

**ROBOT**

**KR 350**

**Installation, Connection, Exchange**

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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 subsequent editions.

Subject to technical alterations without an effect on the function.

PD Interleaf

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Valid for  
 KR 350/2  
 KR 350 L280/2  
 KR 350 L240/2

## 1 General



In the following description, only the KR 350 will be depicted in the illustrations. The information in the description applies to all robot variants, however. Exceptions to this will be clearly marked.



**The Doc. Module “Safety, General” and the robot Doc. Module “Repair, General” are to be observed!**  
**With all work involving the connection of the robot (and of the control cabinet), the control cabinet Doc. Module “Initial Start-up” must be observed.**

Before any installation and exchange work is started, any attached tools or additional equipment that would hinder the installation and exchange work must be dismantled.



**The fork lift truck, lifting tackle and crane must be suitable for handling the robot. For weight of robot see robot Doc. Module “Technical Data”.**

The description of the installation and exchange operations is subdivided into job steps with numbers in brackets appearing before them. The text which immediately follows these steps must also be read if it is specially marked by a **warning triangle** or either of the **hand symbols**, as many of these marked texts refer to the preceding job step.



**Example**  
 (8) Lower the robot slowly without tilting it.



**The robot must be lowered vertically downwards until both locating pins are free.**

Some of the specially marked texts refer exclusively to everything that follows – until the instruction is expressly revoked or the work is completed at the end of a section.



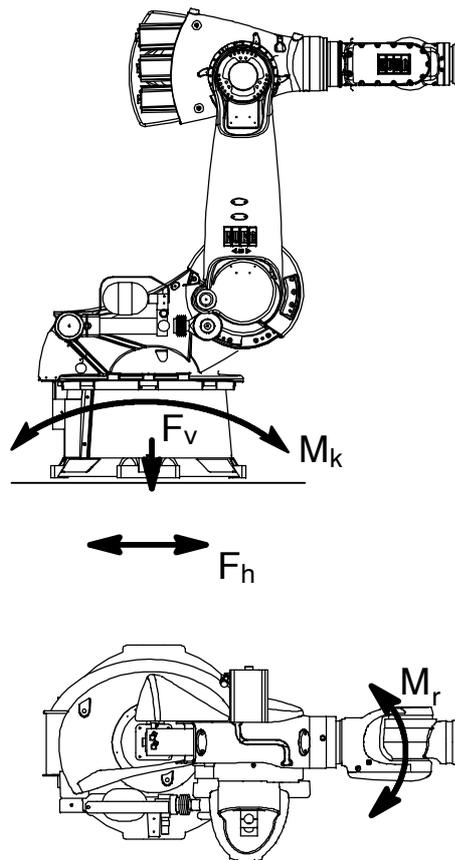
### Example



**Turn main switch on the robot control cabinet to “OFF” and secure it with a padlock to prevent unauthorized persons from switching it on again.**

## 2 Principal loads

Forces occur during operation of the robot which must be safely transmitted to the floor or ceiling. The forces that have to be taken into account for floor- and ceiling-mounted robots are specified in Fig. 1. The drawings with their specifications can be used as a basis for more extensive static investigations.



$F_v$	=	vertical force	$F_{vmax}$	=	28 000 N
$F_h$	=	horizontal force	$F_{hmax}$	=	15 000 N
$M_k$	=	tilting moment	$M_{kmax}$	=	50 000 Nm
$M_r$	=	turning moment about axis 1	$M_{rmax}$	=	26 500 Nm

Total mass	=	robot	+	total load	for type
1940 kg	+	500 kg			KR 350/2
1956 kg	+	430 kg			KR 350 L280/2
1965 kg	+	390 kg			KR 350 L240/2

Fig. 1 Principal loads acting on floor (or ceiling) due to robot and total load

### 3 Mounting variants

Depending on the type, the robot can be installed on the floor or on the ceiling.

There are two mounting variations for installing the robot on the floor or on the ceiling:

- Variant 1 (394.001–08.002), see Section 3.1
- Variant 2 (394.001–08.003), see Section 3.2

If the robot is to be installed on the floor, being directly mounted on a concrete base, all pertinent construction specifications must be observed concerning the grade of concrete ( $\geq$  B25 according to DIN 1045) and the load-bearing capacity of the ground when preparing the concrete foundation. It must be ensured that the surface of the foundation is level and sufficiently smooth. The anchors must be inserted with great care to ensure that the forces occurring during the operation of the robot (Fig. 1) are transmitted safely to the ground.

### 3.1 Variant 1 (394.001–08.002)

Characteristic features:

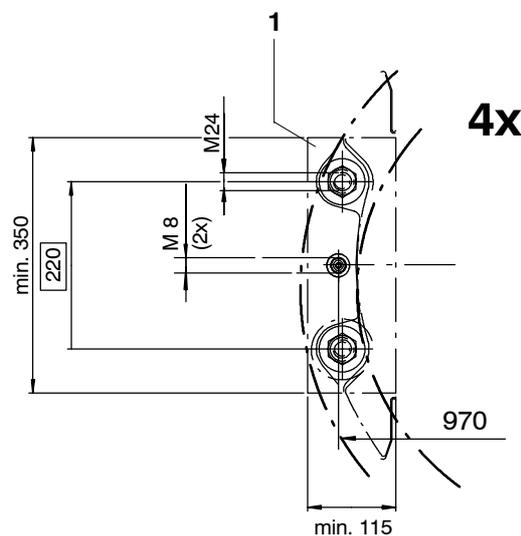
- For floor- and ceiling-mounted robots
- Robot installed on a steel structure prepared by the customer (or on a linear unit of series KL 1500)
- Robot fastened by means of eight M24x100–8.8 ISO 4017 hexagon bolts.



**Retighten M24x100–8.8 ISO 4017 hexagon bolts after 100 hours of operation. Tightening torque  $M_A = 700 \text{ Nm}$ .**

Accessory: “frame mounting kit”

- (1) Prepare mounting surfaces (Fig. 2/1) on steel structure in accordance with Fig. 2.



**Fig. 2 Mounting surfaces for variant 1**

- (2) Drill eight holes for holding-down bolts (Fig. 3/3) and two holes for the locating pins (2, 5) as shown in Fig. 3.



The intended installation position of the robot, i.e. the correct orientation in relation to the working envelope (Fig. 3/4), must be taken into account when drilling the holes.

- (3) Insert locating pins (2, 5) and fasten each one with an M8x55 Allen screw (1) together with lock washer.



The position of the locating pins in relation to the working envelope is important: Looking forwards (4) from the robot towards the working envelope – the robot arm points in this direction when A 1 is in its zero position –, then the sword pin (2) must be on the right and the round pin (5) on the left.



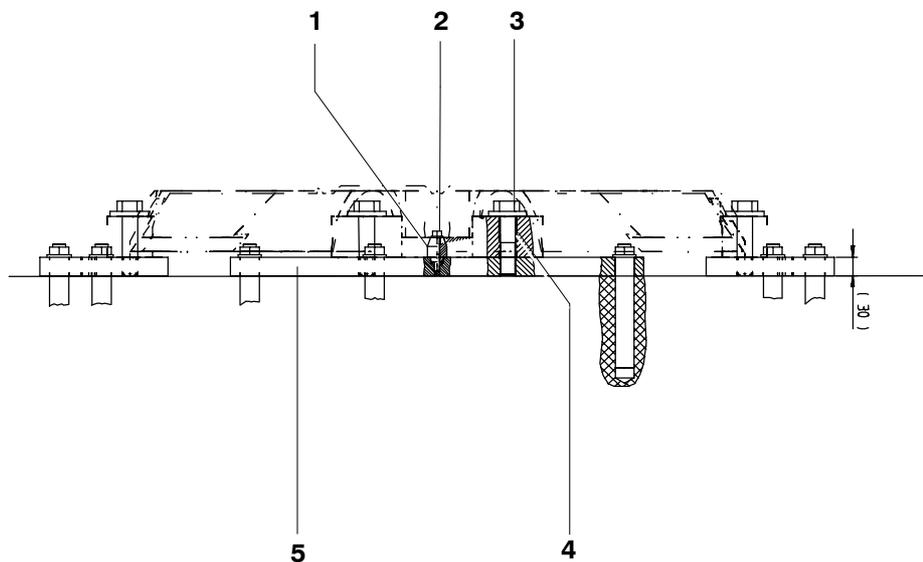


- (2) Fasten each intermediate plate to the bottom of the robot by means of two M24x100–8.8 hexagon bolts (Fig. 5/3) together with lock washers and centering rings (4) in accordance with Fig. 4.
- (3) Lower robot onto the concrete foundation and align it correctly in relation to the working envelope (Fig. 3/4).



To avoid distorting the robot base frame when fastening it to the intermediate plates, differences in level between the concrete foundation and the intermediate plates must be corrected using levelling compound (filling compound).

- (4) Mark the position of the intermediate plates on the concrete foundation and determine the magnitude of the differences in level.
- (5) Lift off robot again together with intermediate plates.



**Fig. 5 Intermediate plates for variant 2**

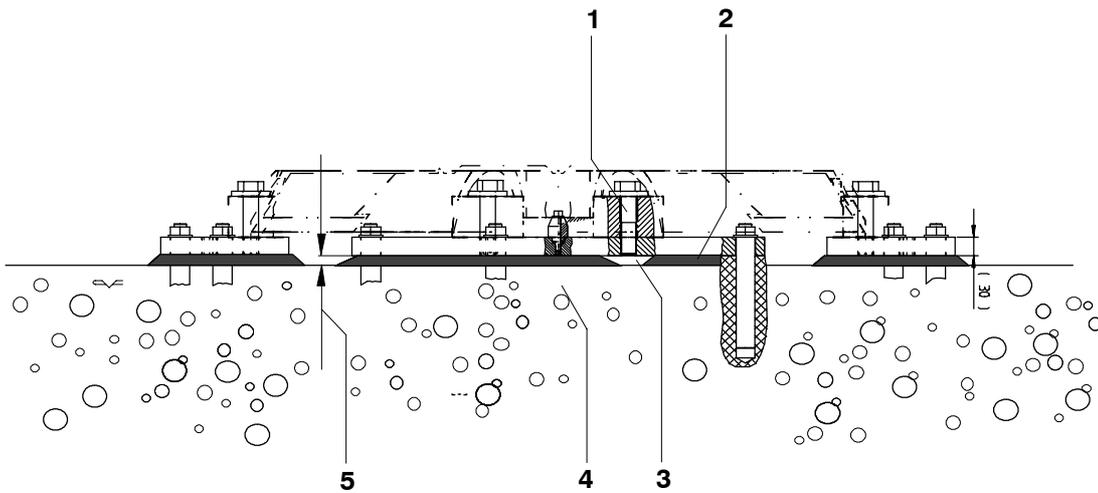
- (6) Apply levelling compound (Fig. 6/2) onto the marked areas on the concrete foundation (4).



“Knauf levelling compound”, for example, is a suitable compound for this purpose. It is applied with a toothed spatula (tooth height > 2 x difference in level (5)).



**The area (3) under each hexagon bolt (1) must be kept free from levelling compound or it must be cleared after the compound has been applied.**



**Fig. 6 Levelling compound**

- (7) Set down the robot in the still plastic levelling compound and adjust its position slightly if necessary.

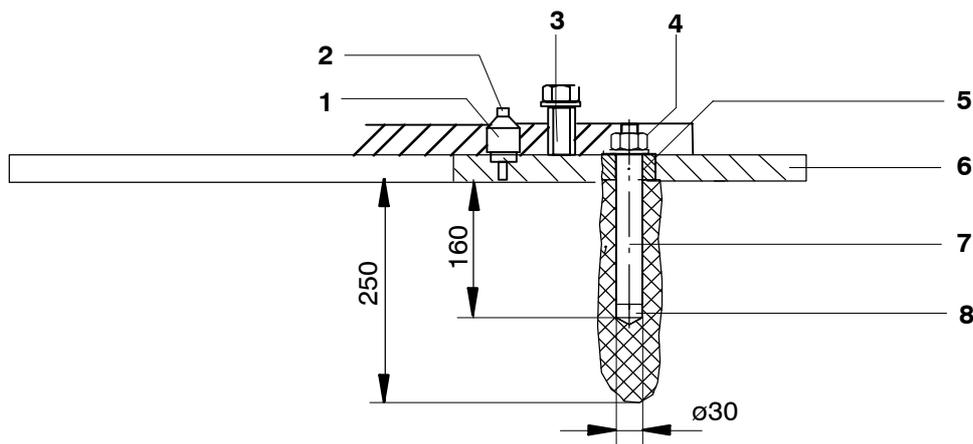


The robot can be levelled by turning an M20x40 hexagon bolt (Fig. 4/4) on each intermediate plate.

- (8) Allow the levelling compound to set for about three hours.  
 (9) Drill four anchor holes (Fig. 7/8) for each intermediate plate; minimum depth in concrete 160 mm.



The holes in the concrete foundation must be drilled through the holes (5) in the plates (6).



**Fig. 7 Anchor boreholes for variant 2**

- (10) Insert anchors (7).

- (11) Screw on hexagon nuts (4) together with lock washers and tighten hexagon nuts with torque wrench in diagonally opposite sequence, increasing the tightening torque to the specified value in several stages ( $M_A = 300 \text{ Nm}$ ).
- (12) Unscrew and remove all hexagon bolts (3) together with lock washers.
- (13) Carefully lift robot vertically and remove centering rings that are then loose.
- (14) Remove Allen screws (2) and replace both set-up pins (1) with locating pins.



The position of the locating pins in relation to the working envelope is important: Looking forwards from the robot towards the working envelope – the robot arm points in this direction when A 1 is in its zero position (Fig. 4) –, then the sword pin (5) must be on the right and the round pin (6) on the left.



**Any levelling compound that has penetrated into the bottom of the holes must be removed from the eight tapped holes in the intermediate plates in order that the robot holding-down bolts can be screwed in completely.**

- (15) Set robot down onto intermediate plates (Fig. 7/6) and fasten it by means of eight M24x100 hexagon bolts (3) together with lock washers.
- (16) Tighten hexagon screws (3) with torque wrench in diagonally opposite sequence, increasing the tightening torque to the specified value in several stages ( $M_A = 700 \text{ Nm}$ ).
- (17) Retighten hexagon nuts (4) of the anchors after 24 hours with a tightening torque of 300 Nm.



**The levelling compound setting time of 24 hours must be strictly observed.**



**Retighten hexagon bolts (3) and hexagon nuts (4) after 100 hours of operation.**

The robot is now ready to be installed in accordance with Section 4.1.

## 4 Installing and connecting the robot

### 4.1 Floor-mounted robots



**Section 1 of this Doc. Module is to be observed.**

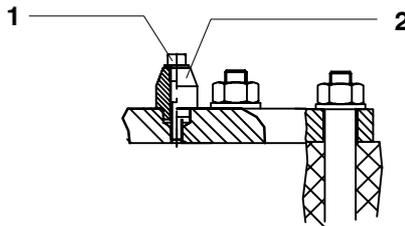
This description applies to robots with mounting variant 1 (Section 3.1) and 2 (Section 3.2). If the robot is to be installed on the floor in an inclined position of more than 10°, KUKA must be consulted beforehand.

The procedure for installing the robot (whether for the first time or as an exchange) is as follows:

- (1) Check that both locating pins (Fig. 8/2) and their fastening screws (1) are undamaged and fitted securely.



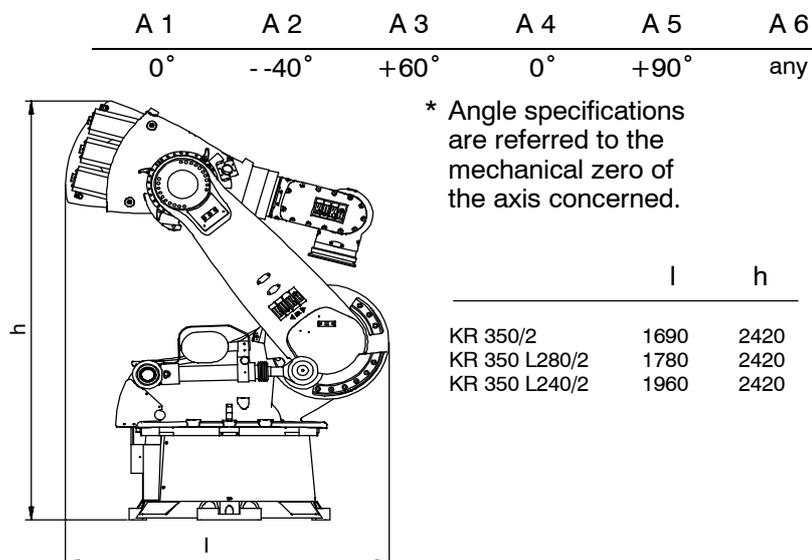
**Damaged locating pins must be replaced by new ones.**



**Fig. 8 Locating pins**



**The robot must be in the transport position (Fig. 9)\*.**



**Fig. 9 Transport position for floor-mounted robots**

- (2) Raise robot with fork lift truck or lifting tackle attached to three eyebolts on the rotating column.



**For reasons of safety, it is imperative for the lifting tackle to be attached to the robot at the specified points. Risk of injury!**  
The transport instructions in the robot Doc. Module “Repair, General” must be observed.

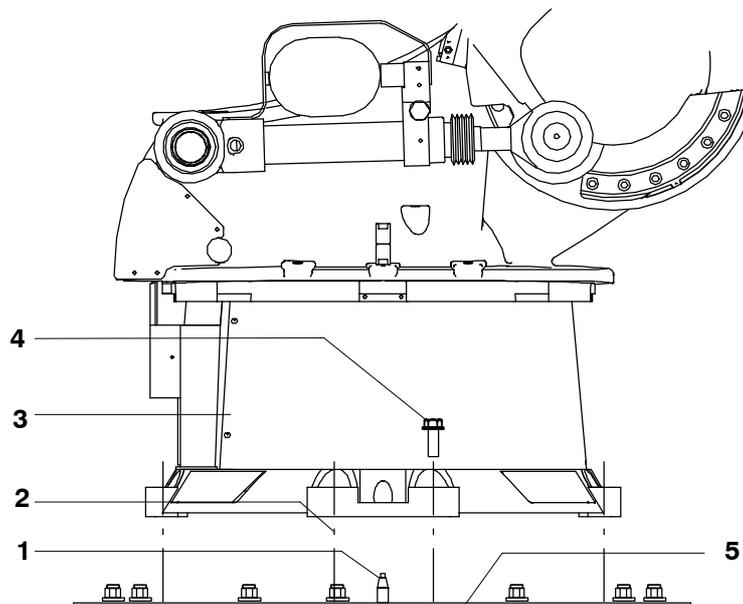


**If the robot is transported by fork lift truck, the forks must be placed in the slots in the base frame or the transport frame. It is forbidden to pick up the robot in any other way using a fork lift truck!**

- (3) Lower robot (Fig. 10/3) vertically onto intermediate plates (5) or steel structure. If lifting tackle is used, particular care must be taken to ensure exact vertical positioning in order to avoid damaging the locating pins during this operation.



**As the robot is lowered, the boreholes (2) must be aligned as accurately as possible with the two locating pins (1). If this operation is carried out inaccurately, it is more likely that parts will be damaged.**



**Fig. 10 Installing the robot on the floor**

- (4) Insert eight M24x100–8.8 ISO 4017 hexagon bolts (4) together with lock washers and tighten them with a torque wrench in diagonally opposite sequence, increasing the tightening torque to the specified value in several stages ( $M_A = 700 \text{ Nm}$ ).



**Retighten the eight hexagon bolts (4) after 100 hours of operation.**

- (5) Remove lifting tackle.
- (6) Connect connecting cables.



**Before performing the next step, it must be ensured that it is not possible for anyone to be injured within the range of the slowly moving robot. The robot may only be moved at manual traversing speed, with all applicable safety rules and regulations being observed.**

- (7) Put robot into operation and move it into a suitable position to install end-effector and additional equipment.



**Turn main switch on the robot control cabinet to “OFF” and secure it with a padlock to prevent unauthorized persons from switching it on again.**

- (8) Install end-effector and additional equipment.



**If any additional equipment (working range monitoring devices, etc.) is installed on the robot, the instructions and warnings in the relevant Doc. Modules must be strictly observed.**

- (9) Connect all other cables which have been removed.
- (10) Put robot into operation.

## 4.2 Ceiling-mounted robots



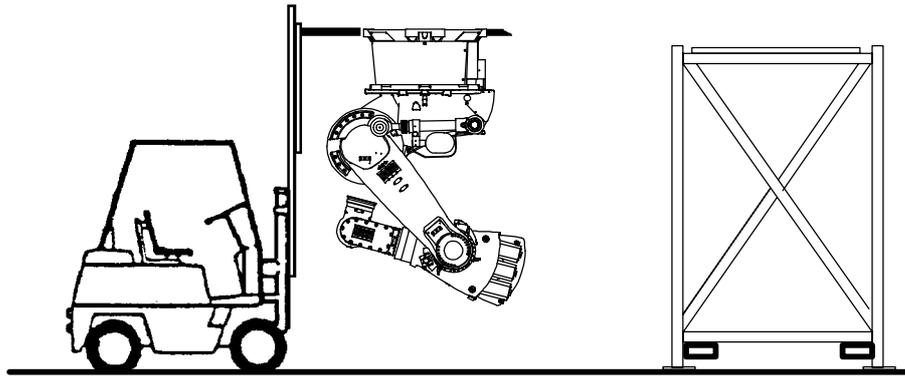
**Section 1 of this Doc. Module is to be observed.**

This description only applies to ceiling-mounted robots with mounting variant 1 (Section 3.1).

For installation on the ceiling, the robot can be transported in a transport frame – already in the correct orientation. It is removed from this frame by fork lift truck and brought to the site of installation (Fig. 11). If the robot has to be turned over, the instructions applying to the counterbalancing system in the robot Doc. Module “Adjustment Instructions” must be observed.



**If the robot is transported by fork lift truck, the forks must be placed in the slots in the base frame or the transport frame. It is forbidden to pick up the robot in any other way using a fork lift truck!**



**Fig. 11 Transporting the robot for mounting on the ceiling**

The procedure for mounting the robot on the ceiling (whether for the first time or as an exchange) is as follows:

- (1) Check that both locating pins (Fig. 8/2) and their fastening screws are undamaged and fitted securely.

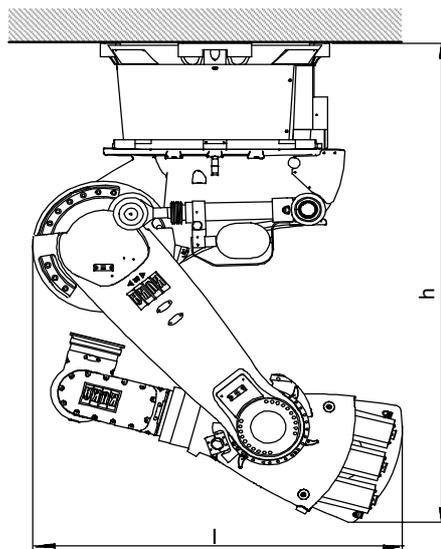


**Damaged locating pins must be replaced by new ones.**



**The robot must be in the transport position (Fig. 12)\*.**

A 1	A 2	A 3	A 4	A 5	A 6
0°	--40°	+60°	0°	+90°	any



\* Angle specifications are referred to the mechanical zero of the axis concerned.

	l	h
KR 350/2	1690	2420
KR 350 L280/2	1780	2420
KR 350 L240/2	1960	2420

**Fig. 12 Transport position for ceiling-mounted robots**

- (2) Raise the robot (Fig. 13/3) vertically with the fork lift truck and place it onto the ceiling structure (5).



As the robot is lifted, the boreholes (2) must be aligned as accurately as possible with the two locating pins (1). If this operation is carried out inaccurately, it is more likely that parts will be damaged.



As soon as the robot is in its exact position on the ceiling, it must be pressed firmly against the ceiling until it is finally bolted to it.

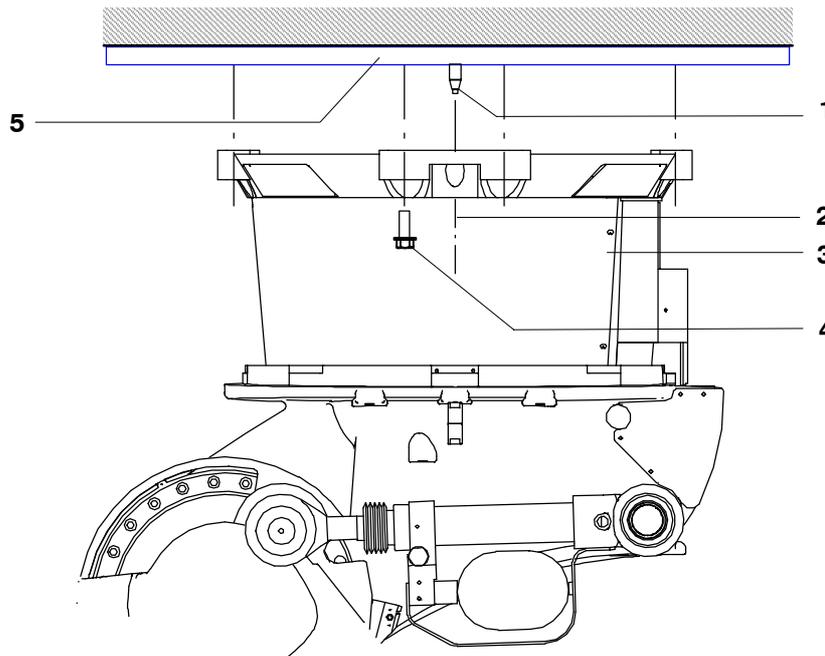


Fig. 13 Installing the robot on the ceiling

- (3) Insert eight M24x100–8.8 ISO 4017 hexagon bolts (4) together with lock washers and tighten them with a torque wrench in diagonally opposite sequence, increasing the tightening torque to the specified value in several stages ( $M_A = 700 \text{ Nm}$ ).



Retighten M24x100–8.8 ISO 4017 hexagon bolts (4) after 100 hours of operation.

- (4) Remove fork lift truck.
- (5) Connect connecting cables.



Before performing the next step, it must be ensured that it is not possible for anyone to be injured within the range of the slowly moving robot. The robot may only be moved at manual traversing speed, with all applicable safety rules and regulations being observed.

- (6) Put robot into operation and move it into a suitable position to install end-effector and additional equipment.



**Turn main switch on the robot control cabinet to “OFF” and secure it with a pad-lock to prevent unauthorized persons from switching it on again.**

- (7) Install end-effector and additional equipment.



**If any additional equipment (working range monitoring devices, etc.) is installed on the robot, the instructions and warnings in the relevant Doc. Modules must be strictly observed.**

- (8) Connect all other cables which have been removed.
- (9) Put robot into operation.

## 5 Exchange

To avoid the need for any major reprogramming after an exchange, the instructions given in the Operating Handbook, Software KR C1A, Chapter “Start-up”, Section “Robot Mastering/Unmastering” must be accurately carried out every time a robot is exchanged.

### 5.1 Exchanging floor-mounted robots

- **Removal**



**Turn main switch on the robot control cabinet to “OFF” and secure it with a padlock to prevent unauthorized persons from switching it on again.**

(1) Remove end-effector (tool) and additional equipment.



The end-effector and additional equipment have to be removed if the robot is to be replaced by another one or if they would otherwise impede the exchange work.



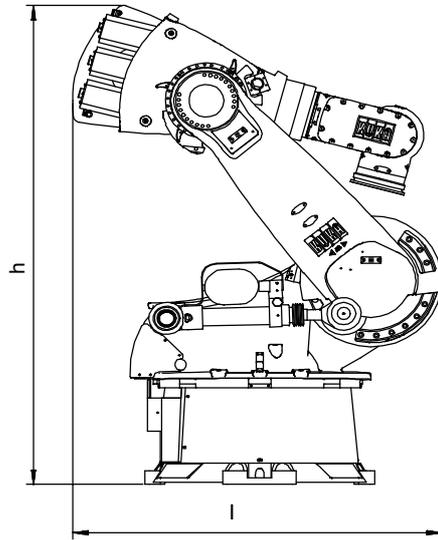
**If the end-effector and additional equipment remain on the robot, this is liable to lead to adverse centers of gravity and collisions. The operator is deemed responsible for any damage resulting in this respect.**



**Before performing the next step, it must be ensured that it is not possible for anyone to be injured within the range of the slowly moving robot. The robot may only be moved at manual traversing speed, with all applicable safety rules and regulations being observed.**

(2) Put robot into operation and move it into transport position (Fig. 14)\*.

A 1	A 2	A 3	A 4	A 5	A 6
0°	-40°	+60°	0°	+90°	any



\* Angle specifications are referred to the mechanical zero of the axis concerned.

	l	h
KR 350/2	1690	2420
KR 350 L280/2	1780	2420
KR 350 L240/2	1960	2420

Fig. 14 Transport position for floor-mounted robots



Turn main switch on the robot control cabinet to “OFF” and secure it with a padlock to prevent unauthorized persons from switching it on again.

- (3) Release and unplug all connectors from the junction boxes (Fig. 15/1).
- (4) Remove electric cables and hose lines from both interfaces of energy supply system A 1 and all other peripheral supply lines to the robot, where necessary.

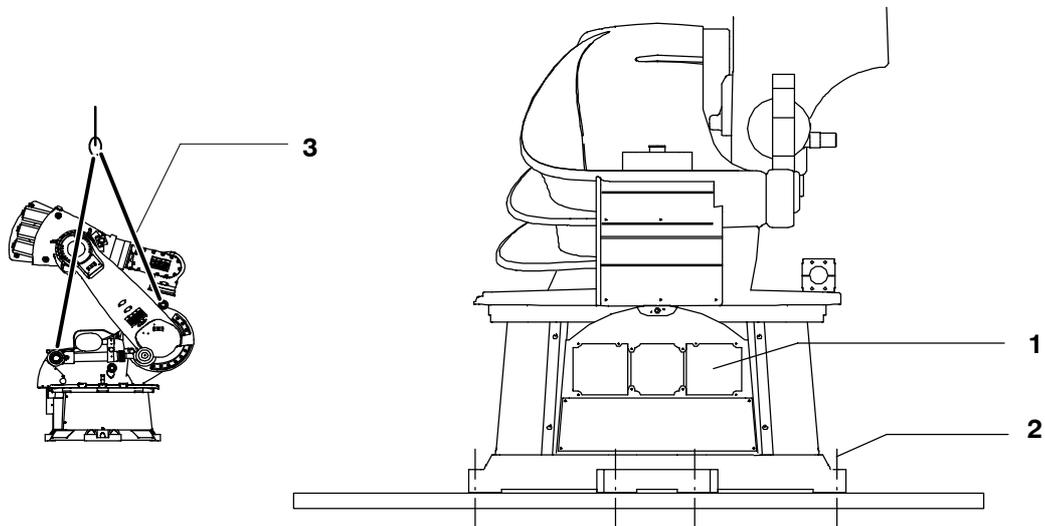


Depressurize and drain hose lines beforehand.

- (5) Remove eight M24x100–8.8 ISO 4017 hexagon bolts (2) together with lock washers.
- (6) Raise robot with lifting tackle (3) attached to three eyebolts on the rotating column.



For reasons of safety, it is imperative for the lifting tackle to be attached to the robot at the specified points. Risk of injury!  
The transport instructions in the robot Doc. Module “Repair, General” must be observed.



**Fig. 15 Removal of floor-mounted robot**



The robot can also be lifted by fork lift truck.



**If the robot is transported by fork lift truck, the forks must be placed in the slots in the base frame or the transport frame. It is forbidden to pick up the robot in any other way using a fork lift truck!**



**The robot must be lifted as vertically as possible until the locating pins are free.**

(7) Lower robot onto a suitable support.



If the robot is not to be reinstalled for some time, it must be protected against corrosion before being put into storage.

- **Installation**

See Section 4.1.

## 5.2 Exchanging ceiling-mounted robots

- Removal



Turn main switch on the robot control cabinet to “OFF” and secure it with a padlock to prevent unauthorized persons from switching it on again.

(1) Remove end-effector (tool) and additional equipment.



The end-effector and additional equipment have to be removed if the robot is to be replaced by another one or if they would otherwise impede the exchange work.



If the end-effector and additional equipment remain on the robot, this is liable to lead to adverse centers of gravity and collisions. The operator is deemed responsible for any damage resulting in this respect.

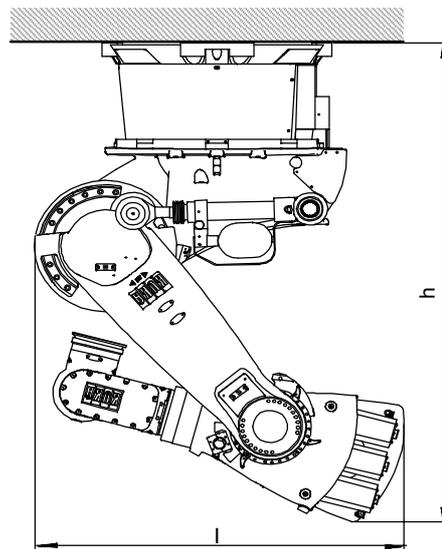


Before performing the next step, it must be ensured that it is not possible for anyone to be injured within the range of the slowly moving robot. The robot may only be moved at manual traversing speed, with all applicable safety rules and regulations being observed.

(2) Put robot into operation and move it into transport position (Fig. 16)\*.

A 1	A 2	A 3	A 4	A 5	A 6
0°	--40°	+60°	0°	+90°	any

\* Angle specifications are referred to the mechanical zero of the axis concerned.



	l	h
KR 350/2	1690	2420
KR 350 L280/2	1780	2420
KR 350 L240/2	1960	2420

Fig. 16 Transport position for ceiling-mounted robots



Turn main switch on the robot control cabinet to “OFF” and secure it with a padlock to prevent unauthorized persons from switching it on again.

- (3) Release and unplug all connectors from the junction boxes (Fig. 17/2).
- (4) Remove electric cables and hose lines from both interfaces of energy supply system A 1 and all other peripheral supply lines to the robot, where necessary.



Depressurize and drain hose lines beforehand.



If the robot is transported by fork lift truck, the forks must be placed in the slots in the base frame. It is forbidden to pick up the robot in any other way using a fork lift truck!

- (5) Move the forks (3) of the fork lift truck into the slots designed for them on the robot and press robot firmly against the ceiling.

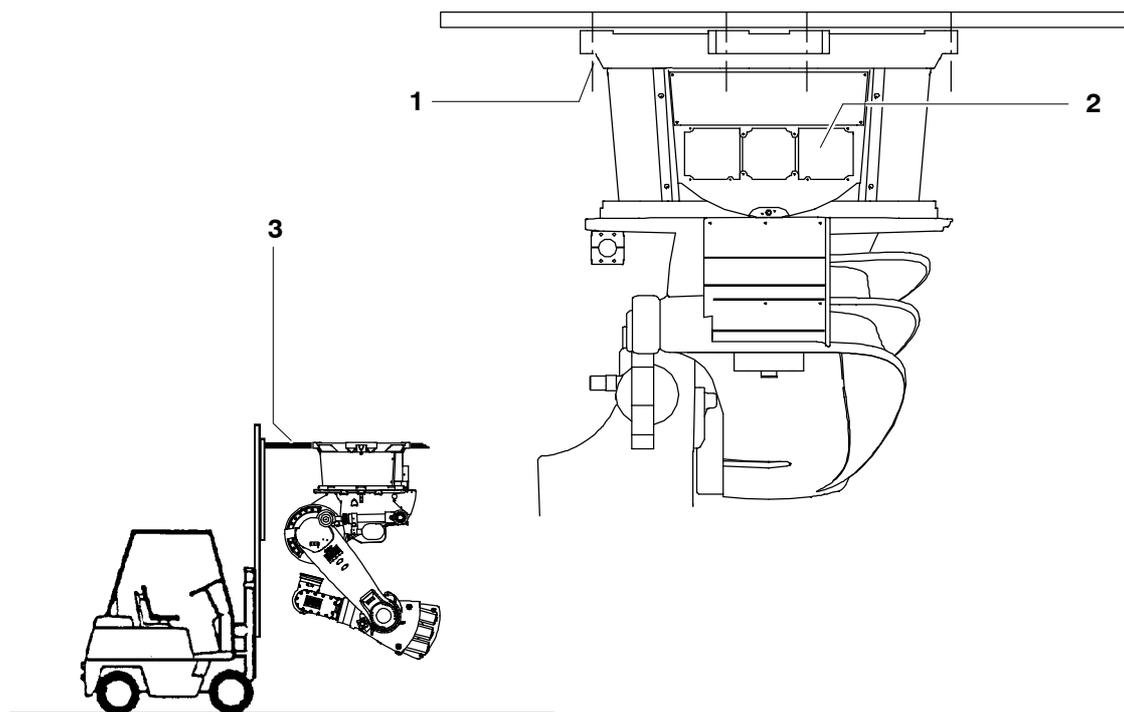


Fig. 17 Removal of ceiling-mounted robot

- (6) Remove eight M24x100–8.8 ISO 4017 hexagon bolts (1) together with lock washers.
- (7) Lower robot slowly without tilting it.



**The robot must be lowered vertically downwards until both locating pins are free.**

- (8) Suspend robot in transport frame and if it needs to be turned over into the floor–mounting position (base frame at bottom, arm at top), turn the robot **together with the transport frame**.



If the robot is not to be reinstalled for some time, it must be protected against corrosion before being put into storage.

- **Installation**

See Section 4.2.