OceanOptics

Wavelength Calibration Light Source

For Products: AR-2, HG-2, KR-2, NE-2, XE-2

Installation and Operation Manual

Document: 27-MNL-WCS-2
Version: 1.0

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Table of Contents

About This Manual

Document Purpose and Intended Audience

This document provides you with an installation section to get your system up and running and basic information about the calibration light source.

Document Summary

Chapter	Description
Chapter 1: **Overview**	Contains a list of package contents and unpacking instructions. Also describes the components on the front and back face of the unit.
Chapter 2: **Specifications**	Contains operating environment specifications, as well as other physical details of the products.
Chapter 3: **Operating Instructions**	Provides instructions for operating the wavelength calibration unit and basic calibration information
Chapter 4: **Troubleshooting and Maintenance**	Describes LED status information

Product-Related Documentation

You can access documentation for Ocean Optics products by visiting our website at **http://www.oceanoptics.com**. Select *Support* → *Documents*, then choose the appropriate document from the available drop-down lists.

Ocean Optics offers a Glossary of spectroscopy terms to help you further understand your state-of-the-art products and how they function, located at: **http://oceanoptics.com/glossary/**.

- Detailed instructions for OceanView Spectrometer Operating Software is located at: **https://www.oceanoptics.com/resources/product-manuals**

Upgrades

Occasionally, you may find that you need Ocean Optics to make a change or an upgrade to your system. To facilitate these changes, you must first contact Customer Support and obtain a Return Merchandise Authorization (RMA) number.

Important Safety Notices

1. The HG-2 assembly emits UV light. Always were UV safe goggles if and when exposed to its light.
2. Do not remove or modify any installed safety device on this equipment. Doing so will void your warranty and create an unsafe operating environment.
3. Dangerous voltages are present in this device. There are NO user serviceable parts inside.
4. Only allow qualified personnel to operate this unit.
5. Do not use the unit if it is damaged in any way. Contact your dealer for repair or replacement information.
6. Always screw in the fiber optic cables before starting the instrument.

WARNING

Protective eyewear **must** be worn when using this equipment.
Never look directly into the light beam, as this can cause eye damage.

The HG-2 assembly emits UV light. Always were UV safe goggles if and when exposed to its light.

This device is designed with safety features. Use of equipment in a manner not specified by Ocean Optics may compromise the protection provided by the equipment.

Light sources contain mercury. Contact supplier to replace bulbs; user should not attempt to replace bulbs.

Warranty

Light Source products are covered by Ocean Optics Exclusive Three Year Warranty. However, there are no warranties for the bulbs.

For details, please visit the following webpage:

https://www.oceanoptics.com/standards-policies/warranty/

This instrument should not be used for any Clinical or Diagnostic purposes. Data generated in these areas is not warranted in any way by Ocean Optics, Inc.

Certifications and Compliance

ISO CERTIFICATION

Ocean Optics, the industry leader in miniature photonics, has been certified for ISO 9001:2015 applicable to the design and manufacture of electro-optical equipment since 2009.

WEEE COMPLIANCE

The WEEE symbol on the product indicates that the product must not be disposed of with normal household waste. Instead, such marked waste equipment must be disposed of by arranging to return to a designated collection point for the recycling of waste electrical and electronic equipment. Separating and recycling this waste equipment at the time of disposal will help to conserve natural resources and ensure that the equipment is recycled in a manner that protects human health and the environment.

This device has been tested and complies with the following standards:

Electrical Safety and Mechanical Safety:
CAN/CSA C22.2 No 61010-1:2012
UL 61010-1:2012
EN 61010-1:2010

Emissions:
EN55011: 2009/A1:2010 Group 1, Class A
FCC Part 15 Class A
Per ANSI C63:4:2003) Verification

Immunity:
EN 613126-1:2013 (Electrical equipment for measurement, control and laboratory use – EMC Requirements – Part 1L General Requirements)
CISPR 11:2009/A1:2010 (Industrial, scientific and medical equipment Radio-frequency disturbance characteristics - Limits and methods of measurement)
IEC 61000-4-2:2008 / EN 61000-4-2:2009 (Electrostatic Discharge Immunity Test)
IEC 61000-4-3:2006 / EN 61000-4-3:2006/A1:2008/A2:2010 (Radiated, radio-frequency, electromagnetic field immunity test)
IEC 61000-4-4:2012 / EN 61000-4-4:2012 (Electrical Fast Transient/ Burst immunity test)
IEC 61000-4-5:2005 / EN 61000-4-5:2006 (Surge Immunity test)
IEC 61000-4-6:2008 / EN 61000-4-6: 2009 (Immunity to conducted disturbances, induced by radio-frequency fields)
IEC 61000-4-11:2004 / EN 61000-4-11:2004 (Voltage dips, short interruptions and voltage variations immunity tests)

FCC AND INDUSTRY CANADA COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules and Industry Canada ICES003. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense.

Chapter 1

Overview

The Wavelength Calibration Light Source units offer wavelength calibration for UV to NIR spectrophotometric systems. Element calibration is ideal for performing fast, accurate spectrometer wavelength calibrations.

Each member of the product line produces distinct lines for calibration as shown below.

Product	Type	Wavelength Range
AR-2	Argon	696 – 1704 nm
HG-2	Mercury Argon	253 – 1700 nm
KR-2	Krypton	427 – 893 nm
NE-2	Neon	540 – 754 nm
XE-2	Xenon	916 – 1984 nm

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Wavelength Calibration Light Source Unit

The Wavelength Calibration units feature an SMA 905 Connector for interfacing with our optical fibers. It operates via a 5 VDC power supply (included with the unit).

The following sections provide instructions on unpacking and setting up your Wavelength Calibration Light Source.

Unpacking the Light Source

► ***Procedure***

1. Unpack your lamp assembly and power supply carefully. Although the lamp is rigidly mounted, dropping this instrument can cause permanent damage.
2. Inspect the outside of the instrument and make sure that there is no damage. Do not use the instrument if damage is present.
3. Use this instrument in a clean laboratory environment

Contents

Your Light Source package should contain the following:

- ❑ Wavelength Calibration Light Source unit
- ❑ Power Supply and region-specific plugs
- ❑ Cable assembly, Wavelength Calibration External Control

Additional Accessories

The following are additional accessories available from Ocean Optics that you may need, depending on your system set-up:

- ❑ Spectrometer
- ❑ SMA-terminated optical fiber
- ❑ Wavelength Calibration Cuvette Holder Adapter
- ❑ Ocean Optics software

WARNING

The beam emerging from the HG-2 light source contains UV radiation that can cause serious eye injury upon direct contact with the eye. Never look directly into the light source.

Dangerous voltages are present, and there are no user-serviceable parts inside. Never open the unit.

Components

The following sections describe the components located on the front and rear of your Wavelength Calibration unit.

Front Panel

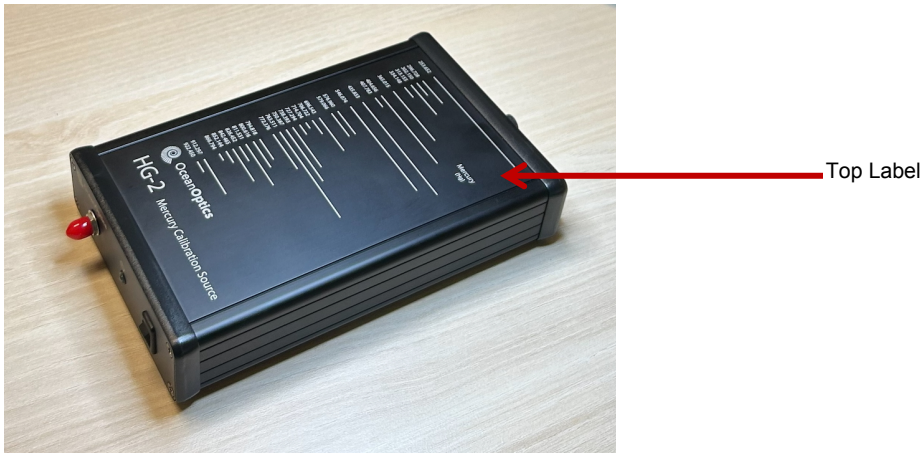
Component	Description
SMA Connector	Covered to protect users from unintentionally looking directly at the beam of light. Connect the fiber cable to the unit **BEFORE** turning the lamp on to avoid unnecessary exposure to radiation. Always wear proper eye protection when using the lamp.
Green LED	Lamp is on
On/Off Switch	Turn lamp on/off

Rear Panel

Component	Description
Input terminal for Remote Enable	Connector for remote enable cable. A signal of 2.5 to 5VDC applied to the yellow wire of the trigger cable will enable the lamp, equivalent to engaging the On/OFF switch. Current draw is: 2.5mA @ 2.5V, 3.9mA @ 3.3V and 8.1mA @ 5.0V. This signal is optically isolated from the chassis ground.
Input Terminal for Power Cord	Plug power cord into this terminal. **Note:** Only connect the power cable to the lamp when the Main Power Switch is in the OFF position. THE INSTRUMENT MUST BE CONNECTED TO A GROUNDED (EARTHED) OUTLET

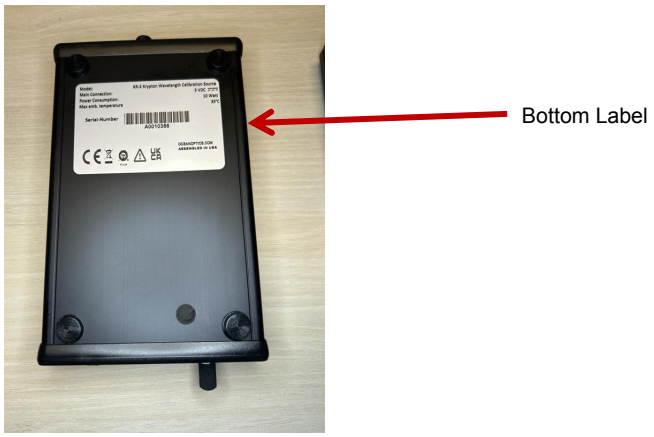
Top Panel

The label on the top of the device provides a quick reference for the strongest emission peaks for the device. Refer to the **Specifications** section of this document for a more complete listing of the emission peaks for each of the devices (AR-2, HG-2, KR-2, NE-2 and XE-2).



Bottom Panel

The bottom panel contains a label providing information regarding the specific device.



Unit Label	Description
Model Number	Identifies the device as a: AR-2 Argon HG-2 Mercury Argon KR-2 Krypton NE-2 Neon XE-2 Xenon Wavelength Calibration Source
Input connection	5 VDC. Through output of certified external plug-in power supply
Power consumption	10 Watts
Max. ambient temperature	35°C
Serial number	Includes both a barcode and a numeric display of the device serial number
Environmental operating conditions	For indoor use only Pollution Degree: 2 Overvoltage Category: I Maximum operating altitude: Up to 2000m

Chapter 2

Specifications

This section provides information on unit specifications, operating environment, and parts list for the Wavelength Calibration light sources.

Unit Specifications

Dimensions (in mm):	102mm(W) x 166mm(D) x 30mm(H)
Power consumption:	2A max at 5 VDC
Power requirements:	5 VDC Through output of certified external plug-in power supply
Bulb life:	Typical 3500 hours
Aperture:	3 mm
Amplitude stabilization:	~ 1 minute
Optical Connector:	SMA 905
Remote Enable Connector:	2 pin connector for attaching remote enable cable.

Operating Environment

The following table provides information on optimizing the operating environment of your calibration light source.

Moisture	5-95% without condensation
Altitude	< 2000m
Ventilation	Unit should be situated so that its location or position does not interfere with proper ventilation.
Temperature	5°C – 35°C. Unit should be situated away from any device that emits excessive heat.
Object and Liquid Entry	Unit should be positioned so that objects do not fall on top of the unit. Additionally, ensure that no liquids are spilled onto the enclosure.

Parts List

Part Number	Description
AR-2	Argon Wavelength Calibration Light Source
HG-2	Mercury Argon Wavelength Calibration Light Source
KR-2	Krypton Wavelength Calibration Light Source
NE-2	Neon Wavelength Calibration Light Source
XE-2	Xenon Wavelength Calibration Light Source
WC-CABLE	Remote enable cable

Strong Emission Lines by Wavelength (nm) For All Units

The following table is a composite of strong emission lines for all of the Wavelength Calibration Light Sources.

253.652	Hg
296.728	Hg
302.150	Hg
313.155	Hg
334.148	Hg
341.790	Ne
342.391	Ne
344.770	Ne
345.076	Ne
345.419	Ne
346.052	Ne
346.658	Ne
347.257	Ne
349.806	Ne
350.121	Ne
351.519	Ne
352.047	Ne
359.353	Ne
360.017	Ne
363.366	Ne
365.015	Hg
368.573	Ne
370.122	Ne
404.656	Hg
407.783	Hg
427.397	Kr
428.297	Kr
431.958	Kr
435.833	Hg
436.264	Kr
437.612	Kr
439.997	Kr
445.392	Kr

446.369	Kr
450.235	Kr
452.186	Xe
462.420	Xe
466.849	Xe
469.097	Xe
469.804	Xe
473.415	Xe
479.262	Xe
480.702	Xe
482.971	Xe
484.329	Xe
491.651	Xe
492.315	Xe
503.135	Ne
503.775	Ne
508.038	Ne
511.367	Ne
511.650	Ne
540.056	Ne
546.074	Hg
556.222	Kr
557.029	Kr
576.441	Ne
576.960	Hg
579.066	Hg
582.015	Ne
585.249	Ne
587.096	Kr
588.189	Ne
594.483	Ne
597.553	Ne
603.00	Ne

607.433	Ne
609.616	Ne
612.884	Ne
614.306	Ne
616.359	Ne
621.728	Ne
626.649	Ne
630.479	Ne
633.442	Ne
638.299	Ne
640.225	Ne
650.653	Ne
653.288	Ne
659.895	Ne
667.828	Ne
671.704	Ne
692.947	Ne
696.543	Ar (Hg)
703.241	Ne
706.722	Ar (Hg)
714.704	Ar (Hg)
717.394	Ne
724.512	Ne
727.294	Ar (Hg)
733.930	Xe
738.398	Ar (Hg)
738.600	Xe
739.379	Xe
740.040	Xe
743.890	Ne
747.244	Ne
748.887	Ne
750.387	Ar (Hg)

753.577	Ne
754.404	Ne
755.979	Xe
758.468	Xe
758.741	Kr
760.155	Kr
763.511	Ar (Hg)
764.391	Xe
768.525	Kr
769.454	Kr
772.376	Ar (Hg)
780.265	Xe
785.482	Kr
788.132	Xe
791.343	Kr
794.818	Ar (Hg)
796.734	Xe
800.616	Ar (Hg)
805.726	Xe
805.950	Kr
806.134	Xe
810.436	Kr
811.531	Ar (Hg)
819.006	Kr
823.163	Xe
826.324	Kr
826.452	Ar (Hg)
826.652	Xe
829.811	Kr
837.761	Ne
842.465	Ar (Hg)
849.536	Ne
852.144	Ar (Hg)
866.794	Ar (Hg)
877.675	Kr
878.375	Ne
881.941	Xe
892.869	Kr

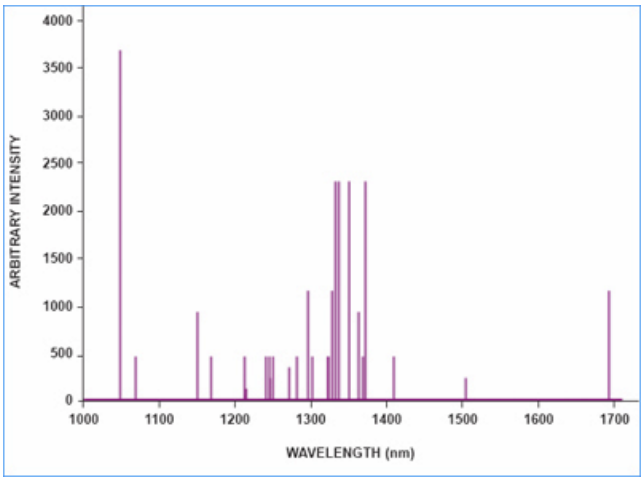
904.545	Xe
912.297	Ar (Hg)
916.265	Xe
922.450	Ar (Hg)
935.422	Ar
965.779	Ar
978.450	Ar
979.970	Xe
992.319	Xe
1047.005	Ar
1067.357	Ar
1083.837	Xe
1107.887	Ar
1117.752	Ne
1144.183	Ar
1148.811	Ar
1152.275	Ne
1166.871	Ar
1171.949	Ar
1181.938	Kr
1211.233	Ar
1213.974	Ar
1220.353	Kr
1234.339	Ar
1243.932	Ar
1248.766	Ar
1262.339	Xe
1270.228	Ar
1273.342	Ar
1280.274	Ar
1295.666	Ar
1300.826	Ar
1317.741	Kr
1322.811	Ar
1327.264	Ar
1331.321	Ar
1336.711	Ar
1350.419	Ar

1363.422	Kr
1365.706	Xe
1367.855	Ar
1371.858	Ar
1382.572	Ar
1390.748	Ar
1409.364	Ar
1414.244	Xe
1442.679	Kr
1473.281	Xe
1473.444	Kr
1504.650	Ar
1517.269	Ar
1520.310	Kr
1532.934	Ar
1537.204	Kr
1541.839	Xe
1598.949	Ar
1605.328	Xe
1620.872	Kr*
1647.290	Xe
1656.023	Xe
1672.815	Xe
1689.676	Kr
1694.058	Ar
1755.350	Kr
1763.882	Xe
1785.738	Kr
1790.450	Xe
1800.223	Kr
1809.090	Xe
1816.733	Kr
1832.530	Xe
1959.940	Xe
1984.638	Xe
2190.851	Kr

AR-2 Specifications

The following sections detail the specifications of the AR-2 Argon Wavelength Calibration Light Source.

AR Spectral Output



Strong AR Emission Lines by Wavelength (nm)

There are more argon emission lines than those printed on the label on the AR-2 housing. The label is intended as a quick, convenient reference and does not list every AR emission line that exists. Wavelengths displayed in blue are listed on the calibration lamp's label.

866.794
912.297
922.450
935.422
965.779
978.450
1047.005
1067.357
1107.887
1144.183
1148.811
1166.871
1171.949

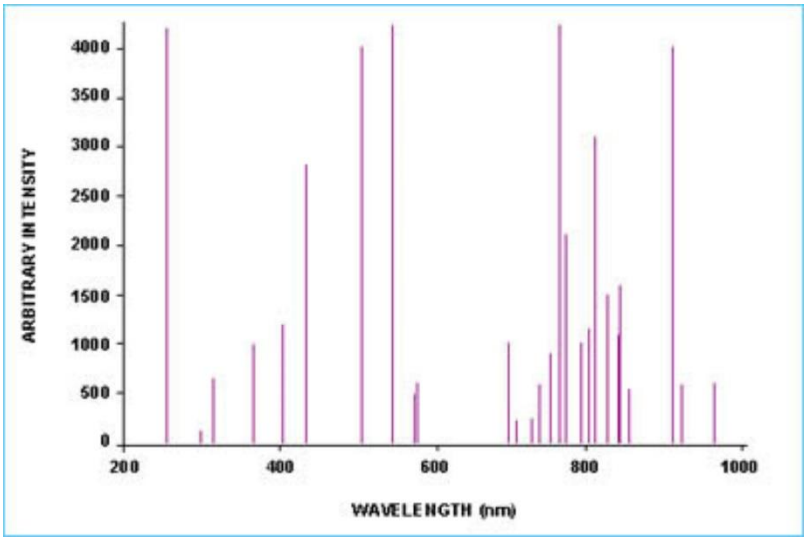
1211.233
1213.974
1234.339
1243.932
1248.766
1270.228
1273.342
1280.274
1295.666
1300.826
1322.811
1327.264
1331.321

1336.711
1350.419
1362.266
1367.855
1371.858
1382.572
1390.748
1409.364
1504.650
1517.269
1532.934
1598.949
1694.058

HG-2 Specifications

The following sections detail the specifications of the HG-2 Mercury Argon Wavelength Calibration Light Source.

HG Spectral Output



Mercury emission lines are <600 nm. Argon emission lines are >600 nm, and are shown here on an exaggerated amplitude scale.

Strong Hg Emission Lines by Wavelength (nm)

There are more mercury emission lines than those printed on the label on the HG-2 housing. The label is intended as a quick, convenient reference and does not list every HG emission line that exists. Wavelengths displayed in blue are listed on the calibration lamp's label.

253.652
296.728
302.150
313.155
334.148
365.015

404.656
407.783 *
435.833
546.074 **
576.960
579.066

* This spectral line is not evident with spectrometers configured with 300 or 600 lines/mm gratings.

** Spectrometers with 1200, 1800, 2400 or 3600 lines/mm gratings have spectral lines evident at 576.96 nm and 579.07 nm.

Strong Ar Emission Lines by Wavelength (nm)

696.543
706.722
714.704
727.294
738.398
750.387

763.511
772.376
794.818
800.616 *
811.531
826.452

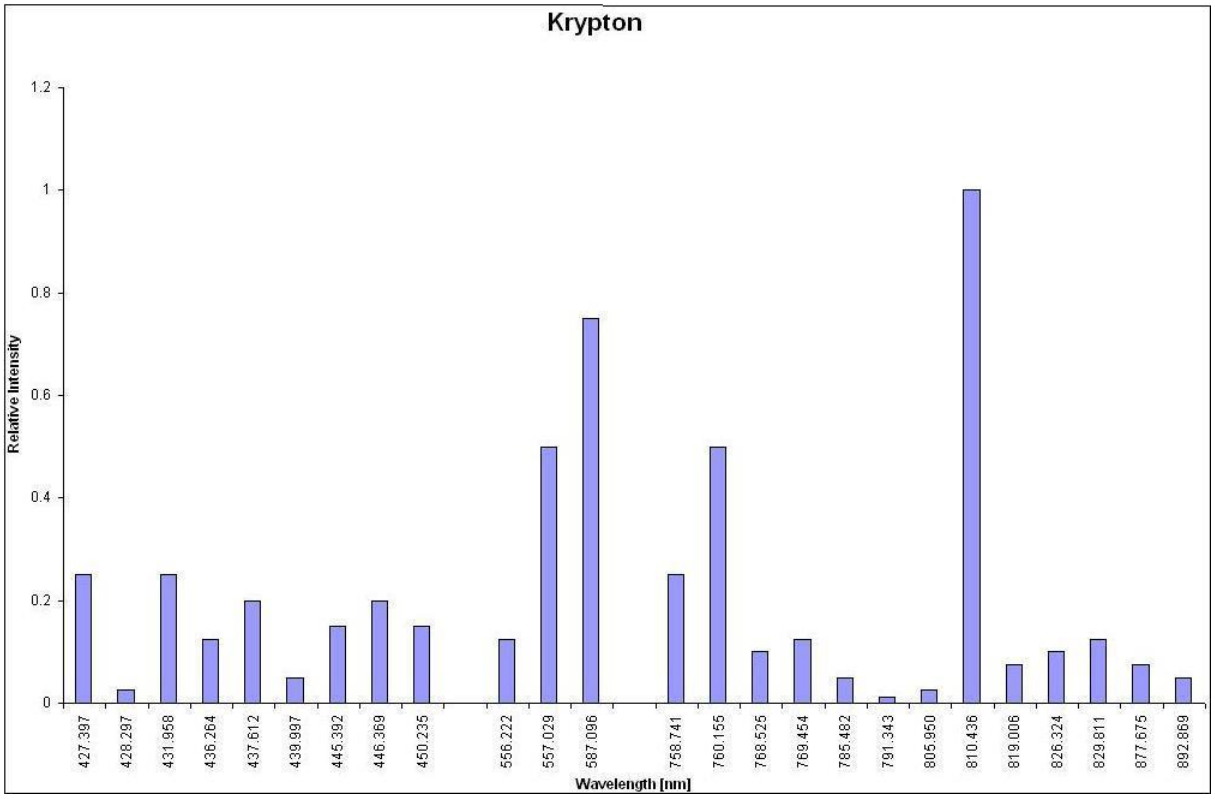
842.465
852.144
866.794
912.297
922.450

* This spectral line is evident only with spectrometers configured with 1800, 2400, or 3600 lines/mm gratings.

KR-2 Specifications

The following sections detail the specifications of the krypton KR-2 Krypton Wavelength Calibration Light source.

KR Spectral Output



Strong KR Emission Lines by Wavelength (nm)

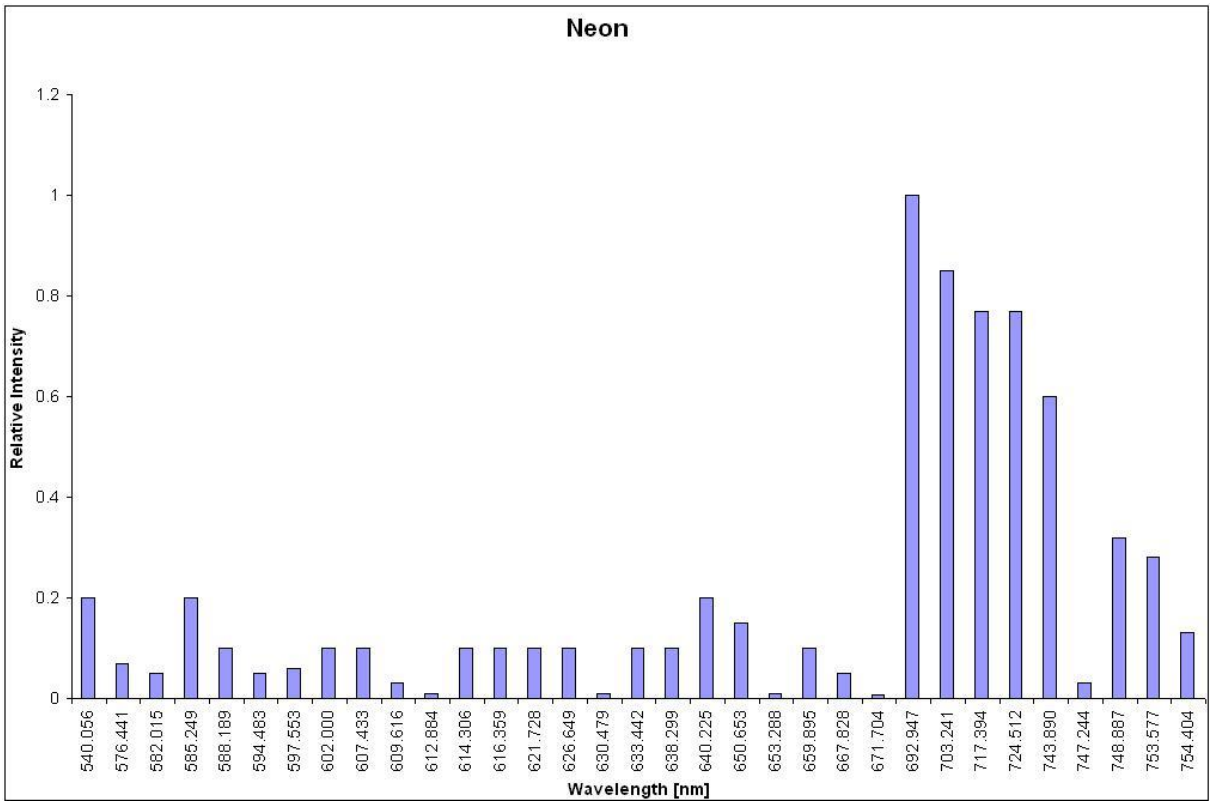
There are more emission lines shown below than printed on the label on the KR-2 housing. The label is intended as a quick, convenient reference and does not list every KR emission line that exists. Below is a list of wavelengths for Krypton. Wavelengths displayed in blue are listed on the calibration lamp's label.

427.397	**768.525**	1363.422
428.297	**769.454**	1442.679
431.958	**785.482**	1473.444
436.264	**791.343**	1520.310
437.612	**805.950**	1537.204
439.997	**810.436**	1620.872
445.392	**819.006**	1689.676
446.369	**826.324**	1755.350
450.235	**829.811**	1785.738
556.222	**877.675**	1800.223
557.029	**892.869**	1816.733
587.096	1181.938	2190.851
758.741	1220.353	
760.155	1317.741	

NE-2 Specifications

The following sections detail the specifications of the NE-2 neon calibration light source.

NE Spectral Output



Strong NE Emission Lines by Wavelength (nm)

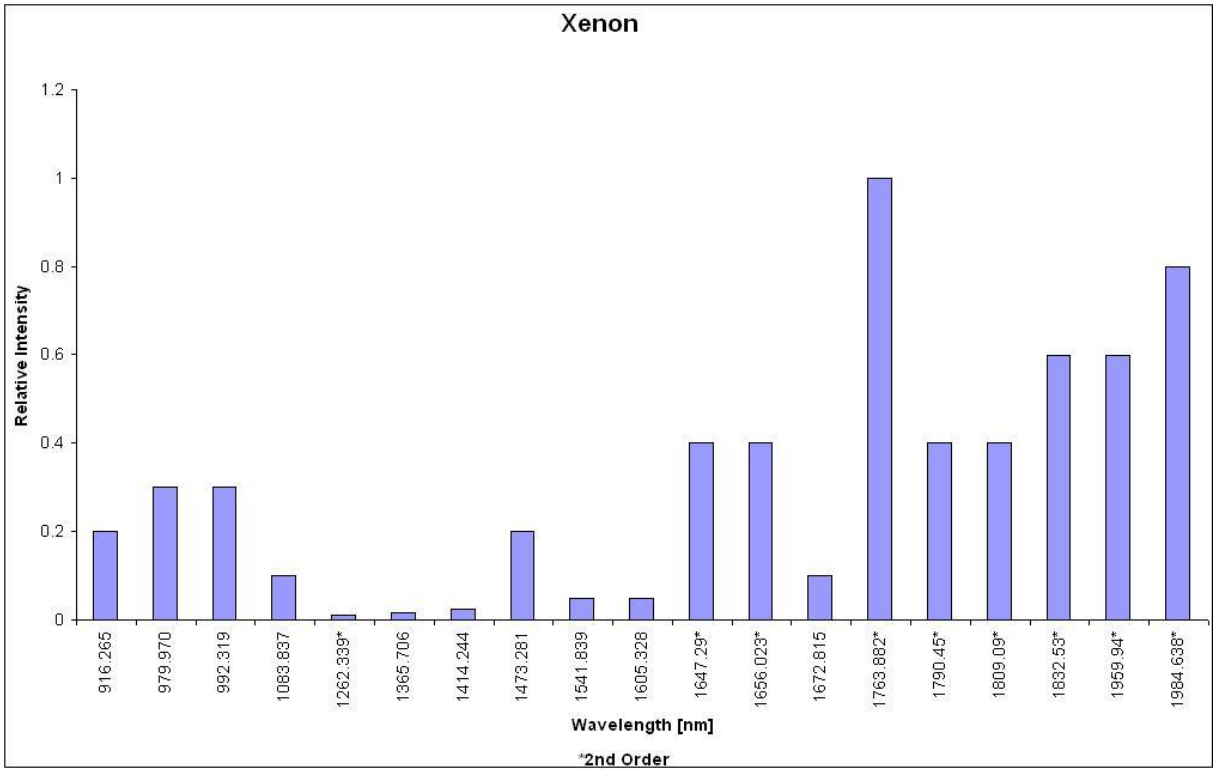
There are more emission lines shown below than printed on the label on the NE-2 housing. The label is intended as a quick, convenient reference and does not list every NE emission line that exists. Below is a list of wavelengths for Neon. Wavelengths displayed in blue are listed on the calibration lamp's label.

341.790	511.367	**640.225**
342.391	511.650	**650.653**
344.770	**540.056**	**653.288**
345.076	**576.441**	**659.895**
345.419	**582.015**	**667.828**
346.052	**585.249**	**671.704**
346.658	**588.189**	**692.947**
347.257	**594.483**	**703.241**
349.806	**597.553**	**717.394**
350.121	**602.000**	**724.512**
351.519	**607.433**	**743.890**
352.047	**609.616**	**747.244**
359.353	**612.884**	**748.887**
360.017	**614.306**	**753.577**
363.366	**616.359**	**754.404**
368.573	**621.728**	837.761
370.122	**626.649**	849.536
503.135	**630.479**	878.375
503.775	**633.442**	1117.752
508.038	**638.299**	1152.275

XE-2 Specifications

The following sections detail the specifications of the XE-2 xenon calibration light source.

XE Spectral Output



Strong XE Emission Lines by Wavelength (nm)

There are more emission lines shown below than printed on the label on the XE-2 housing. The label is intended as a quick, convenient reference and does not list every XE emission line that exists. Below is a list of wavelengths for Xenon. Wavelengths displayed in blue are listed on the calibration lamp's label.

452.186
462.420
466.849
469.097
469.804
473.415
479.262
480.702
482.971
484.329
491.651
492.315
733.930
738.600
739.379
740.040

755.979
758.468
764.391
780.265
788.132
796.734
805.726
806.134
823.163
826.652
881.941
904.545
916.265
979.970
992.319
1083.837

1262.339
1365.706
1414.244
1473.281
1541.839
1605.328
1647.290
1656.023
1672.815
1763.882
1790.450
1809.090
1832.530
1959.940
1984.638

Chapter 3

Operating Instructions

Connecting the Light Source

Follow the steps below to set up your Light Source for use.

► ***Procedure***

1. Plug the 5 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 light source.
2. Connect a fiber to the SMA 905 Connector on the light source. 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.

Note

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 after changing fibers. You should perform a wavelength calibration each time you unscrew the fiber from the spectrometer and change fiber size.

4. Move the On/Off switch (next to the SMA 905 Connector) to the On position. The green LED will illuminate to indicate that the lamp is on.

   Or

   Alternately, you can employ the remote on/off feature utilizing the enable cable which attaches to the back of the device. The remote enable overrides the manual switch position. The yellow wire in the trigger cable is positive, the green wire is negative.

You have now configured the light source for use.

Warming Up the Lamp

After starting the lamp, it must be followed by a 60 second warm-up period to stabilize the output.

Calibrating With the Light Source

The information in this section explains how to calibrate your spectrometer's wavelength using your light source.

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 third-order polynomial.

$$\lambda_p = I + C_1 p + C_2 p^2 + C_3 p^3$$

Where λ = the wavelength of pixel p,

I = the wavelength of pixel 0,
C_1 = the first coefficient (nm/pixel),
C_2 = the second coefficient (nm/pixel^2)
C_3 = the third coefficient (nm/pixel^3)

You will be calculating the value for *I* and the three *C*s.

Calibration Requirements for Ocean Optics Spectrometers

To re-calibrate the wavelength of your Ocean Optics spectrometer, you will need the following items:

- Wavelength Calibration Light Source (AR-2, HG-2, KR-2, NE-2, or XE-2)
- Ocean Optics spectrometer and its manual
- An optical fiber (for spectrometers without a built-in slit, a 50-μm fiber works best)

- 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.

Calibration Procedure

Please see the appropriate manual for your model Ocean Optics spectrometer for instructions on how to calibrate it. Ocean Optics manuals are located at **www.oceanoptics.com/resources/product-manuals/**

Chapter 4

Troubleshooting and Maintenance

LED Status Indicators

The Wavelength Calibration Sources have one LEDs. It used to indicate the following:

Green LED	Lamp is energized

Bulb Replacement

There are no user serviceable parts in the light sources. All service, including bulb must be performed by Ocean Optics, Inc.

To initiate service, navigate to: **www.oceanoptics.com/return-an-item/** to obtain a RMA (Return Merchandise Authorization) number.

It is very important that you obtain a RMA number.

Please **DO NOT SHIP** merchandise to Ocean Optics, Inc. without prior authorization.

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