



DirectMark Tutorial 6 for ProMarker Series | V001_DM-Tutorial (06/2015) ENGLISH





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1 **Objectives of this tutorial**

This document will show:

- The differences between engraving, polishing and annealing on stainless steel •
- The necessary laser parameter settings for a ProMarker 20 W for these different processes •
- Explanations in order to understand what is happening with the material and how the laser pa-• rameters work

Requires:

- ProMarker 300 •
- 20 Watt •
- F160 lens •
- Corel Draw installation •
- Piece of stainless steel





Figure 1: ProMarker series



2 Marking processes for stainless steel and corresponding laser parameters

Main target of this tutorial is to learn how to mark steel and how the different processes work. Stainless steel can be engraved, polished and annealed. Combinations of these marking processes are possible as well.

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2.1 Engraving

Engraving steel means ablation of material on steel parts. Due to the very high energy of the laser, material like steel, titanium and other metals can be vaporized directly. This is possible due to the high pulse power of Trotec's fiber lasers (up to 10 kW pulse power) combined with very small laser spot sizes (Spot diameter of \sim 45 µm with F-160 lens).

With this method, texts, logos,... can be engraved into the material. Material is taken away and the color is changed. The resulting brown color are remains of the burned metal and can be cleaned.

In order to achieve this necessary ablation/vaporization of steel, high powers and relatively slow and medium marking speeds are required. The lower the frequency, the higher the possible pulse energy. That means the lowest possible frequency should be chosen.

Recommended settings for a 20 W fiber laser source: Power: 100% Speed: 300 mm/s (slower for 10 W) Frequency: 20 kHz Focus: Working in focus Resolution: 500 – 1000 dpi Number of passes: 1



2.2 Polishing

Polishing as just a different way of engraving a metal part. If the energy of the laser that is brought onto the material is reduced, less material will be vaporized, burnt, etc.

The result is a "light" engraving, bright marking results and less ablation of material. In order to achieve this, some or even all laser parameters need to be chanced: Less power, higher speeds (results in less energy per distance), higher frequencies (less pulse energy).

Recommended settings for a 20 W fiber laser source:

Power: ~ 50% (more for 10 W) Speed: ~ 2000 mm/s (slower for 10 W) Frequency: ~ 60 kHz Focus: Working in focus Resolution: 500 – 1000 dpi Number of passes: 1

2.3 Annealing

With the annealing process, perfect black markings can be achieved on stainless steel (also possible on Titanium. Not possible on other metals!).

When marking a part by using the annealing process, no material is taken away (no ablation), but the color of the metal is changed by heating it up. When stainless steel reaches temperatures between 200 and 300 °C it will change its color. Different colors can be achieved with different temperatures. For marking metal the target is normally to achieve a "perfect black".

Different things are important concerning the laser parameters:

- No vaporization / melting of metal is allowed. The metal just needs to be heated. This can be achieved by reducing the energy density of the laser impact onto the metal part. The easiest way is to go out of focus which increases the laser spot size considerably (same energy on a much bigger surface means reduction of energy density)
- Annealing is a thermal process and heating up the material needs it's time. Very slow marking speeds are therefore required.

Recommended settings for a 20 W fiber laser source:

Power: 80 – 100 % Speed: 80 - 120 mm/s Frequency: ~ 20 - 30 kHz Focus: Working <u>out of focus!</u> ~ 5 mm for F-160 lens. ~ 7 mm for F-254 lens. Resolution: 1000 dpi Number of passes: 1



3 Creation of a job in Corel Draw and DirectMark

3.1 Open logo in Corel Draw

Open the Corel draw file supplied with this tutorial (if you don't have any appropriate logo available you can use any logo or just create a simple text by yourself):

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3.2 Definition of laser parameters in material database

Click on print and select the DirectMark printer driver as learned in the tutorials before. Click on "properties" and the DirectMark printer driver windows for adjusting the settings will appear. Click on the pencil for entering the material database:

properties Printer In	fo
Material	
Standard / Standard	•
	2000,0100 50,00
Execution mode	
20	
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THOUS	Logo
Graphic	
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Resolution 500 dpi Quantity (max.65535) Rotary Diameter [mm] 20,00	Dithering Stucki Pixel correction (0) Advanced *



Create one new group of materials and name it (example) "Tutorial_6". Create 3 new materials within this group: "Steel_Engraving", "Steel_Polishing" and "Steel_Annealing":

Material database Material Standard Material Steel_Engraving Standard Material Steel_Engraving Standard Material parameter Metal Print mode Power [%] Marking speed [Reg Frequency [kHz] Quality Adv. Anodzed Aluminium Pen Aluminium Param 1 Bitmap 100 300,0 20,00 100 P:1; Pen Aluminum bottle Param 3 Vectors 100 2000,0 50,00 100 P:1; Plastics Param 4 Vectors 100 2000,0 50,00 100 P:1; Plastics Param 7 Vectors 100 2000,0 50,00 100 P:1; Plastics Param 7 Vectors 100 2000,0 50,00 100 P:1; Param 8 Vectors 100 2000,0 50,00 100 P:1; Param 9 Vectors 100 2000,0 50,00 100 P:1; Param 10 Vectors 100 2000,0 50,00 100 P:1;							Mate	rial d	atab	ase	
Standard Material Steel Engraving ■ Standard Metal Description ■ Steel (Annealing) Steel (Engraving) Material parameter ■ Steel (Engraving) Active Name Print mode Power [%] Marking speed [mm/s] Frequency [kHz] Quality Adv. ■ Anodized Aluminium Pen Aluminum Param 1 Bitmap 100 300,0 20,00 100 P:1; ■ Metailighter Param 3 Vectors 100 2000,0 50,00 100 P:1; ■ PA-Polyamide Param 5 Vectors 100 2000,0 50,00 100 P:1; ■ PA-Polyamide Param 7 Vectors 100 2000,0 50,00 100 P:1; ■ PA-Polyamide Param 7 Vectors 100 2000,0 50,00 100 P:1; ■ Param 10 Vectors 100 2000,0 50,00 100 P:1; ■ Param 7 Vectors 100 2000,0 50,00 100 P:1; ■ Param 9 Vectors 100 2000,0 50,00 </th <th> Material database</th> <th>Material</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	Material database	Material									
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Photo plastit Param 11 Vectors 100 2000,0 50,00 100 P:1; Tutorial_6 Param 12 Vectors 100 2000,0 50,00 100 P:1; Steel_Polishing Param 13 Vectors 100 2000,0 50,00 100 P:1; Steel_Annealing Param 14 Vectors 100 2000,0 50,00 100 P:1; Param 15 Vectors 100 2000,0 50,00 100 P:1;	Pen plastic		Param	10	Vectors	100	2000,0	50,00	100	P:1; Z:	
Image: Steel_Engraving Image: Steel_Engraving Image: Param 12 Vectors 100 2000,0 50,00 100 P:1; Image: Steel_Polishing Image: Steel_Annealing Image: Param 13 Vectors 100 2000,0 50,00 100 P:1; Image: Steel_Annealing Image: Param 14 Vectors 100 2000,0 50,00 100 P:1; Image: Param 14 Vectors 100 2000,0 50,00 100 P:1; Image: Param 15 Vectors 100 2000,0 50,00 100 P:1;	Photo plastic		Param	11	Vectors	100	2000,0	50,00	100	P:1; Z:	
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Steel_Polishing Param 14 Vectors 100 2000,0 50,00 100 P:1; Steel_Annealing Param 15 Vectors 100 2000,0 50,00 100 P:1;	Steel_Engraving		Param	13	Vectors	100	2000,0	50,00	100	P:1; Z:	
Steel_Annealing Param 15 Vectors 100 2000,0 50,00 100 P:1;	Steel_Polishing		Param	14	Vectors	100	2000,0	50,00	100	P:1; Z:	
	Steel_Annealing		Param		Vectors	100	2000,0	50,00	100	P:1; Z:	
Positioning Positioning			Positio	ning	Positioning						

In each created material adjust the laser parameters of the first parameter set as follows (in the picture above, the parameters for the engraving process can be seen):

- "Steel_Engraving":
 - Print mode: bitmap
 - Power: 100%
 - Marking speed: 300 mm/s
 - Frequency: 20 kHz
- o "Steel_Polishing":
 - Print mode: bitmap
 - Power: 50%
 - Marking speed: 2000 mm/s
 - Frequency: 60 kHz
- "Steel_Annealing":
 - Print mode: bitmap
 - Power: 100%
 - Marking speed: 120 mm/s
 - Frequency: 25 kHz

Note: These are the recommended parameters for a 20 W fiber laser source and a F-160 lens. Different parameters for different configurations (laser power, lenses,...) necessary!



4 Mark the job in steel with different processes

4.1 Set parameters and mark the image with engraving process

Print the page and change the marking properties as follows:

- Material: Steel_Engraving
- Photo mode
- o Resolution: 1000 DPI
- o Dithering: Stucki
- Pixel correction: 0

Material	го
Tutorial 6 / Steel Engr	aving 🔹
Bitmap P 100 V	300,0 🔟 20,00 🥖
Execution mode	
2	
	U
Photo	Logo
Graphic	
Resolution	Dithering
1000 dpi 🔄	Studi
Quantity (max.65535)	Pixel correction (0)
1 12	4 1 4
Rotary	
Diameter [mm]	-
20,00	Advanced *





Mark the image

- 1. Focus the laser on steel plate
- 2. Exit the property window by pressing OK
- 3. Send the job to the DirectMark software using Print
- 4. Position the job on the steel plate
- 5. Turn off the pilot laser by pressing Border marking

\bigcirc	Laser system is ready. Options: Quick print is deactivated. Options: Automatic border marking	
ending print jobs	1/1	Start (F12)
	6	Border marking (F9)
	Power	Speed

- 6. Start the job by pressing the start button7. Have a look on the result



8. Try all the steps with different resolutions and also with the logo mode. Observe the results and the differences



4.2 Set parameters and mark the image with the polishing process

Print the page and change the marking properties as follows:

- Material: Steel Polishing 0
- Photo mode
- o Resolution: 500 DPI
- Dithering: Stucki
- Pixel correction: 0

Mark the image

- 1. Focus the laser on steel plate
- 2. Exit the property window by pressing OK
- 3. Send the job to the DirectMark software using Print
- 4. Position the job on the steel plate
- Turn off the pilot laser by pressing *Border marking* Start the job
 Have a look on the result



8. Try all the steps with different resolutions and also with the logo mode. Observe the results and the differences





4.3 Set parameters and mark the image with annealing process

Print the page and change the marking properties as follows:

- Material: Steel_Annealing 0
- Photo mode
- o Resolution: 1000 DPI
- Dithering: Stucki
- Pixel correction: 0

Mark the image

- 1. Focus the laser on steel plate and then (IMPORTANT !) defocus ~5 mm.
- 2. Move the z axis ~5 mm upwards.
- 3. Exit the property window by pressing OK

- Exit the property window by pressing OK
 Send the job to the DirectMark software using *Print* Position the job on the steel plate
 Turn off the pilot laser by pressing *Border marking* Start the job
 Have a look on the result



9. Try all the steps with different resolutions and also with the logo mode. Observe the results and the differences



4.4 Combination of different processes

It is also possible and sometimes useful to combine different processes:

- a) One example is to use the polishing process after an engraving cycle to clean the marking content.
 - 1. Try to engrave the logo of the markings before by using the parameter "Steel_Engraving" (assure to be in the focus again!).
 - 2. Leave the steel plate on the same position.
 - 3. Mark the same marking job again but change the marking process to "Steel_Polishing" before.
 - 4. Have a look on the results and observe how the polishing cycle is cleaning the engraved metal surface.



- b) Another example is to polish a certain area before starting an annealing job. This is helpful if a very good contrast needs to be achieved. E.g.: 2D codes or serial numbers that need to be (machine-)legible. Logos, pictures, etc that look just "nicer" with higher contrasts, etc...
 - 1. Create a rectangle with a dimension that is a bit larger than the logo of the exercises before. Fill the rectangle and polish it by using the "Steel_Polishing" parameters.
 - 2. Move the laser 5 mm out of focus for the following annealing job (lift the z-axis 5 mm)
 - 3. Mark the logo by using the "Steel_Annealing" parameters.



Subject to technical changes.

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Technische Änderungen vorbehalten

Trotec Laser GmbH Freilingerstraße 99 A – 4614 Marchtrenk AUSTRIA