REPORT: Rubber cutting by Laser-MicroJet®

for Aonymous

by Jerry Chera; Synova USA

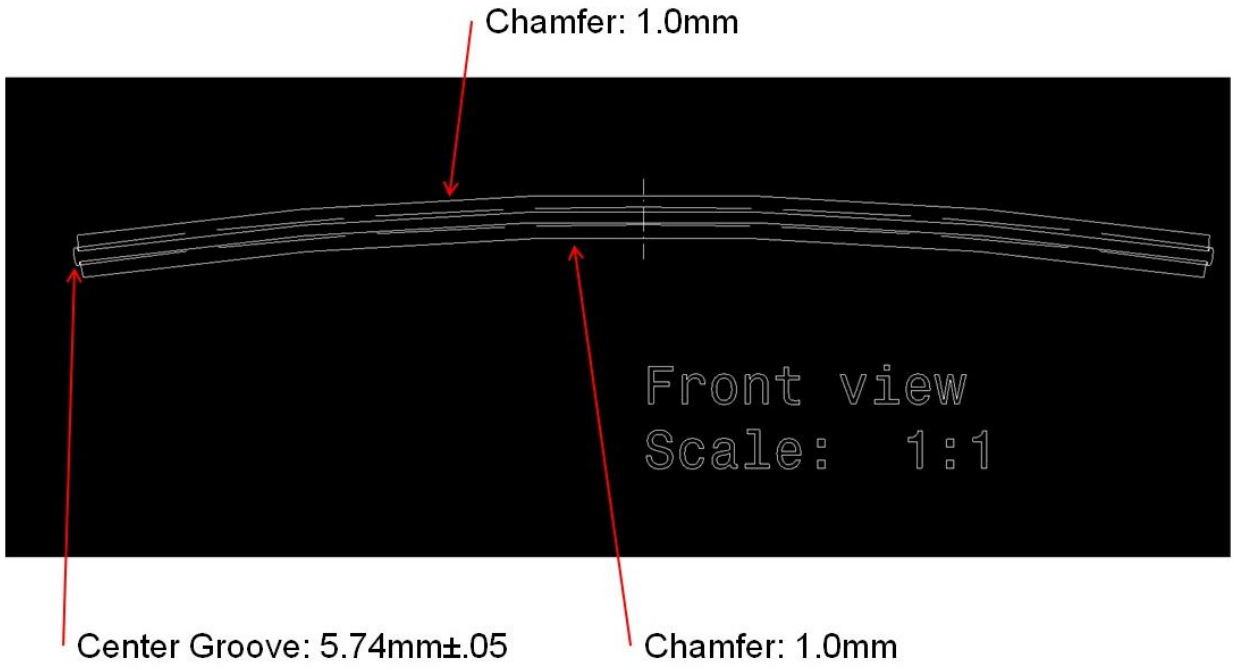
TASK/OBJECTIVES

To test The Laser-MicroJet® technology for cutting slots and pockets in the rubber samples received from Akron.

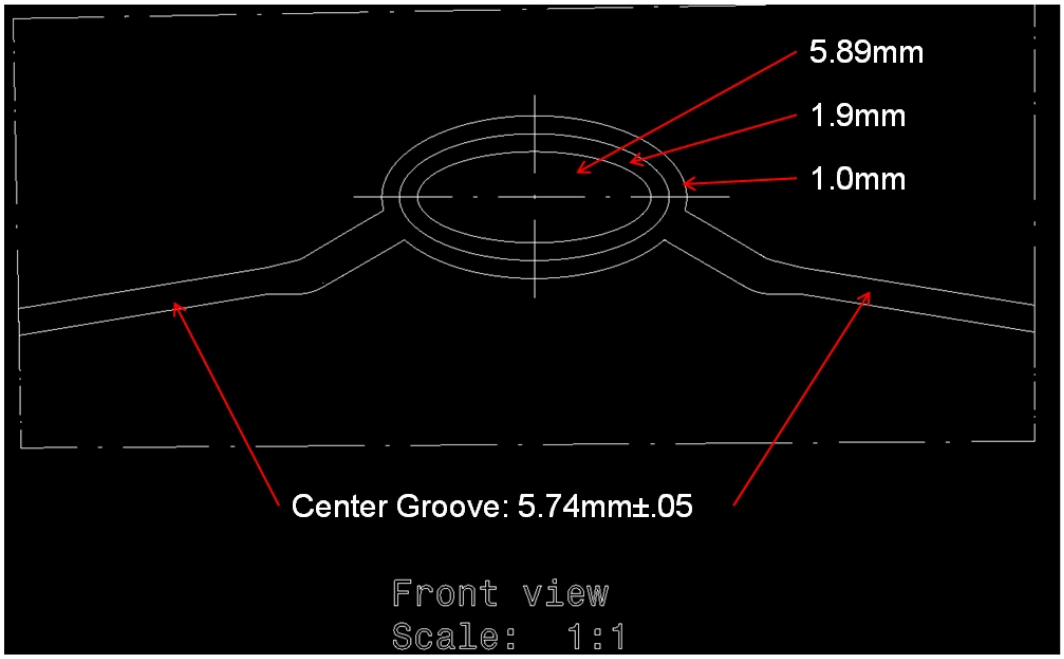
The following are the two main objectives:-

a) To cut a pump groove shape as shown below. ***The numbers here refer to the depth of the cut***.

Release of application report			
	Project Leader		Responsible Application Group
Name:	Jerry Chera	Name:	Dr Benjamin Carron
Date:	06.27.2014	Date:	06.27.2014
Visum:	JC	Visum:	BC



b) To cut a filter pocket shape shown below. ***The numbers here refer to the depth of the cut***.



SAMPLE DESCRIPTION AND PREPARATION

Material	Rubber
Dimensions	200 x 80 mm
Thickness	11mm
Quantity	2

Pic1

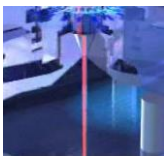
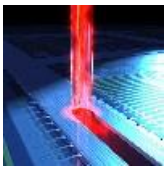
Process: Instrument & Test Parameters

For these experiments, a Synova LDS 200 laser cutting system, equipped with a frequency-doubled Q-switched Nd:YAG laser was used. Tests were conducted in the Fremont CA micro-machining center on a manually loaded machine, which allows cutting and drilling of any kind of metal piece.

Major advantages of the Laser MicroJet technology with regards to this application are:

- High quality cutting
- Cutting of non cartesian patterns
- Low heat damage to the material
- Reduction in re-deposited material

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

	**SYSTEM**	Machine type	LDS200
	**MICROJET® PARAMETER**	Nozzle diameter	80 *µm*
		Water pressure	150 *bar*
		Assist gas	He (1.00 *L/min*)
		Working distance from diaphragm	20 *mm*
	**LASER PARAMETERS**	Laser type	LDP-200MQG
		Wavelength	532 *nm*
		Pulse frequency	40 *kHz*
		Internal power	25 *W*
		SHG temp.	30.9 *deg*
	**CUTTING PARAMETERS**	Speed	30 mm/sec
		No. of passes	See the results section.
		Cutting time	See the results section.

STRATEGY

The pieces were held by Advil tape on to the metal frame as shown in the pic below

Pic2

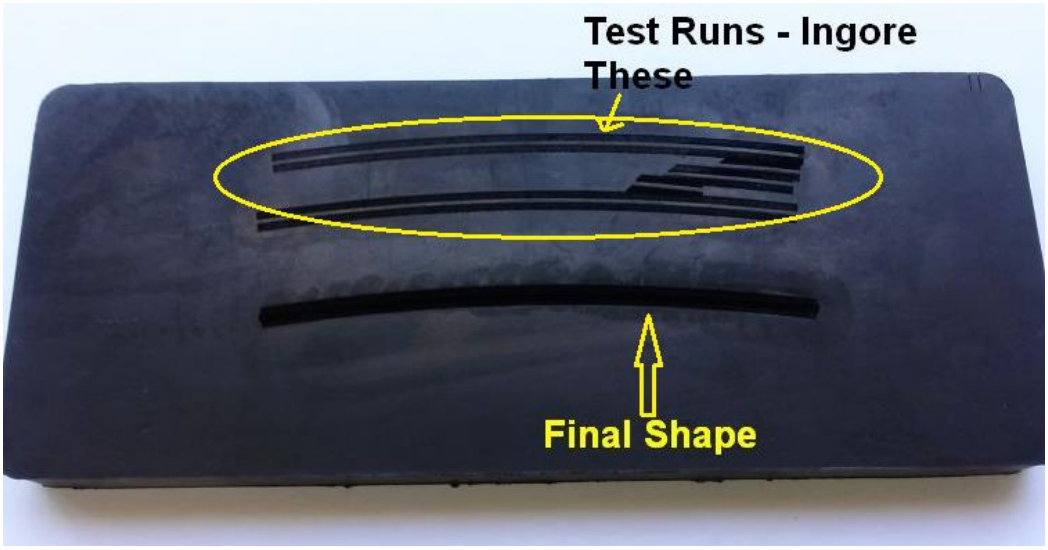
We started with few cut lines and then checked the quality under scope to come up with the parameters that provided acceptable quality.

Once parameters were degined, a pump groove shape was generated on a first piece. The chamfers were cut, followed by the center groove. The technique of hatching was used to create this shape.

Then, we started working on filter pocket on the second piece. It was decided to cut the outermost oval shape first, followed by 2nd oval shape from center, and then the innermost oval shape. The center grooves were cut at the end.

RESULTS

The following pictures highlight the quality obtained with the Laser-Microjet® technology.



Pic3

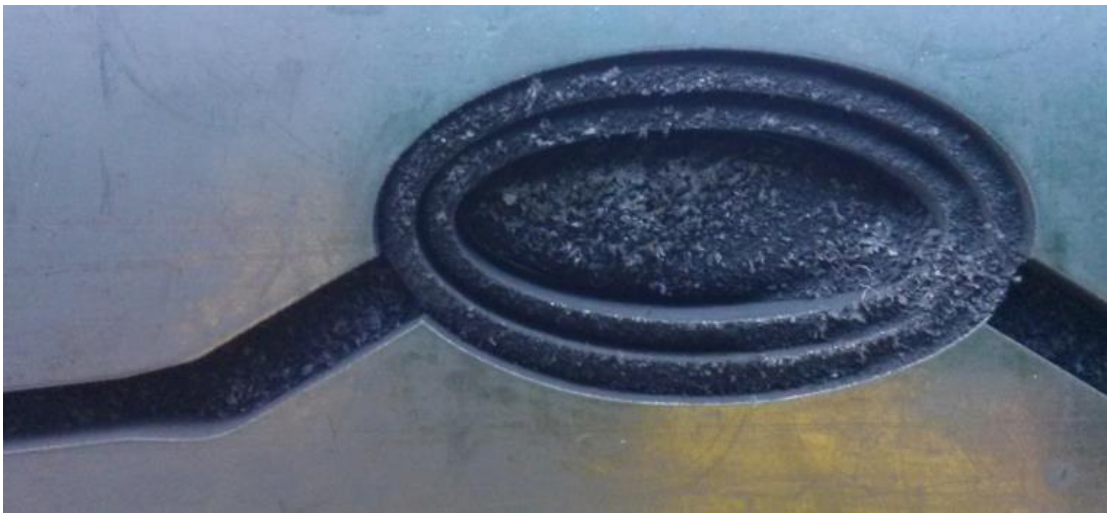
Pic4

Pic5

Pic6

Pic7

Pic8



Pic9

Pic10

DISCUSSION:

The cut came out as expected also but the the bottom of the cut did not have uniform depth. This can be further improved using the high acceleration as part of a more detailed optimization study.

The total time to cut the pump groove shape was 18 minutes

The total time to cut the filter pocket shape was 100 minutes

Again, these times can be significantly improved using a bigger nozzle and higher power.

CONCLUSION

Cutting of rubber 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.

We can improve the speed and quality using optimized parameters, bigger nozzles and higher power. This can be mapped out as a follow-on study as part of a review with Goodyear.

We thank you for your interest in our technology. We do believe that the Laser Microjet technology offers quality and throughput advantages for this unique application.