# "Baltic VET competition for smart growth"

# Training material for mobile laboratories

# What is Tehnobuss

Tehnobuss is a mobile training laboratory that visits general and vocational education institutions all over Latvia. The aim of the mobile training laboratory is to introduce school youth to modern technologies, educational and career opportunities in the field of machinery and metal working in a fun, practical way and facilitate interest in engineering in young people.

Quick video material about Tehnobuss.

Additional information can be found in Tehnobuss website: https://www.tehnobuss.lv/sakums

Information about career or practice in the field of machinery and metal working can be found here: https://www.masoc.lv/sludinajumi/darba-piedavajumi



Mobile training laboratory Tehnobuss

# 3D modeling and printing

## Working with 3D (CAD) applications

Using computers available in Tehnobuss equipped with modeling/sketching (CAD) applications such as Solidworks and Tinkercad, students can independently create simple and even advanced models for their own use.

Video material on the use of CAD application Tinkercad (English).

Video material on the use of CAD application Solidworks (English).

Site dedicated to CAD application Tinkercad.
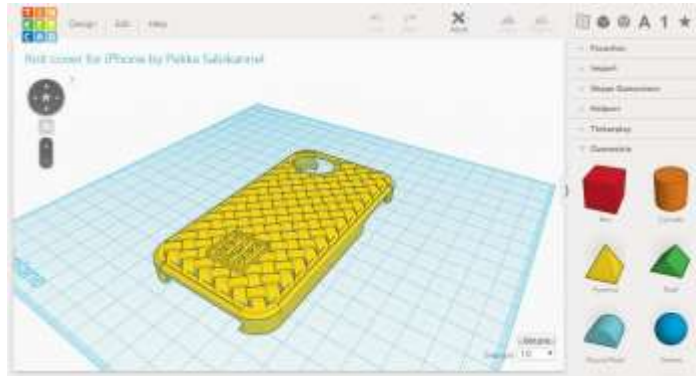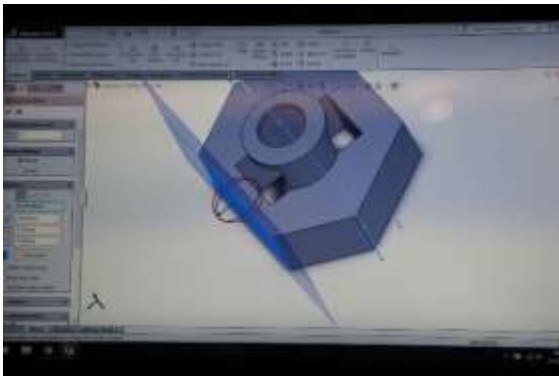


Modeling of spare parts in 3D (CAD) applications available in Tehnobuss

## 3D printer

The models created in the aforementioned sketching/modeling (CAD) application can be printed in Tehnobuss using a Mass Portal 3D printer that uses PLA wire as melting material. Students can use the application Simplify3D to prepare and process models/parts for 3D printing. Other applications can be used at the discretion of students as well.

Quick video material on the function of Mass Portal 3D printers.

Video material on the use of pre-processing software Simplify3D (English).

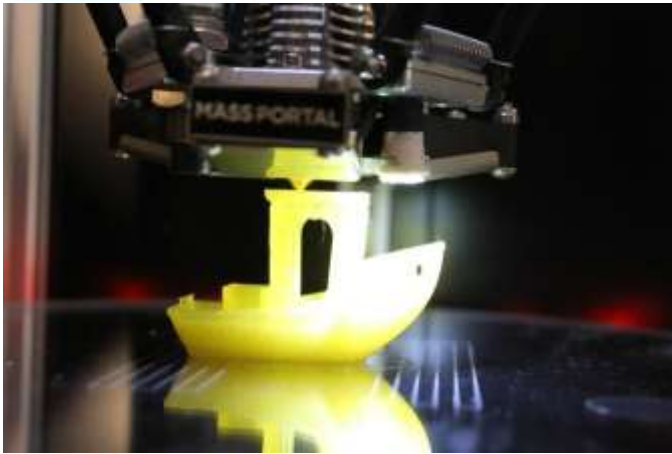Video material on the use of pre-processing software Simplify3D (English).

Printing of parts using a 3D printer in Tehnobuss

# Mechanics

### Gear mechanics stand

The gear mechanics stand in Tehnobuss can be used to facilitate both visual and practical understanding of the principles of mechanics and gears.

The rear part of the gear stand consists of magnets that can be used to attach gears to a steel plate and create various combinations with different turning directions, speed and torque values.

Video material (English) explaining the essence and necessity of gear ratios as well as their calculations.

Video material (English) where the most popular types of gears are explained and displayed.



Gear mechanics stand in Tehnobuss

### Generator stand

The generator (dynamo) stand in Tehnobuss can be used to understand how mechanical energy is converted to electrical energy, and how much force i.e. mechanical energy is necessary to produce a miniscule amount of electrical energy. This stand also helps understand the so called green means of energy production and provides both physical practice and logical thinking: students are encouraged to come up with ways to replace the arms of the person who operates the generator.

Video material showing how to create a generator at home that can be used to both power and charge electrical devices.

This video material (English) shares experience with both positive and negative aspects of dynamo generators.

Generator stand in Tehnobuss

# Welding

**Practical demonstrations in welding**

The ESAB MIG/MAG welding equipment, welding wire and protective gas in Tehnobuss can be used to try out various welding processes, and students can use steel pieces of 4mm thickness to weld a part of their choice or in accordance with a specific drawing.

Tehnobuss is equipped with a welding device, welding wire and protective gas, metal (steel) pieces, protective masks, special protective clothing and gloves for welding and a welding cabin with a steam suction device.

Video material about welding explaining the basics of MIG/MAG welding.

This video material (English) demonstrates various techniques to weld angled connections and T-connections in an MIG/MAG environment using a protective gas.

Site (English) with ideas for parts and objects that can be built using MIG/MAG welding equipment.

Welding demonstration in Tehnobuss

# FESTO pneumatics stand and FESTO model of automated production

The FESTO pneumatics stand and FESTO automated production model in Tehnobuss can be used to explain the essence of mechatronics and demonstrate its use in production and automation.

Tehnobuss is equipped with a pneumatics and sensor stand, tablet, parts of a pneumatic system: cylinders, sensors, tubes, electronic wires, buttons, programmable controller (PLC) and other parts. Therefore students can combine a mechatronic system that uses compressed air using specific or self-made diagrams.

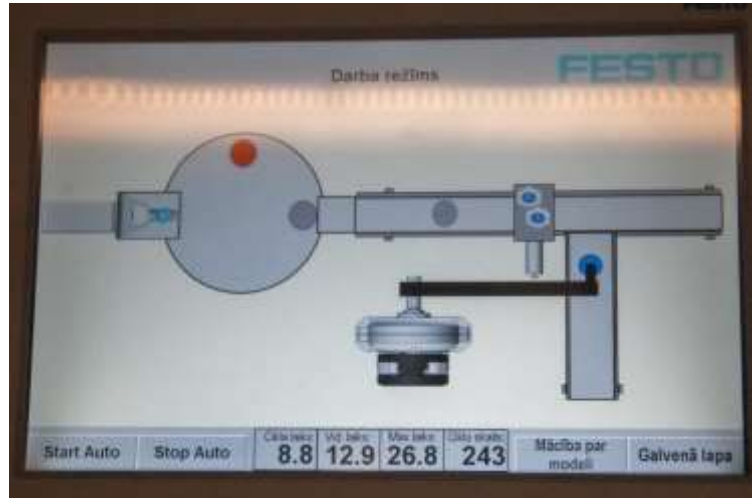Educational video material (English) on how to work with the application FESTO FluidSIM.

Video material on automated production lines created on the basis of mechatronics and welding.




FESTO pneumatics stand in Tehnobuss

FESTO automated production model in Tehnobuss

The WILL Sensor stand tablet can be used to combine a central heating system simulation based on several sensors; therefore the basics of central heating systems can be taught and understanding of the meaning and necessary use of various sensors can be built.

Video material (English) on a modern thermal power central (TPC) that uses wood chips.



WILL Sensor stand in Tehnobuss

# Processing with computer numerical control (CNC) workbenches

**G code creation**

The EMCO computer numerical control (CNC) workbench in Tehnobuss can be used with a self-made G code and prepared CAD models in the WinCam application. Students can prepare a simple mold on a piece's surface or to cut a small part from aluminum or plastic pieces.

Video material (English) on the basics of G and M codes.

Video material (English) that explains the coordinate system.



Building of G code in an EMCO computer numerical control (CNC) cutter in Tehnobuss

Video material with a part building sample in the WinCAM application.

Site (English) with ideas for parts and objects that can be built on computer numerical control (CNC) workbenches.

Site where you can download the computer simulation application CNC-SIMULATOR 4.53 for computer numerical control workbenches.

Creating a part on an EMCO computer numerical control (CNC) cutter workbench in Tehnobuss
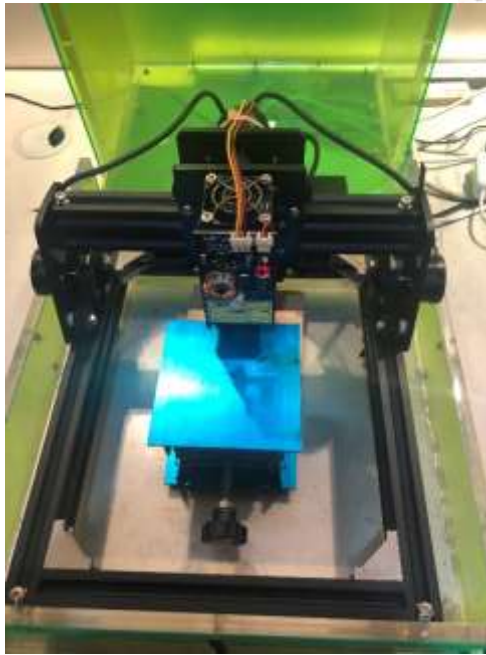
**Laser-cutting workbench**

A laser-cutting workbench ACAN A12 is available in the mobile training laboratory Tehnobuss. The available software can be used to cut necessary parts from paper or perform burning/engraving in veneer and plastic parts, as well as perform engraving in steel parts.

Video material (English) with a sample showing the operation of a laser-cutting/engraving workbench ACAN A12 and its associated application.

Video material (English) sharing creative ideas for work with laser-cutting/engraving workbenches.
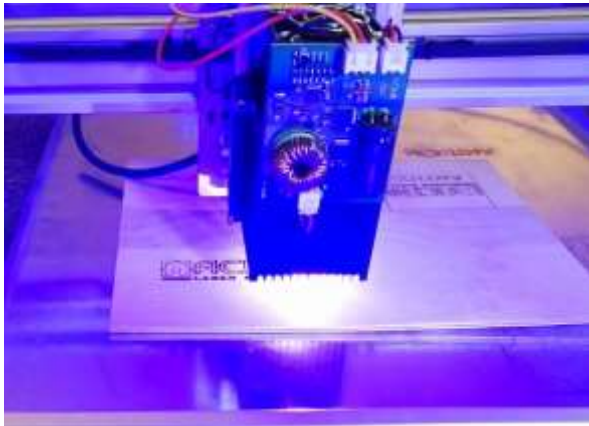
Laser-cutting workbench in Tehnobuss

# Programmable robot Alpha

Programmable robot Alpha 1 is available in the mobile training laboratory Tehnobuss. Using a special mobile application for iOS and Android devices, the robot can be programmed to perform specific movements, and thanks to 16 servo motors the movements can closely resemble human movements.

An interesting [video material](#) in English that explains how to create a 3D printed and Arduino processor-programmed robotic arm that can be operator via a mobile phone and a Bluetooth connection.

Programmable robot Alpha in Tehnobuss

# Welders (MAG) (20P)

1. Which weld is the most accurate? Give brief comments on each of them. (4P)
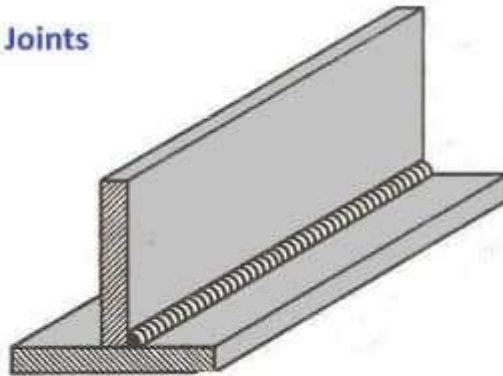


A       B       C

2. Practical task: using MIG/MAG welding equipment, weld two 4mm steel sheets together in a T-shaped joint (one plate is placed perpendicular to the other) (4P)



Tee Joints

3. What are top tree welding parameters to take into consideration when making a weld? (3P)

4. What effect could incorrect welding settings have on a weld bead? Give a brief explanation. (3P)

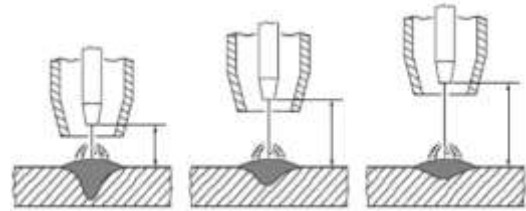5. What is the basic function/essence of shielding gases in welding processes? (2P)

6. The correct distance from nozzle to welding surface using flux cored wire is: (1P)

☐ 10 – 20 mm
☐ 15 – 20 mm
☐ 20 – 30 mm

7. One of the defects of welded joints is pores, explain how they are formed and how they do affect the weld? (3P)

# Mechanical technician (22P)

1. What are the advantages of hydraulics and pneumatics? What makes hydraulics superior to pneumatics? Give examples of where and why hydraulics and pneumatics are used. (4P)

2. Who needs automation and why? (3P)

3. Why do steel materials sometimes need the addition of alloys? Give examples. (3P)

4. Which measuring instrument is the most accurate to make control measurements, if one of the dimensions is specified in the drawing as follows $\varnothing 20^{+0,023}$ mm? (1P)

5. What method is shown in the picture? Give an example where it would be necessary to apply this method in practice. (3P)



6. Practical task – create a scheme initially in the Fluid SIM software, then assemble scheme on the Festo stand. (4P)
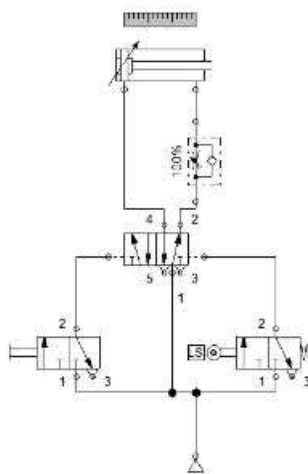
7. Practical task – take measurements with the relevant measuring instruments for a given part and create a 3D model in Solidworks software. (4P)

# CNC operator (14P)

1.      Name the cutting tool in the picture. (1P)



2.      List the advantages or disadvantages of a numerical control (CNC) machine compared to a manual machine. (3P)

3.      What does this symbol mean in a drawing ∨ ? (1P)

4.      Which way of cutting metal sheets with CNC control has the most accurate finish? (1P)

- ☐ Plasma cutting
- ☐ Laser cutting
- ☐ Hydroabrasive cutting
- ☐ Gas cutting

5.      Why is it important to follow the tolerances indicated in the drawing when manufacturing a part? (2P)

6.      What is the difference between G codes and M codes? (2P)

7.      What occupational safety measures should be followed when working with machines with numerical controls? (4P)