LASER-INDUCED DAMAGE THRESHOLD (LIDT) MEASUREMENT REPORT

S-ON-1 (ISO 21254-2) TEST PROCEDURE

SAMPLE: SO_FS_10MM

Request from	
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Contact person	Giedrė Šareikaitė
Purchase order	PO-0000249

Testing institute	
Address	UAB Lidaris Saulėtekio al. 10 10223 Vilnius Lithuania
Tester	Marijus Mickus
Test date	3/17/2020
Sale order	SO1764
Test ID	YMG7MY

Specimen	
Name	SO_fs_10mm
Type	Uncoated (S1 Uncoated)
Packaging	Plastic box

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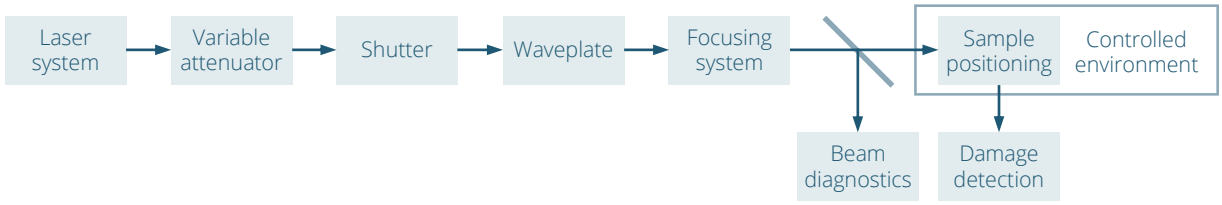
TEST EQUIPMENT

Test setup

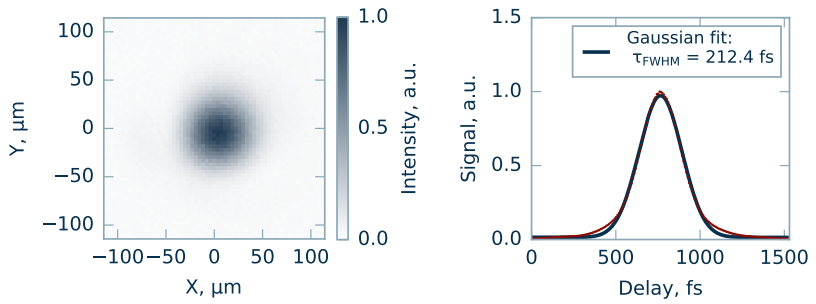


Laser and its parameters

Type	Mode-locked Yb:KGW
Manufacturer	Light Conversion
Model	Pharos SP
Central wavelength	1030.0 nm
Angle of incidence	0.0 deg
Polarization state	Linear
Pulse repetition frequency	100 Hz
Spatial beam profile in target plane	TEM00
Beam diameter in target plane ($1/e^2$)	(100.5 ± 1.2) µm
Longitudinal pulse profile	Single longitudinal mode
Pulse duration (FWHM)	212.4 fs (assuming Gaussian pulse shape)
Pulse to pulse energy stability (SD)	0.6 %

Energy/power meter

Manufacturer	Ophir
Model	12A-P-ROHS
Calibration due date	2020-07-01



(a) Beam profile (b) Pulse profile

Figure 1. Laser parameters used for measurements.

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TEST SPECIFICATION

Definitions and test description

Laser-induced damage (LID) is defined as any permanent laser radiation induced change in the characteristics of the surface/bulk of the specimen which can be observed by an inspection technique and at a sensitivity related to the intended operation of the product concerned. Laser-induced damage threshold (LIDT) is defined as the highest quantity of laser radiation incident upon the optical component for which the extrapolated probability of damage is zero. [1]

LID of the sample is investigated by performing a standardized S-on-1 test procedure.[2]
LIDT value is determined by taking the average of the highest fluence value before which no damage was observed and the lowest fluence value at which damage was first observed.

Test sites

Number of sites	541
Arrangement of sites	Hexagonal
Minimum distance between sites	360 µm
Maximum pulses per site	1000

Damage detection

Online	Scattered light diode
Offline	Nomarski microscope

Test environment

Environment	Air
Cleanroom class (ISO 14644-1)	ISO8
Pressure	1 bar
Temperature	22 C
Humidity	20 %

Sample preparation

Storage before test	Normal laboratory conditions
Dust blow-off	Canned air
Cleaning	None

[1] ISO 21254-1:2011: Lasers and laser-related equipment - Test methods for laser-induced damage threshold - Part 1: Definitions and general principles, International Organization for Standardization, Geneva, Switzerland (2011)
[2] ISO 21254-2:2011: Lasers and laser-related equipment - Test methods for laser-induced damage threshold - Part 2: Threshold determination, International Organization for Standardization, Geneva, Switzerland (2011)

LIDT TEST RESULTS

LIDT VALUE

10^3-on-1	$2.23\ ^{+0.13}_{-0.13}$ J/cm^2

CHARACTERISTIC DAMAGE CURVE

Table 1: Estimated LIDTs from fiting model for sample SO_fs_10mm.

Test mode	Threshold (Catastrophic)	Threshold (Offline detection - microscopy)
1-on-1	$3.52\ ^{+0.18}_{-0.18}$ J/cm^2	$3.42\ ^{+0.18}_{-0.18}$ J/cm^2
10-on-1	$2.85\ ^{+0.19}_{-0.18}$ J/cm^2	$2.85\ ^{+0.19}_{-0.18}$ J/cm^2
10^2-on-1	$2.44\ ^{+0.15}_{-0.15}$ J/cm^2	$2.29\ ^{+0.16}_{-0.15}$ J/cm^2
10^3-on-1	$2.34\ ^{+0.14}_{-0.14}$ J/cm^2	$2.23\ ^{+0.13}_{-0.13}$ J/cm^2

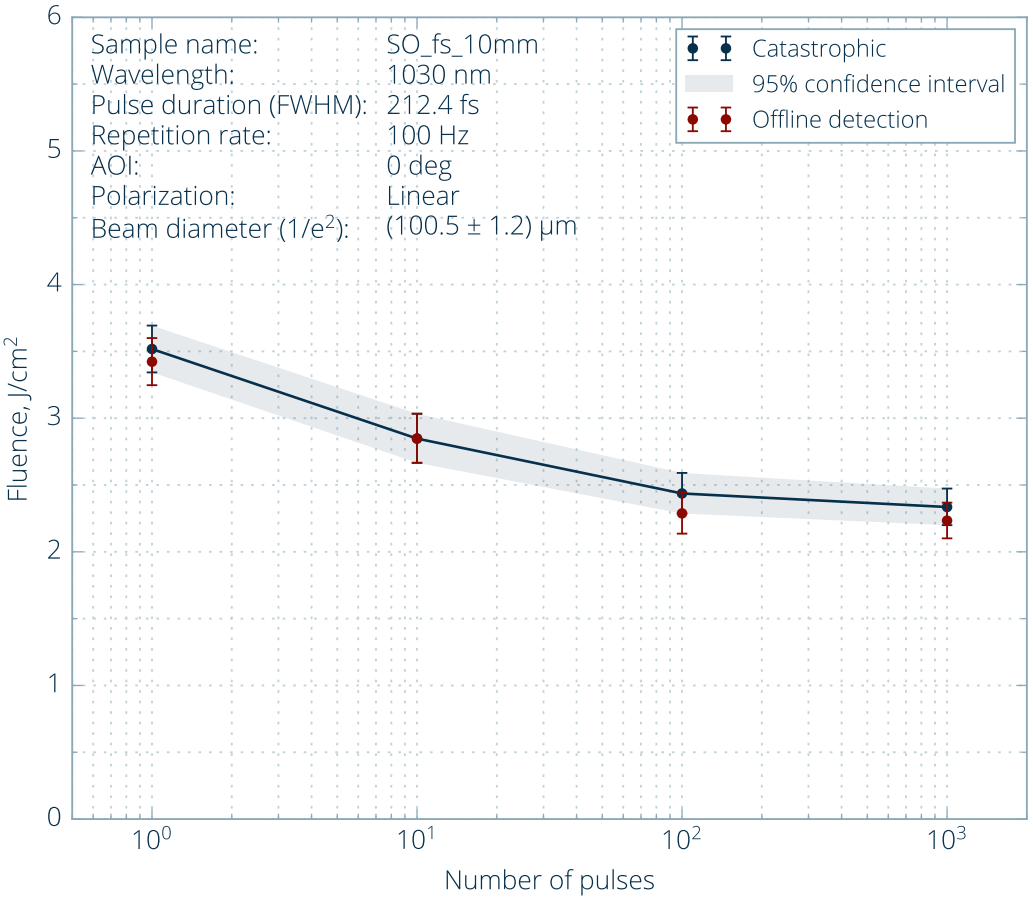
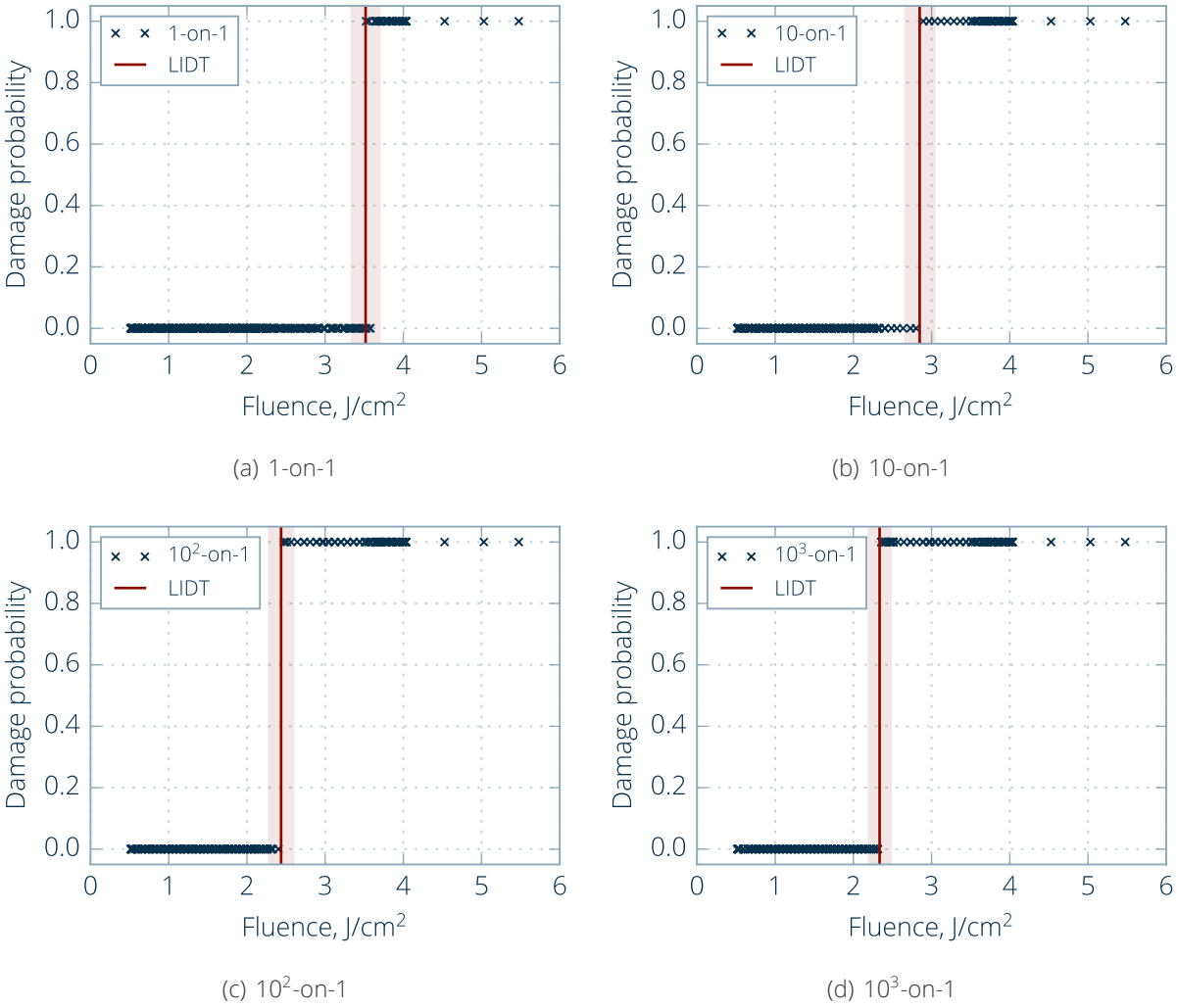


Figure 2. Characteristic damage curve.

DAMAGE PROBABILITY (CATASTROPHIC)



(a) 1-on-1

(b) 10-on-1

(c) 10^2-on-1

(d) 10^3-on-1

Figure 3. Damage probability plots.

TYPICAL DAMAGE MORPHOLOGY (CATASTROPHIC)

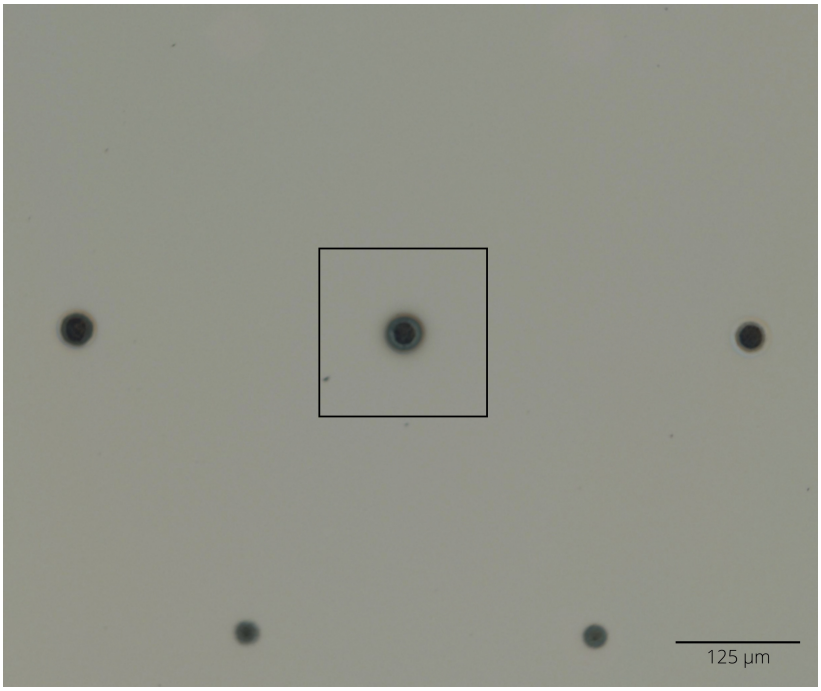


Figure 4. Typical damage morphology: fluence 3.58 J/cm^2, damage after 8 pulse(s).

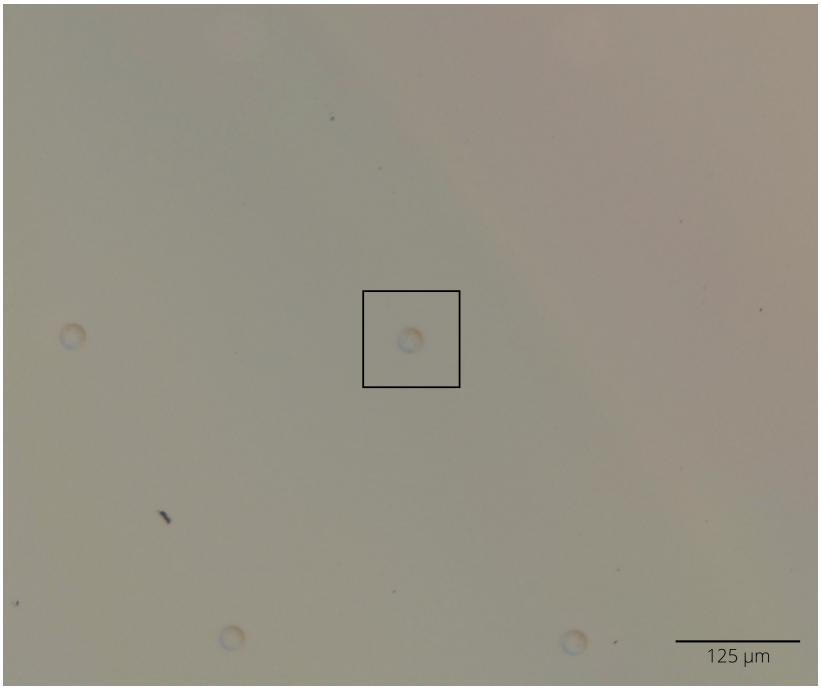
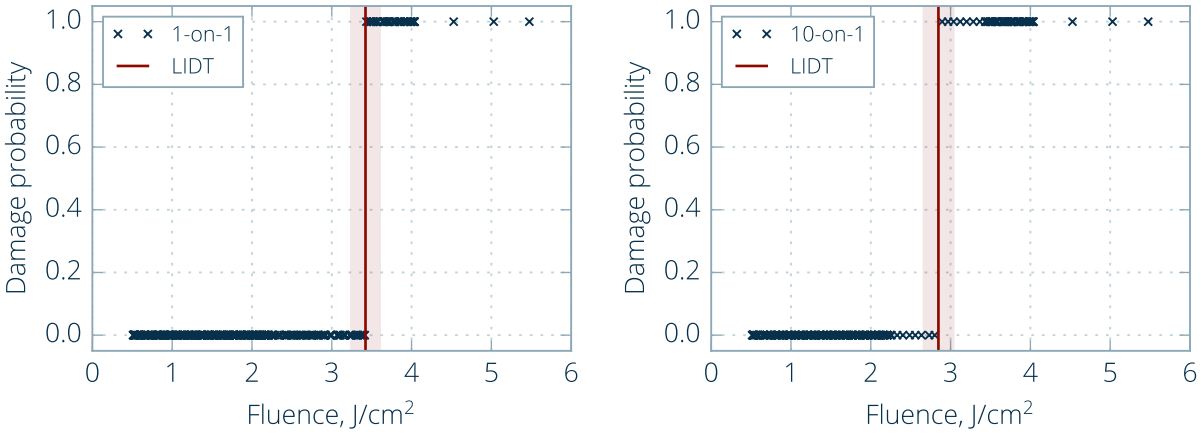


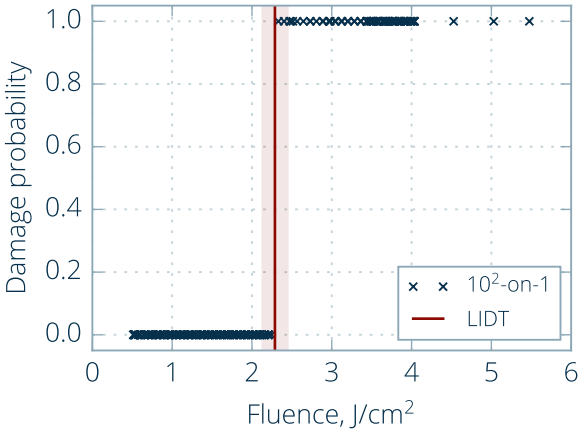
Figure 5. Typical damage morphology: fluence 4.03 J/cm^2, damage after 1 pulse(s).

DAMAGE PROBABILITY (OFFLINE DETECTION)

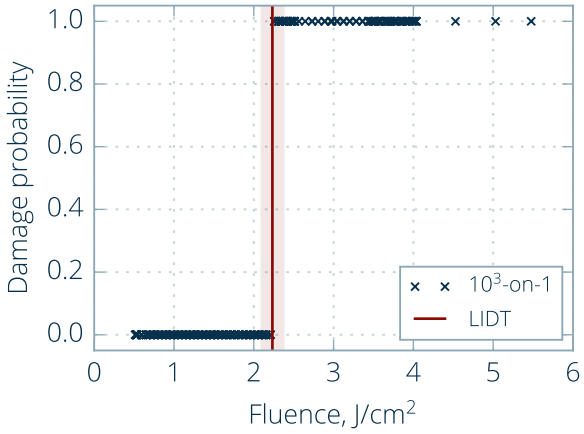


(a) 1-on-1

(b) 10-on-1



(c) 10^2-on-1



(d) 10^3-on-1

Figure 6. Damage probability plots.

TYPICAL DAMAGE MORPHOLOGY (OFFLINE DETECTION)

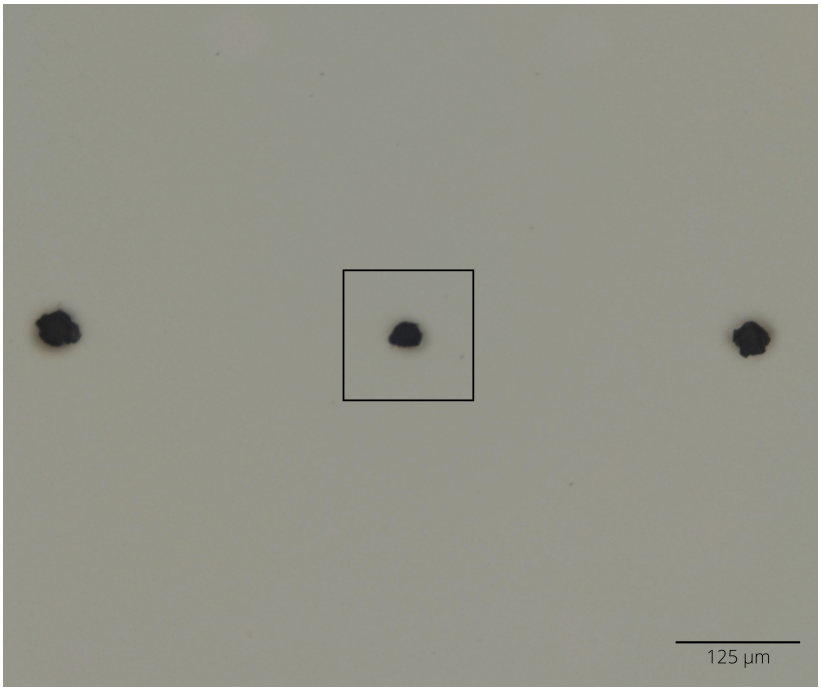


Figure 7. Typical damage morphology: fluence 2.36 J/cm^2, damage after 598 pulse(s).

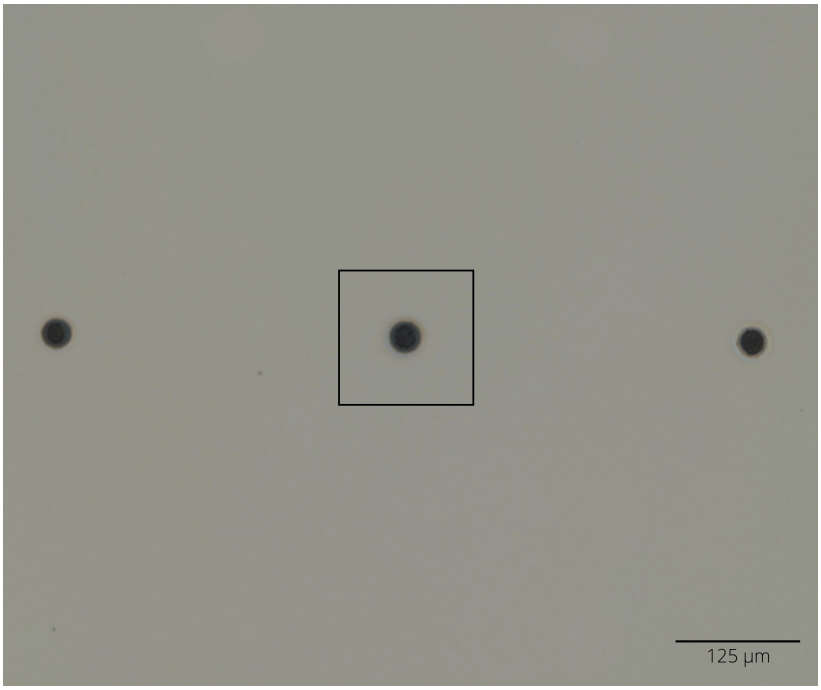


Figure 8. Typical damage morphology: fluence 3.59 J/cm^2, damage after 8 pulse(s).

TECHNICAL NOTES

TECHNICAL NOTE 1: Bulk damages were not found

After the test bulk damages were not found.

TECHNICAL NOTE 2: Back surface damages were not found

After the test back surface damages were not found.

TECHNICAL NOTE 3: Beam was focused inside the sample

Beam was focused inside the sample. Fluence is estimated in the beam focal spot.