Ocean Optics, Inc.
Calibration Laboratories located in:
Winter Park, Florida, USA
Ostfildern, Germany

Certificate of Radiometric Calibration

Certificate Number: 18732
Date: 8/6/2015

Calibration Performed By:

OOI WINTER PARK
4301 METRIC DRIVE
WINTER PARK, FL 32792

For:

LEMNATEC CORP
C/O UNIVERSITY OF ARIZONA
MARICOPA, AZ, 85238, US

Calibrated Equipment Information

Description:	SPECTROMETER, VIS
Model Number:	STS-VIS-L-50-400-SMA
Serial Number:	S05673
Nomenclature:	STS-VIS-L-50-400-SMA
Temp. [°F] / RH [%]:	73 / 56
Cal. Interval:	12 MONTHS
Cal Date [MM/DD/YYYY]:	8/6/2015
Cal. Due Date:	8/6/2016

Manufacturer:	OCEAN OPTICS INC.
Performed By:	BERNARDA CYGAN
Signature:	
Calibration Result:	PASS

The calibration values in units [uJoule/counts] are stored on CD provided with this certificate.
As Found and As Left data are the same unless indicated otherwise in Calibration Notes

Calibration Notes

Calibrated System Configuration: STS-VIS-L-50-400-SMA S/N:S05673 with OCF-101543 and CC-3-UV-T
Calibration voided if fiber and/or cosine corrector is removed.

Standards Used To Calibrate Equipment

ID	Model Number	Description	Last Cal.	Cal. Due Date
11066045	TH803	TEMPERATURE / HUMIDITY RECORDER	8/21/2014	8/21/2015
12221337	OL 83A	PROGRAMMABLE DC CURRENT SOURCE	9/19/2014	9/19/2015
665	68840	POWER SUPPLY, DEUTERIUM	2/11/2015	2/11/2016
AS012494	953.46317178	CALIPER, VERNIER, 24 INCH	9/25/2013	9/25/2015
CH6907	63345	STANDARD LAMP, DEUTERIUM, CATHODEON R48	6/2/2015	
F-1312	OL FEL-C	STANDARD OF SPECTRAL IRRADIANCE, 1000W C	4/30/2015	

Procedures Used In This Event

Procedure	Title	Revision	Revision Date
MET.009	CAL OF SPECTROMETERS	5	8/2/2013

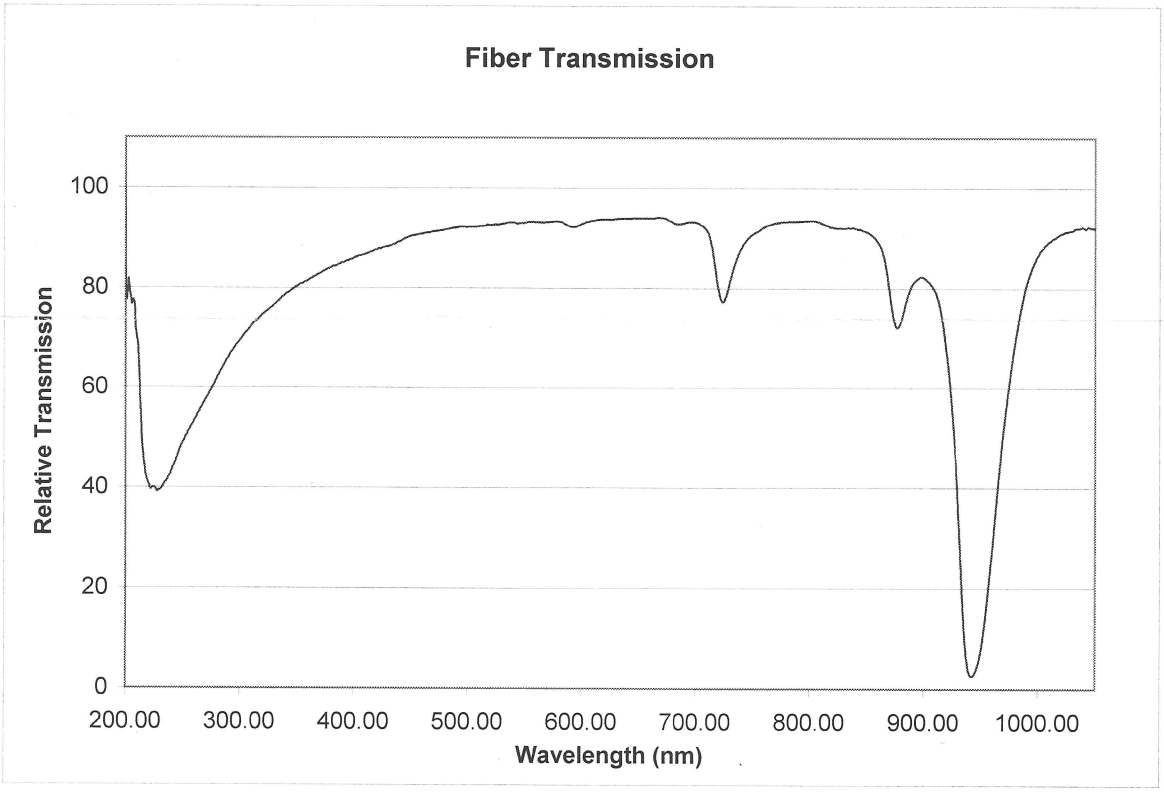
Ocean Optics Inc. is an ISO9001:2008 certified company. All radiometric calibrations were performed in compliance with National Institute of Standards & Technology practices recommended in NIST Handbook 150-2E, Technical Guide for Optical Radiation Measurements. All standards used are traceable to the National Institute of Standards & Technology; or an equivalent national organization, if the standard was calibrated outside the US; or have been derived from accepted values of naturally occurring physical constants. Ocean Optics Inc. responsibilities shall in no event, nor for cause whatsoever exceed the cost of the service represented. This report applies only to the item(s) identified above, at the time of calibration. This report shall not be reproduced, except in full, without written permission from Ocean Optics Inc.

Part #:	OCF-101543
Date:	**July 5, 2015**
Assembly #:	EOS-A657528
Connector 1 #:	QSMA
Connector 2 #:	QSMA
Sales Order #	657528

www.OceanOptics.com
Phone:727-733-2447
Fax:727-733-3962
Info@OceanOptics.com
830 Douglas Ave
Dunedin, FL 34698

Ask about our custom line of Optical Probes and Assemblies.

Fiber Type:	UV-VIS	**Jacketing:**	BX
Fiber Core Diameter:(um)	400um	**Length (meters):**	10.00



Inspection Checklist X
Polish: X
Concentricity: X
Cap Placement: X
Labeling: X
Color Coding: X
Ferrule length: X

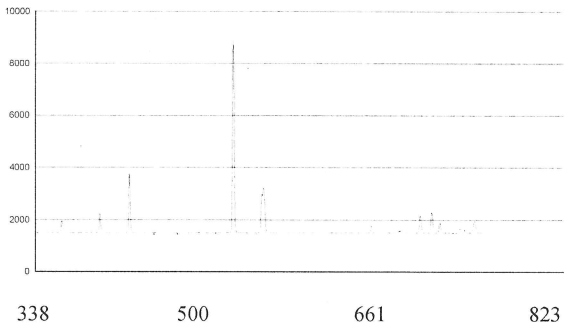
Tested by: Dan Foster

Inspected by: Dan Foster

Your Fiber was tested for performance prior to shipment. Please check your Fiber for breakage upon receipt. Ocean Optics will replace under warranty any broken Fiber returned within three weeks after customer receipt.

RoHS - Compliant

HG-1 Spectrum



Ocean Optics

Wavelength Calibration Data Sheet

Built for:
Order Number:
Model: **STS**
Grating: STS-VIS
Bandwidth: 338 - 823 nm
Options: DET-ELIS Detector, NoneLens, SLIT-50 Slit, 305 Filter,
Serial Number: **S05673**

λ	Pixel #	Predicted λ	Δλ
361.051	51	361.070	-0.019
365.015	60	365.035	-0.020
404.656	146	404.538	0.118
407.781	153	407.837	-0.056
435.834	213	435.787	0.047
467.816	282	467.811	0.005
479.992	308	480.049	-0.057
481.053	311	481.060	-0.007
508.582	369	508.679	-0.097
546.074	449	546.069	0.005
576.959	514	577.105	-0.146
585.249	531	585.327	-0.078
587.091	535	587.168	-0.077
594.483	551	594.476	0.007
614.306	592	614.327	-0.021
626.649	618	626.598	0.051
630.479	626	630.423	0.056
633.443	632	633.389	0.054
636.235	638	636.205	0.030
643.847	653	643.780	0.067
650.653	668	650.605	0.048
659.895	687	659.845	0.050
667.828	703	667.857	-0.029
671.704	711	671.740	-0.036
692.947	755	693.015	-0.068
696.543	763	696.545	-0.002
703.241	777	703.265	-0.023
706.722	784	706.718	0.004
717.394	806	717.350	0.044
724.516	820	724.569	-0.053
727.294	826	727.297	-0.003
738.398	849	738.380	0.018
743.890	860	743.947	-0.057
763.510	900	763.596	-0.086
772.421	918	772.475	-0.054
785.482	945	785.419	0.063
794.817	964	794.838	-0.021
811.531	998	811.432	0.099

This is a sample of calibration peaks used as there were more than can be shown on this page

Calibration Coefficients

First Coefficient:	0.4552871287
Second Coefficient:	2.07884e-005
Third Coefficient:	-1.15371e-009
Intercept:	337.70483398
Regression Fit:	0.9999990463

Stray Light Measurements (AU)

Holmium Oxide (444nm):	1.80
Yellow Dye:	3.46
Blue Dye:	2.75
Molybdate:	N/A
OG550 Filter:	3.39
RG850 Filter:	2.97
FG3 Filter:	1.31

Ruby Pena

Calibrated By: suong.johnson
Calibrated: 03-June-2015

Linearity Test

Serial Number **S05673**

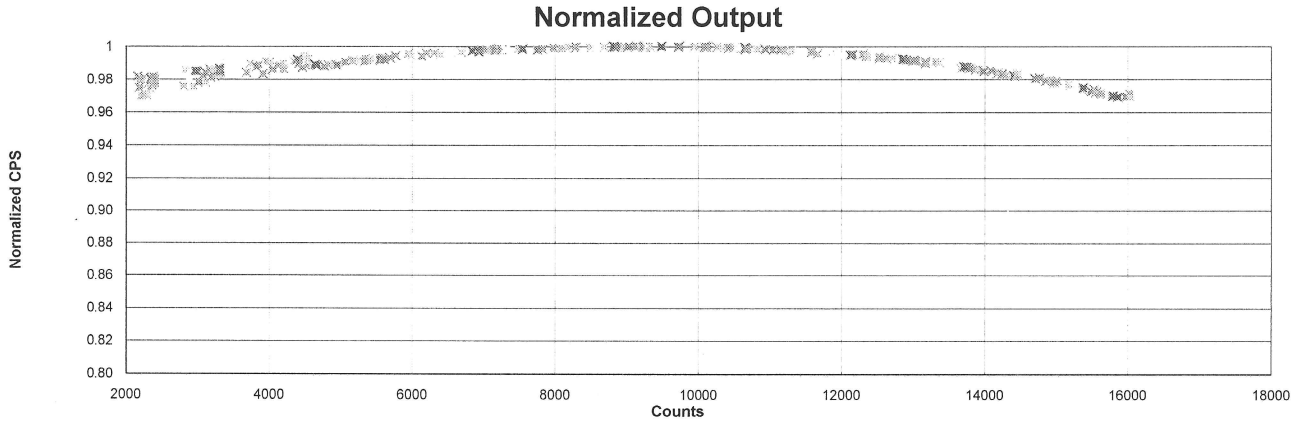
Tech: suong.johnson

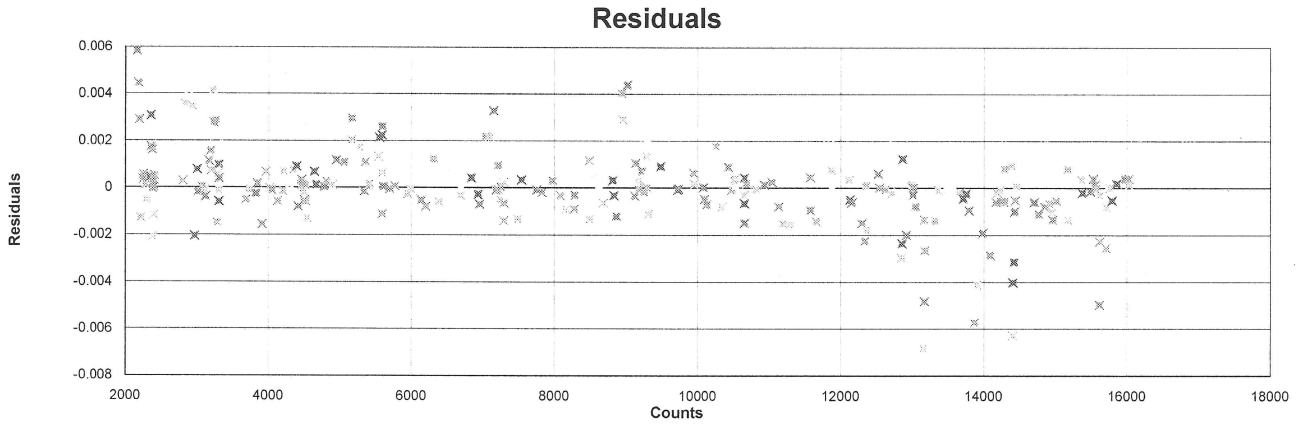
Linearity: **99.83524**

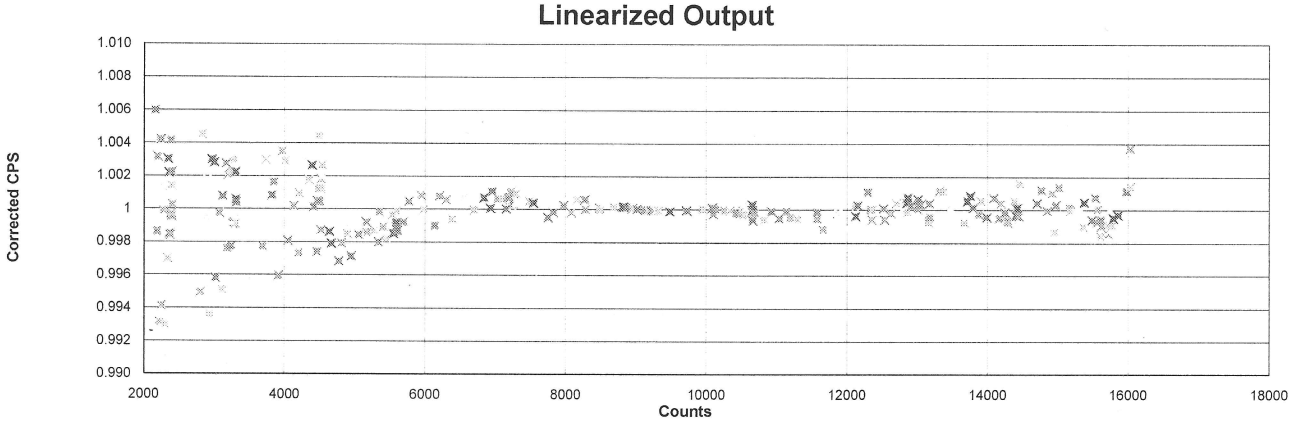
Tested: 6/3/15

Test # 125,865.00

Intercept	0.949207
Coefficient 1	1.56532e-005
Coefficient 2	-1.2123e-009
Coefficient 3	-2.99997e-013
Coefficient 4	8.5854e-017
Coefficient 5	-8.73692e-021
Coefficient 6	4.00488e-025
Coefficient 7	-6.99106e-030







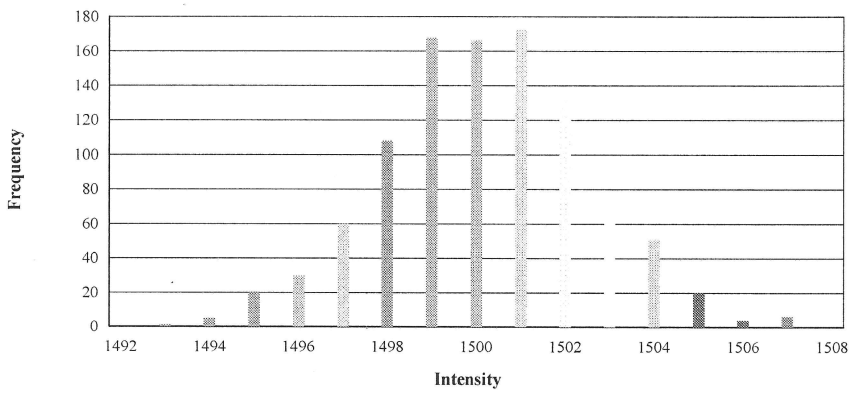
Max **1.00598633**

Min **0.99302107**

Signal Testing

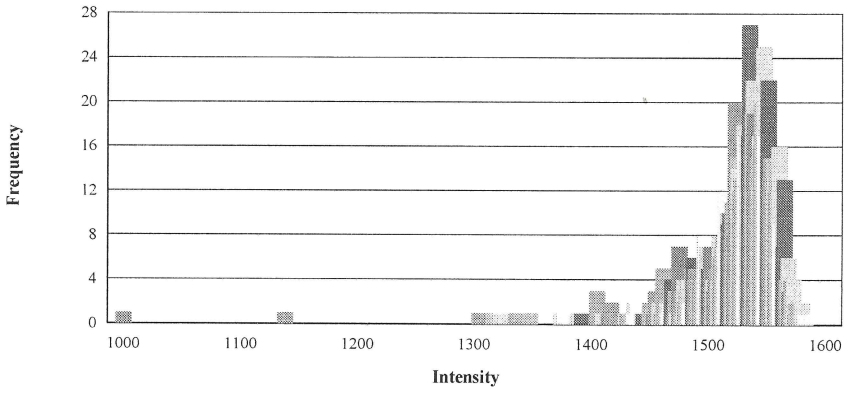
Serial	RMS	Median	Passed	Date	Scans	Time (ms)
S05673	2.31	1,500.00	True	6/3/15	20	1.00

Histogram of Dark Signal



Serial	RMS	Median	Passed	Date	Scans	Time (ms)
S05673	40.85	1,535.00	True	6/3/15	20	2,000.00

Histogram of Dark Signal

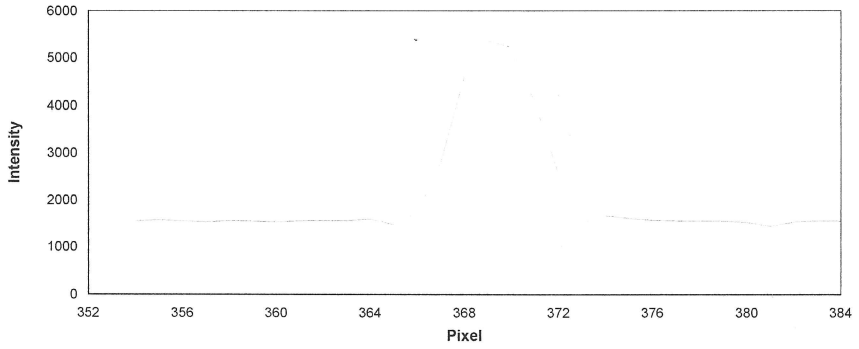


Hot Pixels

Pixel	Cts from Median	RMS
269	-524.17	4.48
322	-386.62	3.55
442	-218.87	2.19
577	-207.62	2.17

Resolution and Accuracy for S05673

Result	FWHM in Pixels	Delta	Wavelength	Peak Source	Date
Passed	4.06	0.09	508.58	Cd	6/3/15 3:29 pm



Result	FWHM in Pixels	Delta	Wavelength	Peak Source	Date
Passed	5.49	0.55	750.39	Ar	6/3/15 3:29 pm