





Growing your profits

Horticultural lighting

PHILIPS



The essence of good lighting

Light is essential for plant growth. Natural sunlight is the cheapest source available but for horticulture it is not always available in sufficient quantities. Especially in regions between 40 and 80 degrees latitude the amount of daylight required for good plant growth is limited during the winter. Therefore, during this period, the use of artificial light has become very common in greenhouses to increase production and quality.

Horticultural lighting and Philips

Philips has been developing light sources for horticulture for many years already. For a deeper understanding of what is required in the greenhouse Philips has close contact with commercial growers. In order to meet these specific requirements we have our own laboratories and test stations and, to further advance our overall knowledge, we contribute to independent research and field testing. This approach has led to the development of no-fuss, highly efficient lamps which have been tailor-made for you.

The role of light

The amount of natural light (global radiation) is in most cases measured in terms of energy (J or W) with a solar meter. Plants use a relatively small part of this radiation for growth and this we call growth light. The majority of the radiation is heat. When you use supplemental light to enhance plant growth, you need to ensure that the lamps are highly efficient at producing growth light, and are not, for example, mostly producing heat.

As evidence mounts that artificial light can increase productivity, more and more growers are turning to artificial light. It is already very commonly used in ornamental crops such as roses, chrysanthemums and lilies and is now increasingly used for vegetables such as tomatoes, cucumber, sweet pepper and lettuce. It is expected that in the future its use will be extended to cover a much wider range of crops.

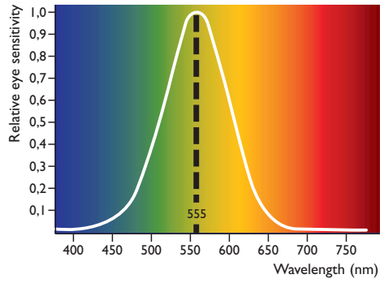
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Growth light

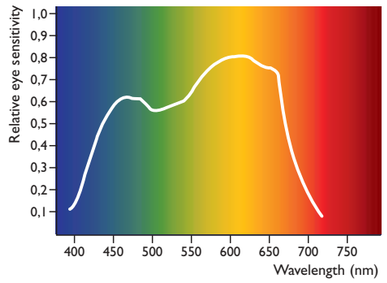
Light is, for the human eye, the visible part of electromagnetic radiation. Most products for lighting are developed for human applications. For these purposes the intensity of visible light is expressed in lux. Lux is a photometric unit and is based on the average sensitivity of the human eye.



Light sensitivity curve of the human eye

This sensitivity is maximal at green/yellow (555 nm) and is declining towards longer (red) and shorter wavelengths (blue).

Plants have a completely different sensitivity for light colours than the human eye. For plant growth it is important to define light as small light particles, also called photons or quantum. The energy content of photons is different, depending on wavelength (light colour). For one Watt of energy, almost twice as many red photons can be produced compared with blue. This means that although they still use the green and blue part for growth – or photosynthesis - they use the red part of the light much more efficiently. In fact we are dealing with a plant sensitivity curve for growth light.



Light sensitivity curve of plants

So, contrary to common belief, plant growth is not determined by lux or energy, but by photons from the blue to red (400-700 nm) part of the spectrum. This is called growth light!

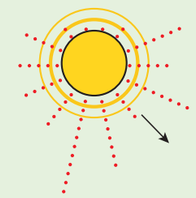
Suitability for photosynthesis

Research at universities and applied research stations has demonstrated that the rate of photosynthesis is related to the amount of photons between 400 – 700 nm. This is called 'Photosynthetic Photon Flux' (PPF). It is the only reliable way of measuring if a light source is suitable for photosynthesis.

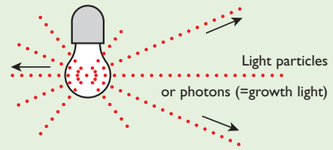
The higher the PPF value per Watt, the more efficient the light source for plant growth. This is why Philips specifies on all his light sources for horticultural use, the PPF value. This is expressed in micromole photons per second (µmol/s).

The Philips MASTER GreenPower lamp is specially developed for maximal growth light and has the highest PPF per Watt available for horticulture.

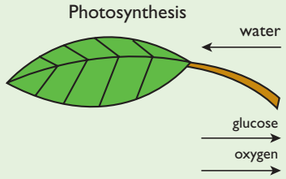
Growth light



Light source as growth light



Photosynthesis







Artificial lighting

There are several ways in which artificial light can be used to improve growth and extend the growing season of commercial crops:

1. to supplement natural daylight and raise growth light levels in order to enhance photosynthesis and thereby improve growth and quality of plants in greenhouses **(supplemental growth light).**
2. to control the light period by extending the natural day length with artificial light **(photoperiodic lighting).**
3. to totally replace daylight with artificial light for ultimate climate control **(cultivation without daylight).**

Philips offers a wide range of lamps for all these horticultural applications.

1 Supplemental growth light in greenhouses

The amount of supplemental growth light required very much depends on plant type, desired plant growth and availability of natural daylight. For this reason Philips has designed a tool that calculates how much additional growth light is required in each individual situation. The tool is available at your local Philips office and allows you to calculate the optimal amount of light your greenhouse requires based on your wishes and/or possibilities.

Depending on plant type and desired plant growth for central European conditions, the following supplemental levels are suggested:

1. 15 – 30 µmol for improving quality, maintenance of the crop and limited production increase;
2. 30 – 45 µmol for seedlings, growth and production of pot plants;
3. 40 – 100 µmol for year-round cultivation, for example, of chrysanthemums and roses and multiple layer cultivation;
4. 100 – 200 µmol for production of plants with high light demand (fruit production of, for example, tomatoes and cucumbers);
5. 100 – 800 µmol for the production of plants under artificial light alone (for example growth chambers)

In the case of MASTER GreenPower 600W/400V: 1 µmol growth light corresponds to 76 lux.



For supplemental growth light applications Philips recommends:

- **MASTER GreenPower**

Figure 1 Supplemental growth light

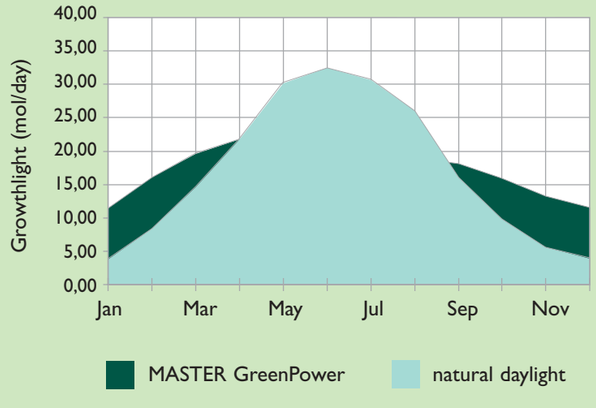


Figure 1 shows an example of how natural daylight is supplemented with MASTER GreenPower during winter. In this example plants are illuminated with 105 µmol growth light (= circa 8000 lux) during 20 hours/day from November until February. In the remaining lighting period the operating hours is less.





For the low dose of light applications Philips recommends:

- **Incandescent (Flower Power Pro or Superlux Agro Pro)**
- **Compact fluorescent (CFL)**

2 Photoperiodic lighting

For many plants the moment of flowering is determined by the length of the light period. The use of artificial light for control of flowering is called photoperiodic lighting. With this method short-day and long-day plants can be cultivated all year round. For example, very good results have been achieved with photoperiodic lighting of chrysanthemum, euphorbia pulcherrima and kalanchoe as well as with gypsophilia and carnations.

The most common ways of influencing the day length are:

- with growth light (also growth takes place during the day prolongation period) or
- with a low dose of light, primary for flower regulation (100 - 400 lux; 2 - 6 µmol/m^2.s).

3 Cultivation without daylight

The total replacement of daylight by artificial light is primarily associated with climate controlled rooms. In these applications, it is essential that the spectral composition of the artificial light is balanced for optimal plant development.

For cultivation of plants without daylight Philips offers you three solutions:

a. MASTER HPI-T Plus
HPI-T Plus lamps have a spectrum closer to daylight, and plants develop very well under this light.

b. A 1:1 mix of 400W MASTER GreenPower and 400W MASTER HPI-T Plus
This combination of light sources has proven a good lighting solution for several species. Compared with HPI-T Plus lamps, MASTER GreenPower lamps offer a higher efficiency in growth light. The little blue in the spectrum of the MASTER GreenPower is compensated by HPI-T Plus.

c. MASTER TL-D Super 80
The use of MASTER TL-D Super 80 fluorescent lamps (for example colour 830 and 840) is also a very suitable option.
TL-D Super 80 lamps offer the following advantages:

- Low temperature of the tube. This allows short distance between lamps and plants (around 15 cm) and thus the possibility to grow plants in multiple layers. TL-D Reflex is particularly suitable for this application. This tube has an internal reflector that creates an efficient lighting system without the need for an external reflector
- Flexible light levels can be arranged. The light level can vary from very low (for tissue culture and seedlings) to high (approximately 800 µmol) with good light distribution.
- Dimming is possible. The light output of a high frequency system (TL-D HF) is continuously dimmable between 100% down to approximately 8%. The efficiency of the fluorescent lamp is comparable with that of the HPI-T Plus.

1:1 mix of MASTER GreenPower and MASTER HPI-T Plus



MASTER TL-D for cultivation without daylight

For cultivation without daylight Philips recommends:

- **MASTER HPI-T Plus**
- **Mix of MASTER GreenPower and MASTER HPI-T Plus**
- **MASTER TL-D Super 80**



Translating knowledge into products

Research to improve knowledge is essential. Philips supports several research projects that study the process of plant growth in relation to light. Leading universities in Europe and the USA, together with several growers and luminaire suppliers, have helped us to determine the most efficient lighting solution for ornamental crops and vegetables. Our international contacts ensure that our level of expertise is as broad as possible. A number of commercial growers with different crops allow us to test new concepts over lifetime. This approach means that new or adapted light sources are intensively evaluated by international experts as well as being tested in practice.

This approach has resulted in Philips designing horticultural lamps that offer you:
- Maximal efficiency in growth light
- Maximal output over life time
- Maximal benefit on plant growth
- Minimal early failure.

Light measurements

Philips has its own independently and officially certified light measurement laboratory. This means measurements can be carried out on the performance of our lamps with the highest accuracy. Here we do all measurements on light sources specified in the IEC standards.



Light measurement laboratory Philips Turnhout.

Stray light

With the increasing use of artificial light in greenhouses, stray light that reflects back out of the greenhouse, is becoming an environmental and social issue. In order to operate in a socially responsible manner, we recommend a range of technical measures, such as the installation of screens, to reduce this issue. Philips is also taking the issue of stray light into account as it develops new technologies for greenhouse lighting systems in the future.



85% screen (partially closed) installed to reduce light pollution

Our customers

It is very important for Philips that you are satisfied with our products. We are developing lamps on the input we get from the market, a policy that has brought us very positive feedback from growers.

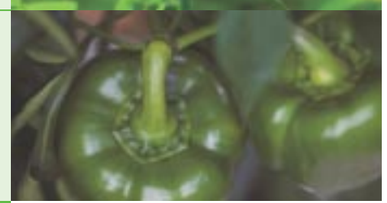
Peter Klapwijk, Klapwijk GreenQ bv Tomato Grower - Monster, The Netherlands
"A good lamp is determined by yield times lifetime. That automatically leads you to Philips. Our contact is good and that's important, as technical development and optimal plant breeding should go hand in hand."



T. Verheul, Rosa Plaza de Berckt Roses - Baarlo, The Netherlands
"I recently visited the Philips Turnhout factory where I received useful and clear information about the lamps and the use of these lamps in horticultural applications."



Cor Boeters, Sunrise Pepper Growers - Wateringen, The Netherlands
"Reliability of the lamp and the manufacturer is our reason for choosing Philips. Our contact is good and people think along with test projects."



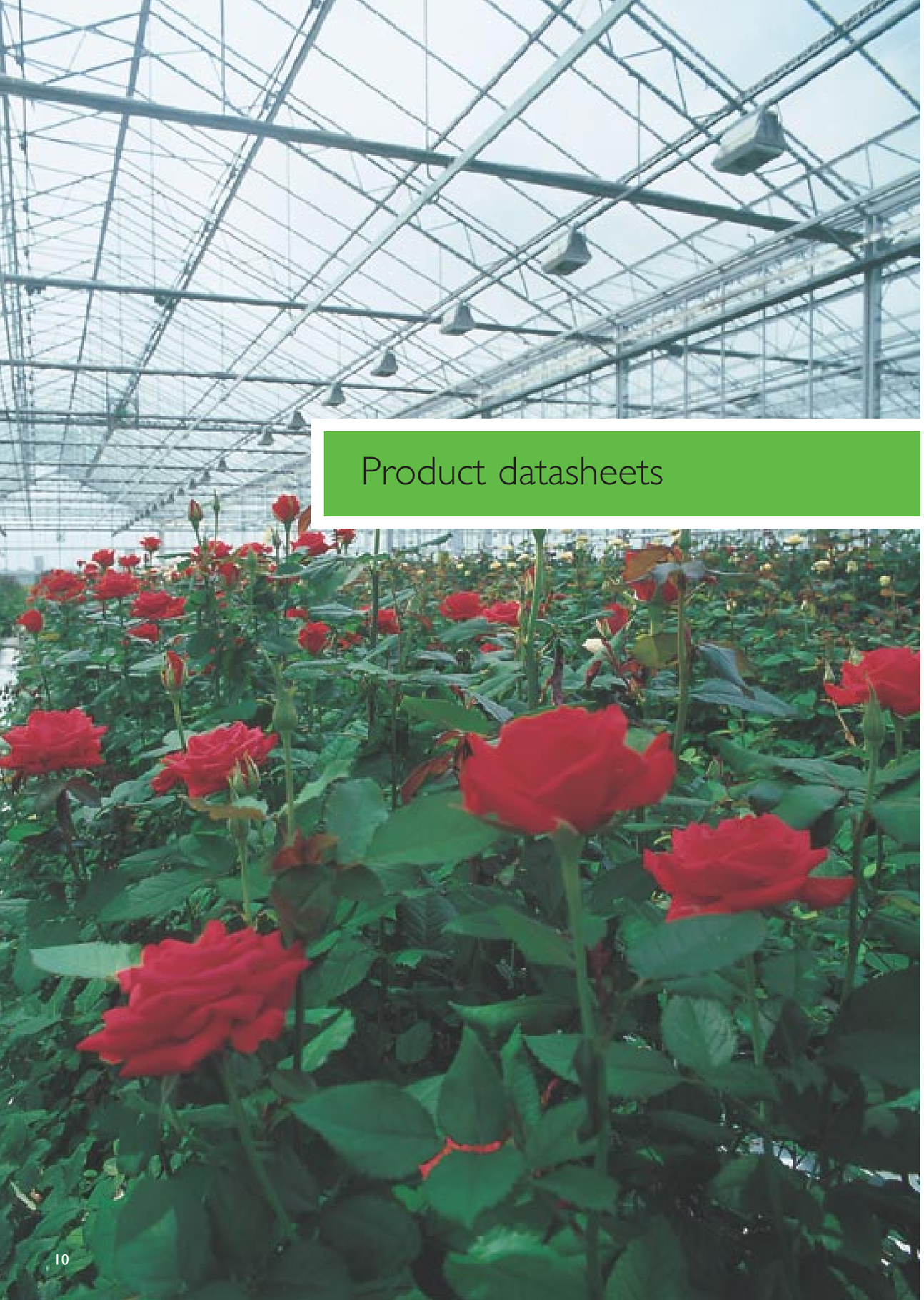
Philips support

Your local Philips agent can demonstrate the benefits of using Philips MASTER GreenPower and other lamps for several crops.

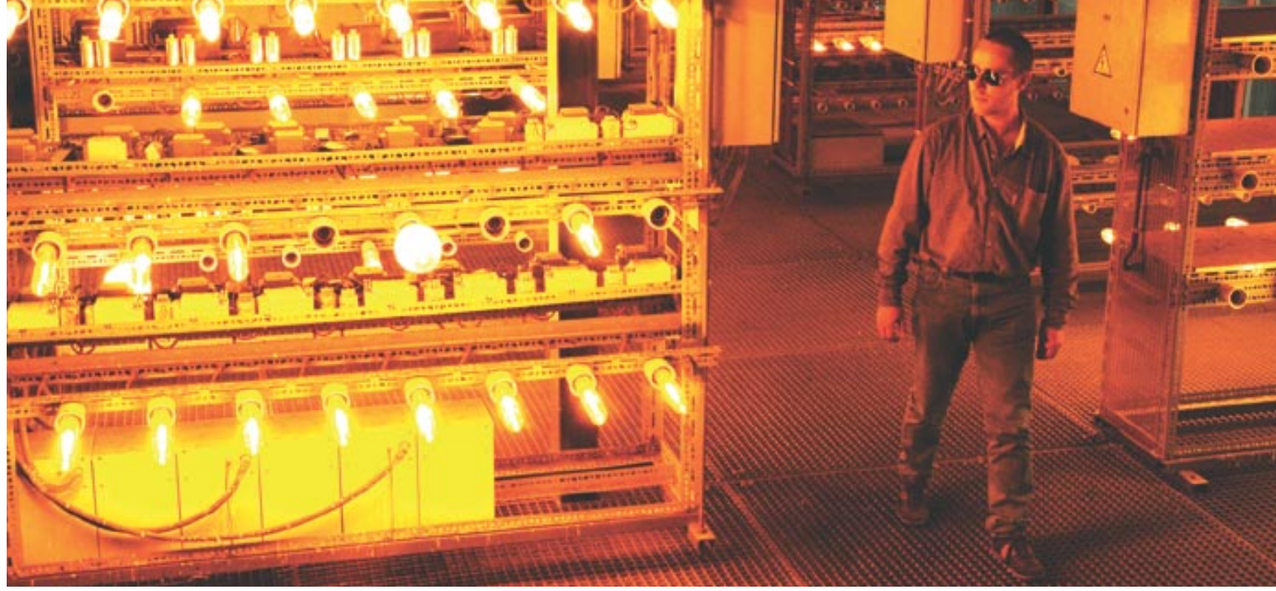
Website Horticultural Lighting

Detailed information and recommendations about using additional growth light in horticulture can be found on our horticultural website:

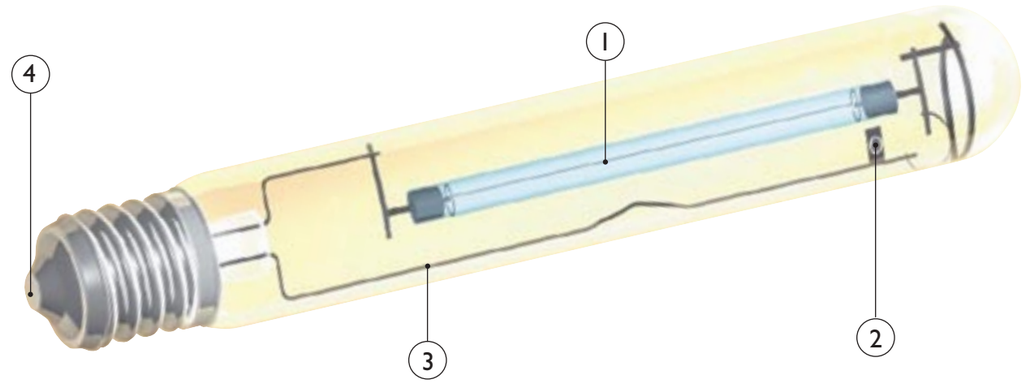
www.horticultural.lighting.philips.com



Product datasheets



Lifetime testing at Philips Turnhout



MASTER GreenPower and MASTER Agro

Leading technology

① PIA technology
The ceramic discharge tube with "Philips Integrated Antenna" technology contains no moving parts and therefore eliminates early lamp failures and guarantees a reliable and extended lamp life.

② ZrAl getter
The "Zirconium Aluminium" getter improves the vacuum in the outer bulb. This ensures a more consistent discharge temperature and lower sodium migration from the discharge tube resulting in excellent lumen maintenance over the total lifetime as well as fewer premature failures.

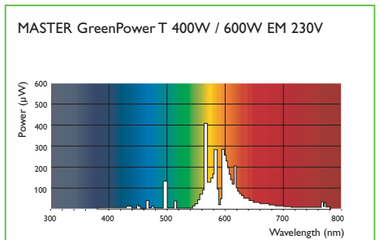
③ Simple and strong construction
The optimised design with only seven internal welds ensures a more robust construction to withstand vibration and adverse environmental conditions, enhancing reliability and prolonging the lifetime.

④ Lead free
The range is constructed with lead-free solder and is 96% "upward" recyclable (the whole lamp with the exception of the discharge tube) in an environmentally conscious way. This means that the recycled components are re-used in the production of new lamps.

MASTER GreenPower T 400W / 600W EM for 230V single phase systems







Lamp

- MASTER GreenPower lamps are High Pressure Sodium Lamps with a ceramic discharge tube, enclosed in a clear tubular outer bulb with optimised growth light (µmol) output and maintenance.

Features

- GreenPower results in optimised growth light output.
- Ceramic discharge tube with PIA technology for long and reliable lifetime.
- ZrAl getter ensures excellent growth light maintenance over life and fewer premature failures.
- Simple and robust construction for enhanced reliability and longer life.
- Lead free solder.

Benefits

- High growth light maintenance safeguards a constant crop quality and quantity over life.
- Optimised performance for horticultural applications.

Comparison of MASTER GreenPower with MASTER SON-T PIA Plus

- MASTER GreenPower lamps are designed for optimal growth light output over lifetime based on an optimal spectral energy distribution for the light sensitivity curve of plants.
- MASTER SON-T PIA Plus lamps are designed for maximal lumen output over lifetime based on an optimal spectral energy distribution for the light sensitivity curve of the human eye.

Application

- Horticultural lighting, intended for the stimulation of CO_2 uptake for improved photosynthesis and plant growth.

Gear

- The lamp requires a ballast and ignitor in accordance with the IEC HPS Plus standard.

Product information

	Growth light PPF* (initial)	Lifetime	Maintenance (nominal)
MASTER GreenPower 400W	725 µmol/sec	12.000 hrs	> 92% at 12.000 hrs
MASTER GreenPower 600W	1100 µmol/sec	10.000 hrs	> 92% at 10.000 hrs

* PPF information: see page 3

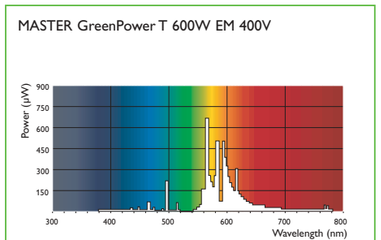
MASTER

Perfect light, perfect sense

MASTER GreenPower T 600W EM for 400V phase/phase systems







Lamp

MASTER GreenPower lamps are High Pressure Sodium Lamps with a ceramic discharge tube, enclosed in a clear tubular outer bulb with optimised growth light (µmol) output and maintenance.

System

The system consists of a specially designed lamp, ballast and ignitor, suitable for phase/phase connection to the mains.

Features

- GreenPower results in optimised growth light output.
- Ceramic discharge tube with PIA technology for long and reliable lifetime.
- ZrAl getter ensures excellent growth light maintenance over life and fewer premature failures.
- Simple and robust construction for enhanced reliability and longer life.
- Lead free solder.

Benefits

- High growth light maintenance safeguards a constant crop quality and quantity over life.
- Optimised performance for horticultural applications.

Comparison of 400V system with 230V system

- Lower installation cost.
- Very low 3rd harmonic.
- Improved growth light, +4,5%.

Application

- Horticultural lighting, intended for the stimulation of CO_2 uptake for improved photosynthesis and plant growth.

Gear

- The lamp requires a ballast and ignitor in accordance with the IEC HPS Plus standard.

Recommendation lamp replacement

- Luminaire must be disconnected from the mains before lamp replacement because outer ring of the lamp holder is connected to a phase and therefore live.

Product information

	Growth light PPF* (initial)	Lifetime	Maintenance (nominal)
MASTER GreenPower 600W/400V	1150 µmol/sec	10.000 hrs	> 92% at 10.000 hrs

* PPF information: see page 3

MASTER

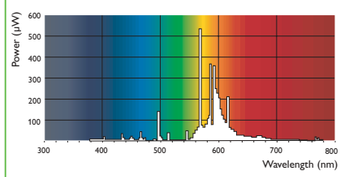
Perfect light, perfect sense

MASTER Agro T 400W for 230V single phase systems





MASTER Agro T 400W EM 230V



Lamp

MASTER Agro lamps are High Pressure Sodium Lamps with a ceramic discharge tube, enclosed in a clear tubular outer bulb with an increased output of blue light designed for horticultural purposes.

Features

- Agro results in extra blue in the spectral energy distribution.
- Ceramic discharge tube with PIA technology for long and reliable lifetime.
- ZrAl getter ensures excellent growth light maintenance over life and fewer premature failures.
- Simple and robust construction enhancing reliability and longer life.
- Lead free solder.

Benefits

- High growth light maintenance safeguards a constant crop quality and quantity over life.
- Especially at lower lighting levels the spectrum of the MASTER Agro lamp will result in a more compact plant development for certain plants and can optimise plant development and quality with good leaf, bloom color and extra branching.

Comparison of MASTER Agro with MASTER GreenPower

- MASTER Agro lamps are designed for applications with low light levels. The extra blue in the spectral energy distribution results in more compact and sturdy plants.
- MASTER GreenPower lamps are designed for optimal growth light output over lifetime based on an optimal spectral energy distribution for the light sensitivity curve of plants.

Application

- Horticultural lighting, intended for the stimulation of CO_2 uptake for improved photosynthesis and plant growth.

Gear

- The lamp requires a ballast and ignitor in accordance with the IEC HPS Plus standard.

Product information

	Growth light PPF* (initial)	Lifetime	Maintenance (nominal)
MASTER SON-T PIA Agro 400W	660 µmol/sec	10.000 hrs	> 85% at 10.000 hrs

* PPF information: see page 3

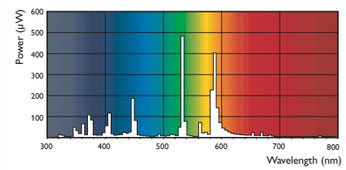
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MASTER HPI-T Plus 400W for 230V single phase systems





MASTER HPI-T Plus 400W 230V



Lamp

MASTER HPI-T Plus lamps are Metal Halide Lamps with a quartz discharge tube, enclosed in a clear tubular outer bulb.

Features

- 3 band technology resulting in high luminous efficacy, both initially and over long lifetime.
- 3 band technology resulting in high color stability for stable plant growth over lifetime.
- Runs both on HPI gear and for higher growth light output on SON gear.

Benefits

- Minimal maintenance cost.
- Initial investment saving options when run on SON ballast resulting in higher growth light output.

Applications

- Horticultural lighting, intended for the stimulation of CO_2 uptake for improved photosynthesis and plant growth.
- Horticultural applications with low levels of daylight in combination with SON lamps.
- Horticultural applications without daylight like growing chambers.

Gear

- Can be run on HPI gear as well as SON gear, resulting in different light output and color temperature.

Recommendation lamp usage

- Luminaire with protective front glass is required.

Product information

	Growth light PPF* (initial)	Lifetime	Maintenance (nominal)
MASTER HPI-T Plus (on SON gear)	540 µmol/sec	7.000 hrs	> 85% at 7.000 hrs
MASTER HPI-T Plus (on HPI gear)	490 µmol/sec	7.000 hrs	> 85% at 7.000 hrs

* PPF information: see page 3

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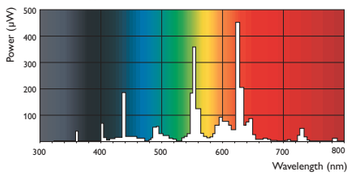
MASTER TL-D

Reflex Super 80

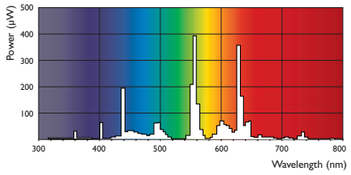


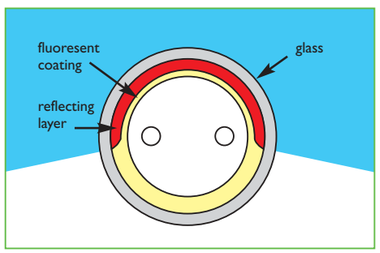


Spectral energy distribution MASTER TL-D Reflex/830



Spectral energy distribution MASTER TL-D Reflex/840





Lamp

MASTER TL-D Reflex lamps are fluorescent lamps with an internal reflector to concentrate the lamplight in the direction in which it is needed.

Features

- Internal reflector with an opening angle of 160° increases the light intensity by 60%.
- High growth light maintenance.
- MASTER TL-D Reflex lamps are 100% retrofit with all TL-D lamps with similar wattage.
- Recyclable; mercury, phosphor and glass can be re-used in production of new TL-D lamps.

Benefits

- Lower initial investment because of built in reflector.
- Internal reflector reduces used space in multi layer cultivation.
- Light output is hardly affected in environments subject to dust accumulation.

Comparison of MASTER TL-D Reflex with standard TL-D

- Up to 60% higher light output resulting in higher yield for existing installation or less battens for new installations.
- 60% longer service lifetime reduces the maintenance and relamping cost.

Applications

- Cultivation of plants without daylight.
- Growth chamber or cabinet with possibility to grow plants in multiple layers.

Gear

- Operates both on conventional but preferably on HF control gear.

Product information

	Growth light PPF* (initial)	Lifetime	Maintenance (nominal)
MASTER TL-D Reflex Super 80 36W	47 µmol/sec	12.000 hrs	> 90% at 12.000 hrs
MASTER TL-D Reflex Super 80 58W	73 µmol/sec	12.000 hrs	> 90% at 12.000 hrs

* PPF information: see page 3

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Perfect light, perfect sense

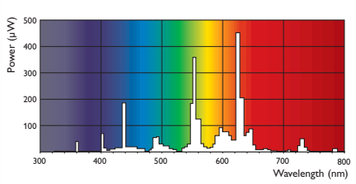
MASTER TL-D

Secura Super 80

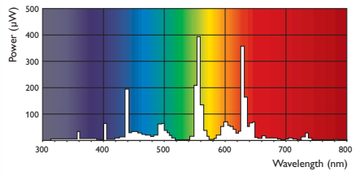


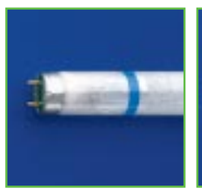


Spectral energy distribution MASTER TL-D Secura/830



Spectral energy distrubition MASTER TL-D Secura/840





Secura



Standaard TL-D

Lamp

- MASTER TL-D Secura lamps are fluorescent lamps with an external transparent protective coating.

Features

- External transparent protective coating.
- Easily identified by a blue ring at the end of the lamp.
- High growth light maintenance.
- MASTER TL-D Secura lamps are 100% retrofit with all TL-D lamps with similar wattage.
- Recyclable; mercury, phosphor and glass can be re-used in production of new TL-D lamps.

Benefits

- Protective coating safely retains all glass and other lamp components if the lamp breaks.

Comparison of MASTER TL-D Secura with standard TL-D

- Up to 30% higher light output resulting in higher yield for existing installation or less battens for new installations.
- 60% longer service lifetime reduces the maintenance and relamping cost.
- Protective coating ensures a safe environment without the possibility of glass fall.

Applications

- Cultivation of plants without daylight.
- Growth chambers or cabinets where safety is essential.

Gear

- Operates both on conventional but preferably on HF control gear.

Product information

	Growth light PPF* (initial)	Lifetime	Maintenance (nominal)
MASTER TL-D Secura Super 80 36W	45 µmol/sec	12.000 hrs	> 90% at 12.000 hrs
MASTER TL-D Secura Super 80 58W	70 µmol/sec	12.000 hrs	> 90% at 12.000 hrs

* PPF information: see page 3

MASTER

Perfect light, perfect sense

Flower Power Pro

100W





Lamp

- Flower Power Pro is an incandescent lamp with internal mirror reflector for horticultural applications.

Features

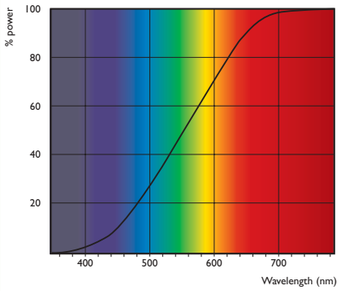
- Built-in reflector eliminates the need for an external reflector system.
- Corrosion free nickel-plated brass cap.

Benefits

- Can directly replace existing 100W and 150W lamps.
- Internal reflector ensures that all light is directed to where it is needed.

Comparison of Flower Power Pro with Superlux Agro Pro

- For less energy consumption;
  Flower Power Pro 100W with a lifetime of 1.000 hrs.
- For longer lifetime;
  Superlux Agro Pro 150W with a lifetime of 2.000 hrs.



Applications

- Photoperiodic lighting in greenhouses.
- To prolong the short days during autumn, winter and spring.

Application advice

- In an installation of 3 x 3.2 m the Flower Power Pro has an installed output of 10.4 w/m^2.
- For stock plants; one lamp per 7.5 m^2.
- For cut-flowers; one lamp per 9.6 m^2.
- Minimal distance of 80 cm between possible obstacle and plants should be maintained due to shadow casting.
- Minimal distance between lamp and plant (Hnett) is 2 m, perpendicular to the plants.
- Nominal voltage variations can influence the lifetime of the lamps.

Product information

	Light intensity at Hnett = 2 m and 1 lamp per 9,6 m^2	Lifetime (average)
Flower Power Pro 100W	100 lux (min/max > 70%)	1.000 hrs

Pro
The quality of light

Superlux Agro Pro

150W





Lamp

- Superlux Agro Pro is an incandescent lamp with a mushroom shaped white coated bulb for horticultural applications.

Features

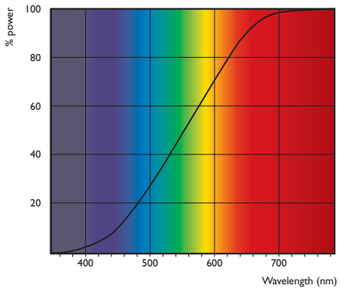
- Internal white coating eliminates the need for an external reflector system.
- Corrosion free nickel-plated brass cap.
- Double lifetime compared with standard incandescent lamps.

Benefits

- Can directly replace existing 150W lamps clear or diffuse.
- Internal white coating ensures that all light is directed to where it is needed.

Comparison of Superlux Agro Pro with Flower Power Pro

- For longer lifetime;
  Superlux Agro Pro 150W with a lifetime of 2.000 hrs.
- For less energy consumption;
  Flower Power Pro 100W with a lifetime of 1.000 hrs.



Applications

- Photoperiodic lighting in greenhouses.
- To prolong the short days during autumn, winter and spring.

Application advice

- In an installation of 3 x 3.2 m the Superlux Agro Pro has an installed output of 15.6 w/m^2.
- For stock plants; one lamp per 7.5 m^2.
- For cut-flowers; one lamp per 9.6 m^2.
- Minimal distance of 80 cm between possible obstacle and plants should be maintained due to shadow casting.
- Minimal distance between lamp and plant (Hnett) is 2 m, perpendicular to the plants.
- Nominal voltage variations can influence the lifetime of the lamps.

Product information

	Light intensity at Hnett = 2 m and 1 lamp per 9,6 m^2	Lifetime (average)
Superlux Agro Pro 150W	100 lux (min/max > 70%)	2.000 hrs

Pro
The quality of light

Philips Lighting

Lamps Europe - Professional Lamps

www.horticultural.lighting.philips.com

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