

# PAL 3001

Electronic measuring device  
for determining the machine capability  
of crimping presses

## Operation Manual

English  
Version 2.1.11



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## Content

1	Safety Regulations for Electrical Machines in Industrial Use	3
2	Function of the equipment	4
3	Intended use	5
4	Technical specification	5
5	Scope of delivery	6
6	Packing	6
7	Transportation	6
8	Storing	6
9	Set up	6
10	Maintenance	7
11	Starting up	7
11.1	Parts, accessories and operating controls	7
11.2	Preparation works	8
12	Perform a press capability test	9
12.1	Slow Motion Test	9
12.2	Fine tuning of the press with 8 kN load	13
12.3	Preparation of a press analysis	17
12.3.1	Press is not yet in the memory of the PAL	18
12.3.2	Press is already in the memory of the PAL	20
12.3.3	Saving of a completed measurement	22
12.3.4	Performing another test on the same press (retest)	23
12.3.5	Performing a measurement with automatic press start	23
13	The PAL PC software	25
13.1	Explanation of the pictograms (mouse click areas)	25
13.1.1	Left side of the toolbar	25
13.1.2	Right side of the toolbar (Device Control bar)	32
13.1.3	Menu bar with drop-down menus	37
13.2	Working view in PAL PC software	42
13.2.1	Bar chart	42
13.2.2	Measurement curves and statistical values	43
14	Test documents	47
14.1	Header	48
14.2	Right column	48
14.3	Footer on the left side	49
14.4	Footer on the right side	49
14.5	Document templates	49
14.5.1	Bar chart	49
14.5.2	Curve chart	50
14.5.3	Number chart	50
14.5.4	Normal distribution	51
15	Calculation of the statistical values	51
16	Testing external crimp monitors	53

## Impress

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No liability for errors and omissions in contents and printing. This manual is not exhaustive.

Specifications are subject to change for product improvement without notice.

All used company labels are accepted.

**Please study this handbook carefully before initial use of the equipment. Keep this handbook at the working place, where you can easily find it and hand it over with the equipment to other persons.**

## 1 Safety Regulations for Electrical Machines in Industrial Use



### Danger


Electrical machines are equipment for use in industrial plants. During operation of the machine dangers may arise through rotating parts and/or high voltage.

In case of improper use of the machine during commissioning, operation and maintenance **severe injuries to persons and damage of property** may arise. The machine may only be used under the provisions stated in the instruction manual, additionally the local working conditions should be considered.



### Warning

- Transportation, installation, commissioning, electrical connection, operation and maintenance may only be carried out by authorized and qualified specialist staff.
- Knowledge of the regulations for the prevention of industrial accidents and first aid measures is a prerequisite for safe and trouble-free operation of this system.
- This instruction manual contains the most important notes for operation of the system in accordance with safety requirements.
- This instruction manual and especially the safety notes contained herein must be observed by all the persons working with the system.
- Knowledge of and compliance with the general accident prevention regulations and first aid measures are required for safe and trouble-free use of the unit.
- All safety and warning instructions in the operating instructions must be strictly observed.
- All claims for compensation in case of damage to property or personal injury are excluded, especially if one of the following causes is responsible for it:
  - The equipment was not used according to the intended purpose.
  - Improper installation, commissioning, operation, and maintenance of the equipment.
  - Operation of the equipment with defective safety devices or with improperly mounted or non-functional safety and protection devices.
  - Non-observance of the information in the operating instructions concerning installation, commissioning, operation and maintenance of the equipment.
  - Unauthorized modifications of the equipment.
  - Repair work performed by unauthorized personnel.
  - Events caused by the effect of foreign bodies and force majeure.
  - Repair work using non-original spare parts


	<p><b>Attention!</b></p> <p>Intended use also includes:</p> <ul style="list-style-type: none"> <li>• Observance of all information in the operating instructions.</li> <li>• Observance and execution of all inspection and maintenance measures.</li> </ul> <p><b>Non-observance is a safety risk!</b></p>
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### Hotline

In case of breakdown of the machine or in case of danger please call our service hotline :

Tel. +49 (0) 8554 94 23 9-0, Fax + 49 (0) 8554 94 23 9-20, eMail [info@cable-tec.net](mailto:info@cable-tec.net)

	<p>Please be aware that the Press Analyser PAL 3001 is a high precision gauge. Handle it with care and provide a clean working environment.</p>
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## 2 Function of the equipment

The Press Analyser PAL 3001 is an electronic measurement device to perform a machine capability check of crimp presses with “mini applicator” standard. During the evaluation, the exact quality condition of the crimping machine will be determined and reported by the calculation of a specific machine capability index (CMK index). Built-in highly sensitive sensor technology is used to evaluate the measurands length and force exactly in micrometer or newton. Even slightest deviations of the press accuracy can be detected due to the precise sensors.

During the measurement, the crimping press is loaded by the PAL 3001 with a constant counterforce of 8kN. The precisely measured values are transmitted to a PC (laptop) during the press test and processed there by the PAL PC software. For further processing, the data is entered into a diagram. Then they are statistically evaluated and presented with selectable document templates.

Additionally, the PAL 3001 can be used as a height setting gauge. In contrast, conventional static dial gauges the PAL 3001 allows to determine the difference between the ideal and the actual shut height very comfortably in an automatic process.

The PAL PC software can also record and evaluate the measurement curves of the installed crimp force monitor during the capability test of the press, so that the capability of the crimp monitor is thus also included in the test. This is possible if the manufacturer of the crimp monitor was willing to disclose the interface to the monitor.

Of course, before delivery the PAL 3001 itself is calibrated with high quality measuring gauges which are released by a calibration laboratory accredited by the German Accreditation Body (DAkkS) to examine crimp presses with “mini applicator” standard. The calibration should be repeated yearly.


### 3 Intended use

The PAL 3001 has been developed for examining crimp presses of “mini applicator type”. Usually, such a press has a maximum press force of approx. 25kN. The PAL 4000 can be loaded up to this force level without any risk of damages. Exceptionally, also larger crimping presses can be tested with the PAL 4000. But in this case special attention must be paid that the PAL won't be damaged because of the high load.

The requirements for temperature and humidity have to be carefully observed. Ignoring these rules can cause accidents or damages. Other use as described in this manual is not allowed and can lead to the loss of warranty claims and liability exclusion of the supplier. Any unauthorized modification of the equipment carried out by user will invalidate the manufacturer's liability to any resulting damage or injury to personnel. This statement also applies for any changes or conversions of the device.

### 4 Technical specification

Type	PAL 3001
Power supply charger	115 – 230 V AC to 18 V DC
Power supply	Battery pack with 10 x Ni-MH batteries, 1.2 V, 2000 mAh (only rechargeable batteries*), size AA
Battery capacity after full load	approx. 3 hours
Counterforce	0 / 1.5 / 4 / 8 / 12 kN
Maximum measurable load	20 kN
Resolution height sensor	1.0 µm
Measuring path height sensor	optimum shut height ± 250 µm
Resolution force sensor at 8 kN	25 N
Calibrated shut height	135.780 mm
Relay output press start	Floating change-over contact up to 50 V AC/DC
Interface	RS232
Recommended room temperature	22°C +/- 5°
Protection class (against foreign substances)	IP 44
Dimensions (W x D x H)	100 mm x 140 mm x 140 mm
Weight	4.4 kg

	<p><b>Danger!</b></p> <p>*Please use only <b>rechargeable batteries*</b> (1.2V nominal voltage).          Never insert alkaline batteries (1.5V nominal voltage, <b>non-rechargeable</b>)!          There is a considerable risk of fire when charging alkaline batteries,          substantial damage to persons and devices cannot be excluded!</p>
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## 5 Scope of delivery

Standard delivery must include:

- Case for transport and storing
- Main unit Press Analyser PAL 3001
- RS232 interface cable (connection PAL 3001 to PC), length 2 m
- Adapter USB 2.0 to 2 x RS232
- Relay box for automatic press triggering
- Sharpening stone
- Slide feed
- Power supply unit 18 VDC with adaptor kit, primary voltage: 100 – 240 VDC
- Serial interface cable RS 232, length 3m
- CD with PAL PC software in the document compartment
- Calibration certificates in the document compartment
- Operation manual

## 6 Packing

The device is packed in a special transportation packing. Please re-use this package again or recycle it according to your local rules.

## 7 Transportation

The transportation of the unit must be free of vibration and shock. The normal packaging is not seaworthy and cannot be used for water carriage. The packing does not protect against wet conditions. Tumbling of the unit during transportation is not allowed. Handle with care! Throwing or falling down of the packed unit can cause damages or total demolition.

## 8 Storing

The PAL 3001 has to be stored in a dry and well-tempered room. The optimum storage temperature is at 20°C. Too high humidity can cause corrosion on important precision parts.

## 9 Set up

The Press Analyser PAL 3001 is intended for the check of crimping presses. For the test, the device must be installed and firmly fixed in the press. Safety devices of the press must never be put out of operation for the press inspection. The Press Analyser has to be set up in a dry, dust free and well-tempered room. It must be protected from improper environment conditions like high or low temperature, direct sun light, vibrations and other mechanical influences, electromagnetic or magnetic fields, humidity or dust.

If any defects, improper functions, damages or problems occur, which cannot be solved by the instructions in this handbook, please set the device out of operation and contact C-tec for support.

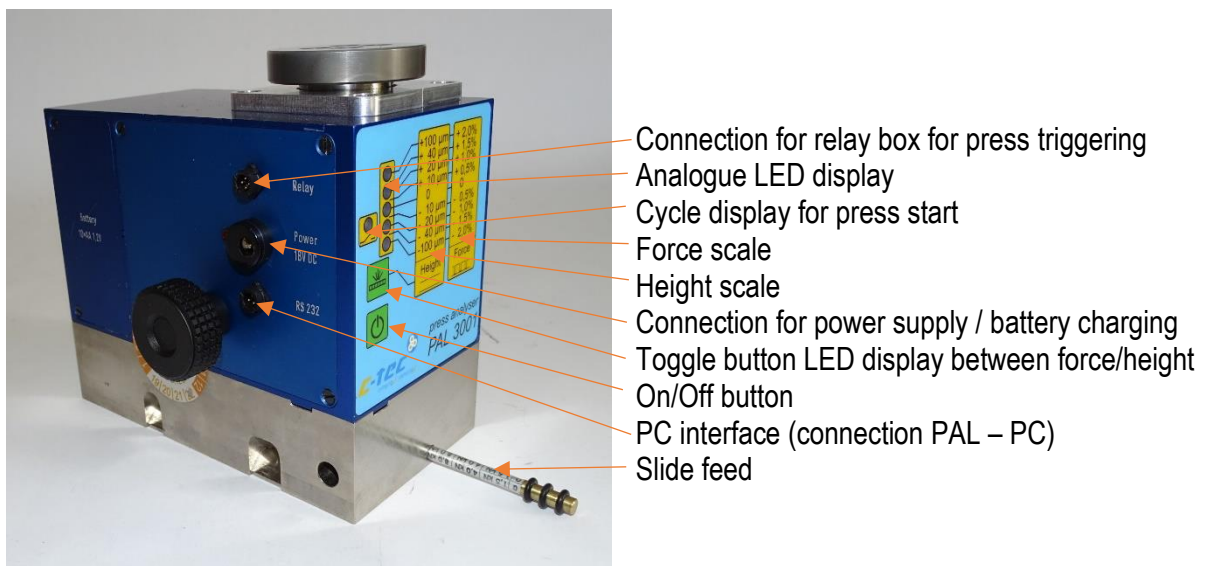
**DANGER TO LIFE:** Never put safety devices of the crimping press out of operation. Please work only with closed protection covers.

## 10 Maintenance

The PAL 3001 requires no maintenance from the user. After the maintenance cycles have expired (can be read in the PAL PC programme) or after one year of operation, the Press Analyser should be sent back to C-tec for inspection and re-calibration.

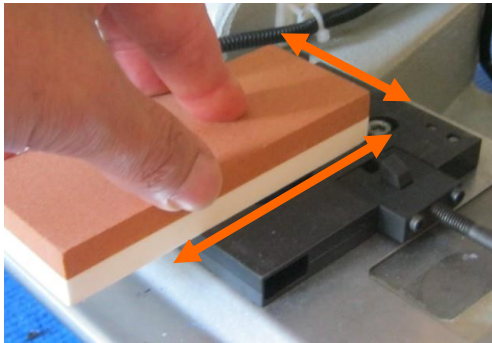
## 11 Starting up

### 11.1 Parts, accessories and operating controls



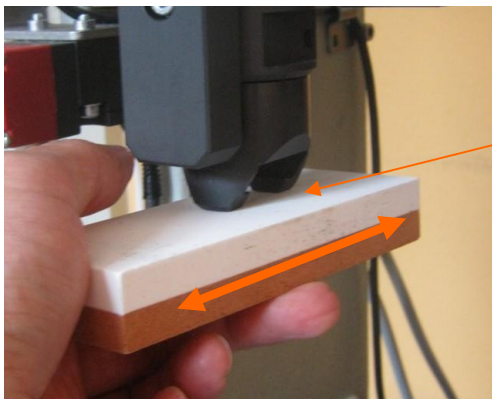


## 11.2 Preparation works



First clean the surface of the base plate with the sharpening stone and possibly sand out imperfections. Remove the grinding dust from the plate with a cloth.

**Note:** If the base plate is damaged too heavily, it must be replaced.

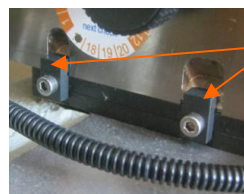


Clean the surface of the pressure piece at the ram in the same way by using the sharpening stone

**Note:** If the pressure piece is damaged too heavily, it must be replaced.



Now set up the PAL 3001 in the press and fix it there.



**Attention:** Both of the firm prisms must equally enter the PAL body.

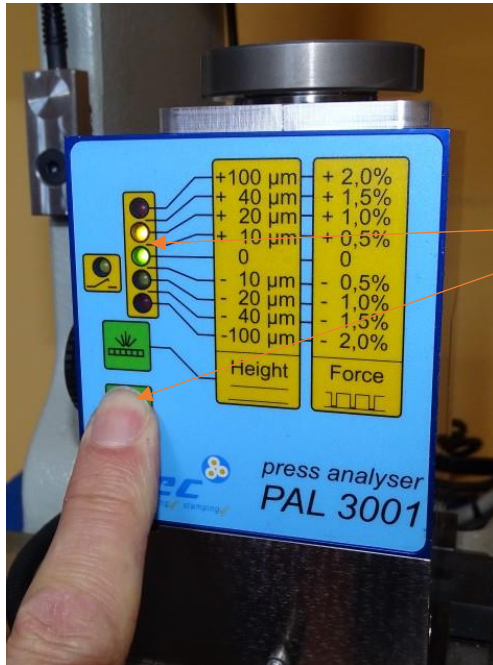


Fix the Press Analyser with the movable clamping claw like a crimping tool.



## 12 Perform a press capability test

### 12.1 Slow Motion Test



Press and hold the ON/OFF button until the two LEDs light up green and yellow.

**Note:** If the unit is not used for more than 10 minutes (no key pressed, no measured curves, or no contact with the PC programme) it switches off automatically.



Push the slide feed inwards as far as it will go (position 0). The PAL 3001 is now set to forceless and thus does not transmit any counterforce to the press.

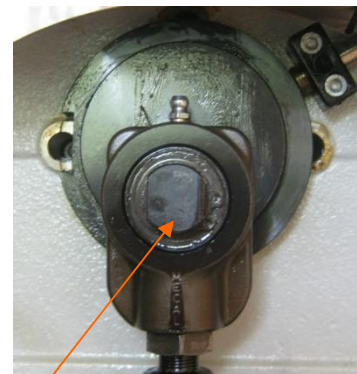


After the slide feed has been set to 0 N, the top red LED starts to light up continuously, signalling that the PAL 3001 is now switched to "Slow Motion" mode.

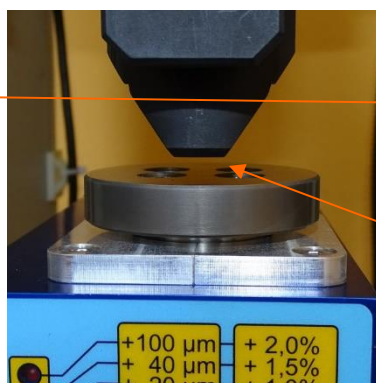
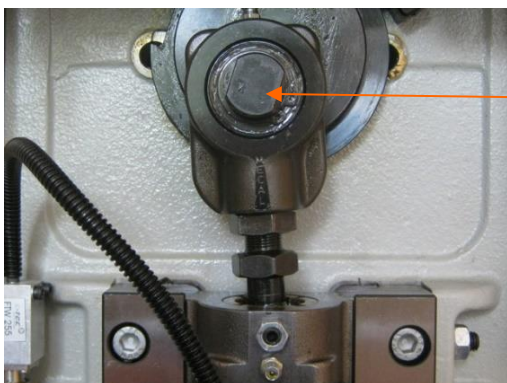
This operating mode allows a rough pre-setting of the shut height of the crimping press. This is to prevent damage to the unit or the press if the press is set too low.



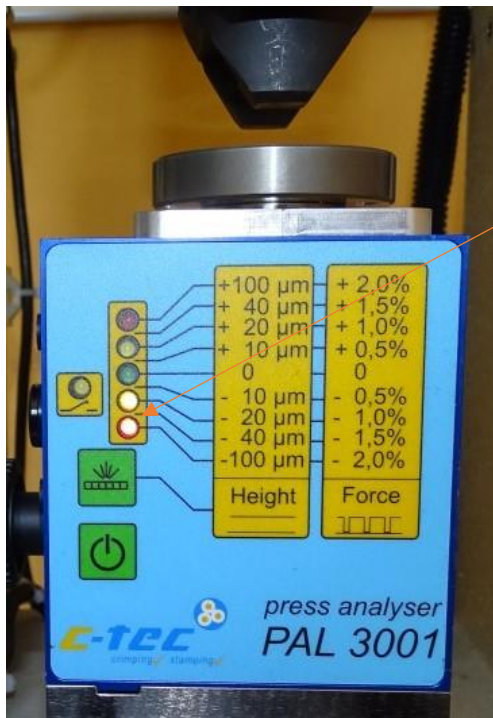
Turn the press ram by hand through bottom dead centre (BDC) and stop shortly after BDC. For presses with creep speed, use it to drive the ram through the BDC.



BDC position (bottom dead center)



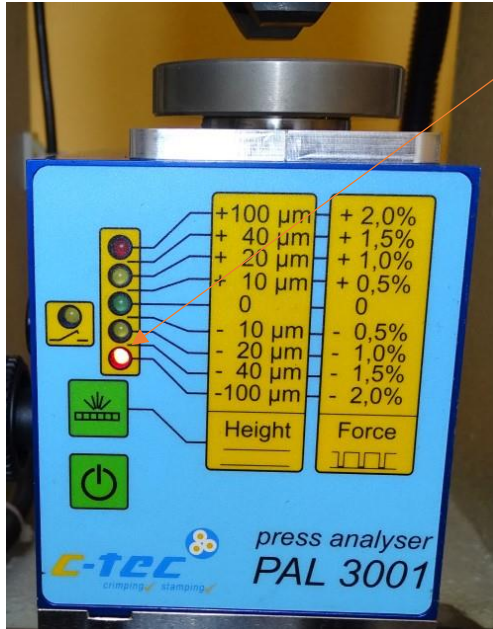
Stop after passing the BDC position (approx. 220°). The press ram should no longer touch the PAL upper part.



The LED display now provides information about the BDC to which the press is currently set. As in this example the yellow and the red LED light up at the same time, the BDC is set between 40 and 100 µm too low. Since this pre-setting takes place without force, the press is not stretched. Therefore, the later measured value, which was recorded under load, is higher. This LED display (yellow and red light up simultaneously) is still in the OK range.

**Caution:** If only the red LED lights up, the OK range has been exceeded.

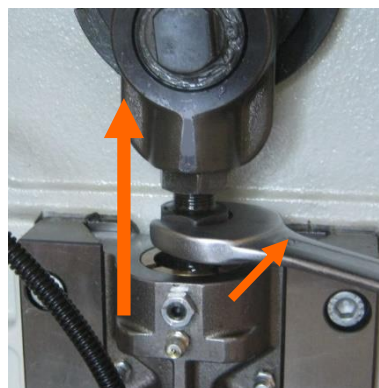
#### Examples of unacceptable deviations of the shut height:



**Attention:** Press is set too deep (only lower red LED lights up).

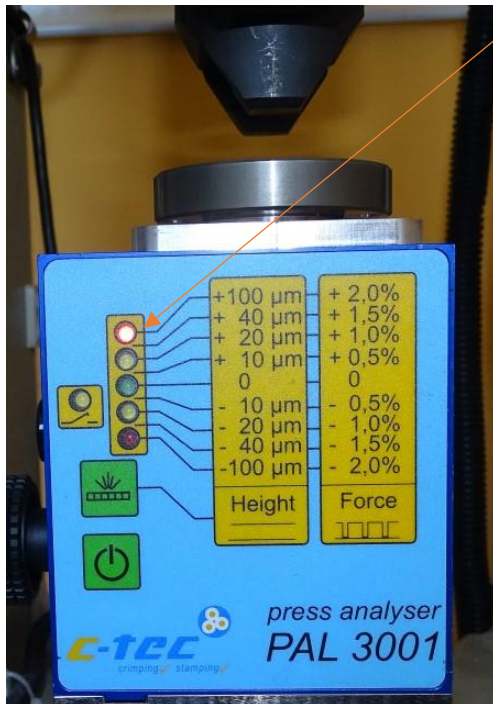
**Press must never be started under PAL load!**

Adjust the bottom dead centre (BDC) on the press ram upwards until at least the yellow and red LEDs light up together (see above).



Move the press ram upwards and secure the adjusting screw again! After each adjustment, drive through the BDC again and check the LED display.

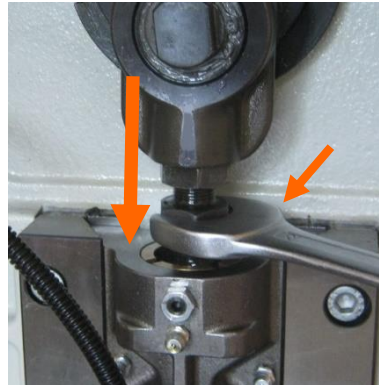




Press is set too high (only the upper red LED lights up).

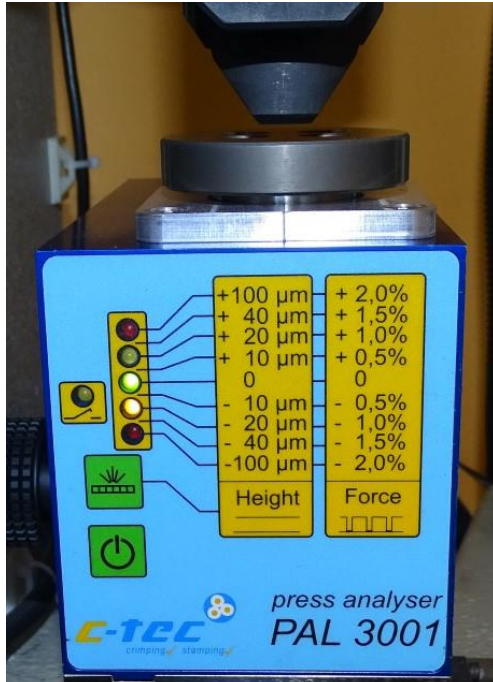
If the press is set too high, there is a possibility that too little force is applied to the PAL when it is loaded and the unit will no longer complete the "learning operation".

Adjust the bottom dead centre on the press ram downwards until the middle green LED lights up.



Adjust the press ram downwards and fix the adjusting screw again! After each adjustment, drive through the BDC again and check the LED display.

Example of tolerable deviation of the shut height:



The bottom dead centre (BDC) of the press is optimally preset.  
All settings with at least one yellow or green LED lit are OK.

**Attention: If only the lower red LED lights up during the slow-motion test, the press must not be started by motor under any circumstances.**

## 12.2 Fine tuning of the press with 8 kN load

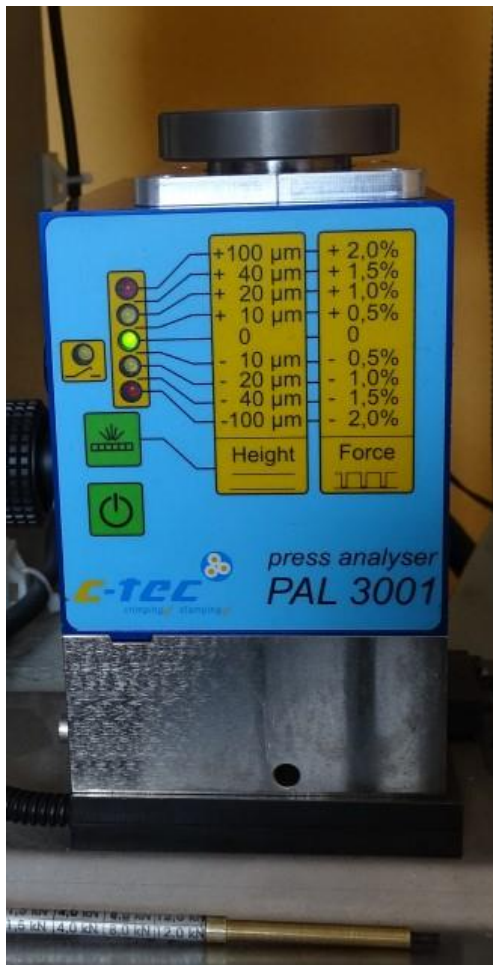


Set the slide feed to 8 kN. Each force position is visually indicated by the labelling on the force adjuster and haptically indicated by a clear latching position.



After setting the test force of 8 kN, unscrew the slide feed to the left and remove it. This is necessary, for example, so that the protective cover of the press can be closed.

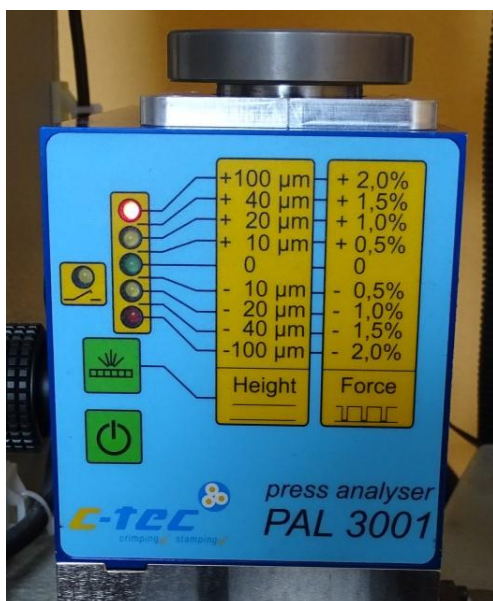




The green LED now starts flashing every second, indicating that the PAL 3001 is ready to measure under load conditions.



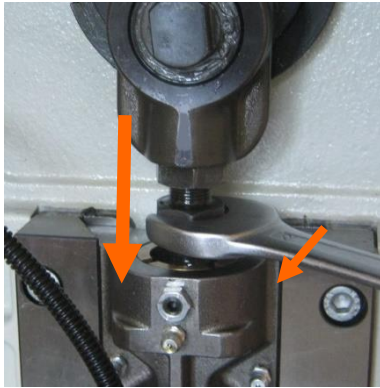
Start/trigger the press by motor via the foot switch or the automatic start system. At least 3 press runs are necessary to "adjust" and measure.



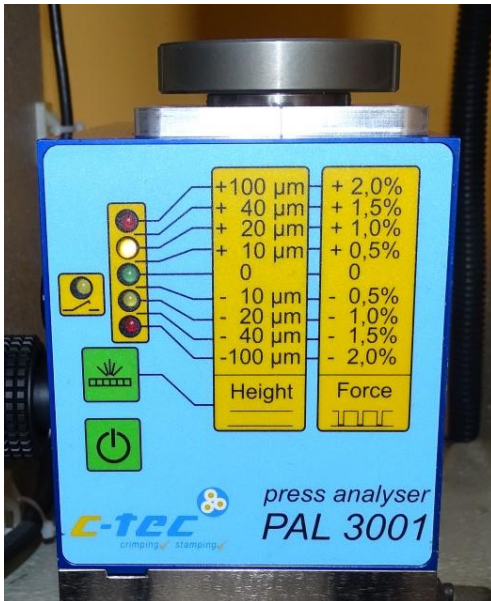
As the unit now loads the press with a counterforce of 8kN, the press "opens". That means that the bottom dead point (BDC), which was previously set without force, shifts slightly upwards, in this example by at least 100  $\mu\text{m}$ . This behaviour can be found in all presses in different orders of magnitude. The lower reversal point must now be corrected downwards.

Correct the BDC downwards by approx. 0.1 mm and restart the press with the motor.





Adjust the press ram downwards and secure the adjusting screw again!  
After each adjustment, start the press and read the height deviation on the PAL LED display.



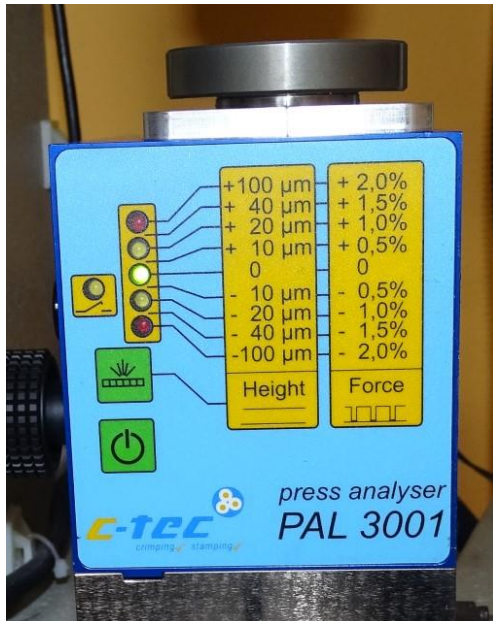
Start/release the press again and read the LED display.  
In this example, the press is still set 20  $\mu$ m too high.

Adjust the press ram slightly downwards again and secure the adjusting screw again!



In this example, the press is still set 10  $\mu$ m too high.

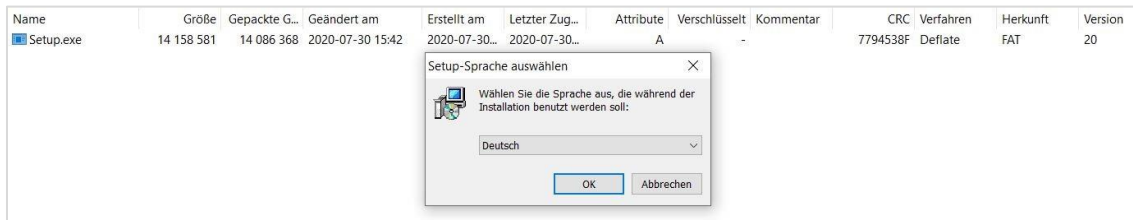
Adjust the press ram only slightly downwards and secure the adjusting screw again!



The press is now set with a tolerance of  $\pm 9 \mu\text{m}$  to the closed component 135.78 mm.

## 12.3 Preparation of a press analysis

If not already done, first install the PAL PC software on the laptop or PC. To do this, remove the installation CD supplied from the document compartment and insert it into the appropriate drive.



Run the installation programme Setup.exe and enter the required information.



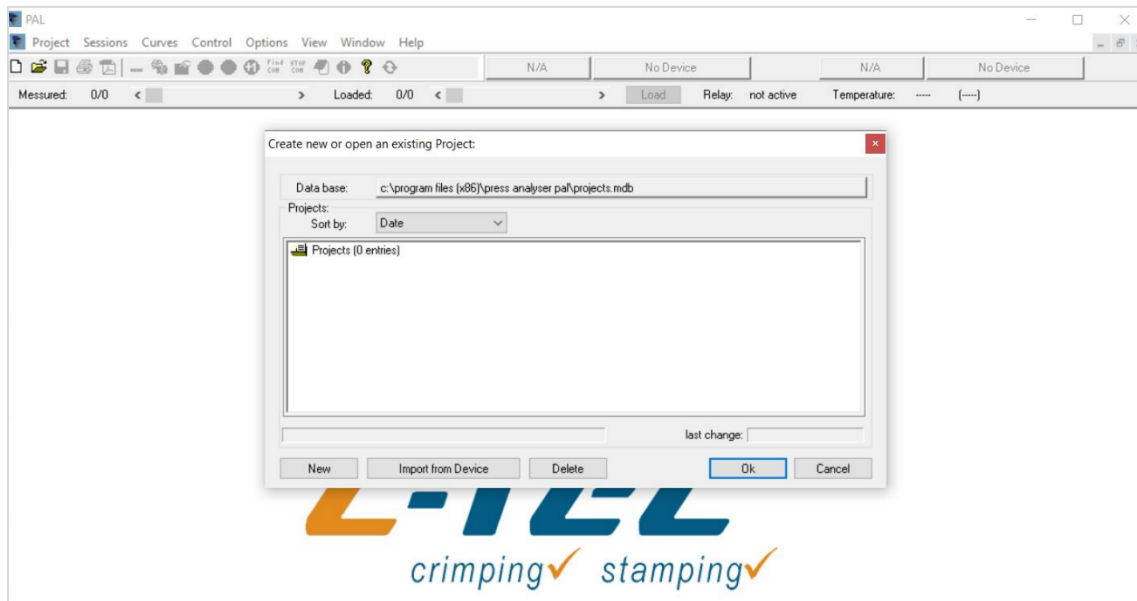
After successful installation, the icon for starting the PAL PC software appears on the desktop.



Connect the RS232 interface cable to the PAL 3001.

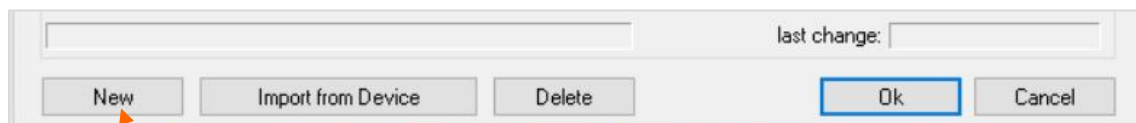


Connect the USB end of the adapter cable (USB 2.0 to 2 x RS232) to the laptop or PC and connect the RS232 cable from the PAL 3001 to one of the serial plugs.

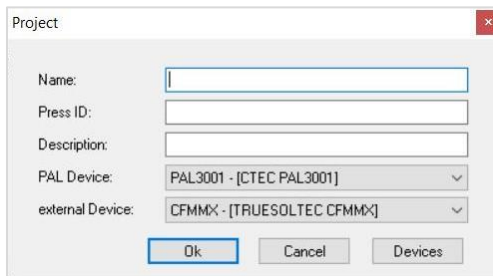


Start the PAL-PC software. The first display window shows all press numbers that have already been checked. In this example, a new installation is shown. No press check has been recorded and saved yet.

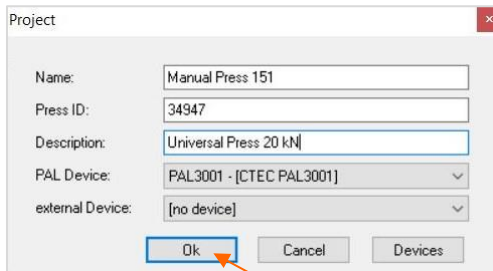
### 12.3.1 Press is not yet in the memory of the PAL



Click on "New"



An empty project input form appears



Fill in the form with the press-specific data.  
**Important:** The press ID is used for unique identification.

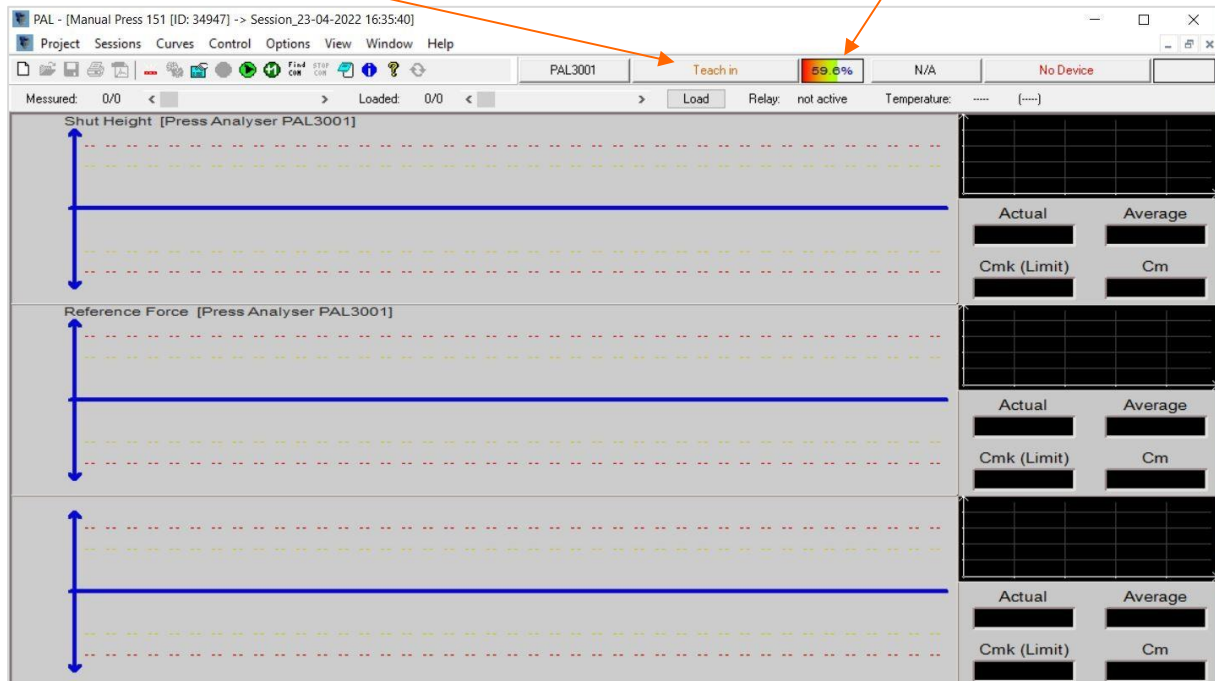


Press ID: 34947

After filling in the input form, click OK.



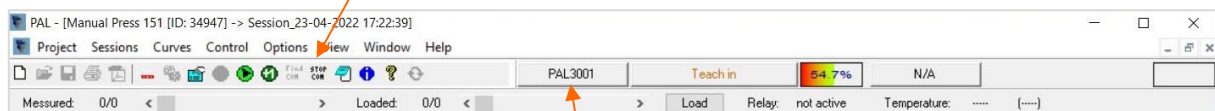
After clicking on the OK button, the measurement recording screen appears. Whether the communication with the PAL 3001 is working properly can be checked by the display of the battery charge level and the message "Teach In".



In case of disturbed communication between the PC and PAL 3001, this information is missing. In this case, first check whether the PAL 3001 is switched on. If this is the case, click on the "Find COM" button and wait until the PAL PC software has selected the correct interface.



As soon as the battery charge level is displayed, the search process is complete and the interface has been found. Then click on "Stop COM".



If the automatic search for the interface does not work, you can also search for it manually. To do this, click on the button "PAL 3001".

Device

PAL3001 [SN: 1510/217 ] - [CTEC PAL3001]

Name: PAL3001

Serial number: 1510/217

Device-Type: PAL3001

Description: [CTEC PAL3001]

Spring Rate: 40 N/μm

Settings:

Channel:

Machine ID:

IPConnect:

☒ connection via serial link

☐ connection via CAL device

Serial connection

Com Port: COM4

Bits per Second: 57600

☐ use network connection

Network connection:

IP Address: 0.0.0.0

Port: 0

Ok Cancel

In the drop-down menu that opens, one of the available interfaces can be selected.

Select the appropriate interface and confirm with OK. Now check whether the battery charge status is displayed. If this is not the case, select another available interface and repeat the test.

### 12.3.2 Press is already in the memory of the PAL

Create new or open an existing Project:

Data base: c:\program files (x86)\press analyser pal\projects.mdb

Projects:

Sort by: Date

Projects (20 entries)

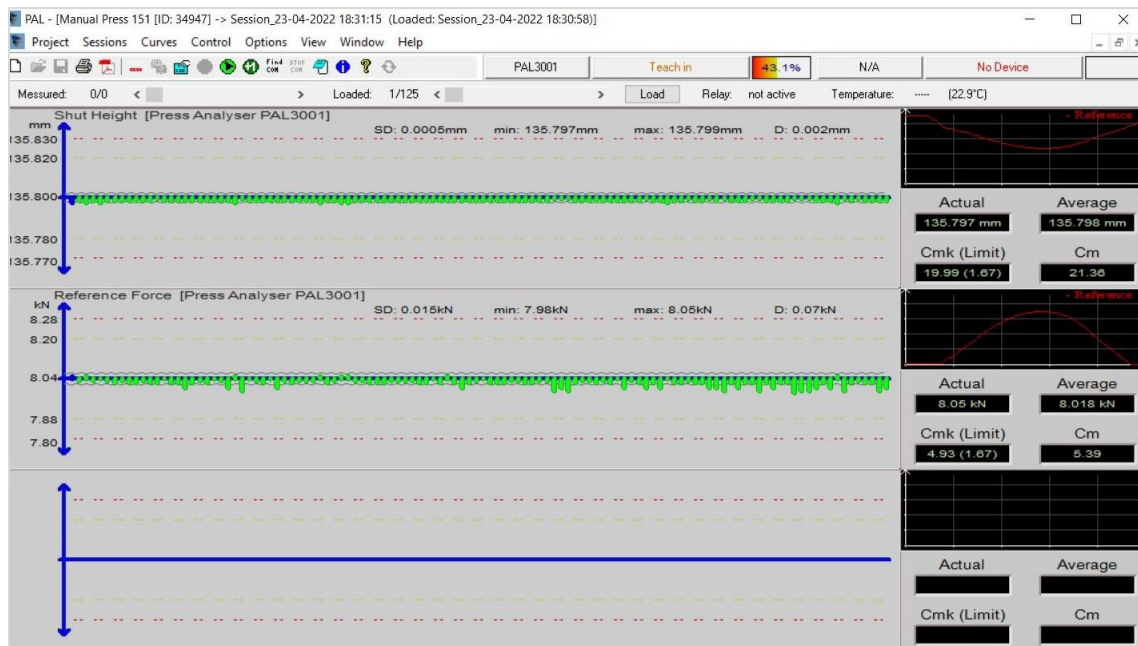
- Showroom (Press ID: 34947)
- Terminator - Milwaukee Show (Press ID: 123321)
- 2558
- 34204
- RG1139
- P 107 C - Show Room (Press ID: 34947-3)
- P107 C - Reihe 1 (Press ID: 34947-4)
- Milwaukee Show 2015 - C&S technologie (Press ID: 007)
- Testpresse C-tec (Press ID: 542239)
- n99

last change:

New Import from Device Delete Ok Cancel

Click on the desired press ID and confirm with OK.





The result of the last test on the selected press is now displayed.



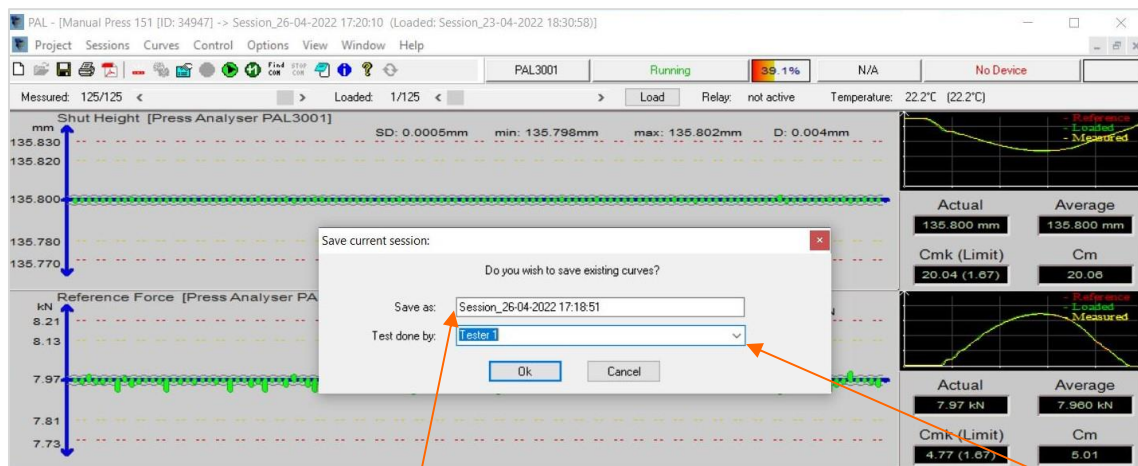
If the press is started, the display is cleared and a new measurement begins.



### 12.3.3 Saving of a completed measurement

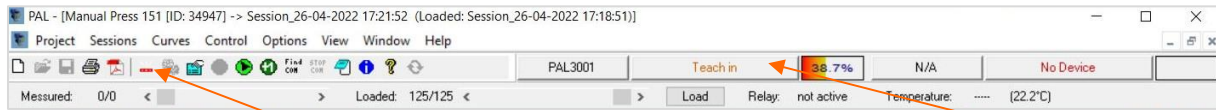
Click on "Save"

125 measured values were recorded.



The name of the measurement is designated as a session and supplemented with the date and time. The name of the tester must be entered in the field "Test done by" or, if already available, the name can be selected from the drop-down menu. By clicking on "OK", the complete measurement with all measurement curves is saved on the PC. If the measurement should not be saved, this can be done by clicking on "Cancel". The measurement is then permanently deleted and may have to be recorded again.

### 12.3.4 Performing another test on the same press (retest)



To start a new measurement, click on the "new measurement" field. If "Teach in" is displayed in the PAL status field, a new measurement recording is started.

### 12.3.5 Performing a measurement with automatic press start

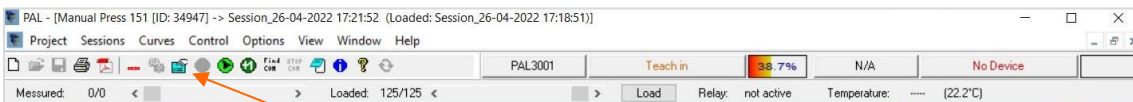


Connect the clock generator for automatic press start (relay box) to the "Relay" output.



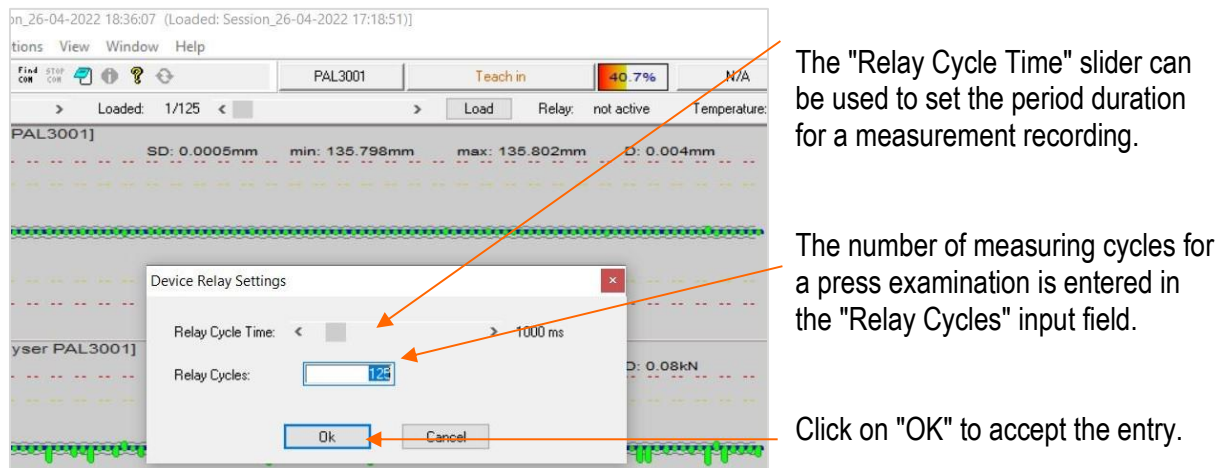
Connect the output of the clock generator to the foot switch start contact.

**Caution:** The connection to the press should only be made by qualified personnel.

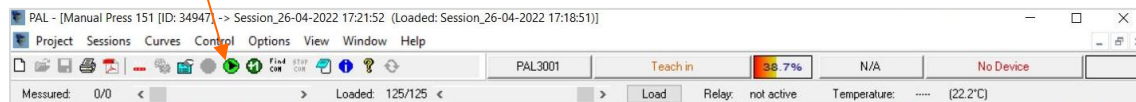


Clicking on the field "Measuring cycle time" opens an input field.





By clicking on "Start", the press is now started automatically for the complete measurement recording.

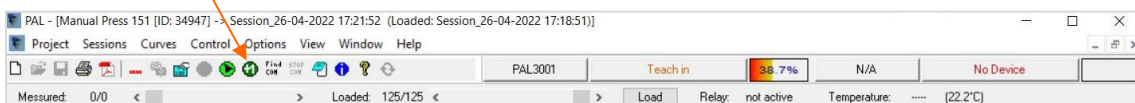


After the previously set number of measuring cycles has been reached, the automatic press start is terminated.

Click on "Stop" to stop the measurement immediately.



By clicking on the "+1" button, a single press cycle is carried out. One exception concerns the "Teach in" process. Here, all necessary teach cycles are executed after clicking on "+1".



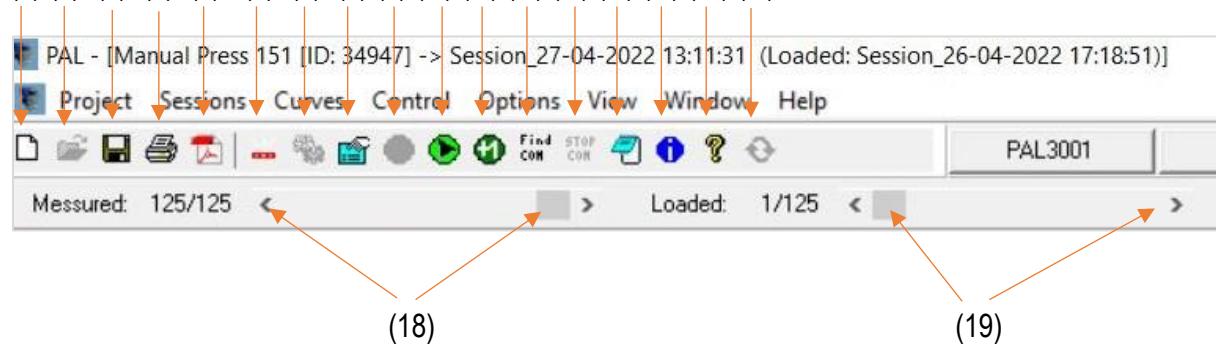
## 13 The PAL PC software



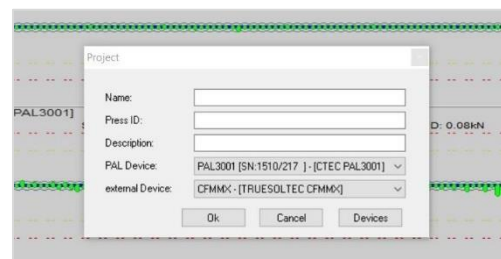
### 13.1 Explanation of the pictograms (mouse click areas)

#### 13.1.1 Left side of the toolbar

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17)



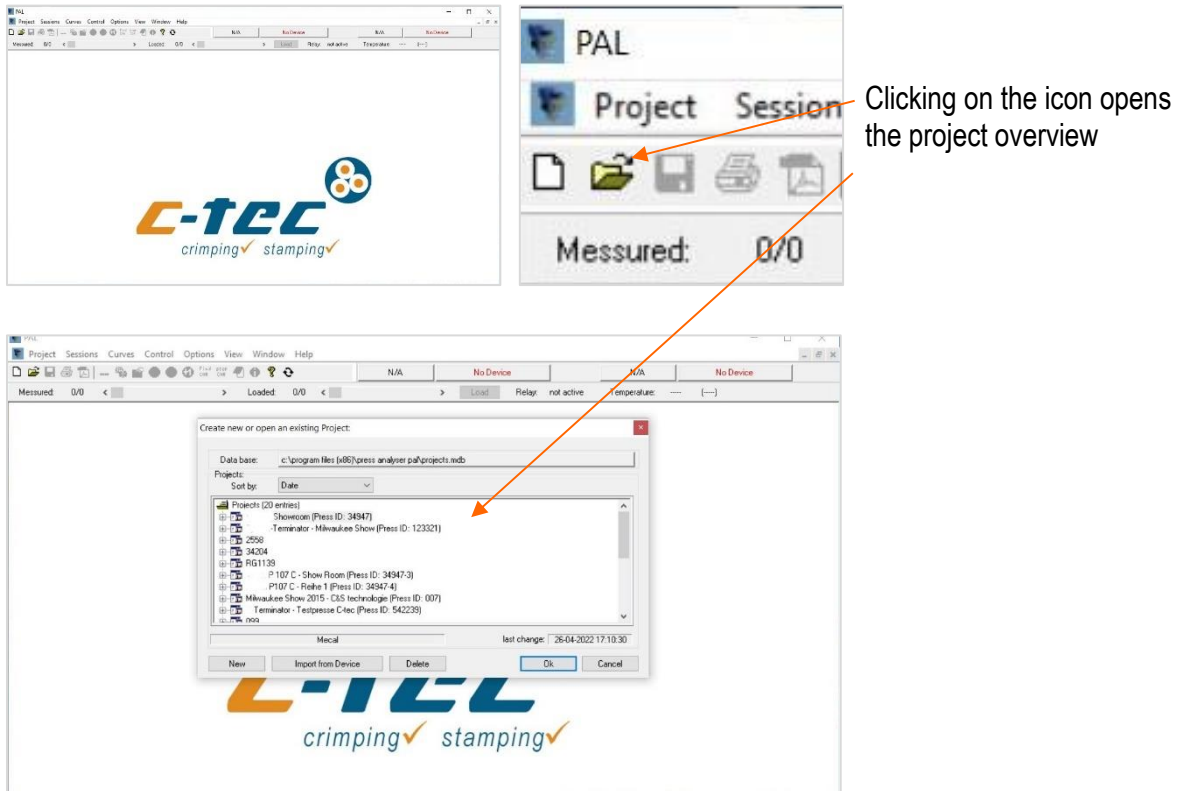
(1) **New project:** after clicking on the field, the project input form for a new press opens.



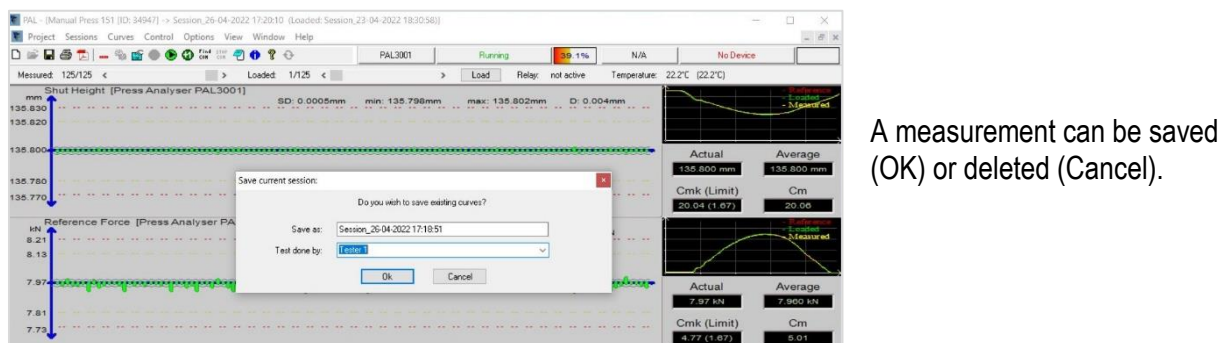
The screenshot shows the 'Project' dialog box. It contains the following fields and options:

- Name:
- Press ID:
- Description:
- PAL Device:
- external Device:
- Buttons: Ok, Cancel, Devices

**(2) Open project:** this button is only active on the start screen and allows you to open the project tree (overview of all presses) or to create a new project.

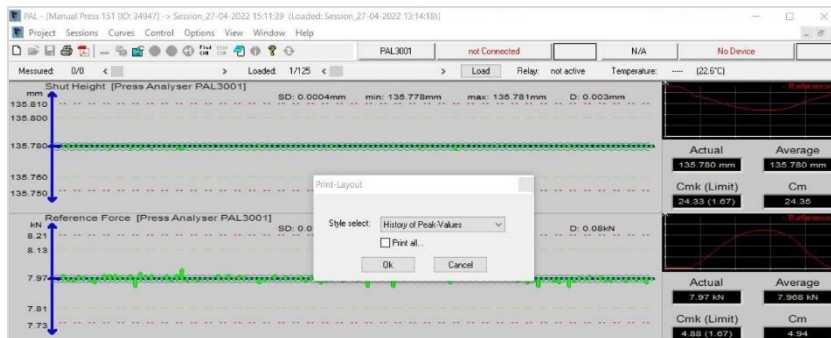


**(3) Save:** Button for saving a measurement



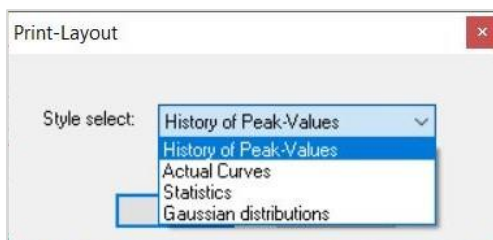


**(4) Print:** the currently opened measurement is printed.



Click OK to print a histogram (bar chart).

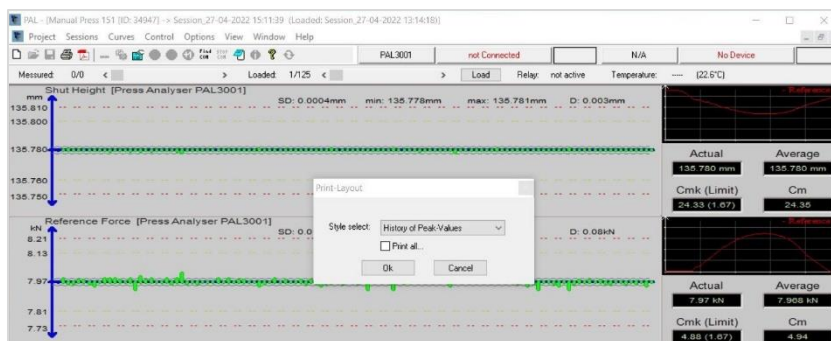
Click on Cancel to exit and not to print.



Various templates for the PDF document can be selected via the drop-down menu.

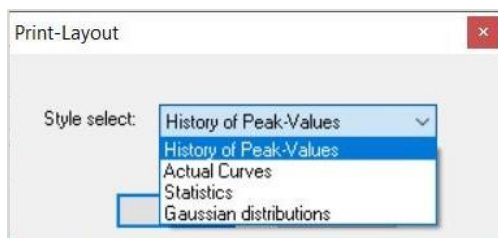
If a check mark is placed in the "Print all ..." field, all four templates (4 pages) are printed.

**(5) PDF export:** the currently displayed measurement is exported as a PDF document.



Clicking OK converts a histogram (bar chart) into a PDF document.

Click on Cancel to exit the process.



Various templates for the PDF document can be selected via the drop-down menu.

If a check mark is placed in the "Print all ..." field, all four templates are filled with the measurement data.

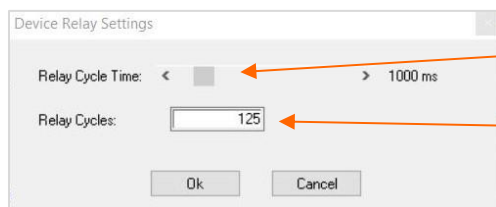
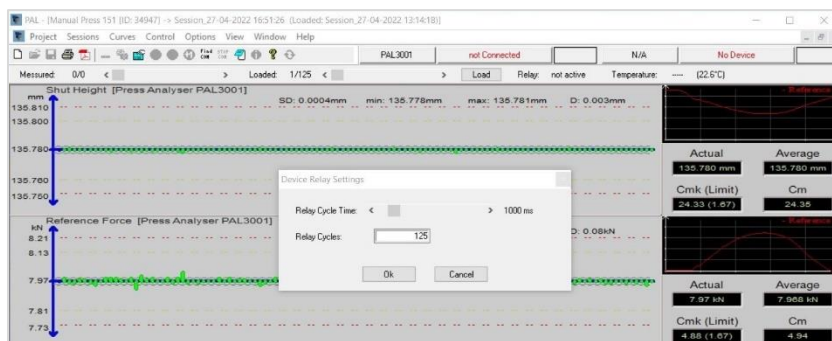
**(6) New measurement:** Clicking on the pictogram starts a new measurement recording.



The message "Teach in" in the PAL 3001 status field indicates that a new measurement recording has been started.

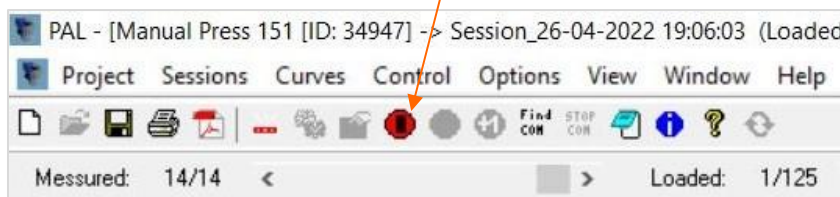
**(7) Crimp monitor:** if the PAL PC software is also connected to a crimp monitor, the calibrated peak force value can be transferred from the PAL to the crimp monitor. This function is only applicable if the connected crimp monitor also allows this.

**(8) Automatic press start:** if you click on the icon, the input field for controlling the clock for the automatic press start (relay box) opens.

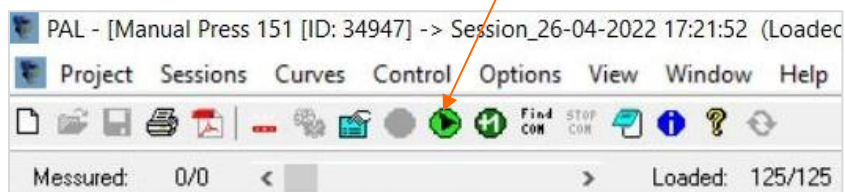


The slider can be used to set the time interval at which the press is triggered.  
In the field "Relay Cycles" it is determined how many cycles are carried out for a measurement.

**(9) Stop automatic press start:** the icon is only active if the press is triggered via the clock for automatic press start. Clicking on the icon interrupts the triggering process.



**(10) Start automatic press start:** by clicking on the icon, the press start can be started via the clock generator.



**(11) Button "+1":** when clicking on the field "+1", the press performs a single rotation in sequence. The "Teach in" process is an exception to this. Here the process is first completed (approx. 3 revolutions) and only then is the press no longer started.

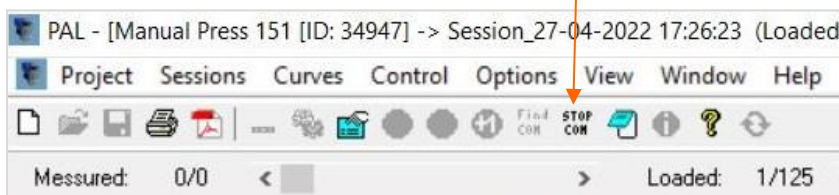


**(12) Find COM:** the PAL PC software checks all available COM interfaces of the computer to see whether a PAL 3001 is connected. As soon as the matching interface has been recognised, the PC connects to the PAL 3001 unit.

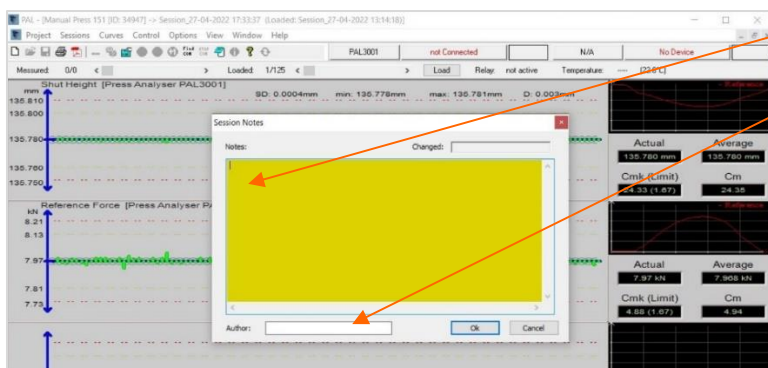


The successful connection is indicated by the message "Teach in" in the status field and the display of the battery charge level.

**(13) Stop COM:** as soon as the PAL 3001 is successfully connected to the PAL PC software, the search function should be stopped by clicking on the Stop COM icon. Otherwise, the PAL will start the interface search again and again (e.g. after restarting).



**(14) Notes:** clicking on the icon opens a text field (notepad). Remarks on the press check can be noted here.



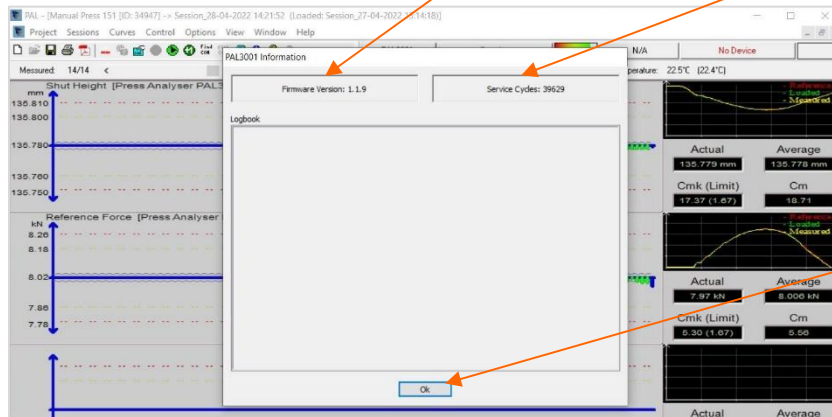
Field for free text.

Field for author's name.

Click on OK to save the text with the measurement.

Clicking on Cancel closes the note field and deletes the text.

**(15) Logbook:** the logbook displays the current firmware version of the unit and the counter reading (countdown) of the service counter. The values are updated as soon as the first measurement curve has been transferred from the PAL 3001 unit.



Click on OK to close the window again.

**(16) Software info:** clicking on the question mark opens the info box for the PAL PC software.

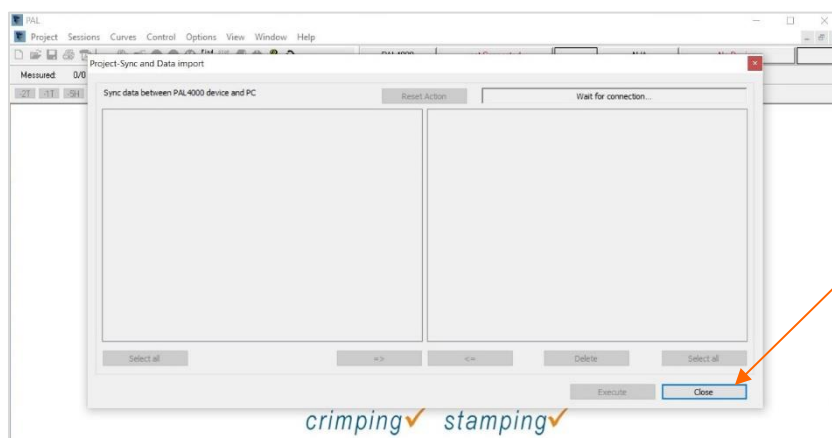


Software version

C-tec service telephone number

Click on OK to close the window.

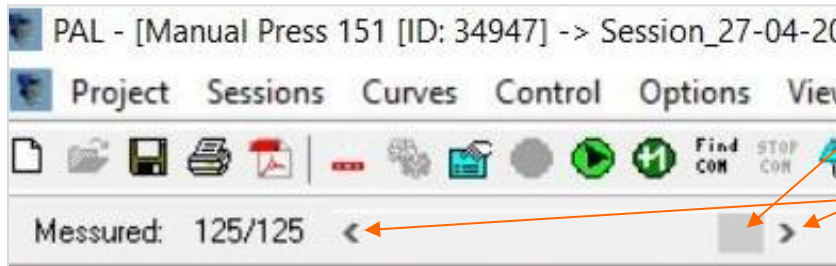
**(17) Data transmission:** the button is only active in the first software window. The corresponding display window is only activated if a PAL 4000 is connected (transfer of PAL measurement data to the PAL PC software).



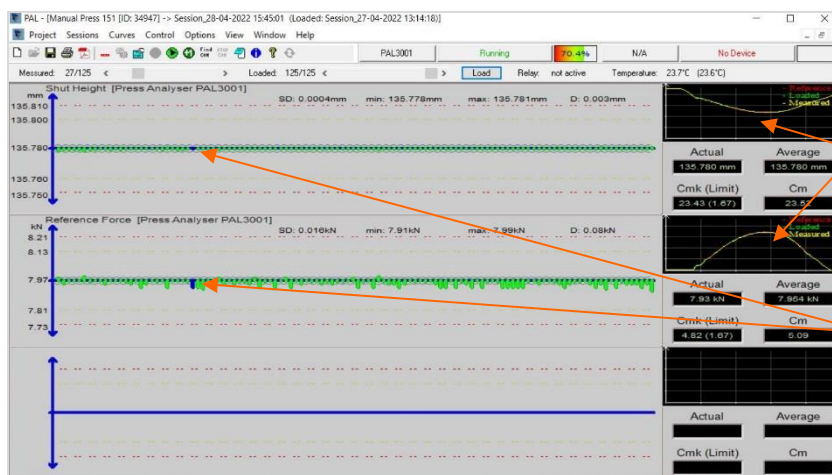
Click on Close to close the window again.



**(18) The slider can be used to view each currently recorded trace.**



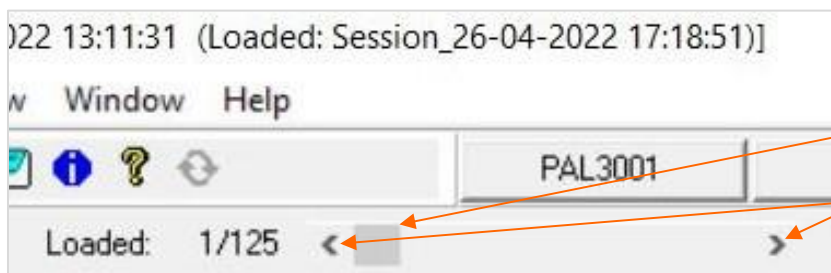
You can move the slider by left-clicking + holding on the dark slider area and moving the mouse or by clicking on the arrows on the left or right.



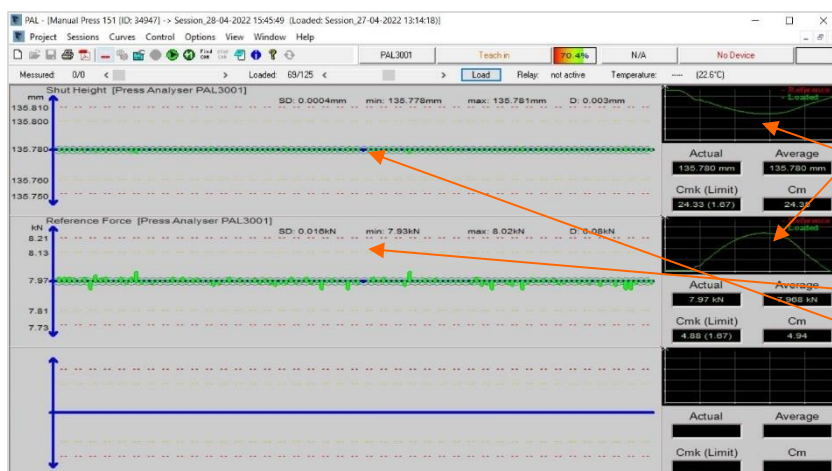
The individual measurement curves can be viewed in the small display fields.

The blue bar shows which trace from the series is currently selected.

**(19) With the slider, each individual trace from a loaded measurement series (e.g., the last recorded measurement) can be viewed.**



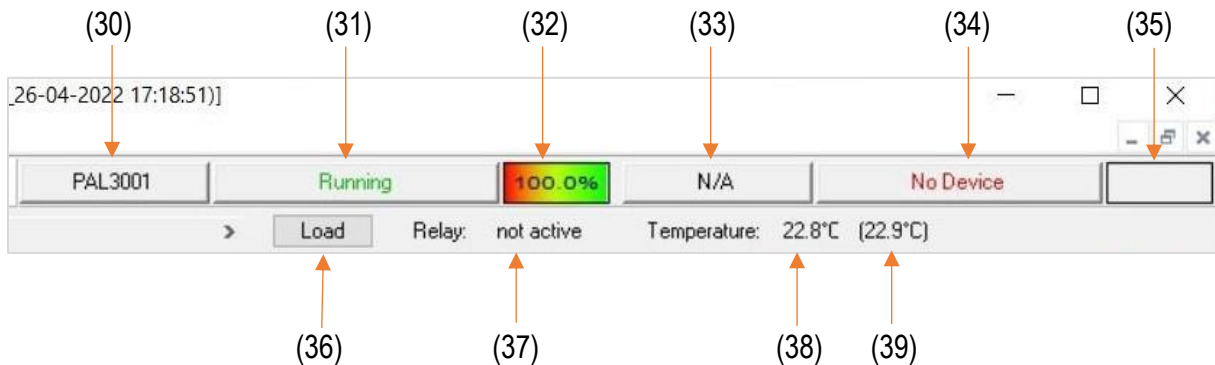
You can move the slider by left-clicking + holding on the dark slider area and moving the mouse or by clicking on the arrows on the left or right.



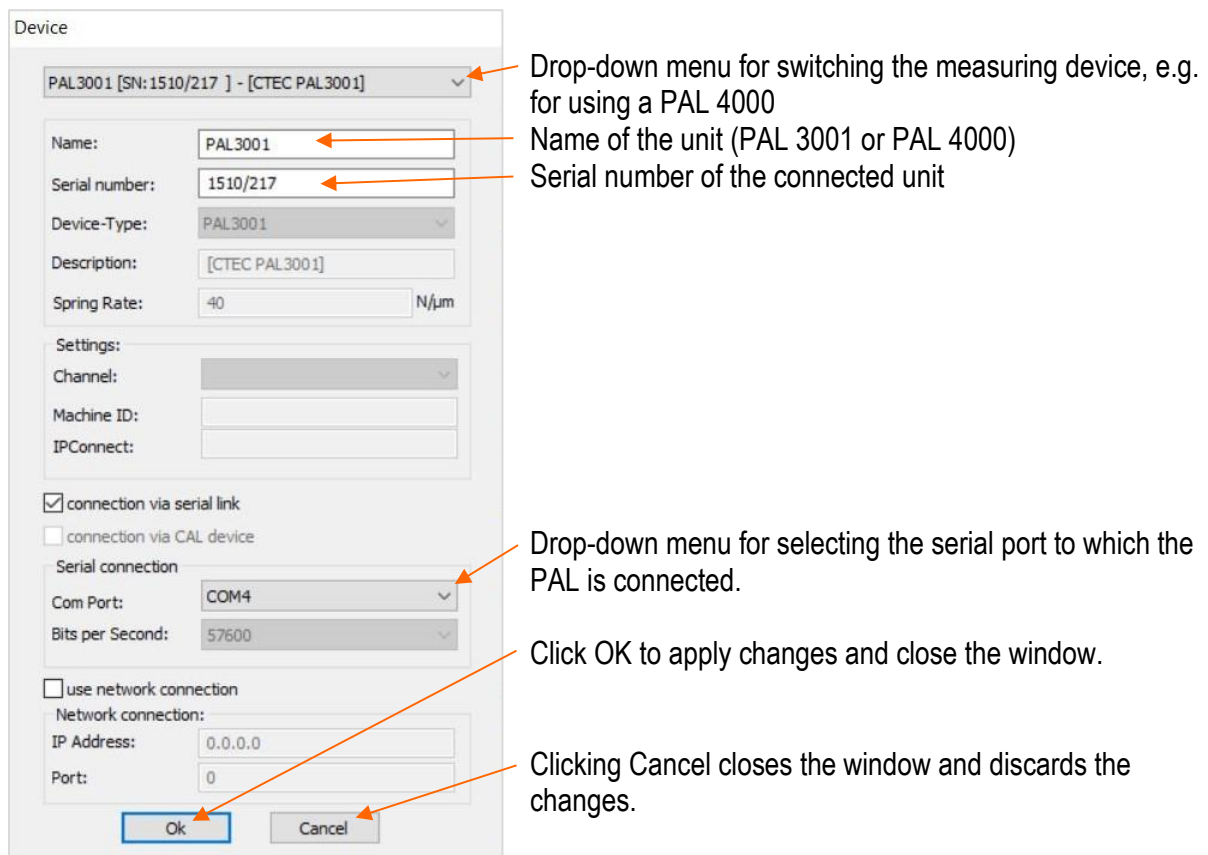
The individual measurement curves can be viewed in the small display fields.

The blue bar shows which measurement curve from the series is currently selected.

### 13.1.2 Right side of the toolbar (Device Control bar)



**(30) Device info PAL:** a field opens with the most important settings options of the PAL

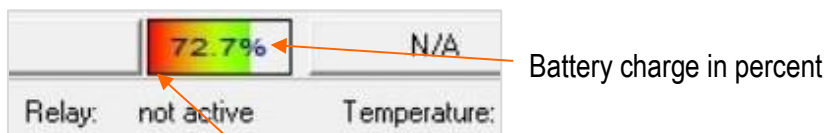




**(31) Activate/deactivate measurement recording:** by clicking on the button, recording of the measured values of the PAL 3001 can be switched on and off again.



**(32) Display of battery charge level**



**Caution: Only use the original power supply unit!**

**33) Info field about connected external devices (e.g. crimp monitor):** clicking on the button opens a field with the most important setting data



Device

CFMMX - [TRUE SOLTEC CFMMX] ✓

Name: CFMMX

Serial number:

Device-Type: CFMMX

Description: [TRUE SOLTEC CFMMX]

Spring Rate: 40 N/mm

Settings:

Channel: Channel 1

Machine ID: 01

IPConnect:

☒ connection via serial link

☐ connection via CAL device

Serial connection

Com Port: COM4

Bits per Second: 38400

☐ use network connection

Network connection:

IP Address: 0.0.0.0

Port: 0

Ok Cancel

Drop-down menu for switching to another external device (e.g. CFM-PRO touch, FSI, etc.)

Name of the selected unit

Drop-down menu for switching the measuring channel, if a dual-channel crimp monitor is to be tested as well.

Setting for the identification number of the crimp monitor, if it is integrated in the network.

Drop-down menu for manual selection of the interface to which the crimp monitor is connected.

Drop-down menu for selecting the transmission speed of the data from the crimp monitor.

Click OK to apply changes and close the window.

Clicking Cancel closes the window and discards the changes.

**(34) Info field for the operating mode of the external device**



The external device is in the "Teach in" mode with measuring channel 1.

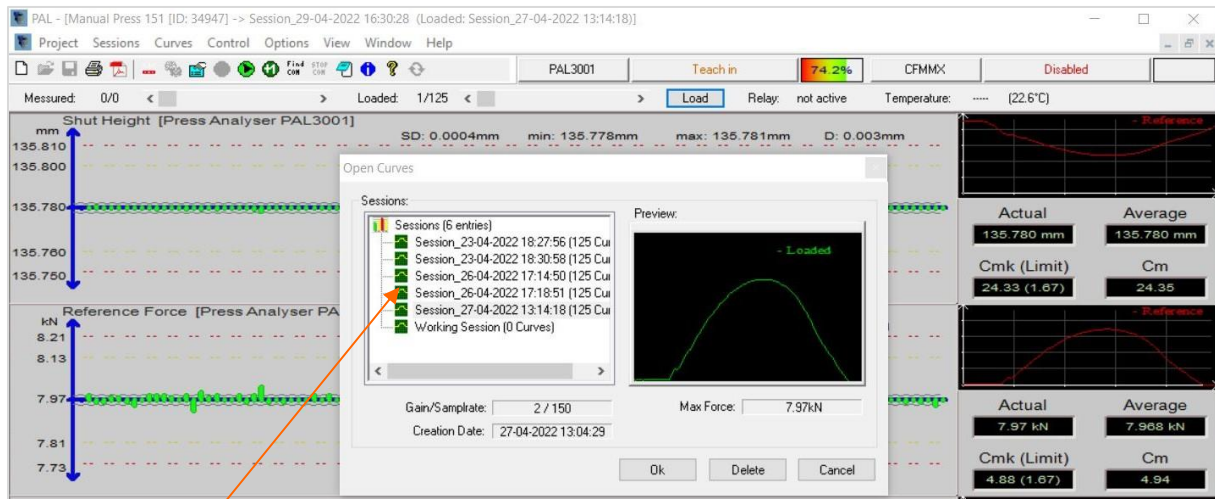


By clicking on the button, the external device can be disconnected from the measurement recording. Click again to reactivate the external device.

**(35) Charge status display external device:** is only displayed if an external device with rechargeable battery.



**(36) Load measurements:** clicking on "Load" opens a selection menu that shows all measurements that have been taken for the opened press project.



Click on a measurement series (session) to select it. If you then click OK, the selected measurement series is loaded into the work screen.

Click on "Delete" to discard the selected measurement series.

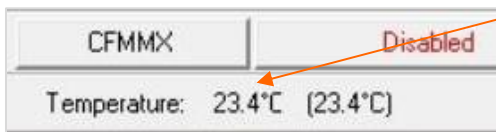
Clicking on "Cancel" closes the menu and nothing is changed in the work screen.

**(37) Necessary press strokes:** the numerical value next to Relay shows how many press strokes are still necessary to record the measured values.



Here, for example, 115 measured values are still required for the capability analysis.

**(38) Temperature:** temperature recording of a current press analysis



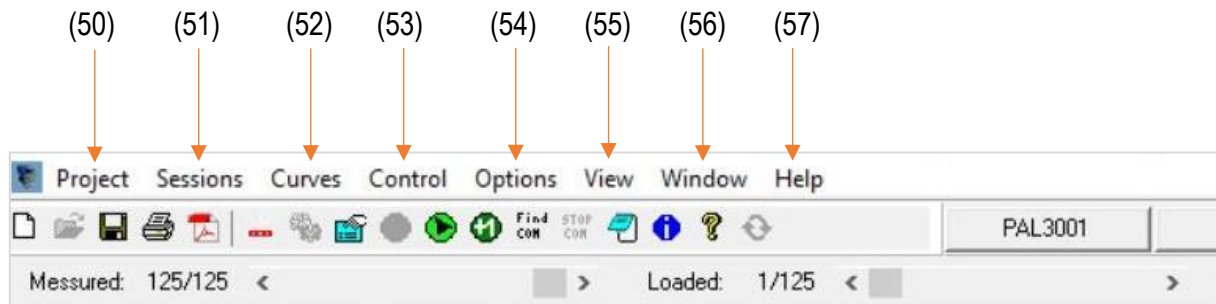
The left temperature display shows the temperature inside the PAL 3001 during the recording of a new press analysis.



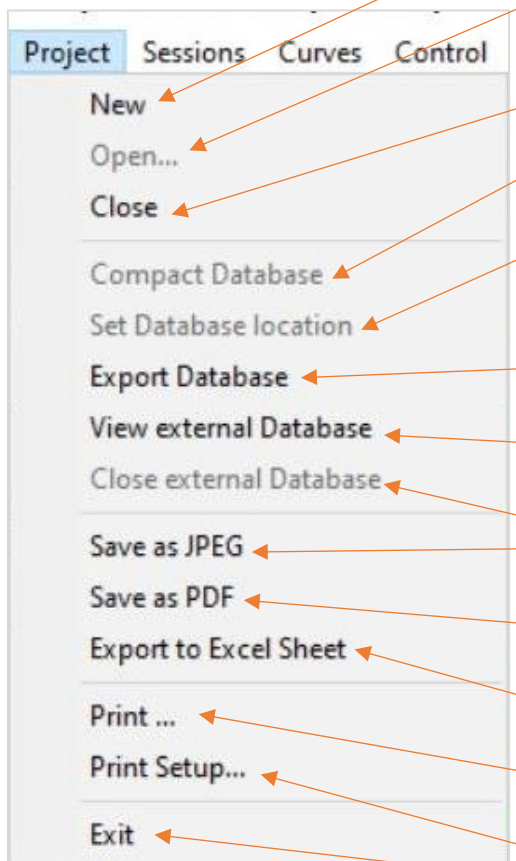
The right temperature display in brackets shows the temperature inside the PAL 3001 matching a loaded press analysis.



### 13.1.3 Menu bar with drop-down menus



#### (50) Menu Project



Opens the dialogue for creating a new press project (13.1 - 1).

Menu item is only active in the start screen and allows you to open the project tree (overview of all presses) or to create a new project.

Closes the work screen and opens the empty start screen.

Function is only active in the empty start screen and enables condensing the database.

Function is only active in the empty home screen and gives the possibility to move the database storage location.

Individual press examinations or complete data sets can be exported from the database to a file.

The previously exported data sets can be viewed and analysed.

Review of exported data is closed.

The measurement in the working view is saved as a JPEG image.

The measurement in the working view is saved as a PDF document (13.1.1 - 5).

All measurements of the press that are open in the working view are transferred to an Excel document.

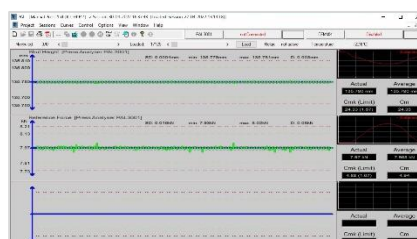
Prints a document of the analysis currently in the working view (13.1.1 - 4).

Set a default printer

Close PAL Close PC programme

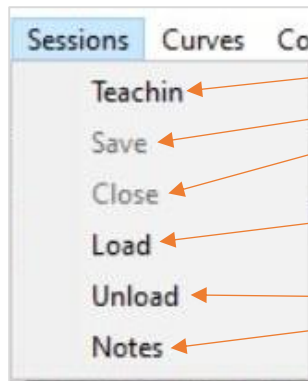


Empty start screen



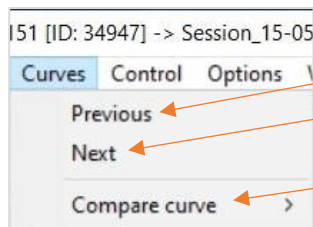
Working view

## (51) Menu Session

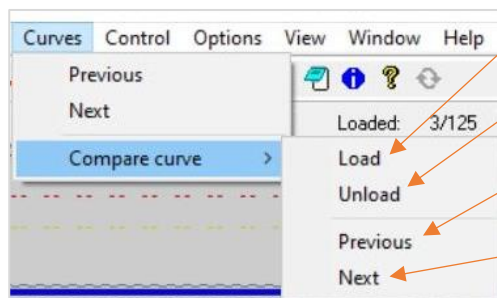


- Teachin → A new press check is started (13.1.1 - 6).
- Save → The data of a press analysis are saved (13.1.1 - 3).
- Close → Close the working view and switch to the empty start view.
- Load → The data of a previous press analysis are loaded into the working view (13.1.2 - 36).
- Unload → The working view is cleared.
- Notes → The notepad is opened (13.1.1 - 14)

## (52) Menu Curves

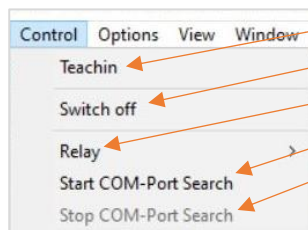


- Previous → Shows the previous curve of the current measurement recording (13.1.1 - 18).
- Next → Shows the next curve of the current measurement recording (13.1.1 - 18).
- Compare curve → Opens the selection for the comparison measurement recording (older recording).

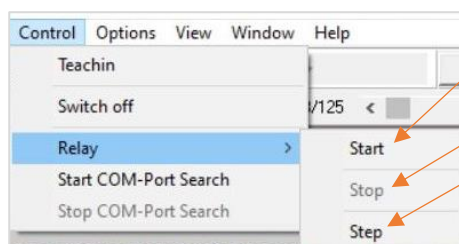


- Load → An older measurement recording is loaded into the working view.
- Unload → The loaded measurement recording (comparison measurement) is deleted from the working view.
- Previous → Shows the previous curve of the loaded measurement (13.1.1 - 19)
- Next → Shows the next curve of the loaded measurement recording (13.1.1 - 19)

## (53) Menu Control

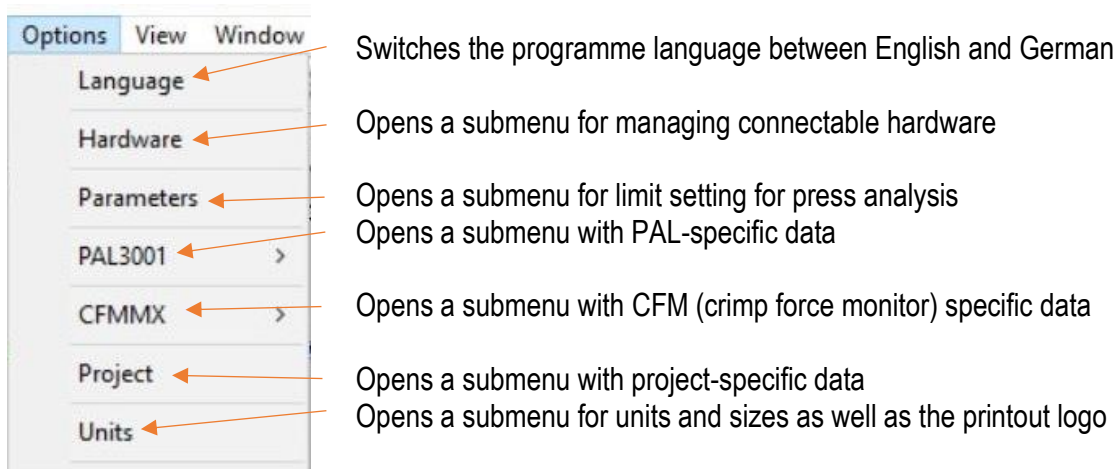


- Teachin → Starts a new measurement recording for the selected press (13.1.1 - 6)
- Switch off → Switches PAL 3001 off
- Relay → Opens the setting menu for the relay (13.1.1 - 8)
- Start COM-Port Search → Starts the automatic COM interface search (13.1.1 - 12)
- Stop COM-Port Search → Stops the automatic COM interface search (13.1.1 - 13)

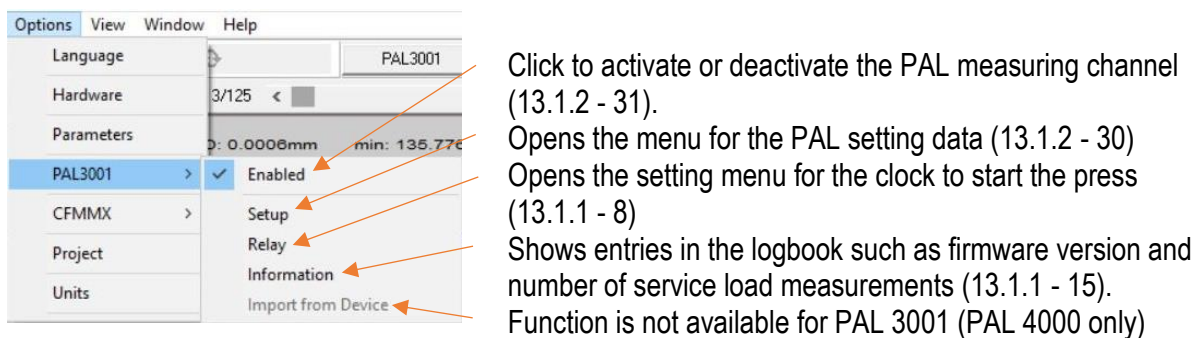


- Start → The press is started automatically by the clock generator (13.1.1 - 10)
- Stop → The automatic press start is interrupted (13.1.1 - 9)
- Step → The press performs only one revolution, except for the teach process (13.1.1 - 11)

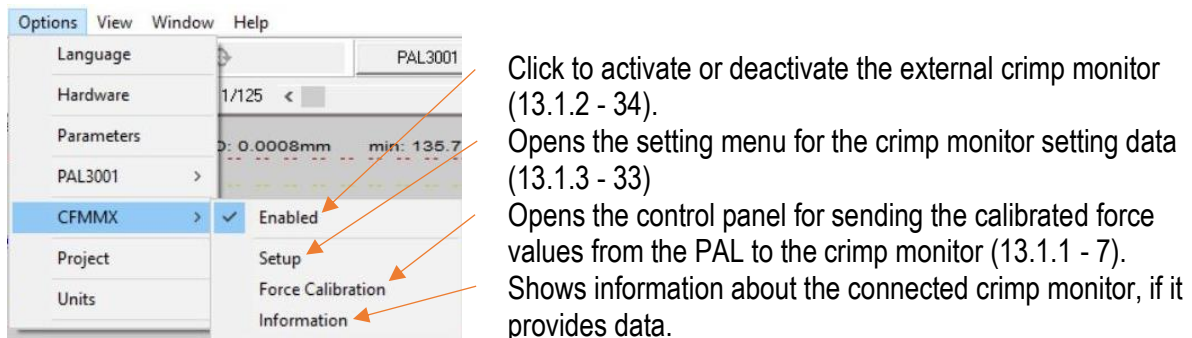
## (54) Menu Options



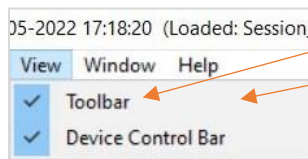
### Submenu PAL-specific data



### Submenu PAL-specific data

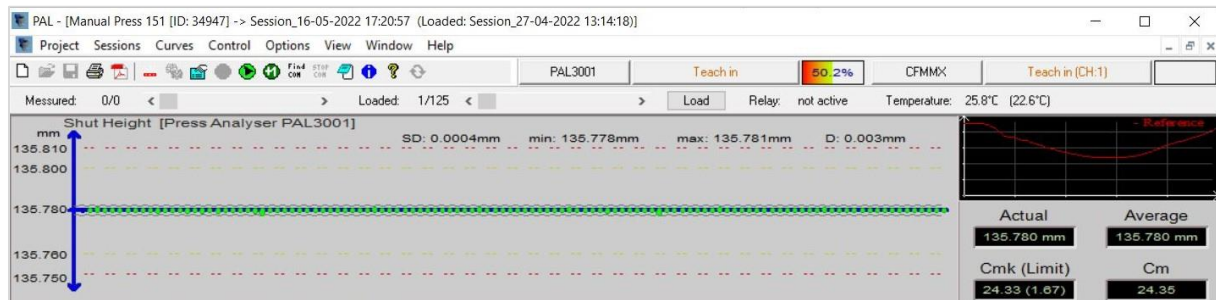


## (55) Menu View

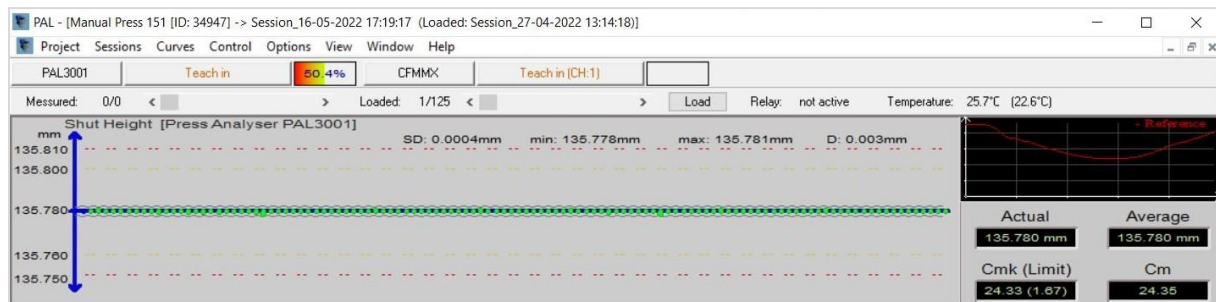


Click to activate or deactivate the toolbar.  
Click to activate or deactivate the control bar.

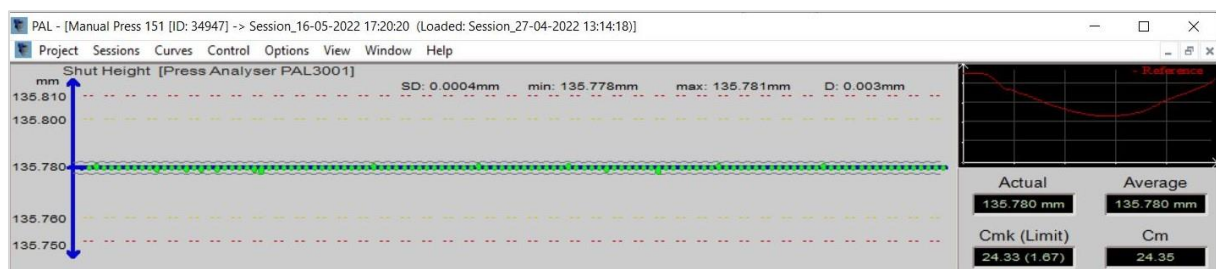
Working view with both "Toolbar" and "Device Control Bar" switched on:



Working view with "Toolbar" deselected:

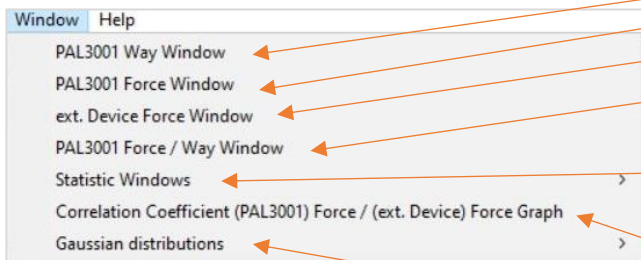


Working view with "Device Control Bar" deselected:





## (56) Menu Window



Curve progression for height measurement  
 Curve progression for force measurement  
 Curve progression of the crimp monitor  
 Curve progression of the force and height measurement superimposed on each other  
 Course of selectable variables during a measurement recording.  
 Correlation between PAL reference force and Crimp Monitor maximum force  
 Distribution of the individual values of a measurement recording according to the Gaussian function.

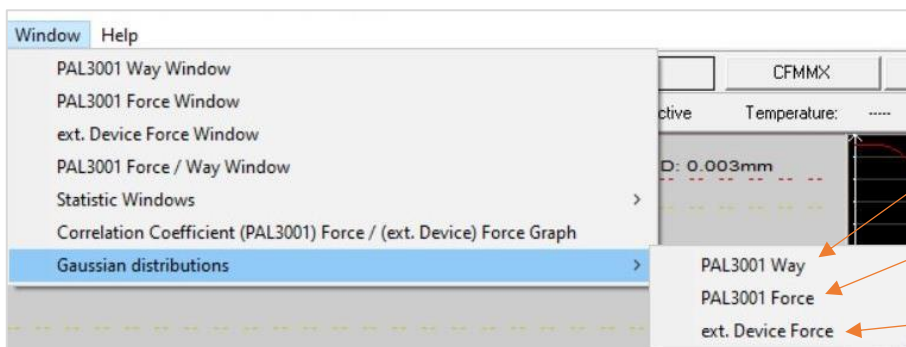
## Submenu Statistic Window



Opens a statistic window

Opens a statistic window

## Submenu Gaussian distributions



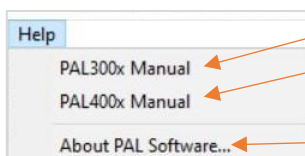
Shows the Gaussian distribution of:

- height measurement

- force measurement

- crimp monitor measurement values

## (57) Menu Help

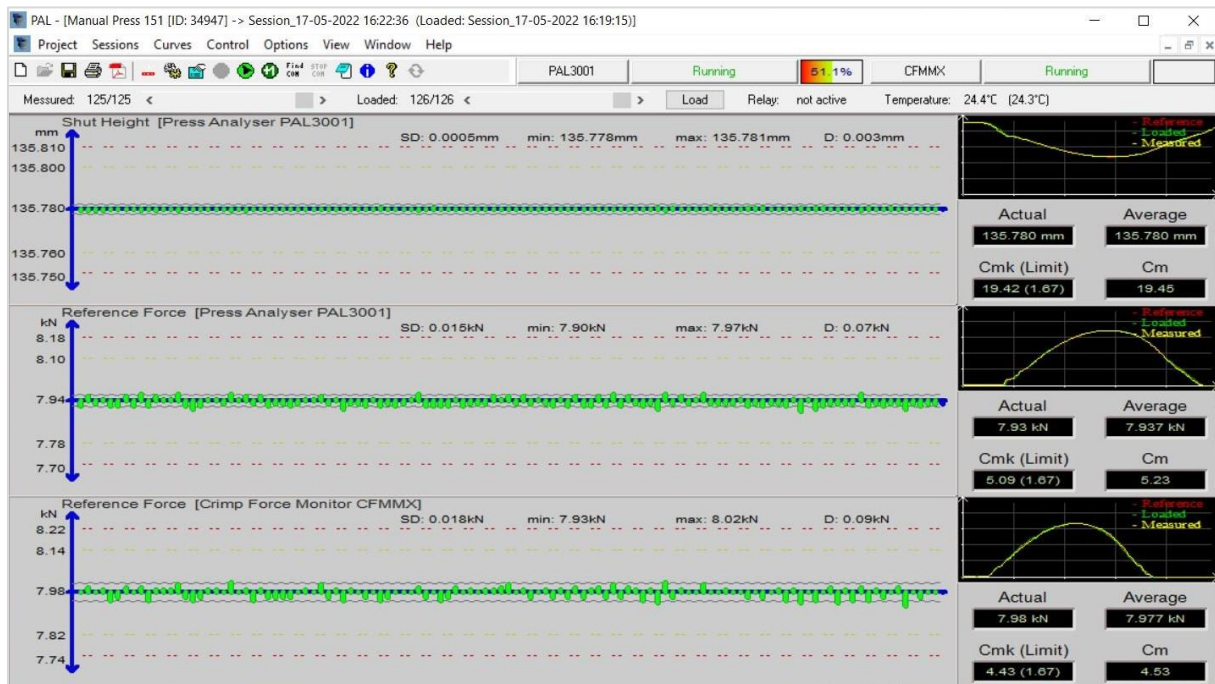


Opens operation manual for PAL 3001

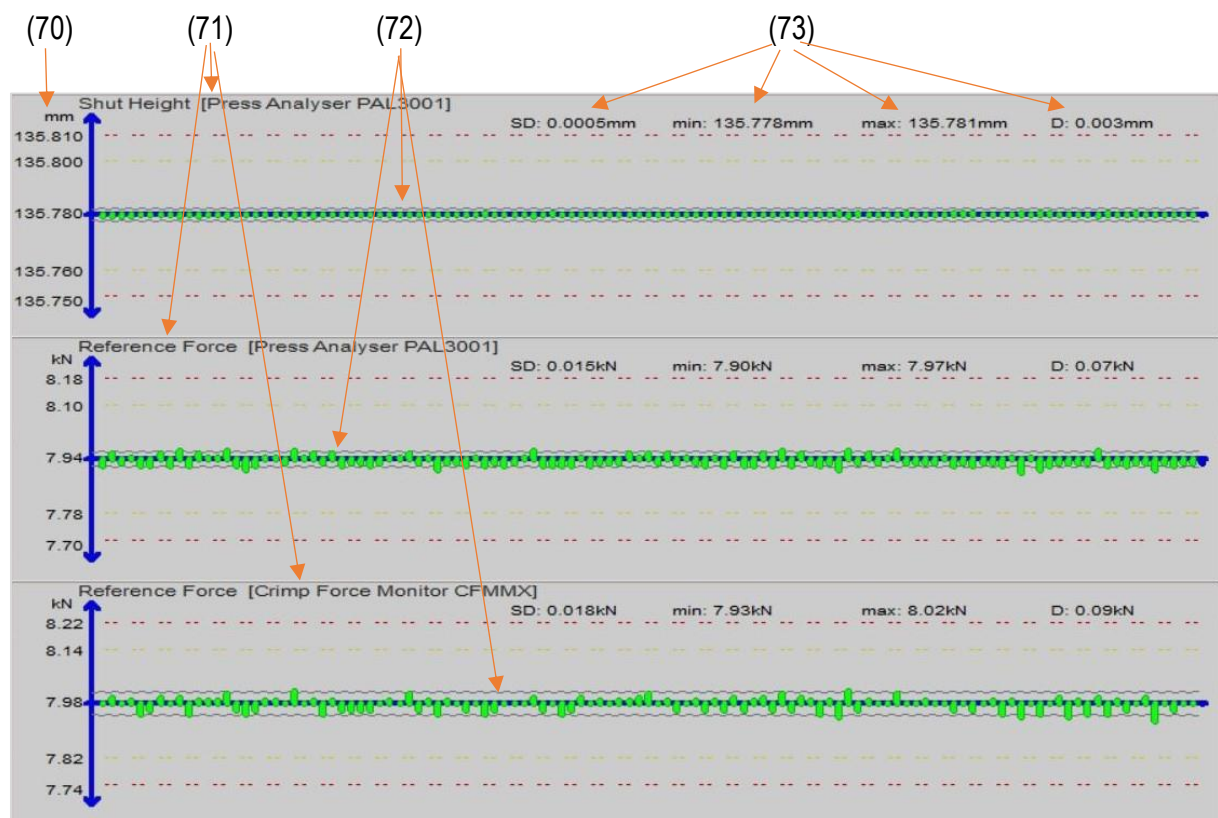
Opens operation manual for PAL 4000

Shows information on PAL PC software

## 13.2 Working view in PAL PC software



### 13.2.1 Bar chart



**(70) Axle labelling of the ordinate**

The axis labelling shows the unit of the measured values (mm, kN or American units such as inch or lbs). The numerical values indicate the mean value, the upper and lower warning limits and the upper and lower threshold values.

**(71) Labeling of the graphs**

The naming indicates the source of the measured values in the individual graphs.

**(72) Measured values on the abscissa**

On the X-axis, the peak values of the individual measurements are displayed in the form of columns. A maximum of 120 individual measurement values can be displayed on one work screen. If more values are recorded, the first measurements are pushed to the left out of the picture, but can be viewed again at any time via the display slider (13.1.1 (18)).

The wavy line above and below the centre axis each represent the greatest inaccuracy of the entire system.

The individual values are displayed in green if they are within the tolerance. If a value reaches the warning limit, it is marked in yellow and if it reaches the threshold, it is marked in red.

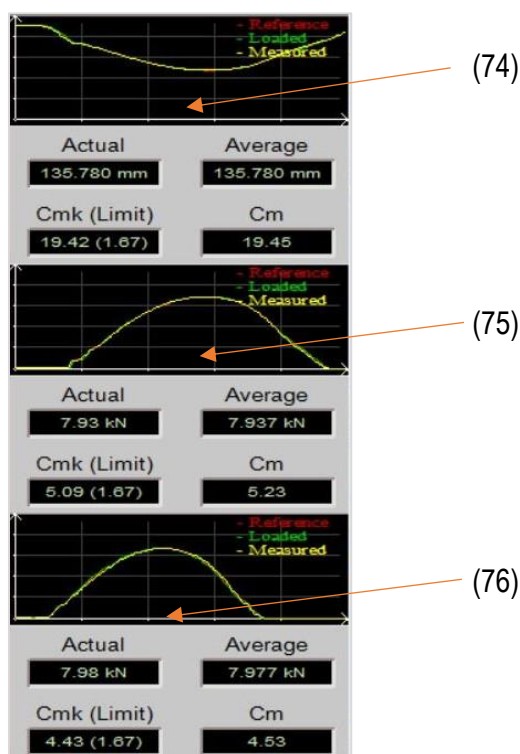
**(73) Maximum deflections**

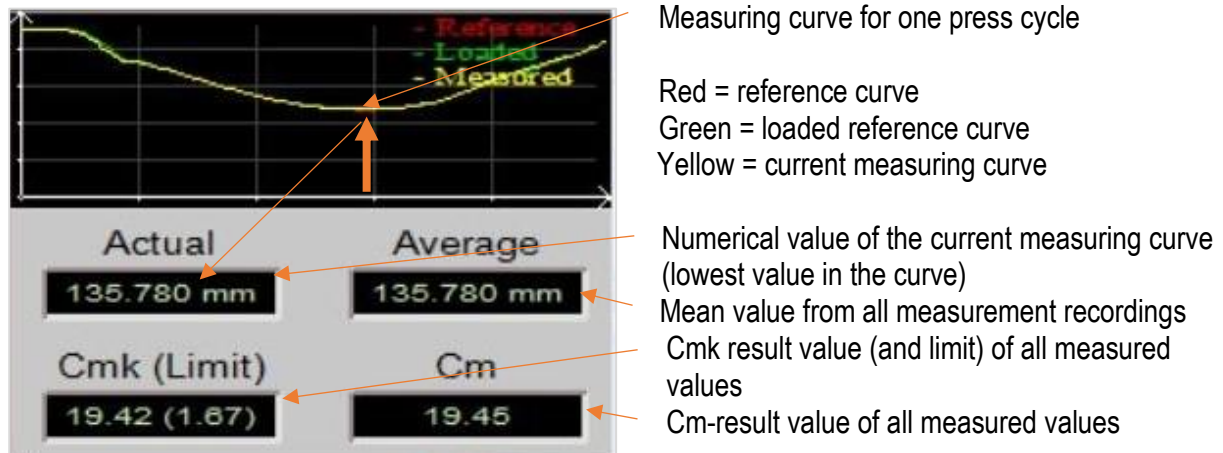
SD = standard deviation of all recorded measured values

Min. = smallest lower measured value

Max. = largest upper measured value

D = span between the smallest lower and the largest upper measured value

**13.2.2 Measurement curves and statistical values**

**(74) PAL shut height measurement**

**Red curve:** The reference curve is calculated from the mean value of the first three measurement curves and forms the comparison curve and the first zero value for all subsequent measurement curves.

**Green curve:** The green curve is loaded from the memory and is the first measurement curve of the previous measurement recording.

**Yellow curve:** The lowest value in the measurement curve (thick arrow) is the current measurement value, which is also transferred to the bar chart.

**Actual:** This numerical value is taken from the lowest reversal point of the measurement curve and forms the measured value for the column diagram as well as for all further calculations. It is always actual in relation to the displayed measurement curve. The value is identical to the lower reversal point of the press.

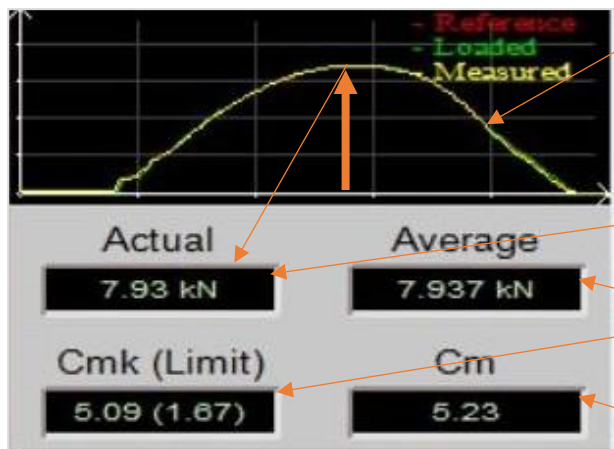
**Average:** The average value is formed from the sum of all measured values of a measurement recording.

**Cmk (Limit):** The Cmk value is the result of the machine capability test. It must not fall below the limit value (number in brackets). If the Cmk value is lower than the limit, the font colour changes to red and the press has the status "not capable" of producing crimps of the required quality.

**Cm:** The calculation of the Cm value is very similar to that of the Cmk value, but no value is placed on whether the measured values scatter around the zero line. This can mean that a press with a good Cm value and a poor Cmk value only needs to be set more precisely to the target shut height in order to also obtain a good Cmk value (machine capability index) when the test is repeated. As a rule, the Cm value is always slightly better than the Cmk value.



### (75) PAL reference force measurement



Measuring curve for one press revolution

Red = reference curve

Green = loaded reference curve

Yellow = current measuring curve

Numerical value of the current measurement curve (maximum value in the curve)

Mean value from all measurement recordings

Cmk result value (and limit) of all measured values

Cm-result value of all measured values

**Red curve:** The reference curve is calculated from the mean value of the first three measurement curves and forms the comparison curve and the first zero value for all subsequent measurement curves.

**Green curve:** The green curve is loaded from the memory and is the first measurement curve of the previous measurement recording.

**Yellow curve:** The highest value in the measurement curve (thick arrow) is the current measurement value, which is also transferred to the bar chart.

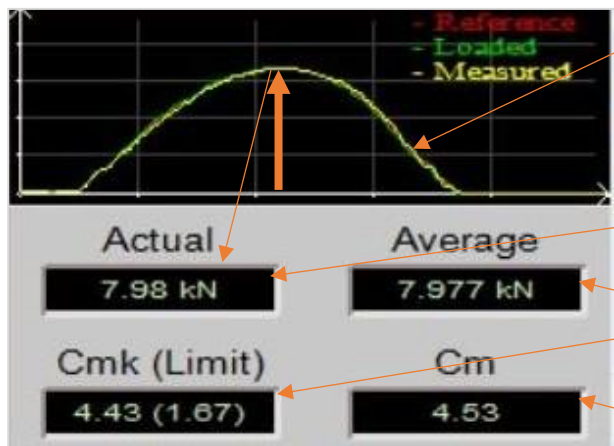
**Actual:** This numerical value is taken from the highest value of the measurement curve and forms the measurement value for the column diagram as well as for all further calculations. It is always actual in relation to the displayed measurement curve. The value is identical to the lower reversal point of the press.

**Average:** The average value is formed from the sum of all measured values of a measurement recording.

**Cmk (Limit):** The Cmk value is the result of the machine capability test. It must not fall below the limit value (number in brackets). If the Cmk value is lower than the limit, the font colour changes to red and the press has the status "not capable" of producing crimps of the required quality.

**Cm:** The calculation of the Cm value is very similar to that of the Cmk value, but here it is not evaluated whether the measured values scatter around the zero line. As a rule, the Cm value is always slightly better than the Cmk value.

### (76) Crimp monitor force curve



Measuring curve for one press revolution

Red = reference curve

Green = loaded reference curve

Yellow = current measuring curve

Numerical value of the current measurement curve (maximum value in the curve)

Mean value from all measurement recordings

Cmk result value (and limit) of all measured values

Cm-result value of all measured values

**Red curve:** The reference curve is calculated independently by the crimp monitor from the first measurement curves and forms the comparison curve and the first zero value for all subsequent measurement curves.

**Green curve:** The green curve is loaded from the memory and is the first measurement curve of the previous measurement recording.

**Yellow curve:** The highest value in the measurement curve (thick arrow) is the current measurement value, which is also transferred to the bar chart.

**Actual:** This numerical value is taken from the highest value of the measurement curve and forms the measurement value for the column diagram as well as for all further calculations. It is always actual in relation to the displayed measurement curve. The value is identical to the lower reversal point of the press.

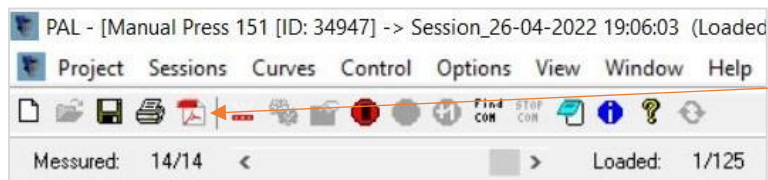
**Average:** The average value is formed from the sum of all measured values of a measurement recording.

**Cmk (Limit):** The Cmk value is the result of the machine capability test. It must not fall below the limit value (number in brackets). If the Cmk value is lower than the limit, the font colour changes to red. However, if the Cmk value of the reference force measurement in the PAL is still OK, this means that there are deficiencies in the crimp monitor that need to be corrected.

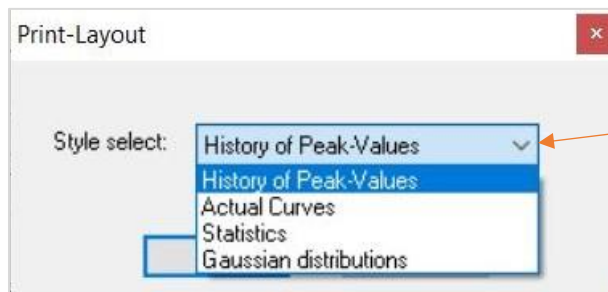
**Cm:** The calculation of the Cm value is very similar to that of the Cmk value, but here it is not evaluated whether the measured values scatter around the zero line. As a rule, the Cm value is always slightly better than the Cmk value.

## 14 Test documents

A test document can be generated from the machine capability test that is displayed in the work screen. The document type is a PDF.



Click on the pdf icon.

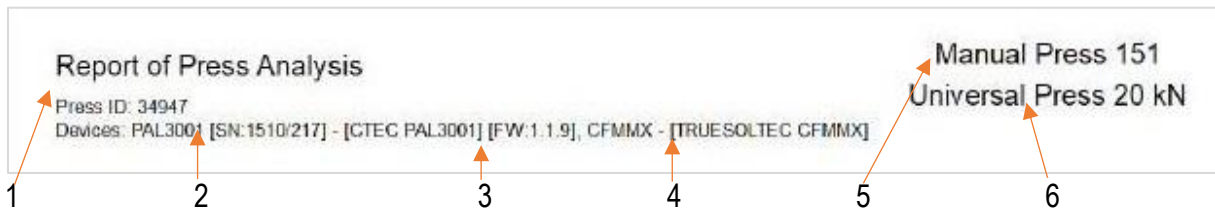


Four different templates can be selected via the drop-down menu.

Standard template: History of Peak-Values (bar chart)

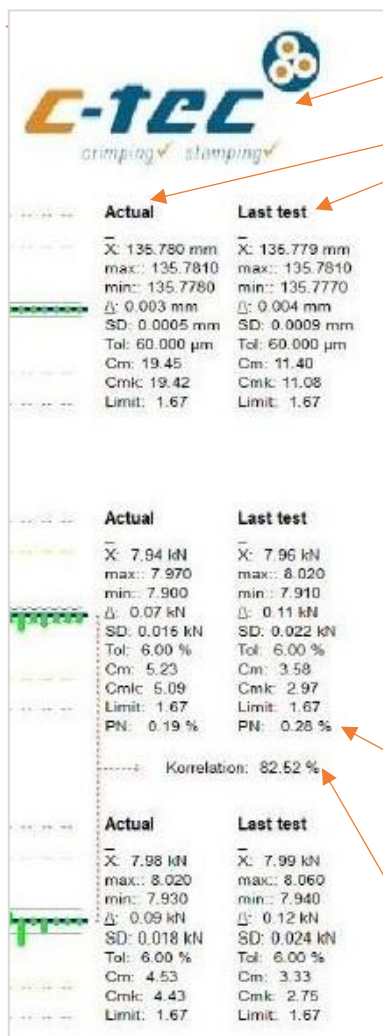


## 14.1 Header



- 1 Identification number (Press ID) of the press that was tested.
- 2 Serial number of the PAL 3001 with which the test was carried out.
- 3 Firmware number of the PAL with which the test was carried out.
- 4 Name of the crimp monitor, if one has been tested
- 5 Name of the tested press
- 6 Description of the press if an entry was made when the project was created.

## 14.2 Right column



Company logo (can be changed - see 13.1.3-54-Units)

Statistical results of the current measurement recording (Actual)  
 Statistical results of the previous measurement recording or loaded older recording for comparison (Last test)

$\bar{x}$ : Mean value formed from all individual measured values

max: The highest (uppermost) value of all individual measured values

min: The lowest (undermost) value of all individual measured values.

$\Delta$ : The range between the highest and lowest measured value

SD: Standard deviation calculated from all individual values

Tol: Tolerance for calculating the Cmk value (60  $\mu$ m = +/- 30  $\mu$ m).

Cm: Capability value without zero reference

Cmk: Capability index with zero reference

Limit: Limit value for Cmk. The result must not be less than the limit.

PN: Press Noise: The percentage value indicates how high the natural vibration of the press is. Values >0.5% are to be considered critical.

Correlation: The percentage indicates to what extent the measured values of the crimp monitor correspond to the reference values from the force measurement in the PAL 3001.



### 14.3 Footer on the left side

Service Cycles: 38930	Number of remaining service cycles
Version: 2.1.19d	Version number of the PAL PC software
Number of curves: 125	Number of recorded measurement curves
Temperature: 24.4 °C - 24.3 °C	PAL temperature from the beginning to the end of recording
Latest Test: 17-05-2022 16:21:54	Date and time of the last measurement
Session: Session_17-05-2022 16:25:04	File name for the document (PDF)
Print Date: 21-05-2022 13:54:44	Date and time of the creation of the document

### 14.4 Footer on the right side

Done by:

Max Mustermann

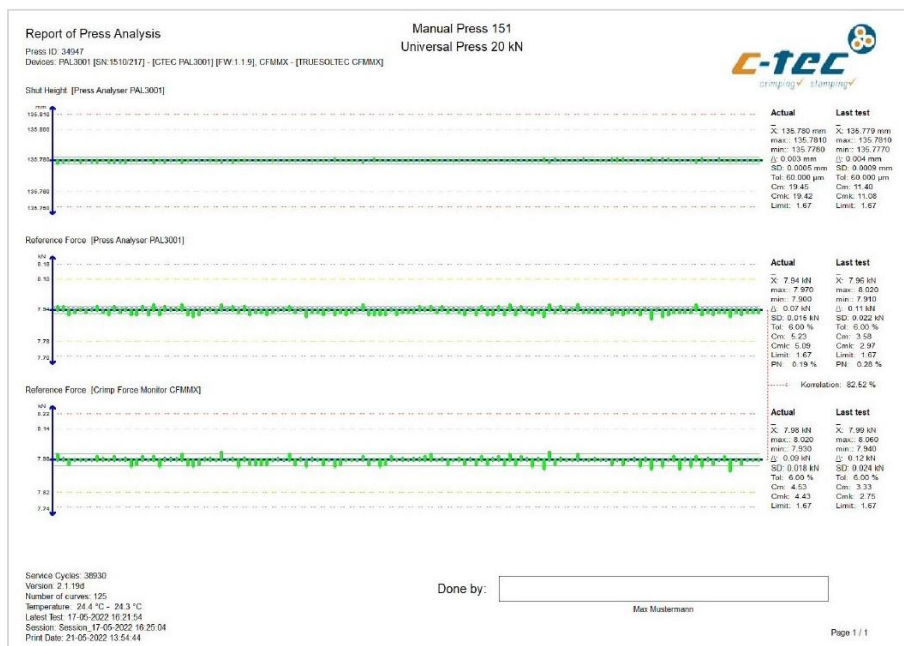
Page 1 / 1

Signature field      Name of tester      Document page

## 14.5 Document templates

### 14.5.1 Bar chart

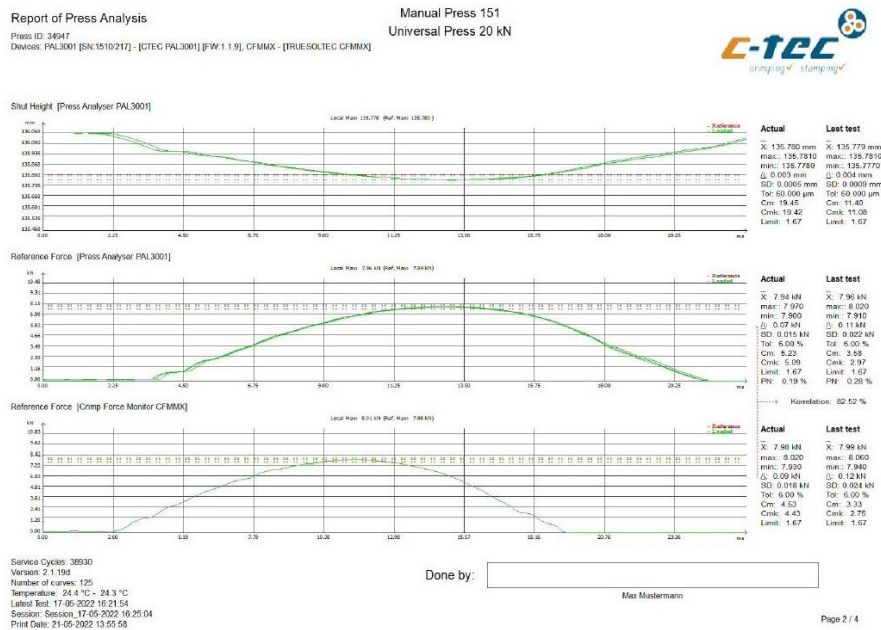
#### History of Peak-Values



All values of the individual measurements are displayed as columns.

## 14.5.2 Curve chart

### Actual Curves



The largest and smallest curve from all individual measurements is entered in the document.

## 14.5.3 Number chart

### Statistics



All numerical values of the individual measurements are entered. The largest and smallest individual value is recorded in bold.

## 14.5.4 Normal distribution

### Gaussian distributions



The values of the individual measurement are entered in a Gauss diagram.

## 15 Calculation of the statistical values

To calculate the Cmk for the force curves, a reference peak value is needed to which all subsequent force curves refer.

After the "teach-in", the Tech Peak (TP) is calculated from the maximum value of the first force curve.

Then the upper and lower specification limits are calculated using the "Specification Limit Force" (SL<sub>f</sub>) in % entered in the "Settings" window:

$$USL = TP \cdot \left(1 + \frac{SL_f [\%]}{2}\right) \quad LSL = TP \cdot \left(1 - \frac{SL_f [\%]}{2}\right)$$

These values are displayed in the histogram ((26), (27) and (28), see PAL programme).

For all following curves, the average of the peak values and the standard deviation is calculated:

$$Average = \frac{\sum Peak[i]}{Count} \quad sd = \sqrt{\frac{\sum (Peak[i] - Average)^2}{Count - 1}}$$

With these values the machine capability Cmk is calculated:

$$CMK_1 = \frac{USL - Average}{3 \cdot s_d} \quad CMK_2 = \frac{Average - LSL}{3 \cdot s_d}$$

The smaller value of the two results is used as Cmk: Cmk = Min (Cmk1, Cmk2)

$$CM = \frac{USL - LSL}{6 \cdot s_d}$$

The Cmk calculation for the shut height is slightly different from the force values.

The reference height is already known (135.78mm or 190.00mm) and must not be determined from the first measured curves. The reference height (Optimum Height OH) in mm is also entered in the "Settings" window like the specification limit for the height measurement SL\_h in µm.

This in turn is used to calculate the upper and lower specification limits for the height measurement:

$$SL\_h [mm] = \frac{\text{Spezifikationsgrenzen für Höhenmessung (SL_h) } [\mu m]}{1000}$$

$$USL = OH + \frac{SL\_h}{2} \quad LSL = OH - \frac{SL\_h}{2}$$

These values are shown in the histogram ((26), (27) and (28), see PAL programme).

The subsequent calculations are identical to the calculation of the Cmk for the force curves.

$$PN \text{ (PressNoise)} = 100 \cdot \frac{Sd}{Average}$$

Calculation of the correlation coefficient:

$$r = \frac{\sum[(x_i - \bar{x})(y_i - \bar{y})]}{\sqrt{\sum(x_i - \bar{x})^2 * \sum(y_i - \bar{y})^2}}$$

Legend:

r = correlation coefficient

x = Peak force PAL

y = peak force Crimp monitor

i = single value

$\bar{x}$  /  $\bar{y}$  = mean value



## 16 Testing external crimp monitors



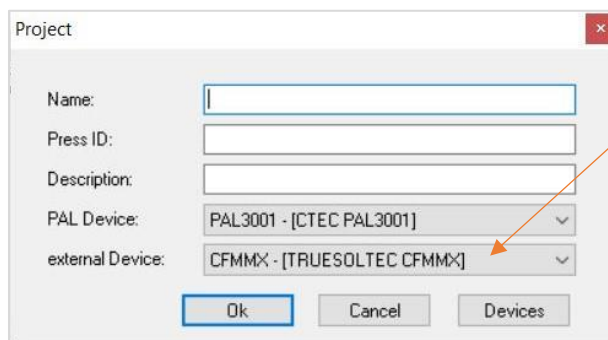
Crimp monitor CFM-MX / CFM-MX (N)

Both single-channel and two-channel units can be tested.



Plug the RS232 interface cable into the RS232-CH2 connector of the crimp monitor and connect it on the PC side to the second channel of the USB 2.0 to 2 x RS232 adapter.

Now the crimp monitor must be activated in the PAL PC software.



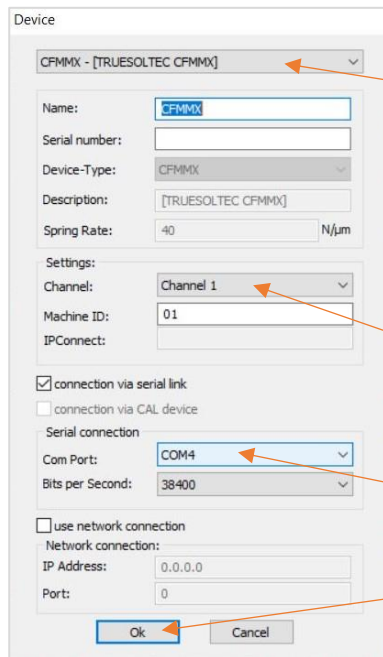
Variant 1: Activate crimp monitor already when creating the press project (see: 12.3.1)

Variant 2: Activate or change the crimp monitor in an existing press project.



Click on this button.

The entry field "Device" opens.

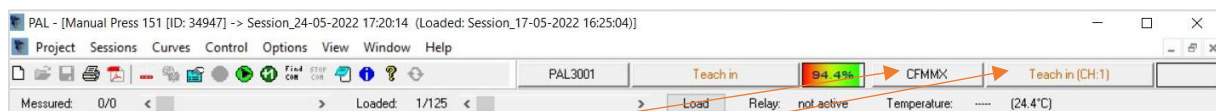


Select CFM-MX from the drop-down menu.

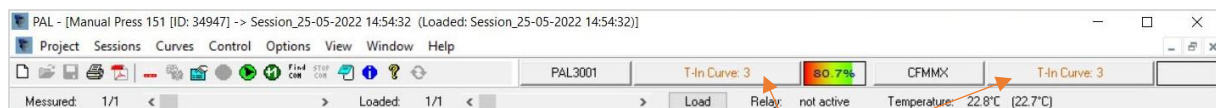
In the drop-down menu, select which measuring channel is to be tested on the crimp monitor.

In the drop-down menu, select the COM port to which the crimp monitor is connected.

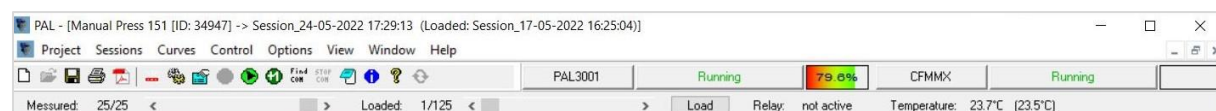
Confirm the selection with OK.



CFM-MX and Teach-in (CH 1/2) should now be displayed in the header.

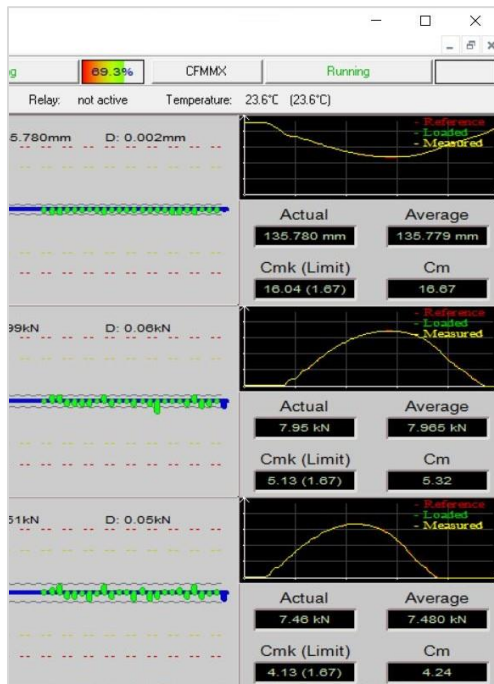


The first 5 measurement curves are recorded as teach-in curves.

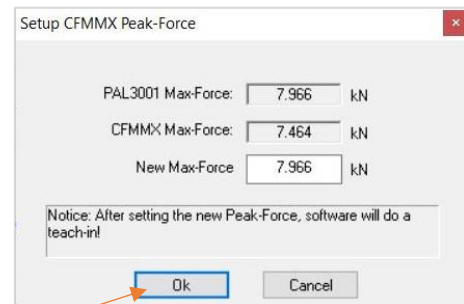
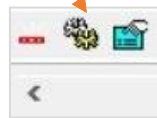


From the 5th trace onwards, the display changes to Running and the recording of the measured values for the capability test begins.

### Transmit calibrated PAL force to crimp monitor



If the calibrated peak force of the PAL 3001 does not match the peak force of the crimp monitor after the first measurement, this can be corrected by clicking on the "gear icon".



Confirm the referencing of the crimp monitor with OK.

### Measurement recording with three measurement channels





**Please consider your environmental responsibility before printing this document.**

### Version legend:

Date	Version	Responsible	Revision
2008	1.0.0	Lothar Schreiner	Change: Original state
27.06.2022	2.1.11	L. Schreiner / M. Egginger	Fundamental revision of all chapters

### Notes: