# Office Lighting Data Collection Protocol - Guide File

## **Overview**

**This document serves as a guide file to support studies investigating non-image-forming (NIF) effects of light in office environments. It includes a briefing template, a step-by-step office data collection guide to use with the supplementary Office Data Collection Template, a reference list for lighting terms and extra guidance to use in cases where the building manager of the office space(s) considered in the study cannot be contacted.**

**The briefing template can be used to prepare a standardized briefing for participant interactions. The data collection guide can be used for collecting the necessary information about the office environment where your study is conducted, ensuring thorough and accurate data on the lighting situation.**

**Please note, this guide file assumes that the following is true for your study:**

1. **You are conducting a longitudinal study measuring person-level light exposure.**
2. **You are using light loggers, worn by participants to measure light exposure.**
3. **You are using an environmental momentary assessment application to collect momentary data of the participants you are following.**
4. **Your participants are office employees.**
5. **Your participants work mainly in an office at the same workplace, not in a home office.**

### Materials Overview

Below is an overview of materials that you will need for following the current template. Check before you start that the following materials are present.

* 1. Office Data Collection Template for collecting office data, with:
     1. Tape measure, laser measure or something similar
     2. Drawing utensils (pen, ruler) and paper
  2. Consent forms for the participants in your study
  3. Wearable light logger sensors
  4. A dock or something similar to read out the data of the light logger sensor
  5. Computer with software installed to read out the data of the light logger sensor
  6. Photocamera or mobile phone with wide-angle lens

### Overview of Study Set Up

Figure 1 provides an overview of the different parts of a longitudinal study with momentary data collection. Sleep diaries are not required if the study does not consider circadian and/or sleep effects but is recommended to include. A diagram of a schedule

AI-generated content may be incorrect.

Figure 1: A schematic overview of the planning of a longitudinal study considering NIF effects of light. Light blue: task for participant, middle blue: task for researcher, dark blue: interaction with participants, pink: optional task for participants.

## **Briefing Template**

**GENERAL RESEARCHER PROTOCOL BRIEFING TEMPLATE**

**STUDY TITLE**  
[Insert Study Title Here]

**VERSION**  
[Insert Date Here]

**MATERIALS AND PREPARATION**

Before starting, ensure the following materials are present:

1. An unsigned consent form for the participant.
2. [Insert the light logger sensor you are using]
3. [Insert other required materials specific to your study, e.g., sensors, devices, etc.].

Verify that the [insert equipment name, e.g., sensor] is present and functioning correctly:

* [Insert specific instructions for checking the equipment].

**START BRIEFING**

1. **Inform the Participant of Study Basics:**
   * Explain the study protocol, what participation entails, and how personal data is handled (details in the consent form).
   * Emphasize that participants can withdraw from the study at any time.
2. **Consent Form:**
   * Ensure the participant reads the information carefully.
   * Obtain the participant’s signature before starting data collection.
3. **[Insert light logger sensor name] Explanation**

Provide the participant with the [insert device name] and explain how to use it. Key instructions include:

* Wear the device during the waking period (from getting up to going to bed).
* Always place the device in the same location (e.g., on the collar) for consistency.
* Ensure the device is not covered by clothing during use. For outerwear, move the device to the top layer.
* When not in use, store the device in [insert storage method, e.g., light-blocking bag].
* Do not expose the device to liquids or humid environments (e.g., swimming, bathing).
* Report any damage or loss to the researcher immediately.

1. IF NEEDED: **[Insert other sensors] Explanation**

**EXPERIENCE SAMPLING APPLICATION AND TAKE-IN QUESTIONNAIRE**

1. Help the participant download the [insert app name] application from the appropriate app store, based on their device.
2. Guide the participant to:
   * Fill in an alias if required (e.g., first name).
   * Allow push notifications when prompted.
   * Accept the terms and conditions.
3. Make sure the intake questionnaire is sent to the participant. Many applications allow this to be automated.
4. Set up the momentary questionnaires to be sent to the participant

**END BRIEFING WITH PARTICIPANT**

After completing the intake questionnaire, the main data collection period starts for the participant. Make sure to provide contact information so that participants can reach you. This should also be in the consent form.

## **Office Data Collection**

This section is to guide you through filling out the Office Data Collection Template, meant for the collection of data on office characteristics of the space(s) you are considering. This part is split into two. The first part is done by filling out the Excel template as provided with this document and the second is taking photographs to supplement this data.

### 3.1 Preparation

Before starting the Office Data Collection Template, make sure you have the following materials on hand.

1. Photocamera or mobile phone with wide-angle lens
2. Tape measure, laser measure or something similar
3. Drawing utensils (pen, ruler) and paper

### 3.2 Office Data Template Fill

This section provides instructions for filling out the Office Data Collection template. See the step-by-step guide below.

1. **Basics**

Fill in the type of office space you are considering and the number of workplaces in the office space you are considering.

1. **Location**

Fill in the geographical location of the office space you are considering.

1. **Time of data collection**

Fill in the start date and end date of the data collection.

1. **Dimensions of room**

Fill in the height, width and length of the room you are in.

1. **Floorplan**

Create a top-down drawing of the workplace. For this, follow the steps below. See also the example (Figure 2) on the next page, and the start point as generated by the Excel template. You can make this drawing either on paper or using computer software (such as Adobe Illustrator).

1. Room Dimensions: Measure and draw the length and width of the room.
2. Orientation: Indicate the orientation of the room by marking "North" on the drawing. You can use a smartphone app to determine this direction but note that these measurements may be somewhat off. A good double check is using maps/navigation software.
3. Participant Position: Indicate the participant’s seating position and their normal viewing direction. (Indicated in RED in Figure 2.)
4. Walls: give all walls an identification number, i.e., Wall1, Wall2, etc. Indicate wall 1 as the wall that faces the participant and then count up while going clockwise. These wall identification numbers are used later.
5. Draw the position and width of all windows, including windows to the inside. (Indicated in BLUE in Figure 2.) Also note the heights from floor to the lower windowsill, and the heights of the windows themselves. Number each window in the drawing, i.e., Win1, Win2, etc., for later use. Please note: a window can be facing to the outside, or to the outside. Additionally, a window is considered a separate window when it is in a frame. If there are multiple windows above each other (i.e., separated by a horizontal frame) you can consider it as one window, but note this in the drawing by adding "this window consists of X number of parts above each other". For multiple windows next to each other (i.e., separated by vertical frames) consider this as separate windows.
6. Electrical Lighting Systems: Mark the center location of all electrical lighting sources, including luminaires (i.e., ceiling lights, desk lamps, standing lamps, floor lamps). (Indicated in YELLOW in Figure 2.) Number each light source, i.e., L1, L2, etc., for later use.

A diagram of a wall

Description automatically generated

Figure 2: Example of a floorplan drawing with all elements requested

1. **Participant location**

Fill in the following questions regarding the location and orientation of the participant in the room.

1. What is the compass direction of the normal view direction from this workplace?
2. What is the distance between the middle of the participants seating location and the closest window to the outside?
3. **Surfaces**

For this part, fill in the following items about the walls, floor and ceiling in the considered room.

1. Note the color of the surface.
2. Note the material of which the surface is made.
3. Note any finishes of the material of each of the surfaces. Finishes refer to the appearance and texture of a surface, which influence how it interacts with light. They can be matte, semi-gossy (or satin), glossy/reflective, textured or rough. Below is

Material finishes can be categorized based on their texture and reflectivity. Glossy finishes are smooth and reflective, characterized by their shiny, high-reflectivity appearance, commonly found in materials like polished metal, high-gloss paint, and glass. Semi-glossy or satin finishes are also smooth but offer moderate reflectivity, providing a soft, subtle sheen between matte and glossy, as seen in satin-finish metals and semi-gloss paint. In contrast, matte finishes are smooth and non-reflective, offering a flat appearance with no shine, as seen in matte ceramics, unpolished wood, and matte paint. Textured finishesintroduce some relief to the surface, with visible differences in thickness and varying reflectiveness depending on the material, such as textured wallpaper. Finally, rough finishes are coarse and uneven, providing a tactile texture with a non-uniform surface, typical of untreated stone and rough concrete.

1. Indicate per wall if the wall neighbours an inside room or the outside.
2. **Windows**

Provide information about the properties of the windows and surfaces in the workplace.

1. Are the windows fully transparent?
2. Are the windows tinted?
3. Is there a coating on the windows (e.g., reflective or UV-protective)?
4. Is something covering the windows? Coverings include printings, foils and stickers.
   1. Namely:
5. Is there a double façade? A double façade (or double-skin façade) is an architectural design feature consisting of two layers of external walls, typically with a gap or cavity in between.
6. **Daylight controls**

Indicate if any of the daylighting systems that are stated below are present and give a short description.

1. Shades

Shades are fabric-based coverings that can be rolled up or down to control the amount of light entering a space. They are often mounted inside or outside the window frame and come in a variety of styles.

1. Blinds

Blinds consist of horizontal or vertical slats made of materials like wood, aluminum, or vinyl. These slats can be tilted to adjust the amount of light entering a room or fully raised/lowered (horizontal blinds) or opened/closed (vertical blinds).

1. Curtains or drapes

Curtains or drapes are fabric window treatments that hang vertically from a rod or track. They are available in a range of materials, colors, and styles, offering both aesthetic and functional benefits.

1. Shutters

Shutters are rigid window coverings made from wood, composite, or other solid materials. They are mounted to the window frame and consist of panels with adjustable or fixed louvers (slats) to control light and airflow. There are interior and exterior shutters.

1. Other…
2. **View to the outside**

Indicate whether the participant has any obstructions in their view to the outside from their position. An obstruction to view refers to any object or structure that blocks, limits, or partially hinders one’s ability to see an area, object, or scenery. Obstructions can vary in size and form. Examples of obstructions inside: Walls, pillars, furniture, or other structures that physically block part of the line of sight. Examples of obstructions outside: Trees, buildings or fences that impede a clear view of the surroundings. The following items are asked in the template:

a) What obstructions are there from the workplace’s seat to the view outside?  
b) What obstructions are there on the outside of the building that are limiting view?

1. **Light sources**

Please write down the following information, for every different light source (as you noted in 5. Floorplan) in the excel template. If there are more than 5 light sources, the template can be expanded. Items a) and b) can be defined relatively easily, with items c) to f) requiring you to find the exact light source and luminaire. To find this information, the recommended option is to contact the building manager of the building the room you are considering is in. The alternative is to define the light source characteristics yourself, for which you can find instructions in Section 5 of this document.

1. Measure and note the height of all light sources relative to the floor.
2. For each light source you noted earlier, please indicate the type of luminaire (fixture) type from the following categories. Also indicate the direction of the illumination (the direction in which the light shines, e.g., down, up, up-and-down, side). Possible luminaire types and the associated direction of illumination are listed below, with Figure 2 giving a schematic overview.
   * *Hanging Lamps*
     + Ceiling lamp, recessed: Always downlighting
     + Ceiling lamp, surface mounted: Always downlighting
     + Pendant lamp: Can be up-, down-, or up-and-down-lighting
   * *Standing Lamps*
     + Desk lamp: Can be up-, down-, or up-and-down-lighting
     + Standing floor lamp: Can be up-, down-, or up-and-down-lighting
   * *Wall Mounted*
     + Wall recessed: Can be side, side-up, or side-down lighting
     + Wall surface mounted: Can be side, side-up, or side-down lighting
   * *Floor Lamps*
     + Floor recessed: Always uplighting

A diagram of a lamp

Description automatically generated

Figure 3: Schematic overview of luminaire types

1. Manufacturer: write down the company that produced the light source.
2. Type of Light Source: Specify the type of light source (i.e., LED, fluorescent, halogen, incandescent).
3. Indicate per light source if the light source gives diffused, semi-diffuse or direct light.
4. Determine for each light source the Correlated Colour temperature (CCT), Colour Rendering Index (CRI) and Spectral Power Distribution (SPD). The CCT and CRI can be filled in the Office Data Collection Template, while the SPD is a graph that can be provided with the filled template.
5. **Lighting controls**

Indicate if any of the control systems stated below are available for adjusting the settings of the electrical lighting and give a short description. Please note that this information can usually be gathered through the building manager.

1. Wall switches (ON/OFF)
2. Dimmers switches
3. Controls for changing the light color
4. Remote controllers (or other controls available to users)
5. Motion or occupancy sensors
6. Other automatic systems…
7. Other…

### 3.3 Supplementary Photographs to the Office Data Collection Template

Photographs taken from the position of the employee can be invaluable to record the relationship between employees and the lighting system and daylight provisions (such as windows). Therefore, the relationship between employee and light exposure can be inferred. This section can also be used for adding valuable material to your analysis with minimal extra effort. Follow the instructions below for taking the photographs. Make sure no people or personal information can be seen in the photographs, due to privacy concerns. Note that these photographs can also be gathered by participants/office employees themselves in an intake questionnaire.

1. For the first photo, sit in the workplace's seat and hold the camera at eye level and point it straight ahead. Then, take a photograph of your view straight ahead, in landscape orientation. Zoom out as far as possible to make the widest field of view possible.
2. For the second photo, staying in the workplace's seat, point your camera straight up and photograph the ceiling directly above you. Again, take the photo in landscape orientation, and zoom out as far as possible to make the widest field of view possible.
3. For the third photo, sit in the workplace's seat and hold the camera at eye level and point it at the window facing out. Then, take a photograph of your view, in landscape orientation. Zoom out as far as possible to make the widest field of view possible.

## **Quick Reference List for Lighting Terms**

Below is a list of lighting terms used in the current document.

**Luminaire**

A complete lighting fixture, including the light source (e.g., bulb or LED), housing, and components for mounting and electrical connection.

**SPD (Spectral Power Distribution)**

A graph showing the intensity of light emitted at different wavelengths. It provides detailed information about the color and quality of light produced by a source.

**CRI (Color Rendering Index)**

A measure of a light source’s ability to accurately reveal the colors of objects compared to natural light (=daylight). It is rated on a scale of 0 to 100, where higher values indicate better color rendering.

**CCT (Correlated Color Temperature)**

Indicates the color appearance of light, measured in Kelvin (K). Lower values (e.g., 2700K) appear warm and yellowish, while higher values (e.g., 6500K) appear cool and bluish.

**Diffused Light**

Light that is evenly spread, softening shadows and reducing glare. It is achieved by scattering light through a material like frosted glass or a diffuser.

**Direct Light**

Direct light refers to light that travels straight from a source to an object or surface without scattering or diffusing. It creates well-defined shadows and provides focused illumination, often used to highlight specific areas or objects. Examples include the beam from a spotlight or sunlight streaming through a window.

**Lighting Types**

Below is a list of common light source types. Please note that this list is not all-encompassing.

1. Incandescent

Recognizable by their warm, yellowish glow and simple, rounded or pear-shaped glass design. When turned on, you can see a glowing filament inside. These bulbs often feel hot to the touch.

1. Fluorescent

Typically found in long tubular forms or as compact spirals. They emit a cooler or neutral white light and may flicker slightly when starting up. Older versions might have a faint buzzing sound and are commonly seen in offices or kitchens.

1. Halogen

A smaller, brighter version of incandescent bulbs with a white, crisp light. These bulbs are often encased in a clear or slightly tinted glass envelope and can get very hot quickly. They're commonly used in spotlights and recessed lighting.

1. LED (Light Emitting Diode)

Easily identified by their cool-to-touch surface and variety of shapes, including small clusters of diodes or more traditional bulb designs. LEDs can emit light in a range of colors and tones, from very warm to daylight white, and often include features like dimming or smart connectivity.

## **Determination of lighting system characteristics**

In case a building manager cannot be reached or when this is not an option, the instructions below can be used to determine lighting system characteristics such as the CCT, CRI and SPD.

### 5.1 CCT and CRI

The process for determining the Correlated Colour temperature (CCT) and Colour Rendering Index (CRI) for light sources is different for the different types of light sources. Therefore, first define the light source type. Then, follow the instructions below.

*For all light sources marked LED, follow the following instructions:*

* Use a tool like for instance the DIALux Luminaire Finder, available at [https://luminaires.dialux.com/en](https://luminaires.dialux.com/en#0).
* Using the information you noted in 1 up to 5, search for the luminaire online.
* See the red boxes in Figure 5 for where CRI and CCT are displayed on the manufacturer's website (in this case Philips).

*For all sources NOT marked LED, follow the following instructions:*

* Examine the Light Bulb or Tube:
  + Many fluorescent and other non-LED light sources have markings on the bulb or tube itself. These markings often include codes that represent the CCT and CRI. Color Code (e.g., 840, 935).
  + The first digit typically indicates the CRI. A code like "8" indicates a CRI of 80-89, while "9" indicates a CRI of 90+.
  + The next two digits represent the CCT in hundreds of Kelvin (K). For example, "40" represents 4000K, while "35" represents 3500K.
* Use Manufacturer’s Specifications on datasheets:
  + Look on the light fixture or the light source for any manufacturer name, model number, or product code. Using this information, you can find the exact light source on the manufacturer’s website. Most lighting manufacturers provide detailed specifications, including CCT and CRI, in product datasheets on their website.
  + Enter the model number on the manufacturer’s website or search for the product datasheet by name. Use these datasheets to find full technical specifications, including both CCT and CRI.

A screenshot of a product page

Description automatically generatedA ceiling with a light fixture

Description automatically generated with medium confidence

Figure 4 (left): Example of a lighting system.

Figure 5 (right): Example of a luminaire on the manufacturer’s website. The red boxes indicate where the name, CCT and CRI can be found.

### 5.2 SPD

To determine the Spectral Power Distribution (SPD) of a light source, you either need to find the luminaire and the datasheet associated, or you need to use a spectrally resolved light sensor, such as a spectrometer or a light dosimeter. Below are the instructions for using the Condor Instruments ActLumus (light logger) sensor to determine the SPD.

1. Make sure there is no influence of daylight on the measurements. Do the measurements after sundown, or make sure the windows are blinded and close any blinds, shutters or curtains, if present. Make sure the lights are turned to maximum brightness.
2. Plug in the ActDock and put the ActLumus in the dock. Make sure the cutouts on the dock align with the sensors
3. Place the ActLumus device on a stable surface at a height representative of the typical eye level for seated occupants (approx. 1.2 meters above the floor). Ensure the logger’s sensor is facing directly upwards, directly beneath the light source.
4. During the measurement, avoid disturbing or moving the sensor, and maintain a consistent office lighting setup (avoid turning lights on/off or adjusting dimmers).
5. On the computer, open “ActStudio.exe”.
6. Navigate to the ActLumus tab in the ActStudio application and connect the sensor by selecting it and waiting for the button next to “Device” to turn green.
7. Go to the RTD (real time data) tab next to the connection.
8. The SPD of the light falling on the sensor can now be seen in the the graph under “Light Spectrum”.