REPORT: Trench cutting by Laser MicroJet®

for Anonymous

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1. TASK

The Laser MicroJet® technology has been tested for creating a specific cut in cylindrical RVS 316 and RVS 304 steel substrates.
The aim was to get an optimal roughness in the cutting of two different cylindrical pieces with the Laser MicroJet® technology.

2. SAMPLE DESCRIPTION

There are two samples: the first one is referred to as the “inserter” (see picture 1) and the second one is referred to as the “RPP” (see picture 2).

SUPPLIED MATERIAL		**Inserter**	**RPP**	
	Material	RVS 316	RVS 304	
	Work diameter	1070	790	µm
	Length	22	74	mm
	Quantity	5	3	*pieces*

Release of application report			
Project Leader		Industry BU Responsible	
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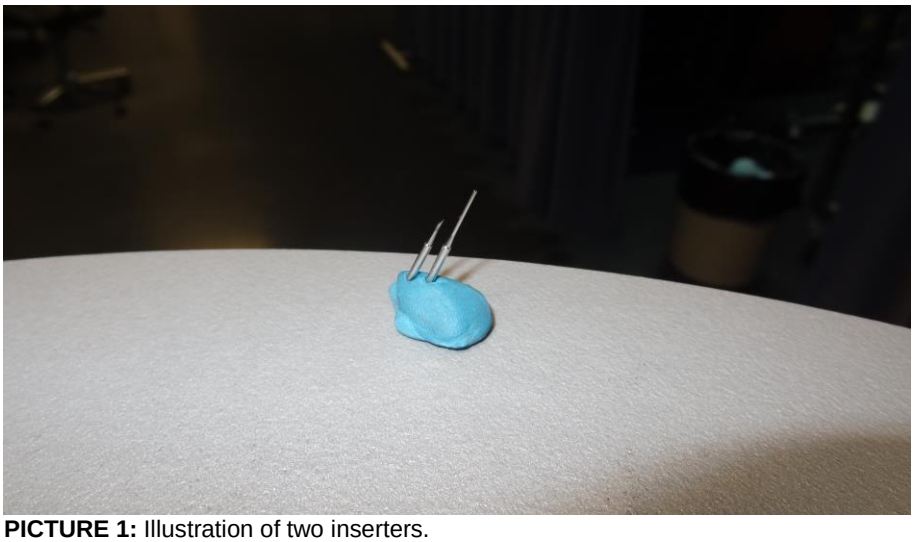
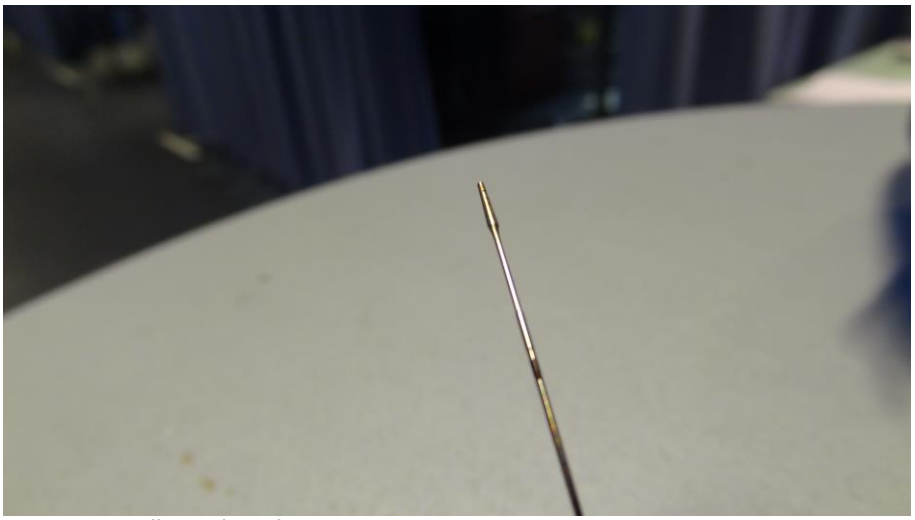
Date:	02.12.2013	Date:	02.12.2013
Visum:	FBR, SK	Visum:	BC



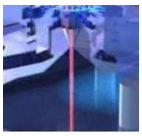
PICTURE 1: Illustration of two inserters.



PICTURE 2: Illustration of an RPP.

3. PROCESS: INSTRUMENT & TEST PARAMETERS

For this application, an LCS300 equipped with two different lasers has been selected as the best machine configurations available in our lab.
The first lasing source tested was a fiber laser working at 515 nm. The roughness obtained was not optimal and hence, we preferred to use a Q-switched frequency-doubled Nd:YAG laser.
The table below summarizes the general parameters used in the experiments.

	**SYSTEM**	Machine type	LCS300
		Fixture	Clamped
	**MICROJET® PARAMETER**	Nozzle diameter	40 *µm*
		Working distance	10 *mm*
		Assist gas	He
		Water pressure	400 *bar*
	**LASER AND CUTTING PARAMETERS**	Laser type	L51G
		Wavelength	532 *nm*
		Pulse duration	120 *ns*
		Repetition rate	6 *kHz*
		Laser power in water jet	7.3 *W*

4. RESULTS

In this section, you can find a summary of the parameters used for each sample as well as the results obtained.

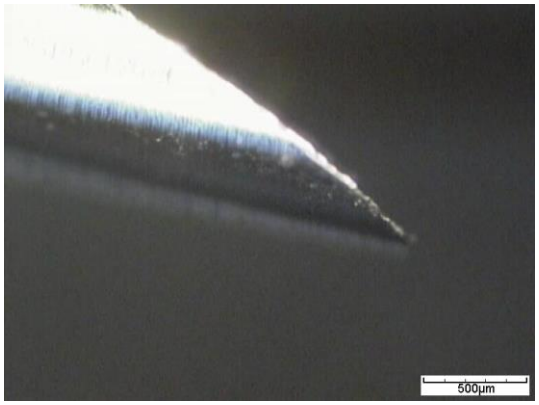
4.1. INSERTER

For the inserter, 6 sets of parameters were tested in order to find the best cutting quality. Please see below the table which summarizes the specific parameters and the results of all tests. Note that only the monopass strategy was proceeded.

N.B.: In order to avoid an unwanted effect at the end of the inserter, we chose to fix the inserter at both ends of samples S5 and S6.

Sample reference	Cutting speed [mm/s]	Finishing pass		Water pressure [bar]	Fixture
		Offset [µm]	Cutting speed [mm/s]		
S1	0.2	-	-	400	Single clamp
S2	0.2	10	0.2	400	Single clamp
S3	0.2	50 10 3	0.2 0.2 0.2	400	Single clamp
S4	0.2	50 10 3	1.0 1.0 1.0	400	Single clamp
S5	0.2	50 10 3	0.2 0.2 0.2	400	Double clamp
S6	0.2	50 10 3	0.2 0.2 0.2	200	Double clamp

For each sample you can find below (see pictures 3 to 14) an illustration of the top view and an illustration of the side view to see the roughness.

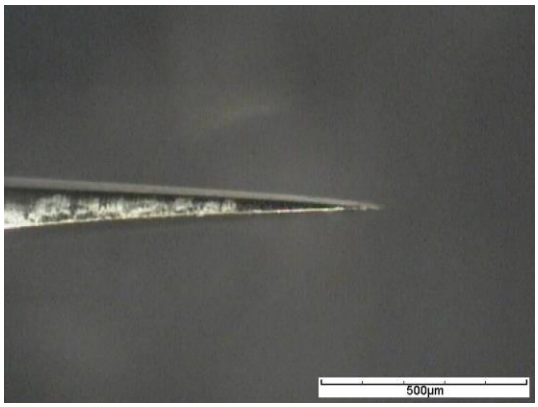


PICTURE 3: Top view of S1.

PICTURE 4: Roughness of S1.

PICTURE 5: Top view of S2.

PICTURE 6: Roughness of S2.



PICTURE 7: Top view of S3.

PICTURE 8: Roughness of S3.

PICTURE 9: Top view of S4.

PICTURE 10: Roughness of S4.

PICTURE 11: Top view of S5.

PICTURE 12: Roughness of S5.

PICTURE 13: Top view of S6.

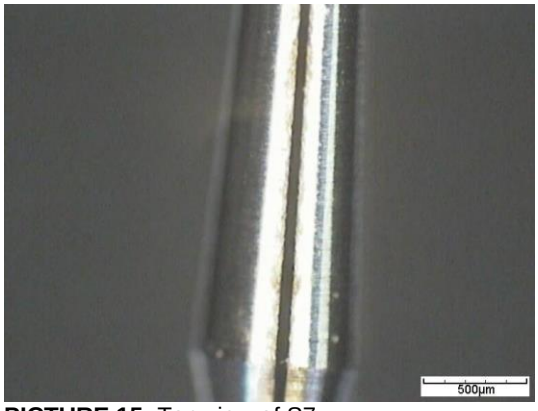
PICTURE 14: Roughness of S6.

4.2. RPP

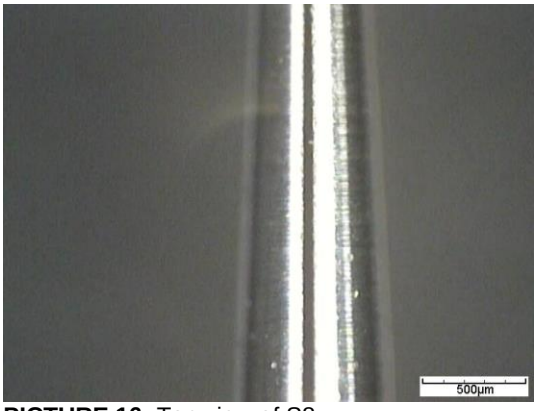
For the RPP, 2 sets of parameters were tested in order to find the best cutting quality. Please see below the table which summarizes the specific parameters and the results of all tests.

Sample reference	Strategy	Number of passes	Cutting speed [mm/s]
S7	Monopass	1	0.2
S8	Multipass	40	10.0

Note that no finishing pass was applied for these samples. The results are depicted below in figures 15 and 16.



PICTURE 15: Top view of S7.



PICTURE 16: Top view of S8.

5. CONCLUSION

The trench cutting in stainless steel substrates has been performed with a Synova LCS300. This machine is based on the Laser MicroJet® technology and combines the advantages of a 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 trenching. These tests show that:

- The LMJ enables to reach your expectations;
- It is possible to limit or avoid the chipping effect thanks to a lower water pressure;
- A strategy with several finishing passes can lead to better results;
- Using clamps avoids vibrations and defects induced by the fall of the cut part.

We are open to further discuss your needs regarding:

- The process time;
- The final dimensions of the workpiece;
- The roughness at the edge.

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.