3) must be taken into account during transportation.

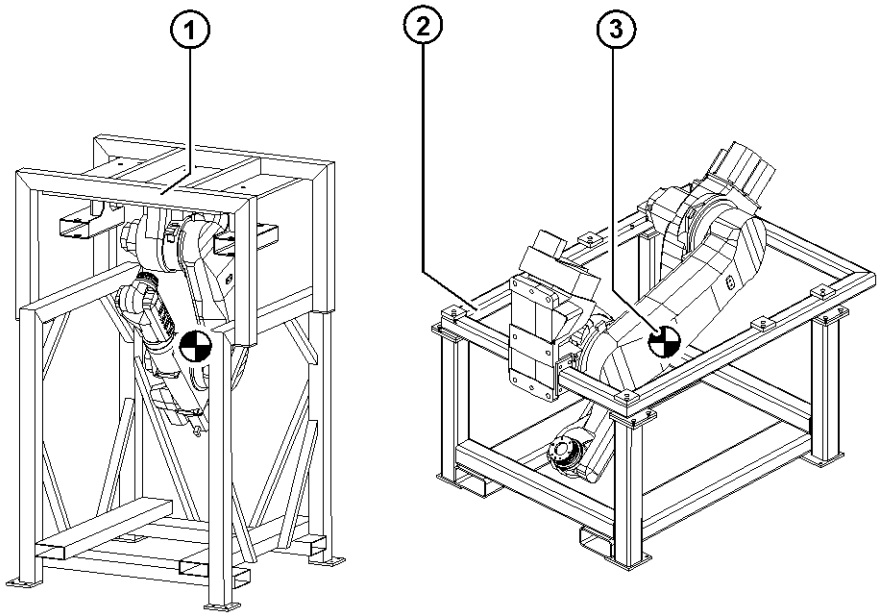

Fig. 7-5: Transport frame

1 Transport frame for inverted robot
2 Transport frame for side-mounted robot
3 Center of gravity

Transporting the beam

The beam can be transported with a fork lift truck or using lifting tackle and a crane. When using lifting tackle, the beam (3) must be picked up in accordance with the following diagram. Tubes with the appropriate carrying capacity can be used as transport aids (2). The necessary holes are provided in the beam. If the carriage is already mounted on the beam, it must be positioned near the center of gravity and secured so that it cannot move. If the beam is transported using a fork lift truck, attention must paid to the position of the center of gravity. When setting it down on the floor, the substructure must be such that no parts can be damaged.

The handling equipment must have sufficient carrying capacity. The weight of the components can be noted from the Order-specific technical data.

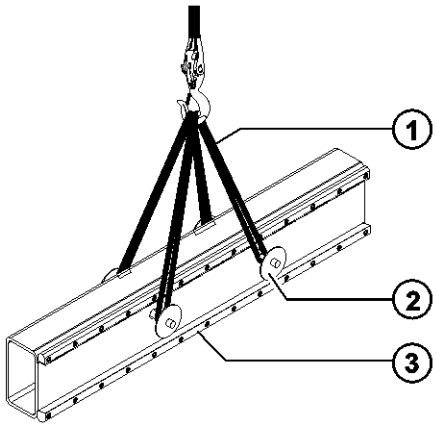

Fig. 7-6: Transporting the beam

1 Lifting tackle
2 Transport aid, tube
3 Beam

8 KUKA Service

8.1 Requesting support

Introduction

The KUKA Roboter GmbH documentation offers information on operation 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:

- Model and serial number of the robot
- Model and serial number of the controller
- Model and serial number of the linear unit (if applicable)
- Model and serial number of the energy supply system (if applicable)
- Version of the KUKA System Software
- Optional software or modifications
- Archive of the software

  For KUKA System Software V8: instead of a conventional archive, generate the special data package for fault analysis (via **KrcDiag**).
- Application used
- Any external axes used
- Description of the problem, duration and frequency of the fault

8.2 KUKA Customer Support

Availability

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

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