industry MAGNUM

General Original User Manual

Magnum 3D-printer

This manual should be read at www.the-industry.se or from the NFC tags next to the Magnum control panel, to get the latest updated version of this manual.

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1 General

1.1 Overview

Magnum is a 3D-printer from The Industry Sweden AB. An overview of machine components can be seen in figure 2. The printing volume of the machine is 1200mm (Width) x 1500mm (Length) x 1200mm (Height). The machine is closed without any protruding mechanical parts to avoid pinch point hazards. The electrical cabinet can be found at the back of the machine. The machine doors that provide access to the printing area are situated at the opposite end. The machine has a heated vacuum table (fig 2 and 3) and one extruder for plastic material fig 4). On the machine's vacuum table, a 2 mm thick aluminium sheet is attached which has the same length and width as the table. The plastic material extruder is fed by plastic granulate. The extruder is equipped with water-cooled cooling inlets. Part of the machine comprises an external water-cooling unit, which controls the temperature of the extruder' cooling inlets. Material feeding to extruder is handled by material tubes led through a cable chain. For additional information about the material transport system, see 4.1.

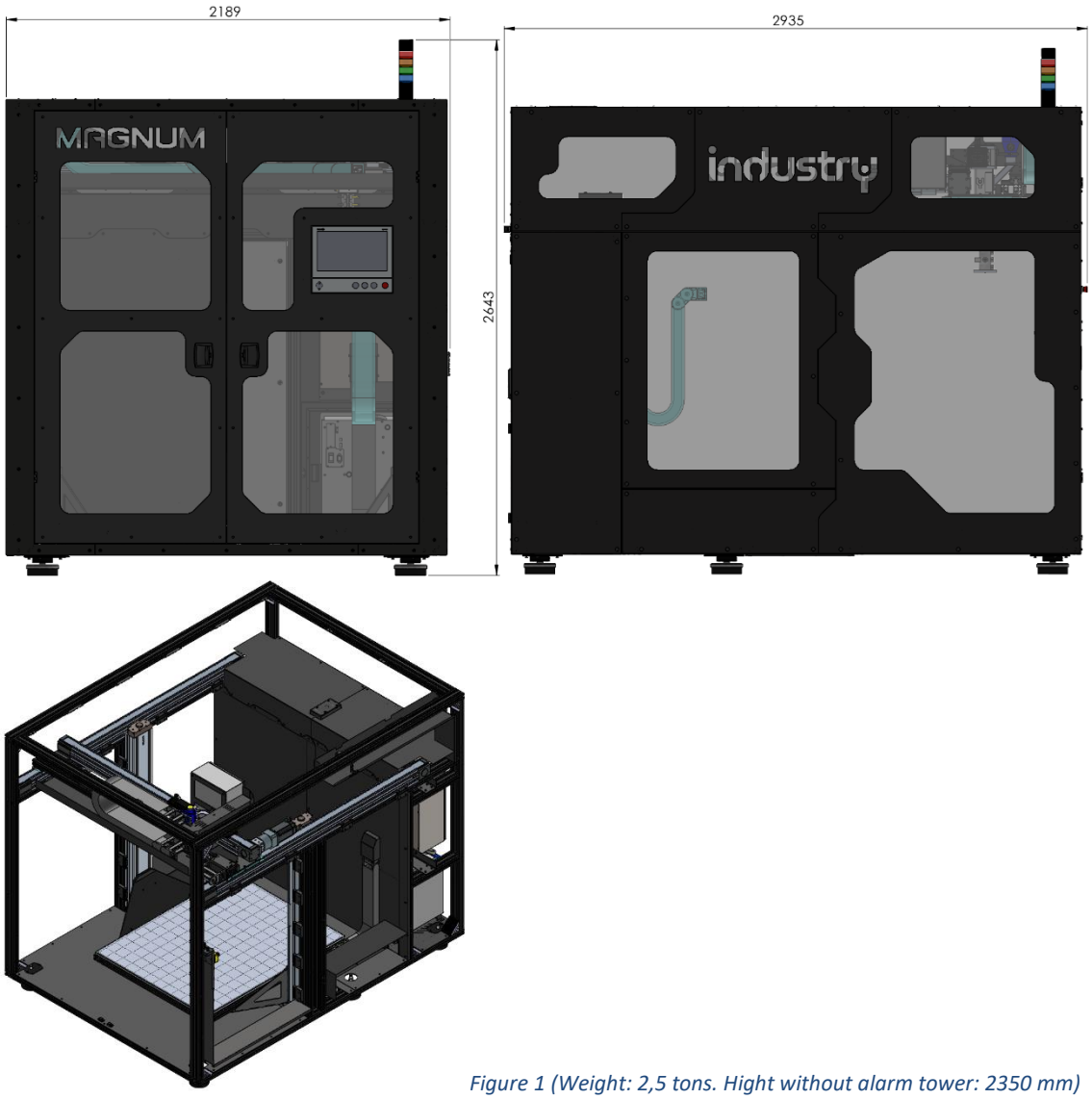


Figure 1 (Weight: 2,5 tons. Hight without alarm tower: 2350 mm)

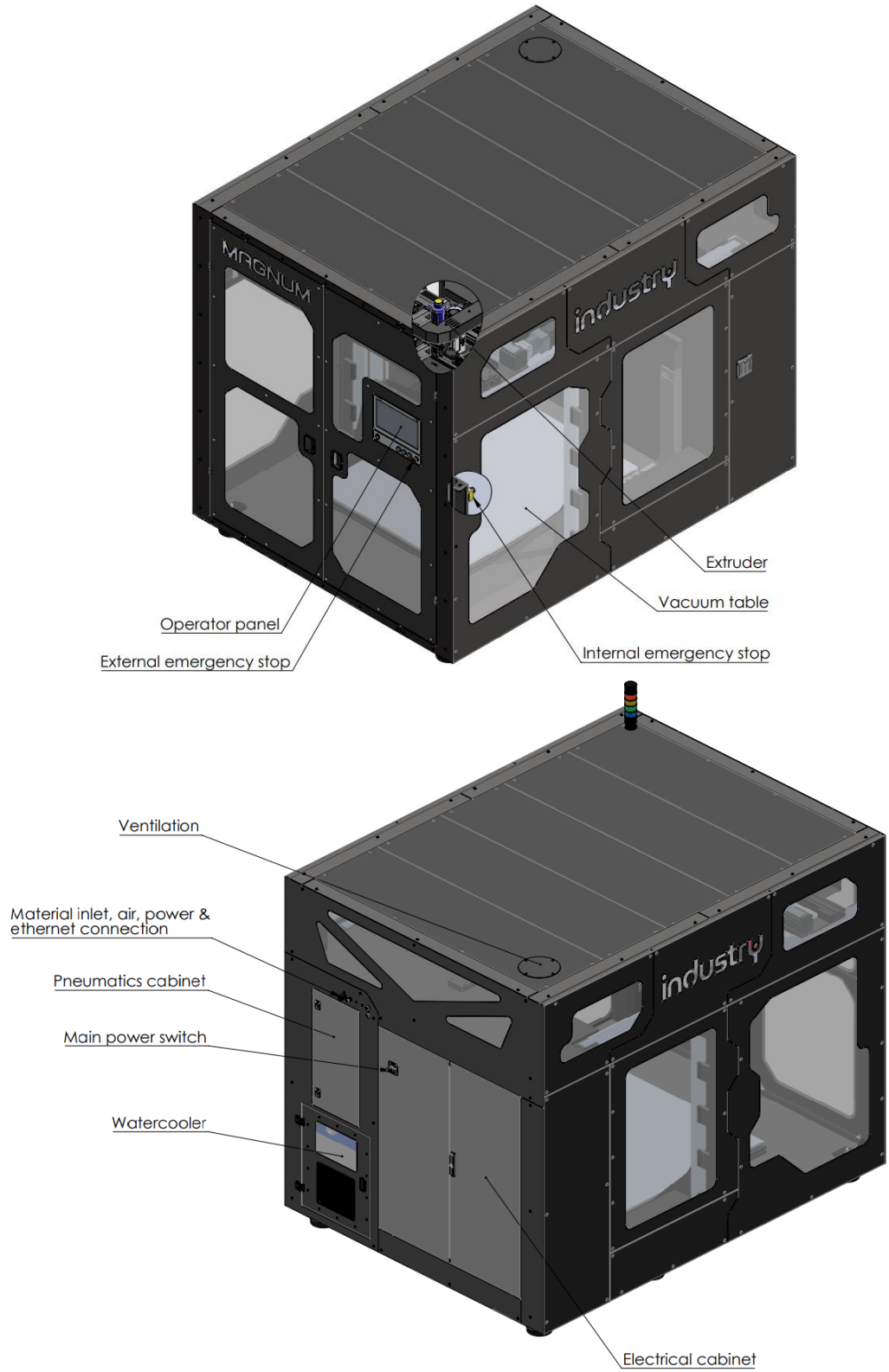


Figure 2 (Location general components)

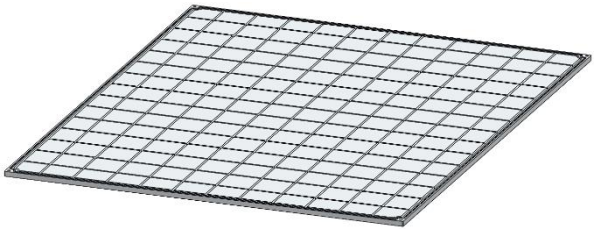


Figure 3 (Vacuum table)

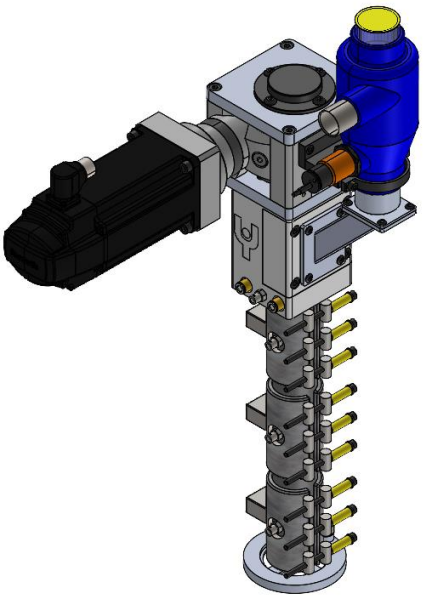


Figure 4 (The extruder)

1.2 Field of Application

- The machine's main field of application is the production of plastic parts.

1.3 Description of the extruder

There are 1 extruder on the machine. It is located in the machine gantry.

- The extruder is for nozzle sizes 2-8mm.
- For detailed information on the individual spare parts of the extruder, see fig 5.
- The extruder is equipped with a water-cooling system to prevent heat from the heating bands to reach the material inlet. Should the material inlet become too hot, the material flow may become uneven due to increase stickiness of material.
- The extruder has three 1200Watts heating bands and one temperature sensor for each heating band.

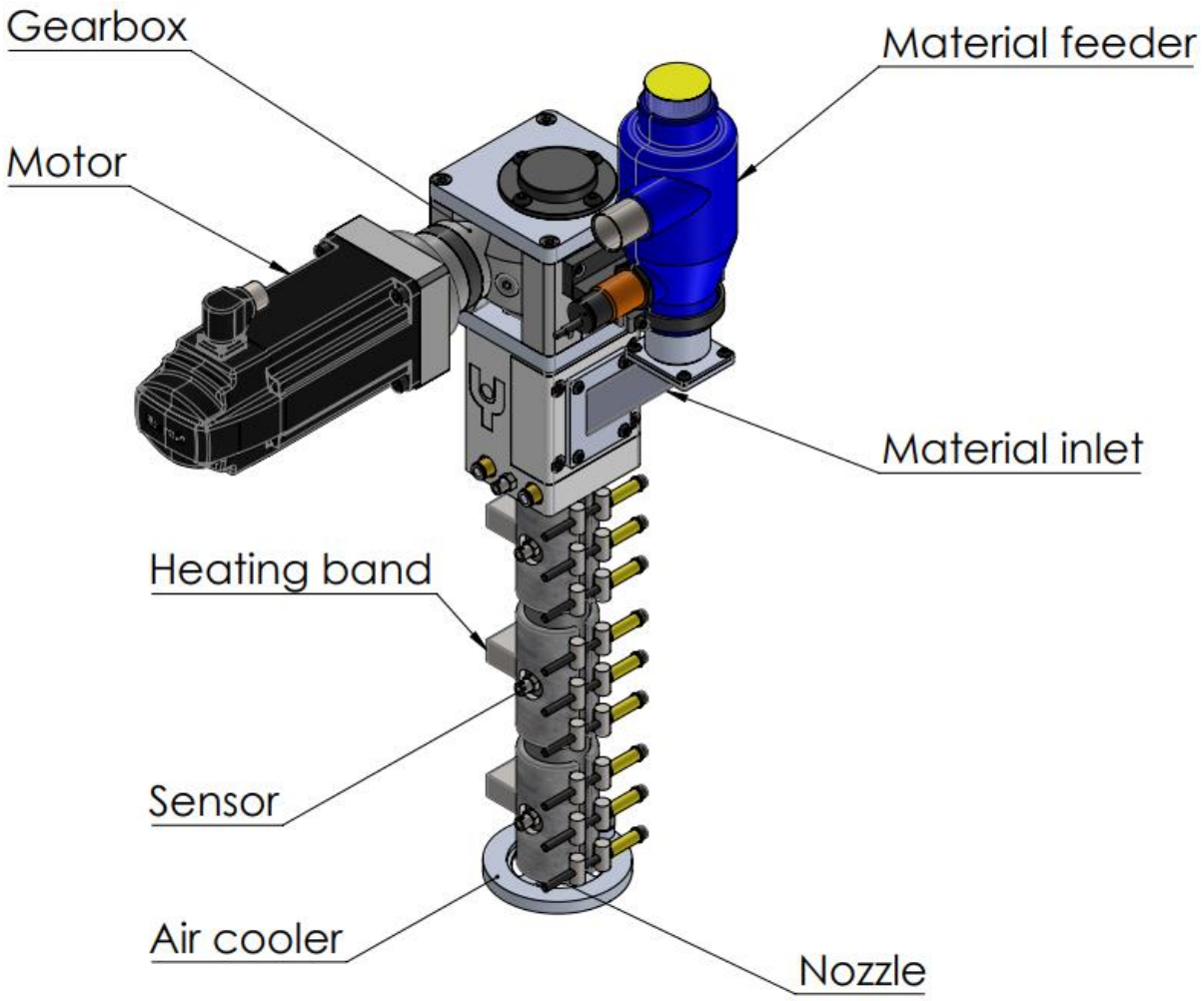


Figure 5 (The extruder)

1.4 Description of the vacuum table

The machine has a vacuum table which acts as the print table on which a print sheet will be placed upon. After it has been equipped with a print sheet, it acts as a surface on which the machine will build 3D-objects with the extruder. It is located at the center of the machine.

- The vacuum table has 1200 x 1500 mm area.
- There are milled grooves on the tables top surface which function as channels for the airflow in order to generate vacuum.

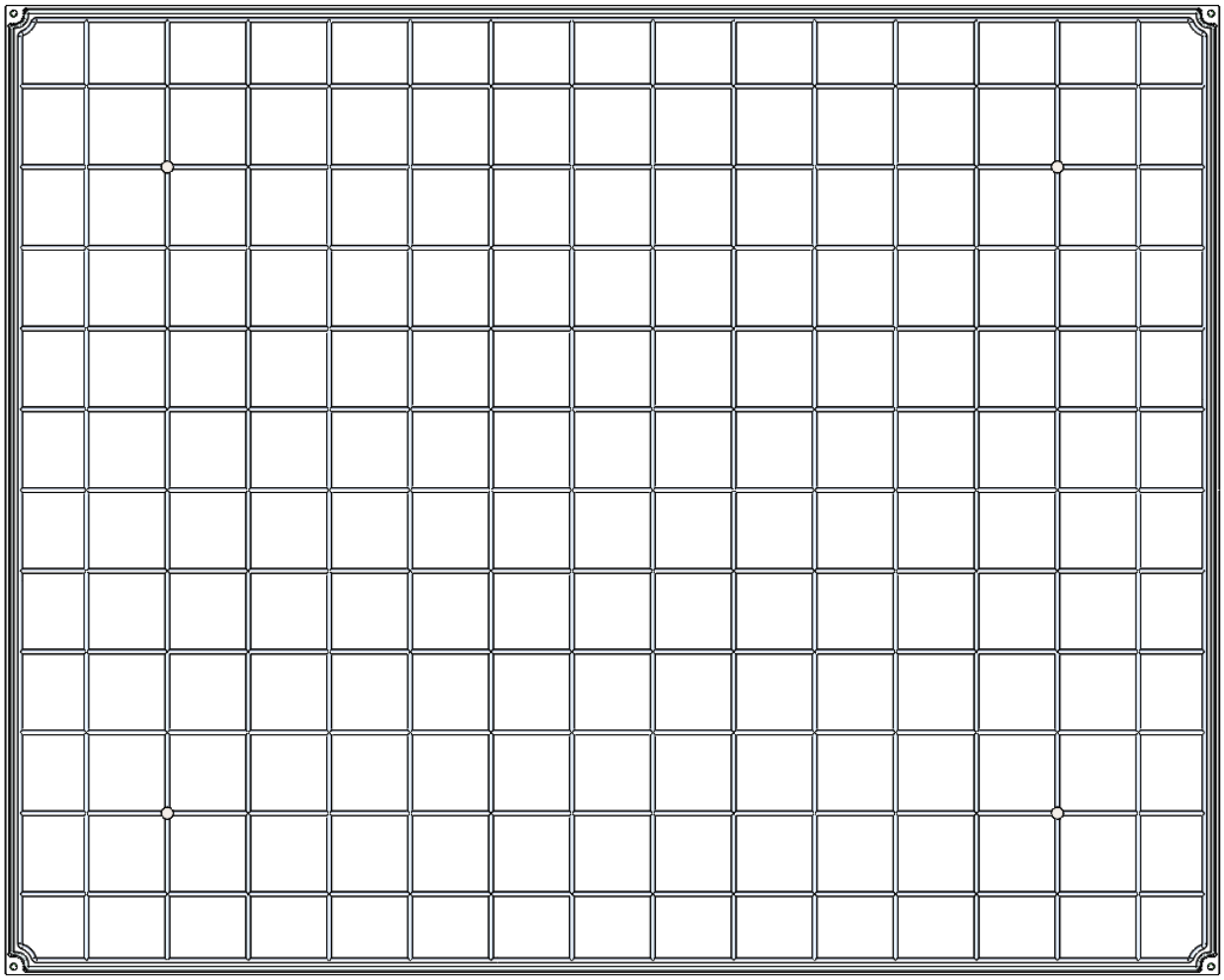


Figure 6 (Top side of vacuum table)

- The grooves on the top surface lead to 4 outlets where the air is ejected via vacuum ejectors.
- All grooves must be covered by the print sheet to reach sufficient vacuum.
- The recommended material for the top sheet is aluminium.
- The recommended thickness for the top sheet is 2mm.

1.5 Description NFC tags

- Next to the control panel are 2 green badges with symbols. These contain an NFC tag. By holding a mobile phone over the badge, the phone reads the NFC tag and directs you to Magnum's unique product information. On the badge with gearwheel there is Magnum's Manual and information relating to all Magnums and on the tray with an "i" there is information about your particular Magnum.

1.6 Description of personnel

The relevant roles of personnel necessary for the full function of the machine:

- Operator
- Maintenance personnel
- Certified electrician

1.6.1 Operator

The operator is the main person interacting and running the machine and removing printed parts from the machine.

1.6.2 Maintenance personnel

The maintenance personnel should keep the machine maintained and checked for any defects. They should also perform the necessary cleaning. Any spare part outside of the electrical cabinet should be switched out by these personnel.

1.6.3 Certified electrician

All components that need to be switched out in the electrical cabinet must be done by a certified electrician. The electrical installation of the machine must be done by a certified electrician.

2 Description of security concept

The machine must be used in accordance to given instructions to ensure the safety of operators and of the machine.
To ensure that no personnel are in the machine during start, the operator must verify an inspection of the inside of the machine. This is done by entering the machine and pushing the internal inspection button.

2.1 Internal inspection

2.2 Emergency stops and power switches

- If the doors are open, the power to the engines, extruder and table heaters is switched off. See door switches (fig 8).

- The machine is equipped with 2 emergency stops, according to fig 9:
    - On the machine operating panel (External emergency stop).
    - On the inside of the machine to the right of the entry doors (Internal emergency stop).

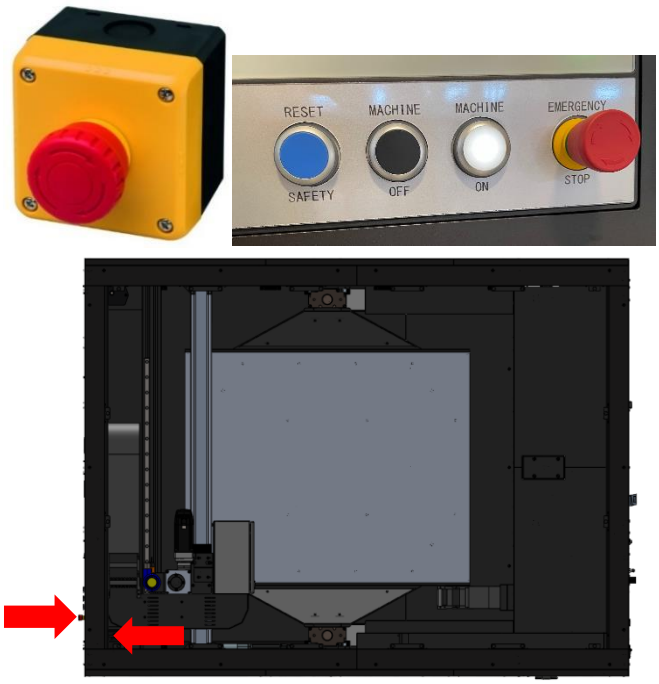


Figure 9 (Emergency stop placement)

- To avoid damage to the extruder, a water-cooling unit is installed that leads cold water through the machine's cable chains and into the extruder' cooling inlets. This unit must be running and maintain a constant temperature of 20(+-5) ℃. For additional information about setting up the water-cooling unit, refer to the separate user manual, according to 4.1.
- The ON/OFF switch for the machine is located on the right door of the electrical cabinet (viewed from the electrical cabinet). See 2.3 (fig 11).

2.3 Instructions for safe inspection and maintenance

During all maintenance work, the procedure "Lockout-tagout" must be applied. Only personnel with maintenance training from The Industry Sweden AB may perform maintenance of the machine. During maintenance of electrical components and printing equipment, the main power switch on the machine must be off (fig 10).

Figure 10 (Main power switch)

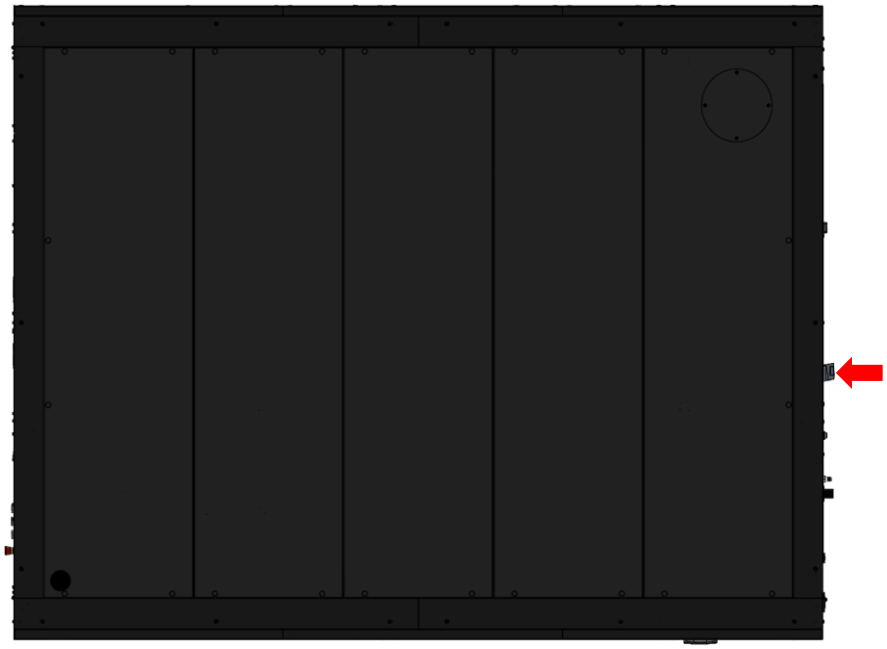


Figure 11 (Location main power switch)

2.4 Information about other hazards

- Burns can occur if unprotected body parts come into contact with the hot vacuum table, nozzles or extruder.
- If a person is inside the machine and the door closes, the emergency stop should be pressed immediately.

2.5 Instructions regarding the use of personal protective equipment

- Protective gloves that protect against high temperatures should be worn at all times when work is performed inside the machine. The gloves must adhere to SS-EN 420:2004+A1:2009 or similar standard.
- It is recommended to wear a sweater with full-length sleeves and long pants during replacement of the nozzle or the print sheet to avoid burns. These clothes must be non-flammable clothing and adhere to EN ISO 11612:2015 or similar equivalent standard.
- Protective shoes must be worn when entering the machine during hot conditions. The shoes must adhere to EN ISO 11612:2015 or similar equivalent standard.

2.6 Prohibited usage

- The machine is forbidden to use if someone is inside the machine. Similarly, the machine must not be used if equipment, tools or various objects are left inside that are not required for regular operation.
- The Industry Sweden AB only takes responsibility for the materials that The Industry Sweden AB has tested and verified in the machine. If damage occurs to the machine as a result of material not verified by The Industry Sweden AB, the warranty is void.
- Maximum printing weight is, in total, 350 kg. Total weight on the table must not exceed this amount.

- The doors to the electrical cabinet must not be opened by staff without training from The Industry Sweden AB.
- The doors to the printing area must never be locked.
- Staff without training from The Industry Sweden AB must not enter the machine if the extruder and table are still warm.
- Temperatures of each material must follow values specified in the corresponding material data sheet, or alternatively adhere to the recommendations provided by The Industry Sweden AB.
- The button Vacuum On/Off, at the operating panel, has a small lamp in the upper right corner. If the lamp is blue the vacuum units are deactivated. Then printing is not allowed.
- If no print sheet is on the table, printing is not allowed.
- Nozzles must not be installed on the extruder before copper paste or similar has been applied on the threads. The graphite oil used must be able to handle temperatures up to 500℃.
- The extruder temperature must not exceed 450℃.
- The table temperature must not exceed 165℃.
  Running programs must be stopped if the water-cooling unit is deactivated or if it's not within a temperature range of 25(+-5) ℃. For additional information about setting up the water-cooling unit, refer to the separate user manual, Watercooling unit.
- Recommended granule size is 2-5 mm.
- If the alarm tower's red signal is lit, push the "Stop" button followed by both "Reset safety" and "Machine on"-buttons on the operator panel. Before any movement is allowed.
- Should the print speed be turned down to 0% for more than 30 seconds during a running program after the heating process and the red signal becomes lit, the machine must then be stopped via the procedure above.
- The maximum kPa for the compressed air is 10 kPa.
- An example of energy consumption: Printing with an extruder temperature of 245 degrees Celsius and a bed temperature of 100 degrees Celsius results in a consumption of 3.3 KWh. A small material dryer consumes 180 wh.

2.7 Details of noise and vibration

The machine has a noise level that falls below a daily noise exposure level of 70 dB.

2.8 Alarm tower functions

The machine is equipped with an alarm tower on the top right side of the machine (seen from the front). It has four signal lights. The function of the signal lights is as follows:

- Green: A program is running without errors.
- Yellow: The machine is idle, and no program is running. The machine is set to program-running mode.
- Red: An error has occurred during a running program. The machine terminates the heating functions of the table and extruder. No movement is possible of linear axles. The acoustical alarm will make a warning noise continuously. If the alarm towers red signal is lit and the acoustical sounds is alarming, push the "Stop" button followed by both "Reset safety" and "Machine on"-buttons on the operator panel.
- Green and yellow: The machine is set to manual operations mode.
- Blue has no function at the moment

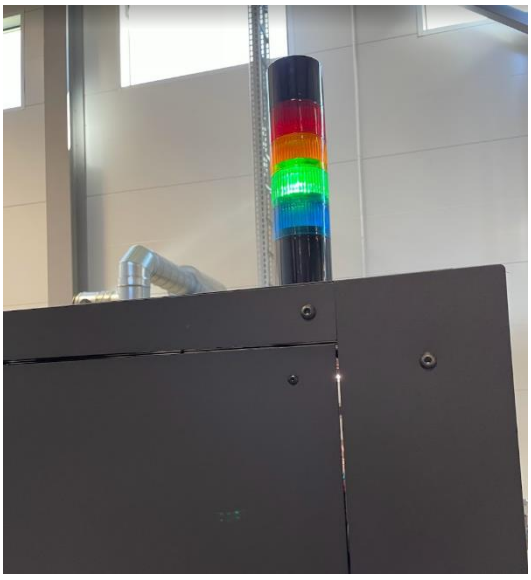


Figure 13a (Alarm tower above operator panel)

2.9 Details of location for placement of the machine

The machine must be placed in a location with regular, or preferably enhanced, ventilation. Preferably according to SS-EN 15251. It is possible to connect an air extraction. See figure 13b.

Figure 13b

2.9.1 Details of fire and smoke hazards

Temperatures of the extruder and table should not exceed the temperatures specified on each material's data sheet. Exhaust fumes, fire hazards and smoke creation could originate from the material if temperatures exceed specifications. If a fire occurs, use carbon dioxide extinguishers.

3 Installation of the machine

Machine must only be maintained by personnel who have received training from The Industry Sweden AB or by personnel from The Industry Sweden AB. An installation of the machine must be done in the appropriate order:

1. Place the Magnum on a smooth and stable floor and remove packaging material
2. Remove transportation support
3. Adjustment of machine feet
4. Detach extruder and linear modules
5. Mount the alarm tower
6. Electrical installation
7. Compressed air installation
8. Water-cooling installation
9. Installation of material feeding system to dryer or hopper
10. Calibration of table height
11. Activate main power switch
12. Calibration of X and Y endpoints
13. Activate material feeding system
14. Activate cooling system
15. Activate main switch for compressed air (Compressed air is a separate system and not included in Magnum)
16. Add print sheet to the table
17. Remove window protection

3.1 Place the Magnum on a smooth and stable floor and remove packaging material

- Magnum must be placed so that it is protected from the elements. Magnum should not be in a room with a temperature below 10 degrees.
- Please note that the machine feet are loose on delivery. Place the machine feet under the axle of each machine foot before setting the Magnum down.

3.2 Remove transportation support

- Remove all red supports. Use Allen key to remove screws. Note that the support under Magnum is heavy. It can be good to put something under it during disassembly. See fig 13c.

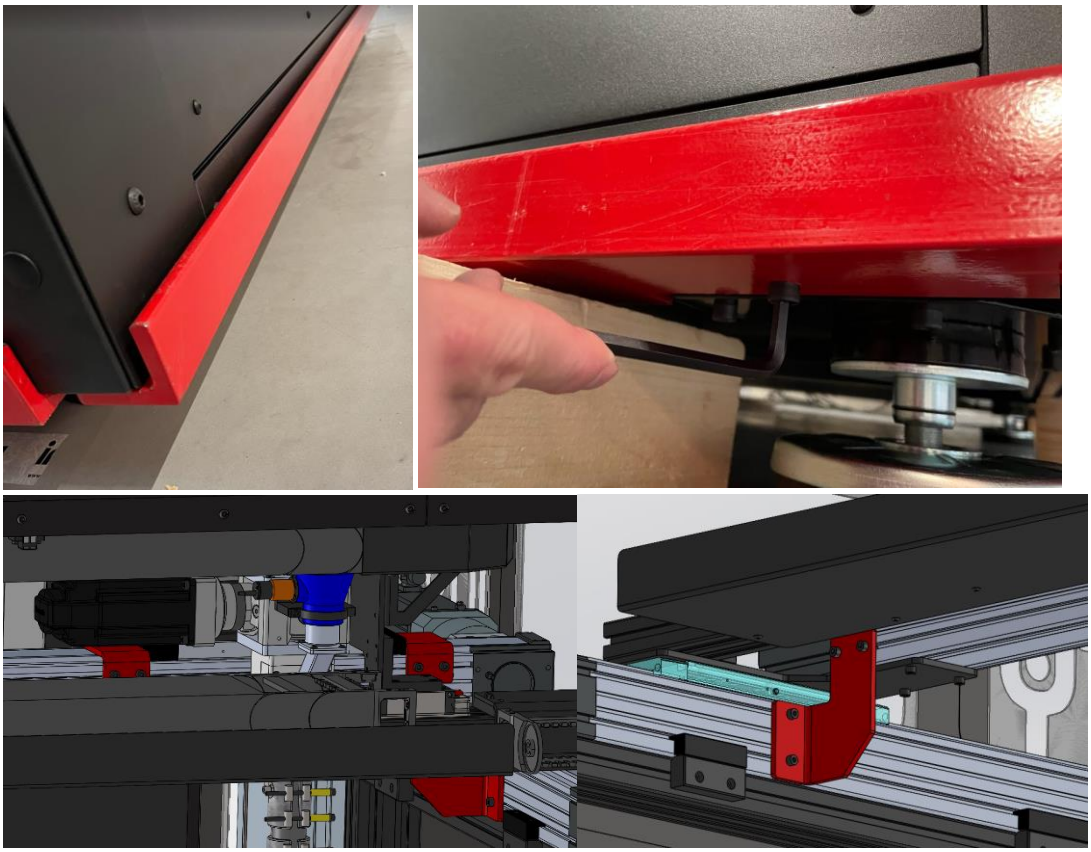


Figure 13c

3.3 Adjustment of machine feet

The machine feet must be levelled. There are 6 feet as illustrated in the figure 51, chapter 5.5.

- Start by removing the inspection hatches on the right and left side. See fig 13d

Figure 13d

- Remove covers in the machine. See picture 13e

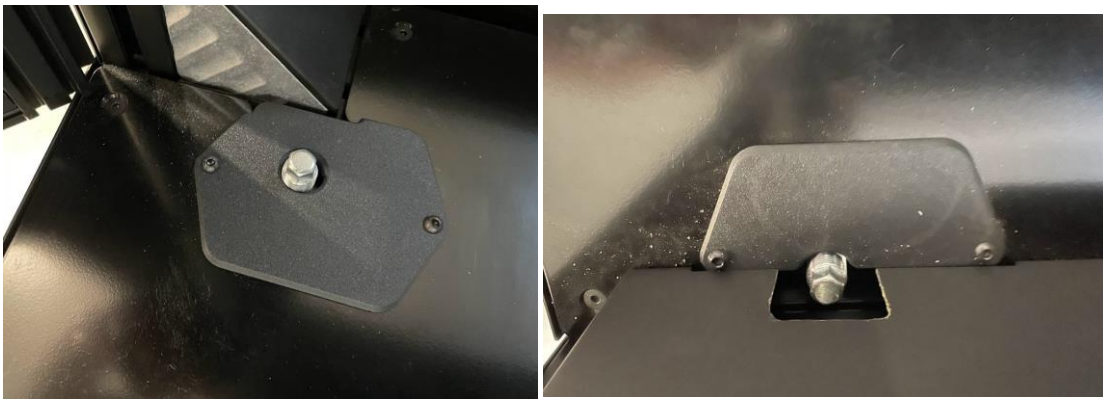


Figure 13e

- The sheet next to the inspection hatch on the left side must also be removed. You reach the last machine foot from the door to the water cooler. See fig 13f

Figure 13f

- Check how straight the machine is, using a spirit level. See fig 13g

Figure 13g

- Then adjust the feet until the machine stands straight. The feet are adjustable by a screw from its' top side, rotating clockwise will further push the foot downwards. There is a nut on the screw which must be loose during the adjustment process and which must be tightened after the process. See figure 14a for a cross section of the foot.

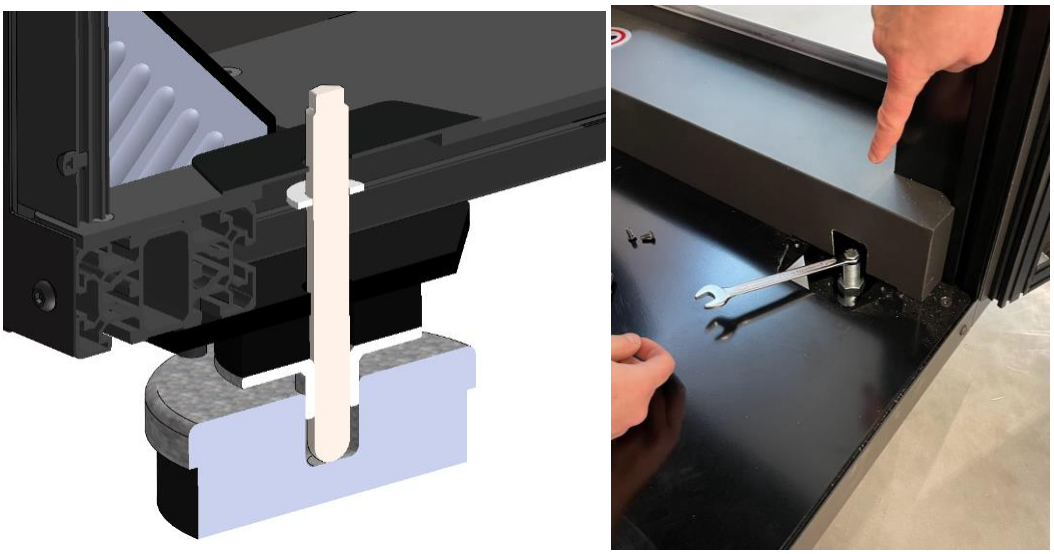


Figure 14a (Adjustable machine feet)

- Replace covers and sheets.

3.4 Detach extruder and linear modules

- Remove the transport supports. See fig 14b

Figure 14b

3.5 Mount the alarm tower

- The alarm tower shall be mounted on the roof of the machine. Insert the plug. Put the tower in place and turn it to lock. See picture 14c

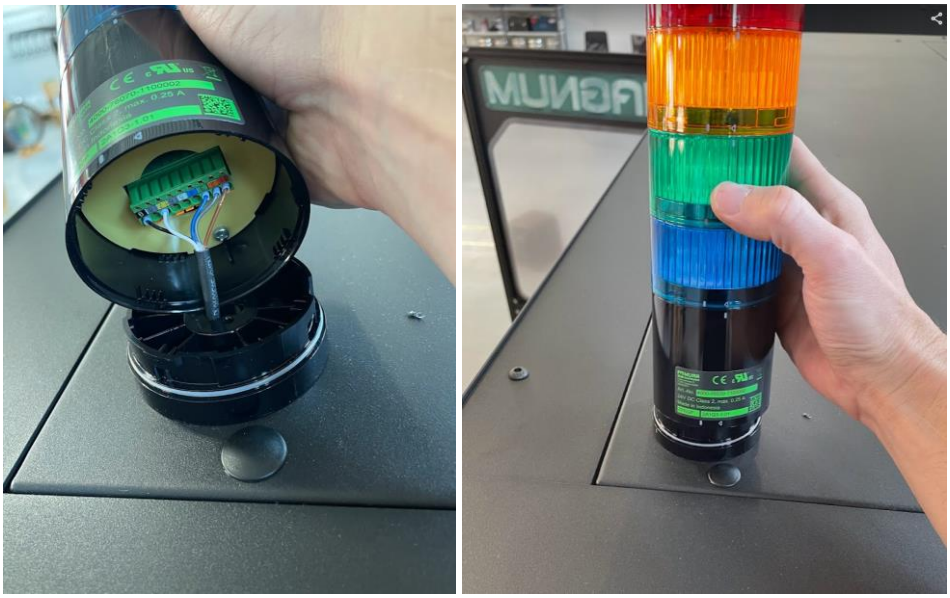


Figure 14c

3.6 Directions for electricity

- The machine requires a 32A three-phase socket, 400V. The electricity is done by certified personnel only. The electrical installation is not done by The Industry Sweden AB.
- Magnum cannot be under an earth fault circuit breaker
- The water cooler requires a 10A socket, 220V.
- Magnum is not sold together with a material dryer. Look in the selected material dryer's manual for what needs it has. (Material Dryer DS 503 MT/T50/VAGN/VA1P Dryer 50Liter, needs 16A socket, 220V)

3.7 Directions for compressed air

- Attach the existing compressed air system to the machine’s compressed air coupling, located on the backside of the machine (fig 15).
- The requirement for compressed air is at least 700 kPa but not above 1000 kPa.

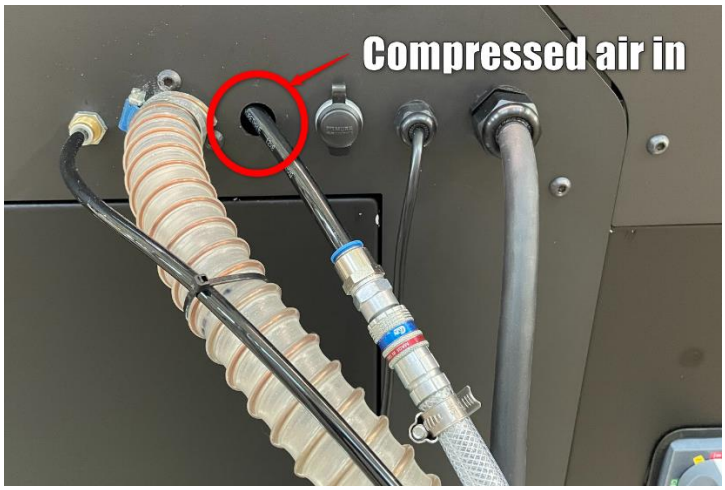


Figure 15 (Port for compressed air, topmost coupling)

3.8 Directions for cooling unit

The cooling unit should be connected to an external 230 V socket with an earth fault breaker. Refer to the user manual Watercooling unit

3.9 Directions for material feeding system

To install the material feeding hose, plug in the appropriate tube for material and air in the corresponding outlet/inlet as shown in fig 17 below. The location of the material feeding outlet/inlet is shown in chapter 1.1 figure 2.

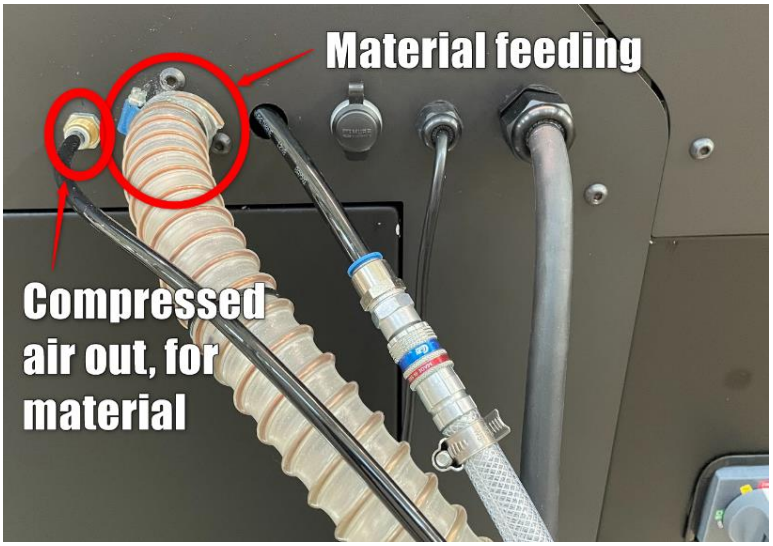


Figure 17

The other end of the material hose needs to be attached to a material hopper or material dryer.

3.10 Directions for calibration of table height

The vacuum table needs to be calibrated for the first extruded layer to be as even as possible. The table is placed on adjustable screws which can be adjusted individually below each screw with a Hex-key. A cross-section of a screw is shown in figure 18a.

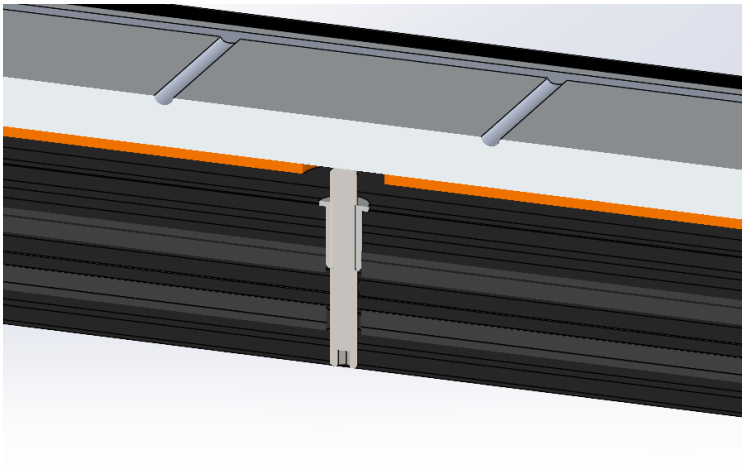


Figure 18a (Adjustable screw)

After the screw has been adjusted it needs to be locked in place. This is done by tightening the nut which is in between the table and the support structure.

The extruder needs to be placed over the individual screw that is being adjusted and measurements should be taken from the tip of the nozzle to the table, where each screw needs to be adjusted to the same value (+- 0,5mm).

Warning! Risk of pinching. Never stand under the table when the extruder is moved around. You can accidentally send the table down. The table goes almost to the bottom of the machine, so it is fatal.

3.11 Activate main power switch

The location of the main power switch is shown in chapter 2.3.

3.12 Directions for calibration of X/Y endpoints

- Start “Indraworks Operation” from the operators’ panel.
- Jog the axles manually according to chapter 4.2.8 until the maximum positions of X and Y has been reached. The machine will then deactivate the servo to indicate that the maximum position has been reached.
- If the machine can jog beyond the axles, contact The Industry Sweden AB for in-depth support.

3.13 Activate the material feeding system

The material feeding system is activated from the screen.

3.14 Activate the cooling system

The external water-cooling unit must be activated and running before any printing can be done. Press RUN. Make sure green light for RUN is lit. The instructions for this can be found in the separate documentation Watercooling unit

Figure 18b

3.15 Activate the main switch for compressed air

The main switch for the compressed air system is located at the pneumatic system shown in chapter 1.1 figure 2, and in chapter 5.4.1 figure 43. It is illustrated in chapter 5.7.1.2 figure 33. Turn the red control to activate compressed air. See Picture 18c

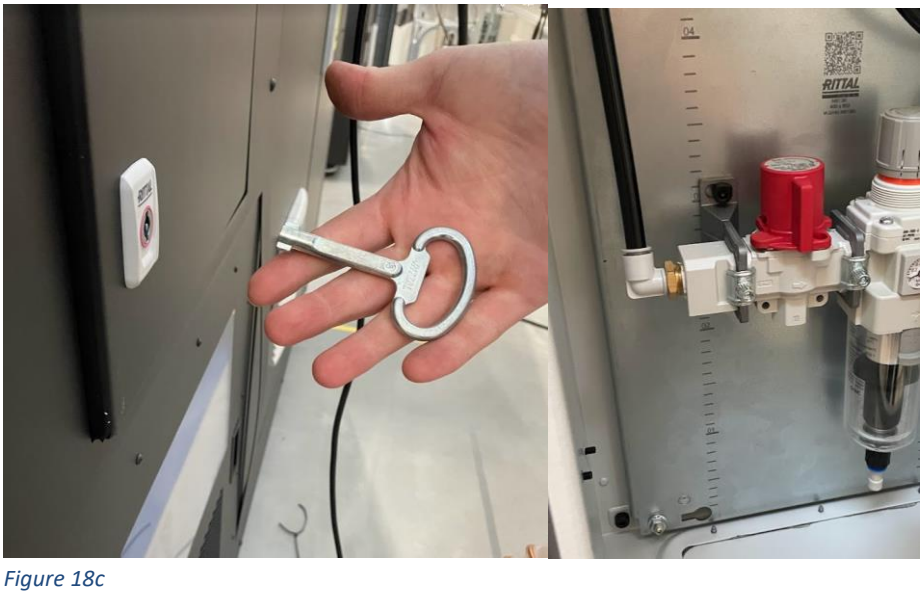


Figure 18c

3.16 Add a print sheet to the table

Before any printing can be done in the machine, a printing sheet needs to be attached to the table. It is preferable that the sheet is in aluminium. The printer should not be heated when inserting a new disc, as the disc may become warped otherwise.

3.17 Remove window protection

- Remove window protection. See picture 18d

Figure 18d

4 Manoeuvring and operation

4.1 Description of operating device

All usage of the machine is controlled through the operating panel. Information about the panel can be found in the attached document, Multitouch display | Bosch Rexroth . To find out all relevant information regarding the basic functions of the operating panel, see below. The screen is equipped with:

- An emergency stop button
- A USB-port
- A blue physical button with no linked function
- A black physical button with no linked function
- A white button which is the physical “Reset”. This needs to be used after the emergency stop or the door switch has been closed.
- A user interface display where all general operation of the machine will be performed.

As the blue and black physical buttons are not linked to any function, they should never be pressed.

Figure 20 (Operating Panel)

4.1.1 Operating device basic functions

The basic functions of the operating panel are:

- Selection and initiation of programs in the machine.
- Manual control of axis X, Y and Z.
- On and off switch for the table's vacuum ejectors.
- Show program code of selected program.
- Report potential error messages.
- Reset program code.
- Print Speed

4.1.2 Operating device location and operator workspace

The operating panel is located at the front of the machine, according to figure 21.

Figure 21 (The front of the machine)

The operator's workspace during machine operation is restricted to the green area according to figure 22 (to the left). During removal of printed parts, the operator may also gain access to the print table according to figure 22
(to the right).

Be careful when entering a hot environment. Negligence or lack of safety equipment can lead to serious injury.

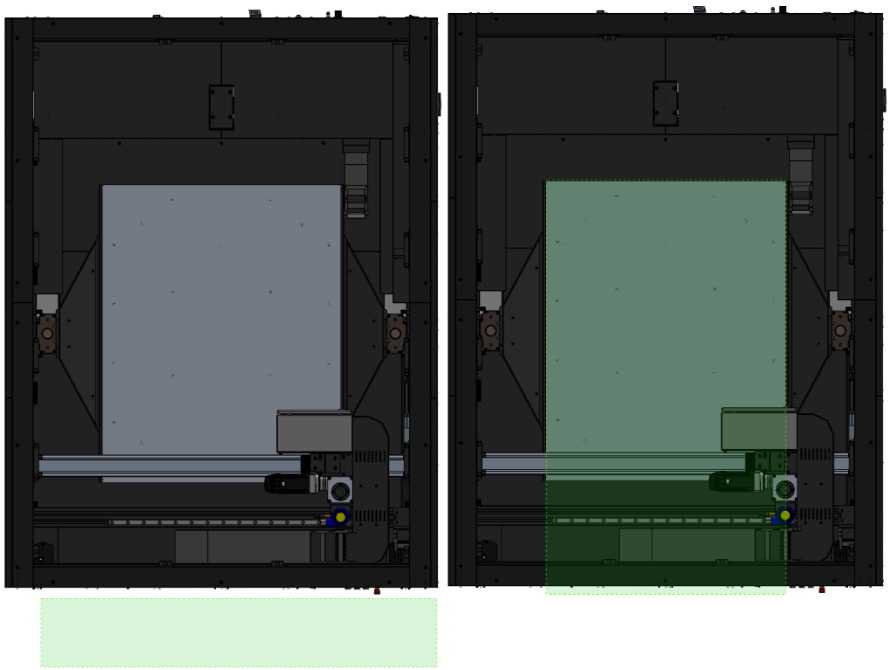


Figure 22 (Workspace of the operator seen from above)

4.2 Instructions for basic functions (on the operator's panel)

4.2.1 Instructions for start:

1. The machine's main power switch must be switched on.
2. Wait for startup by the operating panel.
3. Start "Indraworks Operation". Wait for the application to start.
4. Check 4.2.3 for control measures before initiating a program.

4.2.2 Instructions for stop:

- For emergency stop, press one of the 2 installed red emergency stops, according to 2.2. (fig 9).
- If the doors are open, the motor power will automatically switch off. Heating of extruder and tables also ceases.
- To stop the printing process, press the "Stop" button on the operating panel.

4.2.3 Control measures before initiating a program or manual control

1. Before initiating a program or manual control, the printing surface of the table must be inspected to make sure it is empty.

2. If printing leftovers or unsuitable objects remain on the table, run the program “start-position” and wait for the program to end.
3. Remove print objects or unsuitable objects and close the doors. Ensure that no objects are on the floor of the machine or under the platform.

4.2.4 Instructions for activating vacuum for the vacuum table

1. Before the vacuum to the table is activated, a print sheet must be placed on the table. The sheet should be identical in width and length to the vacuum table and placed so it covers the table’s cutout.
2. Push the button Vacuum On/Off to activate the vacuum in the table to ensure the print sheet sticks. The buttons should then be lit.

4.2.5 Instructions for deactivating vacuum to vacuum table

1. Make sure no program is running.
2. Push the button Vacuum On/Off to deactivate the vacuum in the table and enable the print sheet to come loose.

4.2.6 Instructions for initiating a program

1. Attach the USB flash drive containing the required programs to the operating panel’s front USB-port.
2. Transfer the programs to run into the folder “mnt”, located in C:/IndraMotion_MTX_standard/.
3. To select a program, navigate to the Program Block (fig 23).

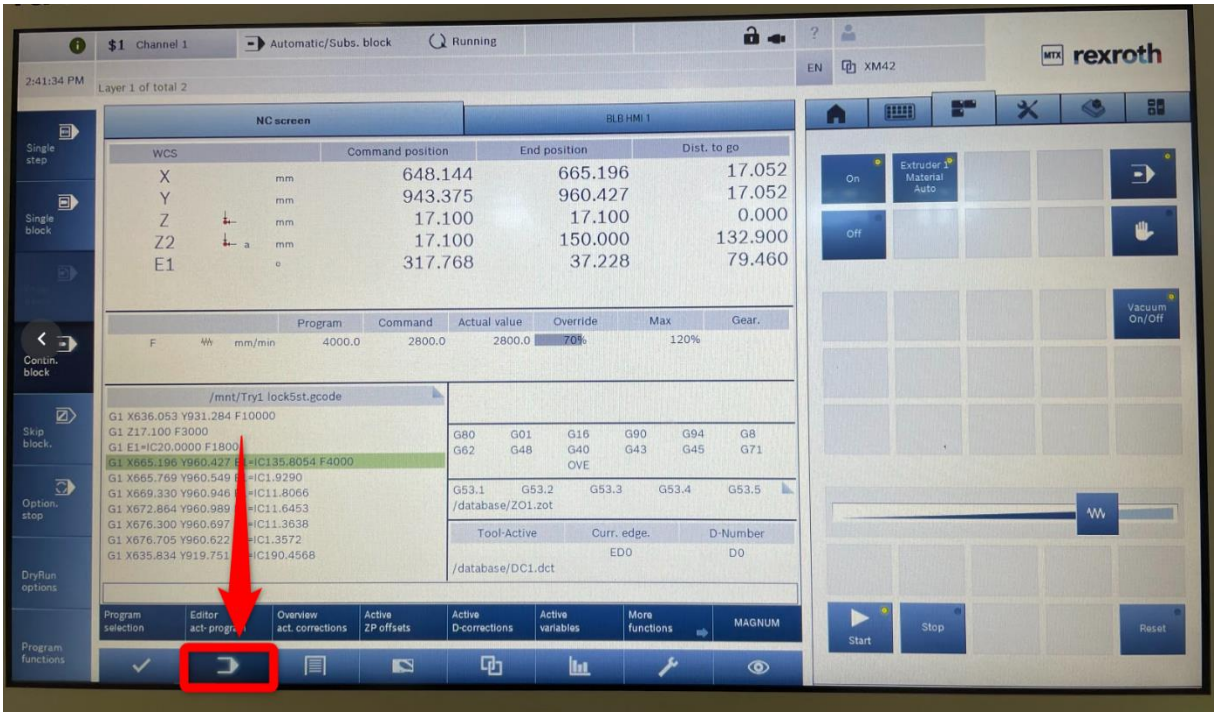


Figure 23

4. Choose “Program Selection” and navigate to the folder “mnt” where all programs are located (fig 24).

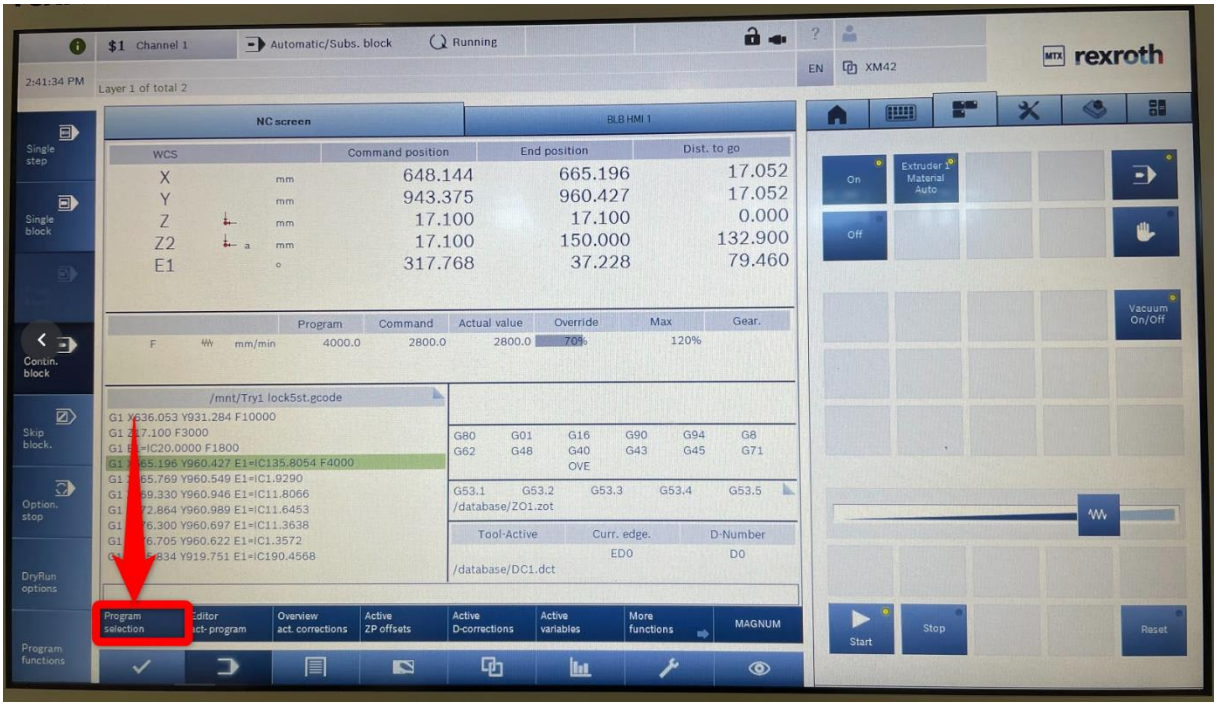


Figure 24

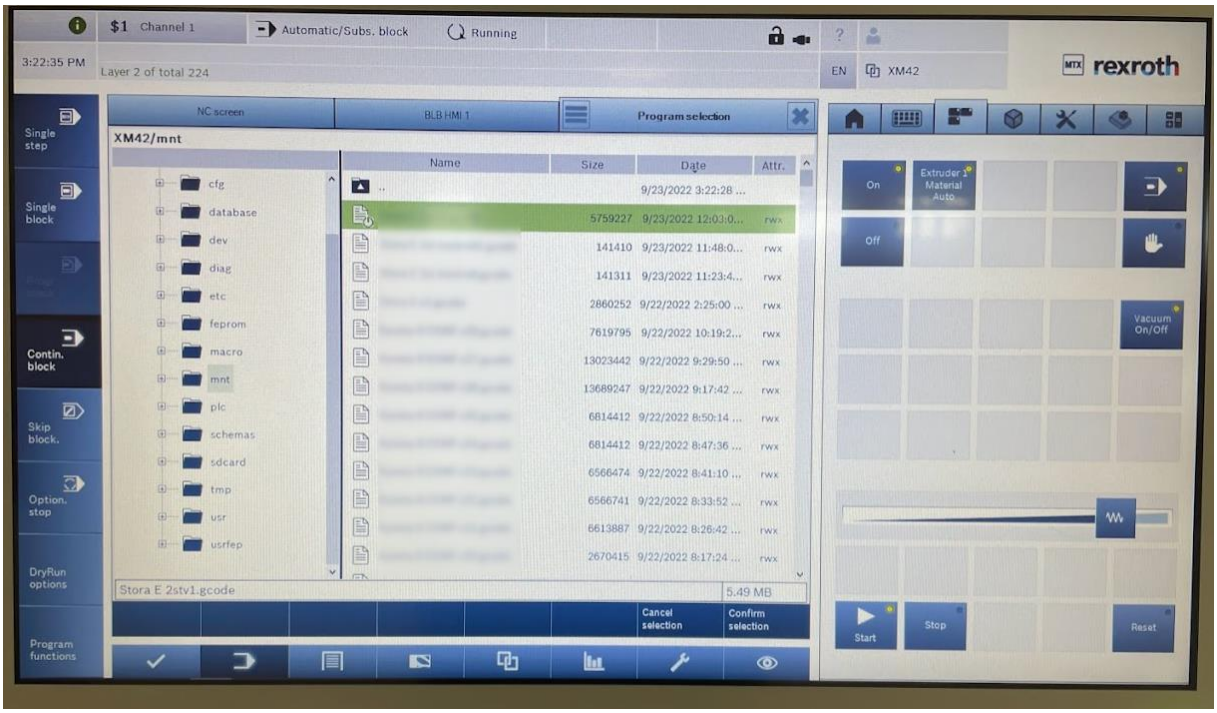


Figure 25

5. Select program and press “Confirm selection”.
6. Activate the vacuum, according to 4.2.4.
7. Close the doors
8. Press the physical “Reset” button on the operating panel.
9. Press the digital “Reset” button on the operating panel.
10. Press ”ON” located according to fig 26.

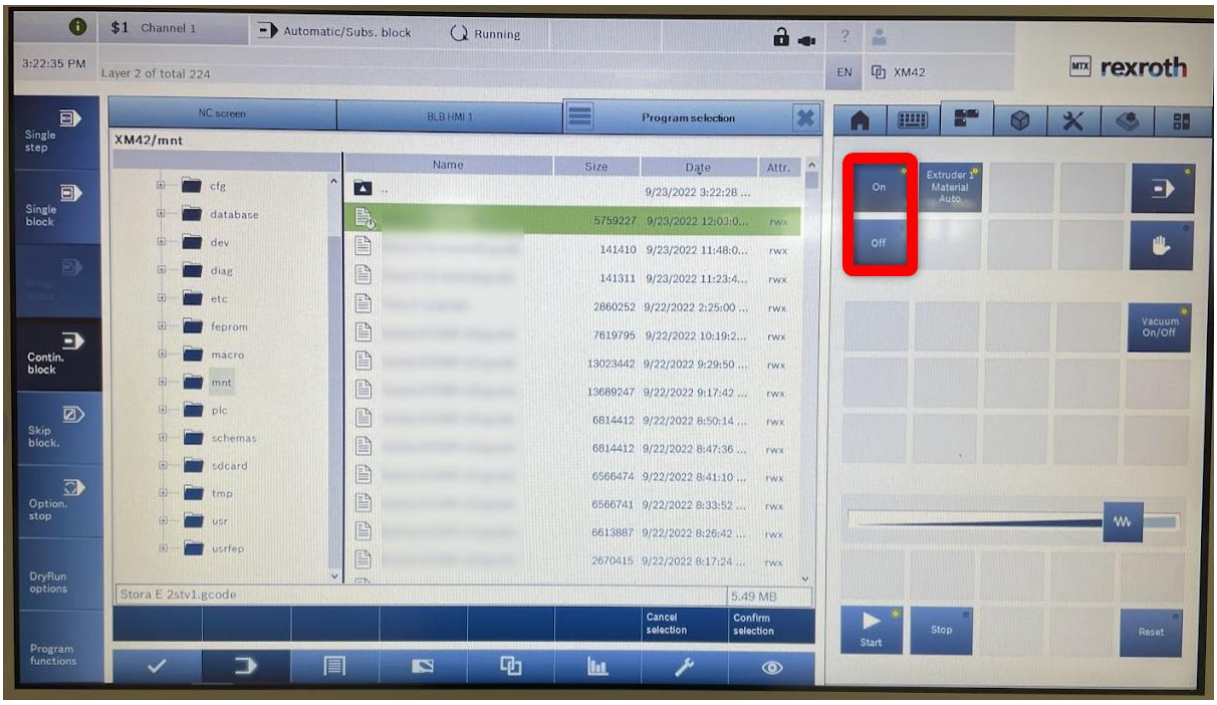


Figure 26

11. Press “Start” to run the selected program. The machine will begin to heat up and start printing when the optimum temperature is reached.
12. Adjust the printing speed by dragging the speed bar horizontally (fig 27).

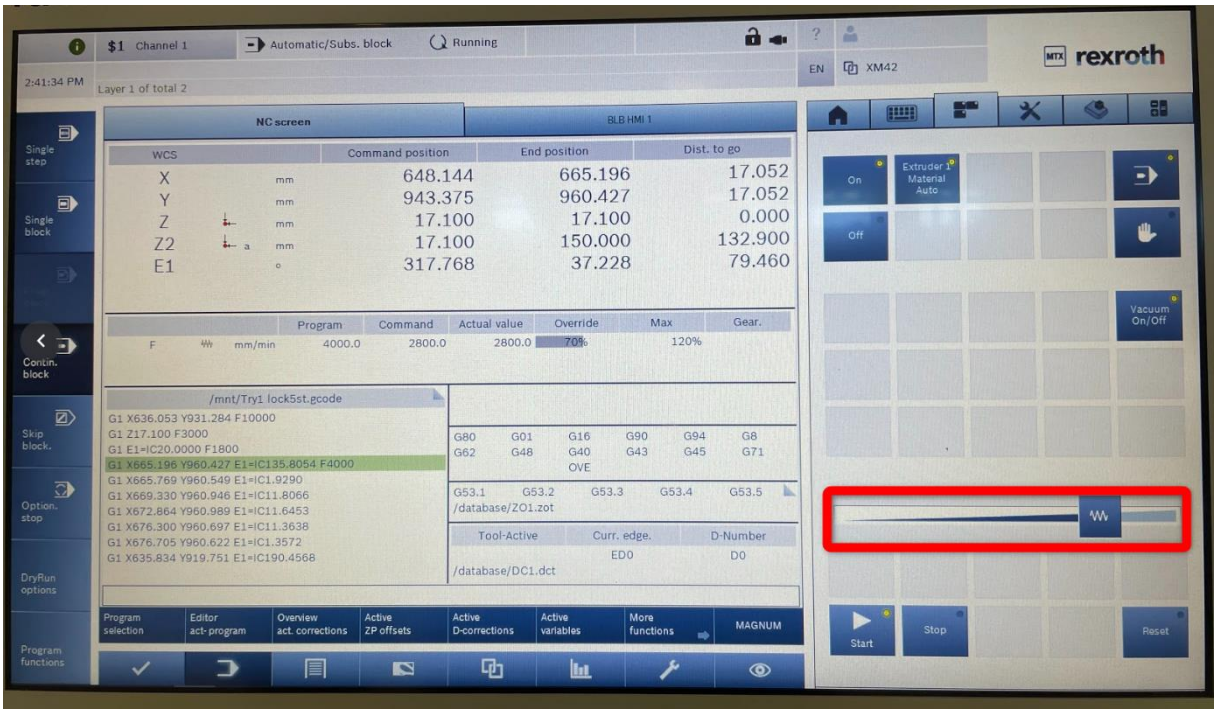


Figure 27

4.2.7 Instructions for emergency stop and restart

1. In case of a restart after using the emergency stop, all pressed emergency stop buttons need to be retracted.

2. Select and run the program “start-position” and wait until the extruder have changed position and stopped.
3. Remove any material from the printing table.
4. If the doors are open, they need to be closed.
5. Press the physical “Reset” button on the operating panel.
6. Press the digital “Reset” button on the operating panel.
7. After both “Resets” have been pushed, the active program will move to the first program line and will not continue from the previous program line.
8. Thereafter, the program can be restarted, or a new program can be selected.

4.2.8 Directions for moving the extruder to the “start” position

- When the printed part is completed, the extruder should return to the “start” position, on the machine’s left-hand side (fig 28).

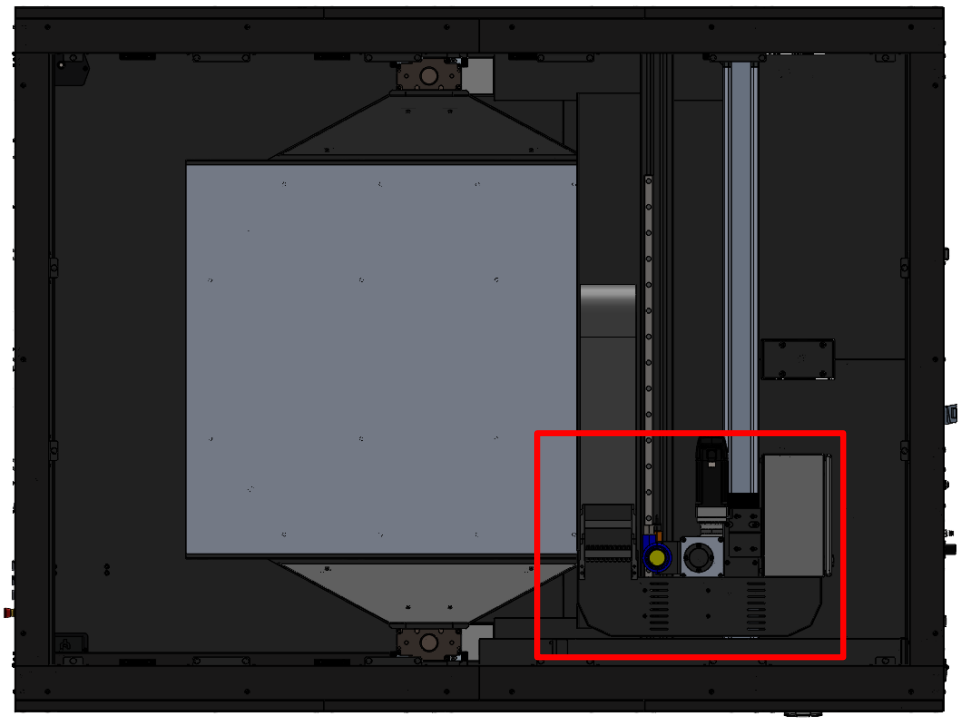


Figure 28 (”Start” position from top view)

- To return the extruder to the “start” position, run the program “start-position”.
- To manually steer the extruder to the “start” position using the operating panel:
    1. Navigate to the Program Block, according to 5.2.6, point 3.
    2. Press the hand-symbol to gain access to the buttons for manual steering (fig 29).

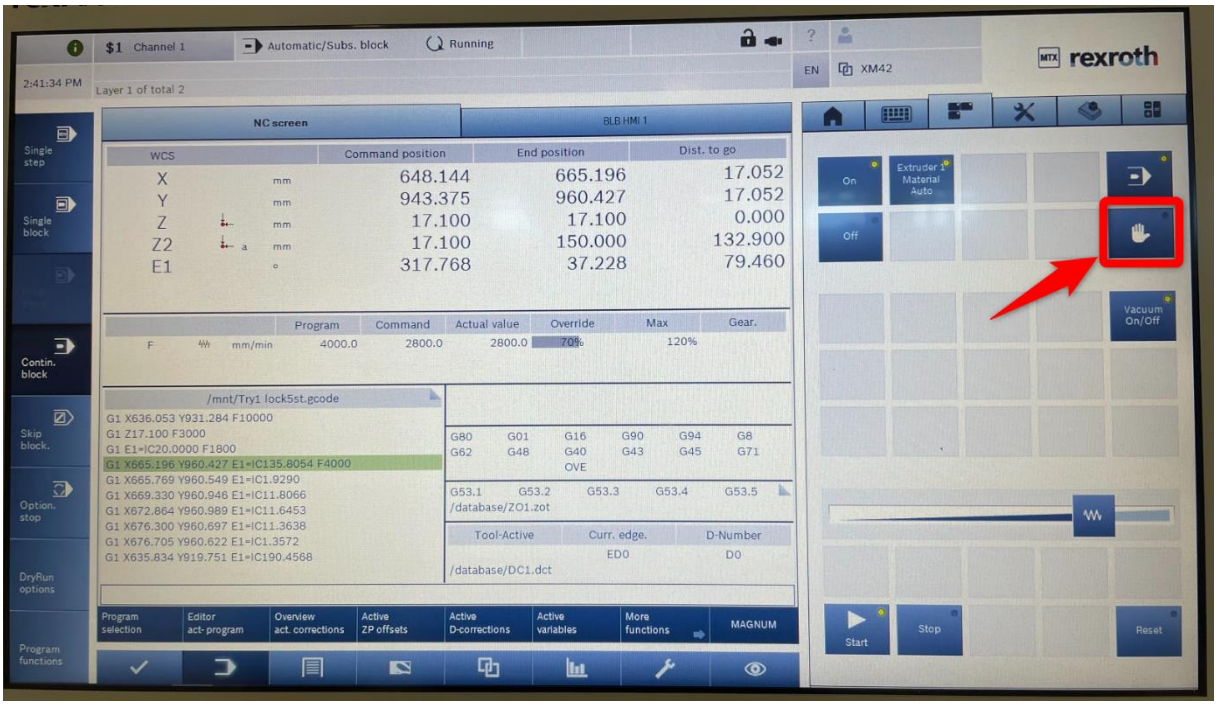


Figure 29

3. Thereafter, X (Length), Y (Width) and Z (Height) can be maneuvered manually.

4.3 Directions for changing the extruder nozzle

<u>Be careful when entering a hot environment and handling hot tools. Negligence or loss of safety equipment can lead to serious injury.</u>

1. If no material has been produced before the change, or if the extruder are empty at the time of changing, point 2 can be ignored.
2. Heat the extruder nozzle to the recommended print out temperature by running one of the following 3 programs:
    a. “Nozzle 170C” (For Extruder 1, material with melting temperature around or below 170℃)
    b. “Nozzle 200C” (For Extruder 1, material with melting temperature around 200℃)
    c. “Nozzle 230C” (For Extruder 1, material with melting temperature around 230℃)
3. When the program is complete, the code is reset to the first program line. This signifies that the extruder is set to the correct temperature for nozzle change.
4. Use the supplied hex key (Allen key) to loosen the active nozzle that needs replacing.
5. Apply graphite oil to the threads of the new nozzle. This must be done for each nozzle change.
6. Screw the new nozzle onto the extruder, as tightly as possible.

4.4 Directions for emptying extruder and the material transport system

1. Disconnect material hoses from the material feeding system (the hopper or the material dryer).
2. Run program “Material Change” to empty extruder.
3. Let the program run until no more material emerges from the extruder.

4.5 Directions for changing material

1. To change material, all points from 4.4 should be followed.
2. Connect the material hoses to the material infusion system.
3. Run program, according to 4.4 point 3, to release new material into the selected extruder until the material emerges in an even flow.
4. Recommended granule size is 2-5 mm.

4.6 Directions for removing the printed model

Be careful when entering a hot environment. Heavy objects must be handled with care. Beware uneven floor level when entering and exiting the machine. Negligence or lack of safety equipment can lead to serious injury.

- When the printed model is completed and the extruder are returned to the “start” position, access to the machine is permitted.
- The printout can be removed from the machine in two ways:
    - Wait until the print sheet has cooled down to 90℃, so the model comes loose from the table. Thereafter, lift or push out the model. The temperature can be seen by navigating to the Error message screen shown in chapter 5.7.1.3 figure 34 and by pressing “more functions” followed by “parameter variable” where the temperature is displayed in the variable “BedTempActual”.
    - Pry carefully loose the model from the table using a lever. Thereafter, lift or push out the model. Forklift or other necessary equipment may be used to assist the unloading of printed part. See figure 30.

Figure 30 (Unloading of printed part with forklift)

4.7 Directions for troubleshooting and alarm tower reset

4.7.1 Instructions for troubleshooting

4.7.1.1 No material is coming out of the extruder

- Check if a program is active. This can be done by checking if the program box is empty or if a program is selected (fig 31).

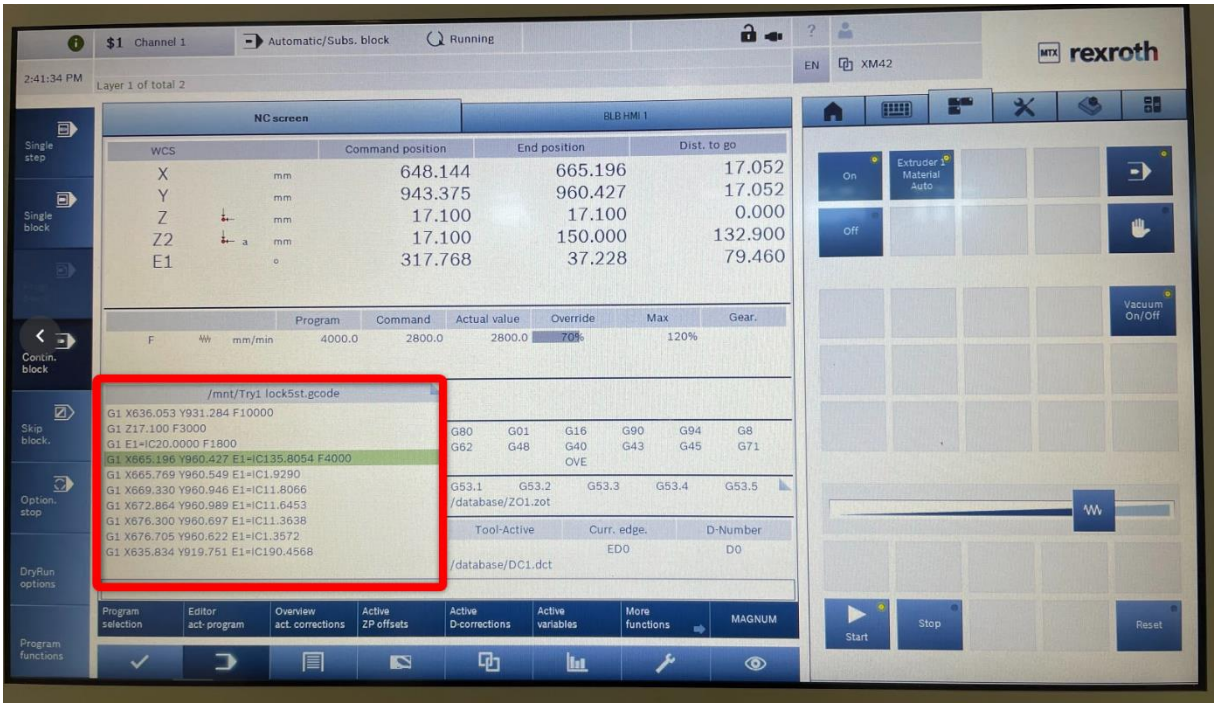


Figure 31

- Check that the speed bar is not in the left-most position. The speed is shown in the column “Override” (fig 32).

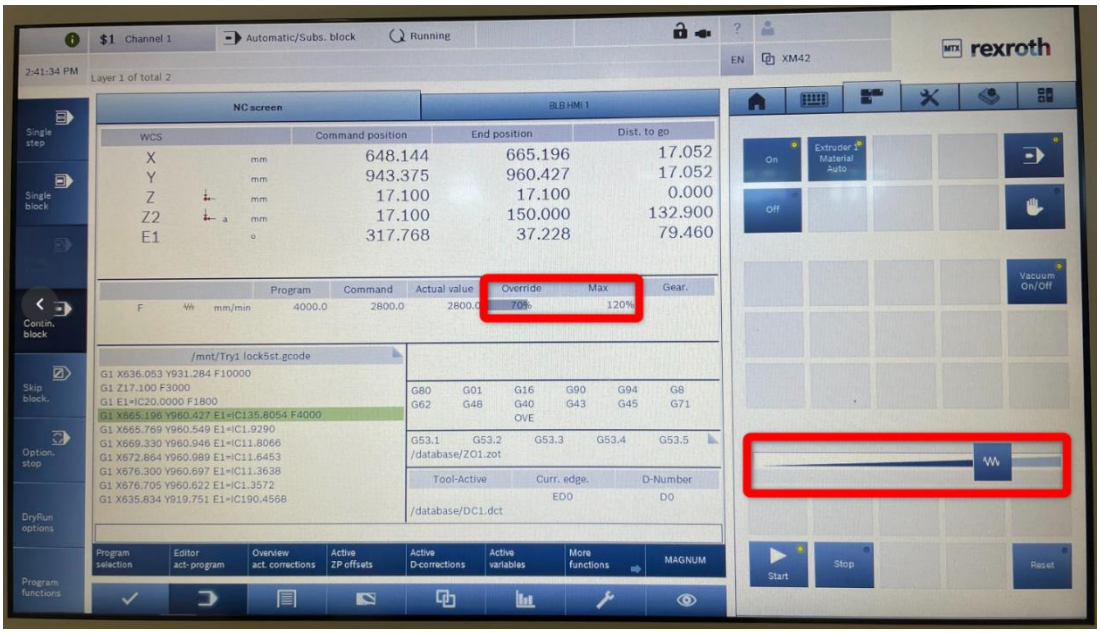


Figure 32

- Check that there is material in the material tubes. If material is not present in the tubes, check if the material feeding system is activated according to chapter 3.9 and 4.7.1.3.

4.7.1.2 Noise from the bed or if air continues to fill the vacuum bed.

1. Check if the O-ring for the vacuum bed is in place or damaged.

4.7.1.3 Material transport

1. Check if there is material in the material tubes above the extruder. If there is no material, refer to point 2.
2. Check if there is material in the silo outside the machine. If there is material, refer to point 3.
3. Check that there is compressed air flow to the machine. If there is compressed air, refer to point 4.
4. Check the main switch for compressed air in the machine (fig 33). If the switch is not off, refer to point 5.

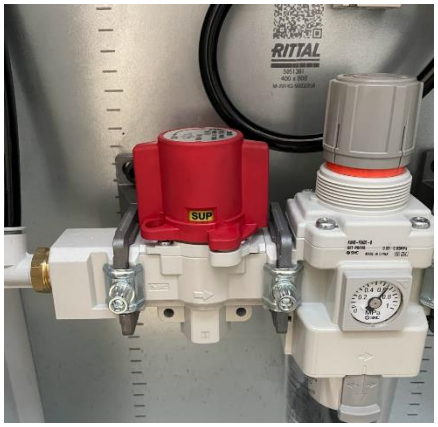


Figure 33 (Main switch for compressed air not switched off)

5. Restart the machine using the main power switch, according to 2.2. If the problem persists, contact support.

4.7.1.4 Error message

1. Error messages are shown in the message box (fig 34).

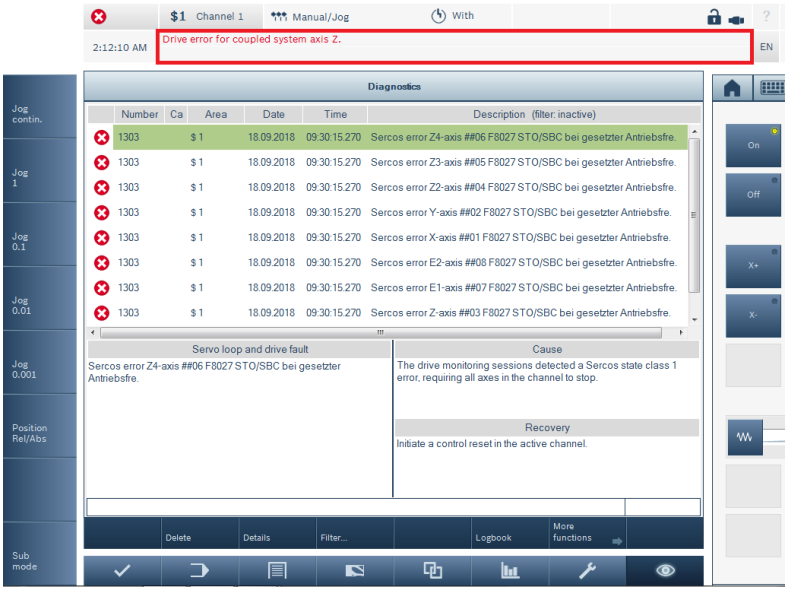


Figure 34

2. For detailed information about an error message, navigate to the Message Block (fig 35).

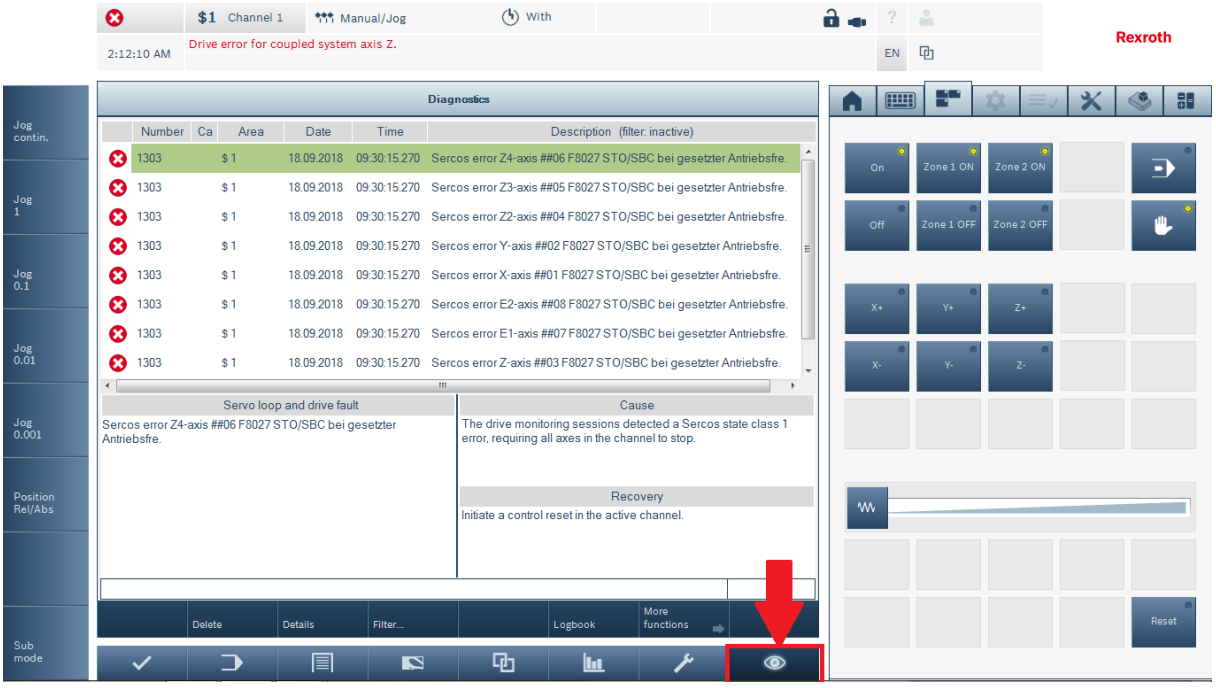


Figure 35

3. To remove an error message, press “Delete” in the Message Block. If the message persists, report it to support.

4.7.1.5 Printing sheet does not stick to the table

- Check that both vacuum zones are active, according to 4.2.4.
- Check that compressed air is present in the machine, according to 4.7.1.3 point 3 and 4.
- Check that the printing sheet covers the entire table’s width and length.
- Check that the table is clean.

- Check that the edges of the printing sheet have no perforations, which may prevent the sheet from maintaining a flat position.

4.7.1.6 Nozzle parameters and selection of nozzle

- Check that the correct nozzle parameters have been specified for the active nozzle. Ensure the diameter of the active nozzle with a caliper.

4.7.1.7 Check for pneumatic leakage

- Turn of the machine using the main power switch, according to 2.2.
- Listen for leakage inside and around the machine.
- If a leak has been identified, it should be handled by replacing the faulty component.

4.7.1.8 Check for nozzle leakage

1. If leakage from nozzle occurs during heating of extruder or during the printing process, the process should be stopped.
2. Run the extruder to the “start” position.
3. Perform removal of nozzle, according to 4.3 point 4.
4. Check for impurities or particles on the nozzle’s and extruder’s surfaces that lie in a plane against each other (fig 36).

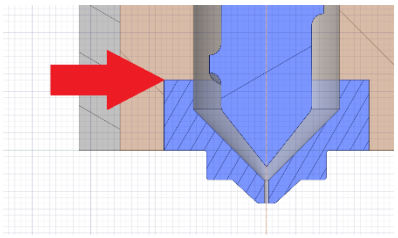


Figure 36 (Contact surface nozzle and extruder)

Be careful when entering a hot environment. Negligence or lack of safety equipment can lead to serious injury.

5. Check if the nozzle’s contact surface is damaged. If the nozzle is damaged, refer to point 8.
6. Clean the contact surfaces on extruder and nozzle.
7. Reinstall the nozzle, according to 4.3 point 5 and 6.
8. Damaged nozzles should be discarded or returned to The Industry Sweden AB.

4.7.1.9 Check for water-cooling system leakage

- Check if moisture or fluid has leaked from couplings located on cooling inlets.
- Check if moisture or fluid has leaked from couplings at the back of the machine, according to figure 15.
- If a leak is detected, the cooling unit must be switched off and the faulty component must be replaced.

4.7.2 Directions for the alarm tower

- If the alarm towers’ red signal is lit, push the “Stop” button followed by both “Reset”-buttons on the operator panel.
- Before any movement is allowed, the program “AlarmReset” must first be run and completed to ensure no damage to the extruder.

4.8 Instructions for operator training

- Operators should read the user manuals and attached technical documentation.
- The Industry Sweden AB provide training for operators upon request.

5 Maintenance

Machine must only be maintained by personnel who have received training from The Industry Sweden AB or by personnel from The Industry Sweden AB.

5.1 Lubrication

Be careful of uneven floor levels when performing maintenance. Risk of falling can lead to injury.

Standard components are to be lubricated according to their intended time interval and instructions.

For guide rails, see the instruction manual Y-axis ball runner block

There is 1 guide rail in the machine illustrated in fig 38 below.

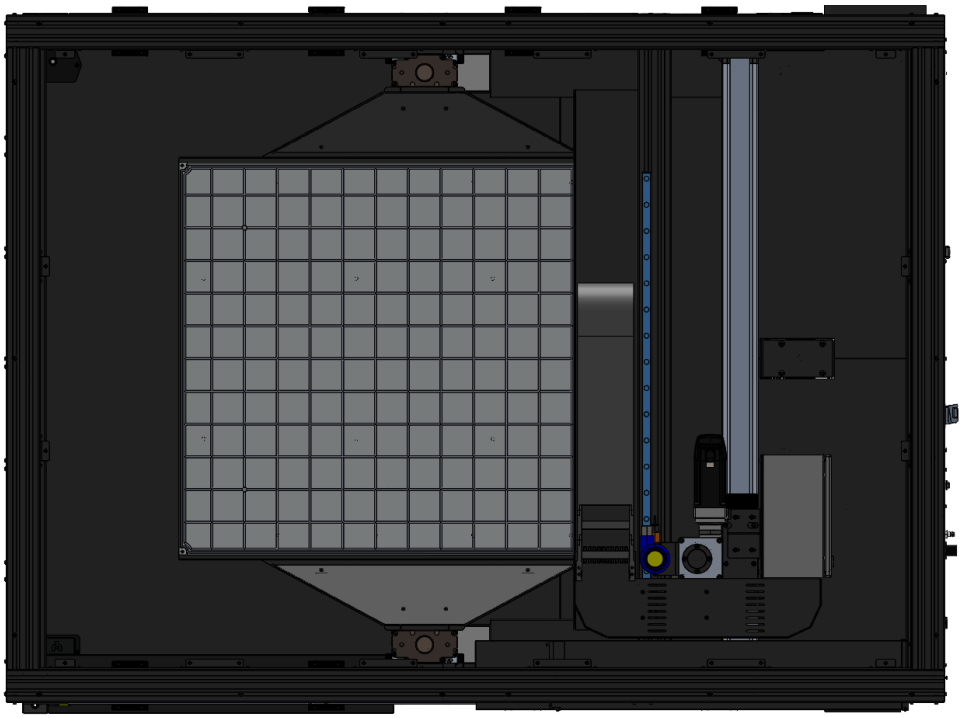


Figure 38

For linear modules, see the instruction manual Z-axis module and Y-axis module

There are 5 linear modules in the machine illustrated in fig 39 below.

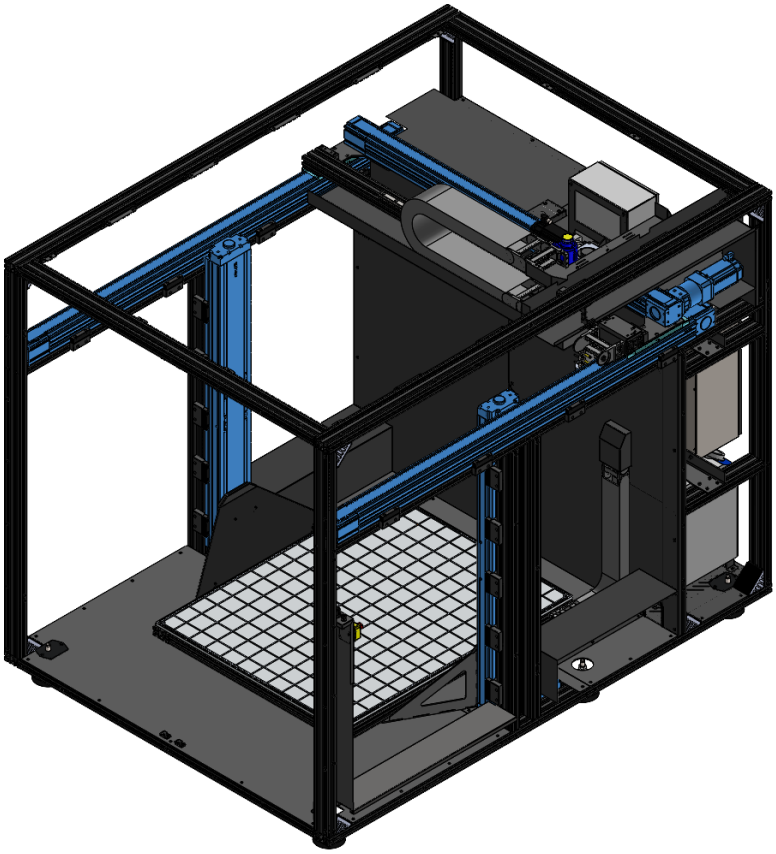


Figure 39

5.1.1 Directions for changing the print sheet on the table

Be careful of sharp edges on the print sheet. Watch out for difference in floor levels when carrying the print sheet. Negligence or lack of safety equipment can lead to serious injury.

- If the vacuum is activated:
  1. Stop potential running of programs by pressing “Stop”.
  2. Ensure the extruder are in the “start” position.
  3. Deactivate the vacuum in the table, according to 4.2.5.
  4. Lift out the active print sheet.
  5. Position the new print sheet so it covers the entire surface area of the table.
  6. Activate the vacuum, according to 4.2.4.

- If the vacuum is not activated:
  1. Lift out the print sheet.
  2. Position the new print sheet so it covers the entire surface area of the table.
  3. Activate the vacuum, according to 4.2.4.

5.1.2 Directions for changing motor

1. Remove the 4 motor screws attached in the gearbox adapter.

2. Open the rubber cap on the gearbox adapter.
3. Rotate the motor or attached axle until the locking screw is visible in the gearbox adapter and loosen the screw.
4. Remove the component and replace with new part.

5.1.3 Directions for changing extruderscrew

1. Remove light tower
2. Remove roofsheet. See fig 40a.

Figure 40a

3. Heat the extruder according to what material you have in the extruder.
4. Turn off the material feed. This is done from the screen.
5. Empty the extruder of all material. Also empty the blue Hopper.
6. Move the extruder so you reach it.
7. Remove the nozzle.
8. Remove the extruder flange (22647). See fig 40b.

Figure 40b

9. Remove the ball bearing. See fig 40c

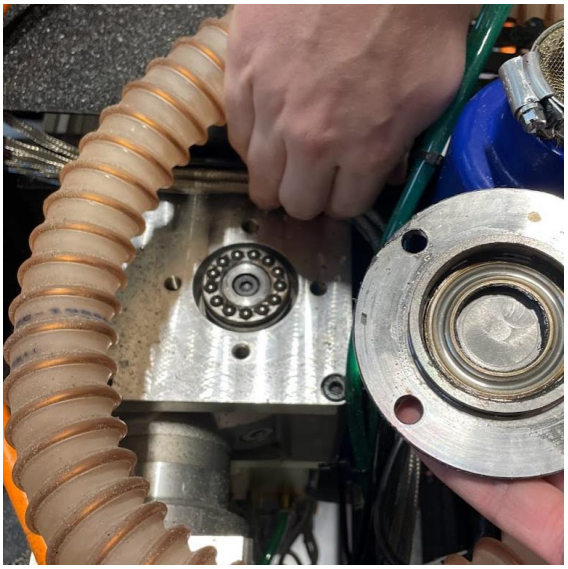


Figure 40c

10. Loosen the M8x25 with a nutcracker. When this is done, someone must be prepared to catch the screw if it comes loose. Use protective gloves. See fig 40d

Figure 40d

11. The screw is now loose. If it doesn't come out on its own, it needs to be banked out. Someone has to receive the screw when it comes off. Use protective gloves. See fig 40e

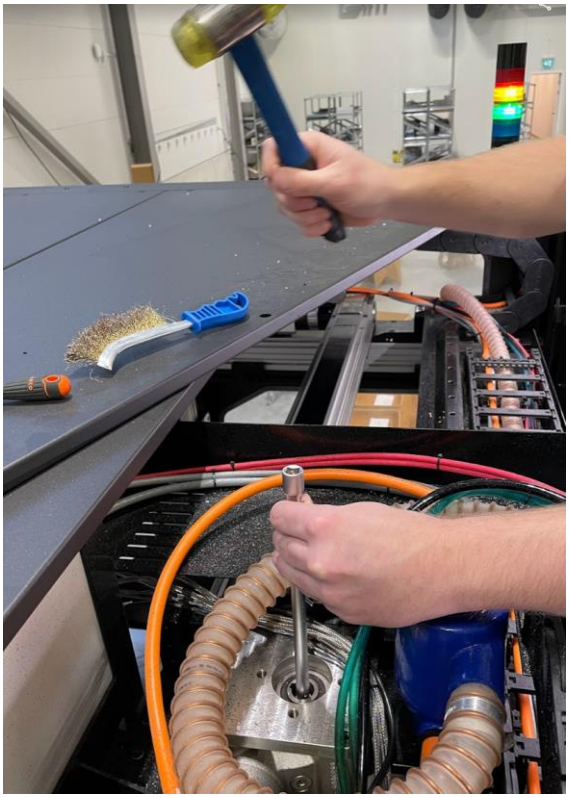


Figure 40e

12. Clean the screw of all material while it is still hot. Use a soft wire brush. Use protective gloves.
13. Note that there is a loose wedge in the shaft of the screw that you need to take care of.

5.2 Directions and time intervals for inspecting protective functions

The protective function of the door switch needs no inspection. If the door stop protective function is broken, the machine will not function. The door´s safety switch must not be bypassed.

5.3 Timetable and actions for inspection and maintenance

Prior to any maintenance or cleaning, the protective equipment must be used and the principle "Lockout-tagout" in chapter 2.3 must be applied. Negligence or lack of safety equipment can lead to serious injury or death.

ACTION	Daily	Weekly	Monthly	Quarterly	Hours
Check nozzle leakage		X			<0,1
Check extruder cooling inlets leakage		X			<0,1
Check ingoing coupling leakage at the back			X		<0,1
Check pneumatic leakage in the machine			X		<0,1
Clean nozzle threads, internal threads on extruder			X		1
Change print sheet				X	0,1
Change filters vacuum table			X		0,1
General cleaning of the machine and extruder			X		
Check function of security switches		X			1

Specific directions can be found at 4.3 and 5.1 and the chapters below.

5.3.1 Directions for cleaning of extruder

The extruder should be cleaned at least monthly according to the points below. Before any cleaning is performed, the machine must be completely shut off at least one hour in advance to minimize risk of damage from hot components. Only when cleaning the inside of the screw may the extruder still be hot.

- Grease may accumulate below the gearbox and the water-cooled material inlet, see fig 41. These should be wiped with a damp cloth or paper. **It is prohibited to use burnable chemicals for cleaning near the extruder heating bands.**

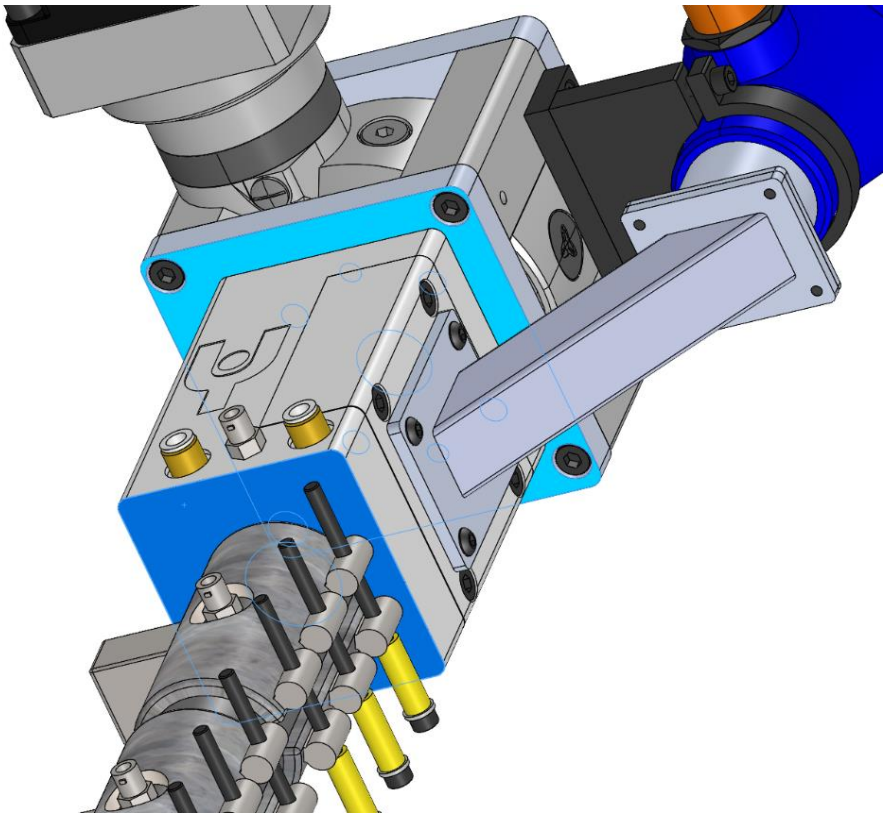


Figure 41

- If excess plastic material covers parts of the heating bands, the bands should be cleaned if possible.
- Remove the sensors from their sockets by pushing them gently against the extruder and twist to release them from the attachment. Clean them with a cloth and reattach them.
- The inside of the extruder needs to be cleaned by running the extruder at 180℃ with at least 500 grams of Loxaclean or similar material.

5.3.2 Description for cleaning of the machine

Beware of uneven floor levels. Risk of falling can lead to injury.

The machine should be cleaned at least monthly according to the points below. Before any cleaning is performed, the machine must be completely shut off at least one hour in advance to minimize risk of damage from hot components.

- Clean the areas which accumulate dust, such as; above the electrical cabinet, on the floor, the shelfs for the cable drag chains and on the gearboxes of the extruder.
- Wipe the dust covers of the linear modules. Refer to linear module document.

5.4 Maintenance of constituent components

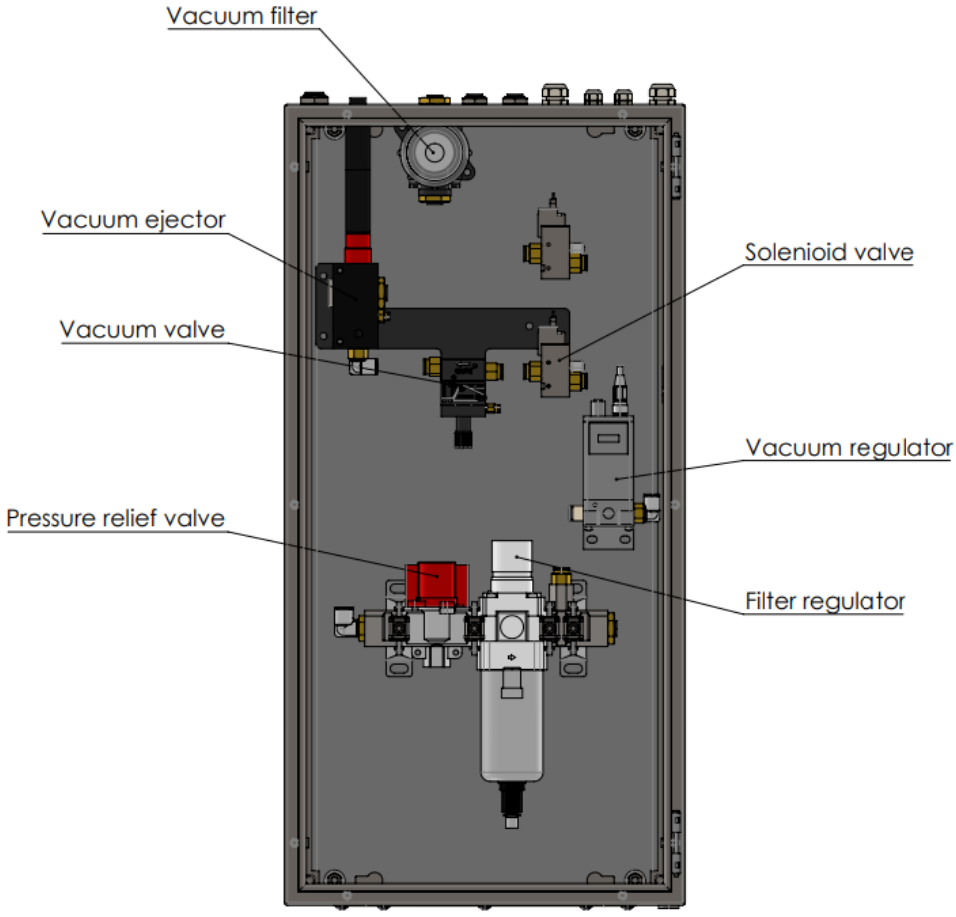
- Magnum consists of many components that have their own instructions for use and different recommended maintenance. See chapter 8 for these separate manuals and how to maintain these components.
- The water in watercooler has 15% ethylene Glycol.

5.5 Specification of spare parts

For the related list of spare parts and for all parts in the electrical cabinet, contact The Industry Sweden AB.

5.5.1 Pneumatic system

The pneumatic system is located on the rear end of the machine. The pressure relief valve is the main switch for the compressed air system.



Figur 43 (Pneumatic system)

5.5.2 Extruder system

See chapter 1.3 for references to the extruder system spare parts locations.

5.5.3 Motor Cables Z

The wiring to each motor consists of one encoder cable and one slightly thicker power cable. Both cables have an orange insulation with metallic couplings in each end for easy removal.

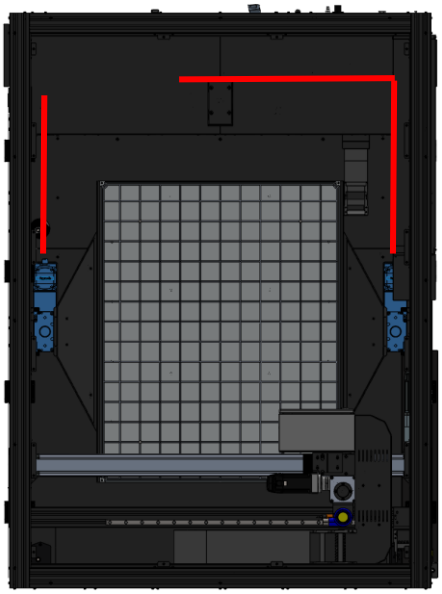


Figure 44

5.5.4 Motor Cables Y

The wiring to each motor consists of one encoder cable and one slightly thicker power cable. Both cables have an orange insulation with metallic couplings in each end for easy removal.

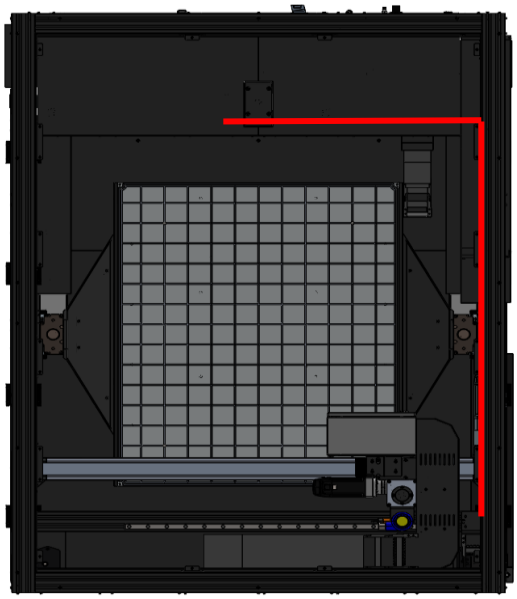


Figure 45

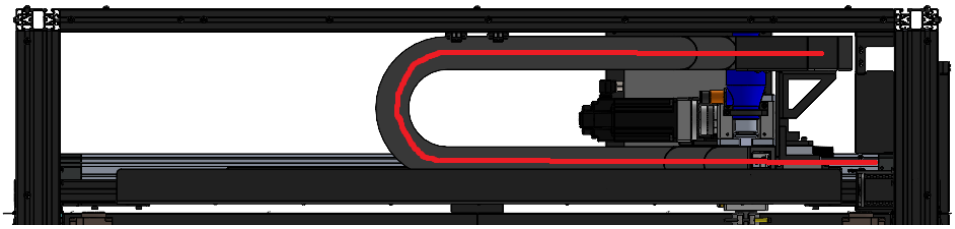


Figure 46

5.5.1 Motor Cables X

The encoder and power cable of the motor for the x-axis is above the electrical cabinet. The wiring to each motor consists of one encoder cable. and one slightly thicker power cable. Both cables have an orange insulation with metallic couplings in each end for easy removal.

5.5.2 Motor positions

All the motors in the machine are located according to figure 47.

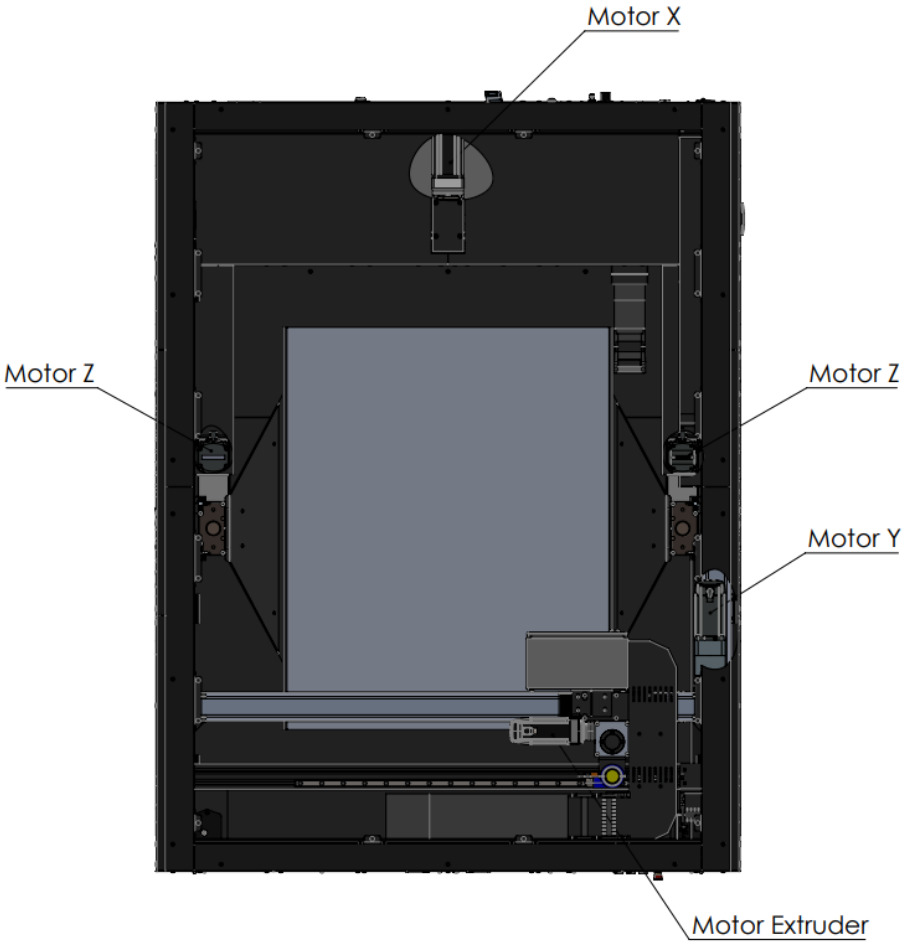


Figure 47

5.5.3 Gearbox positions

All the gearboxes in the machine are located according to figure 48.

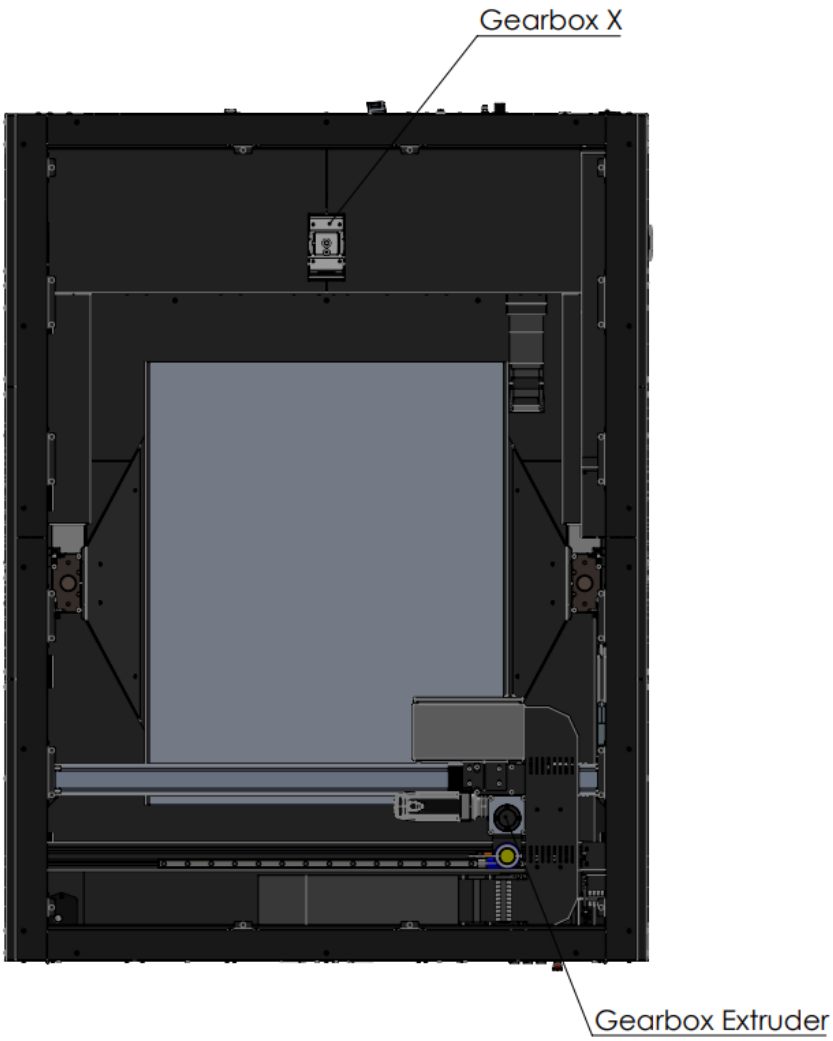


Figure 48

5.6 Directions for transport of the machine

The following steps must be taken before moving the machine:

- Make sure no loose items are inside the machine. E.g. print sheet.
- Move the extruder to the front corner of the machine.
- Attach the transportation plates to lock the X & Y axis. See fig 49.

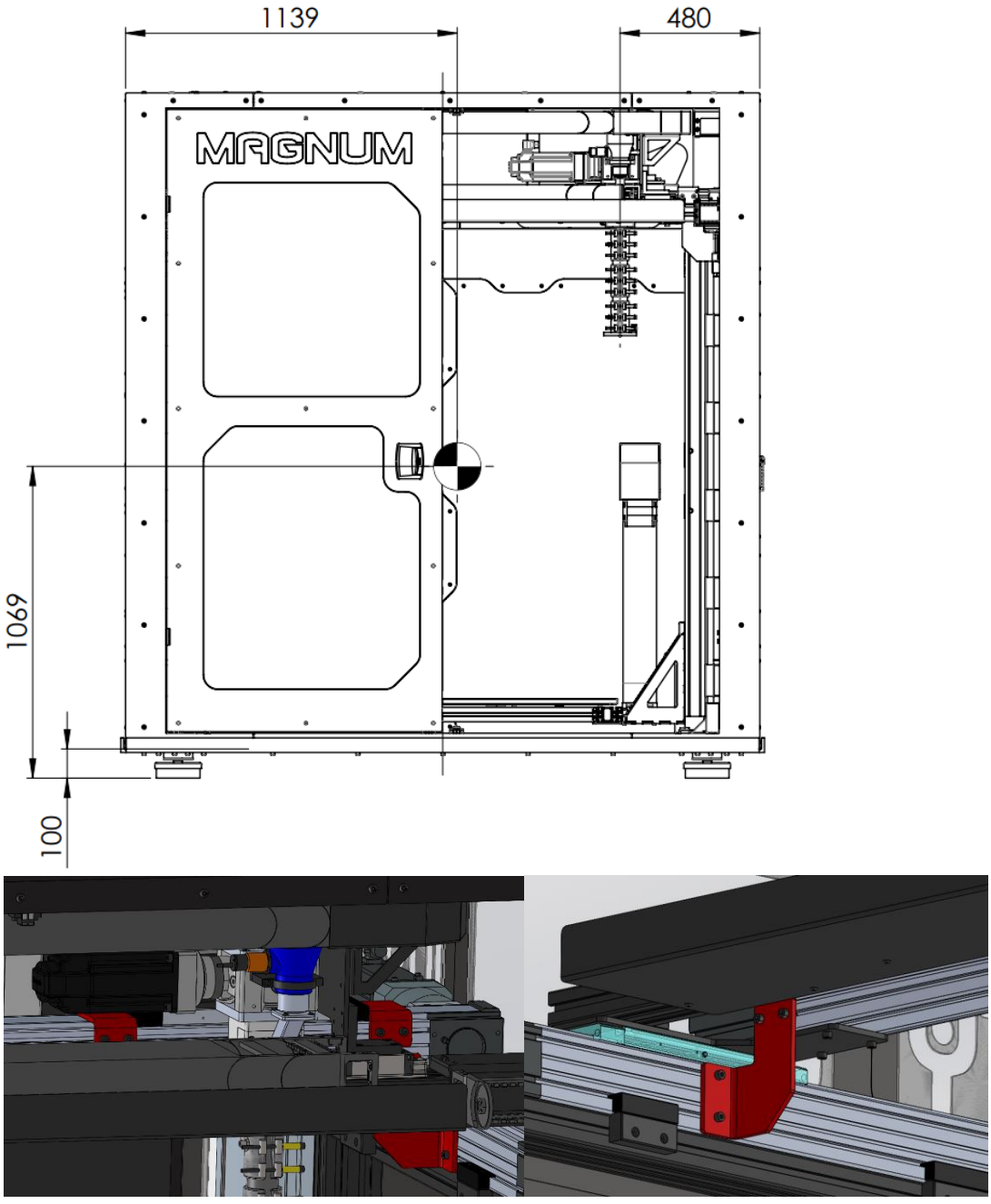


Figure 49

- Attach the transportation supports underneath to the machine frame, according to fig 50

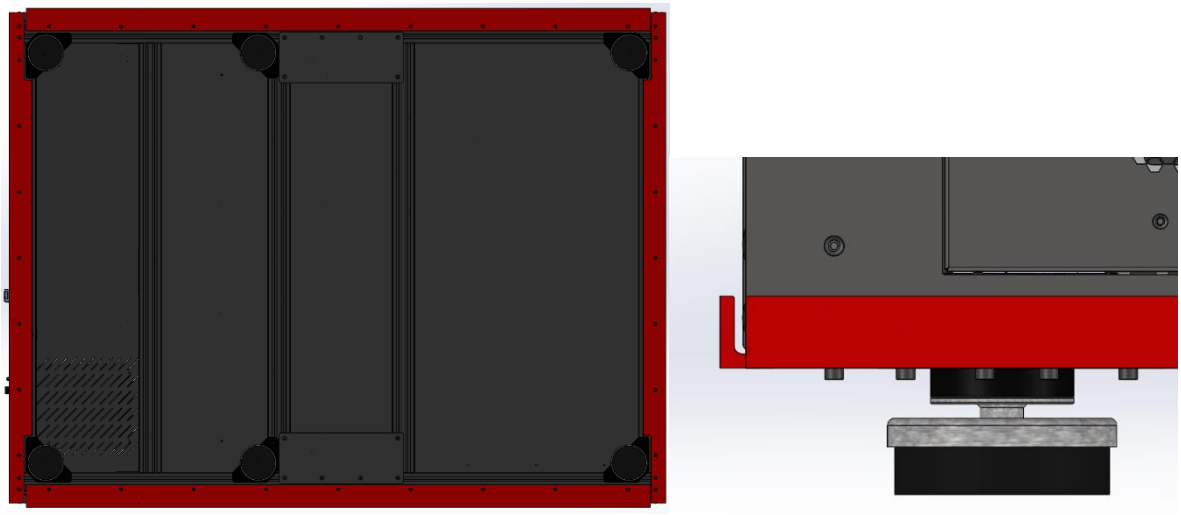
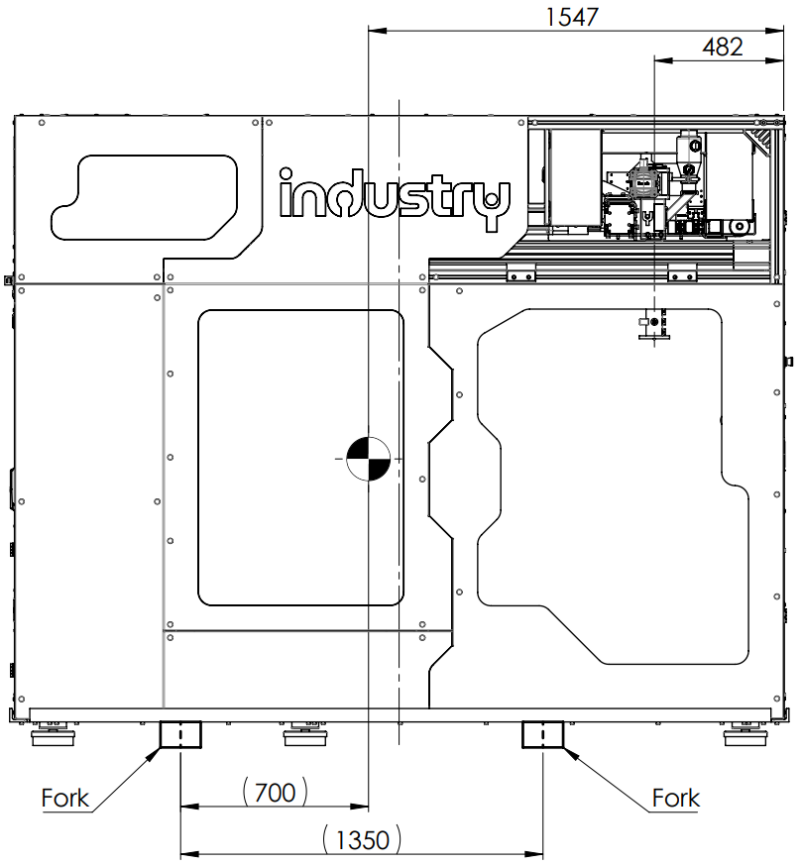


Figure 50

- Release the pressured air according to 4.7.1.3 point 4.
- Unplug the outlets for pressured air from the backside of the machine.
- Make sure the water-cooling unit is switched off.
- Unplug the electricity and secure the cable inside the machine or electrical cabinet.
- Disassemble the alarm tower.
- Use a forklift with fork length minimum 2.2 m and 2,5 ton lifting capacity.
- Lift the machine only in designated areas specified according to figure 51.
- Please note that the machine feet are loose. Place the machine feet under the axle of each machine foot before setting the Magnum down.



Figur 51

5.7 Directions for shutting down, disassembly and disposal

If the machine is considered worn out, it must be disassembled and its parts should be removed for recycling or destruction, according to current regulations.
Before disassembly, all power to the machine must be disconnected and secured. This means both electricity and pneumatics.
In situations in which lifting equipment is needed, the cargo must be first secured to avoid injury to material or personnel.

6 Camera

Download the software on the devices you want to be able to control the camera. Software Basler

Camera specifications you find here: Basler Camera

7 Manufacturer

The Industry Sweden AB (org nr. 559005-6627)
Hästskogatan 2
213 77 Malmö
Sweden

Support: contact@the-industry.se

8 Links to manuals of included products

Material inlet
Extruder / X-axis motor: MS2N06
Extruder / Y-Axis gearbox: NVH040S / NVS063S
Watercooling unit: HRS024-AF-20
Z-axis module: CKK-200-NN-1
Y-axis module: MKR-110-NN-3
Y-axis ball runner block: KWD-030-SLS-C0-N-1
Software Basler
Basler Camera: ACE 2 Pro
Multitouch display | Bosch Rexroth
Vacuum valve
Vacuum regulator: ITV1050-PRF2CS
Vacuum filter
Pressure relief vavle: VHS40-F04A
Filter regulator: AW40-F04DE-B