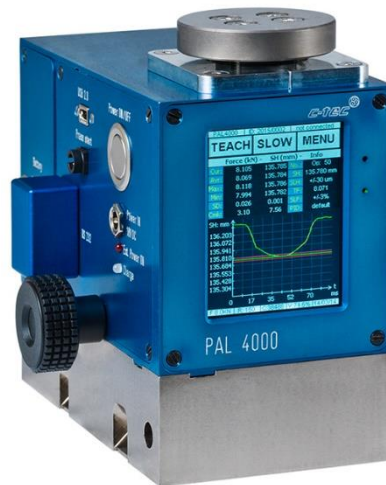


PAL 4000

Electronic measurement device
for machine capability check
of crimping presses

Operation Manual
English
Version 1.1.0



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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

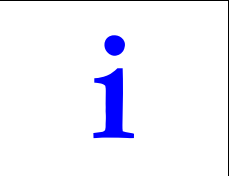
	<p>Attention!</p> <p>Intended use also includes:</p> <ul style="list-style-type: none"> • Observance of all information in the operating instructions. • Observance and execution of all inspection and maintenance measures. <p>Non-observance is a safety risk!</p>
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Hotline

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

	<p>Please be aware that the PressAnalyser PAL 4000 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 PressAnalyser PAL 4000 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 PAL 4000 loads the crimping press with a constant counterforce of 8 kN. The measuring values will be saved and entered in a graph where the values are statistically evaluated. Additionally the PAL 4000 can be used as a height setting gauge. In contrast, conventional static dial gauges the PAL 4000 allows to determine the difference between the ideal and the actual shut height very comfortably in an automatic process.

Of course, before delivery the PAL 4000 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 4000 has been developed for examining crimp presses of “mini applicator type”. Usually, such a press has a maximum press force of approx. 25 kN. 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 4000
Charging device	115 – 230 V AC to 24 VDC
Power supply	Accu-Pack with 10xMignon Accu NiMH, 2000 mAh (only rechargeable batteries*), size AA
Battery capacity after full load	approx. 6 hours
Counterforce	continuously variable from 1 – 20 kN
Maximum measurable load	20kN
Resolution height sensor	0.5 µm
Measuring path height sensor	optimum shut height ± 400 µm
Resolution force sensor at 8 kN	2.5 N
Calibrated shut height	135.780 mm
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	4.6 kg



Danger!

*Please use only **rechargeable batteries*** (1.2V nominal voltage).
 Never insert alkaline batteries (1.5V nominal voltage, **non-rechargeable**)!
 There is a considerable risk of fire when charging alkaline batteries,
 substantial damage to persons and devices cannot be excluded!

5 Scope of delivery

Standard delivery must include:

- Case for transport and storing
- Main unit Press Analyser PAL 4000
- USB 2.0 connector cable (USB-A to USB-B), 3m length
- Relay box for automatic press triggering
- Sharpening stone
- Power supply unit 24 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 4000 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 4000 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.

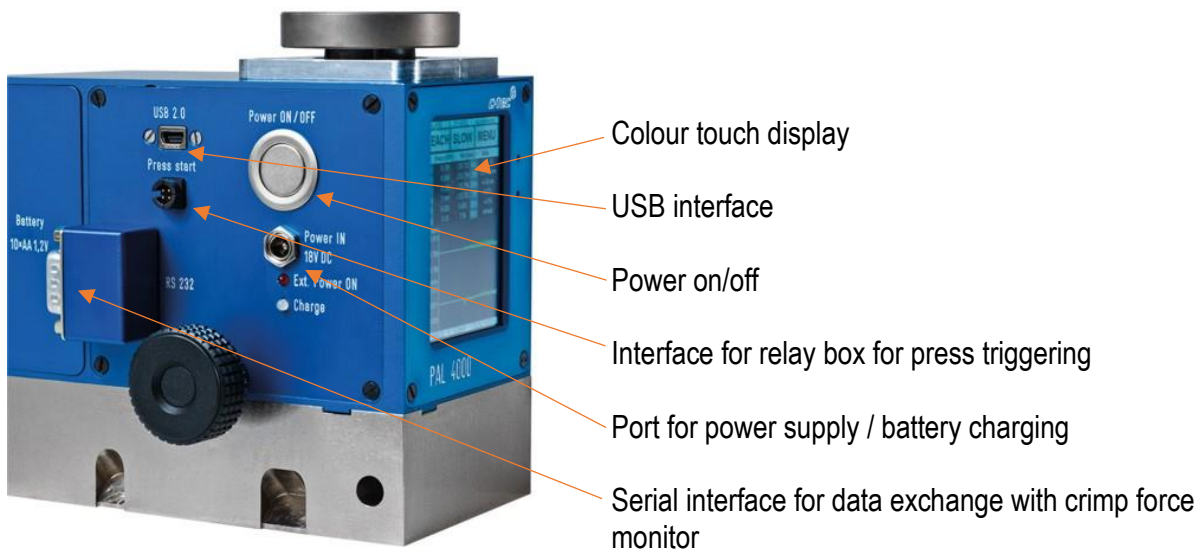
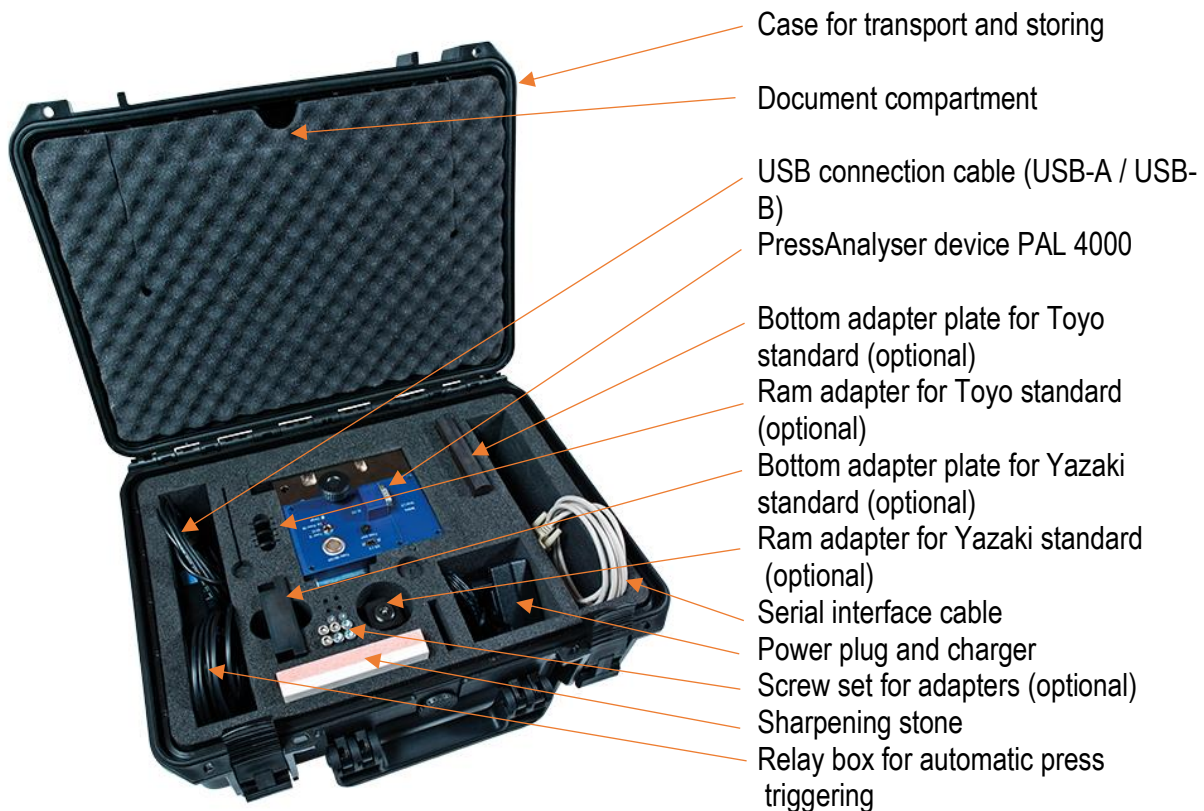
DANGER TO LIFE: Never put safety devices of the crimping press out of operation. Please work only with closed protection covers.

10 Maintenance

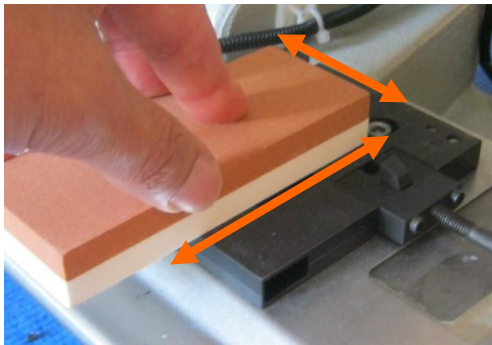
The PAL 4000 requires no maintenance from the user. After the maintenance cycles have expired (can be read in the PAL PC programme) or after one year of operation, the Press Analyser should be sent back to C-tec for inspection and re-calibration.

11 Starting up

11.1 Parts, accessories and operating controls

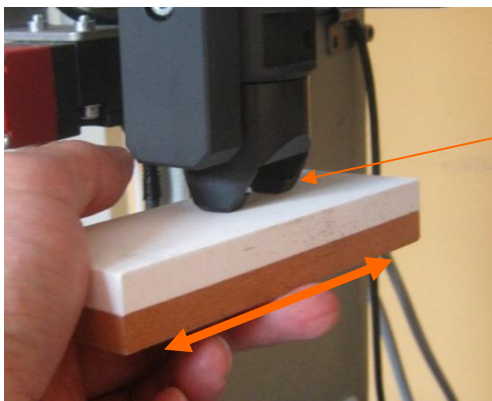


11.2 Preparations



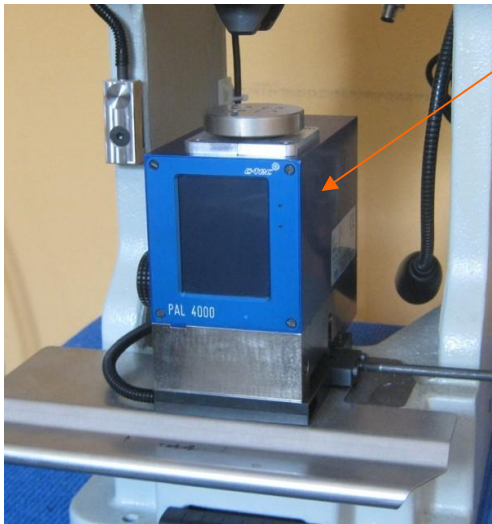
First clean the surface of the base plate with the sharpening stone and possibly sand out imperfections. Remove the grinding dust from the plate with a cloth.

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

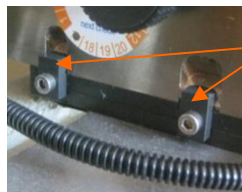


Clean the surface of the pressure piece at the ram in the same way by using the sharpening stone.

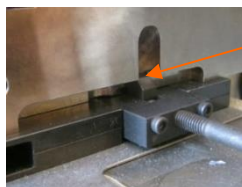
Note: If the pressure piece is damaged too heavily, it must be replaced.



Now set up the PAL 4000 in the press and fix it there.



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



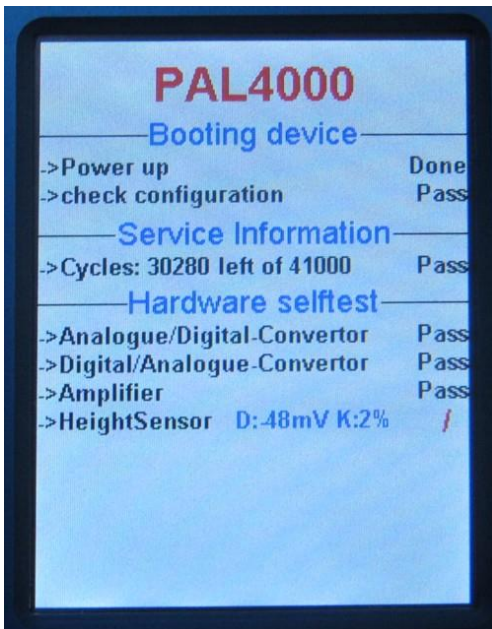
Fix the Press Analyser with the movable clamping claw like a crimping tool.

12 Perform a press capability test

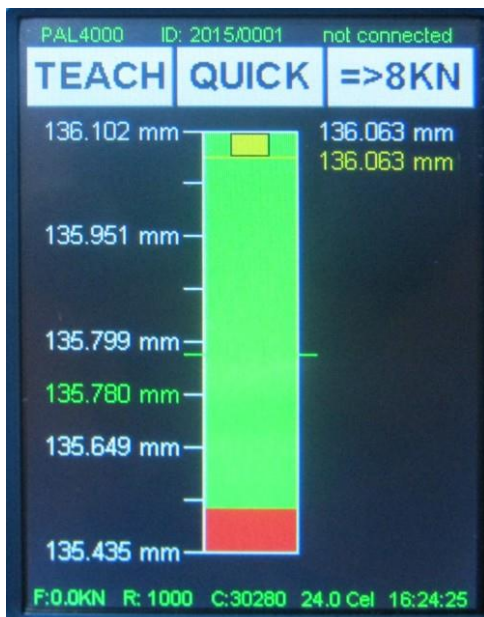
12.1 Slow-motion test



Press the Power ON/OFF button for at least 2 seconds until you hear a short confirmation tone and then release it.



After switching on, the PAL 4000 performs a self-diagnosis.

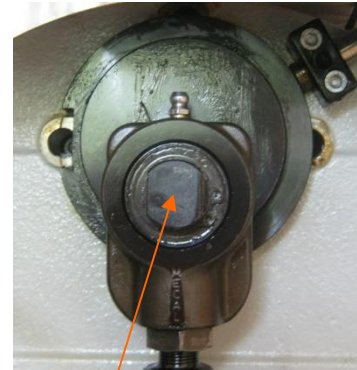


After a successful self-diagnosis the PAL 4000 switches to the slow-motion mode. In this mode, the PAL 4000 sets itself to 0 kN and thus does not apply any counterforce to the press.

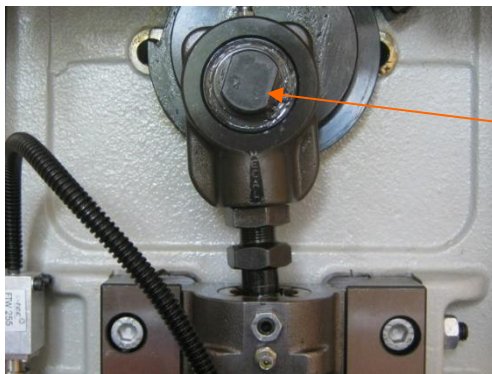
This mode allows a rough pre-selection of the press' shut height. This helps to avoid damages on the PAL or the press if the press is set to deep.



Turn the press ram by hand through the bottom dead center (BDC) and stop shortly after the BDC. If the press has a creep speed it can be used to drive the ram through the BDC.

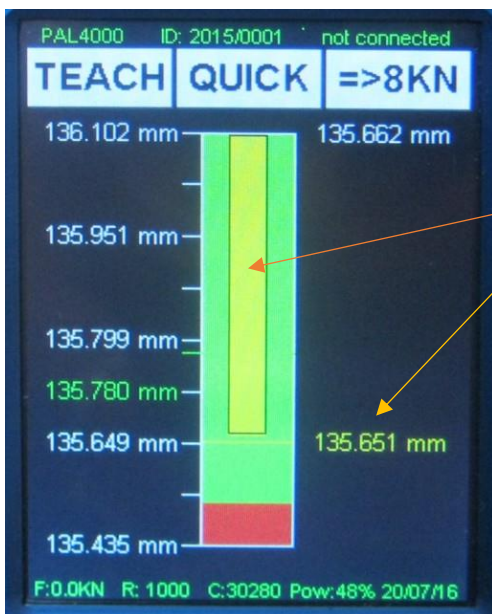


BDC position (bottom dead center)



Stop the ram after the BDC position (approx. 200°).

Important: BDC must be passed through! It does not matter whether clockwise or anticlockwise.

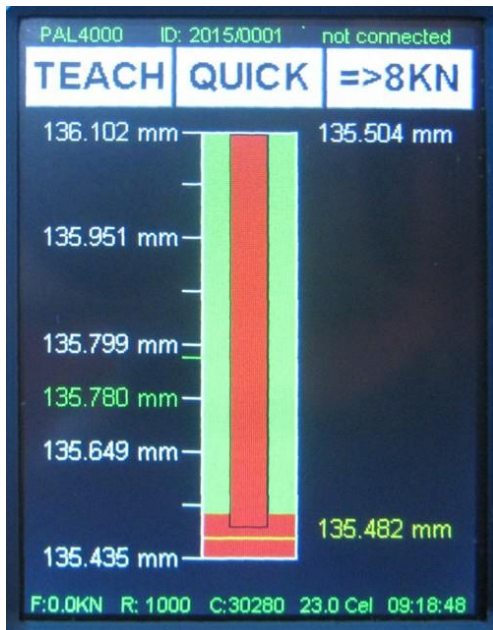


The PAL 4000 display shows the deviation of the BDC from the optimal value of 135.780mm.

The yellow bar indicates the actual depth of the ram. The yellow number on the right side shows the value of the bottom dead center.

In this example the BDC is at 135.651 and thus 0.129mm underneath the optimum value (135.780mm).

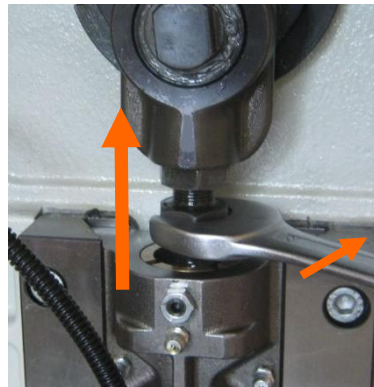
Examples for extreme deviations in the shut height:



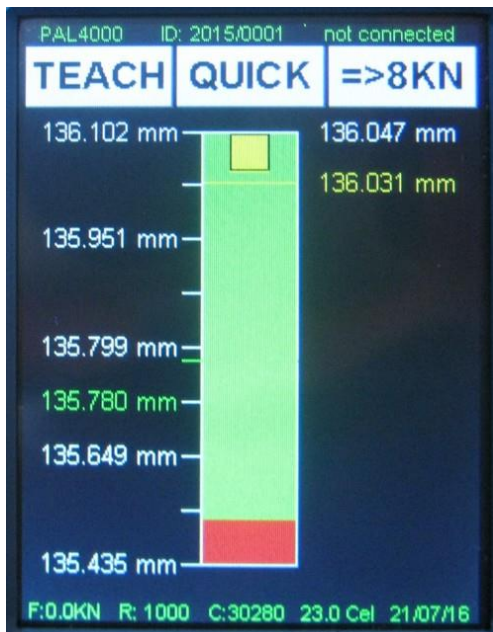
Attention: Press is set too deep (red bar). The BDC is at 135.482 mm and hence 0.3mm too deep.

The press must not be started!

Adjust the press ram approx. 0.3mm upwards.

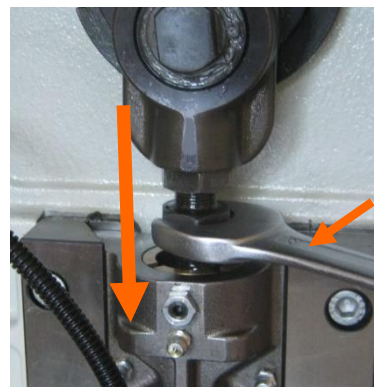


Adjust the press ram upwards and fix it with the setscrew!



Press is set too high (yellow bar). The BDC is at 136.031 mm and thus 0.251 mm too high.

Adjust the press ram approx. 0.25 mm downwards.



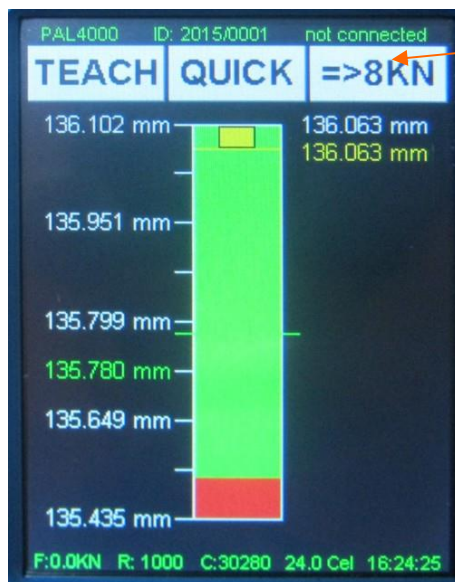
Adjust the press ram downwards and fix it with the setscrew!

Example for tolerable deviation of the shut height:


The bottom dead centre of the press is pre-set optimally. Values between 135.600 and 135.960 are fine.

Attention: If the bar reaches the “red area” in the slow-motion test, the press engine shall not be started by any means.

12.2 Fine tuning of the press with 8 kN load



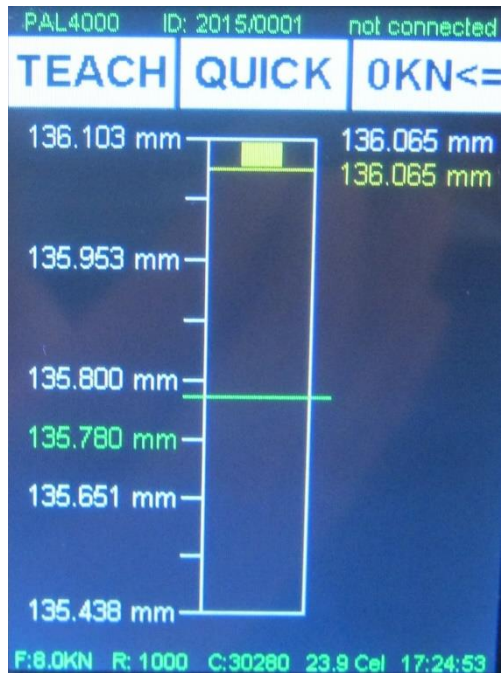
Touch the field =>8 kN on the touch screen. The PAL 4000 chooses the load for 8kN automatically.



The red dot on the force scale shows the current force range of the device.



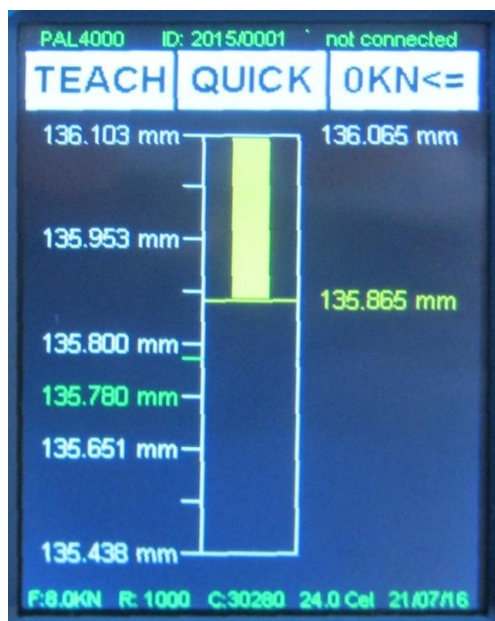
If the button changes to 0 kN<=, the 8 kN position has been reached. In case of touching it again, the 0kN position (slow-motion position) would be approached once again.



The press can now be started with motor power



Start/trigger the press by motor via the foot switch or the automatic start system.

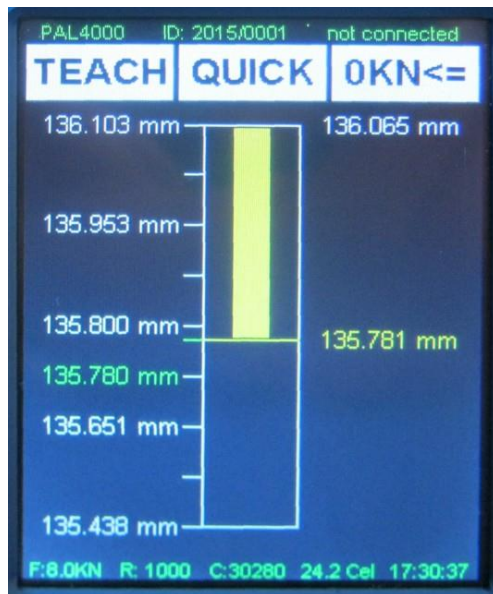


N As the unit now loads the press with a counterforce of 8kN, the press "opens". That means that the bottom dead point (BDC), which was previously set without force, shifts slightly upwards, in this example by at least 100 μm . This behaviour can be found in all presses in different orders of magnitude. 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.



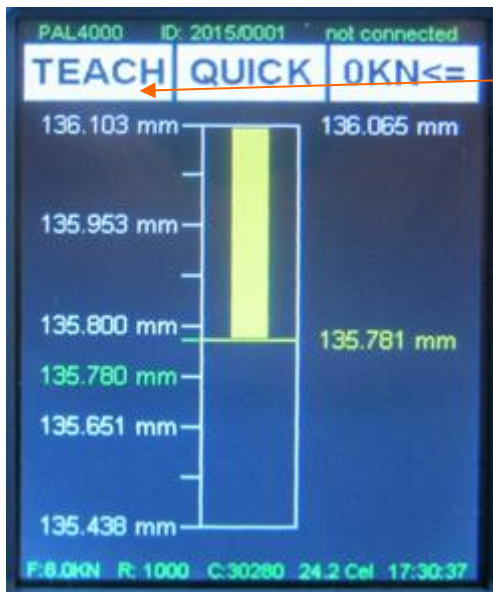
Adjust the press ram downwards and secure the adjusting screw again!



Afterwards the press can be started again with engine power. The lower turning point will be shown in the display. This procedure has to be repeated till the BDC is set around ± 0.005 mm.

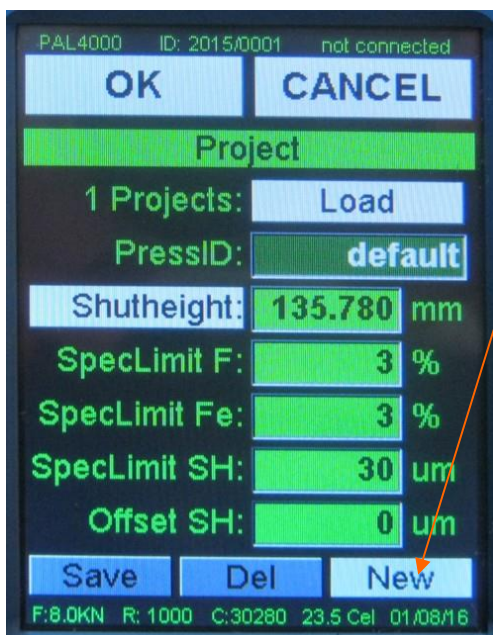
In this example the BDC is set 0.001mm above the optimum. The BDC of the press is thus perfectly set.

12.3 Preparation of press analysis



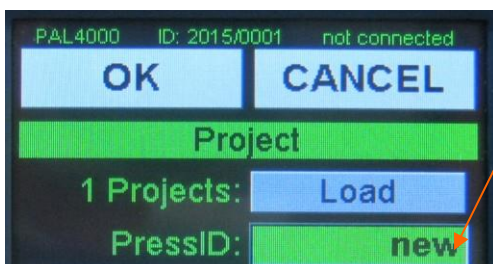
Press TEACH on the touch screen. The display switches to the input window, in which you can enter the data of the crimping press to be tested.

Input window for press data

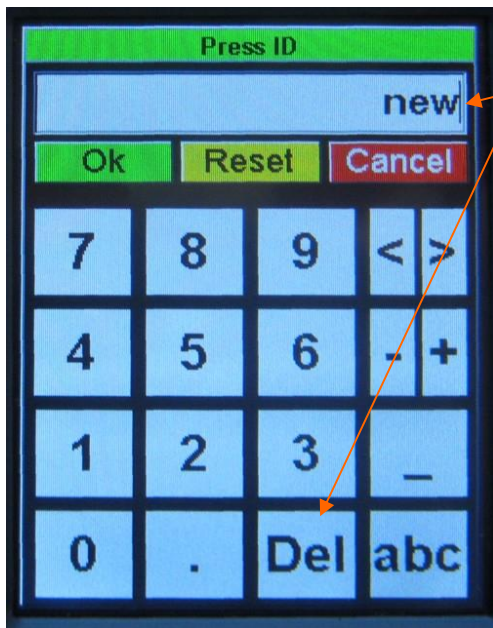


Press the field New first.

The content of the field PressID now changes from default to new.



Touch the field new.

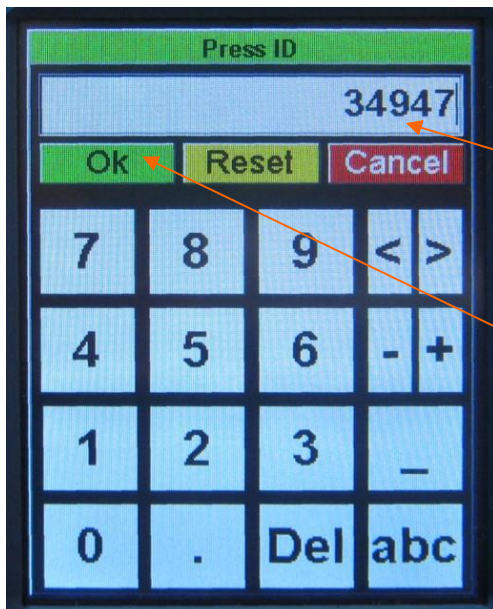


Delete the word -new- by pressing the field Del.

Via the numeric keypad the press number (Press ID) can be entered. It usually can be found on the type label.



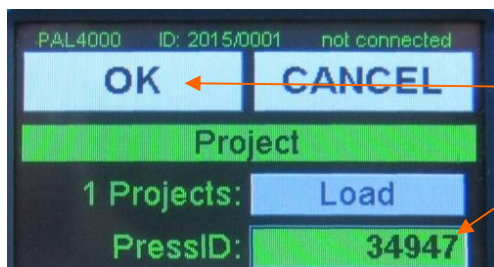
Example:
Press number
is 34947



Enter the press number via the keypad. By touching the field "abc" the keypad switches between the alphabet and numbers.

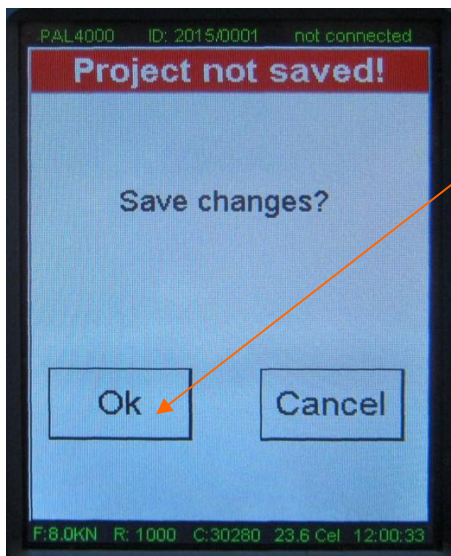
The field "Del" is used to delete wrong entries.

After entering the press number touch the field Ok.

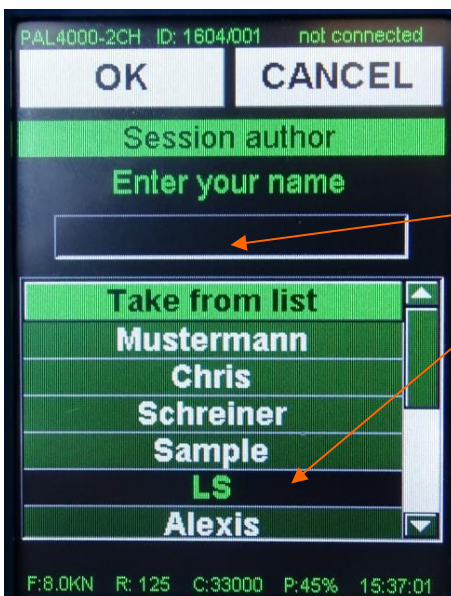


Now hit again on OK to switch the data storage to the actual press ID.

The press number appears in the field Press ID.



Press OK to create a file for this crimping press on the internal mass storage.



Enter test engineer's name

If the name is not available, it can be entered by pressing the field below "Enter your name".

Once the name has been entered, it is saved and can be selected from the list. By pressing the name, it is transferred to the input field for the author.

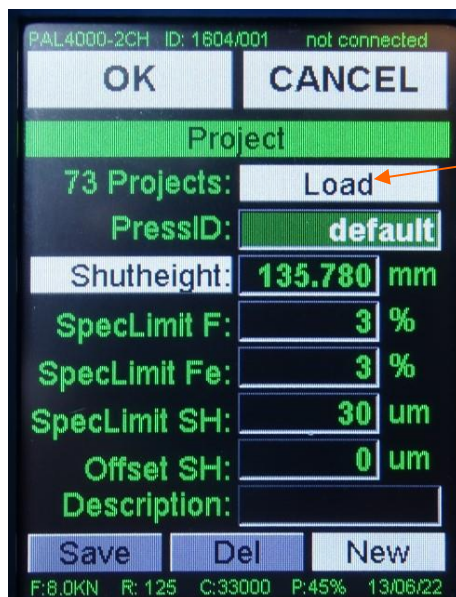


By pressing Ok, the test name is stored for the subsequent measured value recording.

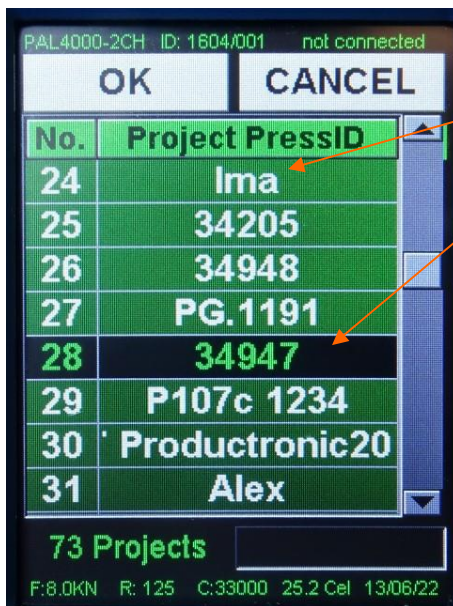


Now a menu appears which can be left by touching the field EXIT.

12.3.1 Press ID already exists in the memory of the PAL 4000

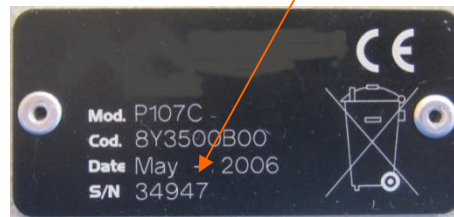


Press on the field "Load".



A list with all available press numbers opens.

Select the identification designation of the press to be tested by touching it and confirm the selection by pressing "Ok".



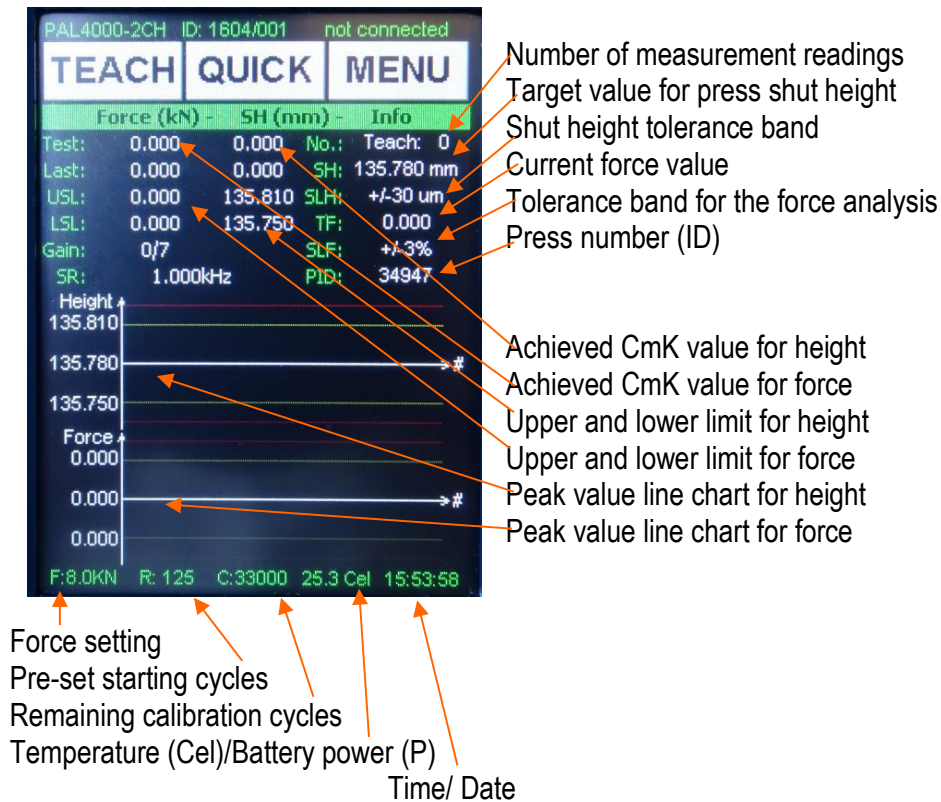
Example for Press ID: 34947



After pressing "Ok", a file is opened for recording the measured values for the crimping press on the internal mass memory.

See above (12.3.1): Enter test engineer's name

The PAL 4000 is now ready for running a press capability test.

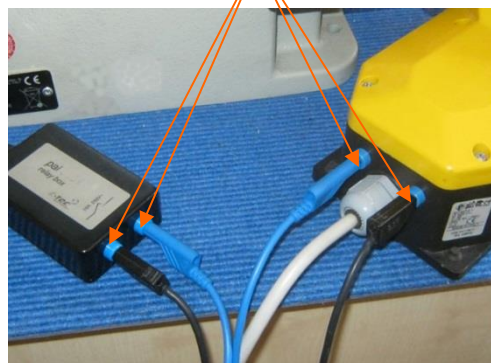


Start the crimping press to record the measuring values. There are two possibilities to do this:

1. Trigger the press manually by the foot switch.
2. The press is automatically triggered by the PAL 4000. For this purpose, the clock generator (relay box) must be connected to the PAL 4000 (connection: "Press Start").

Attention: The connection to the press may only be made by qualified personnel.

A connection to the foot switch signal must then be made from the output of the clock generator.



Connection with the relay box.

12.4 Performing a press analysis

12.4.1 Triggering the press with the foot switch



The easiest way is to start the crimping press with the foot switch for all measuring cycles.
 (C-tec recommendation: 125 cycles)

Example for a conducted test series



Number of measurement readings (125)

Last measurement value

Average over all readings

Largest single value

Smallest single value

Standard deviation

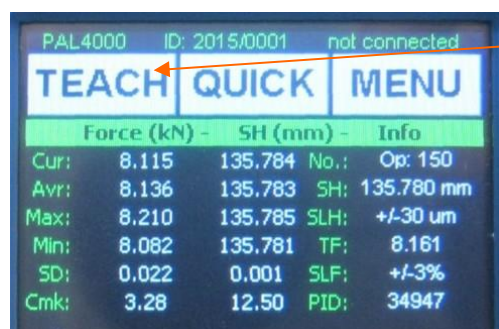
Cmk value of the test (machine capability index)

Column for height measurement

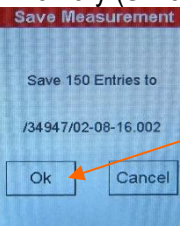
Column for force measurement

Peak value line for height

Peak value line for force



Press TEACH to save the single values in the internal bulk memory (SD card).



The appearing window asks whether the measurement should be saved or discarded.

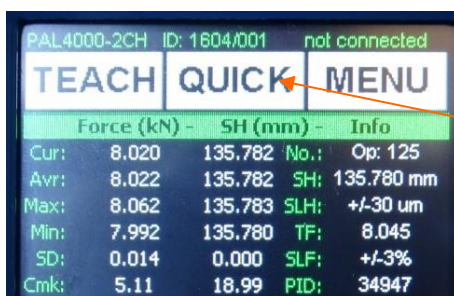
By touching Ok the measurement results will be shifted to the internal mass storage.

If the unit is not used for more than 5 minutes, the PAL 4000 switches off automatically. Before switching off, unsaved measured values are moved from the working memory to the mass memory.

12.4.2 Triggering the press with the PAL relay box



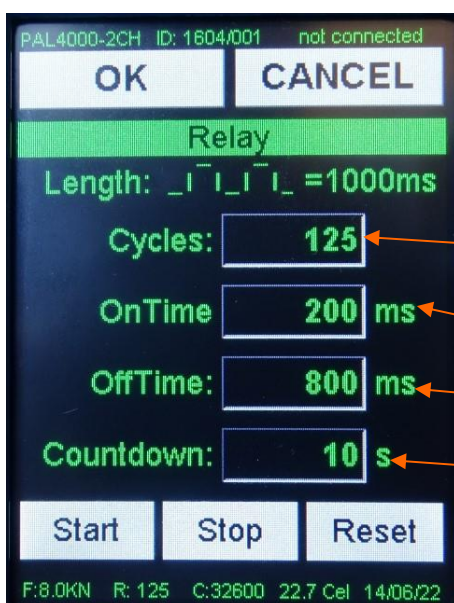
After the connection between the clock (relay box) and the foot switch signal has been established (see also page 21), the press can now be started via the PAL 4000.



Press the field QUICK.



Press SETUP in the menu that now opens.



In the next menu the measuring rate for the press analysis can be set.

Number of press triggers for a test

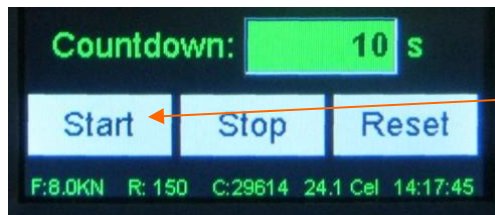
Length of starting signal

Length of signal pause

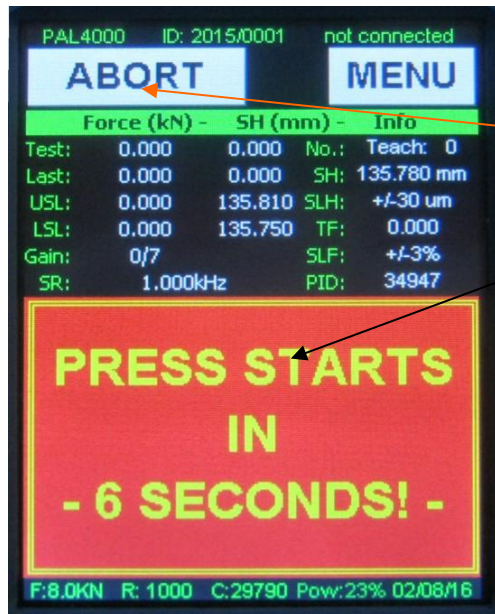
Countdown in seconds

Start signal + signal pause = cycle time

The terms can be changed in wide ranges. Enter the desired value via the numeric keypad.



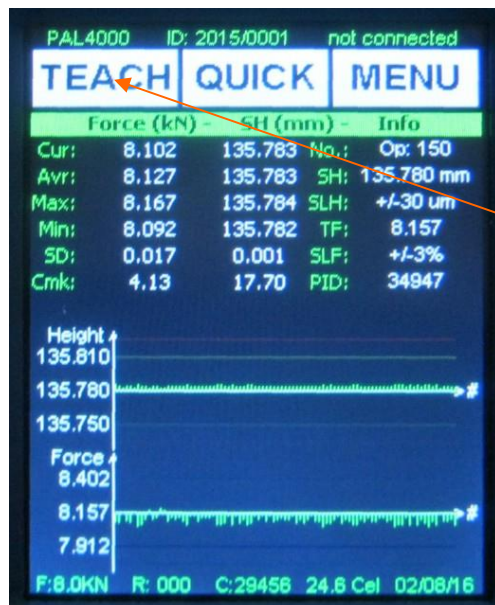
Press Start.



The countdown can be interrupted by touching ABORT.

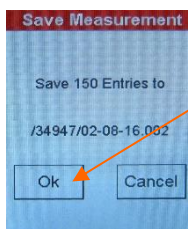
After pressing Start, the selected countdown begins to run. Meanwhile all safety devices can be closed properly. The measurement starts after the countdown has finished. The press will be started cyclically till the test series is finished.

Example for a conducted test series.



For explanation of the display please see 11.4.1

Press TEACH to save the measurement values.



By touching Ok the measurement results will be shifted to the internal mass storage.

13 Transferring the test results to the PAL PC software

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.



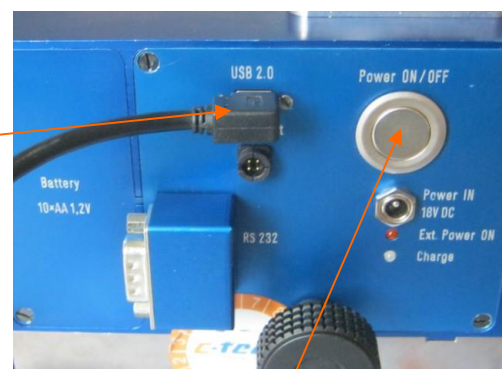
Run the installation programme Setup.exe and enter the required information.



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



Connect the USB cable with the PAL 4000 und a USB port of the PC.



Switch on the PAL 4000

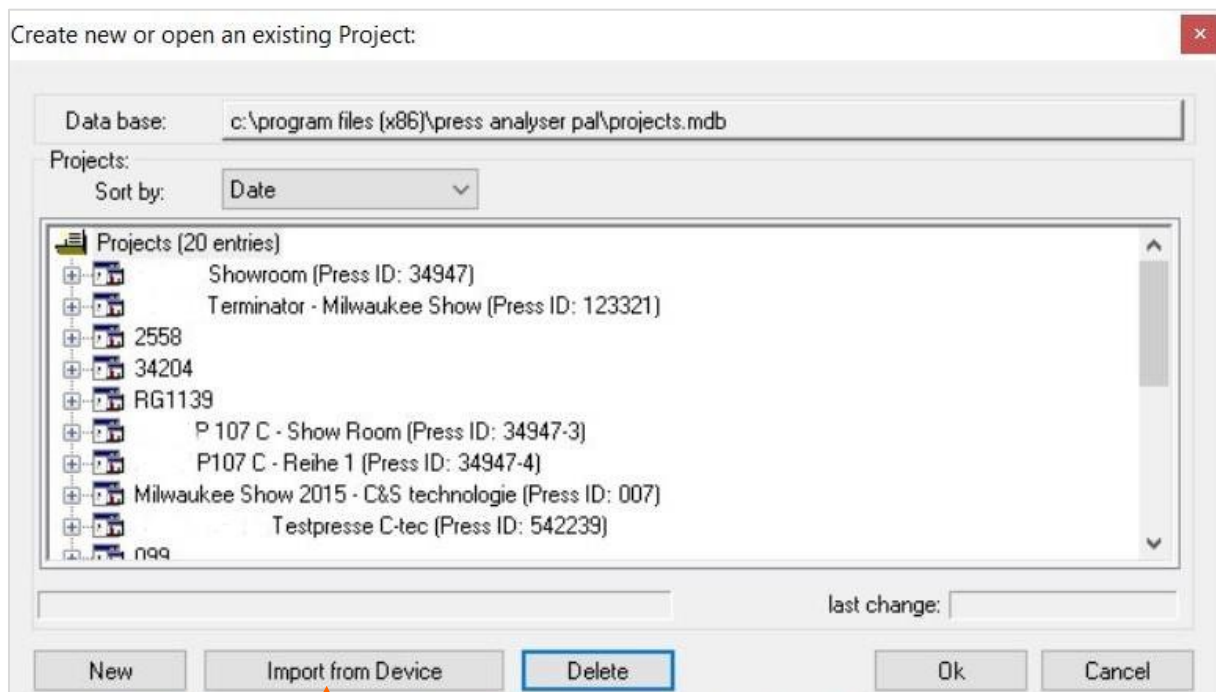


Start the PAL PC software by double click on the icon on the desktop.



From version 2.1.16 on the software is compatible with PAL 4000 as well as PAL 3000.

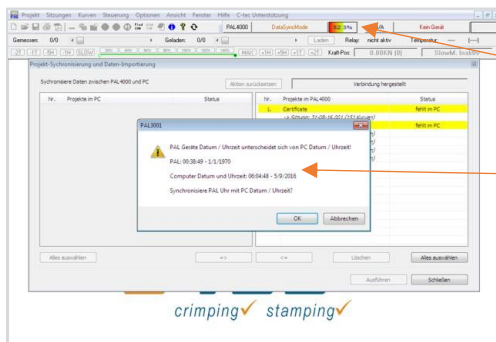
The preview window shows all presses that have already been tested once with PAL and are therefore saved on the PC.



Click on the "Import from Device" button.



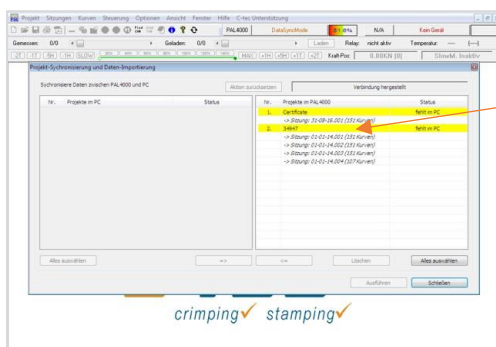
The message: "Wait for connection ..." indicates that the connection to the PAL 4000 still has to be established. If no connection has been established after approx. 60 seconds, click on the "Find COM" field. This is necessary, for example, if a new USB slot is used on the PC or laptop for the first time.



The connection to the PAL 4000 is now established. This can be seen from the display of the PAL 4000 battery charge status. This possible "intermediate message" indicates that the PAL 4000 internal time does not match the PC time. If the time on the PAL 4000 is to be adjusted, click on OK and if not, on Cancel.



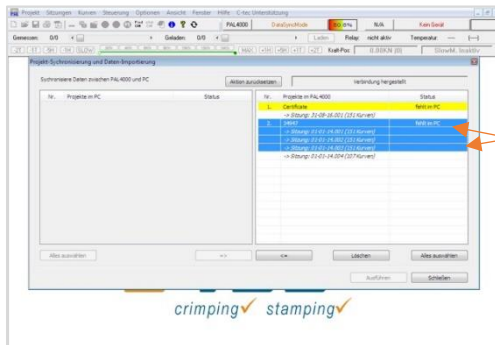
The PAL display shows by the rotating arrows that the connection to synchronise the data with the PC is active.



The right half of the screen now shows the projects (crimping presses) with a yellow background that are stored on the PAL 4000 but not yet synchronised with the PAL PC programme. In this example there are two different presses.

Nr.	Projekte im PAL4000	Status
1.	Certificate -> Sitzung: 31-08-16.001 (151 Kurven)	fehlt im PC
2.	34947 -> Sitzung: 01-01-14.001 (151 Kurven) -> Sitzung: 01-01-14.002 (151 Kurven) -> Sitzung: 01-01-14.003 (151 Kurven) -> Sitzung: 01-01-14.004 (107 Kurven)	fehlt im PC

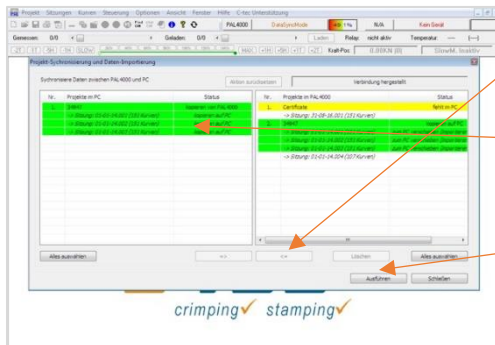
For the first press, one measurement with 150 curves was carried out. At the second press, 4 measurements were made with 150 and 106 curves respectively.



With a mouse click or CTRL + mouse click, individual or several data sets can be selected for transfer.
Example: A press project with three measurement data sets is selected (blue background).

Nr.	Projekte im PAL4000	Status
1.	Certificate -> Sitzung: 31-08-16.001 (151 Kurven)	fehlt im PC
2.	34947 -> Sitzung: 01-01-14.001 (151 Kurven) -> Sitzung: 01-01-14.002 (151 Kurven) -> Sitzung: 01-01-14.003 (151 Kurven) -> Sitzung: 01-01-14.004 (107 Kurven)	fehlt im PC

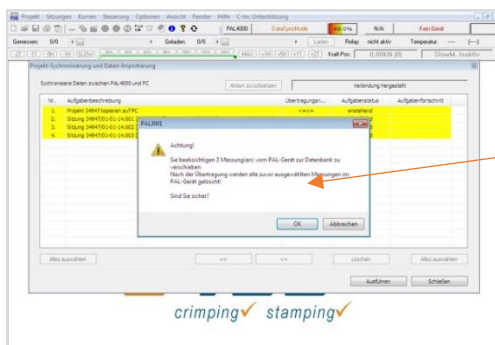
The data set for the press with the serial number 34947 incl. the first three measurement series was selected.



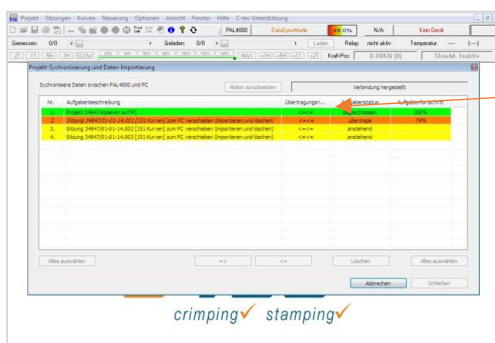
Then click on the <= button (in the direction of PC save).

The left half of the screen now shows green fields to indicate that the PC memory is activated.

Now click on the Execute button.



The security prompt reminds you that the data will be deleted from the PAL 4000 after transfer to the PC!
Click on OK to start the transfer.



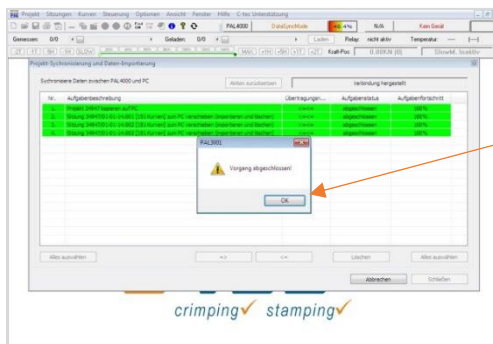
The selected data is now transferred.

Nr.	Aufgabenbeschreibung	Übertragungsri...	Aufgabenstatus	Aufgabenfortschritt
1.	Projekt 39497 kopieren auf PC	<= c.c.	abgeschlossen	100%
2.	Sitzung 39497/01-01-14.003 [151 Kurven] zum PC verschieben (importieren und löschen)	<= c.c.	abgeschlossen	100%
3.	<u>Sitzung 39497/01-01-14.002 [151 Kurven] zum PC verschieben (importieren und löschen)</u>	<= c.c.	<u>übertrag</u>	<u>50%</u>
4.	Sitzung 39497/01-01-14.003 [151 Kurven] zum PC verschieben (importieren und löschen)	<= c.c.	anstehend	

The press ID and the data of the first measurement are already transferred. The second measurement is 50% complete.

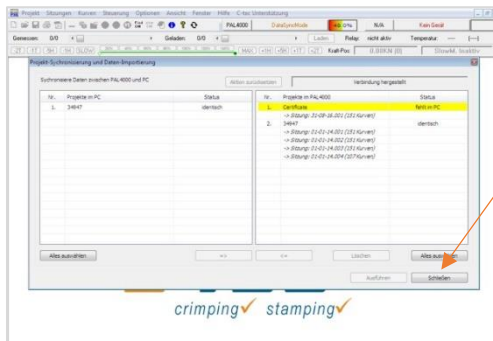
Nr.	Aufgabenbeschreibung	Übertragungsri...	Aufgabenstatus	Aufgabenfortschritt
1.	Projekt 34947 kopieren auf PC	<=<=<	abgeschlossen	100%
2.	Sitzung 34947/01-01-14.001 [151 Kurven] zum PC verschieben (importieren und löschen)	<=<=<	abgeschlossen	100%
3.	Sitzung 34947/01-01-14.002 [151 Kurven] zum PC verschieben (importieren und löschen)	<=<=<	abgeschlossen	100%
4.	Sitzung 34947/01-01-14.003 [151 Kurven] zum PC verschieben (importieren und löschen)	<=<=<	übertrage	8%

The data of the fourth measurement is just being transmitted.

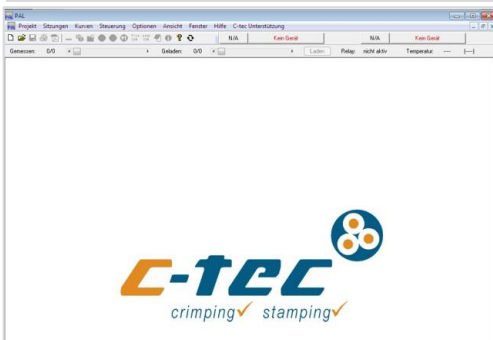


All data have been transferred successfully.

Click on OK to exit.

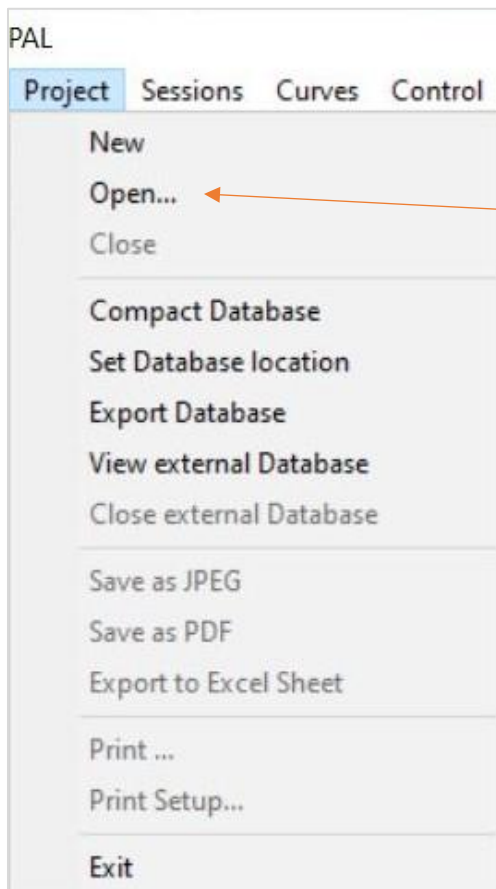


Click on “Close” to exit the synchronization.

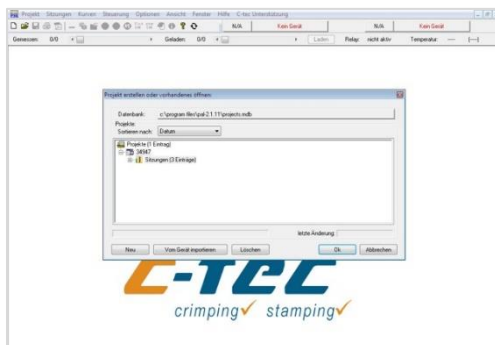


Data synchronization has been completed.

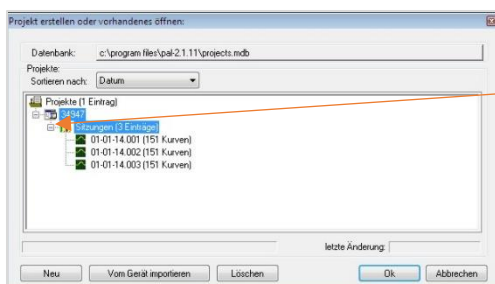
14 Evaluation of the data on the PC



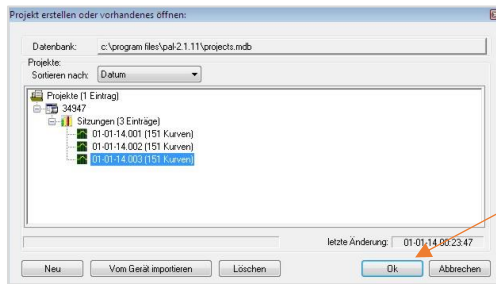
To work with the data on the PC click on "Project" and choose "Open" in the dropdown menu.



The transmitted press project appears in the tree structure.

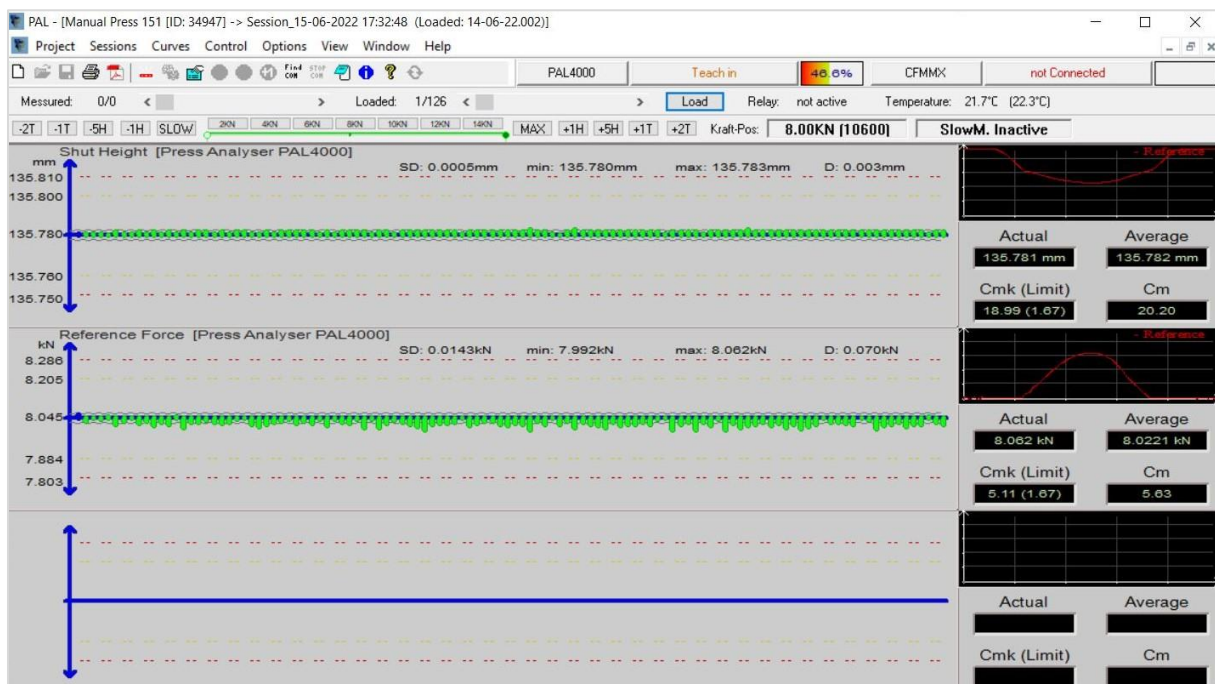


By clicking on the + you can "fold down" the single test series.



You can only select one test series by clicking on it. In the example the last measurement has been chosen.

Press Ok to load the test series.



The measurement data is now available on the PC monitor.

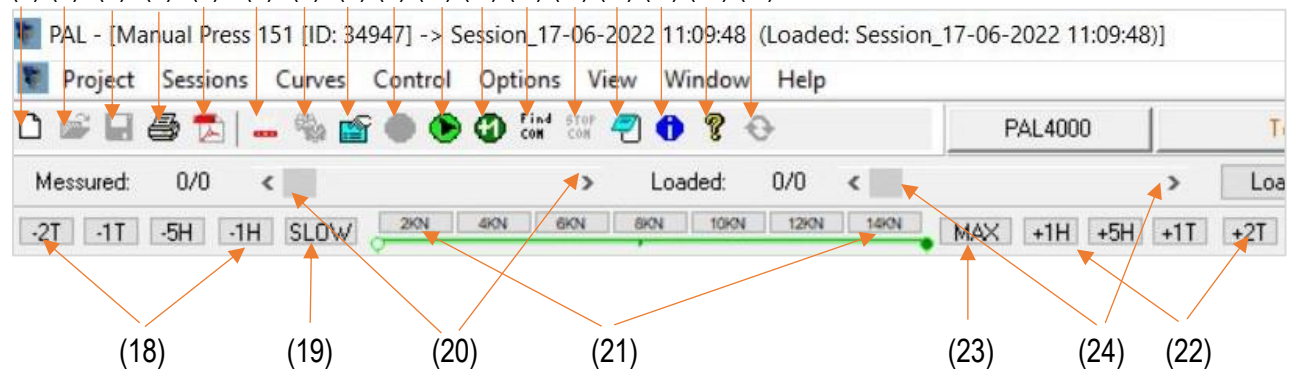
15 The PAL PC software



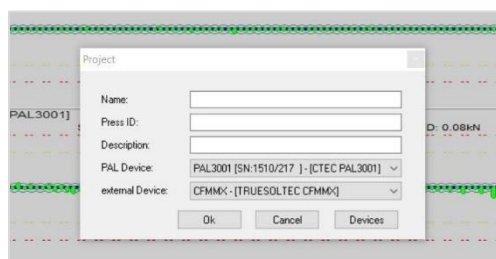
15.1 Explanation of the pictograms (mouse click areas)

15.1.1 Left side of the toolbar

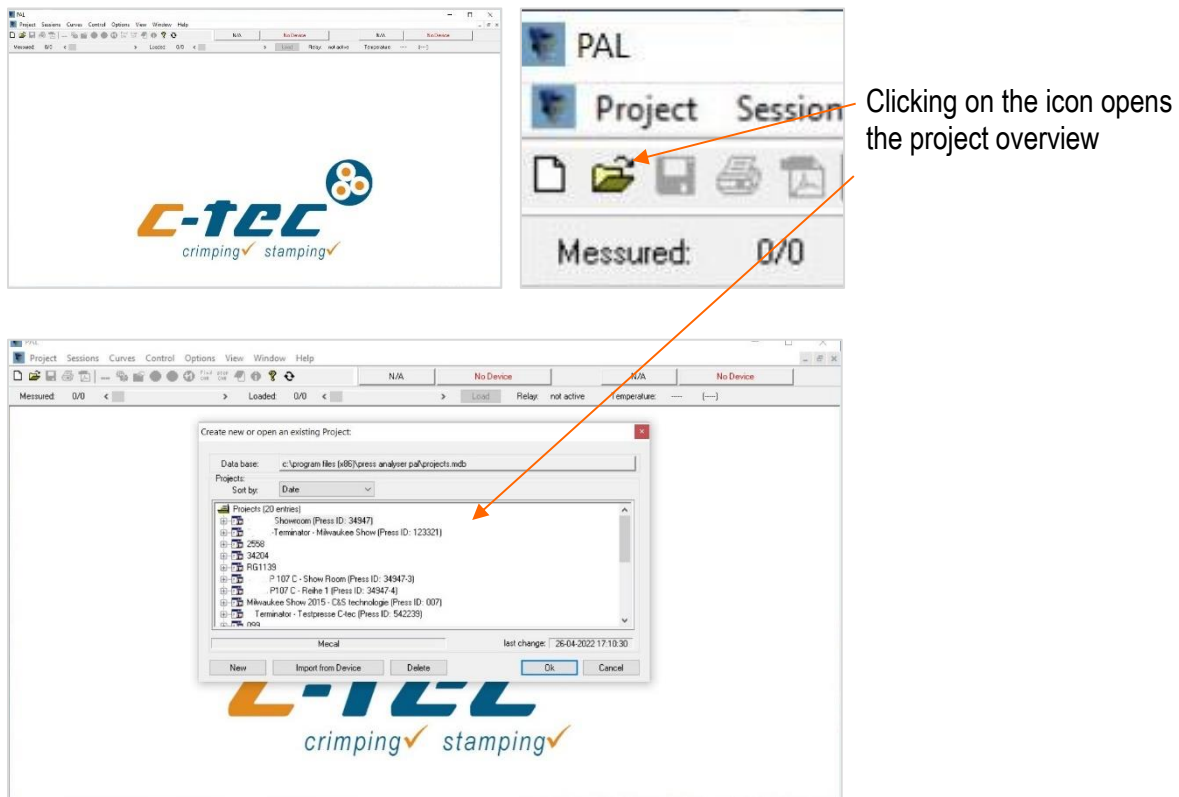
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17)



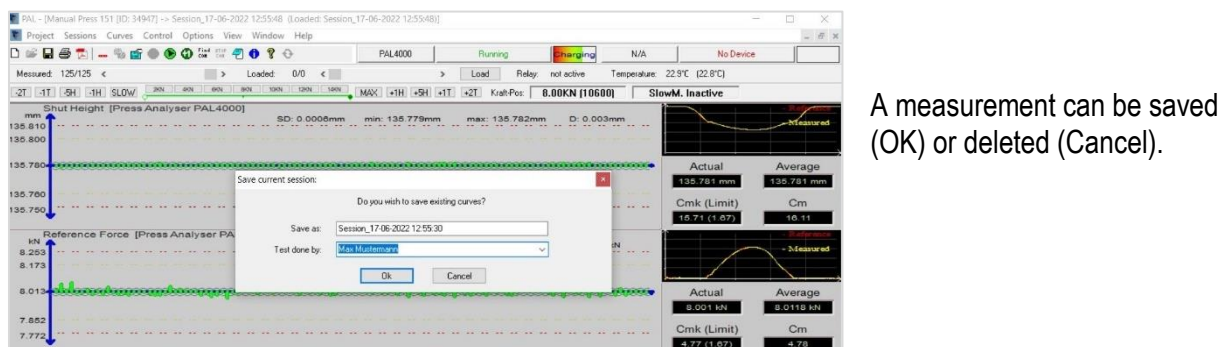
(1) **New project:** after clicking on the button, the project input form for a new press opens.



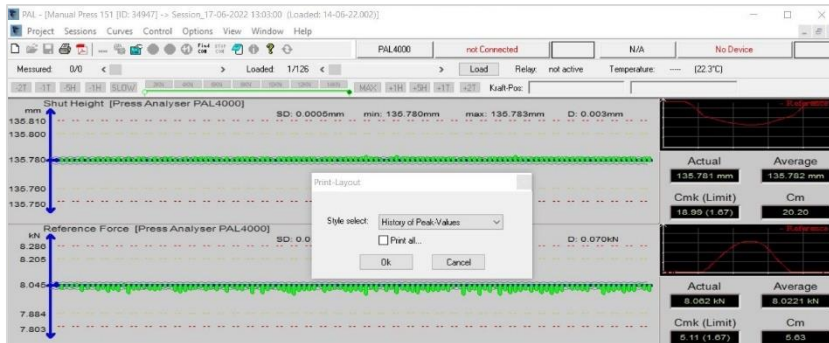
(2) Open project: this button is only active on the start screen and allows you to open the project tree (overview of all presses) or to create a new project.



(3) Save: Button for saving a measurement

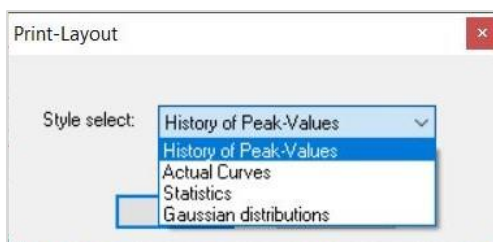


(4) Print: the currently opened measurement is printed.



Click OK to print a histogram (bar chart).

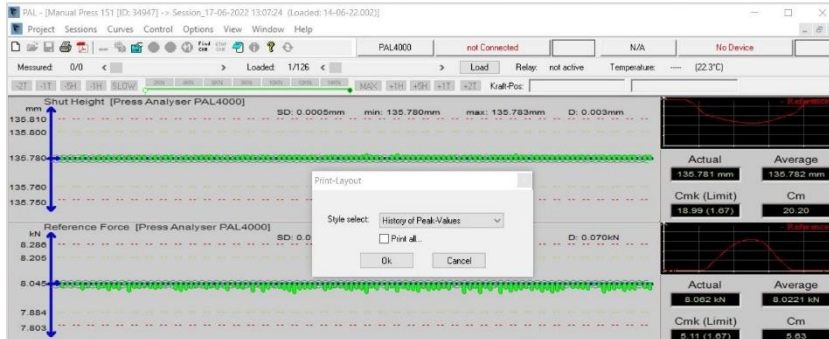
Click on Cancel to exit and not to print.



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

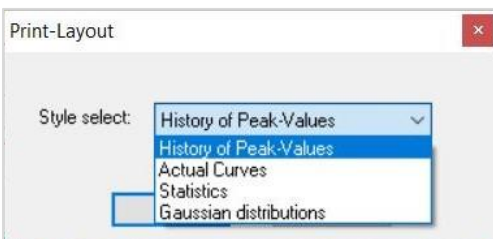
If a check mark is placed in the "Print all ..." field, all four templates (4 pages) are printed.

(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.

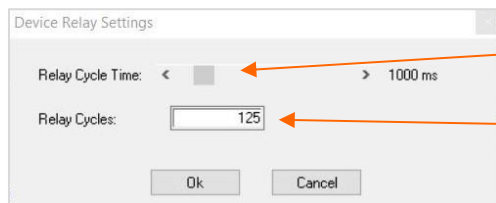
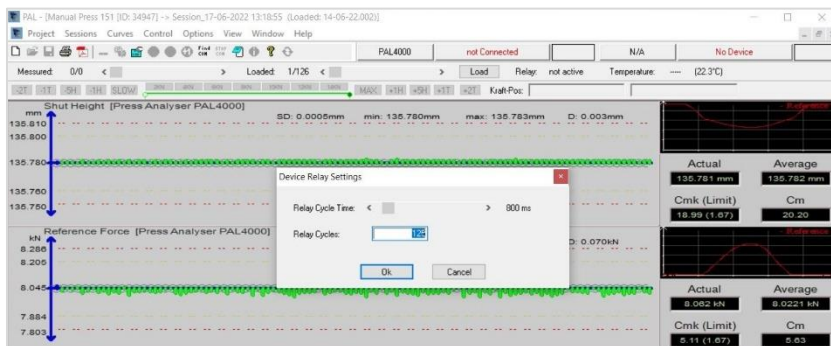
(6) New measurement: Clicking on the pictogram starts a new measurement recording.



The message "Teach in" in the PAL 4001 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.

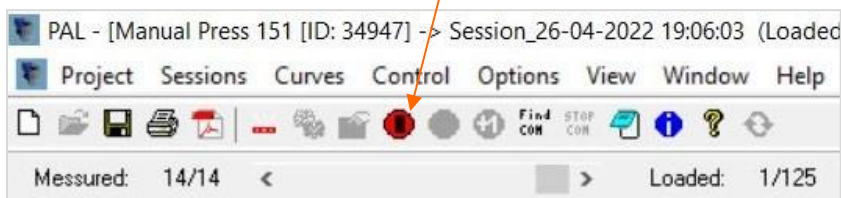
(8) Automatic press start: if you click on the icon, the input field for controlling the clock for the automatic press start (relay box) opens.



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 4000 is connected. As soon as the matching interface has been recognised, the PC connects to the PAL 4000 unit.

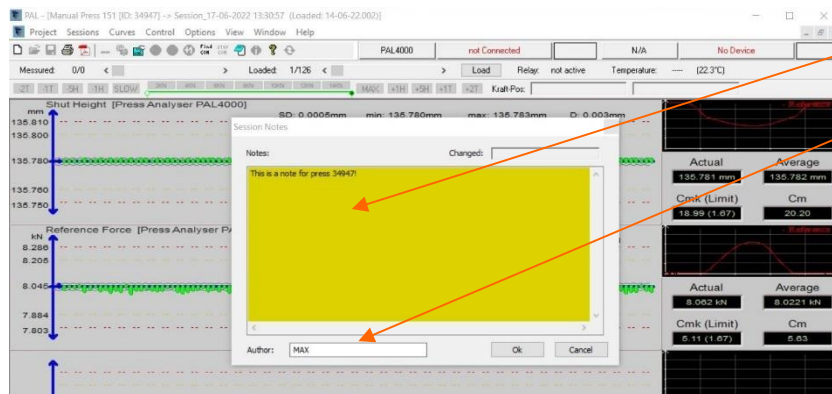


The successful connection is indicated by the message "Teach in" in the status field and the display of the battery charge level.

(13) Stop COM: as soon as the PAL 4000 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.



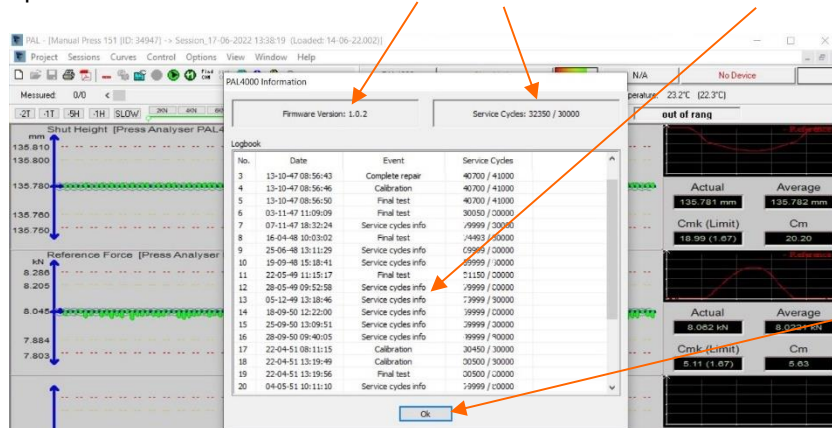
Field for free text.

Field for author's name.

Click on OK to save the text with the measurement.

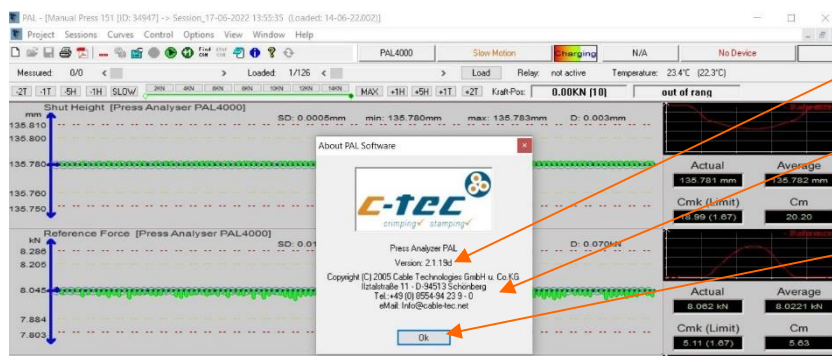
Clicking on Cancel closes the note field and deletes the text.

(15) Logbook: the logbook shows the current firmware version in the PAL, the counter reading (countdown) of the service counter and all maintenance work with date and time. The values are updated as soon as PAL is switched on and communication is active.



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.

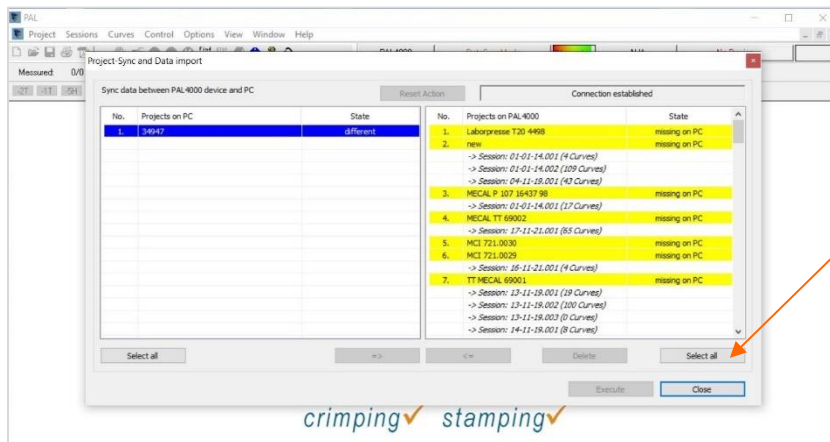


Software version

C-tec service telephone number

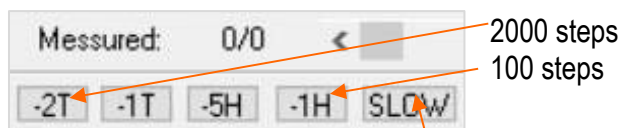
Click on OK to close the window.

(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).



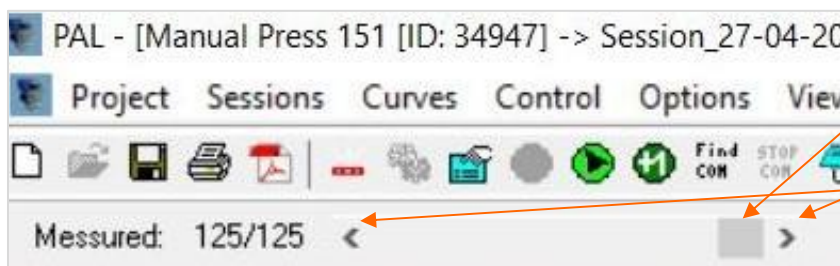
Click on Close to close the window again.

(18) Force reduction: By clicking on the area, the PAL counterforce can be reduced by 100, 500, 1000 and 2000 motor steps respectively.



(19) Slow Motion: By clicking on SLOW, the PAL 4000 is made forceless (no counterforce).

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



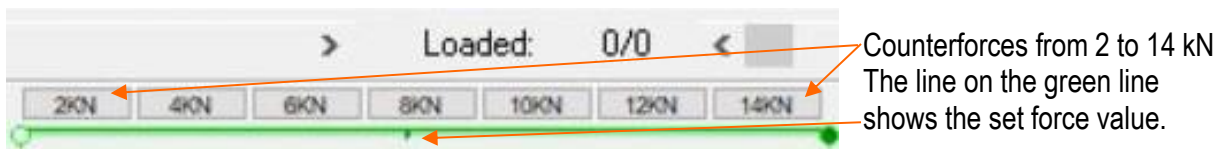
You can move the slider by left-clicking + holding on the dark slider area and moving the mouse or by clicking on the arrows on the left or right.



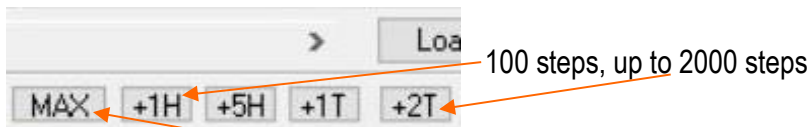
The individual measurement curves can be viewed in the small display fields.

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

(21) Force preselection buttons: by clicking on the buttons, predefined counterforce values can be set.

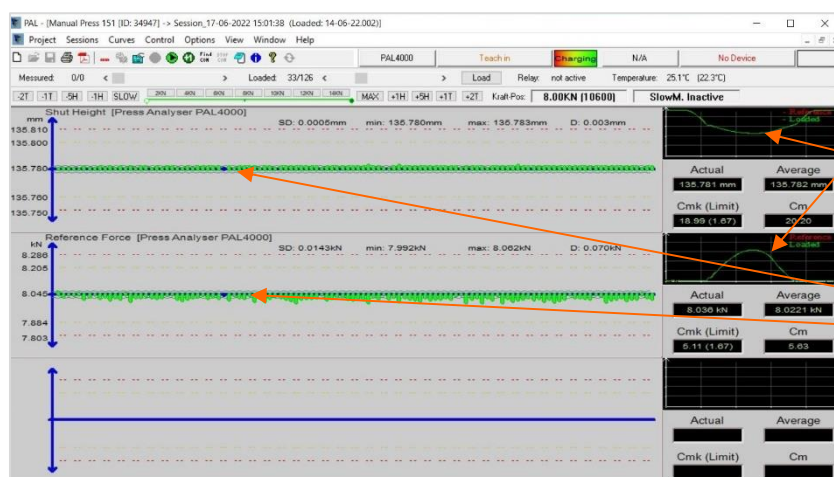
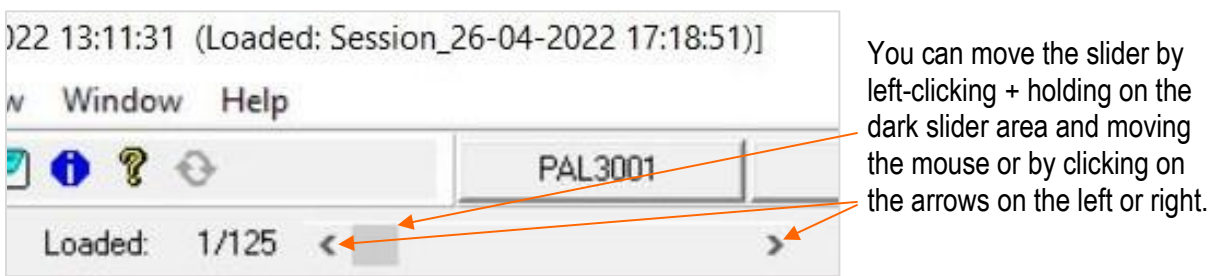


(22) Force Increase: by clicking on one of the buttons, the PAL counterforce can be increased by 100, 500, 1000 and 2000 motor steps respectively.

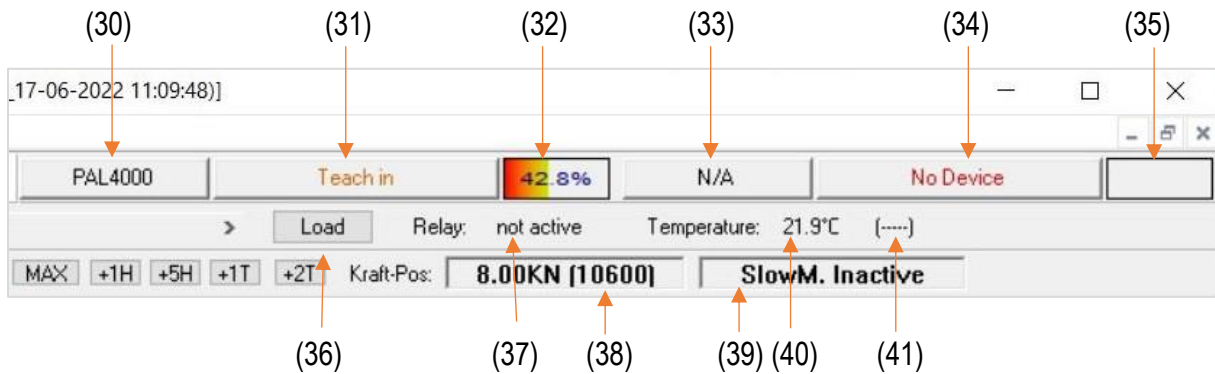


(23) Maximum force: click on the MAX button to set the maximum possible counterforce.

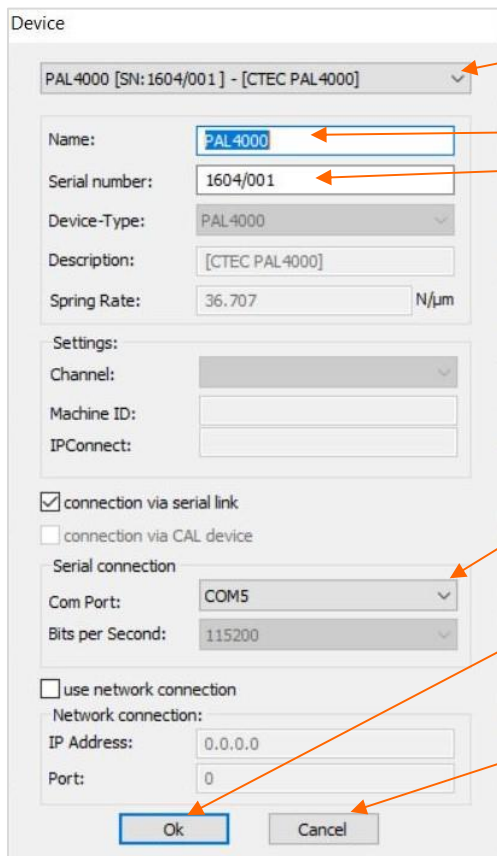
(24) With the slider, each individual trace from a loaded measurement series (e.g., the last recorded measurement) can be viewed.



15.1.2 Right side of the toolbar (Device Control bar)



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



Drop-down menu for switching the measuring device, e.g. for using a PAL 3001

Name of the unit (PAL 3001 or PAL 4000)

Serial number of the connected unit

Drop-down menu for selecting the serial port to which the PAL is connected.

Click OK to apply changes and close the window.

Clicking Cancel closes the window and discards the changes.

(31) Activate/deactivate measurement recording: by clicking on the button, recording of the measured values of the PAL 4000 can be switched on and off again.



Click on the "Teach in" button to switch off the measurement recording.



Click on "Disabled" to activate the measurement recording.

(32) Display of battery charge level



Battery charge in percent



If the charge level has reached the red area, connect the charger/plug-in power supply unit to the PAL 4000.

Caution: Only use the original power supply unit!

The red "Ext. Power ON" LED indicates that the power supply/charger is connected.

The "Charge" LED lights up green as long as the battery is being charged and goes out when the battery is fully charged.

If the "Charge" LED lights up orange, this indicates a charging fault. In this case the battery must be checked and eventually changed.

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



Device

CFMMX - [TRUESOLTEC CFMMX] ✓

Name: CFMMX

Serial number:

Device-Type: CFMMX

Description: [TRUESOLTEC 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 button for the operating mode of the external device



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

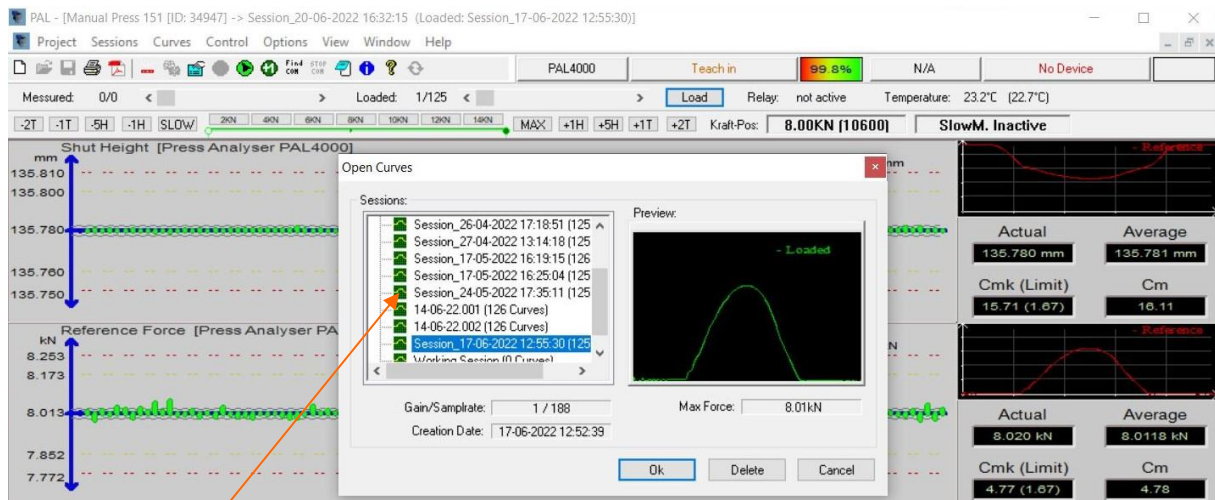


By clicking on the button, the external device can be disconnected from the measurement recording. Click again to reactivate the external device.

(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.

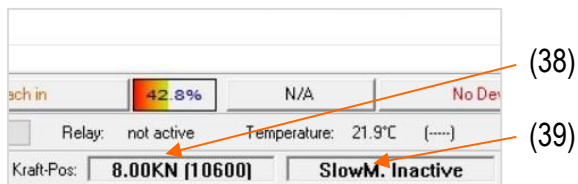
Clicking on "Cancel" closes the menu and nothing is changed in the work screen.

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



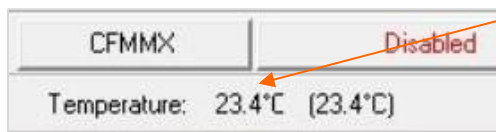
Here, for example, 115 measured values are still required for the capability analysis.

(38) Force setting: the value shows to which force value the unit has been set.



(39) Slow Motion: the display shows whether PAL is in "force-less mode".

(40) Temperature: temperature recording of a current press analysis



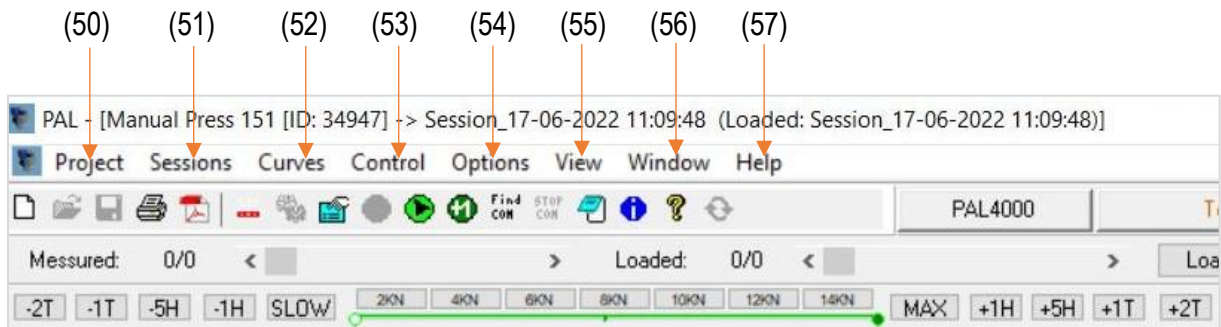
The left temperature display shows the temperature inside the PAL 4000 during the recording of a new press analysis.

(41) (Temperature): Temperature recording during a loaded press analysis

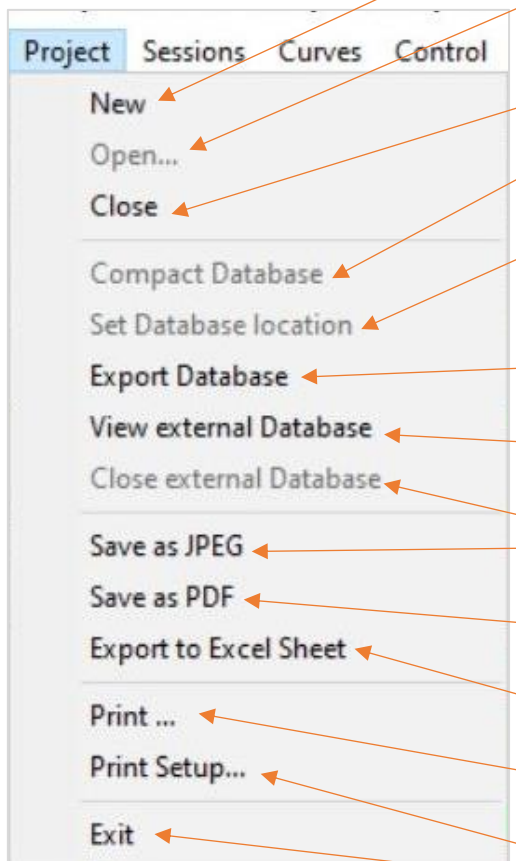


The right temperature display in brackets shows the temperature inside the PAL 4000 matching a loaded press analysis.

15.1.3 Menu bar with drop-down menus



(50) Menu Project



Opens the dialogue for creating a new press project (15.1 - 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 (15.1.1 - 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 (15.1.1 - 4).

Set a default printer

Close PAL Close PC programme

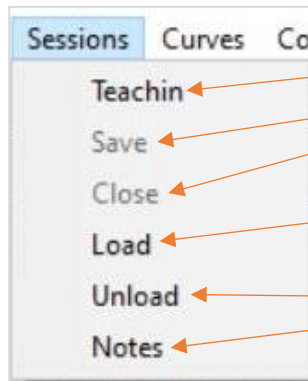


Empty start screen



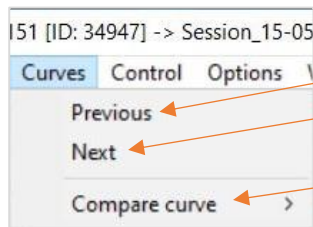
Working view

(51) Menu Session

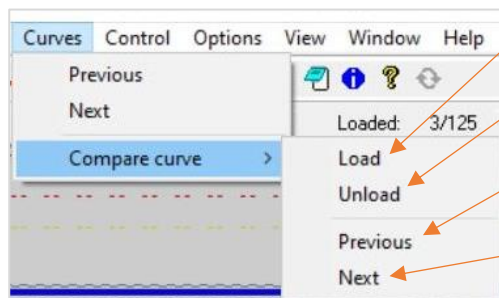


- Teachin → A new press check is started (15.1.1 - 6).
- Save → The data of a press analysis are saved (15.1.1 - 3).
- Close → Close the working view and switch to the empty start view.
- Load → The data of a previous press analysis are loaded into the working view (15.1.2 - 36).
- Unload → The working view is cleared.
- Notes → The notepad is opened (15.1.1 - 14)

(52) Menu Curves

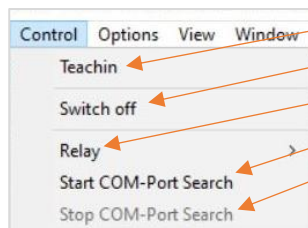


- Previous → Shows the previous curve of the current measurement recording (15.1.1 - 18).
- Next → Shows the next curve of the current measurement recording (15.1.1 - 18).
- Compare curve → Opens the selection for the comparison measurement recording (older recording).

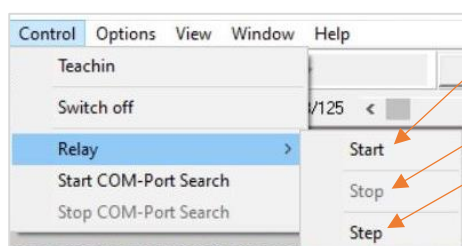


- Load → An older measurement recording is loaded into the working view.
- Unload → The loaded measurement recording (comparison measurement) is deleted from the working view.
- Previous → Shows the previous curve of the loaded measurement (15.1.1 - 19)
- Next → Shows the next curve of the loaded measurement recording (15.1.1 - 19)

(53) Menu Control

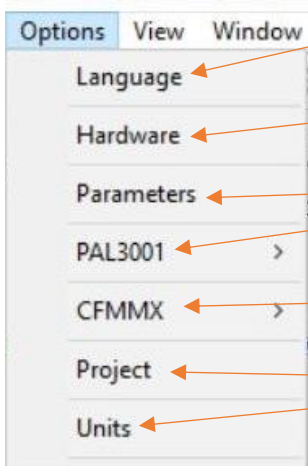


- Teachin → Starts a new measurement recording for the selected press (15.1.1 - 6)
- Switch off → Switches PAL 4000 off
- Relay → Opens the setting menu for the relay (15.1.1 - 8)
- Start COM-Port Search → Starts the automatic COM interface search (15.1.1 - 12)
- Stop COM-Port Search → Stops the automatic COM interface search (15.1.1 - 13)

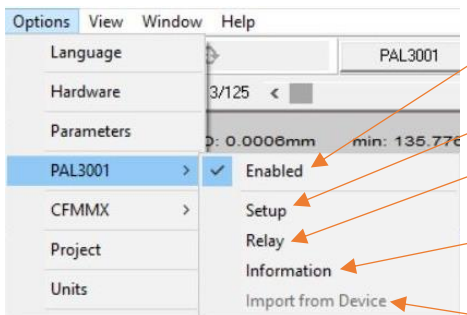


- Start → The press is started automatically by the clock generator (15.1.1 - 10)
- Stop → The automatic press start is interrupted (15.1.1 - 9)
- Step → The press performs only one revolution, except for the teach process (15.1.1 - 11)

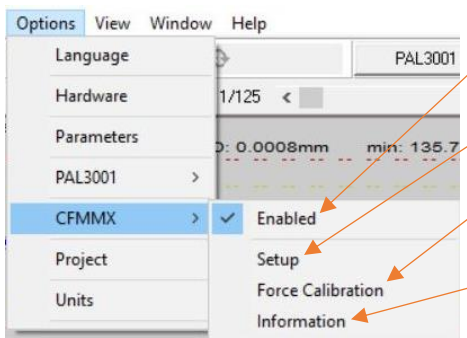
(54) Menu Options

	<p>Switches the programme language between English and German</p> <p>Opens a submenu for managing connectable hardware</p> <p>Opens a submenu for limit setting for press analysis</p> <p>Opens a submenu with PAL-specific data</p> <p>Opens a submenu with CFM (crimp force monitor) specific data</p> <p>Opens a submenu with project-specific data</p> <p>Opens a submenu for units and sizes as well as the printout logo</p>
---	--

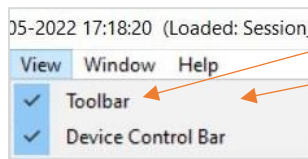
Submenu PAL-specific data

	<p>Click to activate or deactivate the PAL measuring channel (15.1.2 - 31).</p> <p>Opens the menu for the PAL setting data (15.1.2 - 30)</p> <p>Opens the setting menu for the clock to start the press (15.1.1 - 8)</p> <p>Shows entries in the logbook such as firmware version and number of service load measurements (15.1.1 - 15).</p> <p>Import of measurement recordings from PAL 4000 (15.1.1 - 17)</p>
--	--

Submenu PAL-specific data

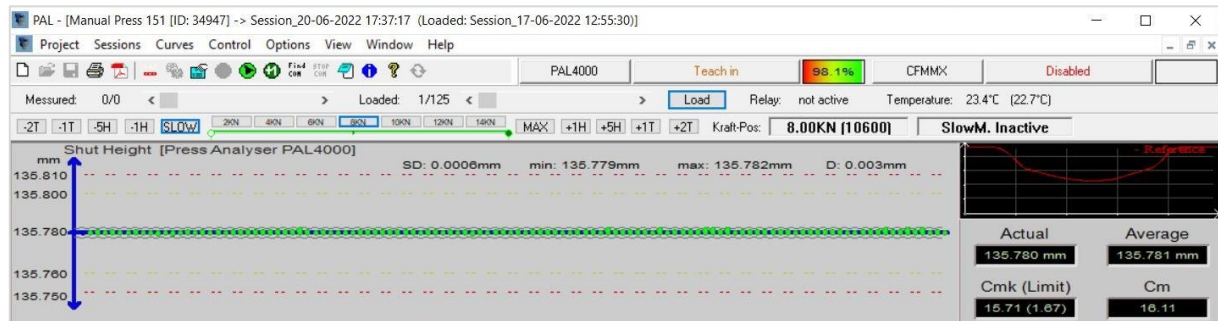
	<p>Click to activate or deactivate the external crimp monitor (15.1.2 - 34).</p> <p>Opens the setting menu for the crimp monitor setting data (15.1.3 - 33)</p> <p>Opens the control panel for sending the calibrated force values from the PAL to the crimp monitor (15.1.1 - 7).</p> <p>Shows information about the connected crimp monitor, if it provides data.</p>
---	---

(55) Menu View

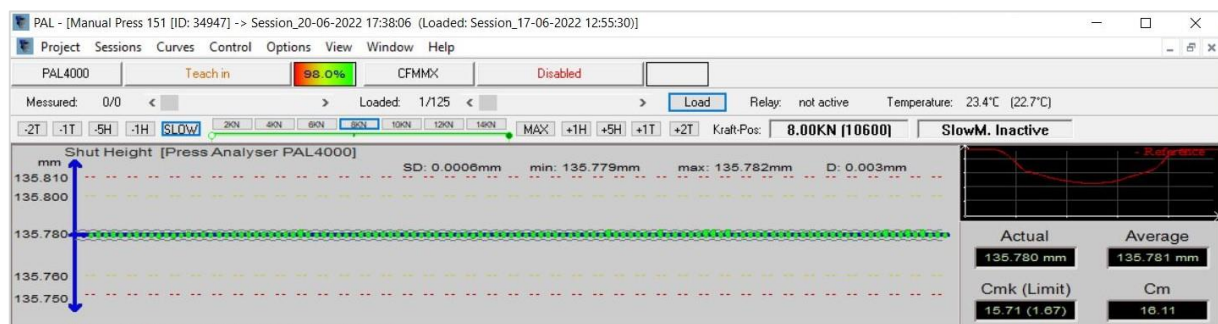


Click to activate or deactivate the toolbar.
Click to activate or deactivate the control bar.

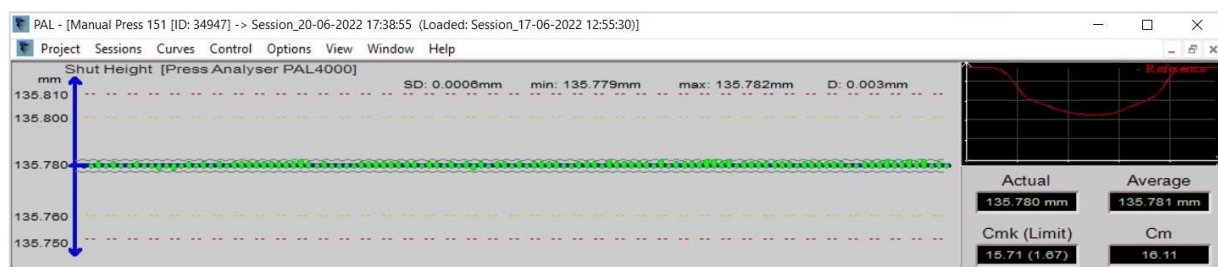
Working view with both "Toolbar" and "Device Control Bar" switched on:



Working view with "Toolbar" deselected:

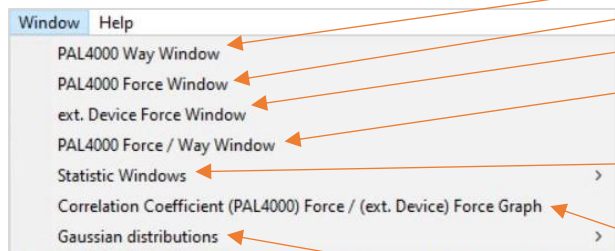


Working view with "Device Control Bar" deselected:



(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.

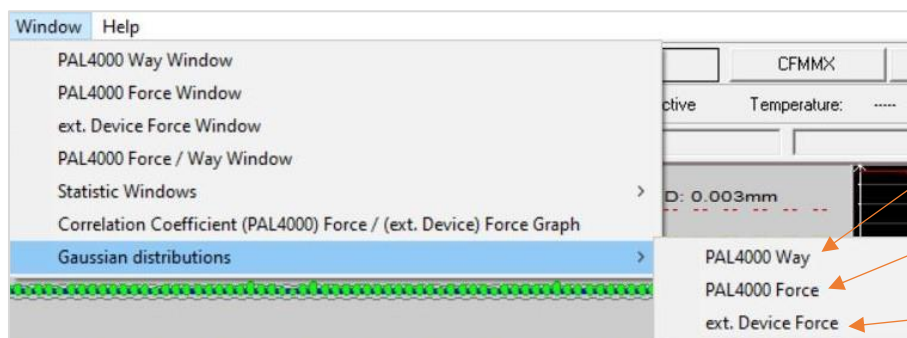
Submenu Statistic Window



Opens a statistic window

Opens a statistic window

Submenu Gaussian distributions



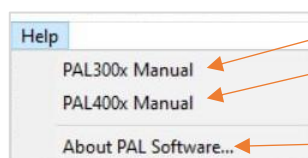
Shows the Gaussian distribution of:

- height measurement

- force measurement

- crimp monitor measurement values

(57) Menu Help

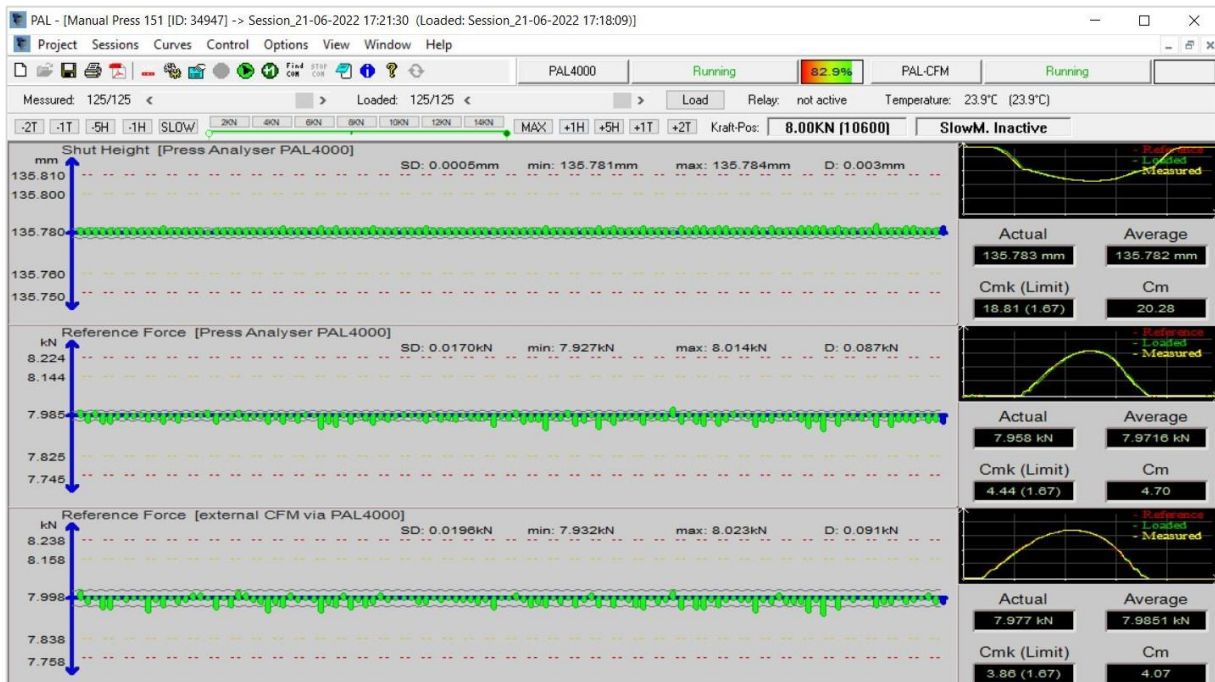


Opens operation manual for PAL 3001

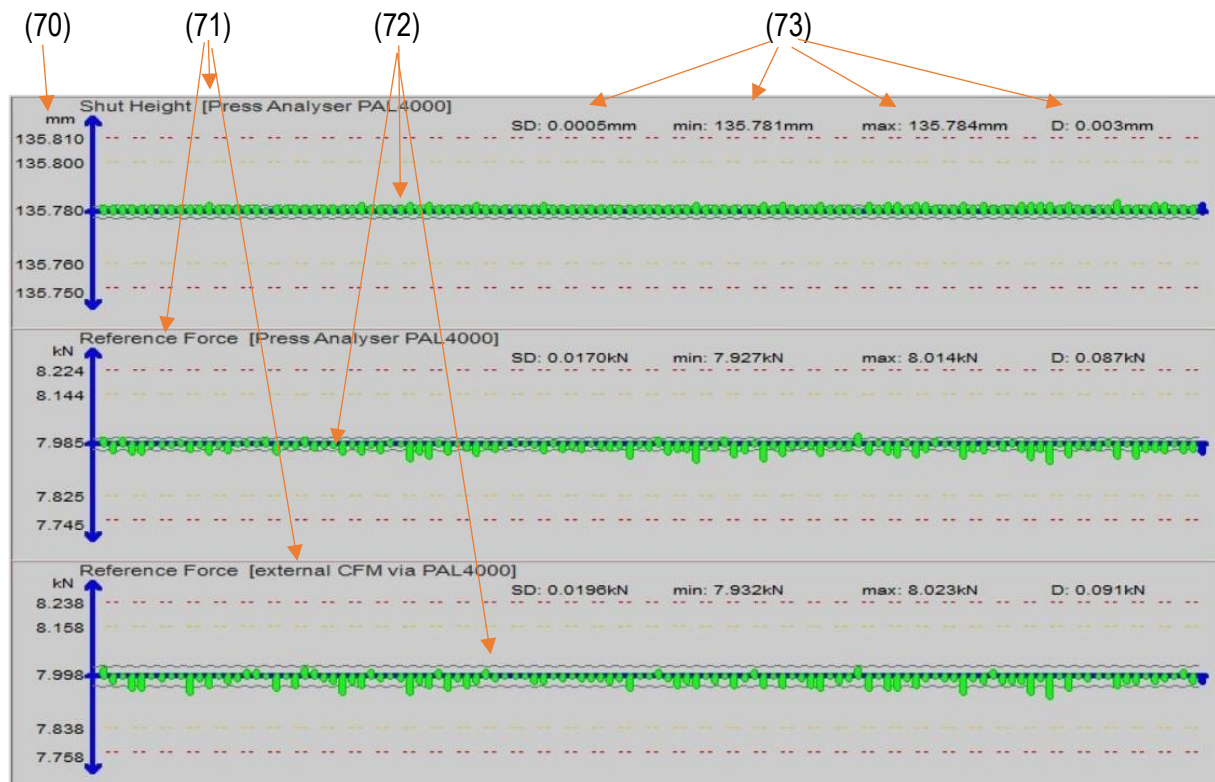
Opens operation manual for PAL 4000

Shows information on PAL PC software

15.2 Working view in PAL PC software



15.2.1 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) Labelling 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.

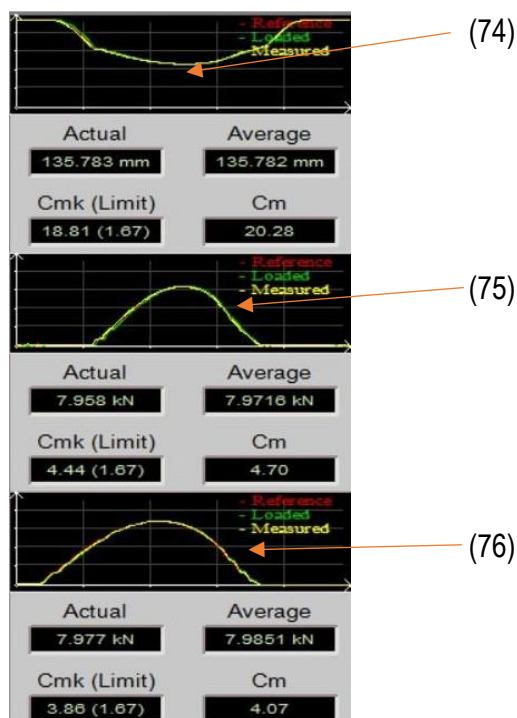
(73) Maximum deflections

SD = standard deviation of all recorded measured values

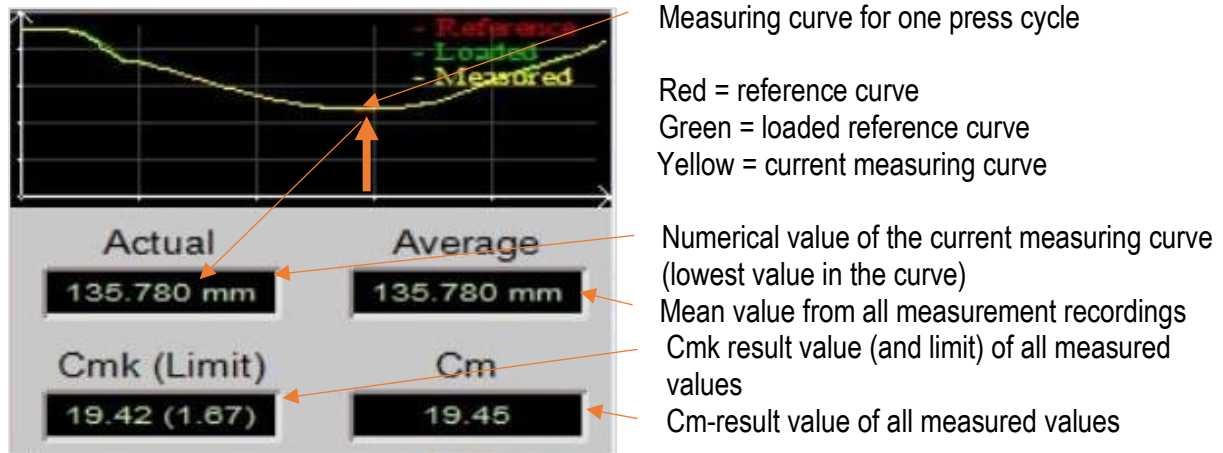
Min. = smallest lower measured value

Max. = largest upper measured value

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

15.2.2 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.

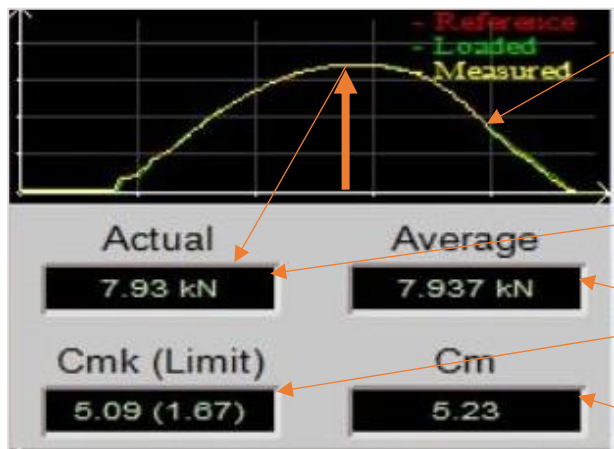
Actual: This numerical value is taken from the lowest reversal point of the measurement curve and forms the measured value for the column diagram as well as for all further calculations. It is always actual in relation to the displayed measurement curve. The value is identical to the lower reversal point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

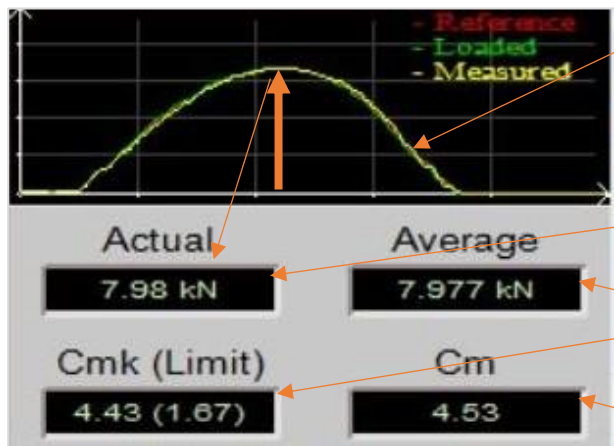
Yellow curve: The highest value in the measurement curve (thick arrow) is the current measurement value, which is also transferred to the bar chart.

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.

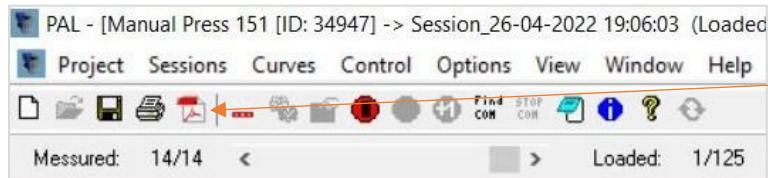
Average: The average value is formed from the sum of all measured values of a measurement recording.

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.

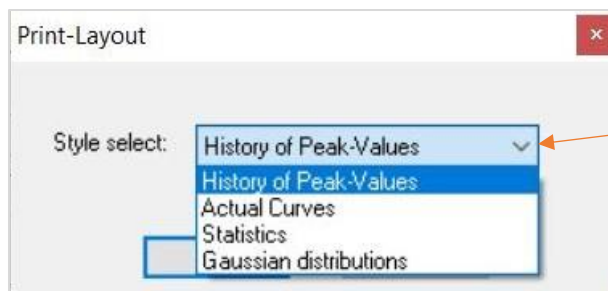
Cm: The calculation of the Cm value is very similar to that of the Cmk value, but here it is not evaluated whether the measured values scatter around the zero line. As a rule, the Cm value is always slightly better than the Cmk value.

16 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.

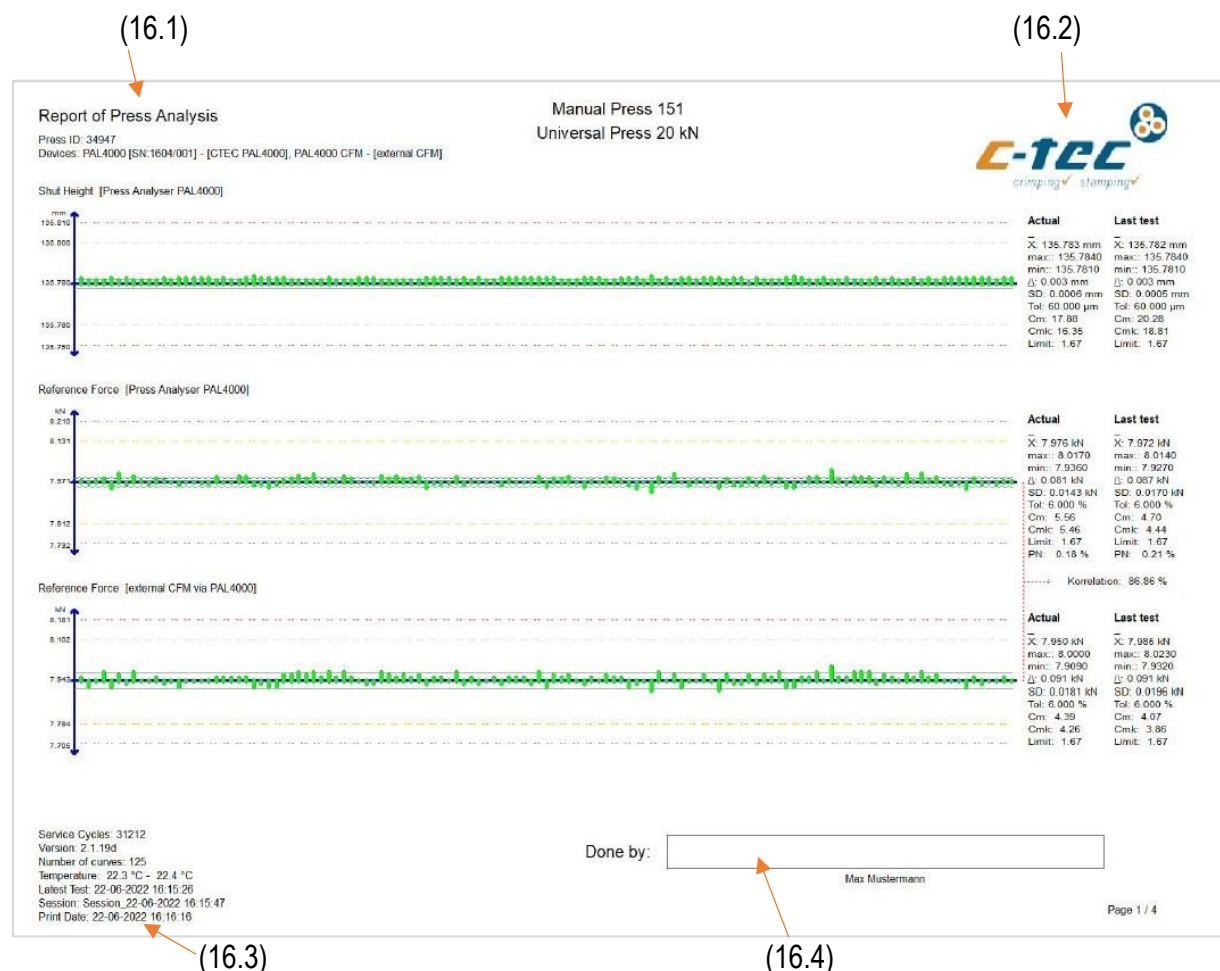


Click on the pdf icon.



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

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

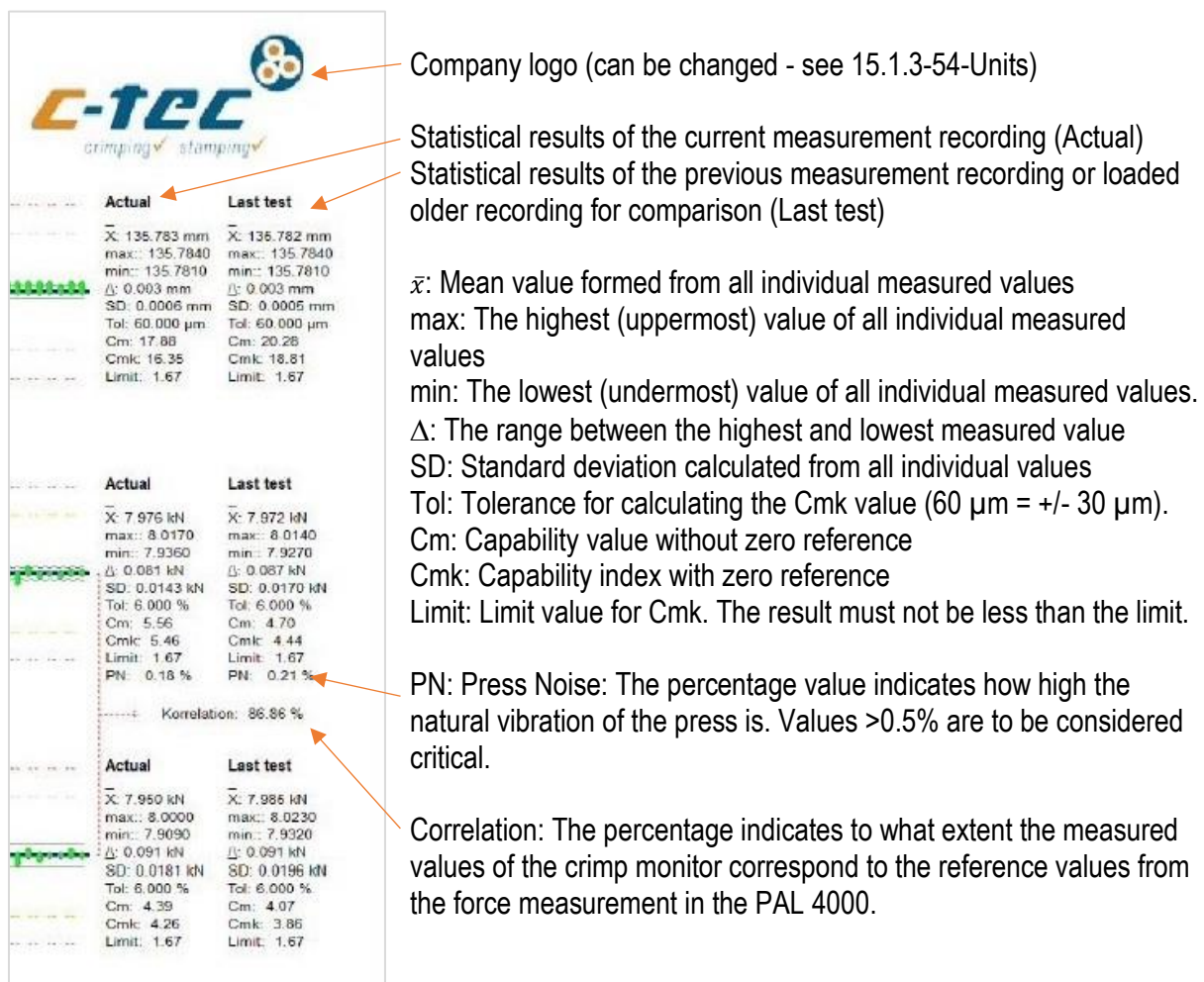


16.1 Header



- 1 Identification number (Press ID) of the press that was tested.
- 2 Serial number of the PAL 4000 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.

16.2 Right column



16.3 Footer on the left side

Service Cycles: 31212	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: 22.3 °C - 22.4 °C	PAL temperature from the beginning to the end of recording
Latest Test: 22-06-2022 16:15:26	Date and time of the last measurement
Session: Session_22-06-2022 16:15:47	File name for the document (PDF)
Print Date: 22-06-2022 16:16:16	Date and time of the creation of the document

16.4 Footer on the right side

Done by:

Max Mustermann

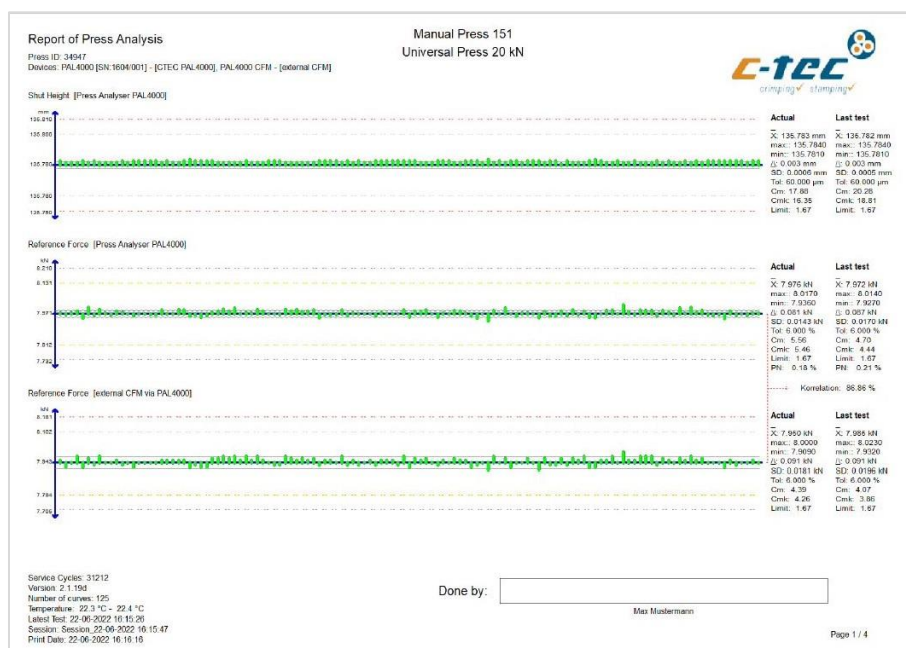
Page 1 / 4

Signature field Name of tester Document page

16.5 Document templates

16.5.1 Bar chart

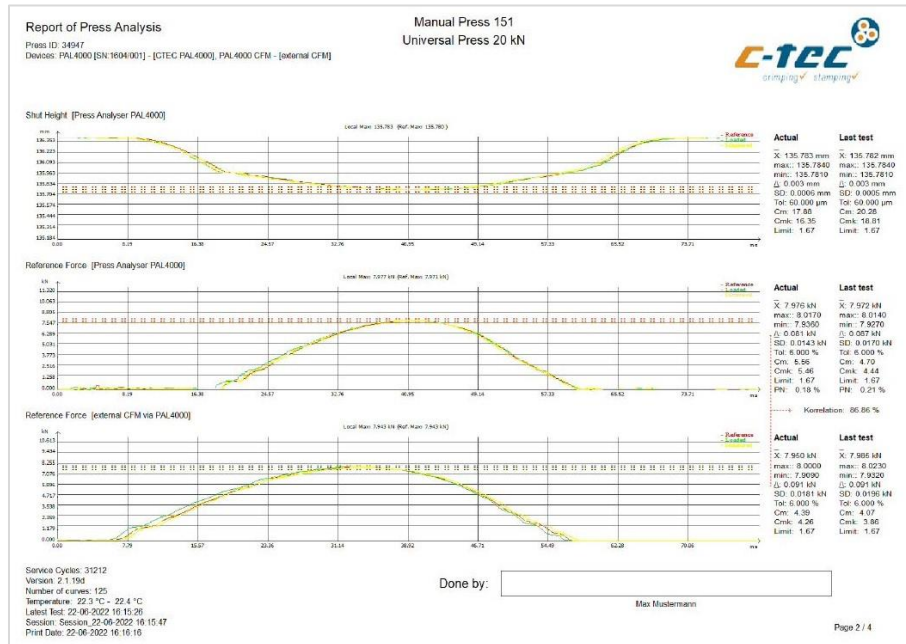
History of Peak-Values



All values of the individual measurements are displayed as columns.

16.5.2 Curve chart

Actual Curves



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

16.5.3 Number chart

Statistics



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

16.5.4 Normal distribution

Gaussian distributions



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

17 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_f) 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:

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

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

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

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:

$$SL_h [mm] = \frac{\text{specification limits for height measurement (SL_h) } [\mu m]}{1000}$$

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

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

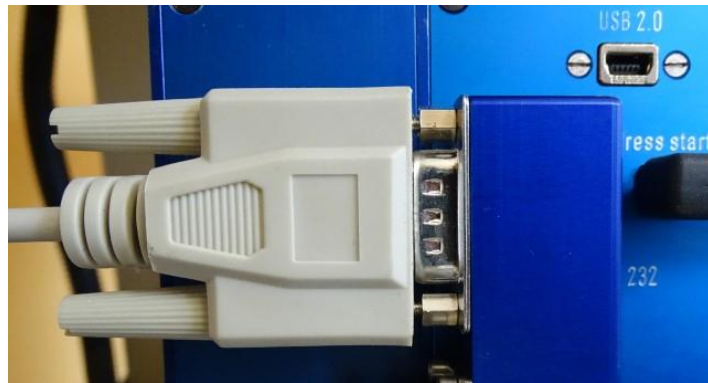
18 Testing external crimp monitors

18.1 Connection of a Crimp monitor CFM-MX (N)



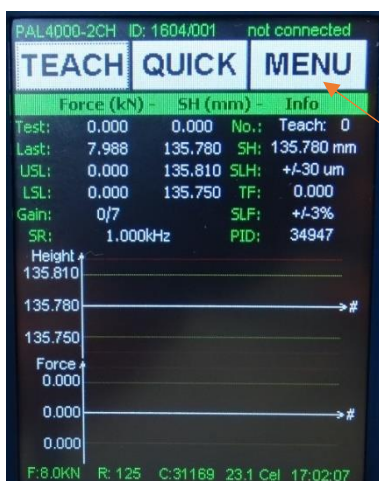
Crimp monitor CFM-MX / CFM-MX (N)

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

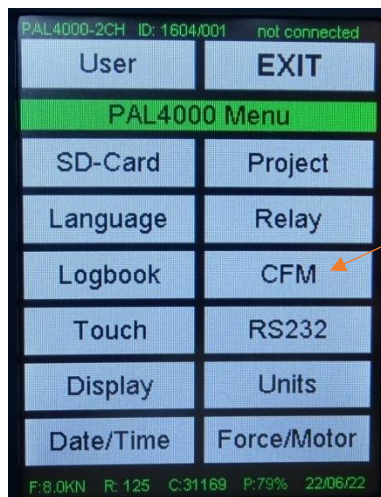


Plug the RS232 interface cable into the RS232-CH2 connector of the crimp monitor and into the PAL 4000.

Now activate the crimp monitor in the PAL PC software.



Touch the MENU button.



Press the CFM button.

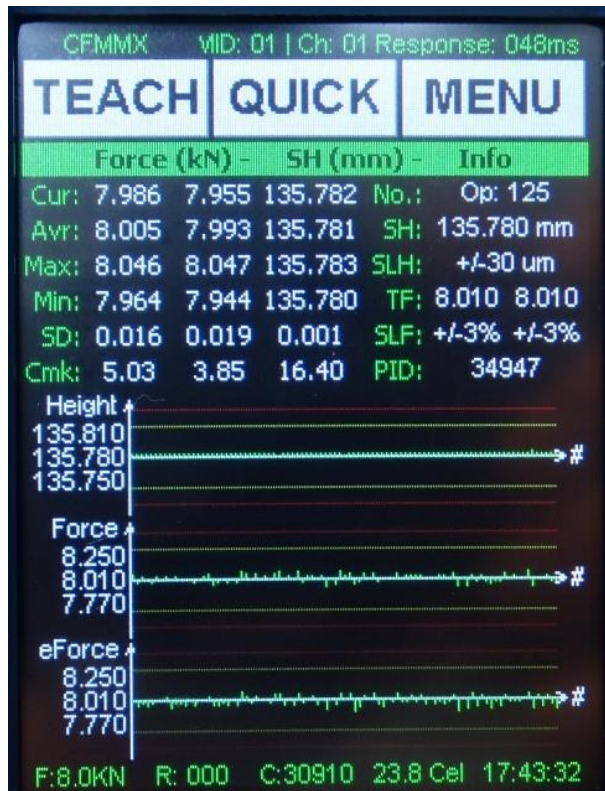
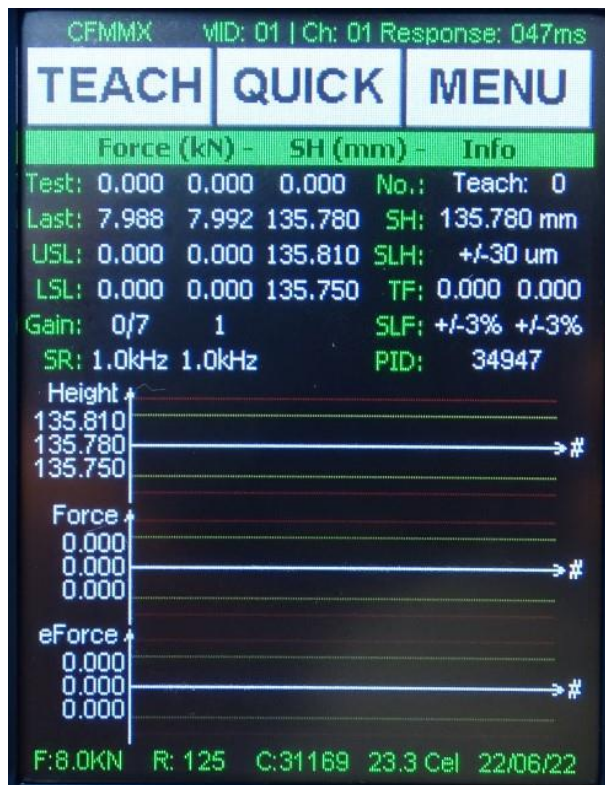


Press on „use CFM on RS232”.



Touch the OK button.

The third measuring channel for data storage from the Crimp Monitor is now available.

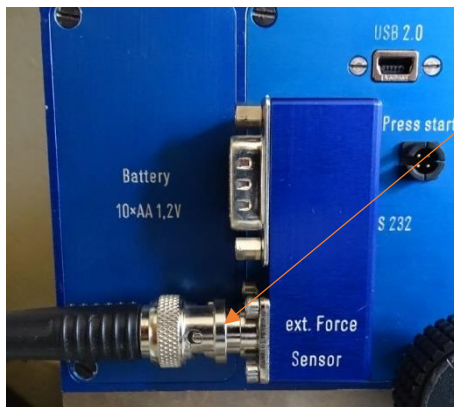


Measured value recording incl. third measuring channel.

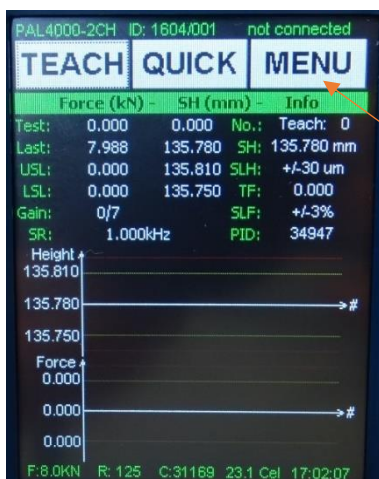
For transmission of the measured values to the PAL PC software, see chapter 13.

18.2 Piezo force sensor connection without crimp monitor

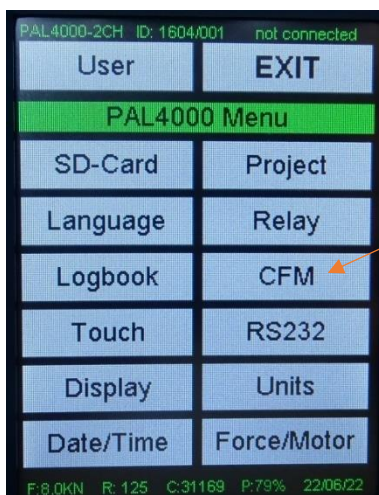
This option can be integrated to the PAL 4000 on request. It can be used to record and test the analogue measured value recording string of the crimp monitor. The optional second measuring channel in the PAL 4000 replicates the analogue part of a crimp monitor and thus makes it easy to test the force sensor, its installation and its wiring.



Disconnect the BNC cable from the crimp monitor and connect it to the ext. force sensor input on the PAL 4000.



Press on the MENU button.



Press the CFM button.

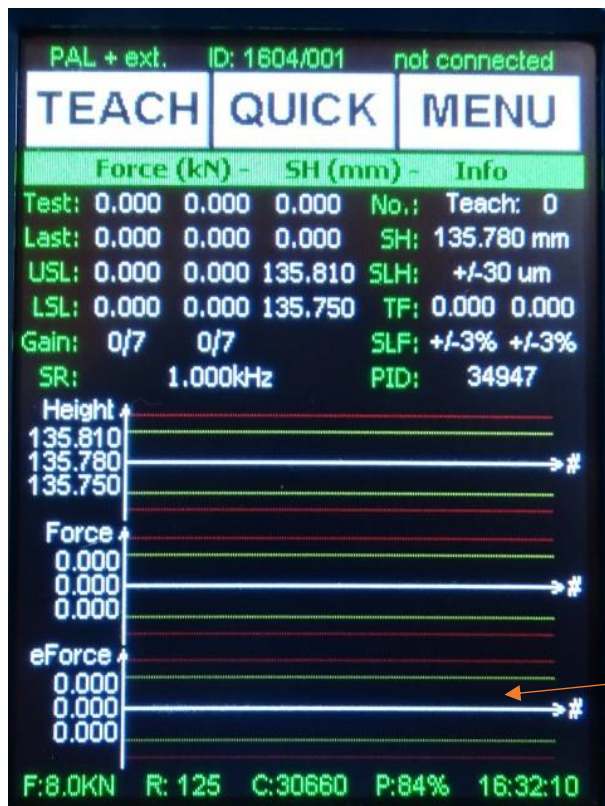


Tap on “use BNC connector”.

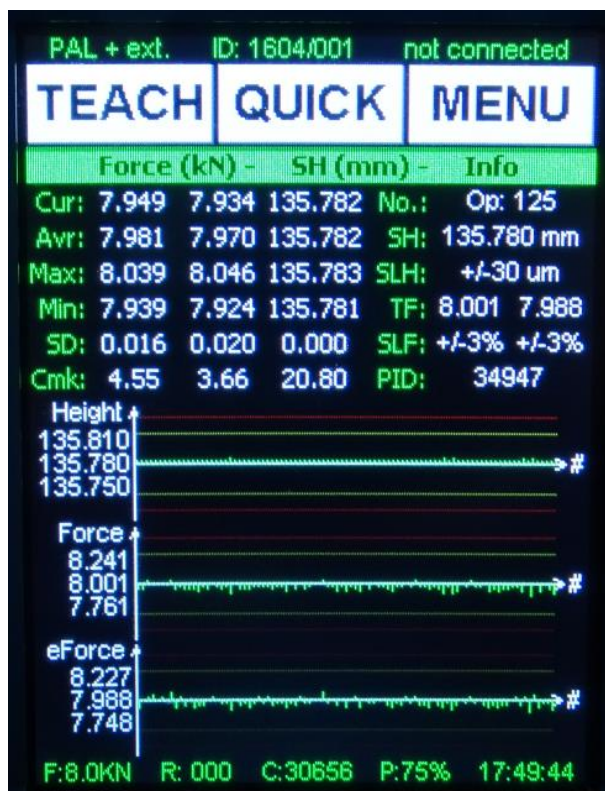


Press the OK button.

The third measuring channel for data recording of the force sensor values of the crimp check is now available.



Third measuring channel



Measurement recording incl. third measuring channel.

For transmission of the measured values to the PAL PC software, see chapter 13.



Please consider your environmental responsibility before printing this document.

Versions legend:

Date	Version	Responsible	Revision
2008	1.0.0	Lothar Schreiner	Revision: Original state
04.07.2022	2.1.11	L. Schreiner / M. Egginger	Fundamental revision of all chapters

Notes: