REPORT: Stainless steel tube cutting by Laser-MicroJet®

for Anonymous

by Stephane Delahaye; Synova SA

TASK

The Laser-MicroJet® technology has been tested for cutting of slots into stainless steel tubes.
The aim of this first test round is to give a first overview of the cutting quality and the process time.

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Stainless steel
	Dimension	Ø 5.16 *mm*
	Thickness	~200 *µm*
	Quantity	3 processed samples *pcs*

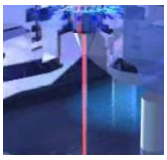
Release of application report			
	Project Leader		Responsible Application Group
Name:	Stephane Delahaye	Name:	Dr Benjamin Carron
Date:	11.02.2013	Date:	11.02.2013
Visum:	SDE	Visum:	

PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LDS 200 equipped with a short pulse laser has been used as the machine configuration in our lab.
It is a manually loaded clean-room compatible machine, allowing to cut, drill, groove, scribe, trench, mark, or grind different kinds 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:

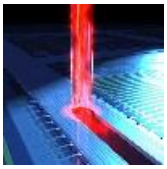
	**SYSTEM**	Machine type	LDS 200
	**MICROJET® PARAMETER**	Nozzle diameter	40 *µm*
		MicroJet® diameter	~32 *µm*
		Water pressure	400 *bar*
		Assist gas	He
	**LASER PARAMETER**	Laser type	EO21G
		Wavelength	532 *nm*
		Pulse frequency	150 *kHz*
		Average power	~14 *W*
		Pulse width	15 *ns*

RESULTS

The three samples have been processed with different cutting parameters which enable to check for the quality and allow selecting the parameters that are best suited for your application.

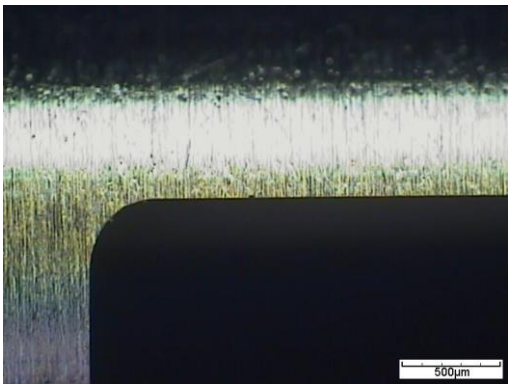
Sample 1 and 2 were processed by using a single pass strategy which gives a better cutting quality. The parameters are given in the table below.

Sample 1:

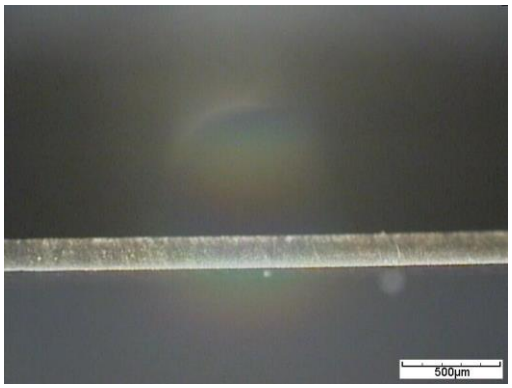


CUTTING PARAMETER		
	Cutting speed	0.6 *mm/s*
	Number of passes	1
	Overall speed	0.6 *mm/s*
	Fixing system	clamps

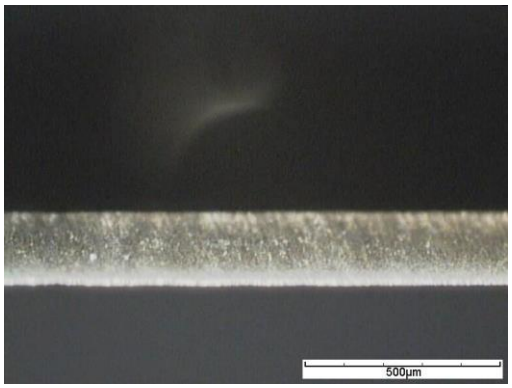
The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.



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

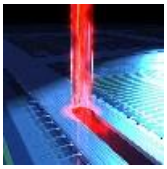


PICTURE 2: Microscope image of the edge (dark field illumination)



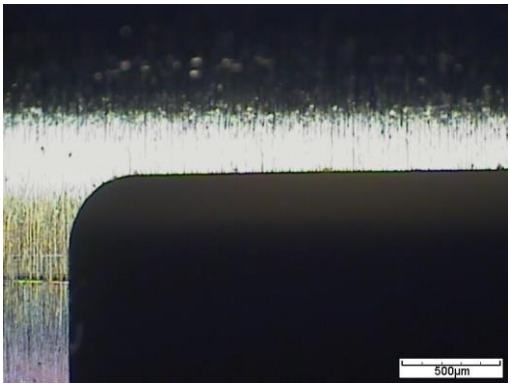
PICTURE 3: Microscope image of the edge at higher magnification (dark field illumination)

Sample 2:

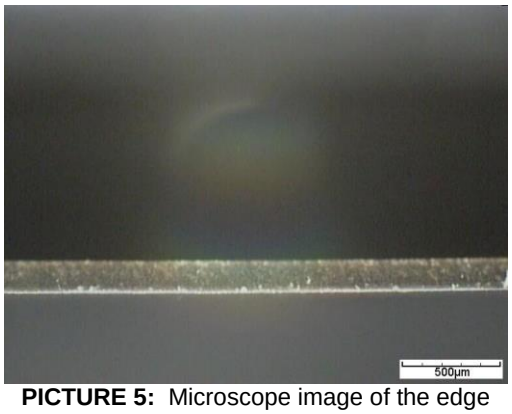


CUTTING PARAMETER		
	Cutting speed	0.8 *mm/s*
	Number of passes	1
	Overall speed	0.8 *mm/s*
	Fixing system	clamps

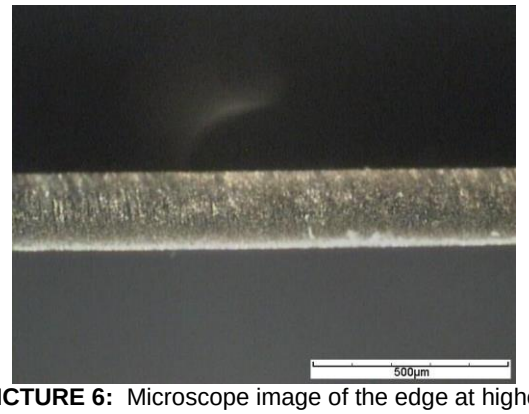
The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.



PICTURE 4: Microscope image of the front side (dark field illumination)



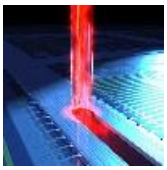
PICTURE 5: Microscope image of the edge (dark field illumination)



PICTURE 6: Microscope image of the edge at higher magnification (dark field illumination)

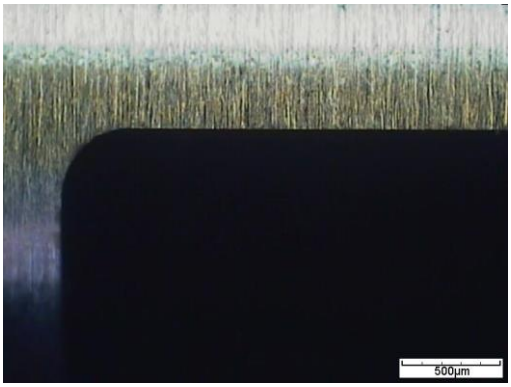
Sample 3:

A multi pass strategy was used to cut the last sample. Overall cutting speed is increased.

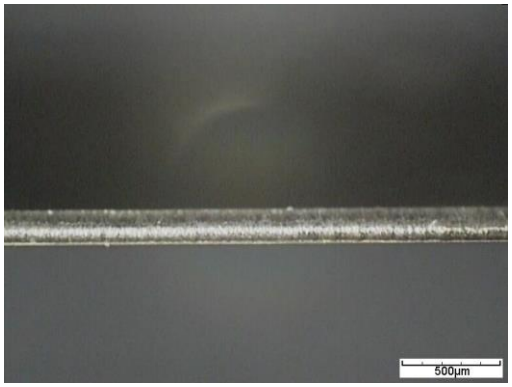


CUTTING PARAMETER		
	Cutting speed	6 *mm/s*
	Number of passes	4
	Overall speed	1.5 *mm/s*
	Fixing system	clamps

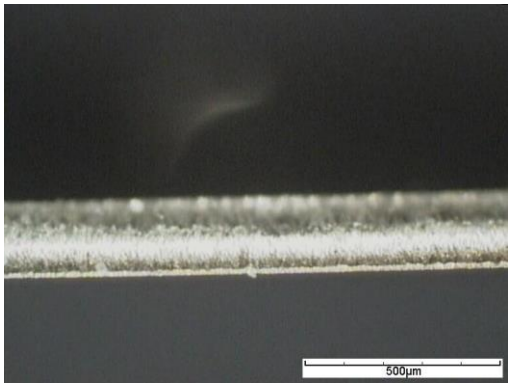
The following microscope pictures give an overview on the quality obtained with the Laser-Microjet® technology.



PICTURE 7: Microscope image of the front side (dark field illumination)



PICTURE 8: Microscope image of the edge (dark field illumination)



PICTURE 9: Microscope image of the edge at higher magnification (dark field illumination)

The following shows customer's expectations and the results we obtained so far.

	Quantified expectations	**Our results**
Burr-free:	Burr free	**Very limited**
Heat-damage free:	No	**No HAZ**
Edge Roughness:	Smooth as possible	**Smooth edges**
Speed:	Highest cutting speed possible	**Can be improved**

CONCLUSION

The cutting of stainless steel was investigated on SYNOVA LDS200. 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 stainless steel with high quality.

These tests show that:

- Excellent front side quality is achievable without burr no HAZ.
- Edges are sharp and clean with the single pass strategy.
- The process speed may be increased with further developments. Indeed a new laser source (available soon) is necessary to improve the cutting speed and cut the full sample.

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