AR-1 Argon Calibration Light Source

The AR-1 Argon Calibration Source is a wavelength calibration source for Ocean Optics NIR-256 and NIR-512 Spectrometers. The AR-1 produces Argon lines from 866-1705 nm, and is an ideal lamp to use when performing fast, accurate spectrometer wavelength calibrations in the NIR range.

The AR-1 features an SMA 905 Connector for interfacing with our optical fibers. It operates with a 12 VDC power supply (included with the unit) or 9V battery (not included).

The following sections detail the features of the AR-1 Argon Calibration Light Sources.

Note: The AR-1 is NOT designed to operate as an excitation source in your experiments.

Parts Included

The AR-1 ships with the following items:

- AR-1 Argon Calibration Light Source
- 12 VDC power supply

Warnings

- The SMA 905 Connector may get extremely hot during lamp operation. After use, allow sufficient time to cool before handling.
- Dangerous voltages are present, and there are no user-serviceable parts inside. Do not open the AR-1.

Using the AR-1

The following sections provide instructions on setting up the AR-1 light source and performing a wavelength calibration using the AR-1:

Configuring the AR-1

Follow the steps below to configure the AR-1:

1. Plug the 12 VDC power supply into a power outlet, then connect the barrel connector of the power supply to the power input on the rear of the AR-1.

   Alternately, you can use a 9-volt battery (not included) to power the AR-1. Open the battery hatch of the AR-1 and install the 9-volt battery, then proceed to Step 2.
2. Connect a fiber to the SMA 905 Connector on the AR-1. If your spectrometer does not have an entrance slit, use a 50 µm diameter (or smaller) fiber. Larger fibers and slits result in reduced optical resolution.

   Please note that if the spectrometer does not have a slit and your experiment requires you to use fibers of varying diameters, you will need to perform a wavelength calibration. You should also perform a wavelength calibration each time you unscrew the fiber from the spectrometer.
3. Move the On/Off switch on the AR-1 (next to the SMA 905 Connector) to the On position. The red LED will illuminate to indicate that the AR-1 is powered on.

You have now configured the AR-1 for use. Proceed to the next section for wavelength calibration instructions.

Performing a Wavelength Calibration

Follow the instructions below to perform a wavelength calibration on your spectrometer using the AR-1:

About the Wavelength Calibration

You are going to be solving the following equation, which shows that the relationship between pixel number and wavelength is a second-order polynomial…

$$\lambda_p = I + C_1 p + C_2 p^2$$

...where λ is the wavelength of pixel p, I is the wavelength of pixel 0, C_1 is the first coefficient (nm/pixel), C_2 is the second coefficient (nm/pixel^2). You will be calculating the value for I and the two Cs.

Calibration Requirements

To re-calibrate the wavelength of your spectrometer using the AR-1, you will need the following items:

- An AR-1 Argon Calibration Light Source
- An Ocean Optics NIR256 or NIR512 Spectrometer
- An optical fiber
- A spreadsheet program (Excel or Quattro Pro, for example) or a calculator that performs third-order linear regressions

Note: If you are using Microsoft Excel, choose **Tools | Add-Ins** and check **AnalysisToolPak** and **AnalysisTookPak-VBA**

Calibrating the Wavelength of the Spectrometer

Perform the steps below to calibrate the wavelength of the spectrometer:

1. Place OOIBase32 into **Scope Mode** and take a spectrum of the AR-1. Adjust the integration time (or the A/D conversion frequency) until there are several peaks on the screen that are not off-scale.
2. Move the cursor to one of the peaks and position the cursor so that it is at the point of maximum intensity.
3. Record the pixel number that is displayed in the status bar or legend (located beneath the graph). Repeat this step for all of the peaks in your spectrum.
4. Use the spreadsheet program or calculator to create a table like the one shown on the next page.

   In the first column, place the exact or true wavelength of the spectral lines that you used. In the second column, place the observed pixel number. In the third column, calculate the pixel number squared. In the fourth column, calculate the pixel number cubed.

   (Continued)

Independent Variable → True Wavelength (nm)

Dependent Variables → Pixel #, Pixel # ^{2}

Values Computed from the Regression Output → Predicted Wavelength, Difference

True Wavelength (nm)	Pixel #	Pixel # ^{2}	Predicted Wavelength	Difference
253.65	105	11025	253.516577	0.133422619
296.73	179	32041	296.979662	-0.249662049
302.15	188	35344	302.220703	-0.070702657
313.16	206	42436	312.6735	0.486499891
334.15	243	59049	334.037188	0.112812248
365.01	298	88804	365.489132	-0.479132164
404.66	368	135424	404.991651	-0.331651335
435.84	423	178929	435.615094	0.224905808
546.08	626	391876	545.48766	0.592339659
696.54	921	848241	696.302678	0.237321917
706.72	942	887364	706.638812	0.081187518
727.29	984	968256	727.151647	0.138352544
738.40	1007	1014049	738.294786	0.105214107
750.39	1033	1067089	750.814613	-0.424612735

5. Use the spreadsheet or calculator to calculate the wavelength calibration coefficients. In the spreadsheet program, find the functions to perform linear regressions.
    - If using Quattro Pro, look under **Tools | Advanced Math**
    - If using Excel, look under **Analysis ToolPak**
6. Select the true wavelength as the dependent variable (Y). Select the pixel number and the pixel number squared as the independent variables (X). After executing the regression, you will obtain an output similar to the one shown below.

Regression Statistics	
Multiple R	0.999999831
R Square	0.999999663
Adjusted R Square	0.999999607
Standard Error	0.125540214
Observations	22

(Continued)

Intercept

	Coefficients	Standard Error
Intercept	190.473993	0.369047536
X Variable 1	0.36263983	0.001684745
X Variable 2	-1.174416E-05	8.35279E-07

First coefficient

Second Coefficient

The figure above notes the numbers of importance.

7. Record the Intercept, as well as the First and Second coefficients. Additionally, look at the value for R squared. It should be very close to 1. If not, you have most likely assigned one of your wavelengths incorrectly.

8. Repeat this process for each channel in your spectrometer system.

AR-1 Specifications

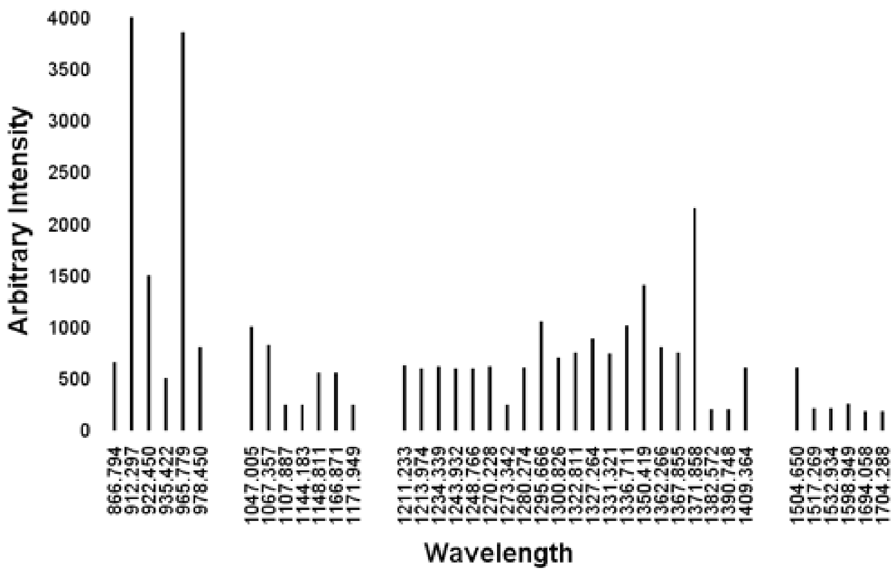
The following sections detail the specifications of the AR-1:

Spectral Output of the AR-1

The list below identifies the most prominent argon peaks. These lines are shown in the graphic on the following page (on an exaggerated amplitude scale):

Argon Peaks

866.794	1280.274
912.297	1295.666
922.450	1300.826
935.422	1322.811
965.779	1327.264
978.450	1331.321
1047.005	1336.711
1067.357	1350.419
1107.887	1362.266
1144.183	1367.855
1148.811	1371.858
1166.871	1382.572
1171.949	1390.748
1211.233	1409.364
1213.974	1504.650
1234.339	1517.269
1243.932	1532.934
1248.766	1598.949
1270.228	1694.058
1273.342	1704.288



AR-1 Specifications

Output	Low-pressure gas discharge lines of Argon
Dimensions (in mm):	125.7 x 70 x 25.8
Power consumption:	250 mA at 12 VDC
Power requirements:	12 VDC wall transformer (included) or 9 VDC battery (optional)
Bulb life:	Approx. 3500 hours (at 20 mA)
Internal voltage:	600 volts at 30 kHz
Aperture:	3 mm
Amplitude stabilization:	~ 1 minute
Connector:	SMA 905