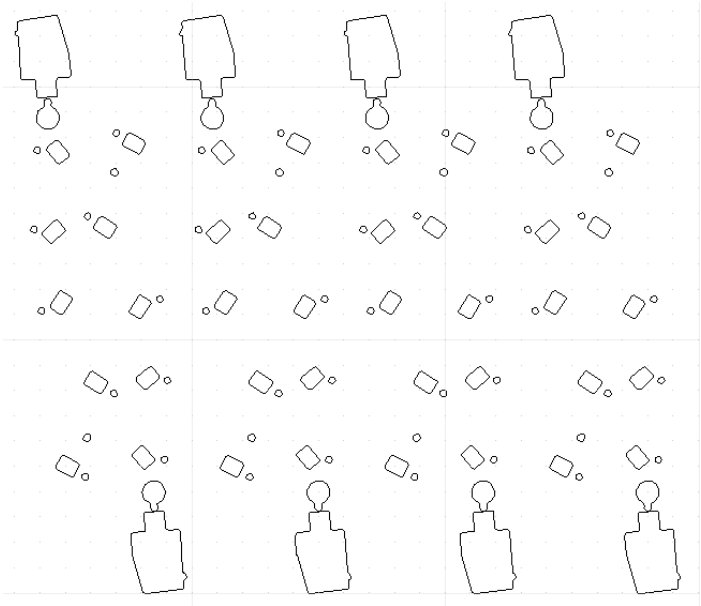
REPORT: Stencil cutting by laser MicroJet®

For Anonymous

by Rémi Laure, Florent Bruckert, Synova SA

OBJECTIVE

The Laser-MicroJet® technology has been tested for cutting plate of stainless steel with two different thicknesses: 0.050 mm and 0.200 mm. The aim was to cut a specific pattern to check the quality and speed of the cutting.

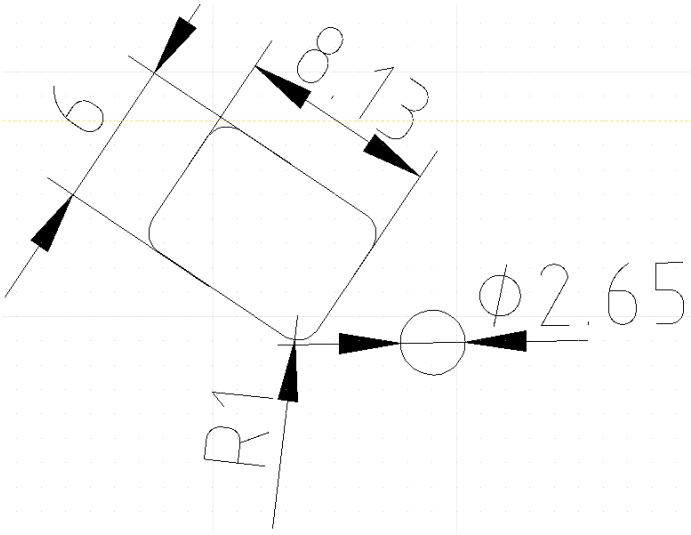


PICTURE 1: Drawing of the "COVER" pattern (350x250mm) required on the two pieces

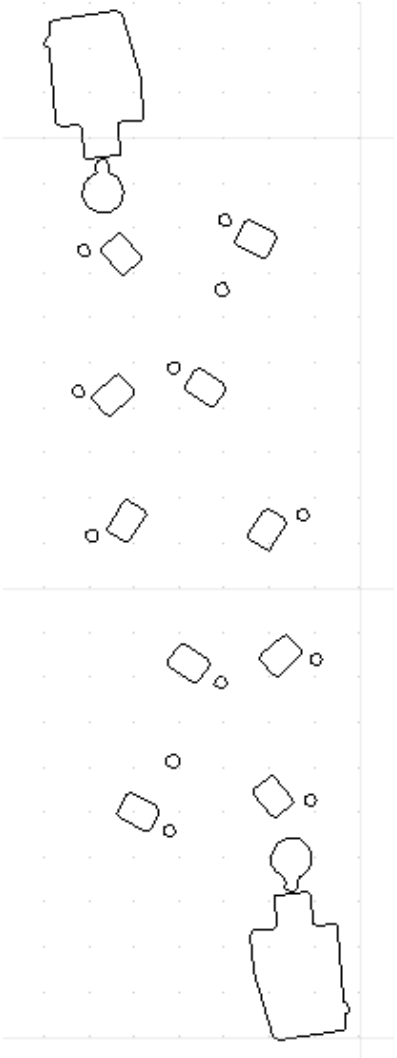
SAMPLES DESCRIPTION

SAMPLE	Piece No.	1	2	
	Material	Stainless Steel	Stainless Steel	
	Thickness	0.050	0.200	mm
	Quantity	1	1	pieces

Release of application report			
Project Leader		Responsible Application Group	
Name:	Florent Bruckert Rémi Laure	Name:	Benjamin Carron
Date:	19.10.2015	Date:	23.10.2015
Visum:	FBR	Visum:	BC

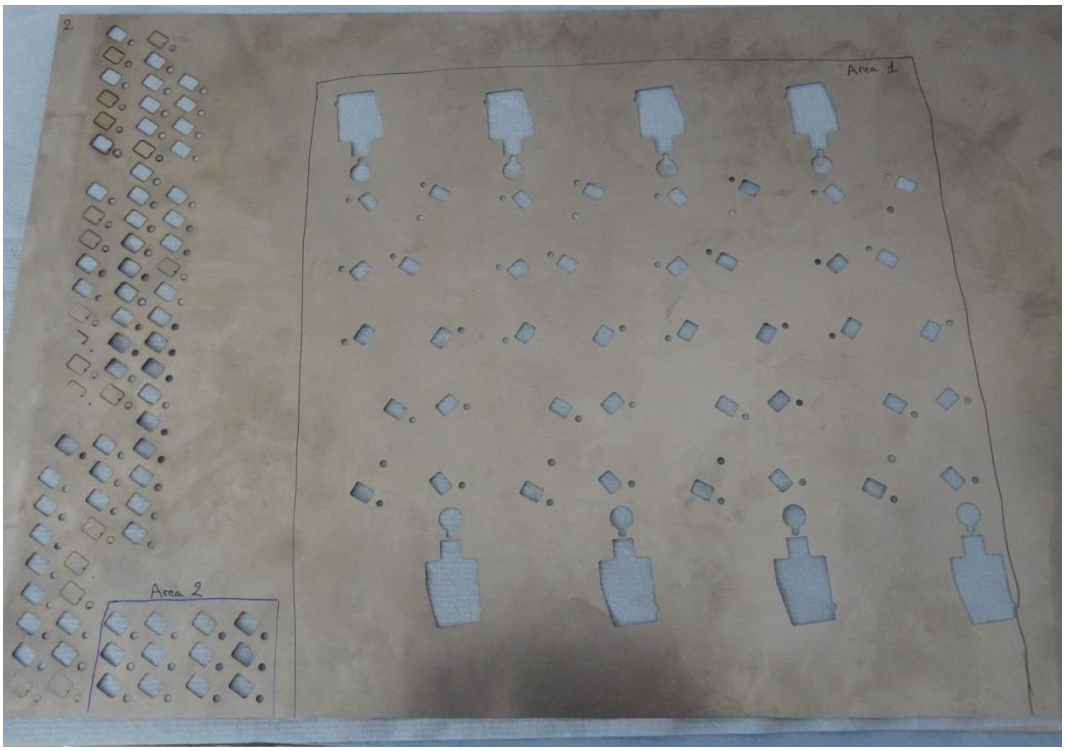


PICTURE 2: Picture of the "Testing" pattern used for the development



PICTURE 3: Picture of the "Vertical" pattern used with different cutting parameters for the cutting of the COVER pattern

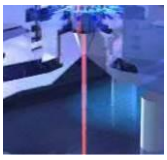
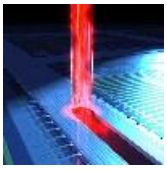
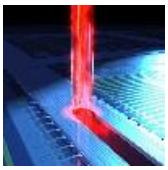
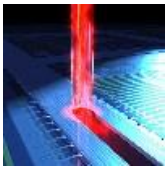
PICTURE 4: Macroscopic picture of piece No.1



PICTURE 5: Macroscopic picture of piece No.2

PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LCS800, 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	LCS800
		Fixing type	Clamped
	**PARAMETERS FOR MICROJET®**	Protect gas	He
		Rate of flow	1 *L/min*
		Working distance	10 *mm*
	**LASER PARAMETERS**	Laser type	L101G
		Wavelength	532 *nm*
	**CUTTING SET 1**	Nozzle diameter	30 *µm*
		Water pressure	400 *bar*
		Laser frequency	6 *kHz*
		Pulse width	120 *ns*
		Power in water jet	5.5 *W*
	**CUTTING SET 2**	Nozzle diameter	30 *µm*
		Water pressure	400 *bar*
		Laser frequency	10 *kHz*
		Pulse width	120 *ns*
		Power in water jet	12.0 *W*
	**CUTTING SET 3**	Nozzle diameter	60 *µm*
		Water pressure	200 *bar*
		Laser frequency	30 *kHz*
		Pulse width	200 *ns*
		Power in water jet	40.0 *W*

To carry out this test we have used both single-pass strategy and multi-pass strategy. A single-pass strategy consists in cutting the piece only once on the same contour whereas a multi-pass strategy consists in cutting the piece several time on the same contour. Furthermore, a finishing pass was performed on some parts to improve the quality of the edge after cutting. The finishing pass corresponds to a pass with a 10 µm lateral offset to remove imperfection at the cutting edge.

For the 0.050 mm thickness plate the MicroJet® Laser cut directly through the stainless steel in one pass. With the 0.200 mm thickness, we need a start hole strategy when using a single-pass strategy. The start hole strategy consists in drilling a hole and then begin the single-pass strategy in this hole to facilitate the cutting.

The following tables list the cutting parameters used during the cutting of the two pieces:

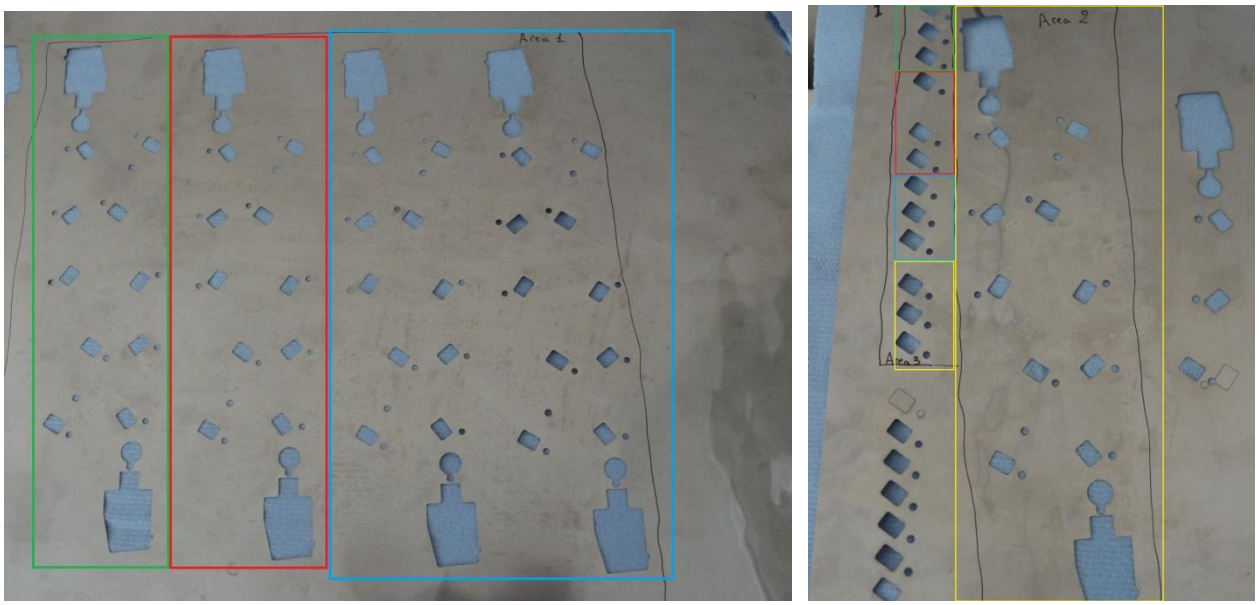
TABLE 1: Cutting Set used for piece No. 1

Test parameter 0.050mm	1	2	3	4
Strategy used	single-pass			single-pass + finishing pass
Cutting set	1			2
Speed	0.5	1	2	10
Speed finishing pass	-	-	-	20
Cutting time for testing pattern	1 min 14 s	38 s	20 s	8s
Cutting time for vertical pattern	21 min 40 s	11 min	5 min 32 s	1 min 54 s
Estimated cutting time for COVER pattern	86 min 40 s	44 min	22 min 8 s	7 min 36 s
Color on picture 6	Green	Red	Blue	Yellow

For the delivery of the 0.050mm piece, we used 3 cutting set to cut the COVER pattern, this correspond to Area 1 on piece:

- 1 vertical pattern with test parameter 1 in the COVER pattern
- 1 vertical pattern with test parameter 2 in the COVER pattern
- 2 vertical pattern with test parameter 3 in the COVER pattern

We also cut 1 vertical pattern with test parameter 4 in the left part of the piece, this is Area2. Furthermore we cut 3 testing patterns of each test parameter on a line starting from the upper left corner and in ascending order from top to bottom. This area, named Area 3, can be used to compare the different cutting qualities.

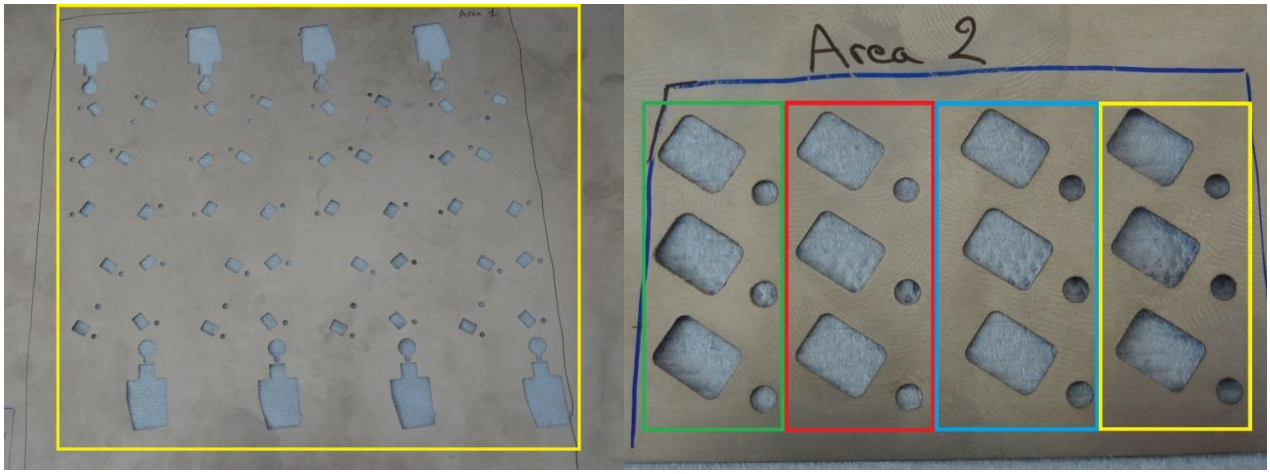


PICTURE 6: Picture of Area 1 on the left and Area 2 and 3 on the right for piece No.1

TABLE 2: Cutting Set used for piece No. 2

Test parameter 0.200mm	5	6	7	8
Strategy used	multi-Pass		single-pass	single-pass + finishing pass
Cutting set	1	2	3	
Speed	20	20	4	5
Speed finishing pass	-	-	-	10
Cutting time for testing pattern	1 min 12 s	28 s	15 s	16 s
Cutting time for vertical pattern	-	-	-	3 min 27 s
Estimated cutting time for COVER pattern	85 min	34 min	16 min	16 min 53 s
Color on picture 7	Green	Red	Blue	Yellow

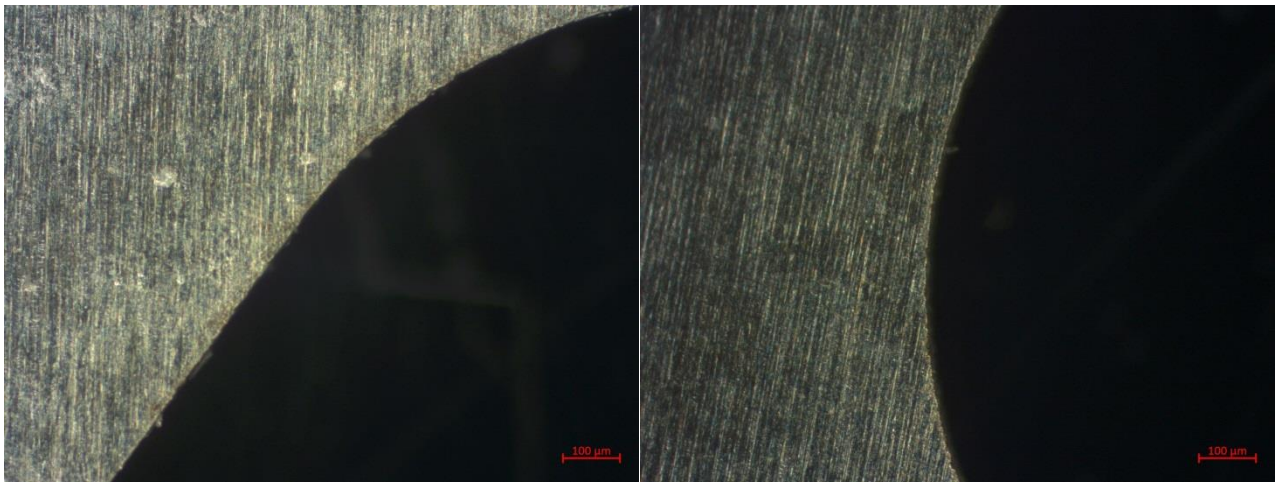
For the delivery of the 0.200mm piece, we used test parameter 8 to cut the COVER pattern, called Area 1. Moreover we cut 3 testing patterns of each test parameter on a rectangle in the bottom left part of the piece and in ascending order from left to right. This is area, named Area 2 on piece, can be used to compare the different cutting qualities.



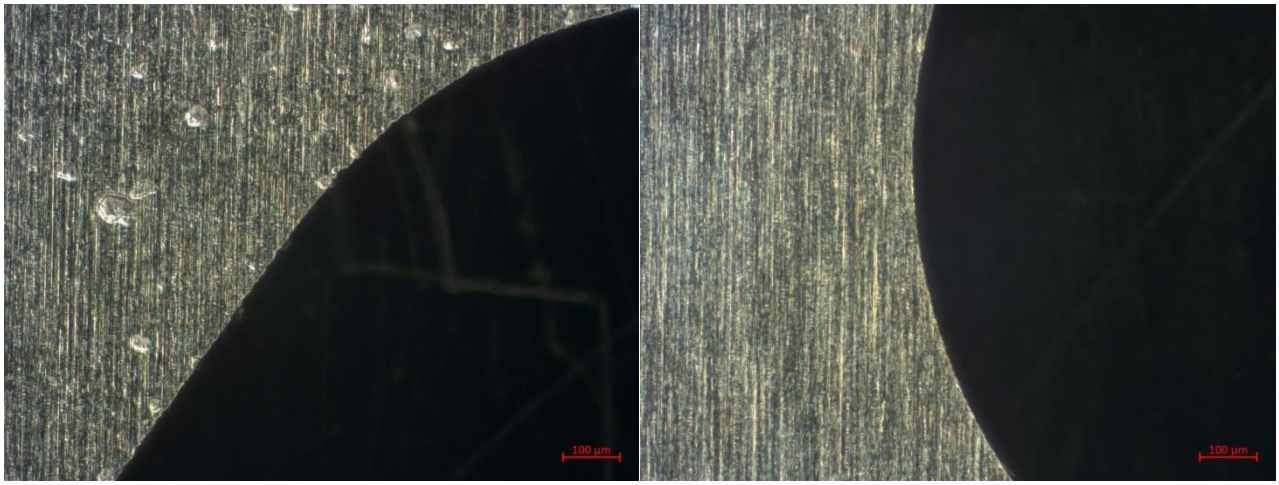
PICTURE 7: Picture of Area 1 on the left and Area 2 on the right for piece No.2

RESULTS

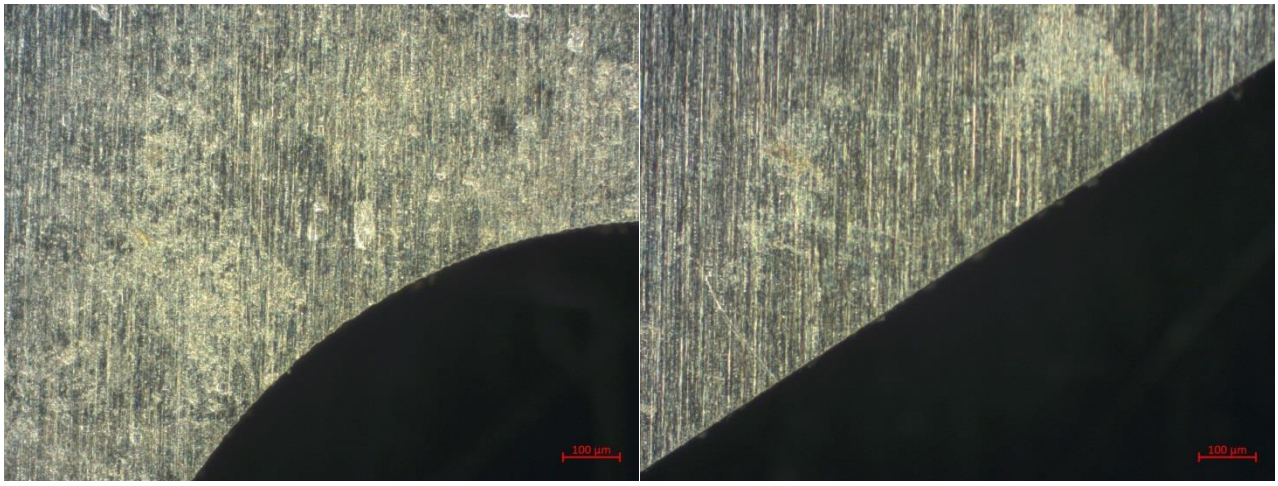
The following pictures show an overview of the cutting quality available on the 0.050mm thickness plate with the LaserMicroJet®, please note that no cleaning was applied after process:



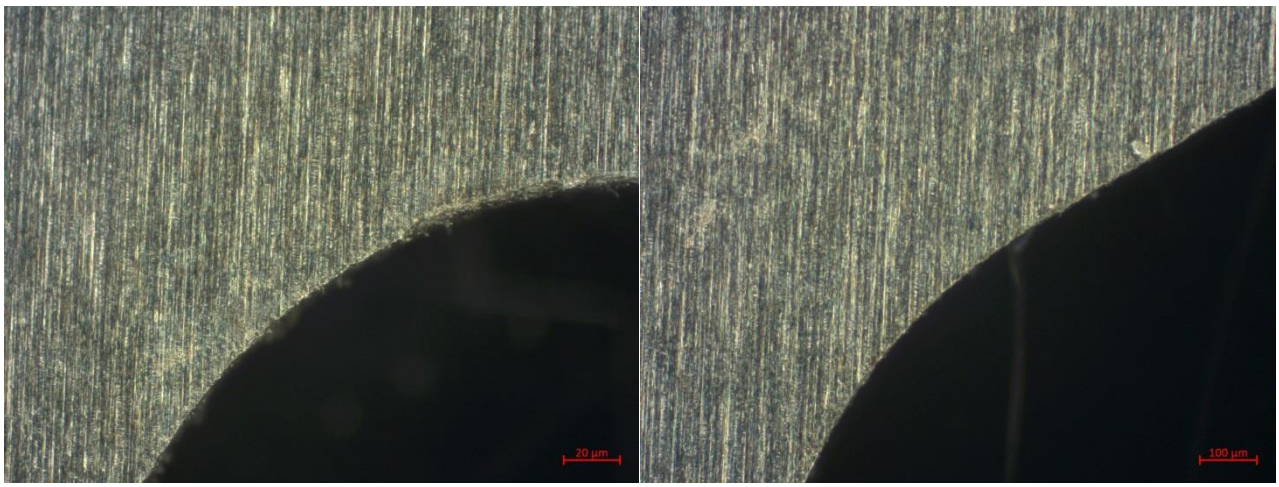
PICTURE 8: Pictures of test parameter 1 (piece No.1), frontside on the left and backside on the right



PICTURE 9: Pictures of test parameter 2 (piece No.1), frontside on the left and backside on the right

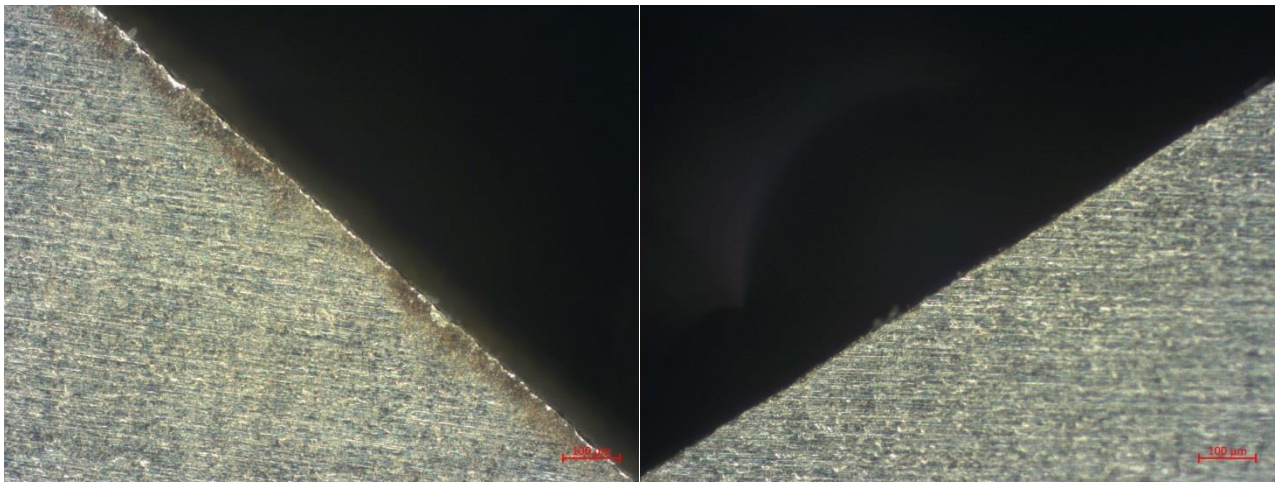


PICTURE 10: Pictures of test parameter 3 (piece No.1), frontside on the left and backside on the right

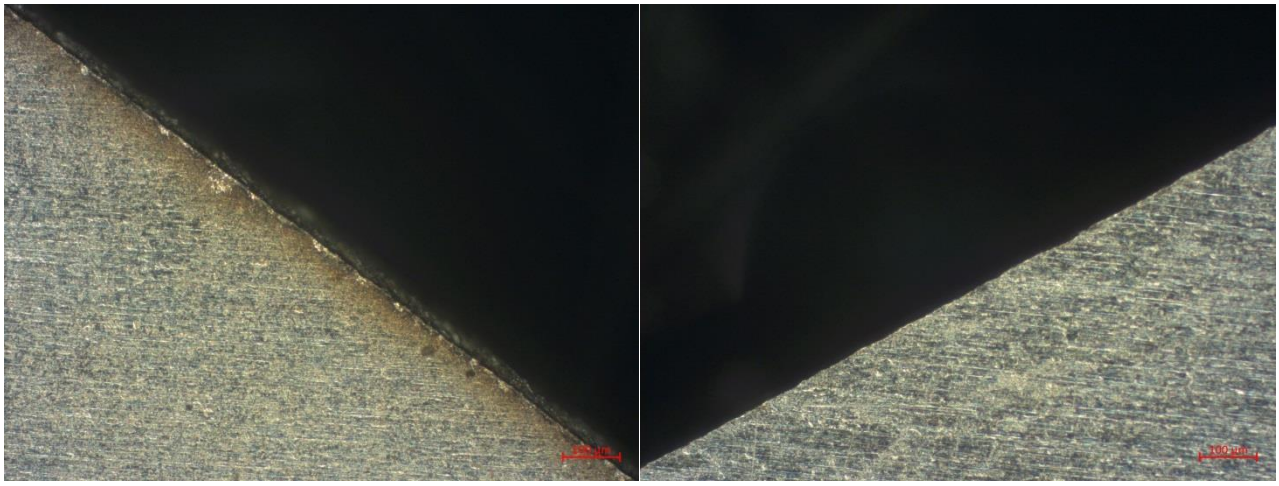


PICTURE 11: Pictures of test parameter 4 (piece No.1), frontside on the left and backside on the right

The following pictures show an overview of the cutting quality available on the 0.200mm thickness plate with the LaserMicroJet®, please note that no cleaning was applied after process:



PICTURE 12: Pictures of test parameter 5 (piece No.2), frontside on the left and backside on the right



PICTURE 13: Pictures of test parameter 6 (piece No.2), frontside on the left and backside on the right

CONCLUSION

COVER pattern cutting was investigated on SYNOVA LCS 800.
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 thin metals cutting with high quality.

The tests show that:

- The processes are stable and repeatable, with excellent quality
- It is possible to cut the COVER pattern in 7 min 36 s for the piece No.1 and 16 min 53 s for piece No.2
- Fast processing is possible but the backside shows a few burrs

We are open to further discuss your needs regarding:

- The cutting strategy to optimize the time and the quality of process.
- The parameters to optimize the cutting quality of the cutting 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.