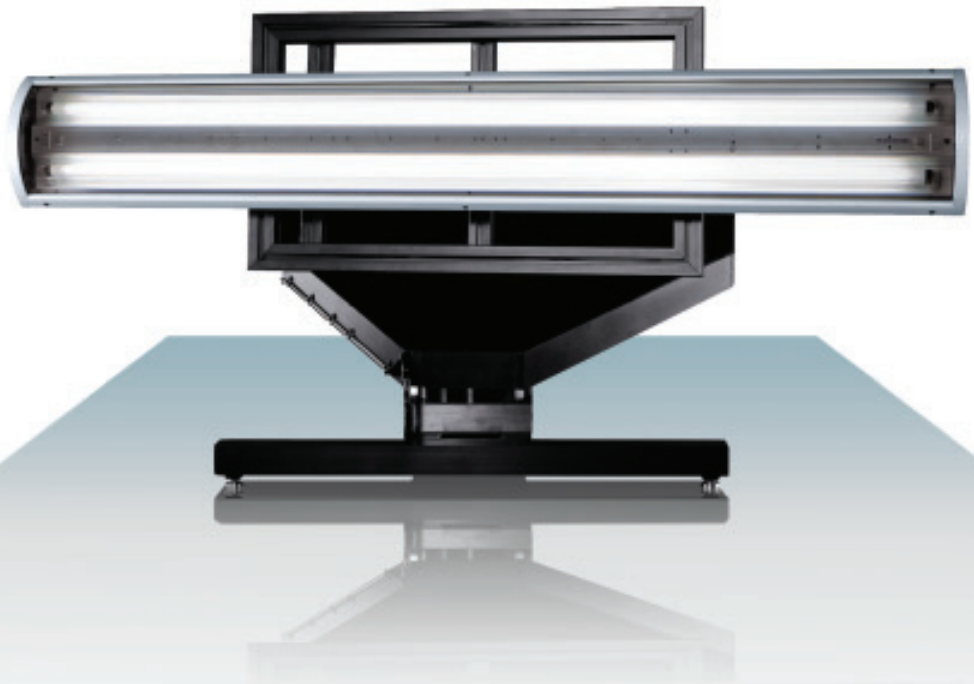


PHOTOMETRY

NFMS IMAGING GONIOPHOTOMETER

AN AFFORDABLE GONIOPHOTOMETER SYSTEM FOR GENERATING STANDARD PHOTOMETRIC DATA FROM LUMINAIRES, LEDs & SOLID STATE LIGHTING

If you're developing the next generation of ultra-efficient lighting, you will know how important fast, affordable and - above all - **accurate** test equipment is when it comes to being able to bring new products to market quickly. Let Pro-Lite / SphereOptics save you time and money with our innovative Radiant Imaging NFMS Imaging Goniophotometer System. Compared with using an external test laboratory to generate photometric data in .ies or .ldt formats, an NFMS goniophotometer system will pay for itself after just some tens of measurements. In addition, you will be able to develop new luminaires more quickly - see the effects of changing LEDs, drive current, lenses or diffuser materials in real time. With NFMS - you are equipping yourself with the power to innovate.



The Radiant Imaging NFMS goniophotometer combines a motorised 2-axis goniometer stage with a ProMetric CCD imaging photometer to perform a 2D near-field angular analysis of the luminance and - optionally - colour from LEDs, luminaires and solid state lighting. Proprietary software then scales the near-field luminance data (cd/m^2) to a far-field luminous intensity (cd) distribution from which polar charts and standard photometric data files are generated.

Data files are produced in the two most popular formats, either IESNA (.ies) or EULUMDAT (.ldt). So-called photometric data defines how much light a luminaire emits and into what directions; lighting designers then use this standardised data with a variety of commercially available lighting design programmes to determine the number and positioning of luminaires in order to create the desired illuminance (lux level) for a project.

Affordability is a key to the success that the NFMS has enjoyed to date. Unlike traditional luminaire goniophotometers, the NFMS exploits an advanced imaging photometer (rather than a simple lux meter) to make NEAR-FIELD luminance measurements, from which the desired FAR-FIELD luminous intensity data is calculated. This means that the size (and cost) of the photometric dark room or enclosure required for the NFMS is much reduced compared to a far-field measurement system. This alone can make an NFMS system economically viable for even small to medium lighting companies.

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THE NEAR-FIELD DIFFERENCE

The measurement of luminaires has traditionally been performed with an illuminance (lux) meter placed in the photometric far-field which views the light source at one angle of azimuth and elevation at a time. The device under test is mounted on a motorised goniometer stage and the photometer views the lamp from a distance of between 10 and 25m, the actual working distance depending upon the size of the light fitting. The cost of a typical far-field goniophotometer system (combined with the associated, large dark room) was often prohibitive, which meant that most manufacturers have used the services of independent test laboratories. The NFMS goniophotometer changes all this by exploiting the latest advances in imaging photometry to make luminaire measurements more accessible.

Rather than using an illuminance meter in the photometric far-field to record the illuminance as a function of angle, the NFMS employs a ProMetric CCD imaging photometer / colorimeter to record spatially-resolved (2D) images of the near-field luminance emitted from the light source. Luminance (units of cd/m^2) is the optical property one measures when working up close to the light source. Spatially-resolved images of the source luminance are recorded in Radiant Imaging's proprietary ProSource (.rs9) format for one angle of azimuth and elevation at a time. ProSource software then performs a well proven ray-tracing operation to scale the near-field luminance readings to equivalent far-field luminous intensity values at the click of a mouse. Standard photometric files in either IESNA (.ies) and EULUMDAT (.ltd) formats can then be generated.

The key difference with a near-field goniometer is that unlike more traditional far-field systems, you don't need a large dark room. The imaging photometer can be placed at almost any distance from the goniometer frame, typically at about 2-3m away. By comparison, you must place the photometer that you use in a far-field measurement at some ten times the source diameter away. So, for a 1.5m fitting, that would mean a measurement distance of at least 15m, perhaps more if the sample has any complicated beam shaping optics. Thus, you save on space with a near-field system compared to a far-field one. Also consider that a near-field measurement means that you can compute the illuminance at any distance from the light source – whereas if you measure the far-field intensity, you only ever know the far-field light levels. Note that the NFMS supports use as both a near-field and a far-field goniophotometer.

The NFMS comprises a 2-axis motorised goniometer stage which scans the device under test over $\pm 90^\circ$ in all directions. The NFMS goniophotometer is available in two sizes. The compact NFMS0400 frame which is rated for samples weighing up to 5kg - ideal for downlighters but it is possible to also measure linear luminaires up to 80cm with this frame. The NFMS0800 is the medium sized frame and this can handle samples up to 25kg, up to 60 x 60cm (square) and up to 1.6m (linear).

CANDELAS AND MORE

The NFMS goniometer and ProMetric imaging photometer are fully automated and under the control of NFMS system software. The parameters reported and charted are as follows:

- 2D near-field luminance (cd/m^2) versus angle over 2π steradians.
- Far-field luminous intensity (cd) versus angle over 2π steradians.
- Total luminous flux (lumens).
- Illuminance (lux) projected onto a user-defined plane.
- Polar and Cartesian plots of luminance and luminous intensity versus angle.
- Beam angles at user-defined thresholds (e.g. FWHM).

Output formats include:

- ASCII format (luminance or luminous intensity versus angle).
- Radiant Source Model (.rs9 format) - compatible with most optical ray tracing software (e.g. Zemax, TracePro, Photopia etc).
- IES photometric format (.ies), per IESNA LM 63 standard.
- EULUMDAT photometric format (.ltd).
- IES & EULUMDAT files support both absolute and relative photometry.

OPTIONAL measurement parameters include (requires an enhanced photometer or spectroradiometer option):

- CIE chromaticity (Cx Cy) & correlated colour temperature (CCT, Kelvin) versus angle.
- Spectral irradiance ($\text{W/m}^2.\text{nm}$) & colour rendering (CRI, Ra, R1-14) as a function of angle.



BENEFITS MORE THAN JUST THE BOTTOM LINE

Compared with using an outside test laboratory for your photometric tests, an NFMS goniophotometer system can pay for itself in months. The many other benefits of using the NFMS goniophotometer include:

- Being a near-field measurement, the dark room required is much smaller than for a traditional far-field installation. The room (or enclosure) size depends upon a number of factors but plan on a laboratory measuring no more than 5 x 5m for the NFMS0800 system. This greatly reduces the facilities cost necessary to perform luminaire measurements compared with a far-field goniophotometer system.
- Having access to an in-house test facility means that new products can be brought to market more quickly and at lower cost. With NFMS, there's no need to wait weeks if not months to obtain your photometric data.
- Standard photometric data is generated automatically. To compile such data manually would be an extremely time consuming and potentially error-prone process.
- Product development cycles are reduced and new innovations tested quickly to establish their feasibility. NFMS enhances your ability to innovate and gives you a distinct competitive advantage.
- When testing complex or lensed LED luminaires with a far-field goniophotometer, the normal 10x source size rule for the far-field distance often doesn't apply - the actual photometric distance can be much greater. This can cause significant errors which a near-field measurement is immune to.



PHOTOMETRIC MEASUREMENTS DON'T HAVE TO BE TESTING

NFMS system software takes all the hard work out of photometric testing of luminaires. Goniometer motion is fully automated - just set the scan range and resolution as required. NFMS software supports multiple scan ranges - you can set a high scan resolution around the beam centre and a lower resolution at the edges. You can also combine a forwards facing with a separate reverse facing measurement to fully characterise those luminaires which emit light in all directions (e.g. "up / down lighters").

ProSource software is bundled with each NFMS system and converts the near-field (as measured) luminance to far-field intensity values (ray traced to infinity). ProSource also provides for the generation of standard photometric data files at the click of a mouse, and can export ray-sets for optical design modelling which are compatible with nearly all commercial optical design software packages (e.g Zemax, Photopia).

The standard ProMetric imaging photometer employed with an NFMS system features a high resolution 512 x 512 pixel, full frame CCD sensor with 2-stage thermoelectric cooler and photometric filter precision matched to the CIE $V(\lambda)$ photopic observer function. With a 16-bit photometric resolution (65,000:1 grey levels), both high level direct as well as low level diffuse light is collected from the luminaire, giving improved accuracy with even bare LED arrays. A motorised filter wheel containing ND0, 1, 2, and 4 filters ensures that even the very brightest luminaires can be measured without difficulty.

If your NFMS system is equipped with a ProMetric imaging colorimeter, you can not only test the luminance and luminous intensity from your luminaire, but also measure the colour temperature and its variation with angle. If you specify the SP-1000 irradiance spectroradiometer option, you enjoy the benefits of a state-of-the-art goniospectroradiometer system. The spectroradiometer not only provides colour corrected measurements with any type of light source, you can also record colour temperature and - uniquely - colour rendering as a function of angle. This capability opens up a powerful new approach to modelling not just the illumination performance of a light source but also its colour and colour rendition.

SPECIFICATIONS & ORDERING INFORMATION

NFMS IMAGING GONIOPHOTOMETER

Goniometer Frame	NFMS0400	NFMS0800
Max. Luminaire Weight	5kg	25kg
Max. Luminaire Length - Linear	800mm	1600mm
Max. Luminaire Size - 2D	500 x 380mm	865 x 600mm
Max. Luminaire Size - Recessed	290mm dia.	355mm dia.
Frame Size (W x D x H), Weight	900 x 360 x 600mm, 25kg	1200 x 750 x 750mm, 40kg
Operating Footprint (Approx)*	970 x 970mm	1400 x 1400mm
Scan Range	0-90° inclination; 0-360° azimuth	
Scan Resolution	User selectable - from 0.25°	
Imaging Photometer**	PM-1603F-0	
Photometer Type	512 x 512 pixel full frame CCD with 2-stage TE-cooling	
Photometric Resolution	16-bits (65,536:1)	
Dynamic Range	0.005 - 10 ⁷ cd/m ² (with internal ND0, 1, 2 & 4 filters)	
Spectral Sensitivity	Matched to CIE V(λ) 1931 photopic observer function	
Photometric Accuracy	+/- 3% (CIE illuminant A source)	
Included in the System:	<ul style="list-style-type: none"> - Your choice of NFMS goniometer frame - Your choice of ProMetric imaging photometer / colorimeter - Lens(es) appropriate to the luminaire size(s) under test and your chosen working distance - Calibration(s) - NIST traceable - Precision 3-axis geared tripod head & tripod for photometer - NFMS software for goniometer control - ProSource software for photometric file generation & ray tracing - T-10 illuminance photometer or CL-200 illuminance colorimeter - On-site commissioning and operator training - 1 year hardware warranty - 1 year software licence & technical support agreement 	
Options:	<ul style="list-style-type: none"> - SP-1000 irradiance spectroradiometer - ProMetric software for standalone use of photometer - Optical table for mounting the goniometer frame 	

* The NFMS operating footprint varies with the size of luminaire under test.

** The NFMS goniophotometer can incorporate any ProMetric imaging photometer / colorimeter, however the PM-1603F-0 is normally the recommended model. For colorimetric measurements, please specify the PM-1603F-1.

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Pro-Lite and Sphere Optics provide a solution for almost any application in measuring the colour and brightness of LEDs, luminaires, lamps and displays. From a simple, inexpensive lux meter, to the world's most advanced imaging photometers, from our near-field imaging goniophotometer to our 3m Labsphere integrating sphere spectroradiometer, we have a light measurement system that you can rely upon to give you accurate, repeatable data. We don't just supply state-of-the-art equipment, we also support you with practical advice and know-how borne out of our decades of experience in light measurement.

Pro-Lite / SphereOptics - your partners in photometry.