fruitcore robotics

# Robot System HORST1000 G2




# Assembly Instructions 2/2

For installation, operating and maintenance personnel

Always keep with the product!

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## Abbreviations

| | |
|---|---|
| I/O | Input/output |
| HORST | Highly Optimized Robotic Systems Technology |
| 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 (MA), 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 this manual carefully and completely before putting the robot system into operation. Handle them with care and keep them at the robot's place of use. An illegible or missing manual must be replaced immediately.

## 1.2 Standards, directives and conformity

The robot system is considered to be a partly completed machinery within the meaning of the EC Machinery Directive 2006/42/EC. All further information can be found in the first part of the assembly instructions.

## 1.3 Signs, symbols and warnings

**Enumerations**

Simple enumerations are marked with "-".

**Instructions for action**

▶ Instructions for action are marked with " ".▶

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

**Warnings**

Be sure to follow 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 which 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.

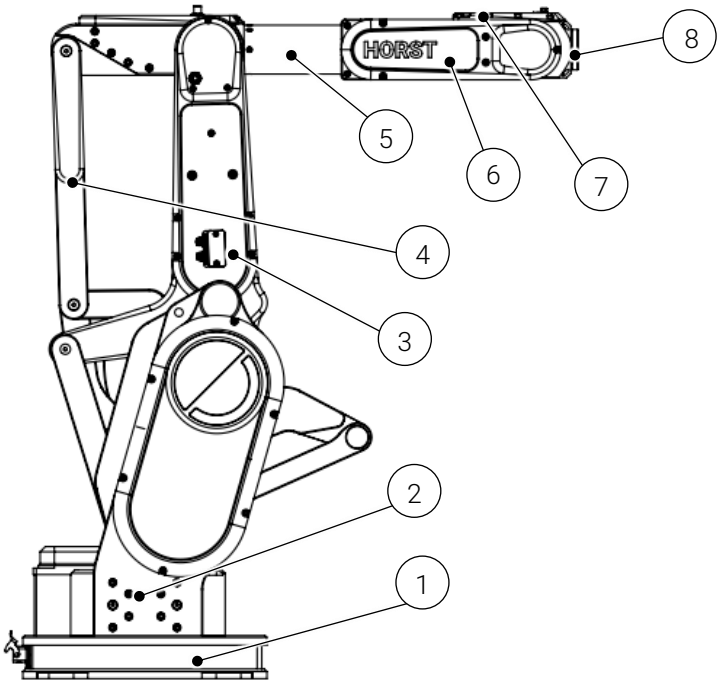
This symbol introduces notes that provide useful, non-safety-related information

# 2 Product description

## 2.1 Scope of delivery

- HORST1000 G2 incl. installation instructions
- Scope of delivery Control
- Transport lock
- Assembly set (1x tensioning strap, 4x DIN 912 M8x20 bolt, 4x DIN 985 nut, DIN 125 washer)
- Shackle (for transportation with lifting gear, seeFig.4

## 2.2 Robots




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

*Fig. 1: HORST1000 robot*

**Robot axes**

The movements are implemented by rotating around 6 robot axes.

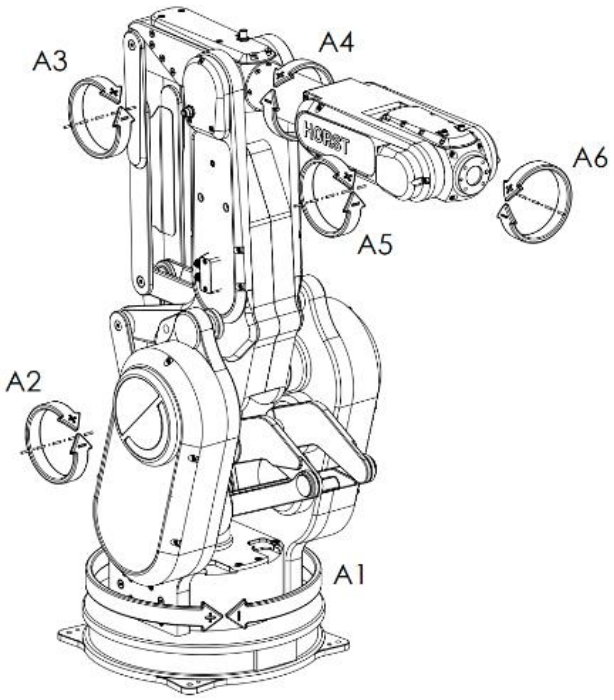



*Fig.2 : Robot axes*

## 2.3 Working range of the robot

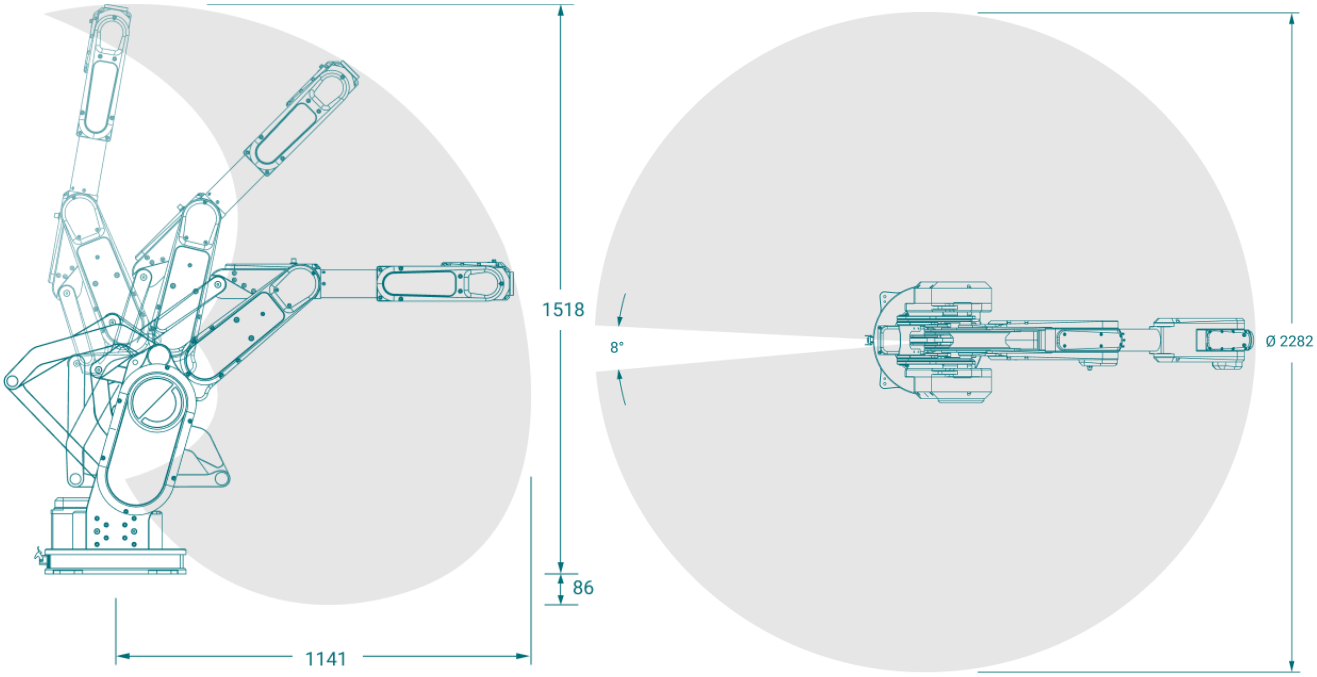



*Fig.3 : Working area of the robot*

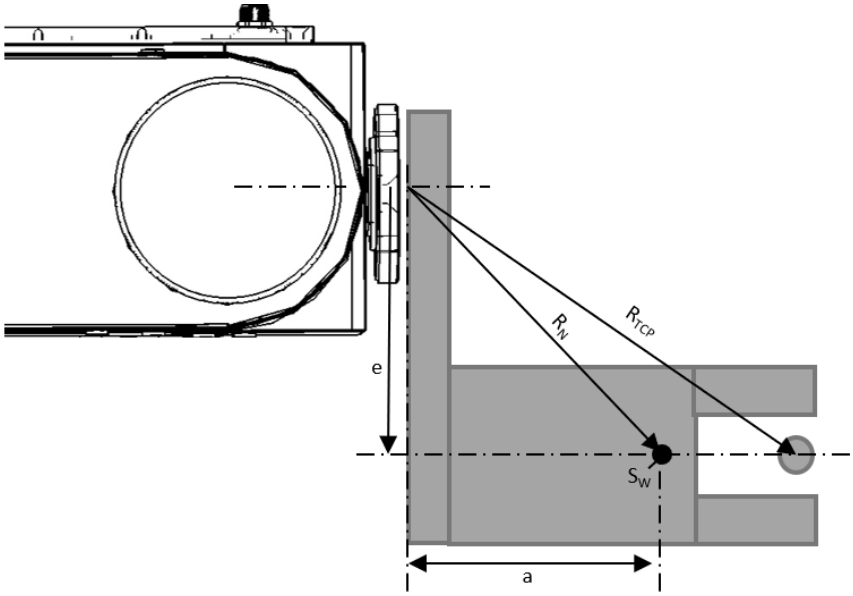
## 2.4 Technical data

| **Robot** | |
|---|---|
| Dimensions (LxWxH) | 1200 x 800 x 1200 mm |
| Robot weight | 105 kg |
| Maximum range | 1141 mm (without tool) |
| Position repeatability | +/- 0.05 mm |

| Robot | |
|---|---|
| Nominal load<br>according to VDI 2861-2 | 12 kg |
| Maximum load capacity | 16 kg (after consultation with fruitcore robotics).<br>**The permissible load capacity is reduced depending on the position of your centre of gravity.** |
| Number of axles | 6 |
| Protection class | IP65 (manual axes); IP54 (main axes) |
| Noise emission | < 70 dB(A) |
| Footprint | 380 mm x 380 mm |

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

The following diagram serves to illustrate the determination of the nominal load:




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

| Axis | Range of motion | Speed (with a load capacity of 0 kg) |
|---|---|---|
| 1 | +/- 176 ° | 290 °/s |
| 2 | +89,5° / -18,5 ° | 110 °/s |
| 3 | +53° / -61 ° | 190 °/s |
| 4 | +/- 176 ° | 570 °/s |
| 5 | +/- 165 ° | 440 °/s |
| 6 | +/- 300 ° | 740°/s |

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

### 2.4.1 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): **0,2s**
- in automatic mode or T2 (speed 100%): **0,6s**.

### 2.4.2 Stopping distance

The stopping distance is the distance traveled 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!**

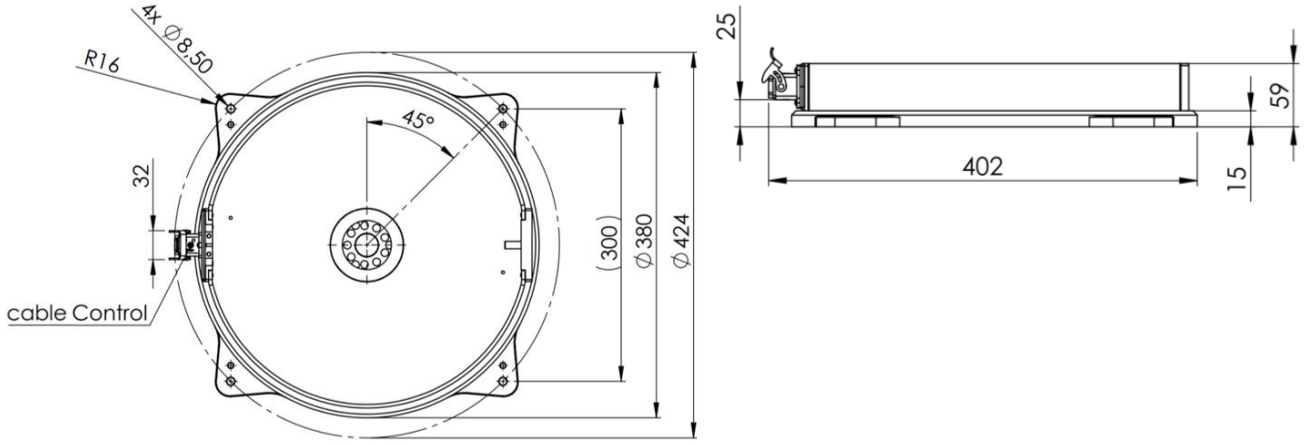
A collision can cause serious damage to the robot system or surrounding objects.

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 | | 16 kg | |
|---|---|---|---|---|---|---|---|---|
| **Speed** | **T1** | **100%** | **T1** | **100%** | **T1** | **100%** | **T1** | **100%** |
| **Axis 1** | 5,5° | 118,1° | 5,6° | 94,3° | 5,6° | 94,7° | 5,6° | 93,2° |
| **Axis 2** | 2,5° | 29,3° | 2,5° | 27,6° | 2,5° | 26,5° | 2,5° | 26,1° |
| **Axis 3** | 3,0° | 33,5° | 3,1° | 39,4° | 3,1° | 30,2° | 3,1° | 22,5° |

## 2.5 Robot base plate



# 3 Transportation

When delivered, the robot is in its shipping or transport position. **In general, the transport lock (seeFig.4 ) must be fitted for any type of transport**. The transport lock is attached to the robot flange (2x DIN 912 M6x8 + 2x DIN 125 M8 washers) and to the linkage (2x DIN 912 M6x16 + 2x DIN 125 M8 washers) with 2 screws each.

**DANGER!**
**Risk of injury due to tipping or falling of the robot**

- ▶ The robot may only be moved using suitable lifting equipment. 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 transportation instructions to avoid personal injury and product damage.

- ▶ Place the robot on the delivered pallet at its approximate installation location using a suitable FFZ or pallet truck.
- ▶ The exact positioning is carried out with a lifting crane or suitable load hooks on a FFZ:

  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-time positioning of the robot. The operator is responsible for multiple use of the lifting gear.

**CAUTION!**
**Risk of damage to the robot**

- ▶ Only remove the transport lock (1) after 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 move the axes of the robot by force.

- ▶ Connect the slings to the shackles and carefully lift the robot and maneuver it to the final location.

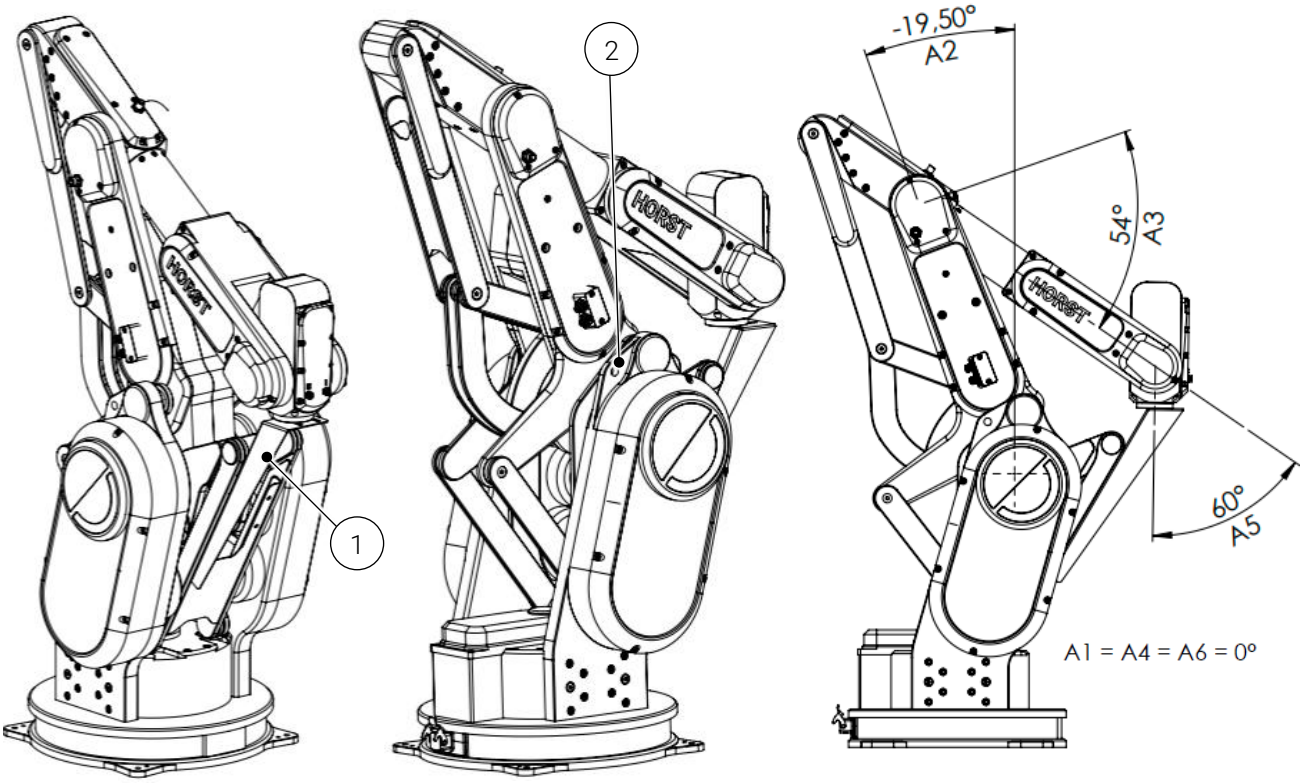



*Fig.4 : Shipping position / Optimum transport position for lifting*

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 brings 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 Fig.4
- Attach the transport aid to the frame and the TCP using the corresponding screws as described above.
- Remove the robot system (see section4.2 ) from the mounting surface.
- Pack the robot, control and panel securely and as described in the general section of this manual.
- Secure the robot system against tipping and falling during transportation.

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

# 4 Assembly

## 4.1 Mounting surface

The robot must be mounted on a suitable, level, solid, dry, vibration-free and non-moving surface using mounting screws. 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 of the mounting surface must be at least twice the weight of the robot (see2.4 ) and twice the maximum tilting moment of the robot (corresponds to approx. 620 Nm).

The robot is not designed to move on a linear axis or a moving platform.

**Before overhead mounting or mounting on a surface with an inclination of >+/- 3°, fruitcore robotics must be consulted.**

## 4.2 Assemble robots

**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 move the axes of the robot by force.
- Only remove the transport lock when the robot is in its final position.

**Note before installation:**

- Check the assemblies for damage. Damaged parts must not be fitted/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.
- Ensure that suitable protective devices are installed. These must stop the robot movements within the danger zone.
- Safety devices (emergency stop, safety stop) may only be connected to safety-relevant interfaces and must be designed redundantly.

- ▶ Prepare the mounting surface according to the drilling pattern.
- ▶ Lift the robot by the shackles provided using suitable lifting gear and position it on the prepared mounting surface.
- ▶ Secure the robot against tipping until it has been fixed to the mounting surface.

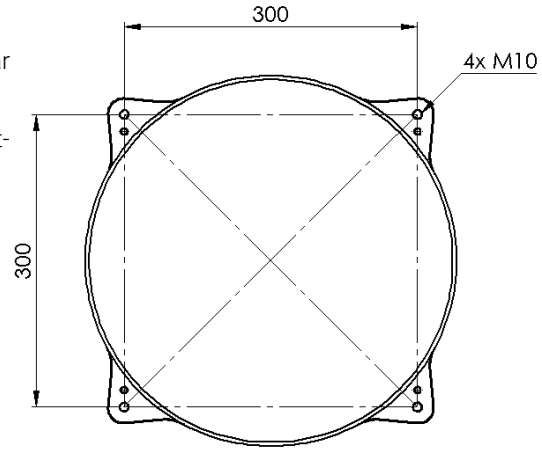



*Fig.5 : Drilling pattern for mounting robot base*

- ▶ Fasten the robot with the 4 supplied mounting screws (DIN 7984, M10x25) to 43 Nm.

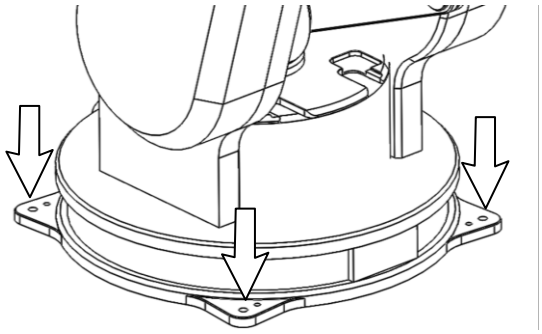


*Fig.6 : Fastening the mounting screws*

## 4.3 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.

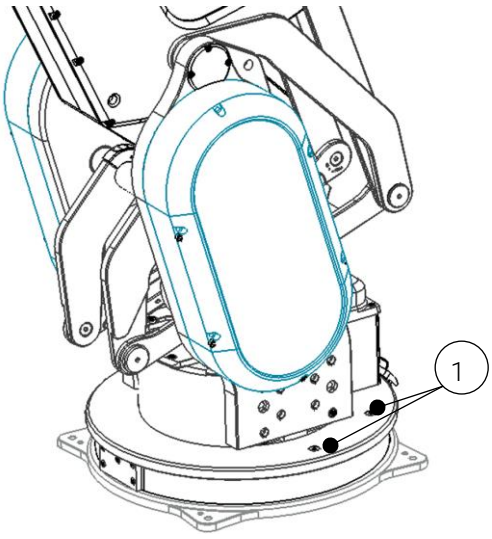



*Fig.7 : Stop screws*

## 4.4 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 45 mm, 50 mm and 60 mm hole spacing are available on the robot. The flange plate is designed with slotted holes and can therefore be used universally.

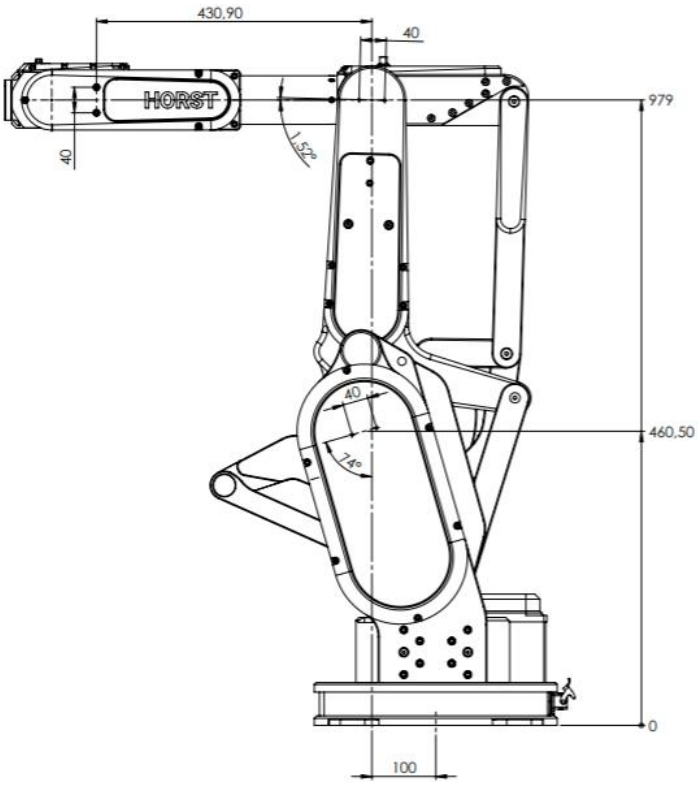



*Fig.8 : Positions of the holes for attachments on the robot*

**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. Avoid loads that exceed those in the chapter2.4 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 mounting.

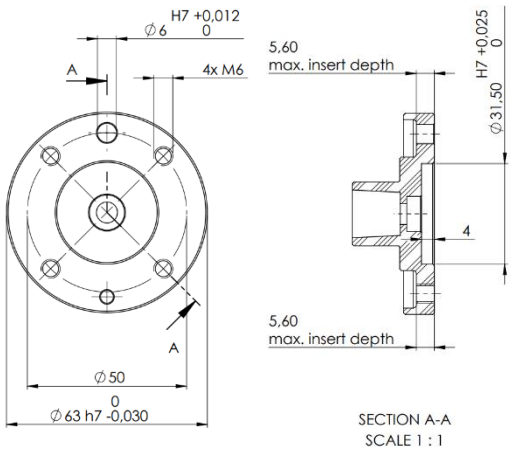



*Fig.9 : Drawing of tool flange*

### 4.4.1 Pneumatic connection of attachments

**ATTENTION!**
**Observe when installing pneumatic valves and lines:**

- When mounting, consider the risk of collision with other assemblies.
- The cables must not be crushed or torn off by the robot movements and they must be secured against coming loose (if necessary with 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.

# 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, be aware of 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 moving axes of the robot.

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

The release of residual stresses or gravity can lead to unintended 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 loosening the tensioning sets. 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.
- Attention: 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 by force, it is possible to loosen the 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.**

- ▶ Secure the robot arm against this.

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

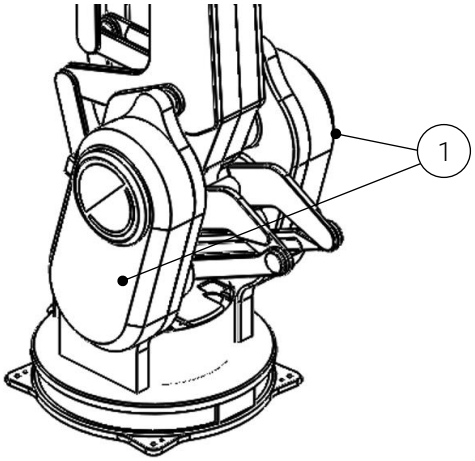



*Fig.10 : Belt drive cover*

(2) Belt

(3) lock washer

- ▶ Loosen the 3 cylinder-screws in the toothed washer (3) using a suitable Allen key.
  - ⇒ The robot arm can now be moved manually.

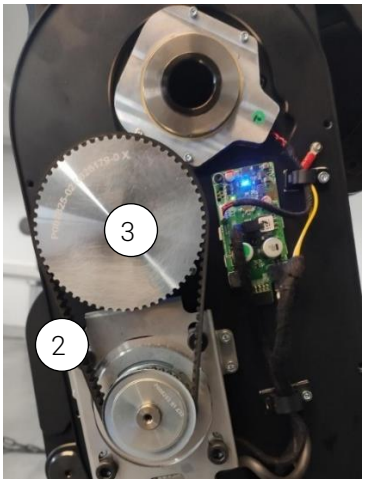


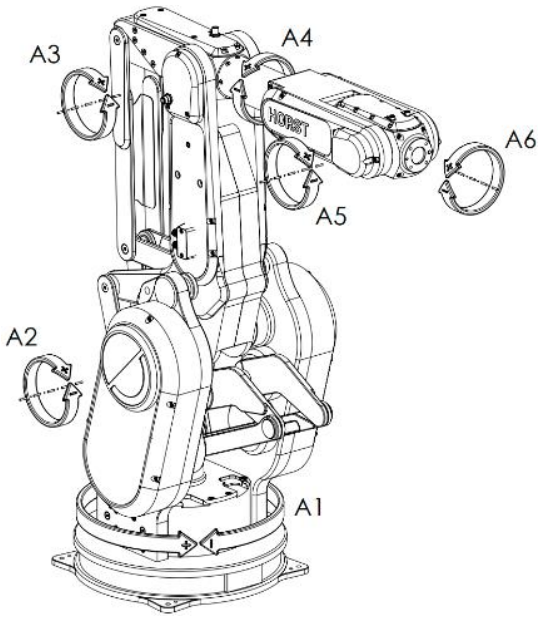

*Fig.11 : Loosening axis 2*

## 5.2 Emergency operation - moving the robot by freewheeling

**DANGER!**

**By acting hastily in emergency situations**

- ▶ Before the procedure, be aware of 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 collapse of the robot. If the power supply to the robot system is stopped, the motor brakes of the axes will engage. If a belt breaks unexpectedly, the robot arm may 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.



**ATTENTION!**
**Danger of machine damage**

- ▶ Remove dust, shavings and other particles from the robot with a vacuum cleaner 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 the 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 this manual, all safety instructions are generally applicable and are therefore described in the general section.**



**DANGER!**
**Danger due to incorrect maintenance**



- ▶ It is essential to observe all maintenance instructions in the general section of this manual (Part 1).

| Task | Interval |
|---|---|
| All maintenance tasks of the general part of this manual | see manual part 1/2 |
| Check all accessible screws for tightness and retighten if necessary | monthly |
| Check the bus cables for damage as well as the correct fit of their screw connections | 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 |