Hard- und Software Burkhard Lewetz

Technical Software Engineering

How does it work…
… with *WinPC-NC* ?

Description of the laser test functions

	Light
✓	**USB**
✓	**Professional**

Image: Mounted laser for engraving and cutting tasks

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In this manual you will learn how to use the laser test functions integrated in *WinPC-NC* and how to further optimise and improve your work results in order to subsequently complete engraving or cutting tasks.

Information on how to assign the correct signals for your laser and other useful instructions on the laser can be found on our homepage in the help section.

Table of contents

1. Overview of the available laser test functions

Since the result of working with a laser depends a lot on the material or surface used and the laser power, ***WinPC-NC*** has internal test functions to always achieve the best result on each material. Therefore, carry out the tests again for each material and determine the individual values for the material used.

The test functions can be found under the menu item *special functions* when the laser module is activated.

Laser greyscale test

The function for the greyscale test comprises two individual steps. As a basis for the *greyscale test*, first of all a *speed test* is carried out to determine the maximum possible speed that will produce a rich black color with full laser power. The determined speed is then used to calibrate the gradation of the greyscale.

Laser cutting test

The ***laser cut test*** function provides you with a tool to find the optimum parameters for cutting and separating your material with a laser.

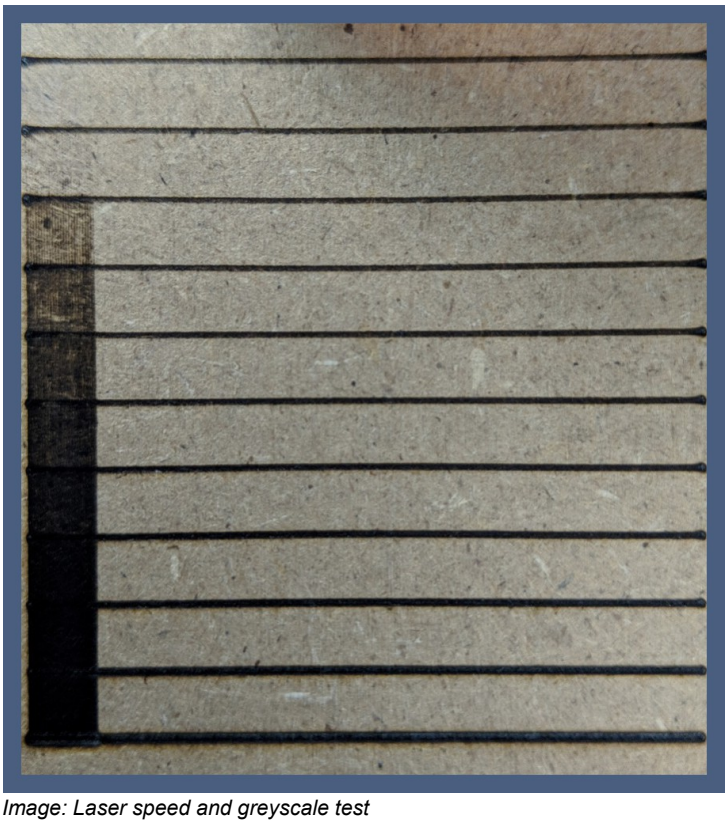
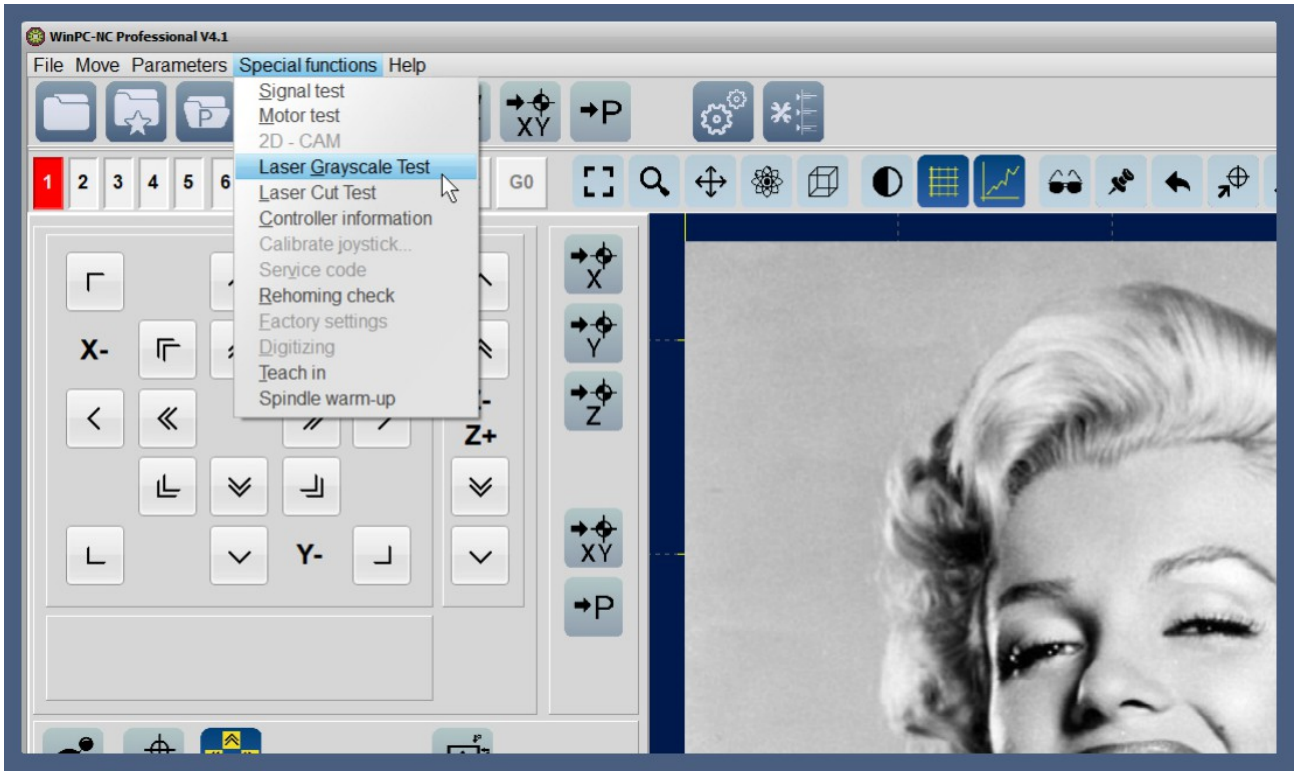


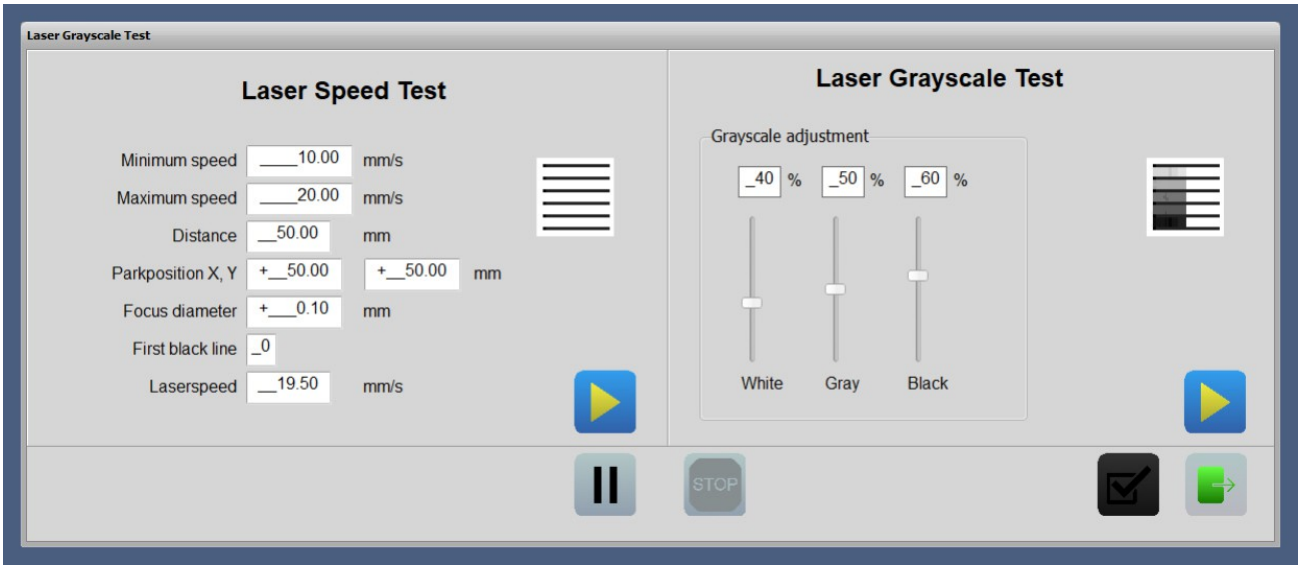
Image: Laser speed and greyscale test

2. Carrying out the laser greyscale test

To enter the test mode, please click on Special functions and then on laser greyscale test.



The following window then opens for the test mode



As you can see in the graphic above, this test mode is divided into two parts. With the parameters in the upper part of the window, the maximum speeds for a rich black can be determined first. To do this, the laser moves at different speeds at maximum power. Then select the best line at which a rich black is just produced. By selecting the line in the

dialog, you have the option of automatically saving the determined speed and then performing the greyscale adjustment.

Explanation of the parameters

Minimum & maximum speed:	***WinPC-NC*** moves 11 lines in even increments between minimum and maximum speed. (The values depend on your machine and the available laser power)
Distance:	Length of the test line
Parkposition X, Y:	Free travel after the test in order to be able to check the results without obstacles
Focus diameter:	Thickness of the laser beam at material
First black line:	Best test result, first rich black line as reference (exact definition to follow)
Laser speed:	Speed determined from the best black line.

Running the speed test

For the first run of the test function, we recommend using the standard parameters as shown in the illustration. If you find that the speed was too low or too high after the first test run, repeat the test with adjusted parameters.

To perform the speed test, first move to the desired zero point on your test material. To do this, you can use the ***manual move*** function before entering the test function.

Then save your XY zero point and set the focus height of the laser correctly.

Now all requirements are fulfilled to start the speed test. To do this, click on *move button* in the left part of the window.

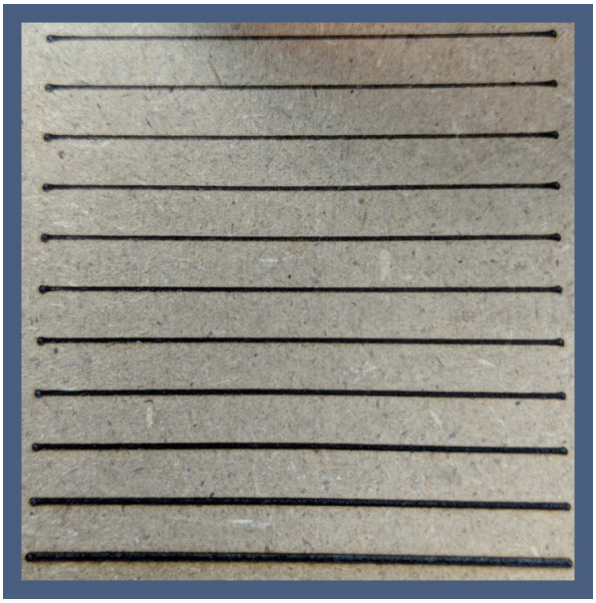
Important note

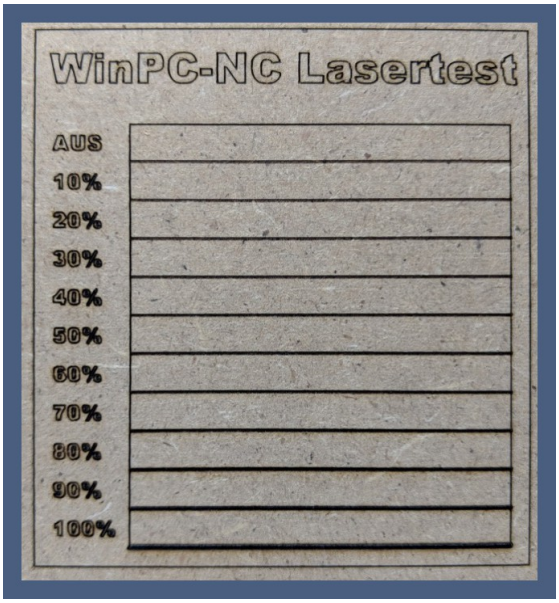
Your machine will now start automatically. You can stop the test at any time by pressing Stop.

For the speed test, ***WinPC-NC*** burns a pattern of 11 lines with full laser power. Each line is burnt at a different speed. A test line consists of 4 lanes, each offset by the defined focus diameter.

The purpose of this test is to determine the maximum possible laser speed at which a rich black line can still be achieved.

You should now find a test pattern on your test material that is similar to the one shown.





Images: Speed test result (right with pre-engraved frame).

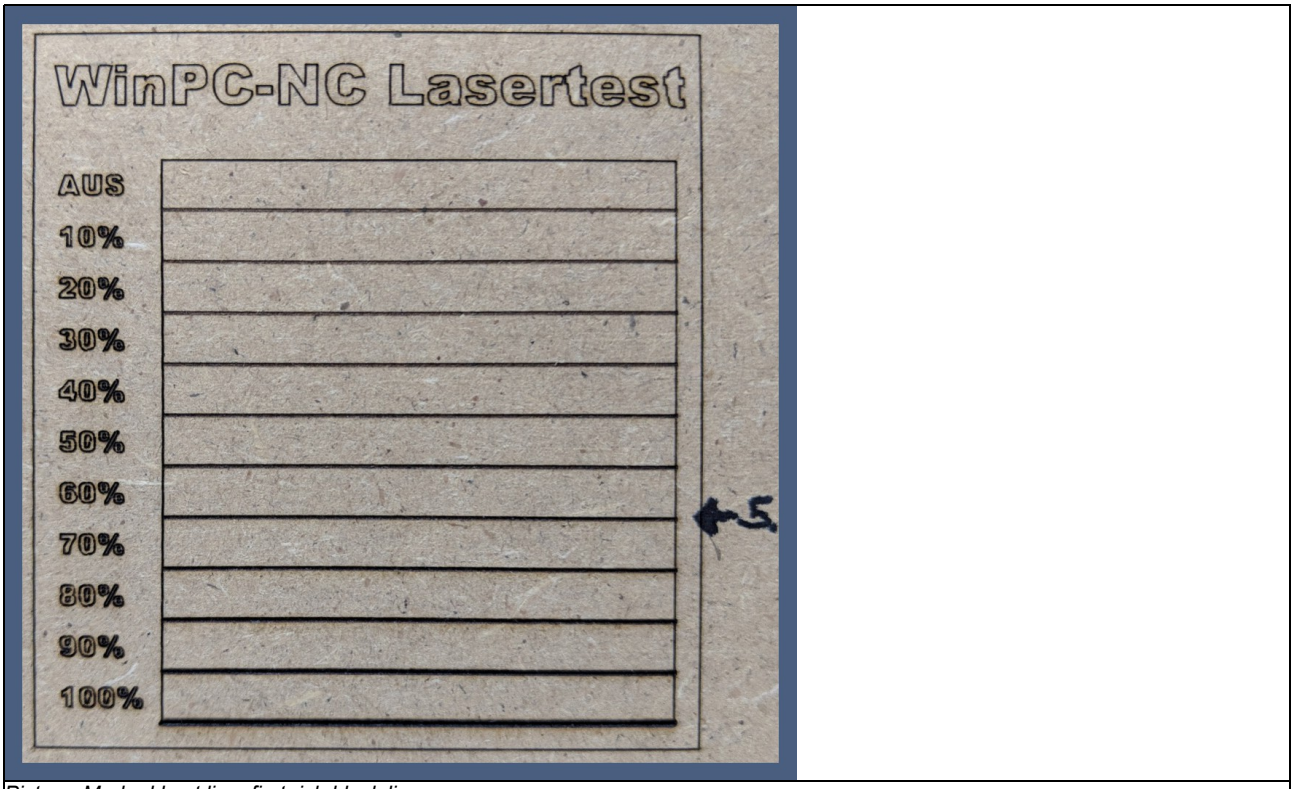
Please notice:

We are using a pre-engraved frame for this guide for better illustration. This frame will not be present in your test and is not necessary for it.

Checking the speed test result

Now in order to find the line with the best speed, we must first inspect it more closely. There are two aspects to consider here. First, the line should be between 0.4 and 0.6 mm wide and the colour should be deep black. There should be no "darker" line.

Once this line has been determined, it is counted starting from the bottom. In the example, it was the 5th line with the best result.

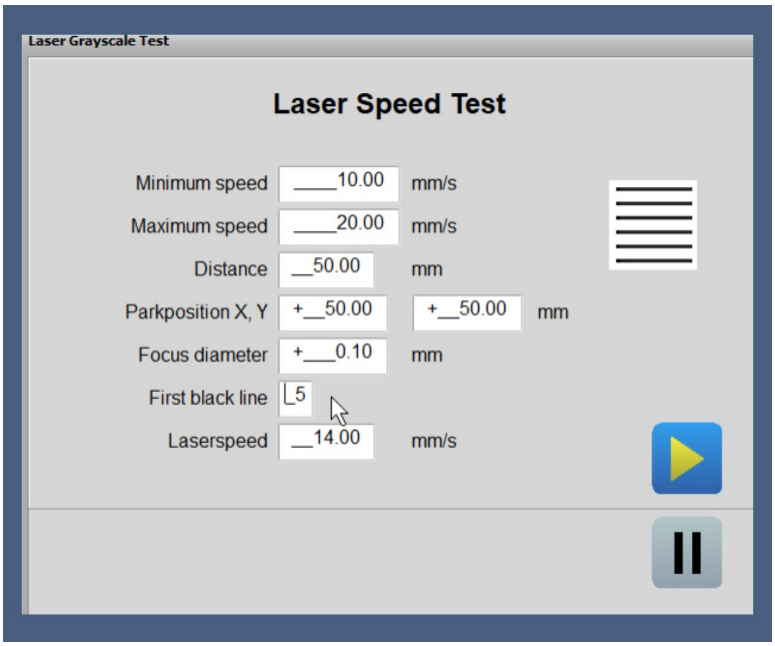


Picture: Marked best line, first rich black line

Adopting the correct parameters

If you have now identified and counted the best line, please enter it as a numerical value in the *best black line* field. ***WinPC-NC*** then automatically calculates the corresponding speed to use in following gray scale test.

Alternatively, you can also adjust the *laser speed* value manually.



Picture: Entering the best black line

The illustration clearly shows that ***WinPC-NC*** uses the best black line to calculate the value for the laser speed. The speed test is now complete.

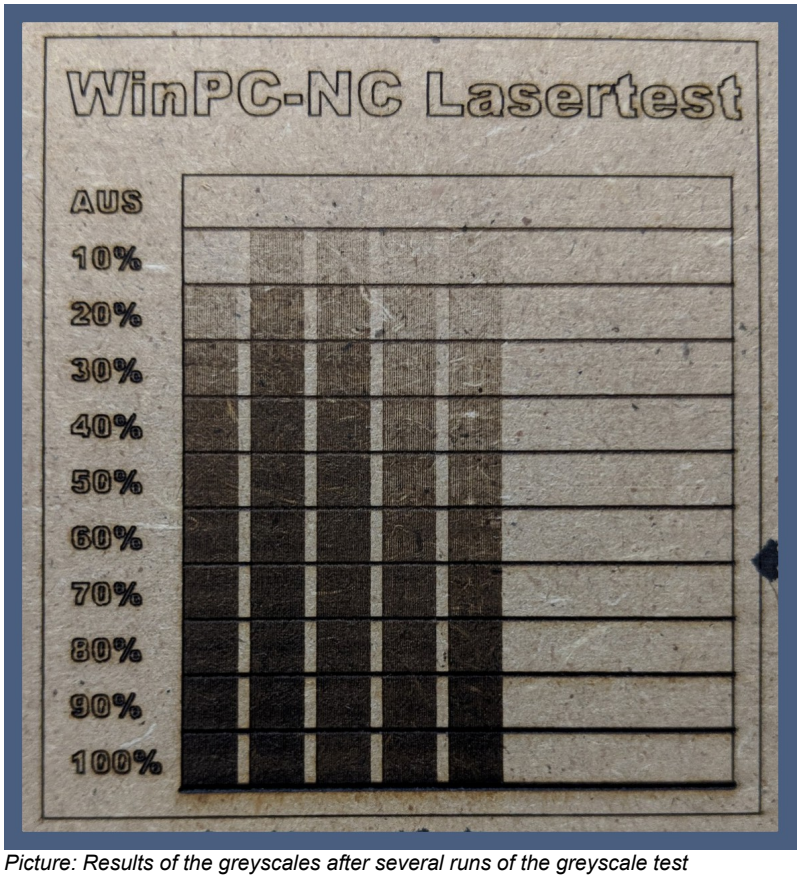
Your machine is now ready for engraving in ***black and white***. Accept the laser speed as the feed speed for your tool in the tool parameters by clicking on the Accept button in the lower part of the window.

If you then want to carry out the greyscale test, please do not close the test window in the meantime. The greyscale test is based on the previously determined laser speed.

Performing the greyscale test

In order to be able to image greyscales with your laser, it is necessary to adapt the power curve of the laser diode to a linear curve of the greyscales. In order to calibrate the correct parameters for this, ***WinPC-NC*** offers the possibility of the *greyscale test*.

Individual lines are scanned at the previously determined laser speed, always offset by focus diameter i.e. 0.1 mm. For each line, the power is dimmed in steps from **OFF to 100%** power. If the test is completed successfully, you should be able to notice a linear progression from white to black with your laser.



Picture: Results of the greyscales after several runs of the greyscale test

The greyscale test in detail

For the greyscale test there are 3 percentage values with which the greyscale value can be adjusted to the power curve of the laser.

White This value sets the threshold above which the laser no longer draws a line.

Grey The grey value is used to average out the grey colour steps and is explained below.

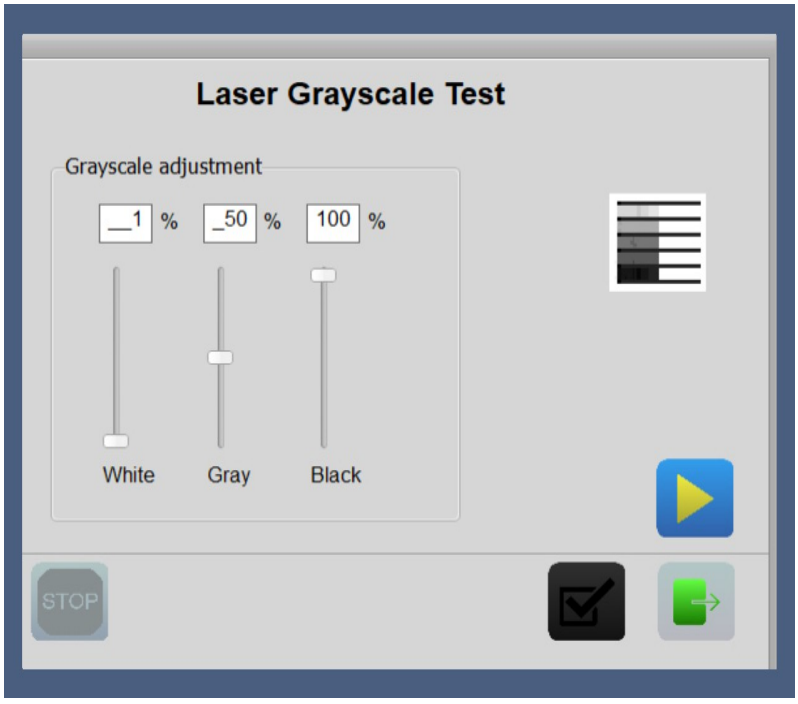
Black This value is used to set the laser power at which the lines are completely black.

For the first test run it is recommended to use the standard values again. These are:

White 1%

Grey 50%

Black 100%

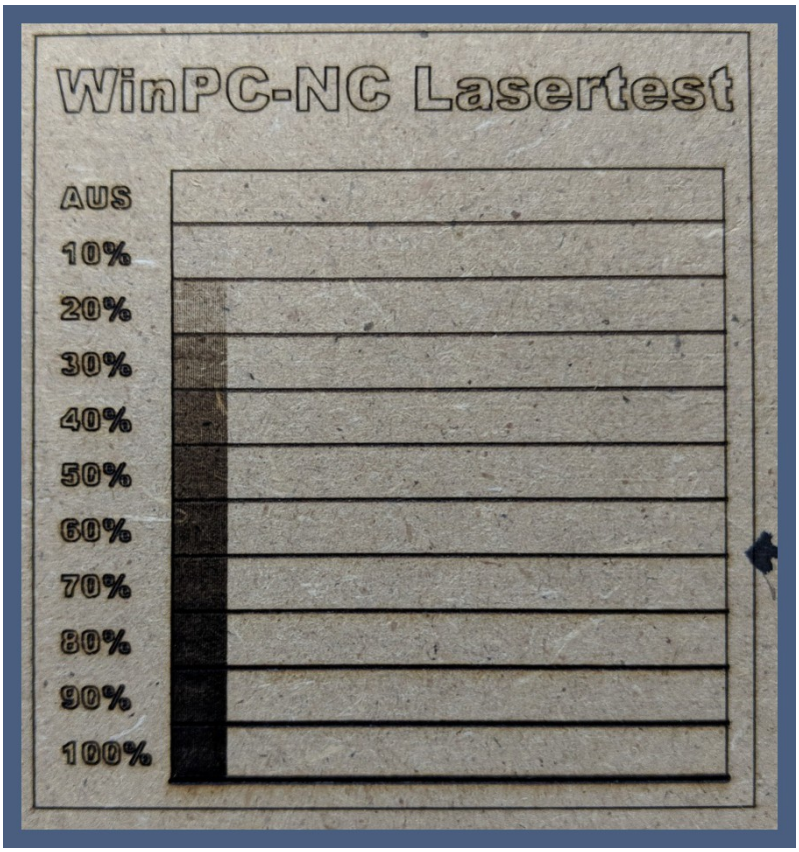


With a click on the *Move* button ***WinPC-NC*** starts to perform the greyscale test. The test is running across the lines from the speed test.

Checking the results and optimising the settings

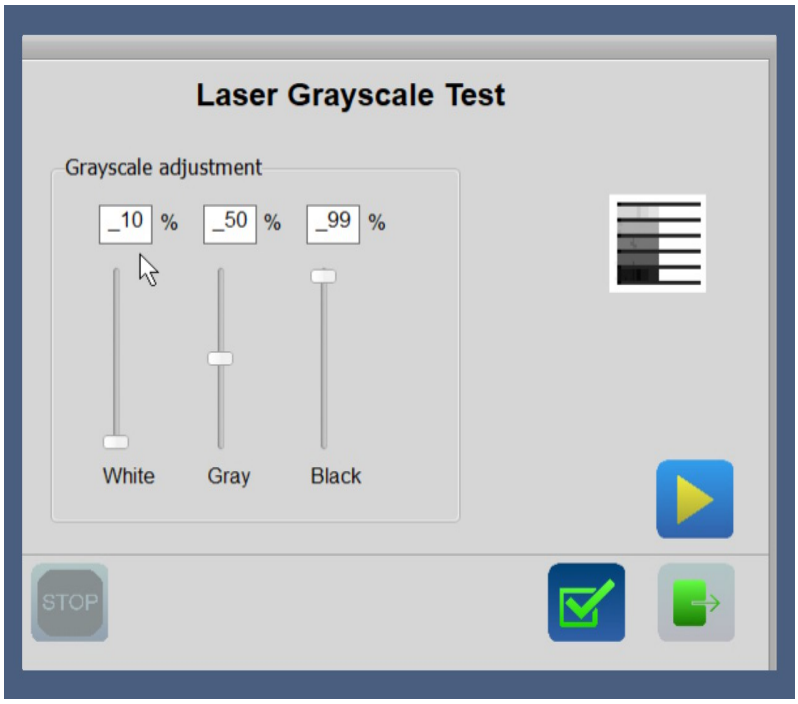
After enough lines have been drawn in the greyscale test, you can interrupt the test with *Pause* button. The laser head moves away from the workpiece and you can check the result.

The lasered lines should look like this or similar.

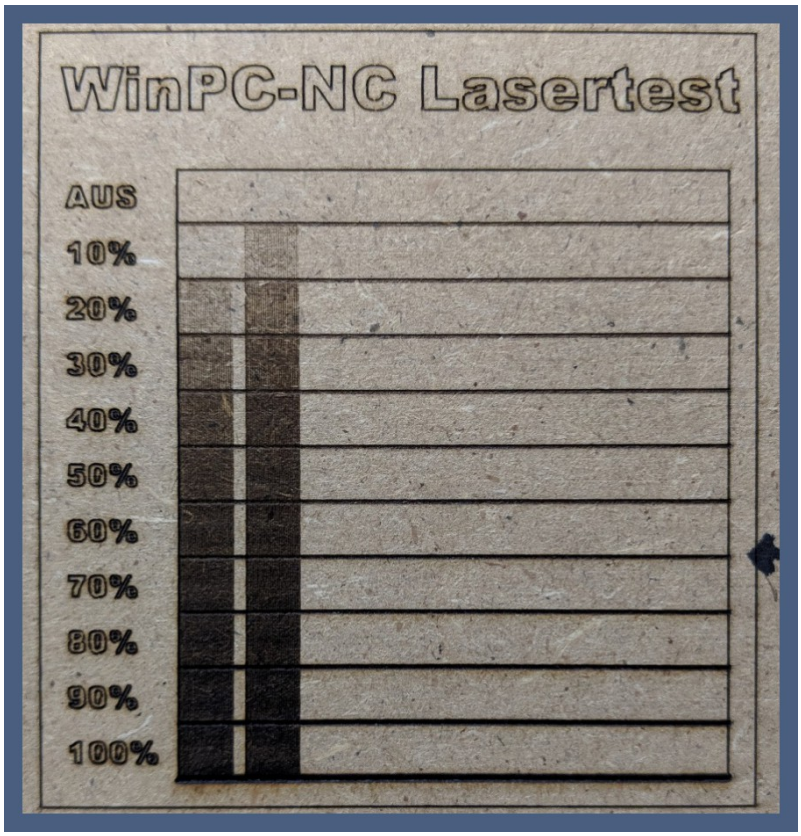


Picture: Greyscale test with standard parameters

After a closer look at the result it is noticeable that in the range between OFF and 20% no change of the grey level takes place. This can now be optimised by adjusting the *white value* and can be increased by about 10% with the slider.



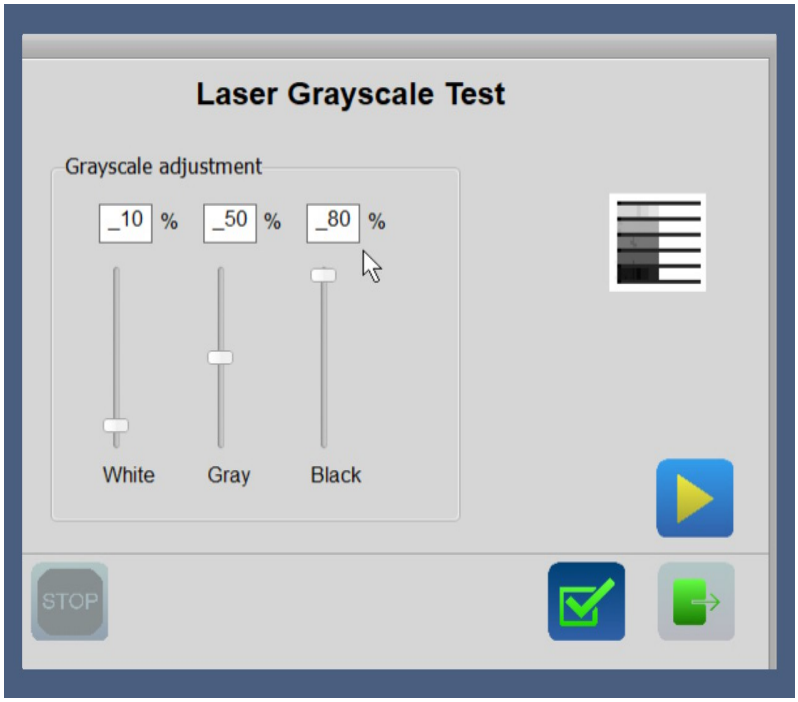
The test is continued and ***WinPC-NC*** draws the lines again with new settings and a small gap to the last test field. The result could look like this.



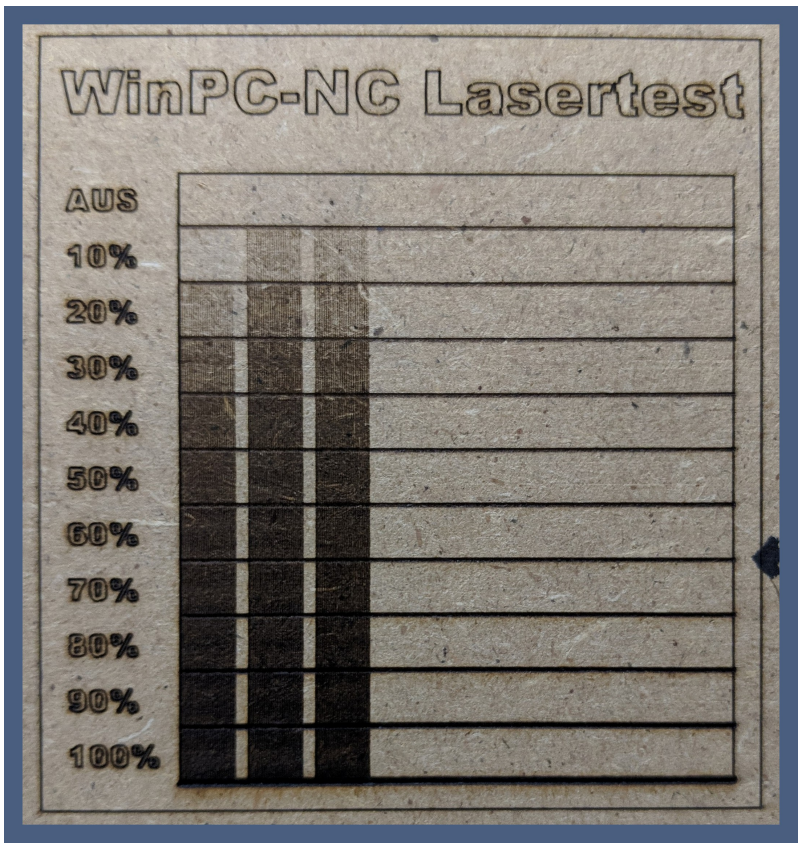
Picture: Result after optimisation of the white value

On reassessment we see that the white value has now been set correctly. In the OFF range no color is visible, from 10% laser power the grey gradient slowly increases.

Now the *black value* will be adjusted. In the test result it is easy to see that in the range between 80% and 100% laser power there is no more increase in the grey value. For this reason, we can limit the power upwards with the help of the *black value* and set the slider to 80%.



The third test could give the following result.

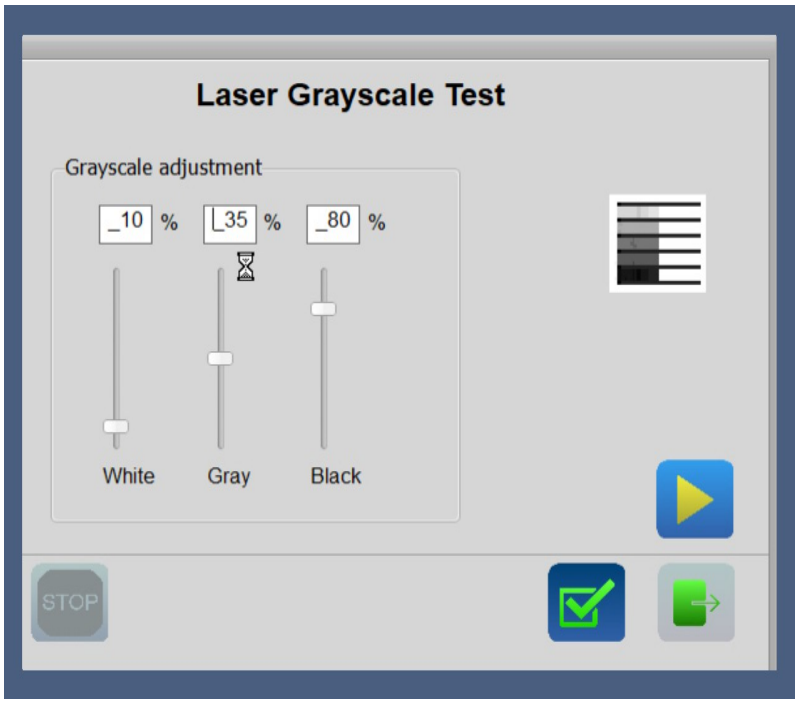


Compared to the second run there is not much difference, but the test and the adjustment was still successful. Only the power ranges in which no change in the greyscale could be detected (80-100% laser power) were cut.

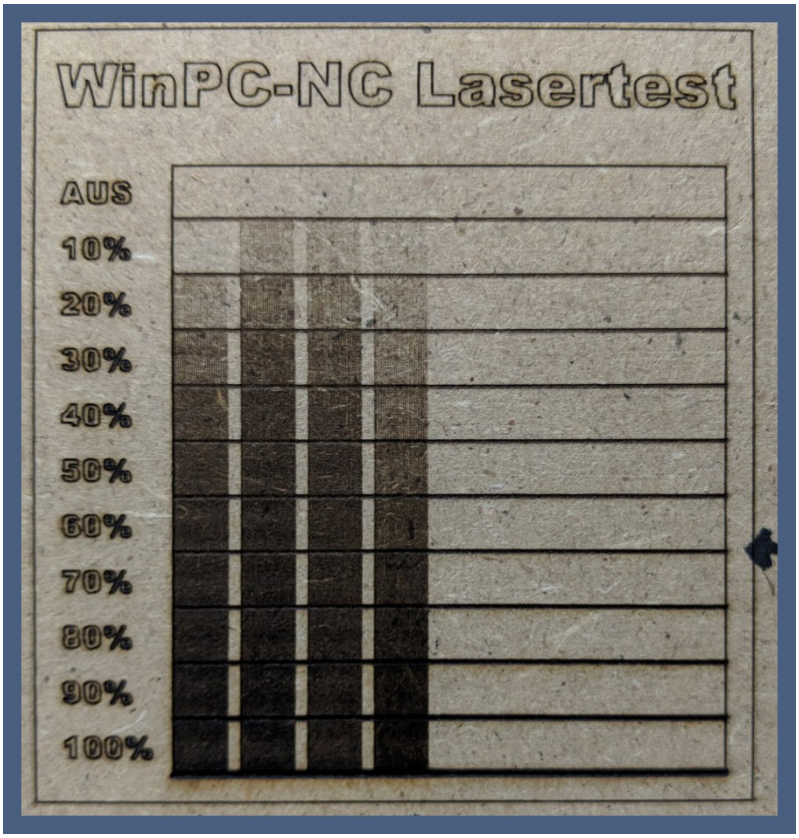
The third step is now to average out or linearise the *grey value*.

In the test result so far, the ideal grey area is clearly in the first third. In the next two thirds towards black, the gradation changes only in smaller steps.

With the *grey value* it is possible to average out and equalise this gradient. For this purpose we enter a grey value of 35% in our example for the 4th test.



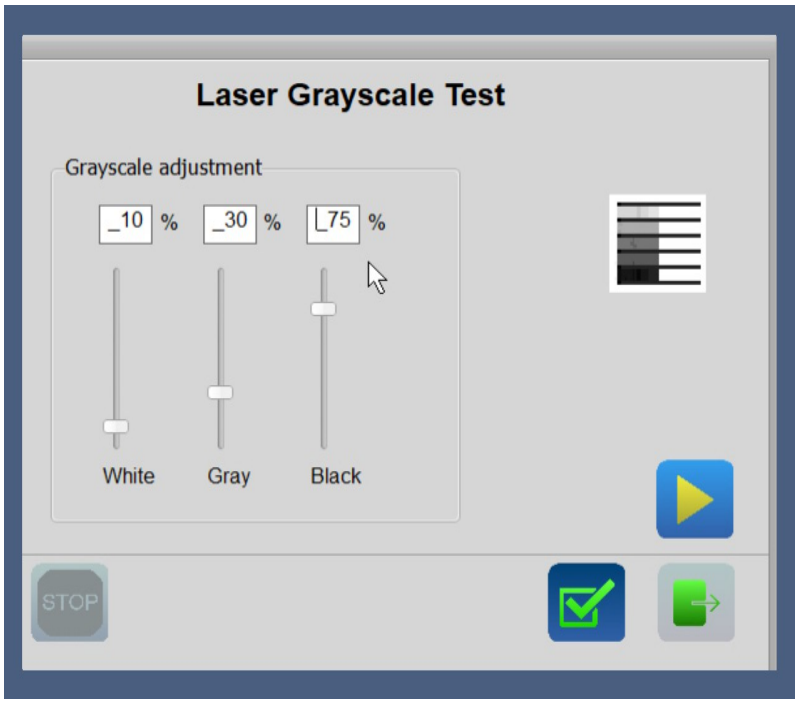
After the 4th test run you will usually get a very nice greyscale gradient. You can see an example of such a gradient here:



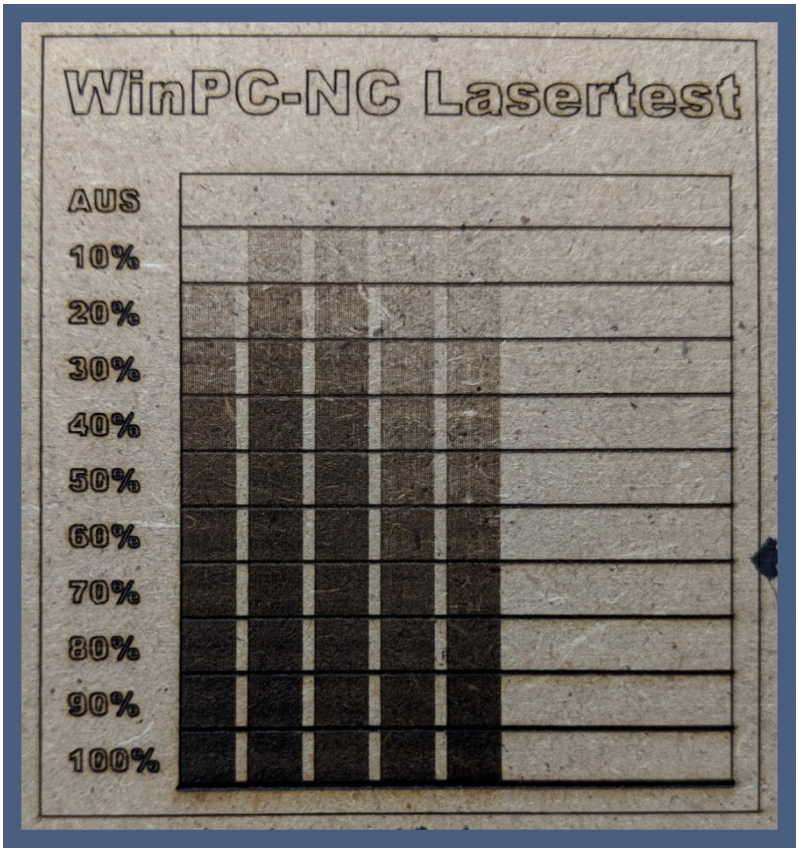
The result is already satisfying and you could work with it without any problems. However, to go into more detail on optimisation at this point, we would like to illustrate a 5th run for the final touches.

In the 5th test run there is little left to optimise. The *grey value* can still be shifted a little towards *white*. In addition, the *black value* could still be reduced by 5% to achieve an even better result.

The final fine tuning of the parameters is done with the following values.

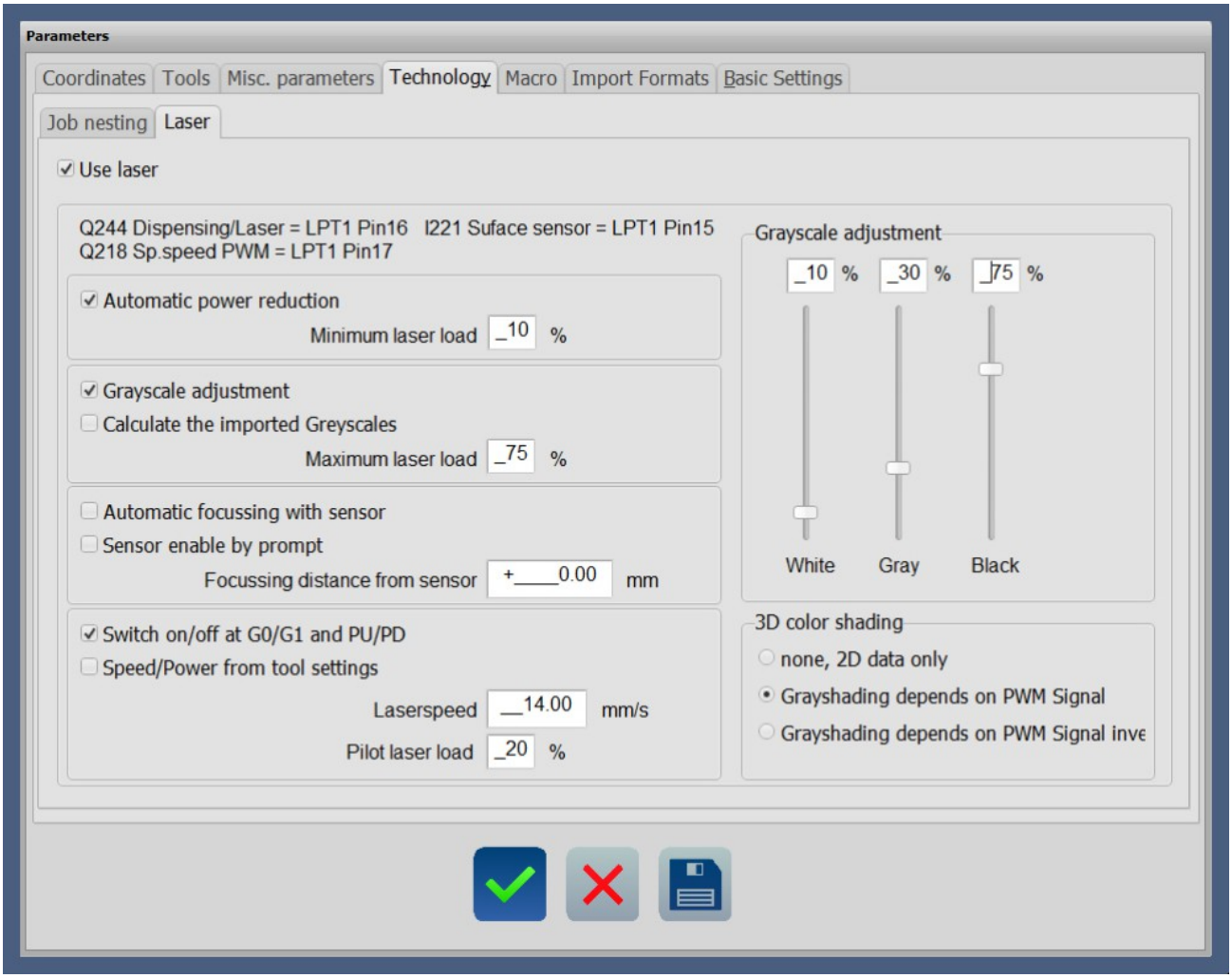


The result of the last optimisation run is now as follows.



After you are satisfied with the result of your greyscale test, you can save the values. To do so, please click on *Apply* button.

As soon as you save the new parameters in the greyscale test, they are taken over directly into the laser settings. You can view these at any time under *Parameter-Technology-Laser*. You can also find the *laser speed* and other important settings for your laser here.



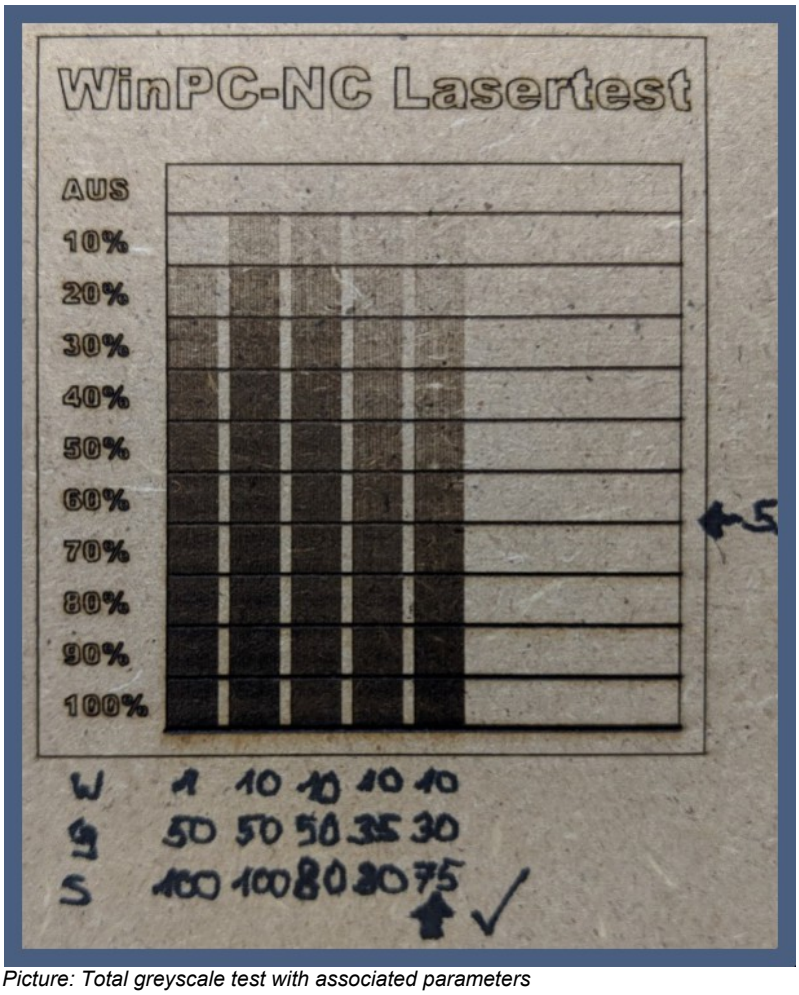
Note

The results of the laser test functions are always material-dependent, i.e. you should perform the laser test once for each material you want to process.

Tip: Save the settings in profiles or save screenshots of the W/G/S and speed parameters so that you can access them again later.

Here you will find once again a detailed picture of the complete greyscale gradient, which can serve as a reference for your own tests.

On the picture you can see an arrow indicating the *Best Black Line* No. 5 and in the lower area you will find the different *white, grey and black values*.



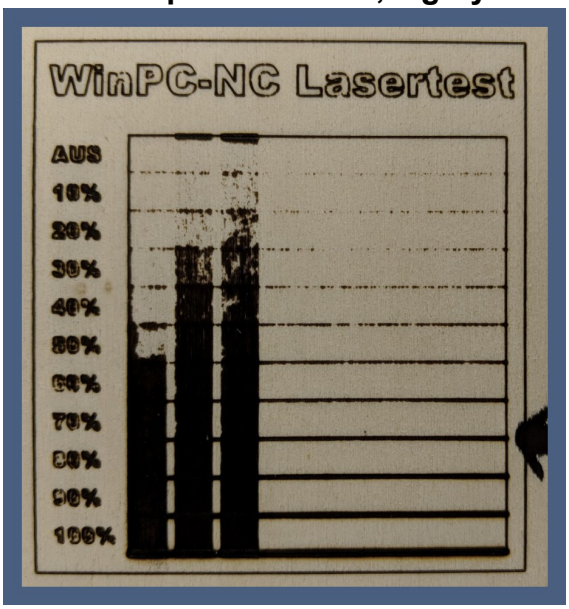
Picture: Total greyscale test with associated parameters

Note :

Not every material can be processed equally well with a laser.

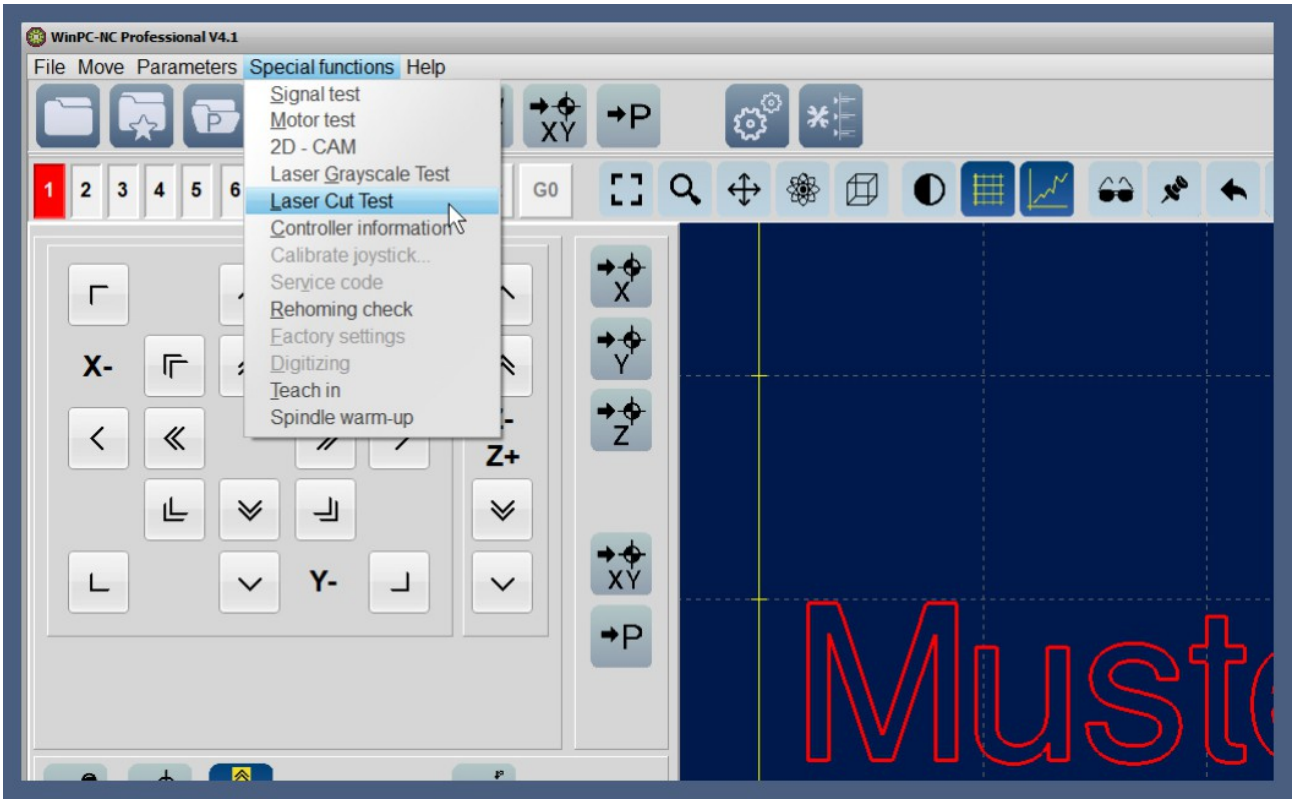
The MDF boards used for our example have excellent properties for engraving with a laser.

On the other hand the greyscale test on poplar plywood is very difficult to perform. Here, a greyscale match is hardly possible.

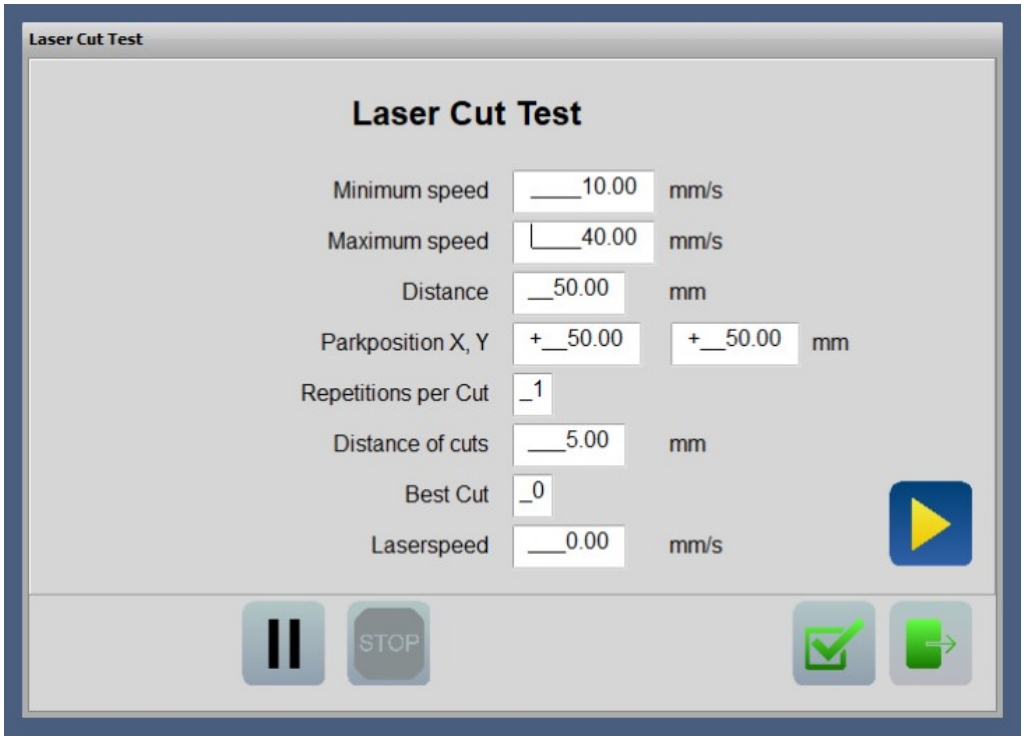


3. Laser cutting test

To access the cutting test, please click on *Special functions* and then on *Laser cutting test*.



The following window then opens for the test mode:



This window is very similar to that of the laser *greyscale test.* Most of the parameters can also be found here. Below you will find a summary and explanation of the possible settings.

Explanation of the parameters

Minimum & Maximum Speed:	***WinPC-NC*** also runs 11 lines here in equal increments between minimum and maximum speed.
Distance:	Length of the test lines
Parkposition X, Y:	Parking position after after the test
Repetitions per cut:	Number of runs per cut
Distance of cuts:	Distance between cutted lines
Best cut:	Best test result, first complete cut of whole material
Laser speed:	Speed determined on the basis of the best cut

Execution of the cutting test

For the first run of the test function we recommend using the standard parameters from the illustration as far as possible. Only for the parameter *Distance of cuts* it makes sense to enter a higher value for some materials. The standard value places the lines very close to each other and an exact assessment is thus made difficult in some cases. However experience shows that a distance of 5mm is suitable for most materials.

For the example, a 0.2mm thick film is used here. This is often used in the automotive sector and is relatively easy to process. As the foils melt quickly at the edges and do not look nice afterwards it is recommended to determine and adjust the parameters in advance with the cutting test.

If you find after the first test run that the speed was too low or too high, repeat the test with adjusted parameters at minimum and maximum speed.

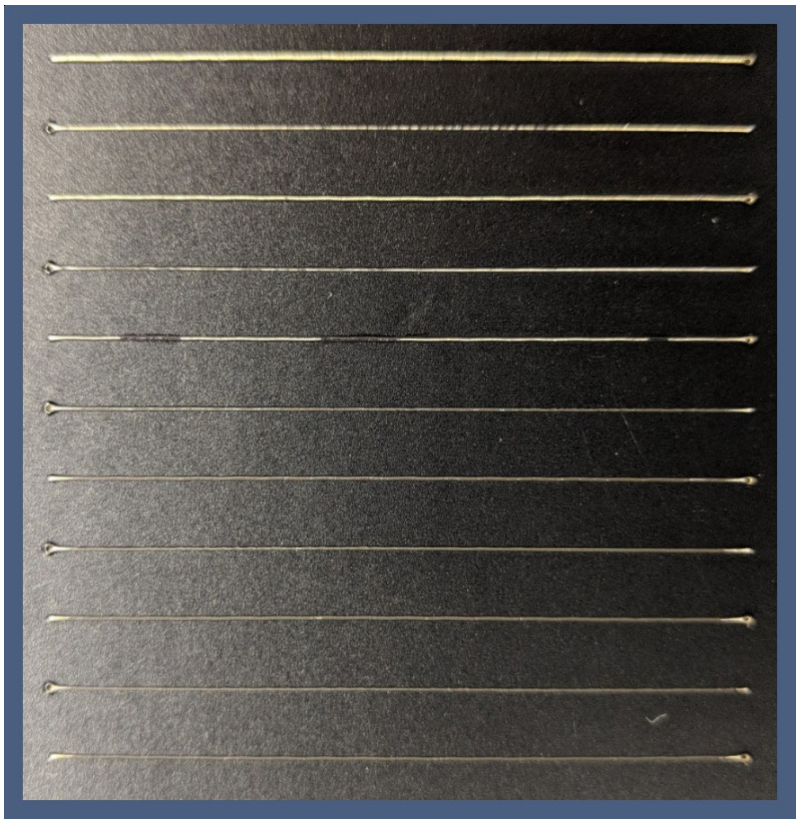
First move to the desired zero point on the test material, save it and set the focus height of the laser correctly.

Now click on *Start move* button in the right part of the window.

Important note

Your machine will now start automatically. You can stop the test at any time by pressing the *Stop* button.

Your machine now cuts 11 lines and uses a different decreasing speed for each of them. If several runs per cut have been set, ***WinPC-NC*** runs the same line several times and can thus also cut thicker materials. After the test is completed, the machine moves freely and remains there so that you can easily check the test result.



Checking the test results

A line that has been cut with the correct parameters can be easily identified. It should have a sufficient and uniform width and be cut quite cleanly. This also means that it must be traversed so slowly or so often that the laser power is sufficient to cut through the desired material completely. However, the traversing speed must also not be too low, otherwise the edges of the cut line will melt or burn and thus become inaccurate/odd.

In the example photo above these features are unfortunately a little difficult to see. The best line is the third from the top. The lines below it, which have been run off more quickly, are not completely cut and you can still see the transparent layer of glue.

Lines 1 and 2 have already been driven too slowly. The edges are not straight and some of the substrate has already been cut.

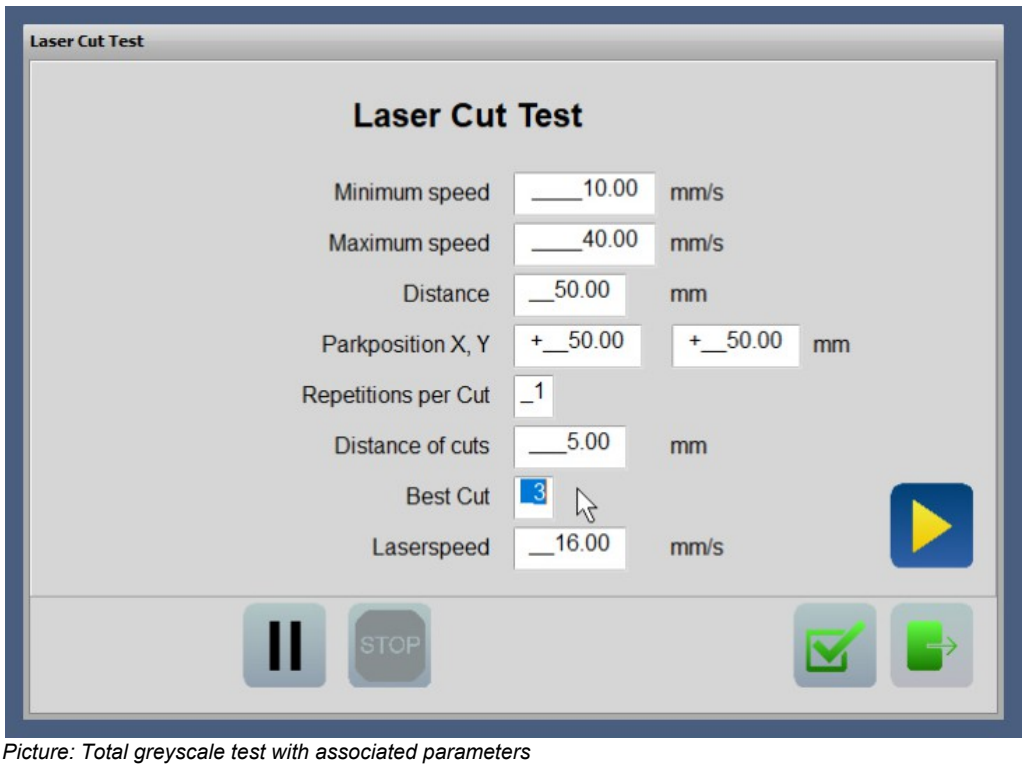
Note

A good way to judge is to take the material from the machine and hold it against the light. You can see very well whether the lines have been cut completely. Odd or unclean cut edges can also be noticed much more quickly this way.

Taking over the correct parameters

To transfer the determined parameters to ***WinPC-NC*** it is sufficient to enter the *number of the best line*. However, in contrast to the speed test, the cutting test is counted starting from the top.

As determined in the previous assessment, the third line from the top is the one with the best result. For this reason, we enter the number 3 in the parameter *Best cut*.



Picture: Total greyscale test with associated parameters

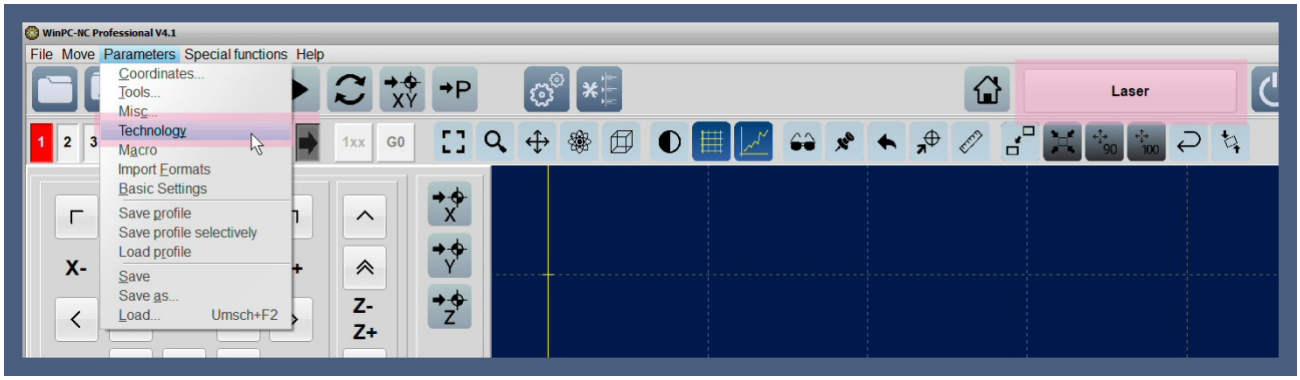
WinPC-NC calculates the corresponding speed from the number entered. In the example, the third line was travelled at 16 mm/s. To save this value permanently, please click on Apply.

You can now exit the *laser cutting* test by clicking on *End* button

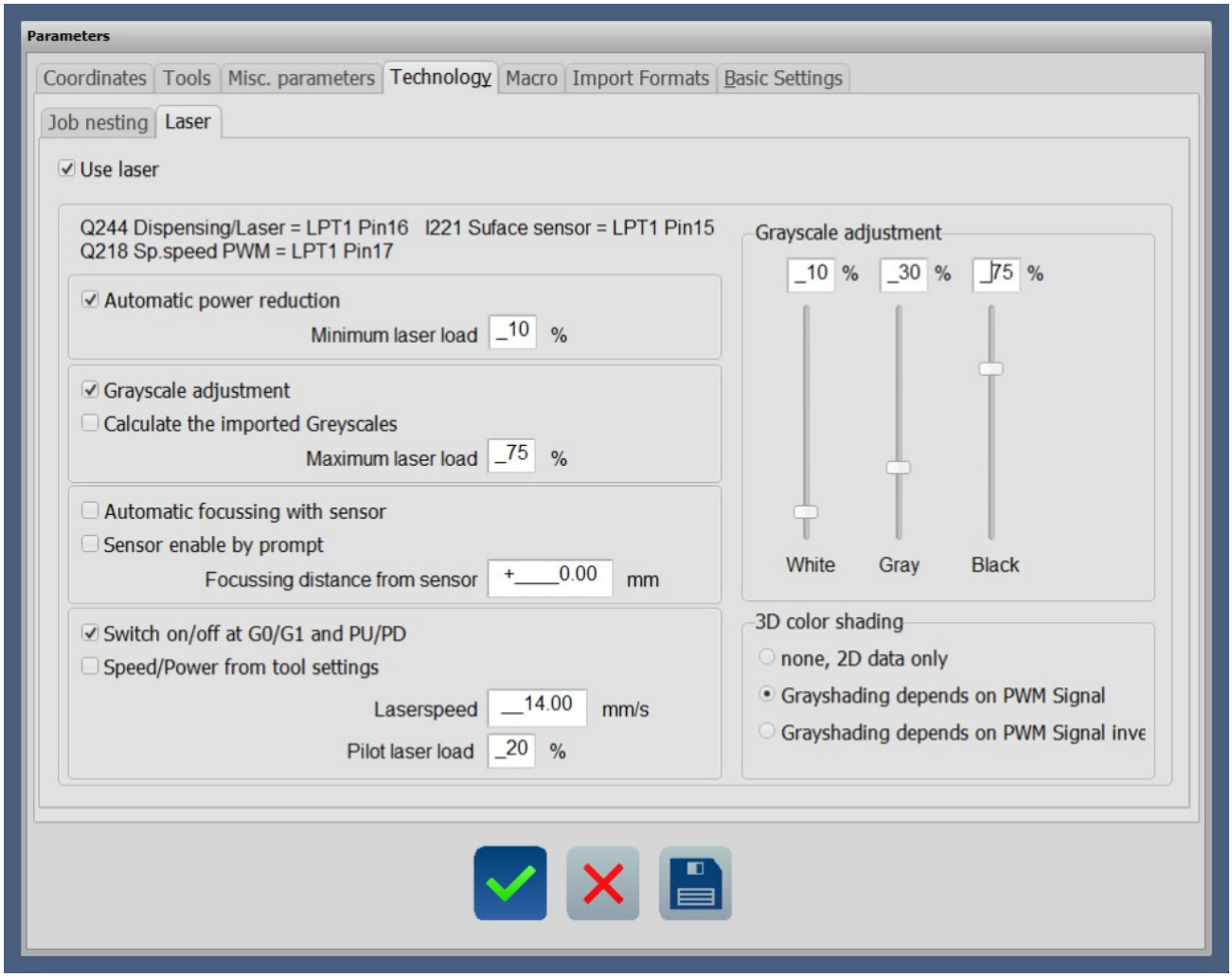
Picture: Cut felt with 4 passes and without burn edges

To change the speed value even without running the complete test cycle, you can use the laser settings in the parameters.

To do this, go to *Parameter Technology* or click into the *Technology* button in button line.



The following menu is then displayed. Here you can check the adopted values and change them manually at any time.



4. Automatic power reduction

Since we dealt with the topic of optimising the parameters for the use of a laser in this part of ***How does it work...***, one important parameter remains to be mentioned in conclusion: the speed-dependent control of the laser power.

How it works

To explain this setting in detail one has to get to grips with the path control of ***WinPC-NC***.

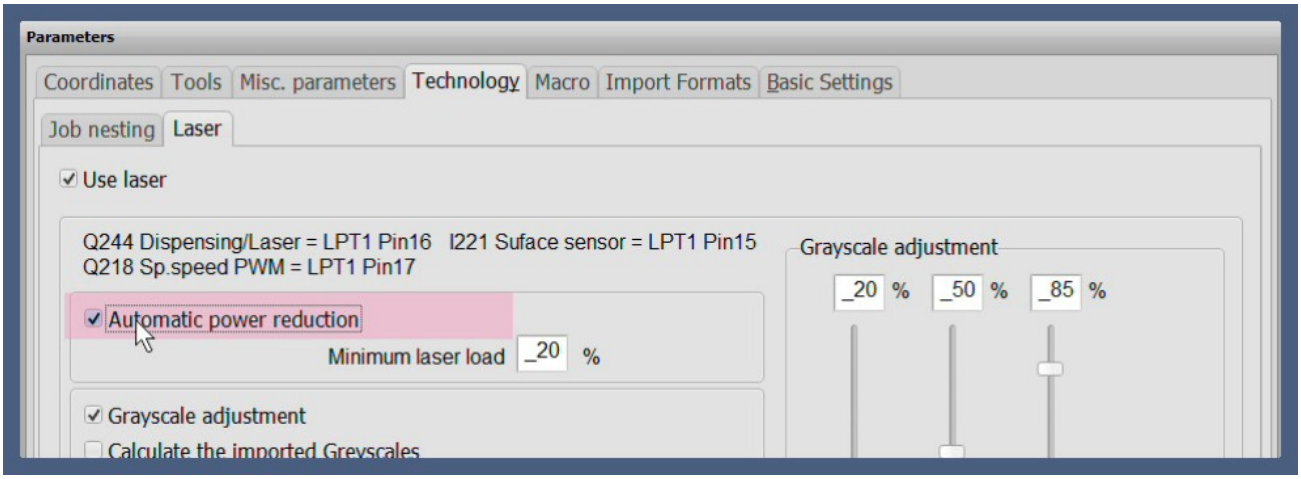
During an axis movement your controller does not always move constantly at the feed rate specified in the tool parameters. Rather this speed is adapted dynamically. This happens fully automatically and is done by ***WinPC-NC*** in the background to avoid overloading the mechanics by changing direction too quickly and to achieve better and more consistent and smoother moves.

In practice, you will notice this especially when tracing rounded contours. While a straight line is always traversed at the set constant feed rate, your control system brakes in curves and corners and moves them significantly slower. This feature has almost no effect on the result when milling and engraving, but when laser cutting you can clearly see the difference in results caused by different speeds in movements.

The contours that were moved more slowly due to this dynamic have received significantly more laser power due to the reduced speed and the material has been excessively heated or burnt as a result.

This manifests itself on the workpiece in the form of burnt edges and unclean contours or the substrate is also burnt. It is also easy to see that straight lines have been processed properly, because the determined speed is maintained exactly.

If you get such a poor laser cutting result yourself you can activate the *Automatic Power Reduction* setting.



With this, ***WinPC-NC*** automatically adjusts the laser power to the reduced feed speed by lowering the laser power accordingly at reduced speed.

The result with identical parameters as above, but with activated speed-dependent power control, then looks like this:

You can clearly see that the previously noticeable areas look much better and the film has been cleanly separated in all places without adding too much power. The edges are straight and not burnt.

At this point, we wish you a lot of fun and success in using your laser with *WinPC-NC*.