LASER-INDUCED DAMAGE THRESHOLD (LIDT) MEASUREMENT REPORT

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

SAMPLE: M0073830 LOT0057492 SU012564

Request from

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Purchase order	PU0015930-AVA

Testing institute

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	10223 Vilnius
	Lithuania
Tester	Egidijus Pupka
Test date	2020-01-14
Sale order	SO1611
Test ID	EPX1OY

Specimen

Name	M0073830 LOT0057492 SU012564
Type	AR Coating (AR 1898 -1918nm+2090-2075 nm)
Packaging	Wrapped in paper

TEST EQUIPMENT

Test setup

Laser system → Variable attenuator → Shutter → Waveplate → Focusing system → Sample positioning | Controlled environment

Beam diagnostics

Damage detection
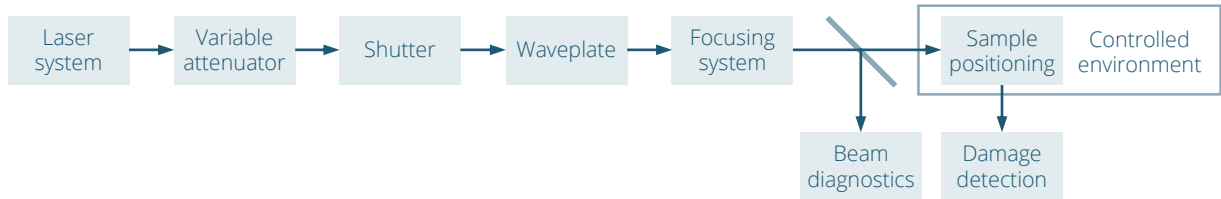
Laser and its parameters

Type	Q-switched, seeded Nd:YAG
Manufacturer	InnoLas Laser II
Model	SpitLight Hybrid with OPO
Central wavelength	2090.0 nm
Angle of incidence	0.0 deg
Polarization state	Linear
Pulse repetition frequency	100 Hz
Spatial beam profile in target plane	Near Gaussian
Beam diameter in target plane ($1/e^2$)	(181.9 ± 5.9) µm
Longitudinal pulse profile	Single longitudinal mode
Pulse duration (FWHM)	(4.0 ± 0.3) ns
Pulse to pulse energy stability (SD)	3.4 %

Energy/power meter

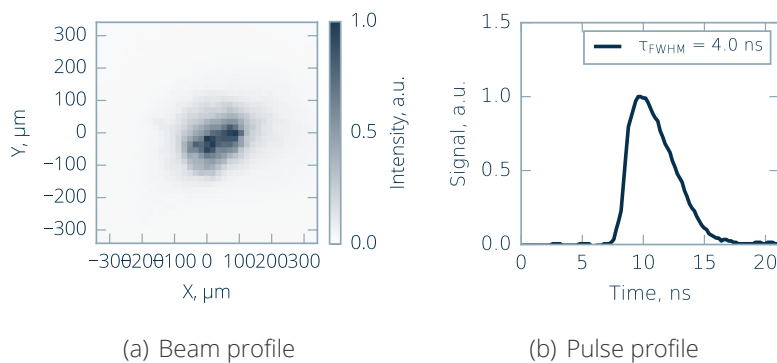|	
Manufacturer	Ophir
Model	PE50-DIF-C
Calibration due date	2020-07-01

(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	160
Arrangement of sites	Hexagonal
Minimum distance between sites	600 µm
Maximum pulses per site	1000

Damage detection

Online	Scattered light diode
Offline	Nomarski microscope

Test environment

Environment	Air
Cleanroom class (ISO 14644-1)	ISO7
Pressure	1 bar
Temperature	23 C
Humidity	26 %

Sample preparation

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

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[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 | $> 20.5 ^{+3.1}_{-3.1}$ J/cm^2 | $> 32.2 ^{+4.9}_{-4.9}$ J/cm^2 (scaled to 10 ns) |

CHARACTERISTIC DAMAGE CURVE

Table 1: Estimated LIDTs from fiting model for sample M0073830 LOT0057492 SU012564.

Test mode	Threshold (Offline detection - microscopy) [4]	Threshold (Offline detection - microscopy) scaled to 10 ns	Threshold (Online detection - scattering) [4]	Threshold (Online detection - scattering) scaled to 10 ns
10-on-1	-	-	$> 20.5 ^{+3.1}_{-3.1}$ J/cm^2	$> 32.2 ^{+4.9}_{-4.9}$ J/cm^2
10^2-on-1	-	-	$> 20.5 ^{+3.1}_{-3.1}$ J/cm^2	$> 32.2 ^{+4.9}_{-4.9}$ J/cm^2
10^3-on-1	$> 20.5 ^{+3.1}_{-3.1}$ J/cm^2	$> 32.2 ^{+4.9}_{-4.9}$ J/cm^2	$> 20.5 ^{+3.1}_{-3.1}$ J/cm^2	$> 32.2 ^{+4.9}_{-4.9}$ J/cm^2

Sample name: M0073830 LOT0057492 SU012564
Wavelength: 2090 nm
Pulse duration (FWHM): (4.0 ± 0.3) ns
Repetition rate: 100 Hz
AOI: 0 deg
Polarization: Linear
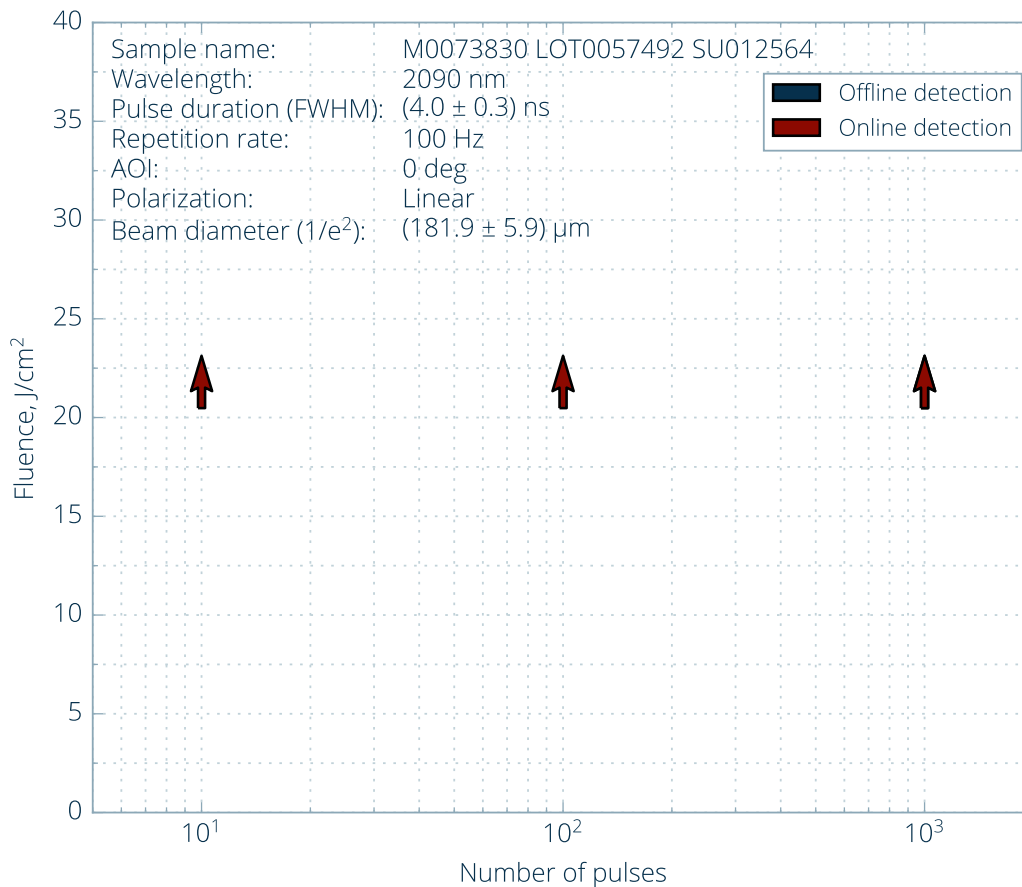Beam diameter (1/e^2): (181.9 ± 5.9) µm

Figure 2. Characteristic damage curve.

[4]Read Technical Note 1

DAMAGE PROBABILITY
(OFFLINE DETECTION)

Sample name: M0073830 LOT0057492 SU012564
Wavelength: 2090 nm
Pulse duration (FWHM): (4.0 ± 0.3) ns
Repetition rate: 100 Hz
AOI: 0 deg
Polarization: Linear
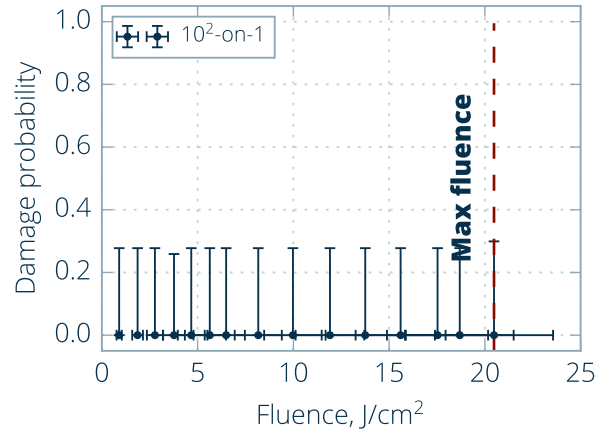Beam diameter (1/e^2): (181.9 ± 5.9) μm
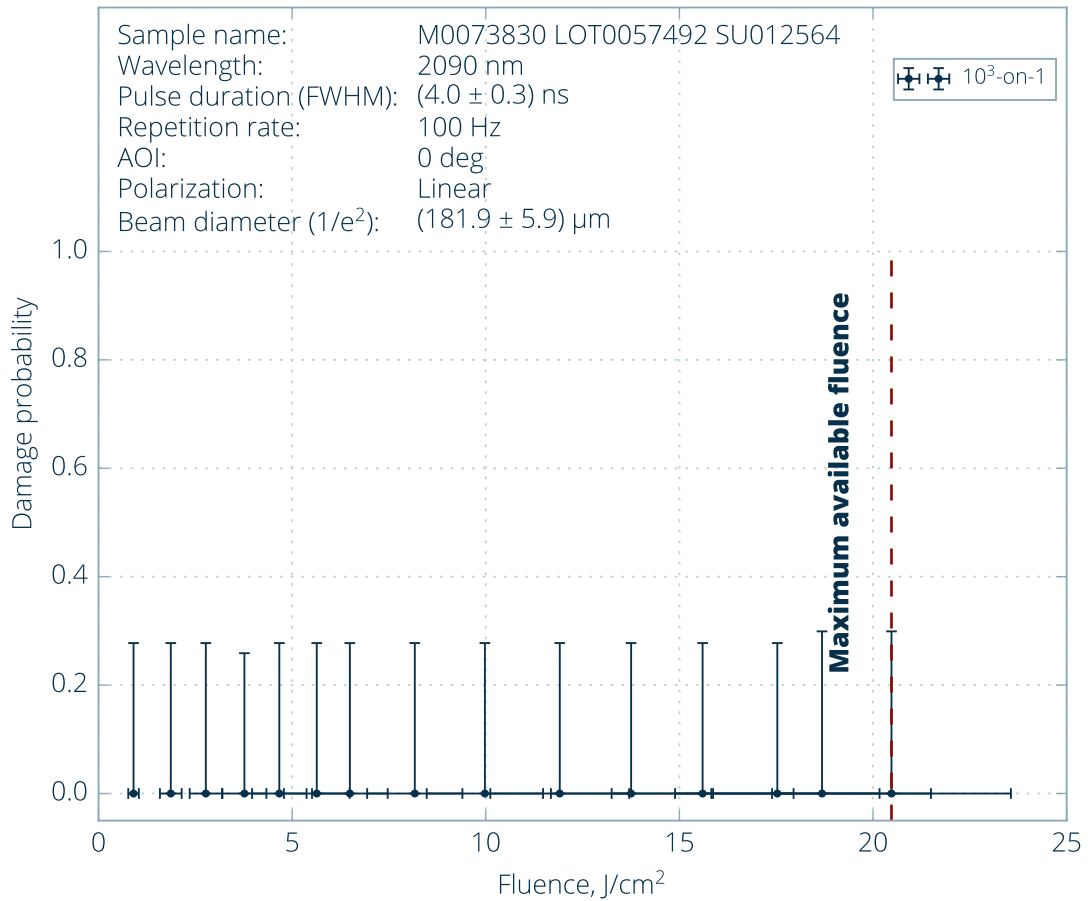
(a) 10^3-on-1

Figure 3. Damage probability plot.

DAMAGE PROBABILITY
(ONLINE DETECTION)
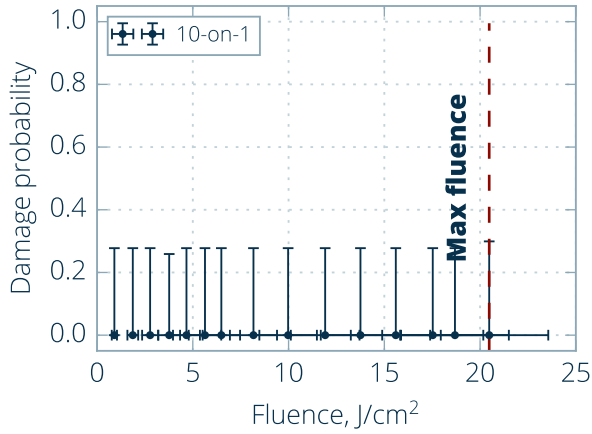
(a) 10-on-1

(b) 10^2-on-1
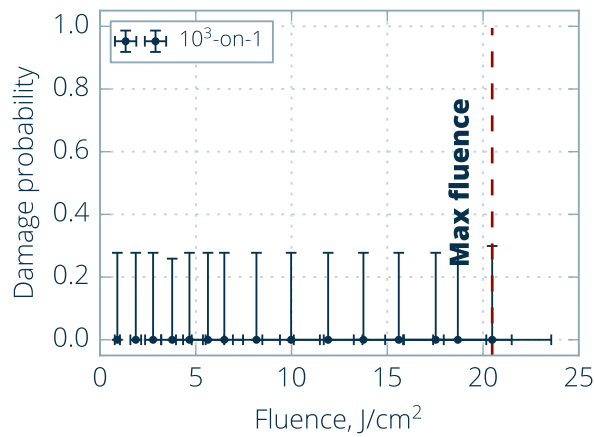
(c) 10^3-on-1

Figure 4. Damage probability plots.

LIDARIS
LIDT Service

TECHNICAL NOTES

TECHNICAL NOTE 1: No damages were found

No damages were found for this type of analysis, therefore, LIDT value could not be evaluated. LIDT value should be higher than maximum fluence value used in the test. This fluence value is written in the thresholds table.