

# GRAFMETAL

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## User manual of GRAFMETAL Ceramic Paste for marking of metals with CO2 lasers (1.3 version)

### Scope

Ceramic Paste is designed for marking metals with CO2 lasers. It is distinguished by its very high processing speed and ease of removal after the process.

### General process description

1. The paste is mixed and an even layer is applied with a spatula (or possibly a brush) to the metal object. One does not need to wait for the paste to dry.
2. The layer is illuminated with laser in the desired areas. The layer absorbs the laser light and cures under its influence. It is necessary to use quite high speeds, the air blowing should not be too strong, so as not to blow away the paste.
3. After the process, wipe off the rest of the uncured layer, you can also help yourself with a cloth, while being careful not to scratch the surface of the metal. The uncured paste can be collected and reused.
4. A permanent black layer is left in the laser exposed areas.

### General remarks

- 1. It is necessary to mix the paste before every use.**
2. It is recommended to perform tests before working with the final metal object. Tests should be performed on the same material type.
3. If the layer adhesion is too weak after laser processing and cleaning (e.g. sometimes noted in case of aluminium, copper, chromium plated surfaces or similar materials), then it is recommended to degrease the surface before applying the product by strongly rubbing the metal with a cloth soaked with alcohol, acetone or similar solvent, but force applied should not be strong enough to produce scratches. If this does not work, then it is recommended to decrease laser speed. If this will not help either, then it is recommended to clean the metal surface with a sandpaper before paste deposition.
4. Laser cover should be closed during the whole time when the device is working. Metals reflect laser light, so if the cover is open, it can deteriorate one's health, lead to burns or lead to blindness. If the laser is not equipped with a cover, then it is necessary to prepare appropriate protection.
5. Using the product for a very long time with insufficient CNC laser table ventilation may lead to deposition of fine soot particles on mechanical and optical laser elements. It is recommended to clean mechanical elements with a paper towel, tissues or ear sticks – dry or after soaking them with isopropyl alcohol, while the optical elements should be cleaned with a cotton cloth after soaking it with isopropyl alcohol. After application of isopropyl alcohol, before using the laser for the subsequent time, one should wait until the solvent evaporates. Any works shall be carried out while the laser power supply is turned off. It is necessary to be cautious while cleaning the optical elements, so they will not get damaged or no longer aligned.
6. It is recommended to periodically monitor if the focusing lens is clean.

### Manual

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**CERAMIC PASTE FOR MARKING OF METALS WITH CO2 LASERS**

### 1. Surface preparation

Prepare the metal object. If it is coated with a protective foil then remove it. In some cases it may be beneficial to clean the surface with a cloth soaked with a solvent by rubbing the metal with a proper force. Sometimes, to obtain good adhesion of the marking layer after laser processing, it may be necessary to clean the surface of the metal object with a sandpaper (sometimes encountered while processing e.g. copper or aluminium).

### 2. Application of the product

The paste should be mixed before each use. If the paste contains lumps, then one should not apply it, but mix it more thoroughly to eliminate the lumps. Apply the layer with a spatula so that it is as even as possible. Alternatively, it is also possible to use a brush. One should be careful that there are no uncovered areas. The paste does not dry out, so one does not have to wait for it to dry, but can go straight to laser processing.

### 3. Laser irradiation

The layer is irradiated with CO<sub>2</sub> laser light (preferably a CO<sub>2</sub> laser of at least 20 W). In the exposed areas, a black layer will be formed, giving a marking effect. Select the cutting parameters based on the data given later in the manual. Fairly high speeds should be used.

To achieve the marking effect, it is enough to apply a single pass of the laser with certain parameters. The file is prepared in the same way as, for example, in the case of engraving laminates.

### 4. Removal of the residual paste

After laser exposure, there will be areas on the metal object irradiated and not irradiated by the laser. It is necessary to remove the unexposed paste, which can be done by wiping off with a cloth, but one should be careful not to damage the surface of the metal. The unexposed paste can also be collected and reused.

## Remarks regarding creation of images for direct marking of photos without dedicated software

Creating images on metals during the marking process based on photos may require conducting a series of trials. If the laser software does not allow you to prepare a suitable file, it is suggested to process the photo with tools such as <https://www.imag-r.com/> or to transform the photo to black and white (but not to shades of gray) with graphics processing programs.

## Example parameters

Reference value: cutting 2 mm (0.08") thick acrylic - CO<sub>2</sub> laser, 80 W x 100% x 30 mm/s (1.2 in/s)

### Marking:

Steel, stainless steel, acid-resistant steel, galvanized steel: 80 W x 100% x 300-500 mm/s (12-20 in/s)

Aluminium, copper, brass, zinc: 80 W x 100% x 100-400 mm/s (4-16 in/s), if the surface is cleaned

better or is more rough, then higher speeds may be applied, for instance aluminium after cleaning it with a 2500 sandpaper: 200-400 mm/s (8-16 in/s), aluminium with mirror finish: 100-150 mm/s (4-6 in/s)

Chrome plated surfaces: 80 W x 100% x 50-150 mm/s (2-6 in/s)

## Yield

Paste:

Thin layer: up to 10 m<sup>2</sup>/l (108 sq ft/l) (4 m<sup>2</sup>/kg (43 sq ft/kg)) of paste

Thick layer: up to 7 m<sup>2</sup>/l (76 sq ft/l) (2,8 m<sup>2</sup>/kg (30 sq ft/kg)) of paste

## Paste thinning

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If the paste is too thick for a given application, it can be thinned by adding pure methanol or another alcohol-based solvent that does not contain water or another solvent that is not alcohol but mixes with alcohols and does not contain water. If thinning was carried out, the solvent must be allowed to evaporate before laser processing.

### Problem solving

Problem	Solutions
When working with aluminium, copper or brass, layer with big marking areas after laser engraving with weak parameters does not adhere to the substrate, when run with strong parameters, the layer cracks during processing or during wiping off.	<ul style="list-style-type: none"> <li>• The paste overheats before hardening by laser.</li> <li>• Decrease line density.</li> <li>• Decrease power and speed.</li> <li>• Use multiple weaker runs instead of one strong.</li> <li>• Exchange material for a thicker one if possible (greater heat capacity, better heat dissipation).</li> </ul>
Marking speed is lower than expected	<ul style="list-style-type: none"> <li>• Degrease the surface with an organic solvent before applying the product.</li> <li>• Clean the surface with fine sandpaper before processing.</li> <li>• Apply a thinner layer of the product. In the case of paste, to do this you can thin it according to previous instructions.</li> </ul>
After marking, you can see discoloration or scorched areas with very little cured thickness.	<ul style="list-style-type: none"> <li>• The applied layer was not even enough and there were areas of low thickness that burned through.</li> <li>• Apply a more even layer, if necessary, then you can dilute the paste according to previous instructions.</li> </ul>
After marking, the layer is mostly very thin or barely visible, you can see the metal from underneath.	<ul style="list-style-type: none"> <li>• Perhaps too low speed or too high power was used, or the line density was too high, so the layer burned out.</li> <li>• Increase the speed of laser processing or reduce the power or decrease line density.</li> <li>• Perhaps the air blow is too high and it blows most of the preparation off the object. Then use a weaker blowing force, for instance by unsealing the compressed air system or by using a tee connector and valve to regulate it.</li> <li>• Maybe the layer is too thin, it is then recommended to apply thicker layer or apply thin layer several times.</li> </ul>
Adhesion of the layer when marking is too weak or the quality is insufficient, but the laser power used is high.	<ul style="list-style-type: none"> <li>• Before applying the product, metal should be cleaned with a cloth soaked with alcohol or acetone or another solvent with a proper force applied when rubbing not to scratch the surface.</li> <li>• If this does not help, then the laser speed should be decreased.</li> <li>• If this will not help either, then the surface of metal should be treated with sandpaper before deposition of paste.</li> </ul>
The product layer does not cure during marking.	<ul style="list-style-type: none"> <li>• It is necessary to increase the laser power or decrease the speed.</li> </ul>
The layer formed during the marking process is not	<ul style="list-style-type: none"> <li>• One may apply a thicker layer of the paste.</li> </ul>

uniform.	<ul style="list-style-type: none"> <li>• It is recommended to increase the laser power or decrease the speed.</li> <li>• If the above actions do not help, then one may consider modification of the computer file used for marking or changing density of lines of laser runs.</li> </ul>
Removal of the product after laser processing produces scratches on metal surface.	<ul style="list-style-type: none"> <li>• Use organic solvent when rinsing the paste.</li> <li>• Try another material for paste removal, e.g. a soft cloth. Use lower pressure when wiping.</li> </ul>
When marking small and thin parts, different results are obtained than for large parts of the same material.	<ul style="list-style-type: none"> <li>• Small elements easily get hot, which changes the marking conditions.</li> <li>• It is recommended to decrease the laser power or to increase the speed.</li> </ul>
The layer formed during the marking process crumbles when one cuts the element, which can be observed in a close vicinity of circa 1 mm from the cutting line.	<ul style="list-style-type: none"> <li>• The marking process should be carried out after the final cutting of the element.</li> </ul>
Sheet metal bends during processing.	<ul style="list-style-type: none"> <li>• It is necessary to decrease the laser power or to increase the speed. If the quality of marking or engraving is too poor, then it is recommended to perform several such mild runs.</li> <li>• Alternatively, one can modify the file for laser processing, so such situation will not occur any more.</li> </ul>
The resulting pattern is wider than it should be. Small holes in the pattern have not formed, only there is a cured paste.	<ul style="list-style-type: none"> <li>• Use lower power or faster laser run speeds.</li> </ul>
Marking of an image produces a uniformly black picture.	<ul style="list-style-type: none"> <li>• One should change the marking file - decrease the brightness before the Newsprint transformation.</li> <li>• It can be beneficial to decrease the resolution.</li> </ul>
Marking of an image produces empty spots and big black spots during the same marking job.	<ul style="list-style-type: none"> <li>• It is recommended to change the marking file - decrease the contrast before the Newsprint transformation.</li> </ul>
Marking of a thin sheet metal with a graphics with a big area to irradiate (e.g. a big black square) makes the sheet bend.	<ul style="list-style-type: none"> <li>• The sheet eventually heats up and bends. It is necessary to either introduce time breaks after each line or to decrease the laser power or to increase the speed or to decrease line density.</li> </ul>
Marking with high power laser parameters makes the sheet bend, while the low power parameters produce low adhesion layer.	<ul style="list-style-type: none"> <li>• It is necessary to either introduce time breaks after each line or to adjust laser power and speed or to decrease line density.</li> </ul>
After marking one can notice bands and overexposed spots. It is particularly present when marking relatively big surfaces.	<p>The problems may be a result of uneven distribution of paste on the object. Possible routes of overcoming the issue:</p> <ul style="list-style-type: none"> <li>• application of thicker and more even layers of paste</li> <li>• decreasing line density</li> <li>• disabling air blow or decreasing the flow of compressed air.</li> </ul>
The obtained marking pattern is non uniform.	<p>The layer of preparation is too thin during laser processing or it is being burnt. It is recommended to:</p> <ul style="list-style-type: none"> <li>• work with one run only with lower laser run speed instead of doing several runs with higher speed</li> </ul>

	<ul style="list-style-type: none"> <li>• deposit thicker layer of paste</li> <li>• decrease line density</li> <li>• disabling air blow or decreasing the flow of compressed air</li> </ul>
A grey-black pattern is obtained during marking, while a black colour is needed.	<ul style="list-style-type: none"> <li>• Apply a thicker layer of the paste.</li> </ul>
Marking of a thin sheet metal with a graphics with a big area to irradiate (e.g. a big black square) initially gives good results, but they get worse with time and finally one does not get any marking effect.	<ul style="list-style-type: none"> <li>• The sheet heats up and the paste heats up as well, so it get temperatures so high that it does not have the useful properties any more.</li> <li>• It is necessary to either introduce breaks during the process or to decrease the laser power or to increase the speed or to reduce line density.</li> </ul>
Using the product for a long time, e.g. many marked objects or marking a very big element with a big area to be irradiated, makes the laser power decrease by itself. It works worse during metal marking as well as during any other laser job, like cutting acrylic.	<ul style="list-style-type: none"> <li>• Probably due to an insufficient ventilation, the soot which formed during the process deposited on optical elements of the laser. It is necessary to clean them with a cotton cloth after soaking it with isopropyl alcohol. After application of isopropyl alcohol, before using the laser for the subsequent time, one should wait until the solvent evaporates. Any works shall be carried out while the laser power supply is turned off. It is necessary to be cautious while cleaning the optical elements, so they will not get damaged. One can consider marking with the laser cover opened to solve the ventilation problem, provided that appropriate safety measures will be taken.</li> </ul>
The paste is too thick.	<ul style="list-style-type: none"> <li>• Thin the paste according to previous instructions. If thinning was carried out, wait for the solvent to dry before laser processing.</li> </ul>
During laser processing a flame can be observed. There are flakes flying in a laser processing chamber. The quality of the marked layer is inadequate.	<ul style="list-style-type: none"> <li>• Probably the laser air blow is is not working, so it is necessary to correct it. Alternatively, one can use slower and weaker laser runs or breaks between runs.</li> </ul>

Hazard statements: H319 Causes serious eye irritation. H335 May cause respiratory irritation. H351 Suspected of causing cancer.

Precautionary statements: P261 Avoid breathing dust/fume/gas/mist/vapours/spray. P280 Wear protective gloves/protective clothing/eye protection/face protection. P304+P341 IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. P305+P351+P338 IF IN EYES: Rinse continuously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. P312 Call a POISON CENTER or doctor/physician if you feel unwell . P337+P313 If eye irritation persists: Get medical advice/attention.

Contains: molybdenum trioxide.

THE PRODUCT IS INTENDED FOR PROFESSIONAL USE ONLY. THE PRODUCER IS NOT RESPONSIBLE FOR ANY INCORRECT USE THEREOF.

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