

<b>LIVA Series</b>	<b>Ultraviolet Intensity Detection</b>	
	Tested Device: LIVA601	Test Time : 2020/ 07/ 15
	EVERTREE Technology Laboratory	Version : 1.0.0

## **Book Sterilizer Documentation**

# **LIVA Series Ultraviolet Intensity Detection LIVA601**

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**ETP-TST-02**  
Ver. 1.0.0



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## 1. Test Method and Composition

### 1) Test Equipment List


No.	Equipment	Model	Manufacturer	Note
1	Book Sterilizer	LIVA 601	EVERTREE CO., LTD	Tested device
2	UV Irradiation Meter	LS126C	Linshang Techonology Co., Ltd	Testing device
3	Book	24cm*17cm*2cm		

### 2) Testing Device Technical Data

Major Items and Features
Ultraviolet Radiation Meter

<ul style="list-style-type: none"> <li>● Spectral-response: 230nm-280nm, <math>\lambda_p=254\text{nm}</math></li> <li>● UV Range: 0-20000<math>\mu\text{W}/\text{cm}^2</math></li> <li>● Resolution: 0.1<math>\mu\text{W}/\text{cm}^2</math></li> <li>● Response time: 1S</li> <li>● Display: 240*160 Dot Matrix LCD</li> <li>● Probe size: Diameter 46mm * thickness 16.5mm</li> <li>● Dimensions: 148mm(L) *76mm(W) *26mm(H)</li> <li>● Probe wire length: 1m</li> </ul>
※ The data above is irrelevant with this test.

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(3) Procedures

Test Configuration
Test Environment

<ul style="list-style-type: none"> <li>- Test Site : Evertree Co., Ltd</li> <li>- Tested Device: Random.</li> <li>- Book Position: Placed on the middle book-shelf.</li> <li>- Probe Position : The probe is placed on top of the book.</li> <li>- Test Number : Measure the ultraviolet intensity at the following positions: 1. each book-shelf; 2. on top of the book.</li> </ul> <p>Test times: Test two times for each position and take the mean value. In total, 24 test have been carried out.</p>

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## 2. Test Item

### 1) Ultraviolet Intensity Detection (LIVA 601)

Ultraviolet Intensity Detection	
Test Object	Book
Date	2020-07-15
Test Purpose	In order to prove that LIVA book sterilizer is effective at killing COVID 19, ultraviolet intensity tests have been carried out at the position of each book-shelf and book top.
Test Device Model	LS126C UV Irradiation Meter

Content : Ultraviolet Irradiation Detection

Test Method:

a. Set the sterilization time for 1 minute. And number the book-shelf from ① to ⑥. Place the probe on the book-shelf to obtain the irradiation dose of the 6 positions. Measure each position twice and take the mean value.

b. Set the sterilization time for 1 minute. Place the probe on top of the book to measure the irradiation dose when the books are fixed at the six book-shelf. Measure twice and take the mean value.















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3.Test Results

<b>Position</b>	①	Book Top	<b>Position</b>	②	Book Top	<b>Position</b>	③	Book Top
<b>Maximum Power</b> $\mu\text{W}/\text{cm}^2$	817.2	851.7	<b>Maximum Power</b> $\mu\text{W}/\text{cm}^2$	726	1184.4	<b>Maximum Power</b> $\mu\text{W}/\text{cm}^2$	761.6	913.4
<b>Average Power</b> $\mu\text{W}/\text{cm}^2$	713.3	787.5	<b>Average Power</b> $\mu\text{W}/\text{cm}^2$	676.2	1099.6	<b>Average Power</b> $\mu\text{W}/\text{cm}^2$	693	846.6
<b>Maximum Energy</b> J / m2	490.32	511.02	<b>Maximum Energy</b> J / m2	435.6	710.64	<b>Maximum Energy</b> J / m2	456.96	548.04
<b>Average Energy</b> J / m2	427.98	472.5	<b>Average Energy</b> J / m2	405.72	659.76	<b>Average Energy</b> J / m2	415.8	507.96
<b>Position</b>	④	Book Top	<b>Position</b>	⑤	Book Top	<b>Position</b>	⑥	Book Top
<b>Maximum Power</b> $\mu\text{W}/\text{cm}^2$	680.8	915.6	<b>Maximum Power</b> $\mu\text{W}/\text{cm}^2$	683	1073.9	<b>Maximum Power</b> $\mu\text{W}/\text{cm}^2$	684.6	896.5
<b>Average Power</b> $\mu\text{W}/\text{cm}^2$	621.8	833.5	<b>Average Power</b> $\mu\text{W}/\text{cm}^2$	627.4	994.3	<b>Average Power</b> $\mu\text{W}/\text{cm}^2$	633	824.2
<b>Maximum Energy</b> J / m2	408.48	549.36	<b>Maximum Energy</b> J / m2	409.8	644.34	<b>Maximum Energy</b> J / m2	410.76	537.9
<b>Average Energy</b> J / m2	373.08	500.1	<b>Average Energy</b> J / m2	376.44	596.58	<b>Average Energy</b> J / m2	379.8	494.52

According to the rest results, the irradiation intensity at different positions of the sterilization room is larger than 308J / m2.

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Test Figure	Position	Test Figure	Position	Test Figure	Position
	①		②		③
	Book Top		Book Top		Book Top
Test Figure	Position	Test Figure	Position	Test Figure	Position
	④		⑤		⑥
	Book Top		Book Top		Book Top

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## Ultraviolet irradiation dose required to inactivate coronavirus and various bacteria

The data in the following table is the result of Coronavirus Ultraviolet Susceptibility. The D90 value indicates the ultraviolet dose for 90% inactivation. The range of D90 values for coronaviruses is 7-2410 J/m<sup>2</sup> and the average of all studies is 308 J/m<sup>2</sup>. Excluding outliers, the mean D90 is 58 J/m<sup>2</sup>, should adequately represent the ultraviolet susceptibility of the SARS-CoV-2 (COVID-19) virus.

Table 1: Summary of Ultraviolet Studies on Coronaviruses

Microbe	D <sub>90</sub> Dose J/m <sup>2</sup>	UV k m <sup>2</sup> /J	Base Pairs kb	Source
Coronavirus	7	0.35120	30741	Walker 2007 <sup>a</sup>
Berne virus (Coronaviridae)	7	0.32100	28480	Weiss 1986
Murine Coronavirus (MHV)	15	0.15351	31335	Hirano 1978
Canine Coronavirus (CCV)	29	0.08079	29278	Saknimit 1988 <sup>b</sup>
Murine Coronavirus (MHV)	29	0.08079	31335	Saknimit 1988 <sup>b</sup>
SARS Coronavirus CoV-P9	40	0.05750	29829	Duan 2003 <sup>c</sup>
Murine Coronavirus (MHV)	103	0.02240	31335	Liu 2003
SARS Coronavirus (Hanoi)	134	0.01720	29751	Kariwa 2004 <sup>d</sup>
SARS Coronavirus (Urbani)	2410	0.00096	29751	Damell 2004
<b>Average</b>	<b>308</b>	<b>0.00747</b>	including all studies	
<b>Average excluding outliers</b>	<b>58</b>	<b>0.03960</b>	excluding Walker, Weiss & Damell	

<sup>a</sup> (Jingwen 2020)    <sup>b</sup> (estimated)    <sup>c</sup> (mean estimate)    <sup>d</sup> (at 3 logs)

Table 2: Performance of the FMUV System against Bacteria and Vegetative Fungi

Bacteria (Yellow) or Vegetative Fungi (Green)	D90 J/m <sup>2</sup>	Survival (CFU) at Exposure Time, seconds						
		0	5	15	30	60	90	120
Multidrug-resistant <i>Pseudomonas aeruginosa</i>	26	1500	400	0				
Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA)	40	8200	1900	0				
ESBL-producing <i>Escherichia coli</i>	26	18000	1000	10	0			
<i>Candida parapsilopsis</i>	98	2300	300	11	0			
Vancomycin-resistant <i>Enterococcus faecium</i> (VRE)*	120	1800	800	100	0			
<i>Fusarium solani</i>	313	1700	1100	300	0			
Carbapenemase-resistant <i>Klebsiella pneumoniae</i> (KPC)	52	7200	2100	28	4	0		
<i>Acinetobacter baumannii</i>	18	4200	1900	38	10	0		
<i>Candida albicans</i>	374	3000	2800	700	32	0		
<i>Clostridioides (Clostridium) difficile</i>	38	2800	2600	1000	20	0		
<i>Aspergillus fumigatus</i>	560	2700	2700	2200	1200	100	10	0

### Reference :

1. Wladyslaw J. Kowalski, Thomas J Walsh, Vidmantas Petraitis. (2020.3). 2020 COVID-19 Coronavirus Ultraviolet Susceptibility. ResearchGate

### Reference Link :

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[https://www.researchgate.net/publication/339887436\\_2020\\_COVID\\_19\\_Coronavirus\\_Ultraviolet\\_Susceptibility](https://www.researchgate.net/publication/339887436_2020_COVID_19_Coronavirus_Ultraviolet_Susceptibility)