POPPE+POTTHOFF

Autofrettage system

Poppe + Potthoff Maschinenbau GmbH

Contents


Table for customer specific equipment
Window and possible access to the working area
System for development and prototype autofrettage
Panel-PC network-compatible
15,000 bar autofrettage pressure
High product variability
Easy access for maintenance

System features

The autofrettage system is used for research and development, as well as for prototype autofrettage. The product's versatility enables autofrettage of a wide range of components. For conversion, jigs can be exchanged.
The jig area can be easily accessed via a large door. A finished part can be removed and a new one inserted.
Autofrettage pressure can be flexibly programmed. The control panel is located on the right hand side at an ergonomic height. All relevant data is displayed to the operator.
The closing force of a clamping device is generated hydraulically and is controlled proportionally to the autofrettage pressure.

A pressure intensifier is used as a high-pressure generator for the autofrettage system.
The pressure intensifier is driven hydraulically via a proportional pressure control valve.
The high-pressure is the result of the transmission ratio on the high-pressure side.

The following steps are carried out

1. Insertion of the part into a jig
The part is manually inserted into the jig.

2. Closing of the protective door, closing of the sealing tips of the clamping device with minimum pressure
The protective door is closed. The sealing tips are moved towards the part and pre-tighten it.

3. Filling the system
The system is filled via a pressure pump. Here, the high-pressure medium is pressed out of the main tank up to the part.
The filling process ensures that there is not too much air in the system.

4. Positioning of the pressure intensifier
As the filling continues, the pressure intensifier is moved to its starting position.

5. Autofrettage pressure development with a proportional clamping force increase
The autofrettage pressure development is regulated up to max. 15,000 bar.
The pressure levels are freely programmable within the performance limits of the system.
To reduce the pressure, the pressure intensifier starts to move forward.

6. Dwell time and autofrettage
Once the pressure has been developed, the autofrettage is carried out. During the dwell time, the drive pressure is monitored and an error message is issued when the pressure undercuts a tolerance limit and the pressure is immediately reduced.

7. Pressure reduction
The pressure is reduced via the pressure generator in accordance with a pressure reduction linear value.

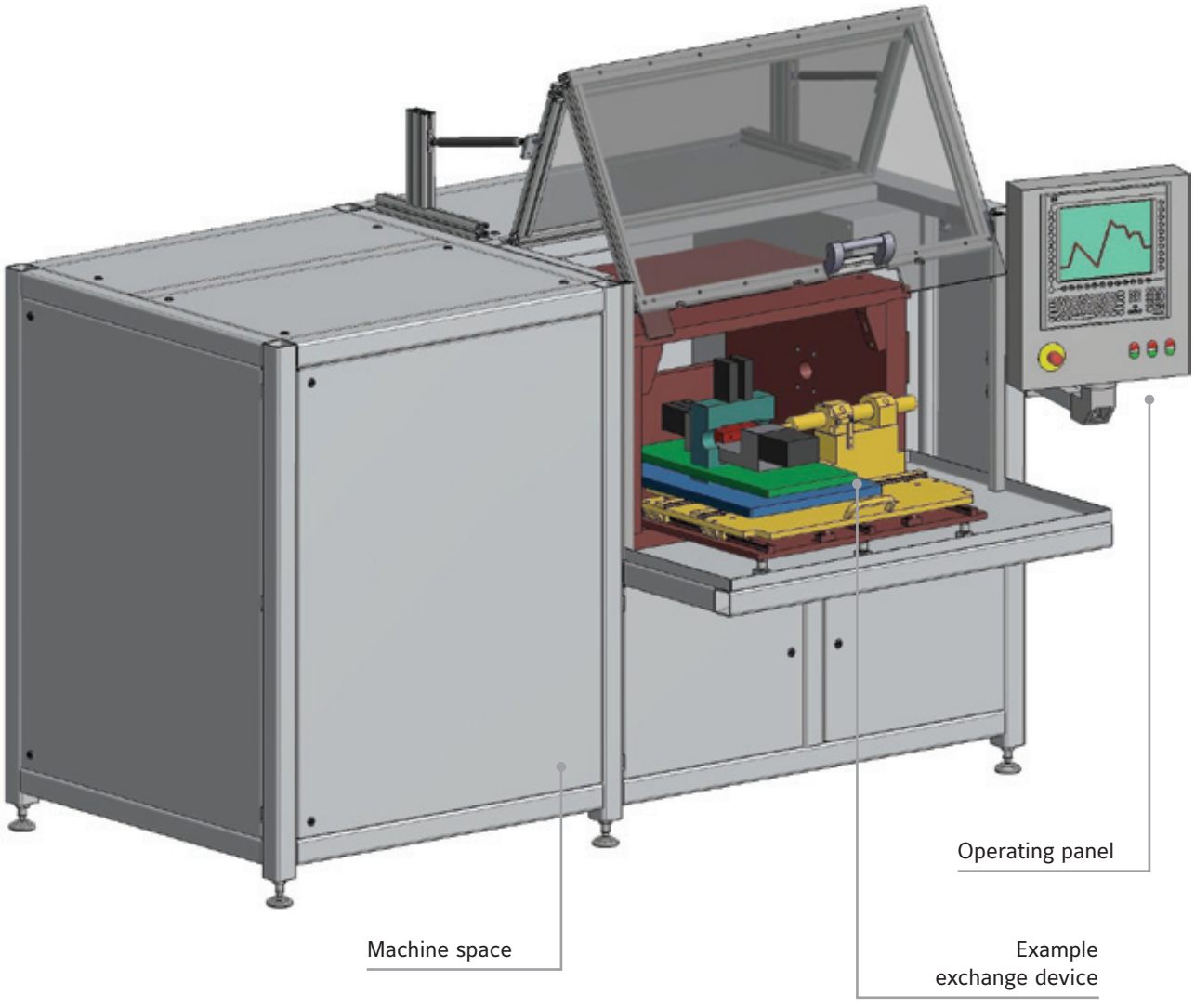
8. Opening of the sealing tips, opening of the protective door
In this program step, the sealing tips are automatically opened, the protective door is opened.

9. Removal of part
The operator removes the part manually.

Structure of the system

The test system comprises two assemblies that are combined into one compact unit.

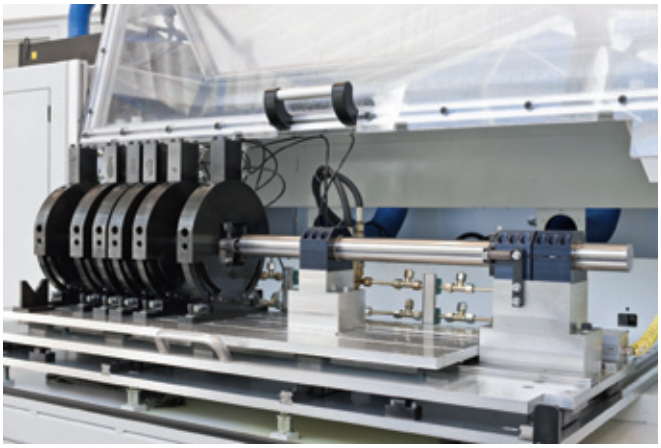
- The pressure generation and the electro switch cabinet are installed on the left-hand side. The right-hand side is designed as a test space.
- All operating elements are positioned ergonomically on the operator side.
- The basic casing is made of steel.
- The casing is a stable, low-vibration frame construction. The welded construction stands on feet so that there is enough clearance to the floor to allow it to be transported via a fork-lift truck. The frame is closed with cassette trays.
- All cladding elements can be easily removed for maintenance work. Many areas can be reached easily via the doors.
- Oil-proof leak collection wells are welded into the base of the frame groups.
- There is a protection chamber on the right-hand side of the casing.
- The entire floor is designed as a drain pan.
- The universal test piece connection is located on the left-hand side inside the chamber. An adapter can be used with this connection to allow it to accommodate the various test pieces.
- There is an automatic protective door installed in front of the chamber.
- A protective transparent screen in the protective door allows the test piece to be observed.
- The protective door cannot be opened during the autofrettage because it is locked mechanically via the safety switch.
- The pressure intensifier is installed horizontally on the left-hand side.
- The machine room of the device houses the media supply and the hydraulic supply.
- The electro switch cabinet is attached on the right-hand side.
- Any oil mist inside the autofrettage chamber is extracted via an oil mist filter.



Device with tension clamps included in delivery

All the tension clamps are mounted to one device support plate. To allow the rail to be placed into the device, the entire device plate is moved out of the operative area.

The rail can be pushed into the device's clamps lengthwise. If the device has a rail, the device supporting plate is inserted until the rail is between the centering tips. The left-hand centering tip is located directly at the outlet of the pressure intensifier which is positioned directly next to the rail.



Device is extended

Pressure intensifier

The pressure intensifier comprises a **drive part** and a **high-pressure part.** The hydraulically driven pressure intensifier is also the media separator.

Drive part
The pressure intensifier is driven via the linear drive part. It is designed as a hydraulic cylinder. The components are the piston rod with a piston and cylinder pipe with a cylinder base and cylinder lid. A position sensor is connected to the piston. The displacement transducer supplies the data about the position of the pressure intensifier. The hydraulic pressure is supplied via the cylinder base.

High-pressure part
The high-pressure is created in the high-pressure part of the pressure intensifier. The actual pressure is measured up to 15,000 bar in the high-pressure circuit. It is controlled via a proportional valve. The piston position of the pressure intensifier is recorded using a position sensor. The stroke width and stroke speed are monitored when the pressure is being built up.

Oil hydraulics

The aggregate has a compact design with the following elements:

- An oil tank made of steel with an effective volume of approx. 200 litres incl. a cleaning lid. The tank has level and temperature measuring devices.
- The hydraulic pressure is generated via an adjustable radial piston pump.
- The pump has a safety valve.
- The pump is driven using a 10 to 15 kW electromotor with 1500 rpm, mains voltage of 400 v / 50 hz.
- The pump motor assembly is equipped with vibration dampers.
- There is a pressure accumulator with 2 or 4 l volume in the pressure line. It has an accumulator safety and locking block with electrical relief.
- The operating media is cooled and filtered via an internal cooling / filter circuit. The water side has stopcocks, a coarse filter and an electrical water valve. The oil hydraulic filtering takes place with a 10 µ filter and has an electrical soiling display.
- All parts are easily accessible for servicing.
- All pipes have cutting ring connections.
- Signs: position numbers on light aluminium with black writing

A collection tray is mounted below the oil tank of the hydraulic system. This collection tray is monitored by leak sensors. In the event of a leak, the hydraulic system is shut down.

Main tank

The main tank is made of stainless steel. A sight glass allows the filling level to be checked. A level switch controls the level in the tank. If the minimum level is undercut, the system is shut down.
A collection tray is mounted below the tank. This collection tray is monitored by leak sensors. In the event of a leak, the system is shut down.

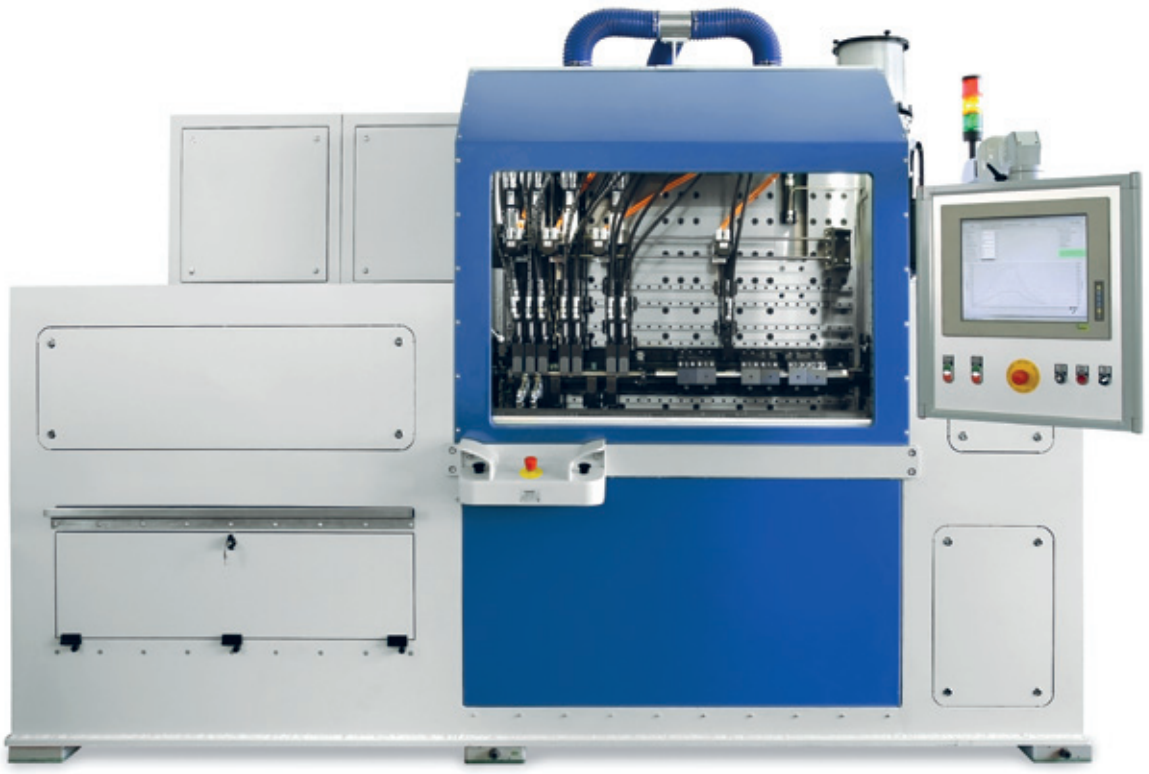
The pressure intensifier and the pipeline system are filled with the filling pump.
This pumps the medium through a fine filter of 10 µ to ensure the purity of the testing medium.
The low-pressure circuit reaches the high-pressure circuit via a non-return valve. The low-pressure circuit is protected by a safety valve.

Return flow collection tank

The high-pressure oil that flows back during the emptying process is fed into the return flow collection tank. The collection tank is made of stainless steel. A sight glass allows the filling level to be checked.A level switch controls the level in the tank.

The lower switch point switches the return pump on. If a maximum filling quantity is exceeded, the upper switching point switches the system off.

The return pump pumps the oil back into the main tank via the 20 µ filter. This ensures that only filtered oil reaches the main tank. A collection tray is mounted below the tank. This collection tray is monitored by leak sensors.



Serial Autofrettage for production

Electronic and electrical system

Electro-system

- The power electrics and the SPS are fitted in a switch cabinet with the protection class IP 65.
- The master switch for the system is mounted in the door of the switch cabinet.
- The power supply is connected directly in the switch cabinet.
- The entire electro system is secured with the required fuses.
- The connected components are wired using terminal strips. The control voltage of the parts is 24 VDC and a pre-fuse is installed for each user.
- Electro-motors over 5 kW are installed with a star/triangle start-up switch. Every electromotor is equipped with an overload fuse.
- The electro-system is designed in compliance with the current regulations and guidelines.
- For optimized operation, the function keys, such as the Control system On/Off , Autofrettage On/Off , EMERGENCY OFF and a PC are mounted in the operating field.
- The system bears the CE symbol.
- The cables are installed in cable ducts.
- The electro system cab be expanded.

Control system

A SIEMENS programmable logic controller is used to control the system. The SPS is connected to the PC and the components of the individual assemblies. All control activities are carried out via the SPS. All operating statuses of the system are processed by the SPS. Error messages are issued in plain text via the screen.

The electrical control system comprises:

- SPS
- Operating elements such as keys, switch etc.
- Emergency-off switch
- PC, operating interface

Operating field

To the right of the testing chamber is the operating panel with the operating field. The switch panel contains all the operating and display elements.

Entries are made via the panel PC.

Operating elements

- Input via PC (panel PC)
- Socket for network connection and USB connection
- Service socket
- Master switch
- On/Off key: Control system
- On/Off key: Testing
- Pushbutton: Emergency off

Operating software

The operating software serves to display the autofrettage process and also acts as a user interface. It contains various forms as well as input/output templates that are used to enter parameters, machine parameters and protocol data. Also, the results of a process can be saved.
The autofrettage process is depicted graphically.

Software with a graphic user interface is used. This software is developed at our company on the basis of the programming language G (Labview).

When the power supply is switched on at the master switch, the panel PC starts up. After the start of the operating system, the operating software starts the machine.
To start the test stand, the control system is switched on; the lamp on the key is illuminated for control purposes.
Instead of the usual mouse operation, the graphic user interface is operated via the touchscreen.

After the start of the program, a screen appears from which the most important components of the program can be reached.

The operating elements of the software have the following functions:

- Pull-down menu

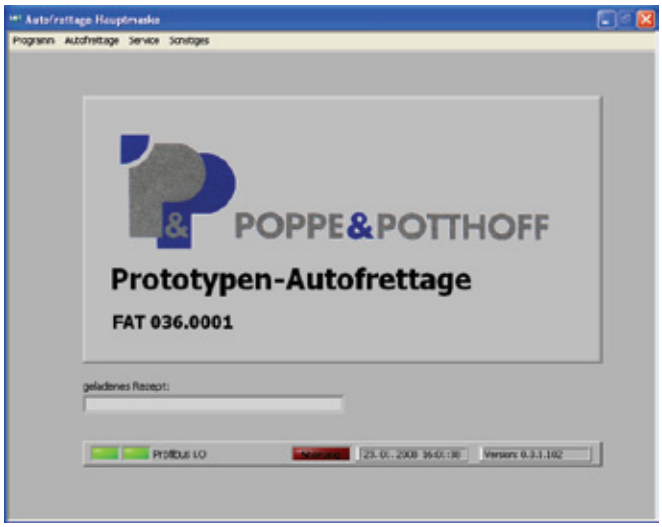
- Button locks into position with display

- Button is pressed

Operating process

The main window of the application is shown after the test stand software has started.

The functions are subdivided into various forms to structure the functions of the operating software; these can be reached via the menu items of the main menu:



The menu item “Autofrettage” contains the menu items:

- Program parameters: creation of autofrettage programs
- Run: carrying out of an autofrettage process and recording

The following forms are password protected and can only be opened with the passwords saved on the form “Passwords”:

- Form “Program parameters”
- Form “Service”
- Form “System values”
- Form “Passwords”

The “Program parameters” form is used to create the autofrettage parameters for the various test pieces.

The program parameters are saved with the text entered into the field “Title of the recipe”.

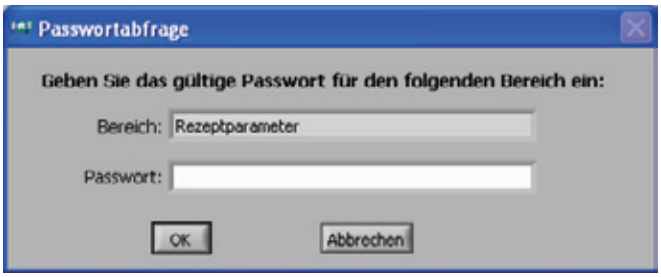
The type number of the rail is entered into the field “Rail type”.

The autofrettage pressure is entered into the field “Autofrettage pressure”.

The dwell time is entered into the field “Dwell time”.
The value entered into the field “Pre-clamping pressure radial” states with what pressure the radial closing cylinder holds the rail after it has been placed into the clamping device so that the clamping table can be moved into the autofrettage position (standard value 8 bar)

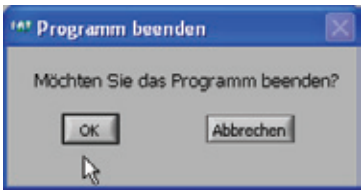
The menu item “Other” contains the following menu items:

- Malfunctions: Displays the current malfunctions
- Message protocols: Displays the past malfunctions
- Passwords: Manages the passwords of the protected areas of the program



The program window can be closed via the menu item “Close program”.

A safety question before the closing process prevents unintentional closing of the program window.



Technical data

Max. number per autofrettage	1
Conditions and tolerances **Max. autofrettage pressure**	p_{max} = 15,000 bar
Pumps **Pressure range max.** **Pressure intensifier**	Pumps 1,000 bar 15,000 bar
Pressure transducer	0–15,000 bar class 0.5
Working temperature	Room temperature
Max. media temperature	+50 °C
Testing medium	High-pressure liquid
Filling quantity of the media tank	80 l
Dimensions of test stand **Size W × D × H**	 approx.: 3000 × 1400 × 2200 mm
Colour	PPM Design
Total mass	approx. 10,000 kg
Device **Size W × D × H** **Material** **Viewing window**	 1400 × 900 × 400 mm Steel Safety glass 12 mm
Operating device **Panel-PC with touchscreen** **Operating keys**	 12.1“ screen Emergency-off, control system. filling, testing, lighting
Electro connection	400 V, 50 Hz, 32 A, 15 kW
Control voltage	24 VDC
Compressed air connection G 1/2“ inside **p_{min}** **p_{max}**	 6 bar 10 bar
Hydraulic oil (depends on supplier)	Hydraulic oil ISO VG 46 DIN 51519
Cooling water	max. 20 °C Q_{max}=30 l/min

Safety equipment

Extensive safety equipment allows the system to be run without constant supervision.

Nonconforming functions are reported to the control system. Malfunctions that could pose a threat to the operating staff or the system itself lead to immediate shutdown.
When the system is shutdown, all necessary system parts are depressurised.

Information

Water quality

Ph-value between 7 and 8.5
Carbonate hardness 6 to 15° dH
Chloride <100 mg/l
with corrosion additive

Power supply

Rated voltage 230/400 V +6 %/-10 %
Frequency 48 to 52 Hz

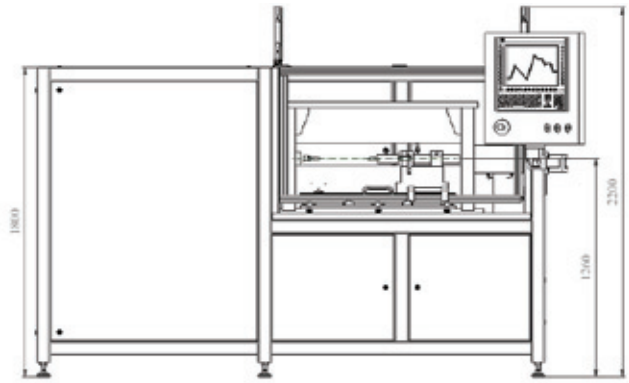
Ambient temperature

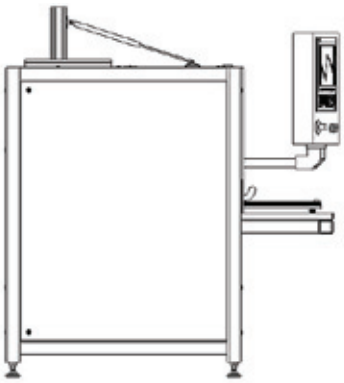
Temperature: 4 to 40°C
Average annual humidity: 75 %
Switch cabinet: IP44

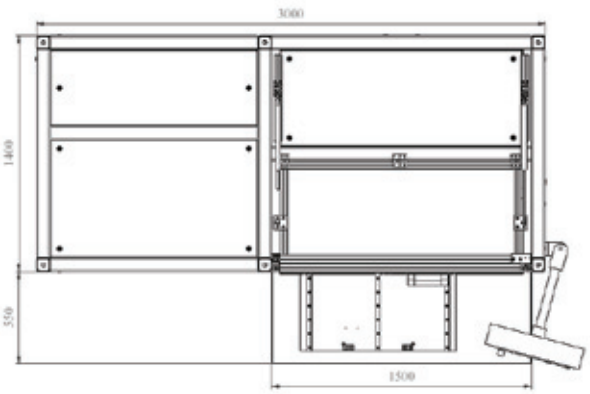
Copyright

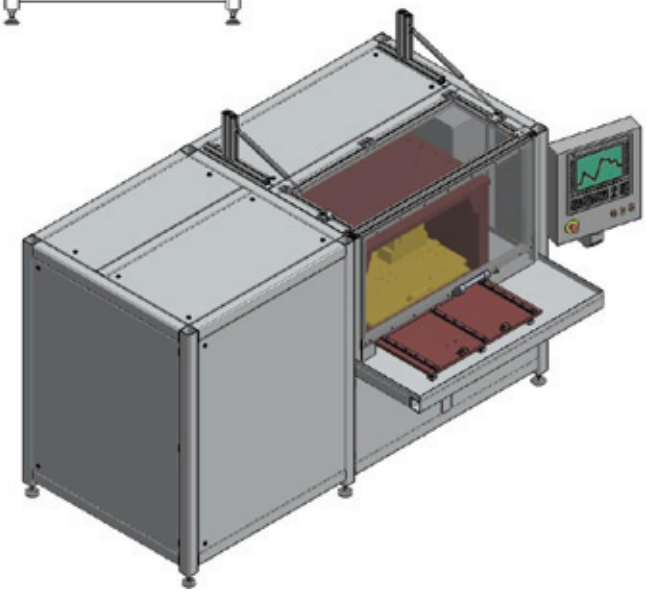
Drawings

Drawings and circuit diagrams are not binding and may change during the design phase.









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