Assembly Instructions 2/2



HORST1500 G2 Robot System

For installation, operating and maintenance personnel.

Always keep with the product!

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Subject to design and machine modifications

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Abbreviations

I/O	Input/output
FFZ	Industrial truck
HORST	Highly Optimised Robotic Systems Technology
MA	Assembly instructions
T1/T2	Teach mode 1/2
TCP	Tool Centre Point

1 Introduction

1.1 Principle

The documentation for the HORST robot system basically consists of the following documents:

1) Assembly instructions
   a) General part,
   b) Robot-specific part (this document),
2) Documentation of the horstOS application software (https://www.fruitcore-robotics.com/de/wissen)

This section of the assembly instructions, together with the general section, forms the assembly instructions for the HORST robot system. This document contains information that applies exclusively to this robot model. All robot model-independent information can be found in the first part of the assembly instructions. Both parts together contain all the important information required to operate the robot system safely, properly and economically.

▶ Read both parts of the MA carefully and completely before the robot system. Handle them with care and keep them at the robot's place of use. An illegible or missing MA must be replaced immediately.

1.2 Standards, directives and conformity

The robot system is considered to be partly completed machinery within the meaning of the EC Machinery Directive. All further information can be found in the first part of the assembly instructions.

1.3 Signs, Symbols and Warnings

Enumerations

Simple enumerations are labelled with "-".

Instructions for action

▶ Instructions for action are labelled with "▶ ".

⇒ Intermediate and final results of the action are labelled with "⇒"

Warnings

Observe these instructions and pass them on to other users.

DANGER!
This warns of an imminent danger that could lead to serious injury or death.

▶ This is followed by a list of instructions for avoiding or eliminating the hazard.

WARNING!
This warns of a potentially imminent danger that could lead to serious injury or death.

▶ This is followed by a list of instructions for avoiding or eliminating the hazard.

CAUTION!
This warns of a potentially dangerous situation that could lead to personal injury.

▶ This is followed by a list of instructions for avoiding or eliminating the hazard.

ELECTRICAL VOLTAGE!
This warns of a potentially dangerous situation that could lead to personal injury.

▶ This is followed by a list of instructions for avoiding or eliminating the hazard.



CAUTION!
Risk of robot damage or damage to property!

▶ This is followed by a list of instructions for avoiding or eliminating the hazard.



Wear protective clothing!

▶ Wear protective equipment: safety shoes, hard hat, safety goggles and work gloves.



Danger of environmental damage!

▶ This is followed by a list of instructions for avoiding or eliminating the hazard.



This symbol introduces notes that provide useful, non-safety-related information

1.4 Scope of Delivery

- HORST1500 incl. installation instructions (this document)
- Scope of delivery Control (see first part of the MA)
- Transport lock for the robot
- 2x Shackle (for transport with lifting gear, see Fig.4)
- Assembly set (1x, 4x DIN 912 M8x20 bolt, 4x DIN 985 nut, DIN 125 washer)
    - ➢ 1x tensioning strap
    - ➢ 4x DIN 912 M8x40- bolt + 4x DIN 985 nut + 4x DIN 125 washer
    - ➢ 1x DIN 912 M8x30- bolt

2 Product Description

2.1 Robot

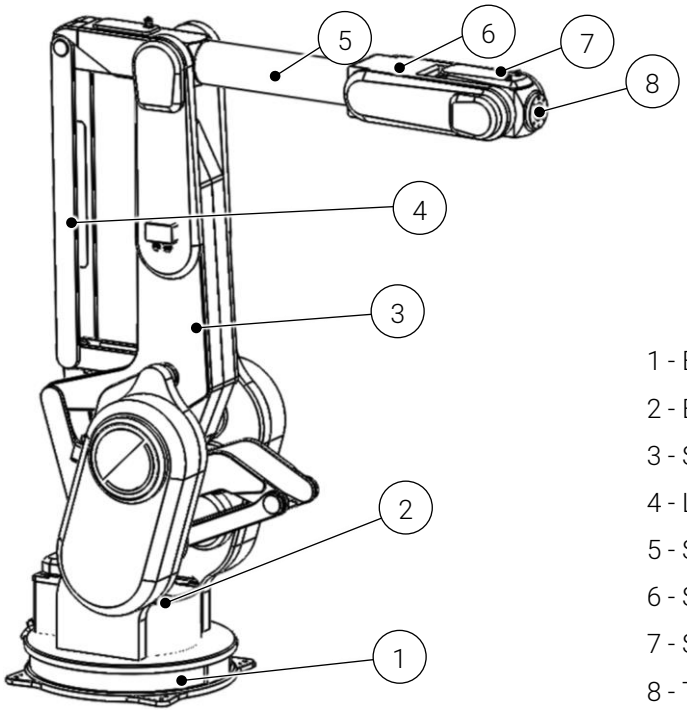


Fig. 1: HORST1500 robot

1 - Base - fixed part with base flange
2 - Base - movable part
3 - Swivel arm
4 - Linkage
5 - Support arm 1
6 - Support arm 2
7 - Support arm 3
8 - Tool flange

Robot axes

The movements are realised by rotating around 6 robot axes.

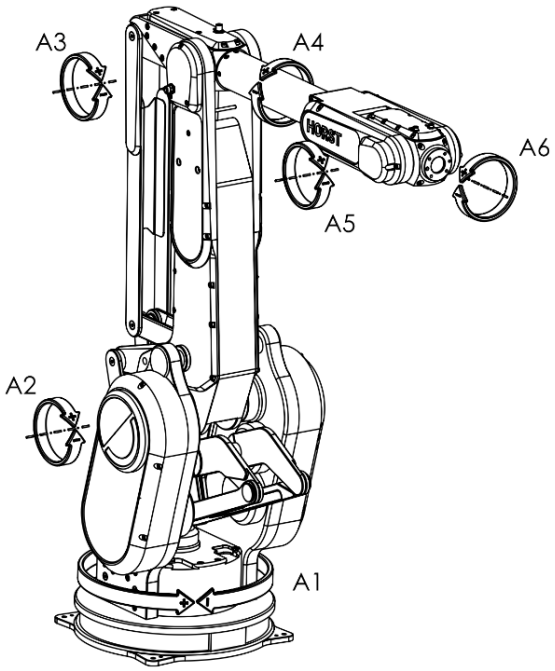


Fig.2 : Robot axes

2.2 Working range of the robot

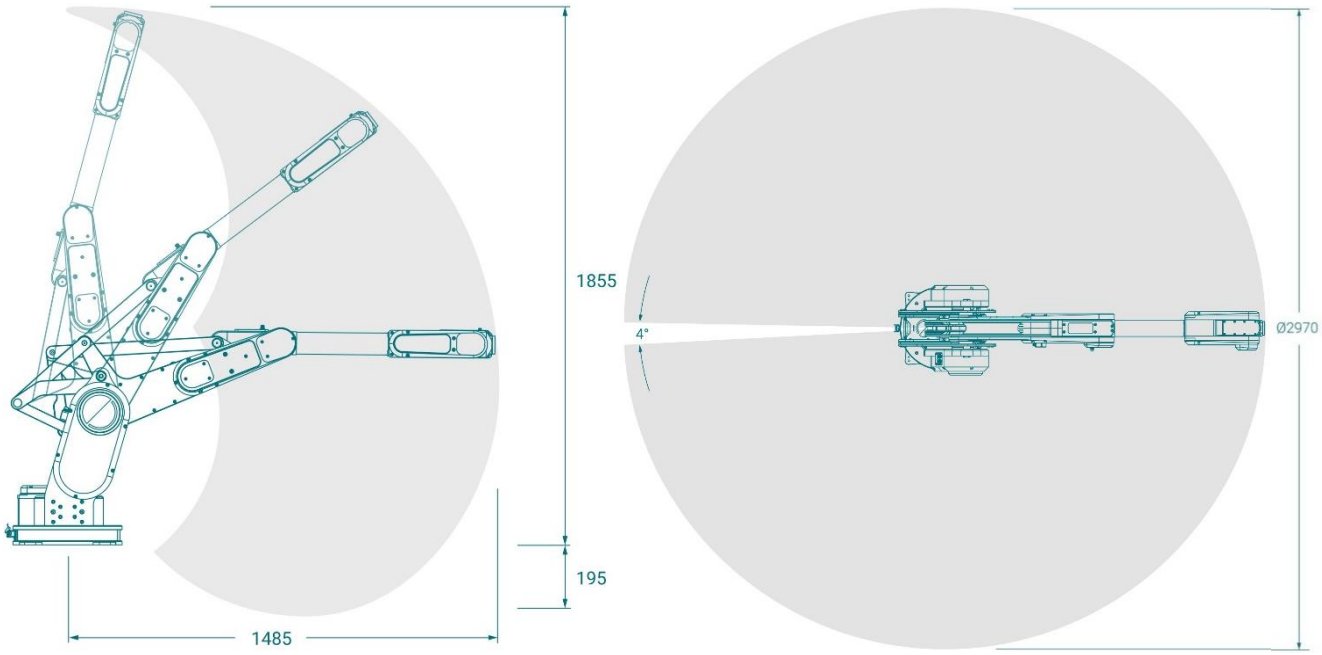


Fig.3 : Working area of the robot

2.3 Technical data

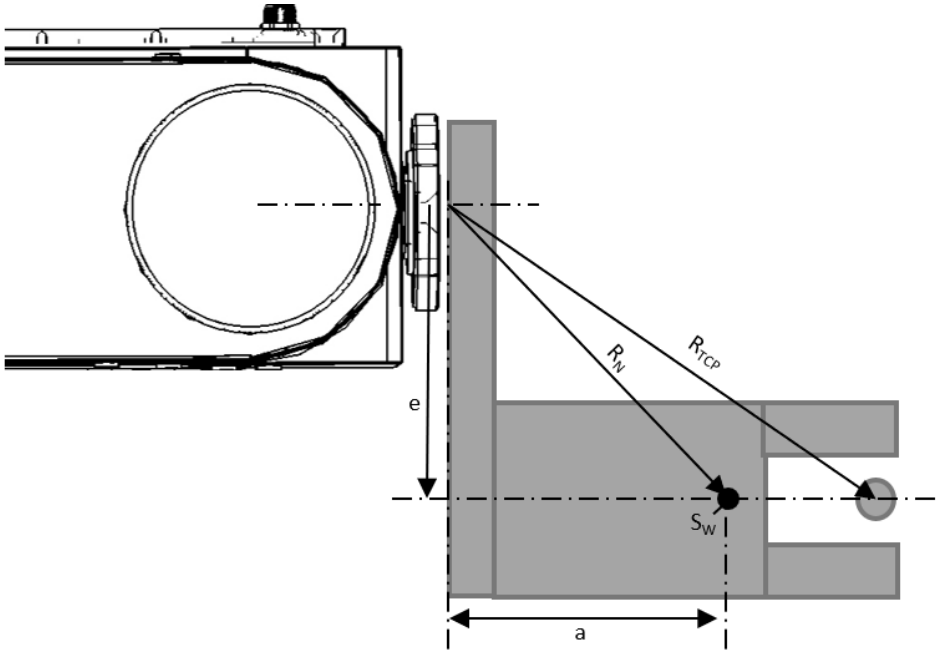
Robots	
Dimensions (LxWxH)	1200 x 800 x 1200 mm
Robot weight	110 kg
Nominal load (VDI 2861-2)	12 kg
Maximum load capacity	15 kg (after consultation with fruitcore robotics). **The permissible load capacity reduces depending on the centre of gravity**
Maximum range	1485 mm (without tool)
Position repeatability	+/- 0.05 mm
Number of axles	6
Protection class	Axes 4, 5 & 6: IP65 / Axes 1, 2 & 3: IP54
Noise emission	< 70 dB(A)
Footprint	380 mm x 380 mm

Ambient conditions	
Ambient temperature	5 - 40 °C
Relative humidity	10 % - 75 %
Operation in potentially explosive environments	prohibited
Height above sea level	up to 1000 m without power reduction

Axle	Range of motion	Speed (with a load capacity of 0 kg)
1	+/- 176 °	260 °/s
2	+89,5° / -18,5 °	100 °/s
3	+62° / -61 °	120 °/s
4	+/- 170 °	560 °/s
5	+/- 165 °	380 °/s
6	+/- 300 °	620°/s

The nominal load characterises the load that an industrial robot can handle as the vectorial sum of tool load and payload without limiting the kinematic and geometric parameters specified for the axes.

The following illustration serves to visualise the determination of the nominal load:



Variable	Value
R_n	190 mm
e	95 mm
a	164.5 mm
R_{TCP}	285 mm

2.3.1 Stopping time

The stopping time is the time between triggering the stop signal and the robot coming to a complete standstill. It is a control variable defined by the control system and is therefore independent of the payload or the projection of the robot arm and the axis under consideration.

It amounts to

- in reduced mode (T1, 250mm/s): **0,4s**
- in automatic mode or T2 (speed 100%): **1,0s**.

2.3.2 Stopping distance

The stopping distance is the distance travelled by the TCP between triggering the stop signal and coming to a complete standstill. It depends on the payload, as it specifies the set (0 - 100 %) absolute speed.

DANGER!
A change in payload can lead to longer braking distances and unexpected collisions with people or other objects and machines. The same applies to the use of a low-pass filter.

▶ Always adjust the safety distances to the corresponding stopping distances.

CAUTION!
Risk of robot damage or damage to property!

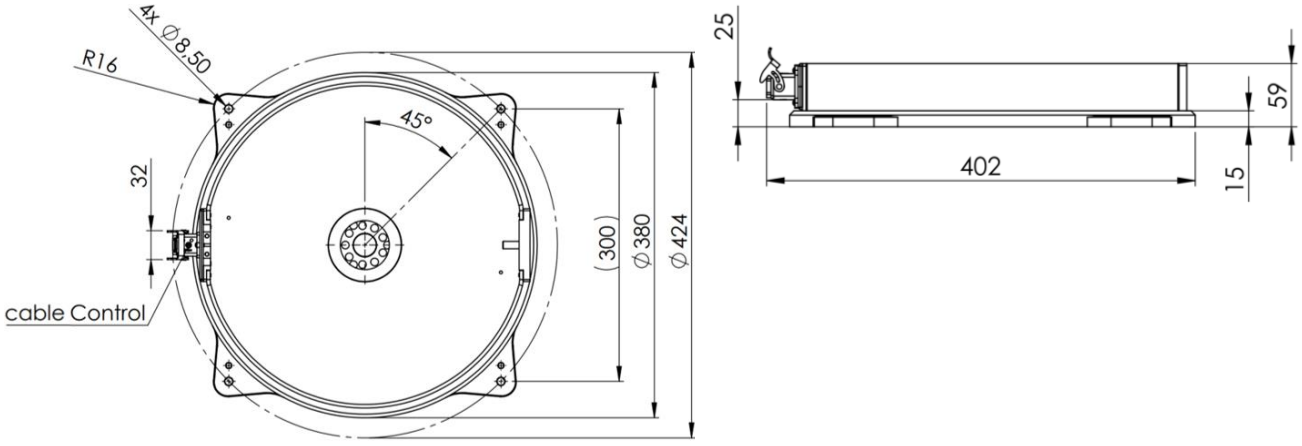
A collision can cause serious damage to the robot system or surrounding objects.

The following values were determined by tests and are intended as a guide. The actual stopping distances may vary depending on the operating mode, application, and number of braking operations. It is therefore recommended to determine the stopping distances under real conditions in the respective application and to check the values at least once a year.

The following table shows the average stopping distance for different loads depending on the set speed for the three main axes 1, 2 and 3 at maximum overhang.

Load	0 kg		8 kg		12 kg		15 kg	
Speed	**T1**	**100%**	**T1**	**100%**	**T1**	**100%**	**T1**	**100%**
Axis 1	4,7°	100,0°	5,6°	94,7°	4,7°	61,4°	4,7°	126,8°
Axis 2	2,9°	26,0°	2,5°	26,5°	2,8°	11,7°	2,9°	22,1°
Axis 3	3,3°	50,0°	3,1°	30,2°	3,3°	20,5°	3,4°	23,9°

2.4 Robot base plate



3 Transport, Assembly and Mounting

3.1 Transportation after delivery

On delivery, the robot is in its shipping or transport position.

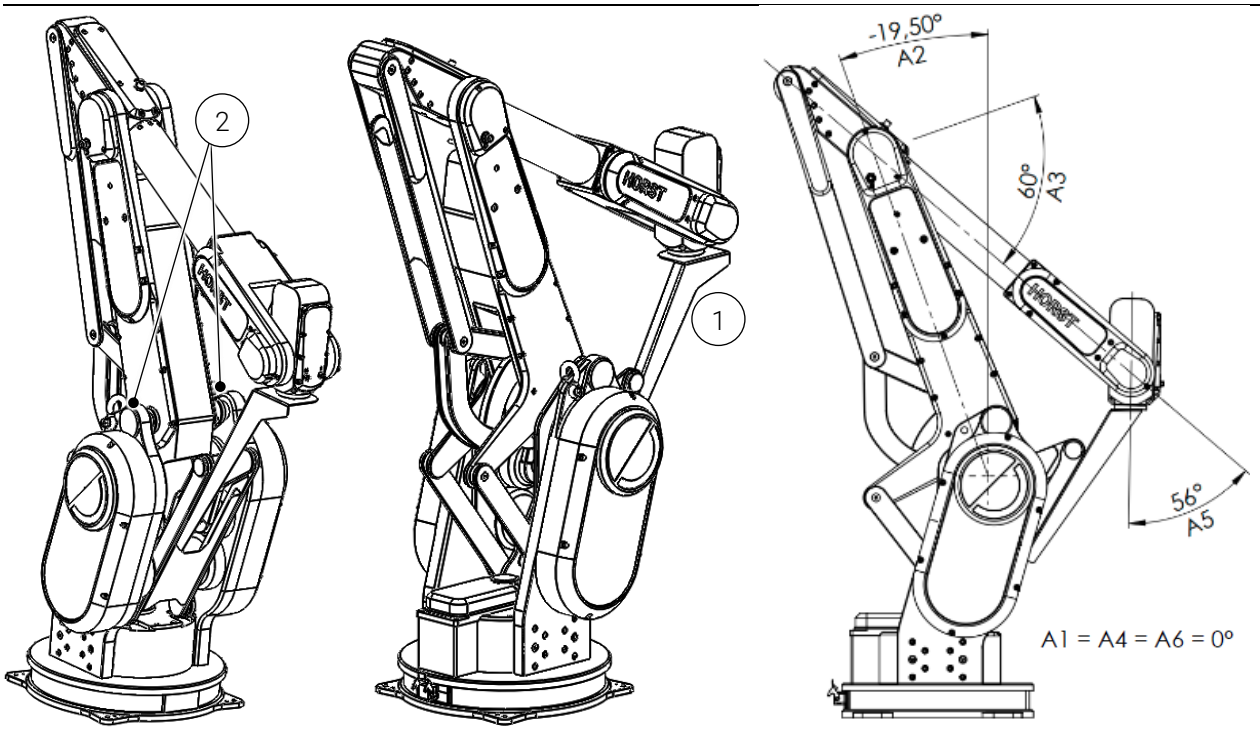


Fig.4 : Shipping position / Optimum transport position for lifting

DANGER!

Risk of injury due to tipping or falling of the robot.

- ▶ The robot may only be moved using suitable lifting gear. Do not carry the robot.
- ▶ The robot is to be transported by crane. Ensure that the robot weight does not exceed the load capacity of the lifting gear used.
- ▶ Always observe the following transport instructions to avoid personal injury and product damage.

CAUTION!

Risk of damage to the robot

- ▶ Do not remove the transport lock (1) until the robot has been placed in its exact location.
- ▶ When craning, ensure that no pressure is exerted on the structure and that the surface of the robot is not damaged.
- ▶ Do not use force to move the robot's axes.

- ▶ Place the robot on the delivered pallet at its approximate installation location using a e.g. a pallet truck.
- ▶ The exact positioning is carried out using a lifting crane or suitable load hooks on an industrial truck:
- ▶ There are holes on the side of the base of the robot for the two shackles supplied (GN 585-10-A).
- ▶ Insert the shackles (2) into the holes and lock their bolts.
- ▶ The shackles supplied are suitable for one-off positioning of the robot. The operator is responsible for multiple use of the lifting gear.
- ▶ Connect the slings to the shackles and carefully lift the robot and manoeuvre it to the final location.

3.2 Assembly and Mounting

3.2.1 Mounting surface

The robot must be mounted on a suitable, level, solid, dry, vibration-free, and non-moving surface. The mounting surface should be made of steel or aluminium or have comparable strength values. The maximum permissible inclination of the mounting surface is +/- 3°. The load capacity must be at least twice the weight of the robot (see 2.3) and twice the maximum tilting moment of the robot (corresponds to approx. 850 Nm).

Before overhead mounting or mounting on a surface with an inclination >+/- 3°, fruitcore robotics must be consulted. The robot is not designed for movement on a linear axis or a moving platform.

3.2.2 Mounting the Robot System



WARNING!

Risk of injury due to the robot falling down.

- ▶ The robot should preferably be placed in its final position using a hoist. If this is not possible, it must be lifted by 4 people due to its high dead weight in order to prevent the robot from being overloaded or falling down.
- ▶ Secure the robot against tipping until it has been fixed to the mounting surface.



CAUTION!

Risk of damage to the robot.

- ▶ Do not lift the robot by the swivel arm or support arm.
- ▶ Do not use force to move the robot's axes.
- ▶ Only remove the transport lock when the robot is in its final position.

Before installation, please note:

- ▶ Check the assemblies for damage. Damaged parts must not be installed/used.
- ▶ Ensure that there is sufficient space for the robot arm to move freely. There must be no obstacles in the working area.
- ▶ If the robot is combined with other machines in a system, make sure that the other machines cannot damage the robot.
- ▶ Prepare the mounting surface according to the drilling pattern.
- ▶ Lift the robot by the shackles provided using suitable lifting equipment and position it on the prepared mounting surface.
- ▶ Secure the robot against tipping until it has been fastened to the mounting surface.
- ▶ Fasten the robot with the supplied mounting screws at 43 Nm. See the following illustrations.
  - ▶ Screw the 4 DIN 7984 M8x40 screws into the 4 M10 through holes (1) and lock them from below with the DIN 985 nut.
  - ▶ Screw the M8x30 screw into the centre of the robot's threaded hole (2) from below.



ATTENTION!

Risk of damage to the robot.

- ▶ Please consult fruitcore robotics if installation with the 5th mounting screw is not possible..

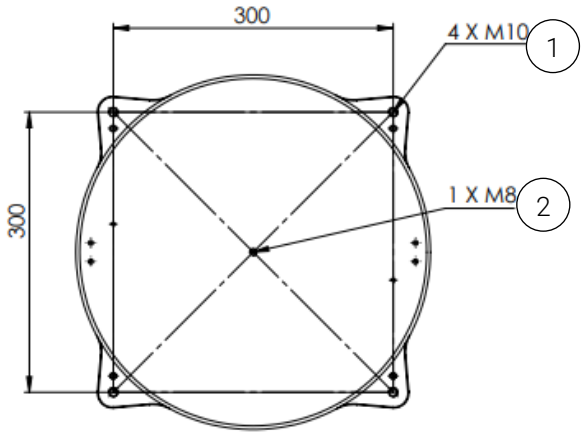


Fig.5 : Drilling pattern for mounting robot base

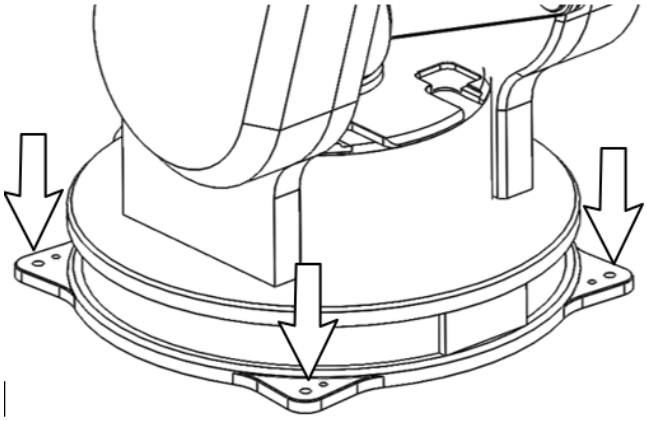


Fig.6 : Fastening the mounting screws

3.3 Restriction of the range of motion

CAUTION!
Risk of damage to the robot.

- ▶ Make sure that the movement range is limited by the software. Never drive into the mechanical end stops of the robot.

If the robot is intended for the "Manual at high speed (T2)" operating mode, the integrator must provide a limited space to reduce the danger zone. The stop bolt is located opposite the main connection in the robot base and therefore limits the movement range of axis 1 to +/- 180° as standard. However, this can be further limited mechanically to +/- 135° or +/- 90°. **In this case, the movement range must also be limited on the software side.**

- ▶ Replace the M8x6 screw (1) of the selected stop position with an M8x12 cylinder head screw.

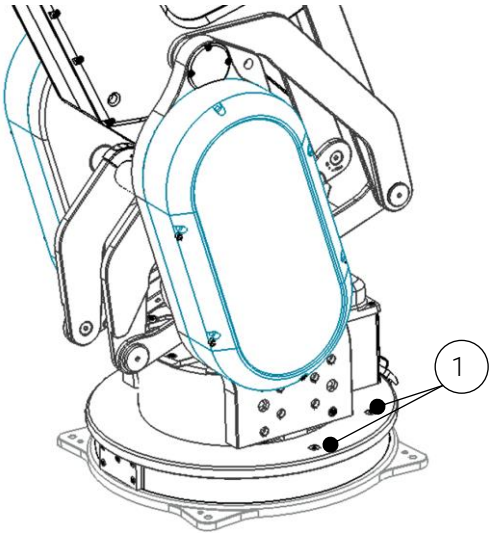


Fig.7 : Stop screws

3.4 Mounting attachments and external energy chains

Holes are provided for attaching add-on parts that are to be mounted on the robot arm (e.g. pneumatic valves).

Screw-on points with 40 mm hole spacing are available on the robot.

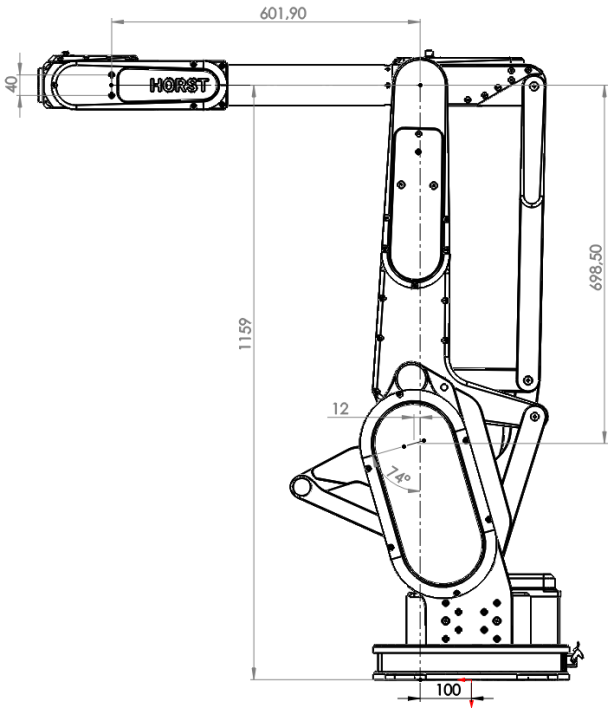


Fig.8 : Positions of the holes for attachments on the robot

ATTENTION!
Do not attach anything to the robot's cables.

▶ Ensure that the robot's cables and external cables are not touched when the robot is moving.

WARNING!
Change in the danger zone due to attachments.

▶ Please note that attachments can change the reach of the robot and therefore the danger zone.

WARNING!
Danger due to ejection of attachments and workpieces during operation

▶ Tighten attachments properly to avoid subsequent hazards.

▶ Avoid eccentric loads if possible. In particular, avoid loads that exceed the loads listed in the chapter2.3 to prevent swinging.

▶ Ensure that the holding forces are adapted to the process parameters.

The robot is equipped with an interface for attachments. It has four holes with M6 threads for attaching the add-on parts.

The Ø6 hole can be used with a pin for more precise installation.

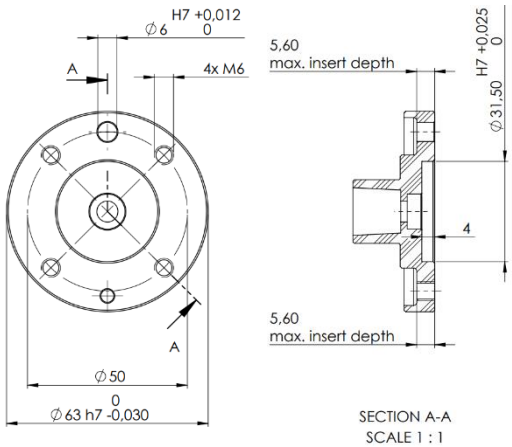


Fig.9 : Drawing of tool flange

3.4.1 Pneumatic connection of attachments

ATTENTION!
Observe when laying pneumatic valves and lines:

- ▶ Consider the risk of collision with other assemblies when mounting.
- ▶ The cables must not be crushed or torn off by the robot movements and they must be secured against coming loose (if necessary, use cable ties or similar).

The pneumatic connection values can be found in the documentation of the attachment part manufacturer.

- ▶ Connect the compressed air supply when all pneumatic components (grippers, lines, valves) are securely mounted.

3.5 Re-Transport

In general, the transport lock (see Fig. 4) must be installed for any type of transport. To transport the robot system again after use, follow the steps below:

- ▶ Before disconnecting the power supply, run the “Shipping Position” program in horstOS to the end. This will move the robot into the correct position for shipping/transport.
- ▶ Alternatively, bring the robot into the transport position using the *free movement* software control. The axis angles to be set can be found in Fig.4.
- ▶ Mount the transport lock with 2 screws each on the robot flange (2x DIN 912 M6x8 + 2x DIN 125 M8 washer) and on the linkage (2x DIN 912 M6x16 + 2x DIN 125 M8 washer).
- ▶ Remove the robot system (see section 3.2.2) from the mounting surface.
- ▶ Pack the robot, control, and panel securely as described in the general section of the MA.
- ▶ Secure the robot system against tipping and falling during transport.

ATTENTION!
The robot system must be in its original packaging for transport. The robot system, and in particular the Control unit, may only be transported in an upright position. Pallets are best suited for this purpose.

4 Commissioning and operation

▶ Please be sure to follow the instructions in the first part of the MA (general section)

5 Emergency and Troubleshooting

5.1 Emergency operation - moving the robot without drive power

The axes of the robot may only be moved without drive power in emergencies, e.g. to free people. The personnel carrying out the work must observe the following warnings and instructions. Specialist fruitcore personnel must be called in to recommission the system.

DANGER!
By acting hastily in emergency situations.

- ▶ Before the procedure, realise whether and which axle(s) must be moved in which direction in order to solve the existing emergency situation.
- ▶ Make sure that no part of your body can get between the robot's moving axes.

WARNING!
Risk of impact and crushing due to robot movements.

The release of residual stresses or gravity can lead to unintentional robot movements.

- ▶ Secure the robot arm against unintentional movement.

WARNING!
Risk of impact and crushing due to unexpected robot movements.

- ▶ If necessary, remove workpieces from the gripper.
- ▶ Disconnect the robot system from the power supply.
- ▶ Disconnect any mounted, compressed air-operated tools from the compressed air supply.

DANGER!
Defective and damaged components and assemblies / incorrect assembly

The robot system must not be restarted after the tensioning sets have been loosened. Incorrect assembly can cause the belts to break.

- ▶ Contact fruitcore robotics.

- ▶ Now move the robot arm in the desired direction with a powerful movement.
- ▶ Then secure the robot again against unintentional movement.
- ▶ Caution: This action voids the warranty, and the robot system may only be restarted after consultation with fruitcore robotics.

WARNING!
Danger due to damaged assemblies as a result of emergency operation

If the robot arm was moved manually in an emergency, components of the robot system may have been damaged. This may result in uncontrolled start-up.

- ▶ Have the robot system checked by fruitcore robotics customer service before putting it back into operation.

If the robot cannot be moved with force, it is possible to loosen the toothed pulley of the belt transmission so that axis 2 can move freely.

DANGER!
Risk of impact, crushing and shearing due to the robot arm falling down.

- ▶ Secure the robot arm against this.

- ▶ Remove the covers (1) of the belt drives on both sides using a suitable screwdriver.
- ▶ Caution: This action voids the warranty, and the robot system may only be restarted after consultation with fruitcore robotics.

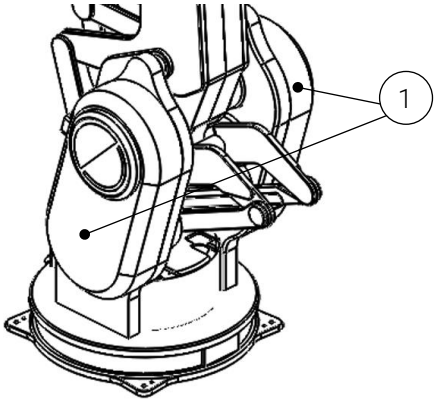


Fig.10 : Belt drive cover

2 - Belt

3 - disc

- ▶ Loosen the 3 cylinder screws in the toothed disc (3) using a suitable Allen key.

  The robot arm can now be moved manually.

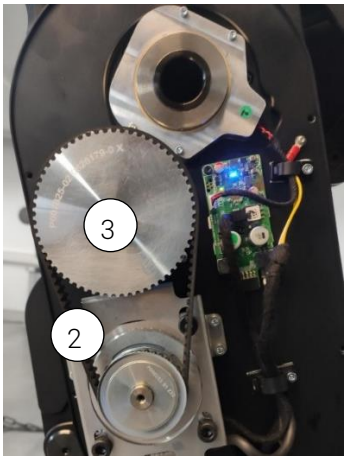
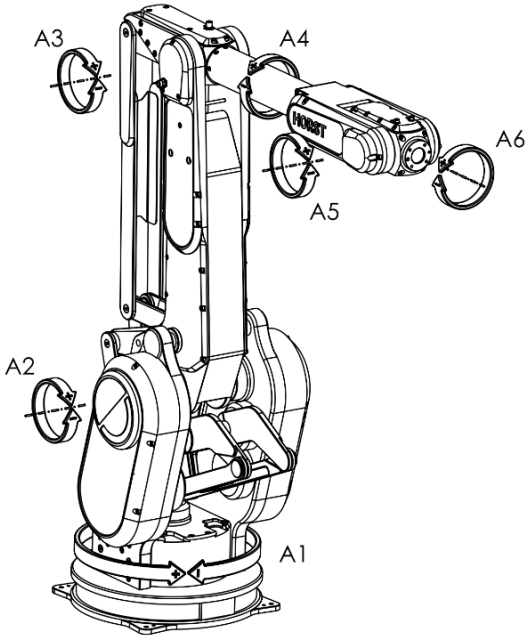


Fig.11 : Loosening axis 2

5.2 Emergency Operation - moving the robot by freewheeling

DANGER!
By acting hastily in emergency situations.

- ▶ Before the procedure, realise whether and which axis(es) must be moved in which direction in order to solve or improve the existing emergency situation.
- ▶ Please refer to the adjacent illustration.
- ▶ Move the robot in Free Driving mode in small steps until the emergency situation has been resolved.



6 Cleaning and Maintenance



Risk of crushing, impact and cutting!
Possible personal injury due to unforeseen movements/collapse of the robot.

- If the power supply to the robot system is stopped, the motor brakes on the axles engage. Due to the elasticity of the belt drives, they can still move slightly. Manual intervention can therefore lead to injuries even when the system is at rest. If a belt breaks unexpectedly, the robot arm can collapse.
- During maintenance work, the robot arm must be adequately secured against collapsing. Do not stand under the robot arm.
- Do not reach into the linkage or between the axes of the robot system at any time.



Danger from ejected parts!
Possible personal injury due to unexpected ejection or dropping of parts.

- Ensure that tools or components are securely attached to the robot.
- If necessary, remove workpieces from the gripper before cleaning and maintenance.

6.1 Cleaning

Depending on the environmental conditions of the robot system, the components may become dirty. fruitcore robotics recommends cleaning the robot once a week.



Wear protective clothing!

- Wear safety goggles, protective gloves, and a dust mask when cleaning.



CAUTION!
Danger of machine damage

- Remove dust, shavings and other particles from the robot with a hoover or a clean cleaning cloth, NOT with compressed air.
- Do not use any aggressive, flammable, or abrasive liquids/cleaning agents to clean the robot system.
- Avoid the ingress of liquids into the parts of the system.



Environmental protection!

- Dispose of waste and used cleaning cloths in an environmentally friendly manner.

6.2 Maintenance and Repair

Only the robot-specific maintenance tasks are mentioned in this section of the MA; all safety instructions are generally applicable and are therefore described in the general section.

DANGER!
Danger due to incorrect maintenance

▶ Observe all safety instructions regarding maintenance from the general part of the MA (Part 1).

Task	Interval
All maintenance tasks of the general part of the MA	see MA part 1/2
Check all accessible screws for tightness and retighten if necessary	monthly
Check bus cables for damage and the correct seat of their screw connection	monthly
Contact fruitcore robotics to have the timing belts inspected	15,000 operating hours
Contact fruitcore robotics to have the gearboxes inspected	30,000 operating hours