REPORT: Brass cutting and grooving by Laser-MicroJet®

for Anonymous

by Mr Stephane Delahaye; Synova SA

TASK

The Laser-MicroJet® technology has been used for cutting and grooving brass samples.
The main goal of this new iteration was to decrease the time of process and show the feasibility of grooving.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Disc of brass
	Dimension	Ø 39 *mm*
	Thickness	400 *µm*
	Quantity	20 *pcs*

Release of application report			
	Project Leader		Responsible Application Group
Name:	Mr Stéphane Delahaye	Name:	Dr Benjamin Carron
Date:	23.05.2012	Date:	23.05.2012
Visum:	SD	Visum:	BC

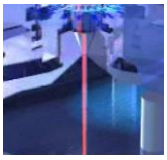
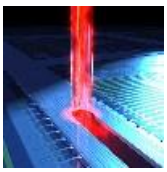
PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LCS 150 equipped with a dual cavity Nd:YAG laser has been used as the machine configuration in our lab.
It is a manually-loaded machine allowing to cut, drill, groove, scribe, trench, mark, or grind a wide range of materials.

Major advantages of Laser-MicroJet® technology with regards to your application are:

- Cutting of arbitrary shapes
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation
- Advantageous process rates

In the table below, the optimized processing parameters used in the experiments are summarized:

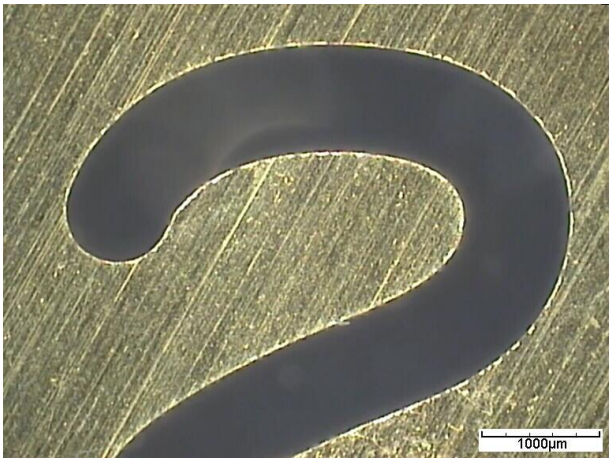
	**SYSTEM**	Machine type	LCS 150
	**MICROJET® PARAMETER**	Nozzle diameter	60 *µm*
		MicroJet® diameter	~48 *µm*
		Water pressure	200/350 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	L202G
		Wavelength	532 *nm*
		Pulse frequency	See results *kHz*
		Average power	See results *W*
	**CUTTING PARAMETER**	Cutting speed	See results *mm/s*
		Number of passes	See results
		Time of process	See results *min*
		Fixing system	Clamps

RESULTS

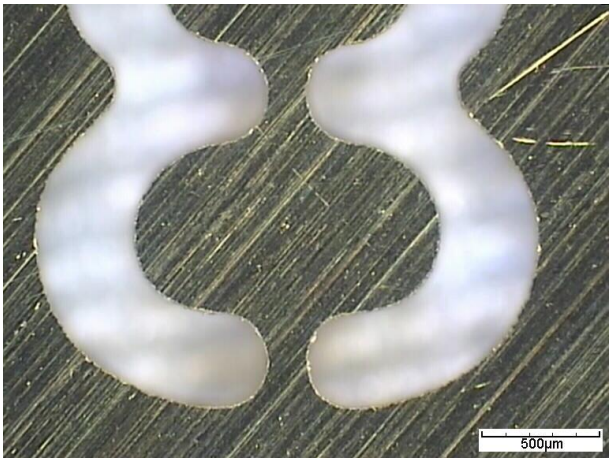
1. Cutting discs of brass

MICROJET® PARAMETER	Water pressure	Peckhole: 150 Piece: 350	*bar*
LASER PARAMETER	Pulse frequency	Peckhole: 8 Piece: 14	*kHz*
	Average power	Peckhole: 44/44 Piece: 47/47	*W*
CUTTING PARAMETER	Cutting speed	Peckhole: 10 Piece: ~3	*mm/s*
	Number of passes	Peckhole: ~45 Piece: 1	
	Time of process	~4	*min*

The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.



PICTURE 1: Microscope image of the frontside (dark field illumination)

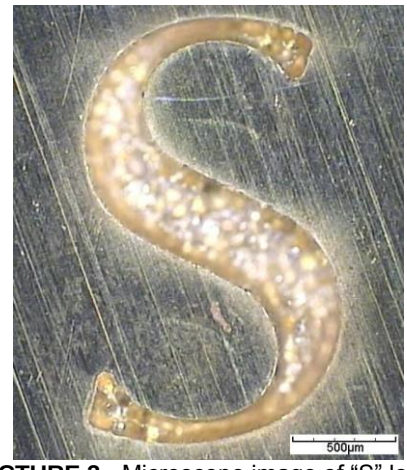


PICTURE 2: Microscope image of the backside (dark field illumination)

2. Grooving: “S” letter

MICROJET® PARAMETER	Water pressure	200	*bar*
LASER PARAMETER	Pulse frequency	10	*kHz*
	Average power	~10	*W*
CUTTING PARAMETER	Cutting speed	3	*mm/s*
	Number of passes	2 (2 different directions)	
	Time of process	~2.4	*min*

The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.



PICTURE 3: Microscope image of "S" letter (dark field illumination)

PICTURE 4: Microscope image of "S" letter (dark field illumination)

3. Grooving: number "2"

MICROJET® PARAMETER	Water pressure	200 *bar*
LASER PARAMETER	Pulse frequency	40 *kHz*
	Average power	~10 *W*
CUTTING PARAMETER	Cutting speed	~5 *mm/s*
	Number of passes	4 (4 different directions)
	Time of process	~3 *min*

The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.

PICTURE 5: Microscope image of the number "2" (dark field illumination)

PICTURE 6: Microscope image of the number "2" (dark field illumination)

The table below summarized Anonymous expectations and our results:

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Speed / throughput:		Disc of brass: ~ 4 min Letter "S": ~3 min (Grooving depth: ~180 um) Number "2": ~3 min (Grooving depth: ~250 um)
Edge Roughness:		Very good quality cutting

Cutting is of very good quality: sharp angles and curves are well defined
Roughness of the grooved surface can be improved by adjusting speed, power and frequency

Remarks: The pieces have been cleaned in an ultrasonic bath during ~ 1min after cutting.

CONCLUSION

The cutting and the grooving of brass samples was investigated on SYNOVA LCS 150. This machine is based on the MicroJet® technology and combines the advantages of the high energy pulsed laser with a hair-thin water jet. While the laser is used for material ablation, the water jet is used for guiding the laser light, cooling the edges and preventing the sample from particle contamination, advantages that are essential for cutting and grooving brass samples with high quality.

These tests show that:

- It has been possible to reduced the process time of cutting disc of brass to about 4 min
- Frontside and Backside are of very good quality
- No heat-damage has been observed
- Grooving was investigated successfully and time of process can be reduced with further optimization. Indeed it depends on quality/ depth/geometry requested.
- Frequency seems to have an impact on the grooved surface roughness

Finally to summarize:

- Best quality is obtained using small nozzle (40 and 50 µm) and one cavity frequency-double Q-swithed Nd:YAG laser.
- Best process time is achieved with big nozzle (50 and 60µm) and double cavity frequency-double Q-swithed Nd:YAG laser. A collimation lens with a focal of 250mm can allow the use of a 40µm nozzle if only one of the two cavities of the laser is used.

We thank you for your interest in our technology and we hope our results meet your requirements. Our sales agency will contact you soon to obtain a feedback about the analysis of these results and to discuss with you the further steps.