# Laser-Induced Damage Threshold (LIDT) Measurement Report

# ISO 21254-2: S-on-1 Test Procedure

Sample: 2-HPCB-A-0125

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Tester/date: E. Pupka / 2016-10-05

## Specimen

Name of sample: 2-HPCB-A-0125

Type of specimen: Polarizing Cube for High Energy Applications

Storage, cleaning: Membrane box

## Test specification

Third harmonic of pulsed Nd:YAG InnoLas Laser: SpitLight Hybrid laser ($\lambda$ = 355 nm, linear polarization, pulse duration 8.2 ns). $\lambda/2$ plate combined with additional polarizer attenuator, online scattered light damage detection, offline damage detection using Nomarski microscopy.

## Laser parameters

| | |
|---|---|
| Wavelength: | 355 nm |
| Angle of incidence: | 0 deg. |
| Polarization state: | linear S and P |
| Pulse repetition frequency: | 100 Hz |
| Spatial beam profile in target plane: | $TEM_{00}$ |
| Longitudinal beam profile: | Single mode (SLM) |
| Beam diameter in target plane $(1/e^2)$: | (204.4 ± 7.4) µm (average from 500 pulses) |
| Pulse duration: | (8.2 ± 0.4) ns |

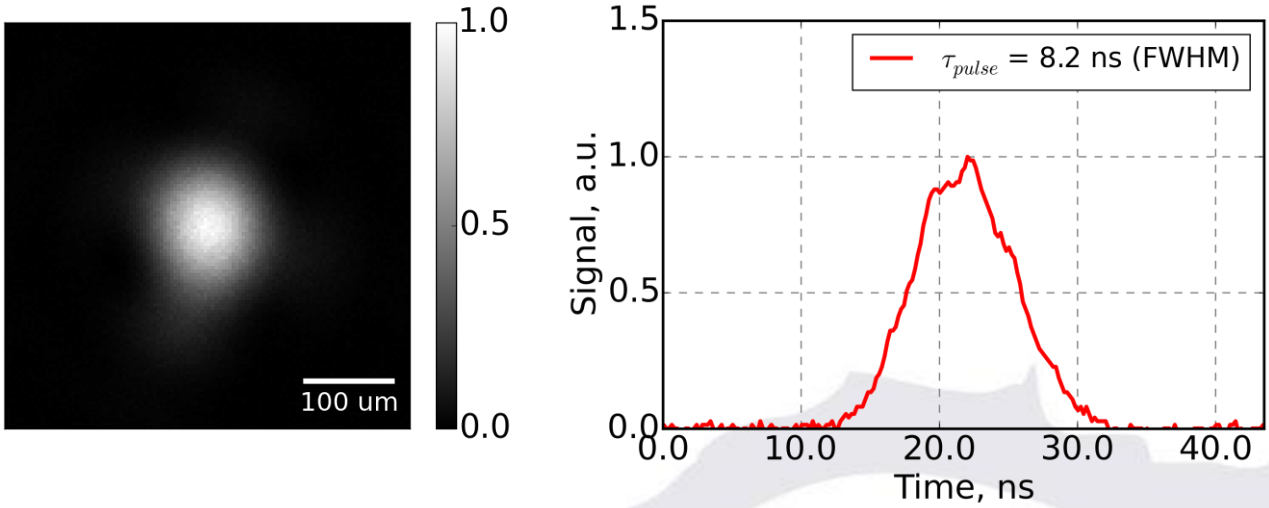


Fig. 1 Spatial beam profile in target plane (left) and temporal pulse profile (right)

| **Test procedure:** | **S-on-1 test** |
|---|---|
| Number of sites per specimen: | 127 (S pol.), 110 (P pol.) |
| Arrangement of test sites: | Equally spaced |
| Minimum distance between sites: | 650 µm |
| Damage detection: | Online scattered light diode,<br>offline Nomarski microscopy |
| Storage of the specimen: | Original packaging, normal laboratory conditions |
| Test environment: | Industrial environment |
| Cleaning: | Compressed air |
| Definition of LIDT: | Nonlinear fit to 0% of damage probability |

**Test result:**

Table 1 Summarized LIDT's for sample 2-HPCB-A-0125.

| Test mode | Polarizing surface threshold (S pol.), J/cm2 | Polarizing surface threshold (P pol.), J/cm2 |
|---|---|---|
| 10-on-1 | 2.56 ≤ 2.94 ≤ 3.07 | 4.73 ≤ 5.18 ≤ 5.96 |
| 100-on-1 | 2.38 ≤ 2.66 ≤ 2.87 | 4.73 ≤ 5.18 ≤ 5.96 |
| 1000-on-1 | 2.29 ≤ 2.52 ≤ 2.64 | 4.73 ≤ 5.18 ≤ 5.44 |

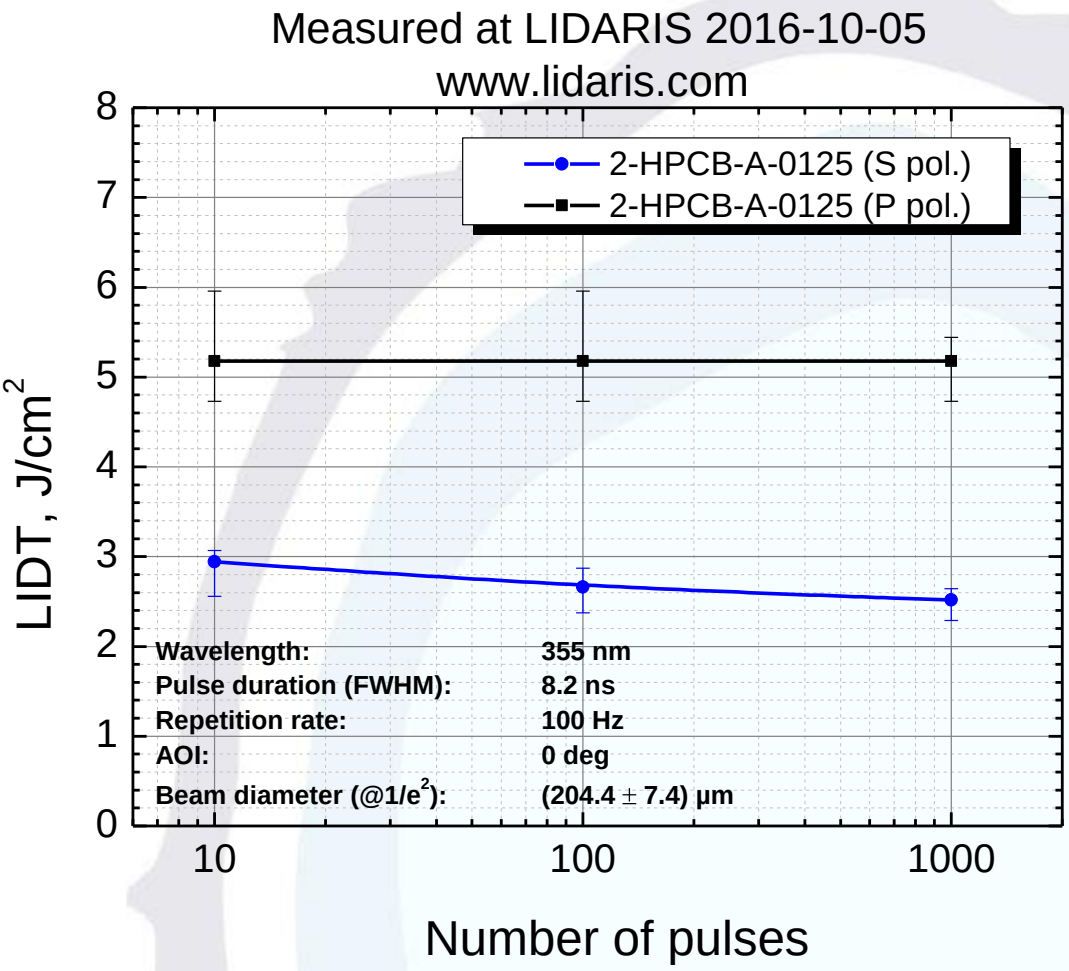


Fig. 2 Characteristic damage curve.

**Typical damage morphology:**

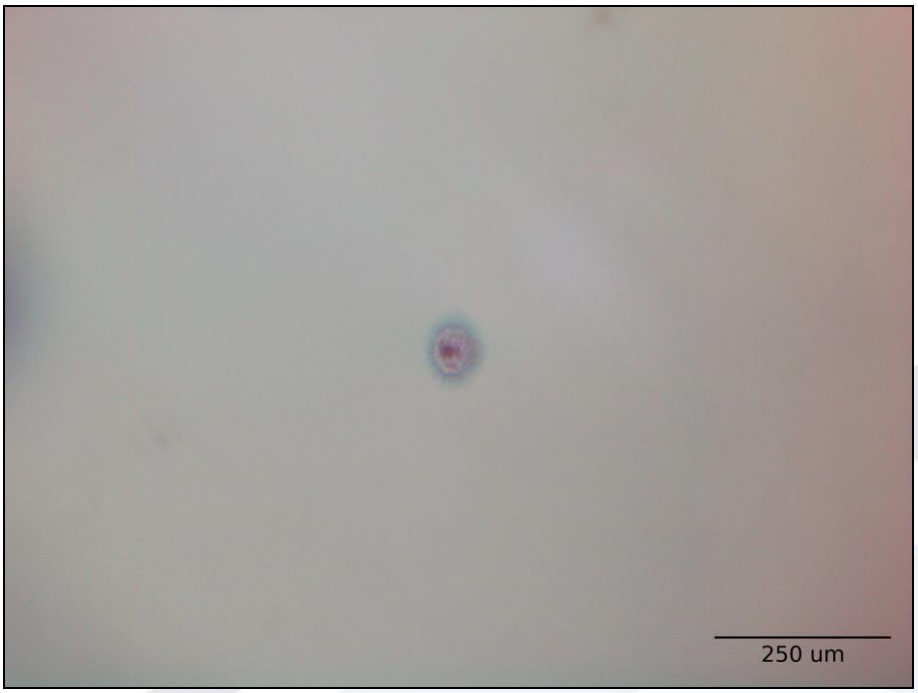


Fig. 3 Typical polarizing surface damage morphology (S pol.)
(Fluence 3.77 J/cm$^2$, damage after 12 pulses)

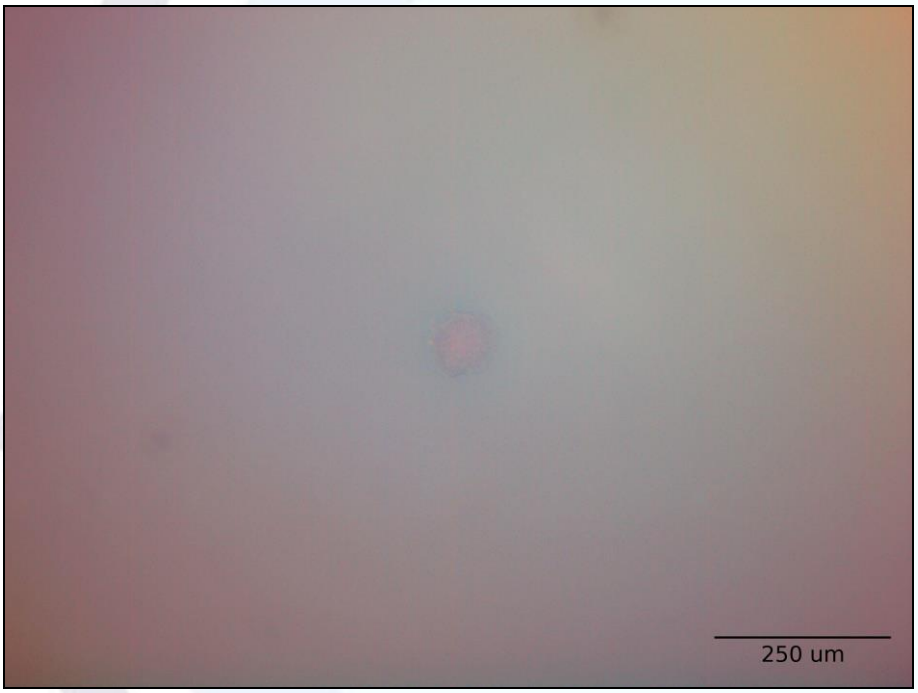


Fig. 4 Typical polarizing surface damage morphology (S pol.)
(Fluence 2.70 J/cm$^2$, damage after 748 pulses)


Fig. 5 Typical front surface damage morphology (P pol.)
(Fluence 6.61 J/cm$^2$, damage after 12 pulses)

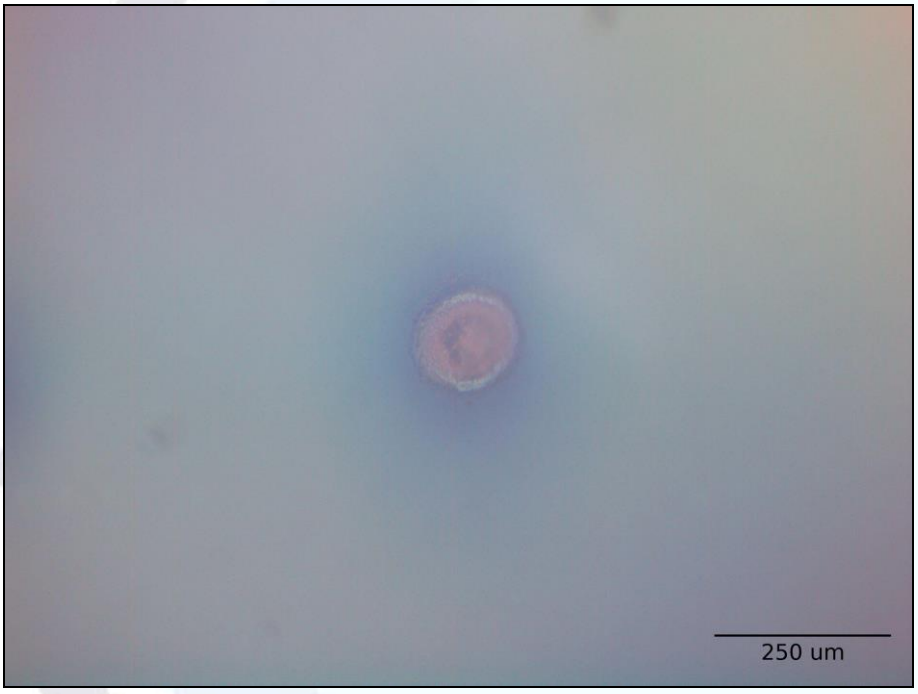


Fig. 6 Typical front surface damage morphology (P pol.)
(Fluence 5.51 J/cm$^2$, damage after 738 pulses)

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**Technical note:**

1. The provided threshold values are calculated for normal incidence in relation to the front surface in order to compare the LIDT values of different surfaces. The actual damaging fluence value on polarizing surface is cos(45°) ≈ 0.7 times lower.

2. Per customer request, beam waist was always kept on the polarizing surface when translating the sample, therefore fluence values for other surfaces are up to ~10% lower (Rayleigh length was 28 mm).

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