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Instruction Manual of Operating Standard Lamps

Version 2.1

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1. Table of contents

2. Definition

2.1. Scope

This instruction manual describes the operation and alignment procedures for the standard lamps used for spectral irradiance, luminous intensity and illuminance measurements.

2.2. Object and field of application

OSRAM Wi41/G: Standard lamp used for low-level luminous intensity and illuminance measurements.

OSRAM Sylvania: 1 kW standard lamp used for high-level luminous intensity and illuminance measurements. The lamp is operated in horizontal beam direction.

OSRAM Wi40/G Globe: Standard lamp used for luminous flux measurements.

FEL lamp: 1 kW standard lamp used for spectral irradiance measurements. The lamp is operated in horizontal beam direction.

DXW-lamp: 1 kW standard lamp used for spectral irradiance measurements. The lamp is operated in vertical beam direction.

3. Equipment

3.1. Photometric standard lamps

3.1.1. Luminous intensity lamps for low illuminance level (0.1 – 500 lx)

The photometric standard lamps of Aalto used for illuminance calibrations in the range of 0.1 – 500 lx are of type Osram Wi41/G. The bulbs are mounted on a special lamp base and sold by PRC Krochmann GmbH [1].

The rest of the lamp mount consists of mounting plate with adjustable mechanics on top of a rail carrier. The lamp is attached to the mounting plate by two screws. Standard lamp in place is presented in Figure 1. One side of the envelope of the lamp is coated grey, with only a square-shaped opening is left un-coated. The filament of the bulb can be seen through this opening, and the lamp must be mounted in such a way that the opening faces the detector(s).

Each lamp is operated with an individual current around 5.85 A to achieve a colour temperature of 2856 K (CIE standard illuminant A). Precise currents and corresponding colour temperatures for each lamp can be found in [2]. The voltage across lamp terminals is approximately 30 V.

Two of the lamps (cds9501 and cds9905) are used as working standards, and their colour temperatures should be checked once a year, unless the lamp has been operated less than 15 hours since the previous check. If the nominal value of the colour temperature exceeds 2856 ± 5 K, the operating current should be adjusted. This possible ± 5 K variation is covered by the ± 15 K expanded uncertainty of the colour temperature. The other three lamps are for maintenance purposes and their operating currents must not be changed.

Each lamp uses the same alignment (diffraction) mirror (Figure 2). The mirror is attached to the mounting plate with a magnet. Alignment is performed after the lamp is put in place.

Distances are measured using the front surface of the alignment mirror as a distance reference plane.

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[1] PRC Krochmann GmbH, Wilmersdorfer Str. 39, D-10627 Berlin, Germany.

[2] Quality manual of luminous intensity laboratory.

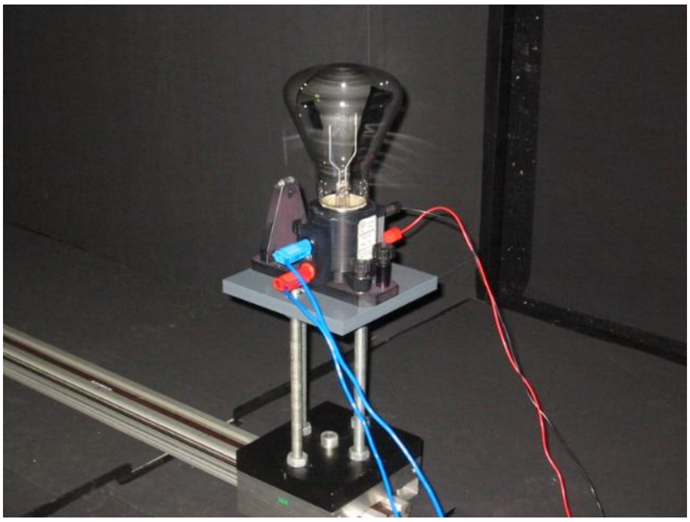

Figure 1. OSRAM Wi41/G in place.

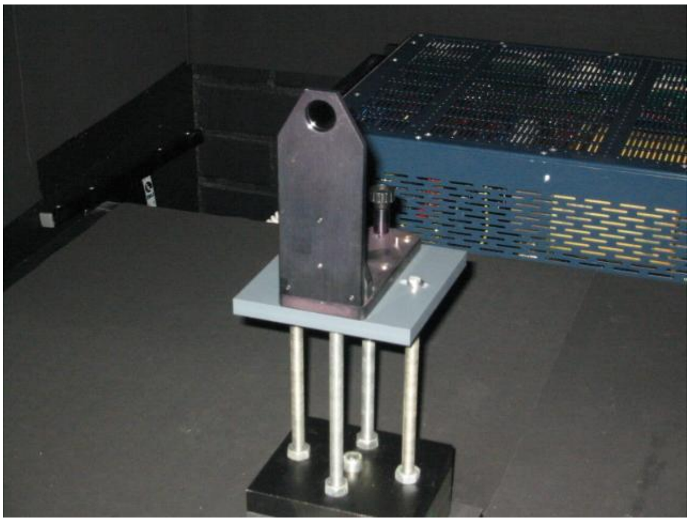

Figure 2. Alignment mirror.

3.1.2. Luminous intensity lamps for high illuminance level (100 – 4000 lx)

The photometric standard lamps of Aalto used for illuminance calibrations in the range of 100 – 4000 lx are of type Gigahertz Optik BN-9101 (Figure 3) [3]. The bulb, manufactured by Osram Sylvania (alternately General Electric), has been permanently mounted into rigid socket. The representative of Gigahertz Optik GmbH in Finland is Mitaten Finland Oy [4].

[3] Gigahertz-Optik GmbH, P.O. Box 1445 (Fischerstrasse 4), D-82178 Puchheim, Germany.

[4] Oy Mitaten Finland Ab, P.O. Box 6 (Teollisuustie 5), 02701 Kauniainen.

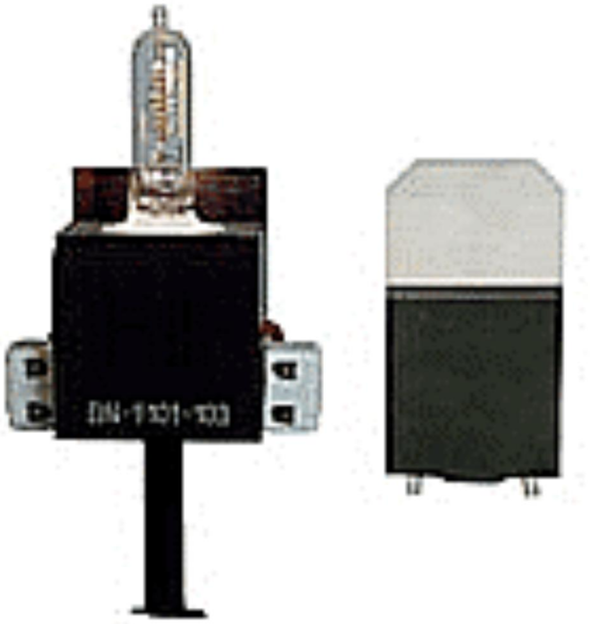

Figure 3. BN-9101 standard lamp of Gigahertz Optik with its alignment jig.

The lamps are operated with a specified current around 7.2 A to achieve a colour temperature of 2856 K. The colour temperature should be checked once a year, unless the lamp has been operated less than 15 hours since the previous check. If the colour temperature exceeds 2856 ± 5 K, the operating current should be adjusted. A valid current can be found in [2]. The voltage across the lamp terminals is approximately 83 V.

3.1.3. Luminous flux standard lamps

The photometric standard lamps of Aalto used for luminous flux calibrations are of type Osram Wi40/G Globe lamp numbered as lms9901, lms9902, lms0003, lms0004, and lms0005. The lamps have an E27 type of screw base. The lamps are operated with specified currents around 5.5 – 5.8 A. The colour temperatures of the lamps are between 2700 – 2750 K. The voltages across the lamp terminals are around 29 – 30 V.

3.2. Radiometric standard lamps

3.2.1. FEL

The spectral irradiance standard lamps of Aalto are all of FEL type. The lamps are operated with constant current of 8.0000 A or 8.1000 A, depending on the type. The voltage across lamp terminals is approximately 105 V. The preferred current value must be asked from the customer before operating the lamps.

Each lamp has its own alignment jig (Figure 3). The alignment jig is assembled in front of the lamp so that the grooved surface is pointing towards the detector(s). Distances are measured with respect to the reference plane that has been defined to be the front surface of the lamp socket (Figure 4). Other reference planes (e.g. centre of filament, or the surface of the alignment jig) are not to be used unless specifically specified by the customer.

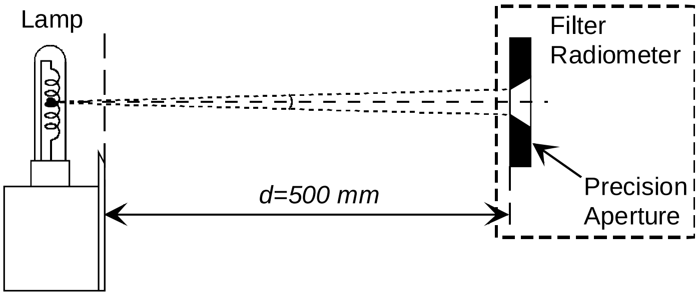

Figure 4. Distance reference planes with Aalto FEL lamps.

The code of the Gigahertz Optik FEL lamps is BN-9101 Spectral Irradiance Standard Lamp (1000 W Tungsten Halogen Lamp). There are two sub-types: BN-9101-1, FEL Type (8.0000 A current); and BN-9101-2, Sylvania FEL-S.T6 Type (8.1000 A current).

The code for the alignment jig is BN-9101BA-01: Calibration Position Alignment Tar-get.

FEL lamps are operated and calibrated in horizontal orientation.

3.2.2. DXW

FMI and STUK have DXW type lamps (Figure 5).

DXW lamps are mainly operated with vertical optical axis.

The operating current is typically 8.000 A. The preferred current value must be asked from the customer before operating the lamps.

DXW lamps have similar alignment jigs as FEL lamps. Preferred alignment procedures and reference planes must be asked from customers before starting calibrations.

In the optical power laboratory there is a 1-m optical stand with baffles that can be used for operating DXW lamps in vertical orientation.

Figure 5. DXW type lamp.

3.3. Power supplies

Power supply in use is Heinzinger PTN55 125-10 (Figure 6). It provides DC current up to 10 A and DC voltage up to 125 V. The power supply is sold by Heinzinger Electronic GmbH [5].

Figure 6. Power supply Heinzinger PTN55 125-10.

In the figure, from the left:

On/off switch, current and voltage controls (analog displays, coarse/fine knobs), negative and positive terminals (upper is sense, lower is output) and protective ground. Below the current control section is a remote control interface and a switch that should always be in position "Int". The container below the power supply contains the oil bath for the precision resistor, see Figure 10.

Sense terminals are used if the lamp voltage is measured directly from the lamp base, as is usually the case. The switch between the sense terminals must be in position "on" to enable this feature. The wires from the sense terminals must be connected to the voltage measurement connectors on the lamp base. Otherwise the power supply will malfunction.

[5] Heinzinger Electronic GmbH, Anton-Jakob-Strasse 4, D-83026 Rosenheim, Germany.

4. Methods and procedures

4.1. Assembling lamps to optical rail

The setup used for measuring standard lamps on an optical rail is depicted in Figure 7. The baffle is inserted only after aligning the setup. The setup is similar to all lamps measured in the optical power/luminous intensity laboratory of Aalto.

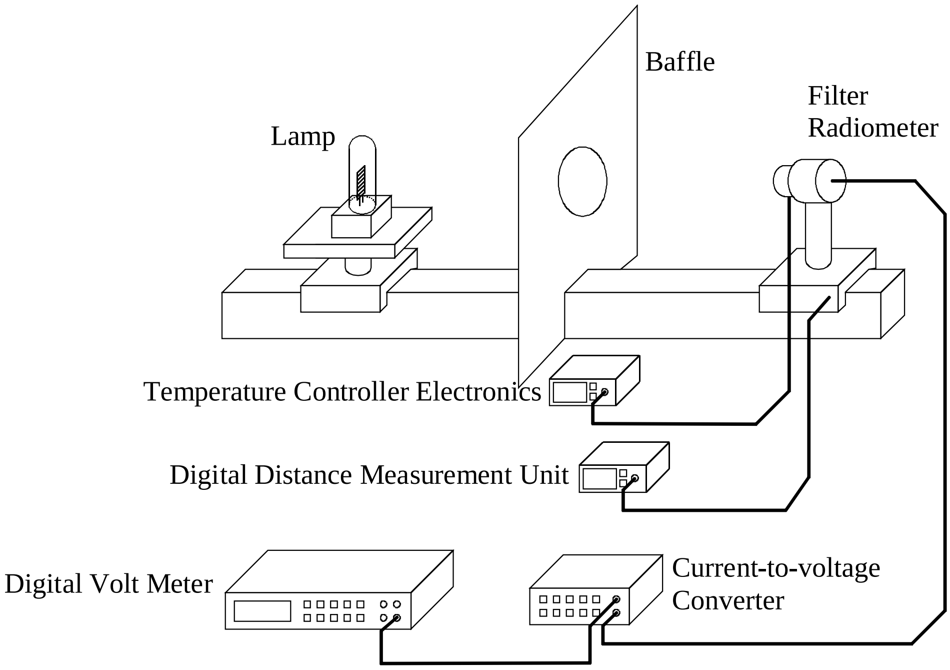

Figure 7. Setup for measuring standard lamps with the filter radiometer.

The lamp, the detector (filter radiometer in the figure), and the alignment laser are mounted on stands that allow rotation, tilting, and movement in *x*, *y* and *z* axes.

The alignment laser is assembled between the lamp and the filter radiometer on a removable, screw-tightened stand. After alignment, the laser and the stand are removed.

Lamps should not be assembled on magnetic base plates because there is a danger of destroying the lamps.

Detector is assembled on a carriage with a distance measuring capability. A magnetic stand should be used if during the calibrations the detector needs to be interchanged with a measuring device under calibration.

The optical axis is set 346 mm above the rail measured from the upper surface of the rail. OMTec two-beam alignment laser is used to determine the axis. There are tar-gets on the walls at each end of the rail where the laser beams should be aimed. The laser beams then mark the optical axis. The attachment pieces listed with lamps and detectors below have been designed to lift all accessories to this defined optical axis.

Prior to measurements, the alignment of the laser beam on the targets on the walls is checked. A photometer or a filter radiometer is aligned with the laser. The carriage carrying the meter is then moved along the rail, at least in the distance range that is to be used. If properly aligned, the laser hits the centre of the meter at any position. If alignment can't be achieved, the targets on the walls may have moved and need realignment.

The positions of the targets are aligned with the two-beam alignment laser, attached on a moving roller carriage, and two iris diaphragms. The irises are mounted at both ends of the rail, directly on top and in the centre of it at the height of 346 mm. The two laser beams are aligned to the centres of the irises. The carriage supporting the laser is then moved along the rail (*z*-direction). With proper alignment, the laser beams should hit the irises at any position of the laser. If not, the *x*- and *y*-positions of the irises are fine-tuned. After receiving satisfactory alignment, the targets are attached on the walls to note the laser positions.

The purpose of the baffle(s) is to avoid light from the lamp reaching the detector indirectly through reflections from the rail, the walls, or other surfaces. Generally, the opening of the baffle should be as small as possible to give best protection. However, the opening should be large enough so as not to cause vignetting. This can be verified by looking at the lamp filament from the direction of the detector. The filament has to be fully visible to the detector input at all measurement distances.

4.2. Alignment procedures

4.2.1. Photometric standard lamps

4.2.1.1. OSRAM Wi41/G

These lamps are aligned perpendicular to the rail using a diffraction mirror. A magnet keeps the mirror in place and improves repeatability of the alignment. All devices can be aligned to the optical axis using the following optical mounts (from bottom upwards):

Lamp: Rail carrier (no distance measurement sensor), adapter plate, linear translator, rotation platform, dual axis goniometer, 75 mm post holder, 50 mm post + collar (M6 thread upwards), mounting plate. No magnetic base plate!

Laser: Screw-tightened stand, 150 mm post holder, 200 mm post + collar, small tilt stage.

Detectors: *Reference photometer*: rail carrier with distance measurement sensor, adapter plate, magnetic base plate (optional), 150 mm post holder, 150 mm post + collar, large tilt stage, 50 mm post (M4 thread upwards).

PRC photometer: rail carrier with distance measurement sensor, adapter plate, magnetic base plate (optional), 75 mm post holder, 75 mm post + collar, large tilt stage, 75 mm post (M6 thread upwards).

Alignment procedure:

- Set suitable distance between the lamp mount and the photometer* carrier (about 1.5 m). Insert the OMTec alignment laser and its stand in halfway between the lamp and the photometer.
- Before assembling the lamp and the photometer, align the OMTec alignment laser in such a way that the two laser beams hit the targets on the walls at the both ends of the optical bench. The laser beam now marks the optical axis, which is parallel to the optical rail and 35 cm above it.
- Put the photometer and the lamp in place and attach the diffraction mirror to the lamp mount.
- Guide the laser beam to the centre of the photometer (into the centre of the aperture and filter) by adjusting the position of the photometer. Align the photometer so that the reflected beam is returned back to the centre of the alignment laser.
- Guide the opposite laser beam to the centre of the diffraction mirror by adjusting the position of the lamp mount. Align the lamp mount so that the centre of the reflected diffraction pattern hits the centre of the alignment laser output.
- Loosen the screws of the laser stand and remove the alignment assembly.
- Move the photometer towards the lamp so that the reference planes (front surfaces of the diffraction mirror and the photometer) slightly contact.
- Zero the length measurement unit. Move the photometer farther from the lamp and repeat the previous step a couple of times to make sure that the distance is reset properly. Remove the diffraction mirror.
- Move the photometer to its correct measurement distance. Take into account the 3.0 mm distance between the front surface of the photometer and the aperture plane and the distance offset of the particular lamp. These values and measurement procedures for HUT/MRI photometric calibrations are found in [2].
- Place one baffle between the lamp and the photometer close to the lamp (about 25 – 30 cm). The diameter of the baffle should be 40 – 50 mm.

The lamp and the photometer are now aligned and ready for measurements.

Note: The alignment of the lamp mount needs to be checked each time a lamp is replaced, since removing and attaching the lamp may affect the alignment.

* In photometry, filter radiometer is called reference photometer. For simplicity, both reference photometer and PRC-photometer (secondary standard) are referred as “photometer”.

4.2.1.2. Osram Sylvania

Osram Sylvania lamp is aligned perpendicular to the rail using the alignment jig. The grooved surface of the alignment jig must be pointed away from the lamp (towards the photometer). All devices can be aligned to the optical axis using the following optical mounts (from bottom upwards):

Lamp: Rail carrier (no distance measurement sensor), adapter plate, linear translator, rotation platform, dual axis goniometer, 75 mm post holder, 75 mm post + collar (M6 thread upwards), mounting plate. No magnetic base plate!

Laser: As with Wi41/G.

Detectors: As with Wi41/G.

Alignment procedure:

- Insert and align the OMTec alignment laser as described above.
- Insert the photometer and the lamp into their places and attach the alignment jig to the lamp.
- Use the back-reflection from the centre of the alignment jig to align the lamp. The rest of the alignment process is described above.

4.2.2. Radiometric standard lamps

4.2.2.1. FEL

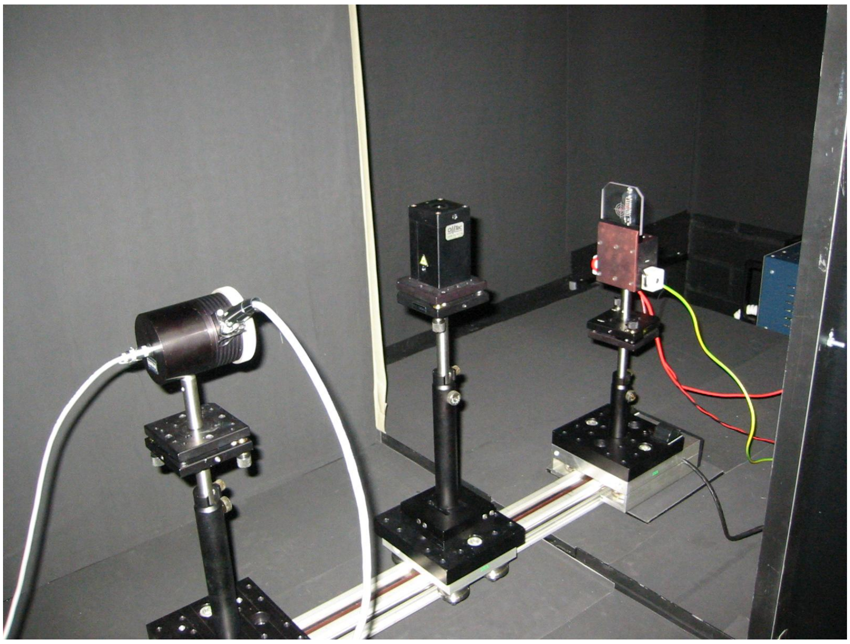

Figure 8. Alignment of FEL lamps using the alignment jig and the OMTec dual-beam alignment laser.

FEL lamps are aligned perpendicular to the rail using the alignment jig (Figure 8). The grooved surface of the alignment jig must be pointed away from the lamp (towards the filter radiometer). The optical axis is marked with white targets on both ends of the rail. All devices can be aligned to the optical axis using the following optical mounts (from bottom upwards):

Lamp: Rail carrier (no distance measurement sensor), adapter plate, linear translator, rotation platform, dual axis goniometer, 75 mm post holder, 75 mm post + collar (M6 thread upwards), mounting plate. No magnetic base plate!

Laser: Screw-tightened stand, 150 mm post holder, 200 mm post + collar, small tilt stage.

Detectors: *Filter radiometer*: rail carrier with distance measurement sensor, adapter plate, 150 mm post holder, 150 mm post + collar, large tilt stage, 50 mm post (M4 thread upwards).

Alignment procedure:

- Insert the OMTec alignment laser halfway between the lamp and the filter radiometer.
- Before assembling the lamp and the filter radiometer, align the Omtec alignment laser in such a way that the two laser beams hit the targets glued in the walls at the both ends of the optical bench. The laser beam is now in the optical axis.
- Insert the filter radiometer and the lamp into their places. Insert the alignment jig to the lamp.
- Insert the 900 nm filter (900c) into the filter radiometer.
- Guide the laser to the centre of the filter radiometer (into the centre of the aperture and filter) by adjusting the position of the filter radiometer. Align the filter radiometer so, that the reflected beam is returned back to the centre of the alignment laser.
- Guide the other laser to the centre of the alignment jig of the lamp by adjusting the position of the lamp. Align the lamp so, that the reflected beam is returned back to the centre of the alignment laser.
- Remove the alignment laser. Remove the alignment jig.
- Place the filter radiometer as close as possible to the lamp and measure the distance between the reference plane and the filter radiometer with a calibrated length rod. A suitable length for the rod is 150 mm. The rod should be placed between the front surface of the filter radiometer and the front surface of the lamp socket (reference plane, see Figure 4).
- Zero the length measurement unit.
- Move the filter radiometer to its correct measurement distance. Take into account the length of the rod used, and the distance between the front surface of the filter radiometer and the aperture plane (3.0 mm for FR1997 and FR2001).
- The measurement distance for Aalto FEL lamps is 500 mm. Measurement distance with customer lamps has to be asked.

- Place one baffle between the lamp and the filter radiometer approximately halfway between the lamp and the detector. Suitable size for the opening of the baffle is approximately 50 mm.

The lamp and the filter radiometer are now aligned and ready for measurements.

4.2.2.2. DXW

DXW lamps are calibrated with a 1-m vertical rail (Figure 9). Please note that the optical breadboard has to be earthed to the protective earth of the power line to reduce electrical disturbances at low signal levels! This can be accomplished with a short wire connecting the breadboard to the protective earth pins of a nearby Schuko socket using an alligator clip.

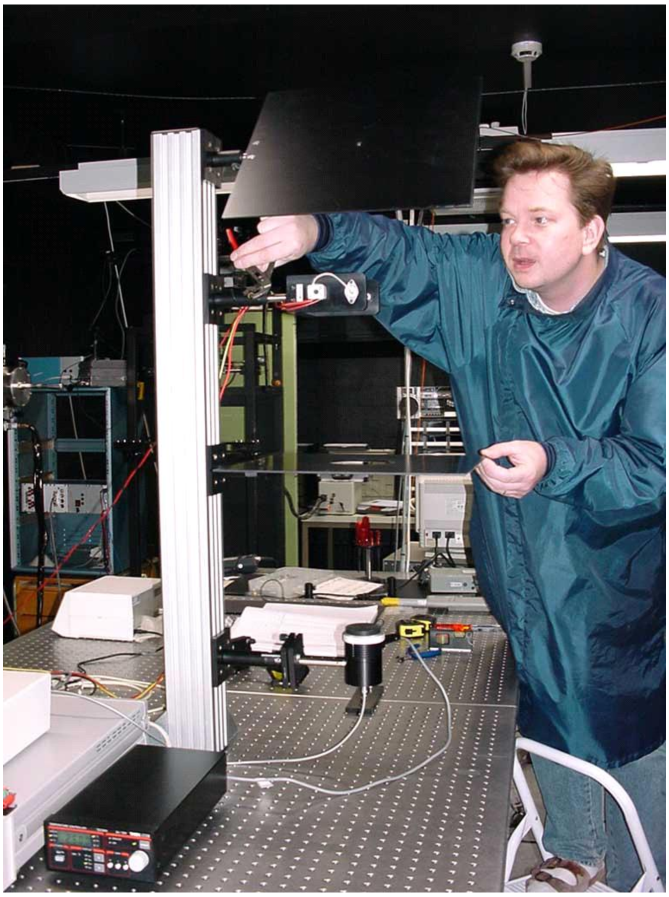

Figure 9. Components assembled on the 1-m vertical optical rail for calibration of a DXW lamp.

All devices can be aligned to the optical axis (273 mm from the rail surface) using the following optical mounts (from bottom upwards):

1. Filter radiometer: 75 mm holder, 75 mm post + collar, tilt stage, 100 mm post (M4 thread upwards).
2. Baffle: 75 mm holder, 75 mm post (+ collar).

3. Laser: 75 mm post holder, 200 mm post + collar, tilt stage.
4. Lamp: 50 mm post holder, 75 mm post + collar, tilt stage, 50 mm post (M6 thread upwards).
5. Stray light shield above lamp: 75 mm holder, 75 mm post (+ collar).

Alignment procedure:

- Place the rail in the optical table. Ensure straightness of the rail with a spirit level (vatupassi).
- Attach lamp to the top of the rail.
- Insert filter radiometer to the bottom of the rail.
- Align as with FEL lamps using the alignment jig and the OMTec laser.
- Lock the tilt stages of the lamp and the filter radiometer e.g. with clamps. Otherwise the stages may tilt due to the load of the devices.
- Distance is measured with a ruler. Check the scale by drawing two lines to the optical bench and measuring their distance with both the ruler, and the magnetic length scale. The latter is traceable to the length scale of MIKES.
- Place one baffle between the lamp and the filter radiometer.
- Place the black sheet (looks like a baffle but with no opening) behind the lamp at 45 degree angle (see Figure 9). This reduces back-reflections from the ceiling. Please note that the anodised aluminium reflects IR radiation from approximately 700 nm upwards. This has no effect on the UV calibrations, but needs to be taken into account if near-IR region is to be measured.

DXW lamps are customer lamps. Before starting calibrations, ask the customer to specify the required measurement distance, the reference plane, and the operating current. Ask also the last measured voltage for the lamp. Fill in customer log books and apply their quality assurance procedures if necessary.

4.3. Distance measurements

In most of the calibrations on the 4.5-m optical bench, distances are measured with the electro-magnetic distance measurement system. There is a magnetic ruler in the rail. Rail carriers are equipped with sensors, and a display shows location with 0.1-mm resolution.

Distances are often defined with respect to a reference plane, which is typically the front surface of the lamp housing. In such case, the filter radiometer on a rail carrier is placed in contact with the reference plane, and the display is zeroed. A calibrated length rod may be used in between. The length of the rod, and the 3-mm recess of the aperture are accounted for.

If the reference plane of the lamp has been defined to be the centre of the filament, a 1-m auxiliary optical rail and a telescope attached on a rail carrier is used to transfer the reference plane out of the lamp. The auxiliary rail is assembled parallel to the main rail. The telescope on a rail carrier on the auxiliary rail is set so that the center of the filament is seen through the telescope, and the distance display is zeroed. The rail carrier is then moved so that a suitable reference plane, e.g. the front surface of the lamp, is seen through the telescope, and the distance offset is noted. After that, distances can be measured with respect to the new reference surface. If the lamp has no suitable external reference plane, the distance between the lamp filament and the filter radiometer may also be directly measured and set with the telescope.

4.4. Connection of the power supply

Connection of the power supply is depicted in Figure 10. The connection is the same for all lamps measured in the optical power/luminous intensity laboratory. Extreme care should be taken to use correct polarity of the current!

The power supply is operated in current controlled mode. The operating current is measured by using a precision resistor. The voltage drop across the single value precision resistor is used to determine the current with an accuracy of 0.001 %.

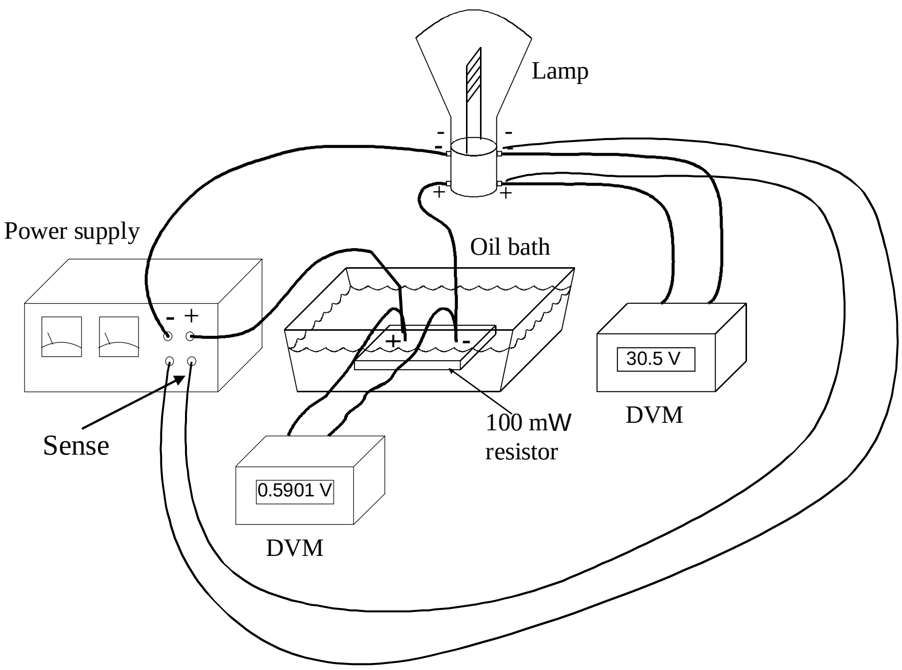

Figure 10. Connection of the lamp, power supply and the associated electronics. If only one DVM is available, lamp voltage and currents are coupled to the front and rear terminals.

4.5. Soft start and soft shut down

The lamps should not be turned on or off instantly. Current needs to be ramped up and down slowly. Soft start and soft shut down are accomplished using the current limit of the power supply.

- Before switching the power supply on, check that both the coarse and fine-tuning (current) knobs of the power supply are in zero-position. Check also the polarity of the lamp terminals (red cables should go to the terminals marked with “+”) and that the alignment target has been removed from the lamp base.
- Raise the fine-tuning knob gradually to position 5.0.
- Raise the current with the coarse-tuning knob gradually so that the current reaches its nominal value (e.g. 8.1 A) in approximately 2 minutes.
- Allow lamps output stabilise for minimum 20 minutes, or as the customer has specified. During this period, light must be blocked so that it does not irradiate the filters, if filter radiometer is used.
- Monitor the lamp current and lamp voltage during the warm-up. The lamp voltage must not deviate from its earlier value by more than about 0.1 V.
- After the lamp has stabilised, use the fine-tuning to set the current to its exact value. It is possible to obtain accuracy of 10^{-5} in the current setting (e.g. 8.1000 A).

Switching off takes place according to the same scheme, but in reverse order.

4.6. Log books

Log books are kept for all lamps. The log books are stored with the lamps. FEL lamps are stored with their alignment targets and log books in grey flight cases in the optical power/luminous intensity laboratory. Photometric lamps with their log books are stored in the closet in the corner of the laboratory.

The log books contain the operating currents for the lamps. The following data are filled in each time when burning the lamps:

- Date
- Time for switching the lamp on and off
- Burn hours during the measurement session
- Total (cumulative) burn hours for the lamp
- Voltage in the beginning and at the end of the session (the begin voltage is the first voltage measurement after the stabilising period)
- Operator initials

- All unexpected events and observations on the lamps are written to the log books. These may include sudden appearance of dirt in the lamp envelope, change of the lamp voltage, sudden power break down, accidental wrong polarity.

5. Safety and handling precautions

- 1 kW lamps operated at 8.1 A produce lots of UV radiation. Avoid staring to the lamps. Use protective clothing and limit staying in the vicinity of the lamp to minimum.
- Never move hot lamps. They may explode or the filaments may damage! Allow lamp to cool down for a minimum of 2 hours before disassembling the setup.
- Do not touch the envelopes of the lamps. If you notice finger prints in the glass, it is important to know, whether they are fresh or older stains. Check the lamp log and the latest calibration certificate to see whether they mention the stain. If it is an old stain, do not attempt to clean it. If it is fresh, clean it with ethanol or isopropanol as well as you can. Write down the operation and describe the final condition of the lamp to the log book and to the next calibration certificate.
- Before operating, the dust should be removed with soft brush or by blowing clean air.
- Do not touch the surfaces of the filters or the edges of the apertures.
- If, by accident, any optical component gets dirty or damaged, notify all colleagues who might be using the equipment. In case of damage to the lamps, record the incidence to the log book.
- If transported abroad (intercomparisons) the lamps are to be hand-carried in their cases. Avoid any kind of shocks to the cases.
- Before flying, write a certificate on the contents of the case (emphasize that the lamps are completely harmless) have it signed by the head of the national standards laboratory or the head of department, and get university stamp for the certificate (from kanslia). This is to ensure that the security officers at the airport do not open the lamps.
- The standard lamps should not be operated if there is a possibility of losing the electricity during the measurement, e.g., during a thunderstorm or service breakdown. If the electricity is lost during a measurement, the lamp power supply and other critical devices must be turned off immediately to prevent damages when the electricity is restored.

6. Field calibrations

Field calibrations may be done for certain customers, e.g. STUK and FMI. Quality assurance routines and operating instructions of the customers are to be followed. This concerns e.g.

- Operation of the customer lamps, including current and voltage monitoring.
- Control and monitoring of environmental conditions.
- Alignment and distance measuring.

The procedures used should be recorded to the calibration certificates with care, and the effect of deviations should be estimated and added to the uncertainty budgets.

7. Laboratory accommodation and environment

The spectral irradiance and luminous intensity measurements are done mainly in the Optical Power Laboratory, which is located in room I136 in the basement of the Department of Signal Processing and Acoustics. This laboratory is a clean room. Instructions for using the clean rooms have been given in [6].

During calibrations:

- The Clean Zone aggregate should be on to prevent dust.
- Temperature should be monitored.
- Humidity should be monitored.

Humidity and temperature values during the calibrations are written to calibration certificates.

Optical components such as interference filters, $V(\lambda)$ filters and photodiodes may suffer from high humidity. If humidity exceeds 70 % R.H. these components are not to be taken out from the dry cabinet in the corridor of the laboratory. Frictional electricity may damage electronics with very dry conditions, so humidity during measurements should be 15 – 70 %. Temperature should be within 18 – 27 °C. These limits are applied to all photometric and radiometric calibrations unless otherwise stated in the corresponding Quality or Instruction Manuals. Measurements are either postponed, or the conditions may be improved with heating, cooling, humidifiers, or dryers.

Measurements with the filter radiometer may also be done outside the university. These field measurements should be done in corresponding laboratory conditions.

[6] Clean room instructions / Puhdastilaohjeet.