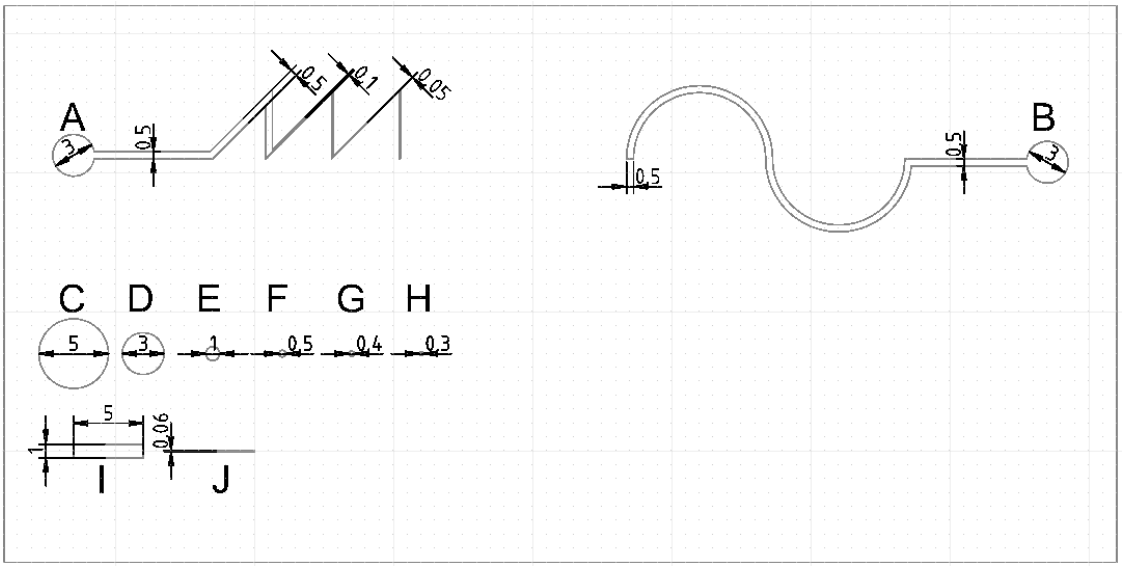
REPORT: Stainless Steel cutting by laser MicroJet®

for Anonymous

by Florent Bruckert, Rémi Laure, Synova SA

OBJECTIVE

The Laser-MicroJet® technology has been tested for cutting a template with multiple forms (picture 1 shows the requested patterns to cut for this test) in 2 and 5 mm stainless steel plates. The aim was to firstly check the feasibility and finally to check the resulting quality and process time.

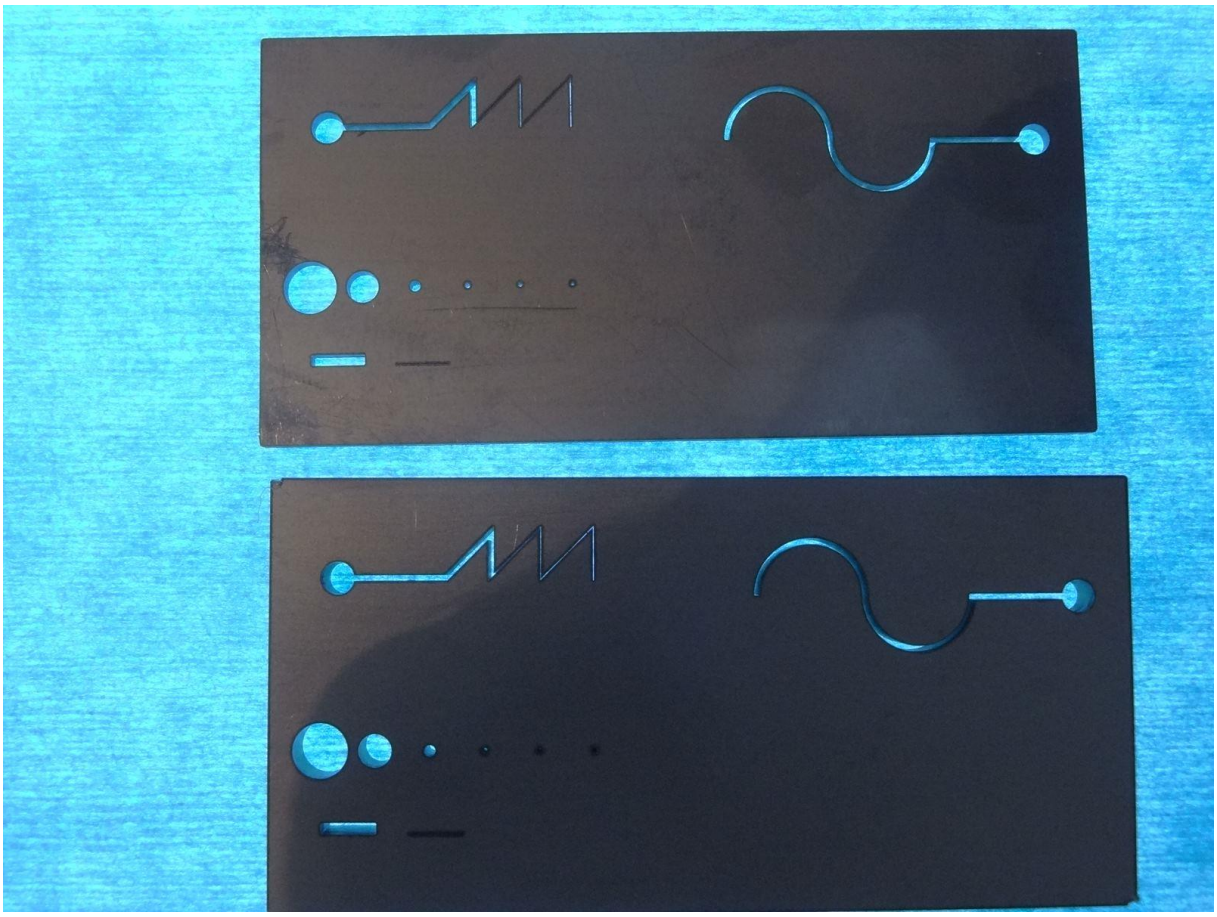


PICTURE 1: Special patterns to cut (dimensions in mm)

SAMPLES DESCRIPTION

SAMPLE	Material	Stainless steel	
	Thickness	2.0 and 5.0	mm
	Quantity	2	pieces

Release of application report			
Project Leader		Responsible Application Group	
Name:	Florent Bruckert	Name:	Benjamin Carron
Date:	06.01.2016	Date:	18.12.2015
Visum:	FBR	Visum:	BC



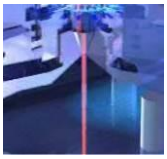
PICTURE 2: Macroscopic view of the production: template cut in plates of 2 mm (top) and 5 mm (bottom)-thick SS plates

PICTURE 3: Macroscopic view of one plate after processing

PROCESS: INSTRUMENT & TEST PARAMETERS

To carry out this test we use a multi-pass strategy which consists in cutting the piece by "scanning" the contour several times.

For these experiments, the LCS300, Nd:YAG laser, has been selected as the most suitable machine configuration available in the lab.
In the tables below, the optimized processing parameters used in the experiments are summarized:

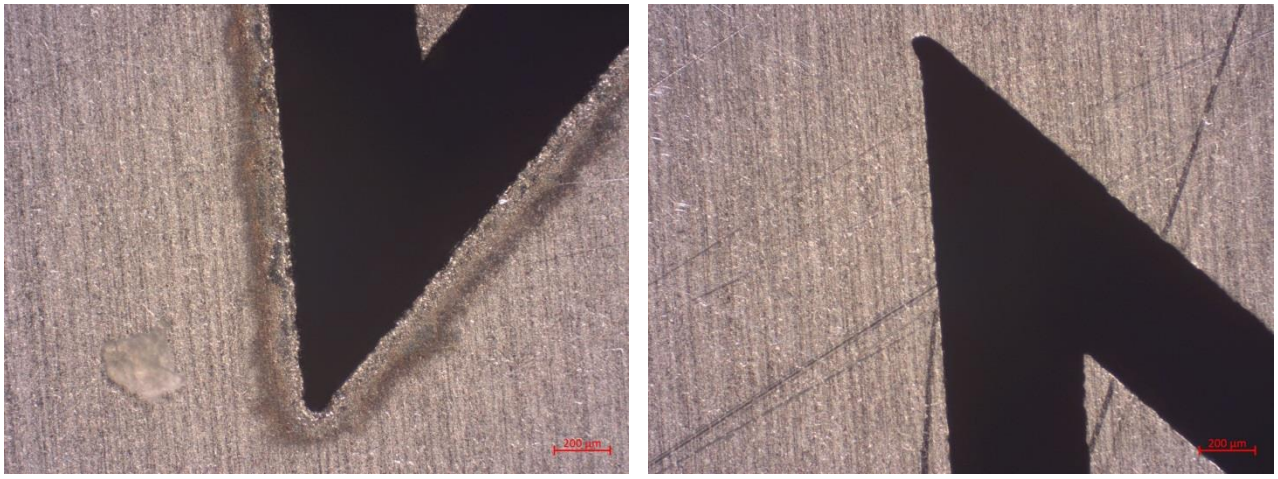
	**SYSTEM**	Machine	LCS300
		Fixing type	Clamped
	PARAMETERS FOR MICROJET®	Nozzle diameter	40 *µm*
		Cutting width	60 *µm*
		Protect gas	He
		Rate of flow	4.0 *L/min*
		Waterjet pressure	400 *bar*
		Working distance	12 *mm*
	**PARAMETERS FOR LASER**	Laser type	L51G
		Wavelength	532 *nm*
	Parameters for cutting	Laser frequency	6 *kHz*
		Pulse width	140 *ns*
		Power in water Jet	13.5 *W*

Thickness	Reference (see Picture 1)	Motion speed (in mm/s)	Number of passes	Cutting time
2.0 mm	A	4	34	14 min
	B	4	34	14 min
	C	4	26	1 min 45 s
	D	4	28	1 min 08 s
	E	4	32	28 s
	F	2	29	24 s
	G	2	54	33 s
	H	2	626	4 min
	I	4	36	1 min 40 s
	J	4	50	1 min 17 s

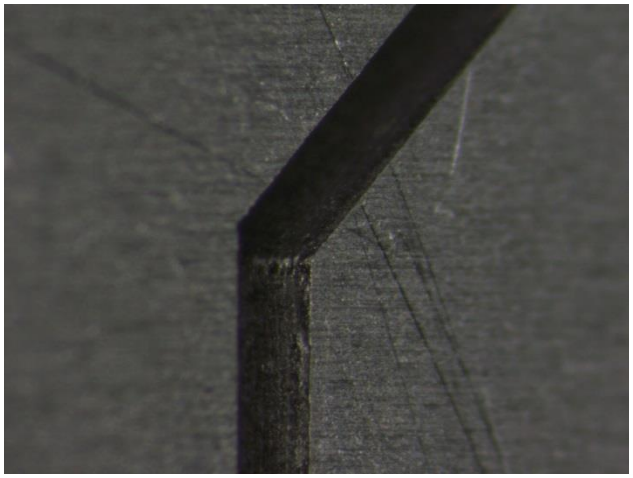
Thickness	Form (see Picture 1)	Motion speed (in mm/s)	Number of passes	Cutting time
5.0 mm	A	2	49	39 min
	B	2	50	40 min
	C	4	75	4 min 54 s
	D	4	100	4 min
	E	4	100	1 min 20 s
	F	2	2 000	>10 min
	G	2	2 200	20 min
	H	Not cut	Not cut	Not cut
	I	4	NA	6 min 42 s
	J	4	NA	4 min 13

RESULTS

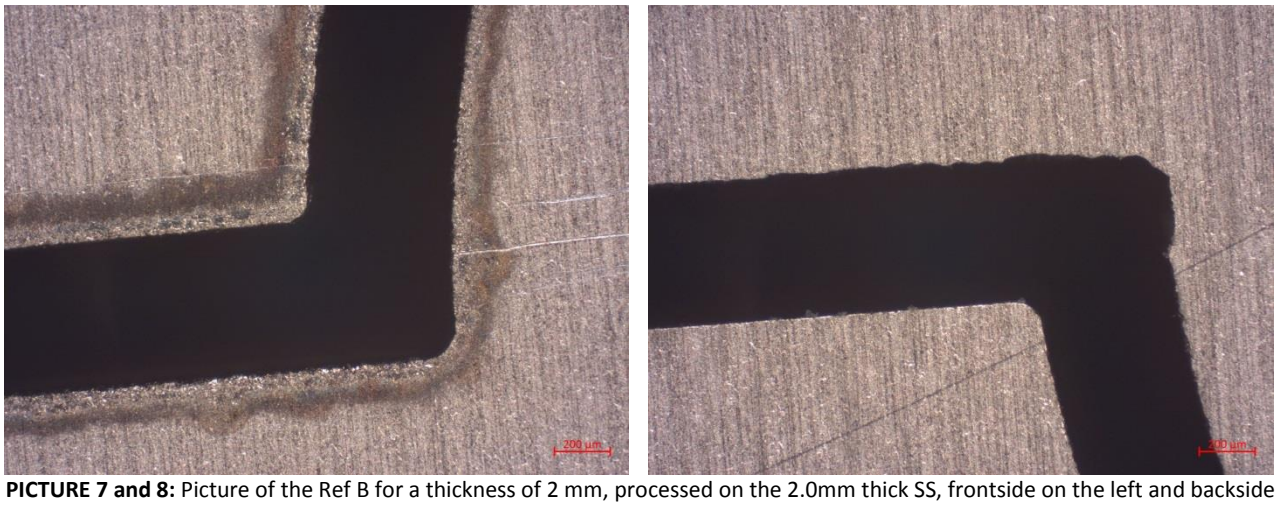
The following pictures show an overview of the cutting quality obtained with the LaserMicroJet®:



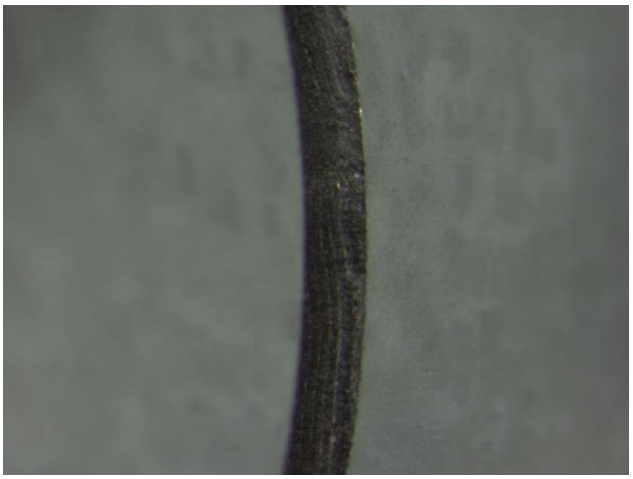
PICTURE 4 and 5: Picture of the Ref A processed on the 2.0mm thick SS, frontside on the left and backside on the right



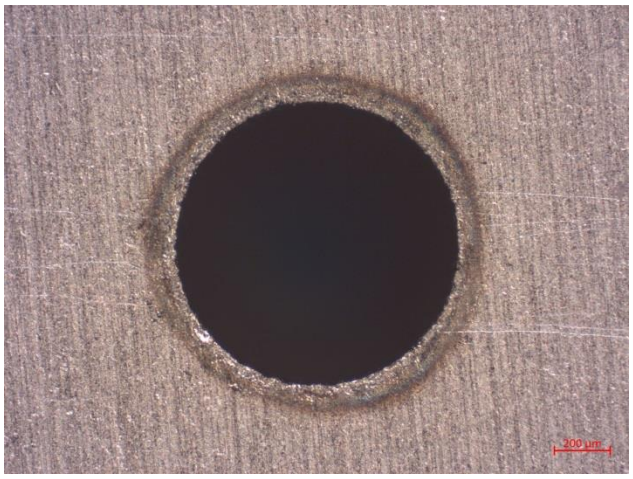
PICTURE 6: Picture of the edge of cutting for the Ref A on the 2.0mm thick SS

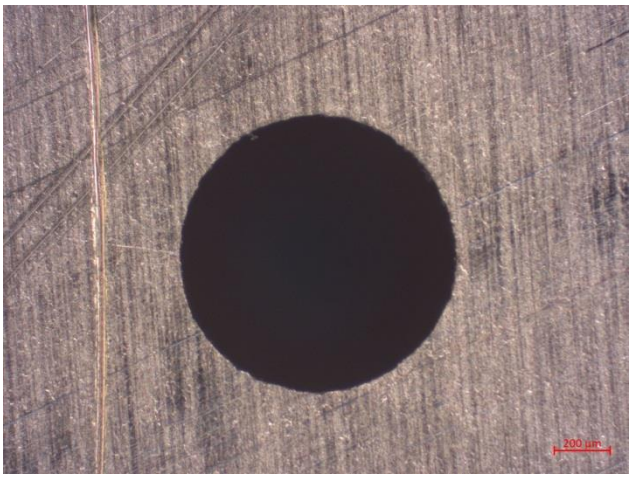


PICTURE 7 and 8: Picture of the Ref B for a thickness of 2 mm, processed on the 2.0mm thick SS, frontside on the left and backside on the right

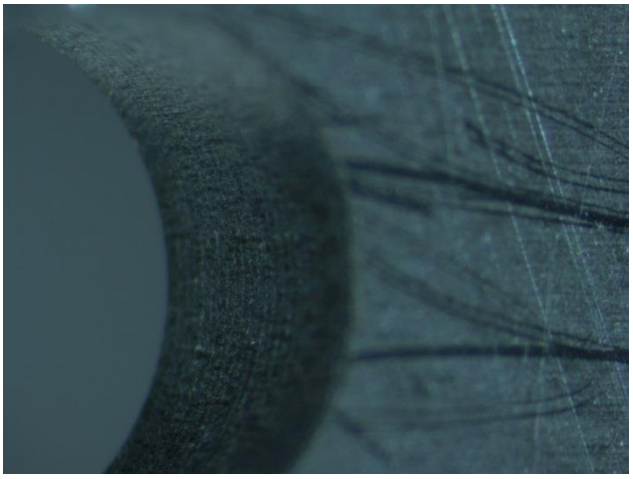


PICTURE 9: Picture of the edge of cutting for the Ref B on the 2.0mm thick SS

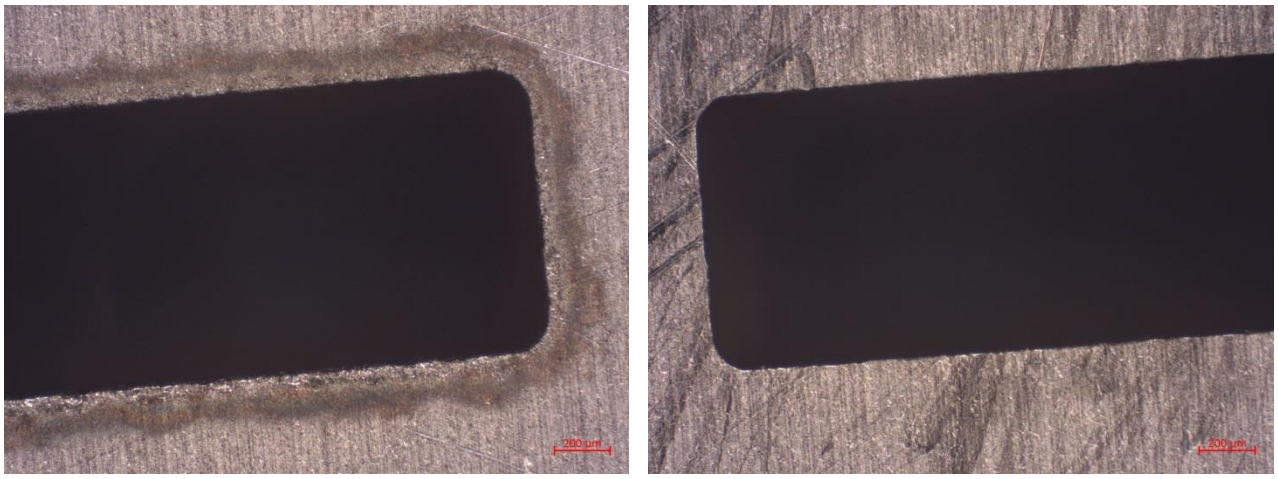




PICTURE 10 and 11: Picture of the form E for a thickness of 2 mm, frontside at left and backside at right

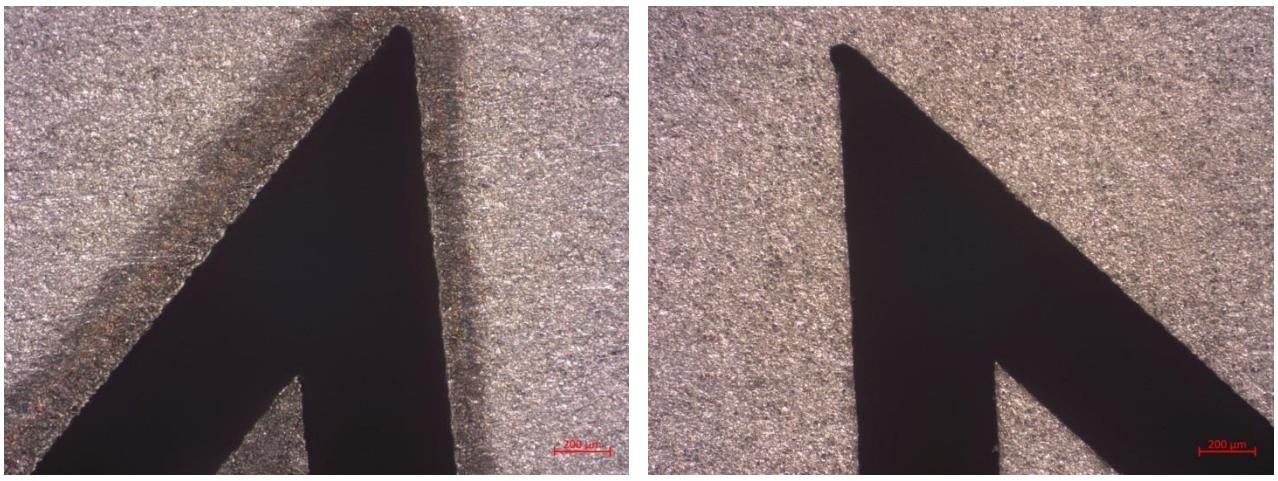


PICTURE 12: Picture of the edge of cutting for the form D and a thickness of 2 mm

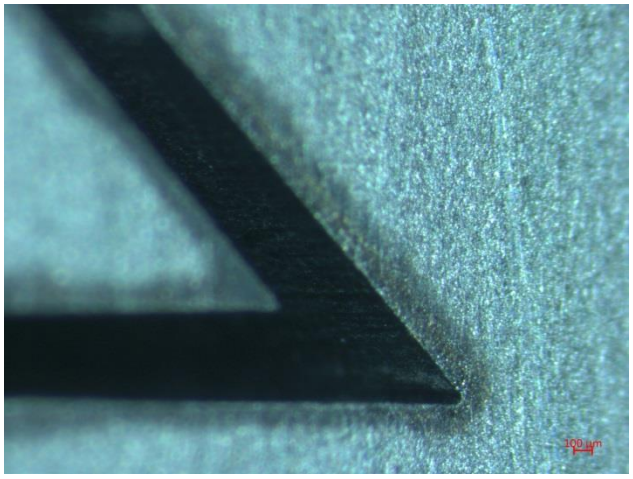


PICTURE 13 and 14: Picture of the form I for a thickness of 2 mm, frontside at left and backside at right

PICTURE 15: Picture of the edge of cutting for the form I and a thickness of 2 mm

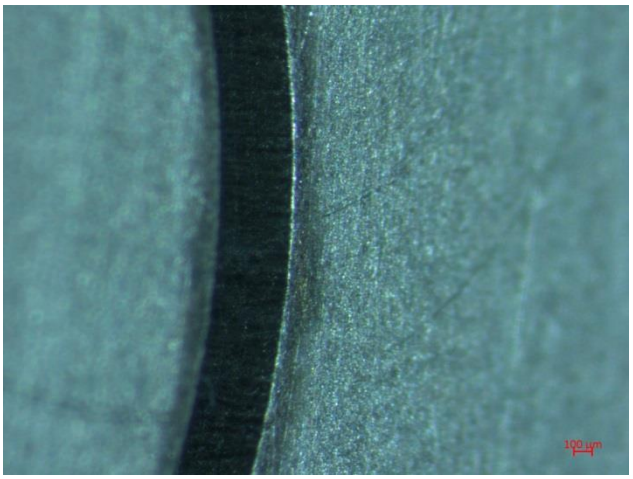


PICTURE 16 and 17: Picture of the form A for a thickness of 5 mm, frontside at left and backside at right

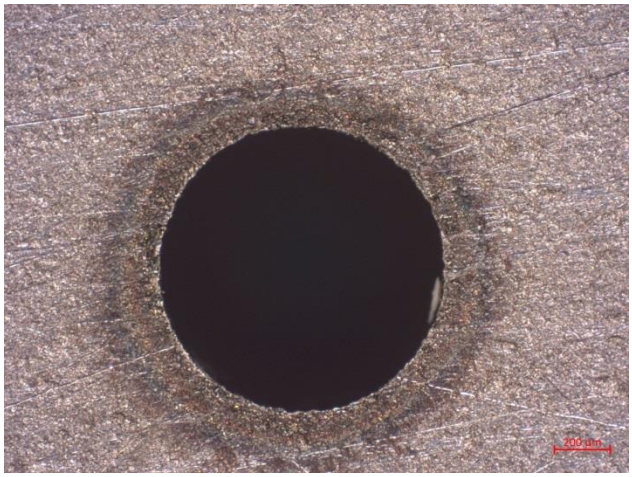
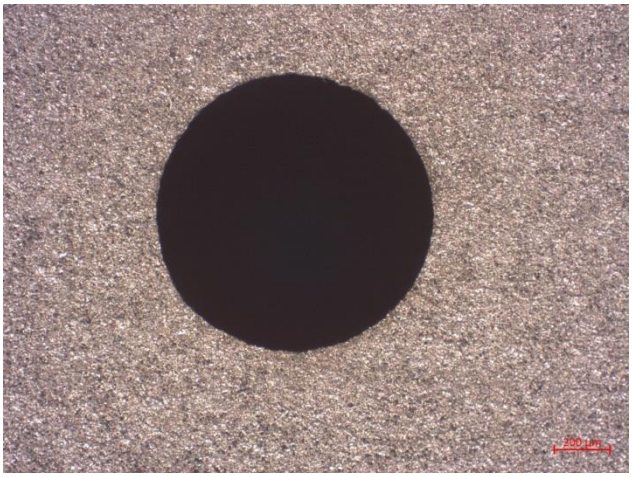


PICTURE 18: Picture of the edge of cutting for the form A and a thickness of 5 mm

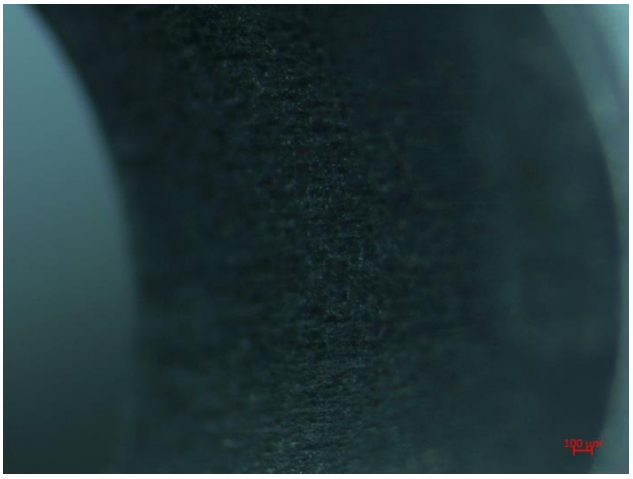
PICTURE 19 and 20: Picture of the form B for a thickness of 5 mm, frontside at left and backside at right



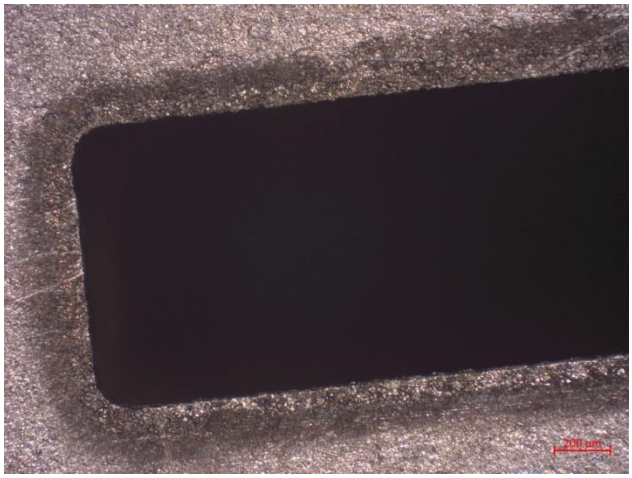
PICTURE 21: Picture of the edge of cutting for the form B and a thickness of 5 mm

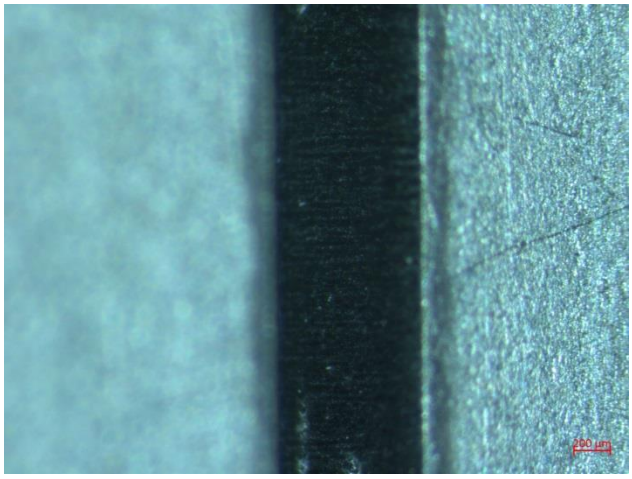
PICTURE 22 and 23: Picture of the form E for a thickness of 5 mm, frontside at left and backside at right



PICTURE 24: Picture of the edge of cutting for the form D and a thickness of 5 mm




PICTURE 25 and 26: Picture of the form I for a thickness of 5 mm, frontside at left and backside at right



PICTURE 27: Picture of the edge of cutting for the form I and a thickness of 5 mm

CONCLUSION

A stainless steel plate cutting was investigated on SYNOVA LCS 300.
This machine is based on the MicroJet® technology and combines the advantages of a high energy pulsed fiber 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 particle contamination, advantages that are essential for metals cutting with high quality.

The tests show that:

- It is possible to cut the drawings Ref A to J on both thicknesses (2.0 and 5.0mm).
- The measured taper is lower than 10µm on all patterns.
- The minimum diameter reached on the 2.0mm thick SS is 0.3mm (Ratio=6.7).
- The minimum diameter reached on the 5.0mm thick SS is 0.4mm (Ratio=12.5).
- A very small deposition (not HAZ) close to the frontside edge that can be easily brushed away.

We are open to further discuss your needs regarding:

- A specific post processing to clean up the deposition at the top surface.
- Control of the final dimensions according to the compensation offset.

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.