LASER-INDUCED DAMAGE THRESHOLD (LIDT) MEASUREMENT REPORT

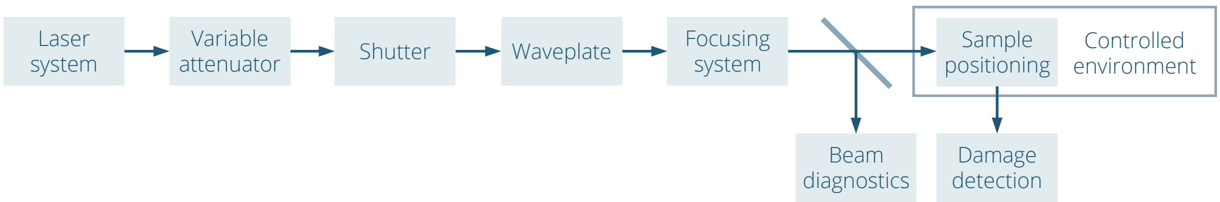
S-ON-1 (ISO 21254-2) TEST PROCEDURE

SAMPLE: M0050867 LOT0045568 ID 63517

Request from	
Address	Altechna Mokslininku st. 6A 08412 Vilnius Lithuania
Contact person	Aurelija Vasiljeva
Purchase order	PU0019033
Testing institute	
Address	UAB Lidaris Saulėtekio al. 10 10223 Vilnius Lithuania
Tester	Lina Vigricaite
Test date	30/09/2020
Sale order	SO2030
Test ID	YXX49Y
Specimen	
Name	M0050867 LOT0045568 ID 63517
Type	HR Dielectric Coating (HR(Rs>99,8% Rp>99,3%)@ 527-532)
Packaging	Plastic box

TEST EQUIPMENT

Test setup

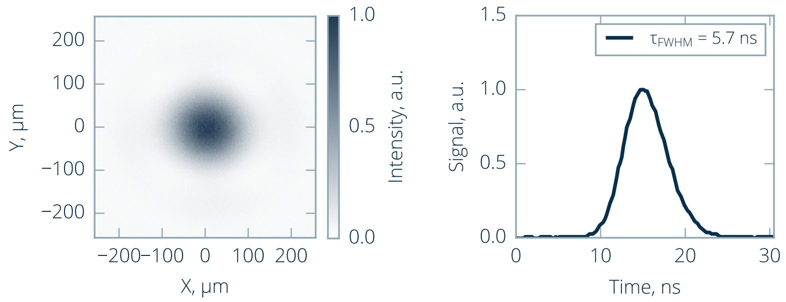


Laser and its parameters

Type	Q-switched, seeded Nd:YAG
Manufacturer	InnoLas Laser
Model	SpitLight Hybrid
Central wavelength	532.0 nm
Angle of incidence	45.0 deg
Polarization state	Linear P
Pulse repetition frequency	100 Hz
Spatial beam profile in target plane	TEM00
Beam diameter in target plane ($1/e^2$)	(226.6 ± 2.8) μm
Longitudinal pulse profile	Single longitudinal mode
Pulse duration (FWHM)	(5.7 ± 0.3) ns
Pulse to pulse energy stability (SD)	1.8 %

Energy/power meter

Manufacturer	Ophir
Model	PE50-DIF-C
Calibration due date	2021-06-01



(a) Beam profile (b) Pulse profile

Figure 1. Laser parameters used for measurements.

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 fitting experimental damage probability data with a model derived for a Poisson damage process assuming degenerate defect ensemble. [3]

Test sites

Number of sites	209
Arrangement of sites	Hexagonal
Minimum distance between sites	750 µm
Maximum pulses per site	1000

Analysis information

Online detection	Scattered light diode
Offline detection	Nomarski microscope
Software version	e254241 - 41bd8ff

Test environment

Environment	Air
Cleanroom class (ISO 14644-1)	ISO7
Pressure	1 bar
Temperature	21 C
Humidity	50 %

Sample preparation

Storage before test	Normal laboratory conditions
Dust blow-off	None
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)

[3] J. Porteus and S. Seitel, Absolute onset of optical surface damage using distributed defect ensembles, Applied Optics, 23(21), 3796–3805 (1984)

LIDT TEST RESULTS

LIDT VALUE

10^3-on-1	$15.2^{+1.6}_{-3.1}$ J/cm^2	$20.1^{+2.2}_{-4.2}$ J/cm^2 (scaled to 10.0 ns)

CHARACTERISTIC DAMAGE CURVE

Table 1: Estimated LIDTs from fiting model for sample M0050867 LOT0045568 ID 63517.

Test mode	Threshold (Online detection - scattering)	Threshold (Online detection - scattering) scaled to 10.0 ns	Threshold (Offline detection - microscopy)	Threshold (Offline detection - microscopy) scaled to 10.0 ns
10-on-1	$15.2^{+1.6}_{-3.1}$ J/cm^2	$20.1^{+2.2}_{-4.2}$ J/cm^2	-	-
10^2-on-1	$15.2^{+1.6}_{-3.1}$ J/cm^2	$20.1^{+2.2}_{-4.2}$ J/cm^2	-	-
10^3-on-1	$15.2^{+1.6}_{-3.1}$ J/cm^2	$20.1^{+2.2}_{-4.2}$ J/cm^2	$15.2^{+1.6}_{-3.1}$ J/cm^2	$20.1^{+2.2}_{-4.2}$ J/cm^2

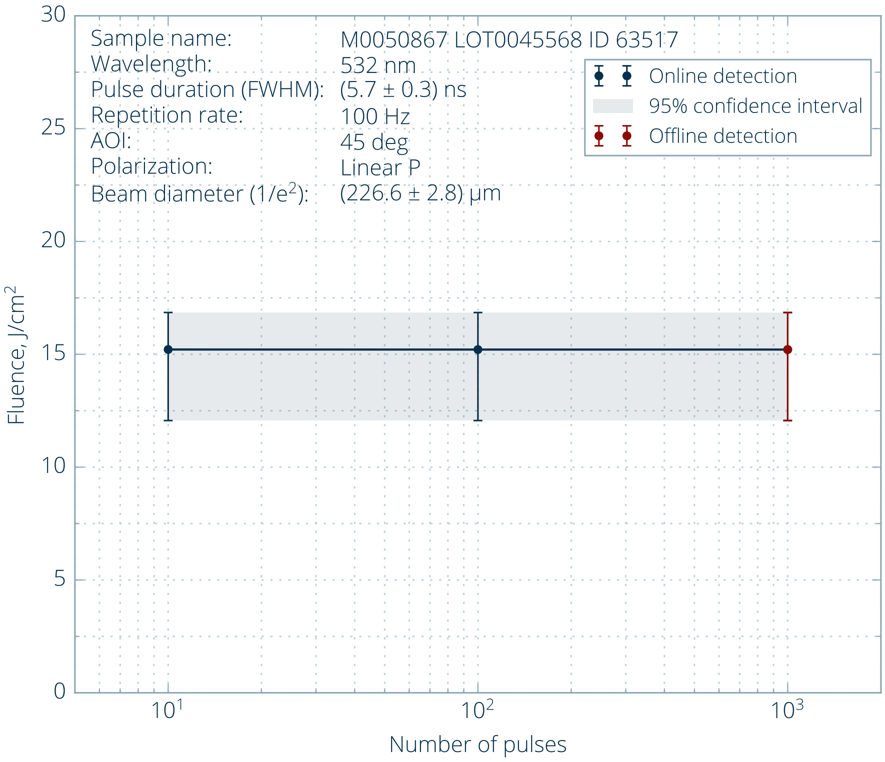
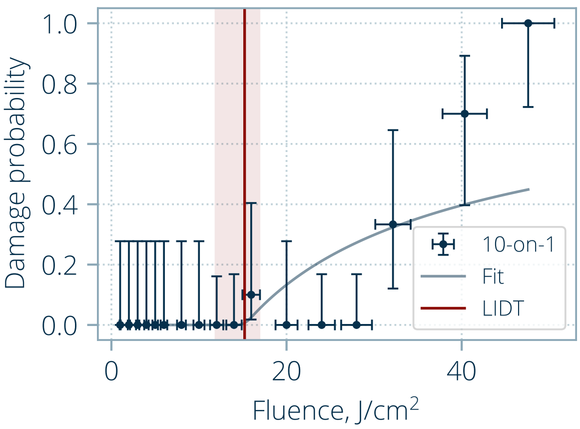
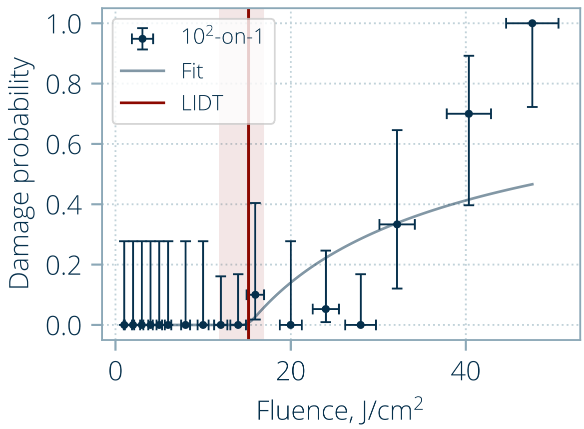


Figure 2. Characteristic damage curve.

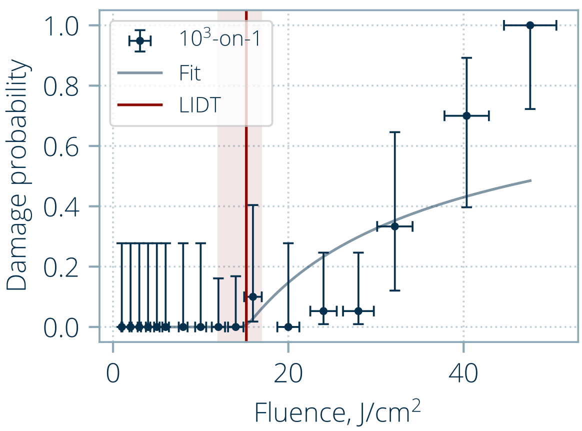
DAMAGE PROBABILITY (ONLINE DETECTION)



(a) 10-on-1



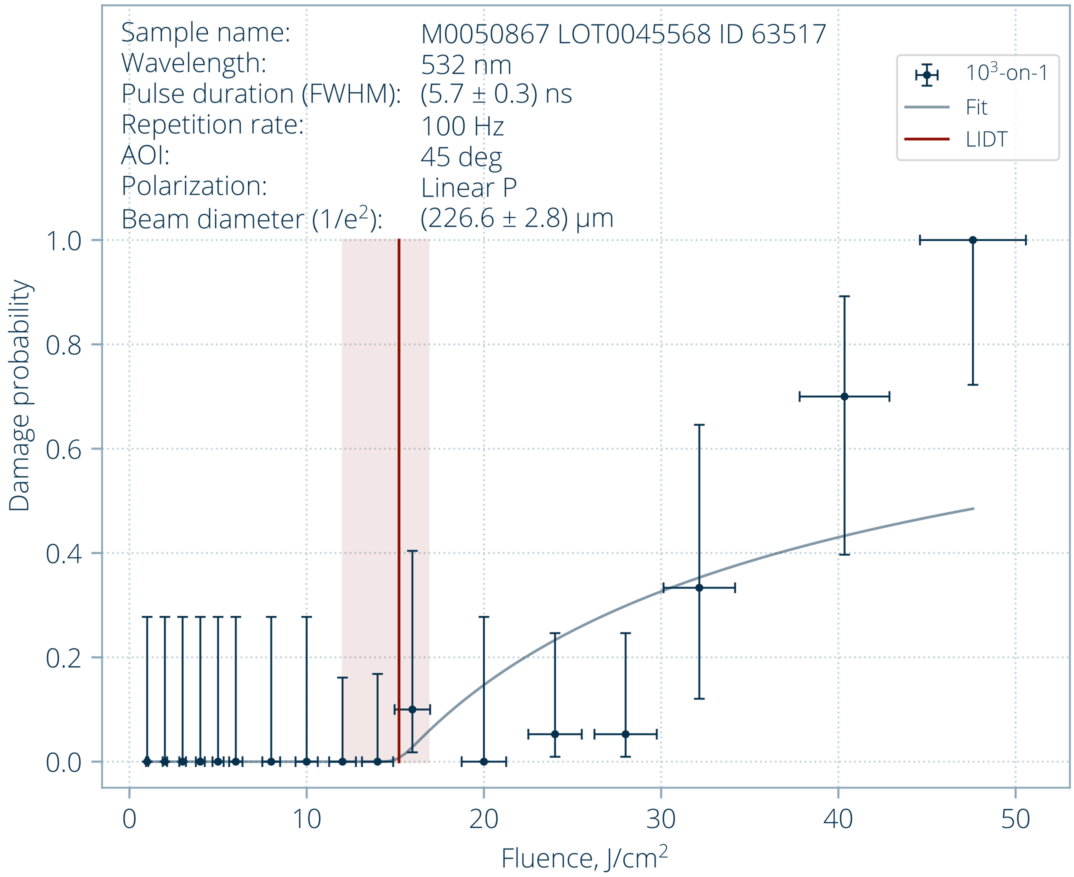
(b) 10^2-on-1



(c) 10^3-on-1

Figure 3. Damage probability plots.

DAMAGE PROBABILITY (OFFLINE DETECTION)



(a) 10^3-on-1

Figure 4. Damage probability plot.

TYPICAL DAMAGE MORPHOLOGY (OFFLINE DETECTION)

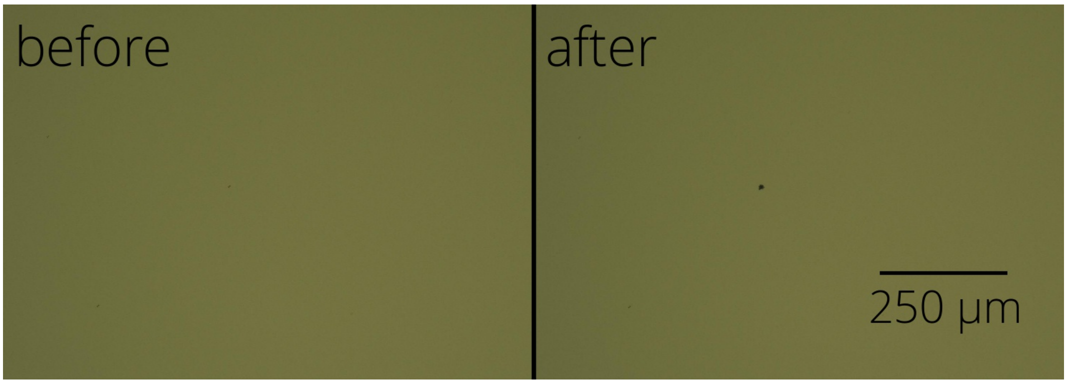


Figure 5. Typical damage morphology: fluence 15.6 J/cm^2, damage after 4 pulse(s).

Figure 6. Typical damage morphology: fluence 40.6 J/cm^2, damage after 2 pulse(s).

TECHNICAL NOTES

TECHNICAL NOTE 1: Oblique incidence

According to the ISO 21254-2:2011 standard, for spatial beam profiling perpendicular to the direction of beam propagation and angles of incidence differing from 0 degrees, the cosine of the angle of incidence is included in the calculation of the effective area, which leads to correct evaluation of laser fluence at different angles of incidence (Figure 7).

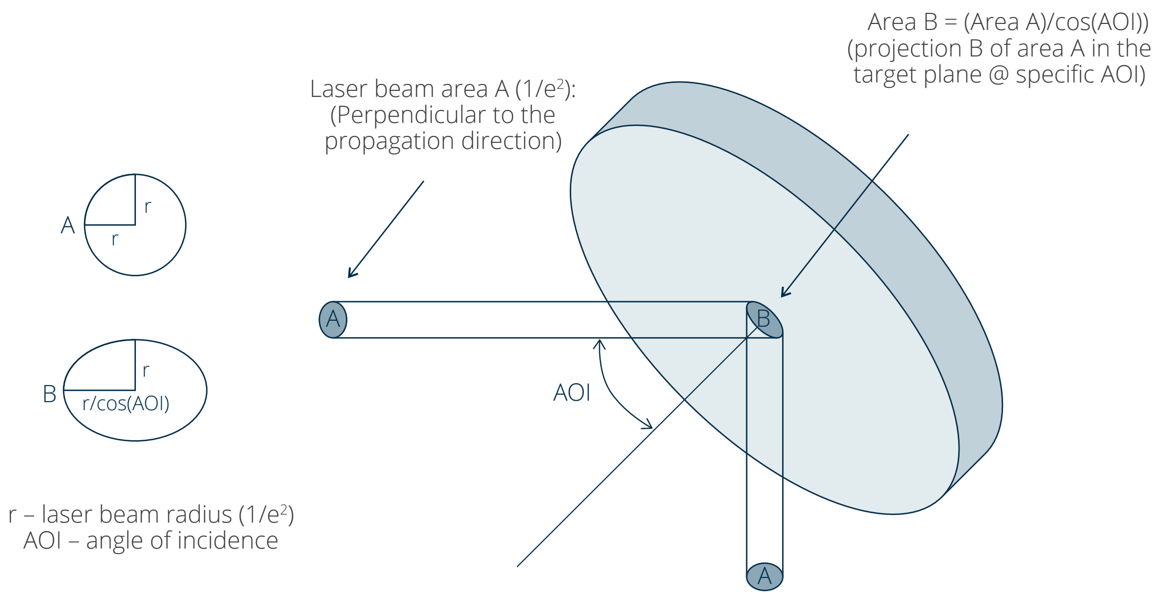


Figure 7. Oblique incidence.