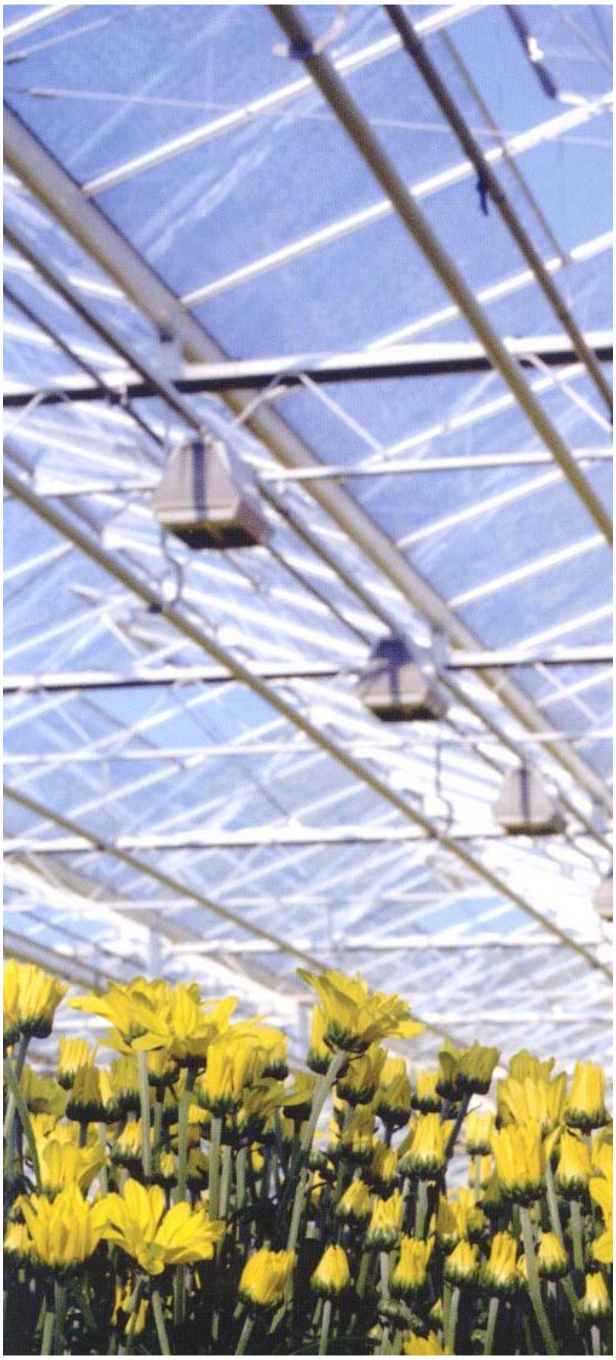
Inspection and Maintenance of Assimilation Lighting



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Regular Maintenance for Maximum Output

Assimilation lighting is part of the electrical installation, which in itself is sufficient reason to have the installation checked on a regular basis. Although most growers replace lamps and clean reflectors at regular intervals to ensure that their crops are well-lighted, the actual maintenance of the system often leaves much to be desired. Besides lamps, a number of components of the lighting installation require technical attention. Examples include the Total Energy (TE) installation, which is usually covered by a service contract with the supplier. In accordance with NEN 3140, NEN 1010 and/or other regulations, a number of elements of the electrical installation should be regularly inspected by a certified electrical contractor. Also, a well-maintained lighting installation will enable the grower to control operational costs, safety, and the reliability of the installation.

This manual “Inspection and Maintenance of Assimilation Lighting” has been drafted specifically for electrical contractors. The manual deals with the necessity for zero-measurement, timely replacement of lamps, inspection of the fixtures, and parts replacement. This manual has been drafted by suppliers of assimilation lighting and aims to promote improved reliability of lighting installations. The manual also aims to increase growers’ awareness of the necessity for regular maintenance.

Lamps and Fixtures

There are several suppliers that offer maximum reliability through lamp warrantee plans. This means that guarantee conditions also cover lamp failure, which means that the all-important aspect of continuity is optimized.
Nevertheless, several different problems may cause substandard performance of the assimilation lighting system. For instance, broken lamps that are not replaced will cause the igniter to continue to pulsate, which will have an adverse effect on the life of the igniter. The new ‘automatic cutout’ type 400V installations are an exception to this rule, in that they are not affected by lamp failure (see also appendix I).

Loose Lamp Connections
Lamps that burn alternately could be the result of loose connections in either lamp or fixture. In practice, a tap on the fixture will often cause the lamp to light up. After a certain amount of time, these lamps usually switch off again. Loose connections in lamp or fixture may lead to high voltage peaks and subsequently cause igniter failure. Therefore, it is important to repair the defect as soon as possible.

End of Lamp Life Cycle
When a lamp has reached the end of its life, it will often fail and once it has cooled off, switch on again. This is also referred to as cycling or reciprocating of a lamp.
This is a signal that the lamp should have been replaced earlier! This untimely replacement of lamps has an adverse effect on the life of the fixture components.

Group Replacement

The components of the assimilation lighting assembly influence one another during their useful life. If well tuned, the system will run smoothly and group replacement will not be a problem. During the process of lamp replacement, it is advisable to start by substituting a small number of lamps and to subsequently assess any adverse consequences. In practice, the capacitor quality could be substandard, or the installation may be overloaded. If necessary, lamp and capacitor replacements can be combined (see appendix 2 Group replacement).

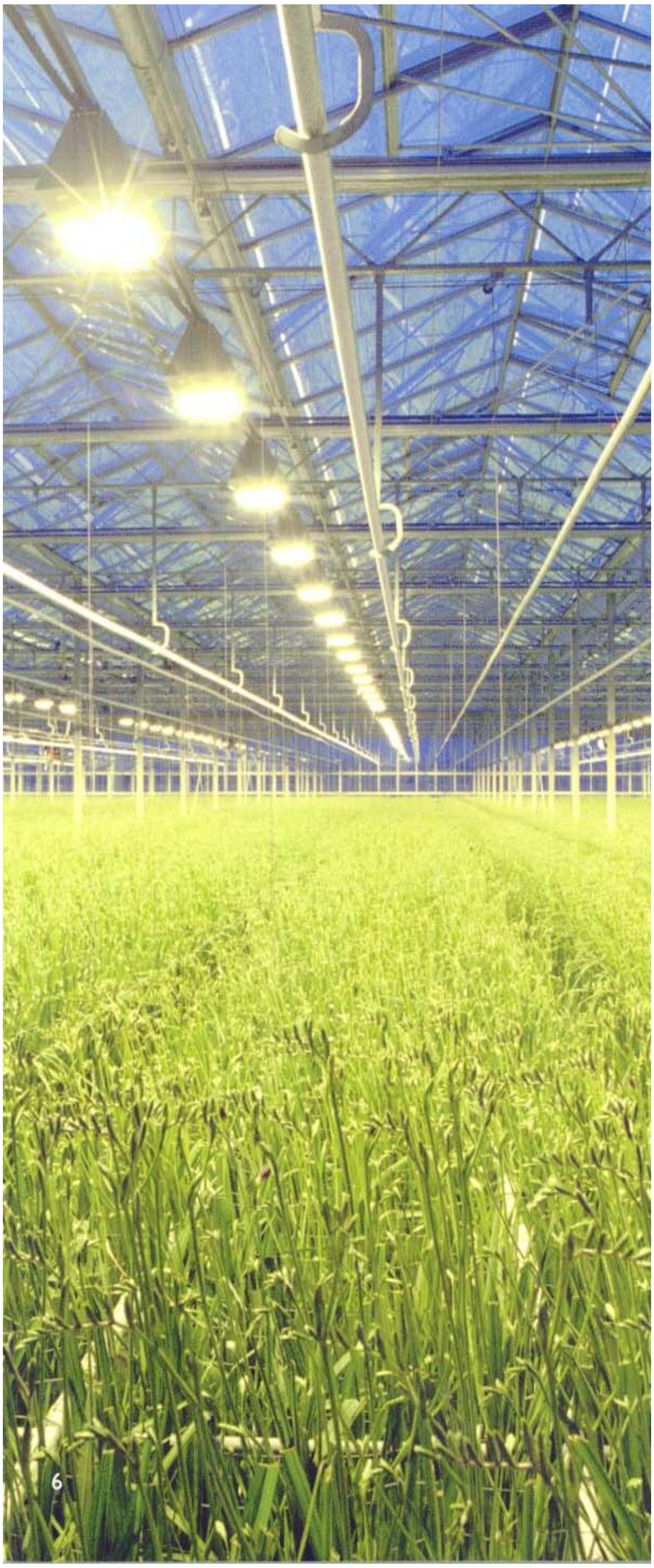
Fixtures

Fixtures may also be the cause for substandard performance of the installation. Amongst others, capacitors are applied in the fixture to limit the current in the fixture (reactive current/buffer). The life of these capacitors is 30,000 hours (NEN 6048/6049 standard). During the life– in practice this is approximately 8 years – the value of the capacitors will slowly decrease. Harmonic distortion of the mains voltage causes a substantial decrease in the life of the capacitors, as do voltage peaks and/or elevated temperatures. If the harmonic distortion is higher than indicated by IEC (see appendix 3), this will also lead to additional heating of the cables, distributors, fixture connections and components. These factors, or the ageing process (f.i. corrosion) of the installations may cause failing connections in the installation.

Zero-measurement

In order to detect deviations, the lighting installation will have to be tested on a regular basis (conducted on a yearly basis after the first three years). For new installations, it is advisable to execute zero-measurements (after 100 hours and with a fully operational lighting installation) to determine contributing factors like harmonic distortion. It is also advisable to record the measurement data in a report (see appendix 4), allowing you to compare the results of subsequent measurements with present readings.

Points of Attention in Inspection and Maintenance



1. Is the installation drawing available and has this been updated?

2. Assessment of the distributors (main distributors and subdistributors)

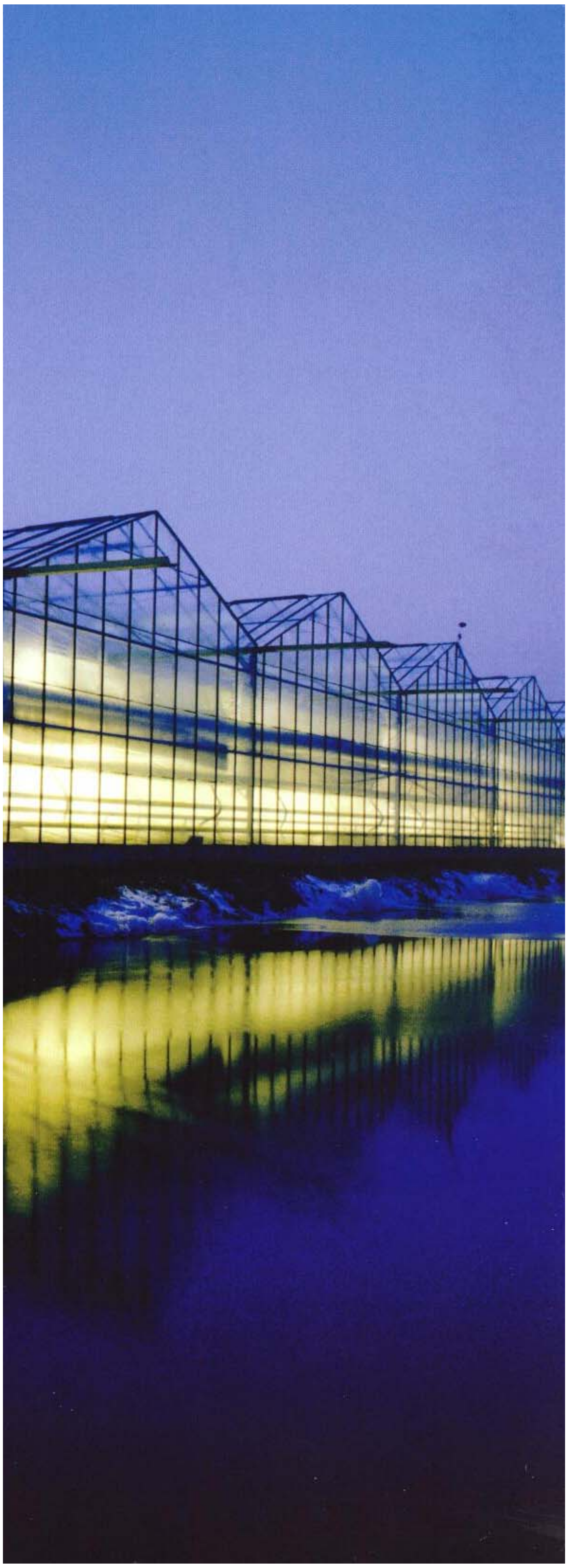
3. Mains voltage analysis (distortion of mains voltage, current, power factor/cos phi, and voltage measurement).
During these measurements, the entire lighting installation should have burned for at least an hour, to ensure that it is no longer in the start-up phase.
The sample report (see appendix 3) list the measurements that should at least be performed (a/o PF (cos φ)=min 0.85).
Measurement in the subdistribution stations at strict level!

4. Capacitance measurement of the capacitors.
In order to secure representative results, a minimum number of capacitors (1% of the total number of fixtures with a minimum of five) should be measured.
The report includes the measured and initial capacitance values of the capacitors.
As a rule of thumb, capacitors should be replaced if their values have declined more than 11-15%.

5. Visual inspection of the fixtures.
Simultaneously with the capacitance measurement of the capacitors, fixtures should also be inspected for loose contacts, and signs of wear and overload (discoloration of contact blocks and isolation materials). This should also be executed with 1% of the fixtures, with a minimum of five.

6. External switching devices like field break switches may also cause failure.

Appendix I



Preventing problems by using reliable lamps
Philips has designed the MASTER SON-T PIA Green Power lamps specifically for Horticultural purposes. These lamps are so sturdy and reliable, that they are covered by the Warrantee Plan Assimilation Lighting. Philips guarantees the MASTER SON-T PIA Green Power lamps for up to 10,000 hours or three lighting seasons. Users also receive warrantee on light reduction throughout the life of the lamp, which is up to 10,000 hours or three lighting seasons. In the event of lamp failure during the warrantee period, Philips will supply a replacement lamp via your electrical contractor. Philips guarantees its 600W lamps for 10,000 hours or 3 years and 400W lamps for 12,000 hours or 4 years (normal use).

Everyone benefits
The benefits of the Lamp Warrantee Plan are apparent, both for growers and electrical contractors. Growers will benefit from increased operational reliability, lower replacement costs, and budgeted replacement costs. Since crops grow more evenly under optimal light distribution and with a consistent high lighting level, both crop quality and quantity will be at their best. Electrical contractors will be able to replace lamps in sizeable batches, for instance during the regular maintenance runs of the lighting installation.

Appendix 2

Points of attention in group replacement of horticultural lamps
During lamp replacement, a number of issues should be taken into consideration. The following text will clarify the correlation between the different components in the lighting installation, and any consequences and recommendations in order to solve possible problems.

General information:
A lighting system consists of different components: Lamp (bulb), ballast, igniter, capacitor, housing, reflector, mains voltage installation, cables, filters, switch boxes, etc.
To avoid confusion, we will define the following terms:
The lamp (also referred to as bulb) is the light emitting entity consisting of a glass balloon with a metal cap.
The fixture is the housing in which lamp, ballast (vsa), igniter, capacitor, and the reflector have been mounted.

Tolerance and dispersion:
All of the above components exercise a certain degree of influence one another during their life. Well tuned systems will function smoothly and will allow for uncomplicated group replacement cycles.
However, the tolerance of the components has a normal (average) value in the beginning of the life cycle. Over time, these values of the different components will decrease due to normal wear. Each component is subject to dispersion. In lamp replacement, the decay of the values and the dispersion of the components during their life will sometimes cause problems. Such occurrences may have a limited duration (100-200 hours), but they can also be more persistent.

Spare capacity:
When setting up a lighting system, please note that calculations of the available capacity of the installation (TE or other electrical connection) allow for a margin, and that dispersions and decrease of the values mentioned above are taken into consideration. Most electrical contractors are well aware of such factors and take them into account.

The relation between lamp, ballast, capacitor, and current:
The discharge tube of the lamp (the luminous part of the lamp) has a certain electric potential (lamp voltage). In order to realize the best possible light output, the voltage has to be limited. This is realized by mounting a ballast between the power supply and the lamp (ballast = choke). However, the ballast will cause the current to lag the voltage, causing the power factor (cos φ) to drop below 0.5. This is a situation that the electricity companies will not accept, and that is not beneficial to the proper operation of a TE. If current and voltage are not in step, the apparent potential is higher than if they are. This means that, to satisfy the demand, increased power will have to be supplied via the mains. Therefore, electricity companies demand a reasonable ratio between the apparent potential (AP) and the actual potential (W). This ratio, which has to be at least 0.85, is referred to as the power factor (cos φ = cosine phi).
Mounting a capacitor with a pre-lagging current and a given value (see diagram), will cause the power factor to exceed the 0.85 requirement.

Relation between lamp and cos φ:
A low lamp voltage means that a greater current is required, and will result, together with a lower capacitor value, in a decreased (too low) power factor (and vice versa). In order to gain a better understanding of this relation, we will provide some additional information on the individual components.

The lamp:
A 600W lamp has a nominal lamp voltage of 110V. The admissible dispersion in accordance with IEC (international) standards at 100 hours is app. 15V. Therefore, the value of individual lamps may vary between 95V and 125V, and the average batch value will be between 100 and 120V. During the life cycle, the lamp voltage may increase to up to 150V.
The lamp that is most commonly used is the SON lamp, a high-pressure gas-discharge lamp, with a "burner" (discharge tube) that is filled with sodium-mercury amalgam and xenon gas. It will take 100 burning hours before new lamps have stabilized in both lamp voltage and operation. During this induction period, the lamp voltage may be slightly decreased.

The capacitor:
The capacitors have a nominal value, with a tolerance of up to 10%. The minimum capacitor value has to be set to ensure that a > 0.85 power factor can be obtained after group replacement.

Recommendation:
It is because of the above that group replacements require sample measurements of the capacitors to determine if the output is still acceptable. If the value measured is low, the capacitors have to be replaced in advance of group replacement of the lamps.
In accordance with NEN 3140, regular maintenance should be performed on the installation. Parameters that could be checked are electrical parameters such as mains voltage, distortion, and power factor.

Caution:
If the capacitor value in the installation is low and the lamps have to be "burned in" at a low lamp voltage, this may cause the power factor to drop below 0.85. However, such situations usually last for a relatively short period of time.

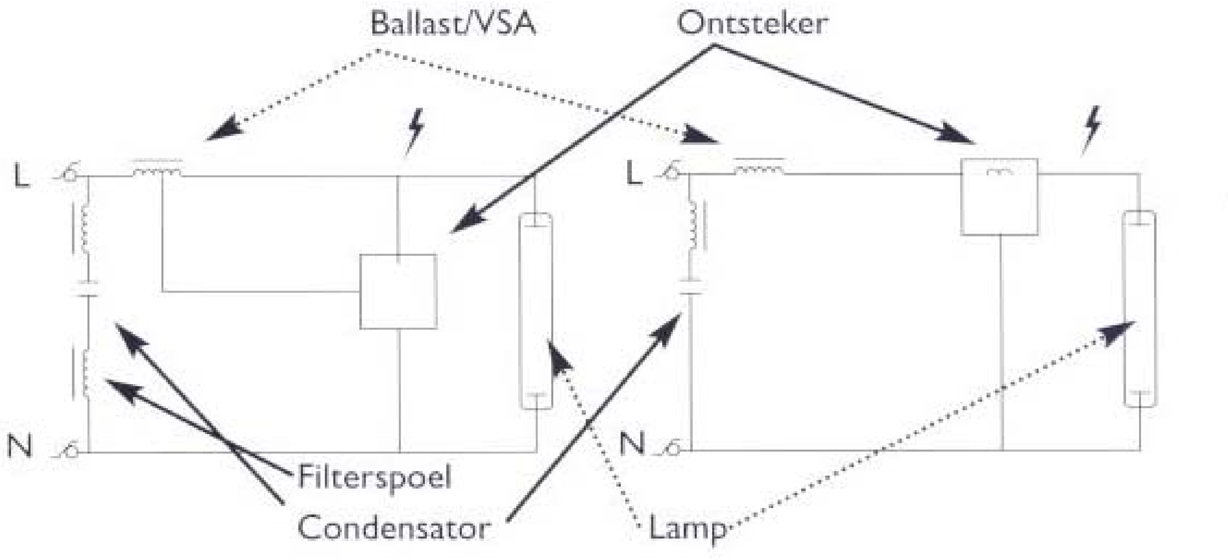
Recommendation:
A low power factor measured during the start up of the installation, means that you are well advised not to switch on all lamps at the same time. In such cases, the solution could be to phase the burning in process, f.i. in three groups, at a time interval of 100 hours.

If the average batch value of the lamp voltage is at the low end of the tolerance (f.i. 100V), combined with a low capacitor value, this will cause the power factor (PF) to be low for a considerable period of time.

Recommendation:
If low capacitor values are measured during the group replacement process, the best method is to replace lamps in stages, f.i. 1/3rd at the beginning of the lighting season, 1/3rd at the end of the year, and 1/3rd at the beginning of the following lighting season.

If the lamp base or the centre contact of the lamp has been burnt, also check the lamp fixture and replace if required. Fasten lamps properly.

Possible systems:
Semi-parallel igniter system   Serial igniter system



Appendix 3 Harmonic distortion

Odd harmonics (not a multiple of 3)			Odd harmonics (multiple of 3)			Even harmonics		
Harmonic sequence n	Harmonic voltage %	Harmonic current %	Harmonic sequence n	Harmonic voltage %	Harmonic current %	Harmonic sequence n	Harmonic voltage %	Harmonic current %
5	6	10	3	5*)	30xPF	2	2	2
7	5	7	9	1.5*)	5	4	1	
11	3.5	3	15	0.3		6	0.5	
13	3		21	0.2		8	0.5	
17	2		>21	0.2		10	0.5	
19	1.5					12	0.2	
23	1.5					>12	0.2	
25	1.5							
>25	0.2 + 1.3.25/n **)							

**) Values listed for the 3rd and 9th harmonics relate to single-phase networks. The levels in three-phase networks are at approximately 1/3rd of the values listed above.*

***) This compatibility formulation incorporates possible resonance conditions in the network. For substantial charges, target values have been established to limit the present emissions, which may depend upon the network impedance (depending on the conditions agreed between supplier and customer). These target values can be represented by the formula 0.2 + 0.5 x 25/n, and are below the compatibility level.*

Limit value guidelines
230V installation: THD volt. Max app. 6%; THD current max app. 25%
400V installation: THD volt. Max app. 4%; THD current max app. 4%
Source: EnergieNed – guidelines for admissible harmonic currents.

Appendix 3 Harmonic distortion

Sample report of assessment assimilation lighting installation

Installation data:

Project:			Address:			
Power supply	O Public net O WK-installation (island) O WK-installation (parallel to the net)					
Department	Fixtures					Lamps
	product	Type	Capacity (W)	Date installed	Number	Burning hours

Measurement main distributor:

Phase	Voltage (V)	Current (A)	PF (cos φ)	THD RMS Voltage	THD RMS Current
L1					
L2					
L3					
N					
Distortion. Include a print of the measurement, stating both harmonic distortion of both current and voltage (a/o the 3rd, 5th, 7th, 9th, 11th)					

Serial measurement:

Nr.in department	Phase	Voltage (V)	Current (A)	PF (cos φ)	Number of fixtures	THD RMS Voltage	THD RMS Current
	L1						
	L2						
	L3						
	N						
	L1						
	L2						
	L3						
	N						

Capacity measurement capacitors (total capacity (µF) per fixture):

Fixture from dept.	Replacement value	Value measured	Fixture from dept.	Replacement value	Value measured

Observations/details:

For instance: visual inspection findings, previously executed maintenance (e.g. replacement of capacitors), date/findings previous measurement, earlier problems (e.g. defective fixture)	

Assessment performed by:

Name company:	Name inspector:
Telephone number:	Date inspection:

Philips Nederland b.v. – licht
Boschdijk 525
NL-5621 JG Eindhoven
Tel.: +31(0)40 278 75 00 (Information)
+31(0)40 278 75 01 (Dokumentation)
www.horticultural.lighting.philips.com
www.lighthouse.philips.com

Hortilux Schréder b.v.
Vlotlaan 412
NL-2681 TV Monster
Tel.: +31(0)174 28 66 28
E-Mail: info@hortilux.com
www.hortilux.com

Industria Technische Verlichting b.v.
Rietbaan 10
NL-2908 LP Capelle a/d IJssel
Tel.: +31(0)10 264 01 64
www.industria.nl

Lights Interaction Agro b.v.
Lage Dijk 29 d
NL-5705 BX Helmond
Tel.: +31(0)492 35 94 85
E-Mail: info@lights-interaction.com
www.lights-interaction.com

AVAG-Platform Toeleveranciers Glastuinbouw
Postbus 146
NL-2690 AC 's-Gravenzande
Tel.: +31(0)174 44 66 60
E-Mail: info@avag.nl
www.avag.nl

Interpolis Agro
Postbus 456
NL-2260 ME Leidschendam
Tel.: +31(0)70 452 45 00
www.interpolis.nl/agro