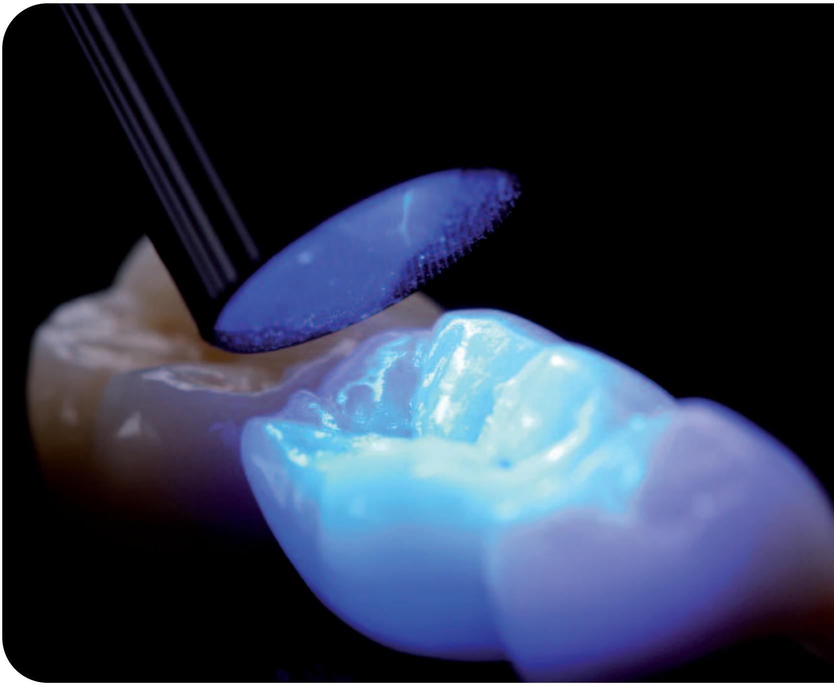


It's good to know the facts

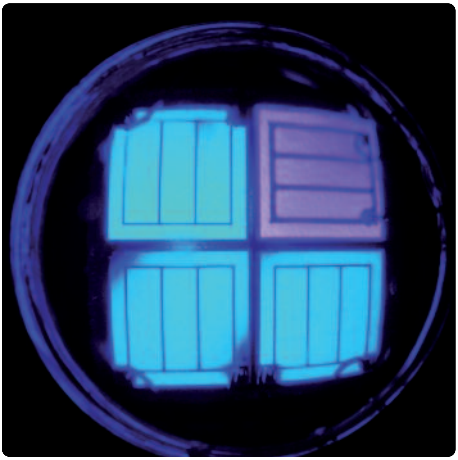
ivoclar vivadent
passion vision innovation

User's Guide

to the clinically relevant criteria for selecting a polymerization light

Light-emitting diodes: a story of success

Were we able to look into the future, we would see LEDs everywhere around us. In the past, LEDs were mainly used for advertisement signs and as background light, but LEDs are being used for an increasing number of applications, ranging from architecture and lighting design to traffic signals and even medicine. The full potential of this young and promising technology has not been realized yet. Given their superior technical properties, LEDs offer an immense potential for innovation and growth. LED lights are not only much more energy-efficient than conventional halogen lamps, but they also offer an unmatched service life.



Requirements of clinicians

LEDs have become an integral part of the light-curing procedure in the dental practice. A wide variety of polymerization lights were introduced into the market over the past few years. These lights do not only allow to cure restorations thoroughly, but they also raise many questions, such as "What light intensity is required?" and "How long does it take to cure the restorations?" or "Which materials are cured, which aren't?".

Given our experience with light-curing materials, such as Tetric EvoCeram, we have decided to summarize the most important information about this promising technology. This User's Guide provides an insight into the decisive product features and clinically relevant criteria which are crucial for the daily use of LED curing lights.

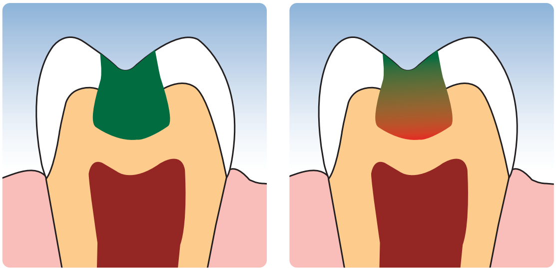
Sufficient curing, the main objective of the treatment

Sufficient curing is the prime concern of polymerization. A restoration made of light-curing materials will only be a long-term success if it is sufficiently cured. Insufficient polymerization may result in sensitivities, discolouration and the formation of marginal gaps and increased abrasion. As the surface of light-curing composites appears hard after only short curing, it is impossible to determine the polymerization quality in practice, neither by tactile means using a probe nor using other instruments.

The physical values of the entire cured material are what matters. This includes the achieved hardness – in particular on the bottom side of the restoration –, the flexural strength and elasticity as well as the abrasive values. The specifications of the manufacturers regarding the gentle curing of the various materials are an important guideline. At least well-known suppliers base such recommendations regarding curing time and program on clinical tests with various materials and various layer thicknesses.

Sufficient curing depends on many factors. The most important ones are, however, high light intensity and the activation of the photoinitiators used, i.e. the suitability of the curing light for the materials used.

Light-curing materials, such as composites, are mainly composed of organic monomers and inorganic fillers.



The surface of the restoration is correctly cured (green) in both the entirely cured (left) and the insufficiently cured restoration. The risk presented by insufficient polymerization (red) in deep areas of the restorations cannot be identified from the surface.

The various photoinitiators

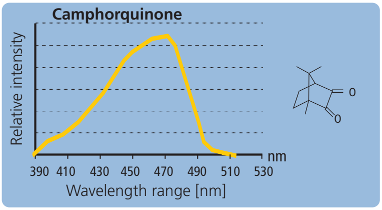
In order to transform a monomer into a polymer, photoinitiators, which break down into radicals when irradiated with light and thus cause a polymerization reaction of the monomers, are required. The most commonly used initiator is camphorquinone.

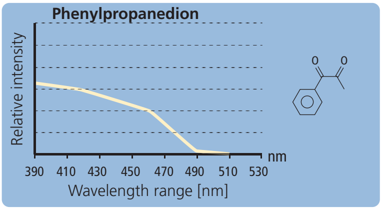
Camphorquinone absorbs light in the wavelength range between approx. 390 and 510 nm and displays a yellow colour, which unfortunately also affects the shade of the cured restoration. Composites in Bleach shades, which are used for very light restorations that match the shade of bleached teeth, but also other materials such as adhesives, contain, among other things, also whitish photoinitiators, such as phenylpropanedion (PPD) or Lucirin TPO, which absorb light in the wavelength range between 380 and 430 nm.

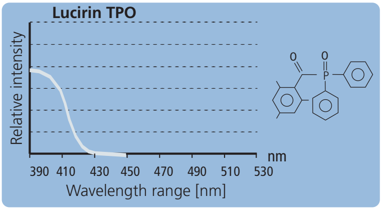
Camphorquinone

Lucirin TPO

The ability of a curing light to cure all materials, therefore, decisively depends on the wavelength range that is emitted by the light. Given their broadband emission spectrum, halogen lights activated the various initiators without any problems. Because they typically have a narrow emission spectrum, conventional LED lights are not automatically suitable to universally cure all materials. Today, however, there are LED curing lights which generate blue light in the range between 380 and 515 nm and which are thus suitable for all light-curing materials.



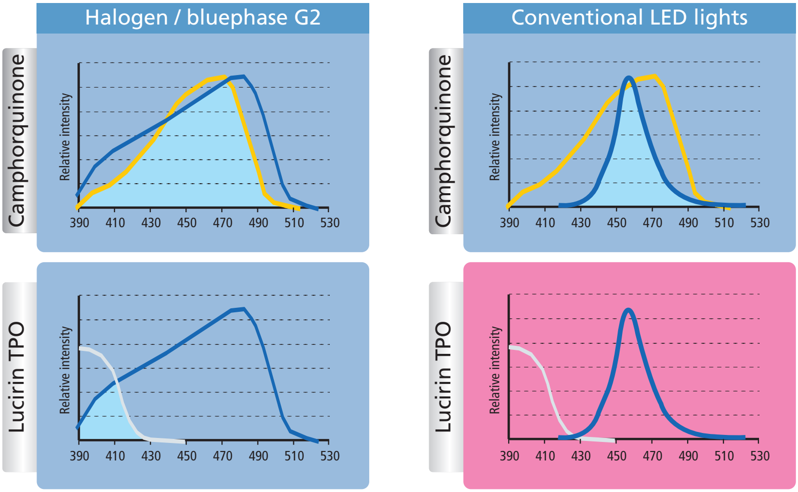




Structural formula and absorption spectrum of camphorquinone, PPD and Lucirin TPO

Wavelength range

LEDs in general have a more limited light spectrum than halogen lights. Therefore, the polymerization of materials which do not exclusively contain camphorquinone as photoinitiator might be problematic even when modern LED lights are used. Depending on the polymerization light used, this may be the case with very light composites (Bleach shades) and special adhesives. In such situations, lights with a spectrum which is not designed to match only the absorption maximum of camphor-quinone, such as the new bluephase, offer significant advantages.



Complete curing is only provided when the overlap (light-blue) between the emission spectrum of the light (dark-blue line) and the absorption spectrum of the photoinitiator (yellow/white line) is sufficient.

In order to safely use the materials in the own practice, a negative list of the incompatible materials is required from the manufacturer of conventional LED lights.

Compatibility

The materials listed below, among others, are known to be problematic. Depending on the LED curing light that is used and the light emission spectrum, the material and the light may be compatible or incompatible.

Restorative composites

- Pyramid enamel A1, N and T from Bisco
- Solitaire 2 from Heraeus Kulzer

Adhesives

- Touch & Bond from Parkell (compatible successor product: Brush & Bond)
- AQ-Bond from Sun Medical (compatible successor product: AQ-Bond plus)

Luting composites

- Panavia F from Kuraray (compatible successor product: Panavia F2.0)
- Calibra opak from Dentsply

Light-curing protective varnishes

- BisCover from Bisco
- Luxaglaze from DMG
- Palaseal from Heraeus Kulzer
- Stern Vantage Varnish LC from Sterngold
- LLC Quik glaze from All Dental Prodx
- ProSeal

etc.

"Another obstacle for LED technology continues to be narrow spectral output that will not cure all current resin formulations."

"No one has a comprehensive list of incompatible products."

"Clinicians should verify compatibility of their light & resins."
(CRA, Vol. 30, Issue 2, February 2006)

" … most units only work with CQ [camphorquinone] photo-initiator … "
(The Dental Advisor, Vol. 23, No. 5, June 2006)

"… composite sample that appears hard may not be sufficiently converted …"

"Check with the resin manufacturer about compatibility."
(ADA, American Dental Association: Professional Product Review, Vol. 1, Issue 2, Autumn 2006)

"Resin glazes (clear) and bleach shades (white) of composites may not contain CQ … [and] require a curing light that emits light at a lower wavelength around 420nm."
(REALITY Now, #184, Nov'/Dec' 2006)

" … is the issue of LEDs not being able to cure all materials."

" … mandate that you still have a halogen around."

" … solution is to buy an LED that is capable of curing all materials."
(REALITY Vol. 20, 2006)

?

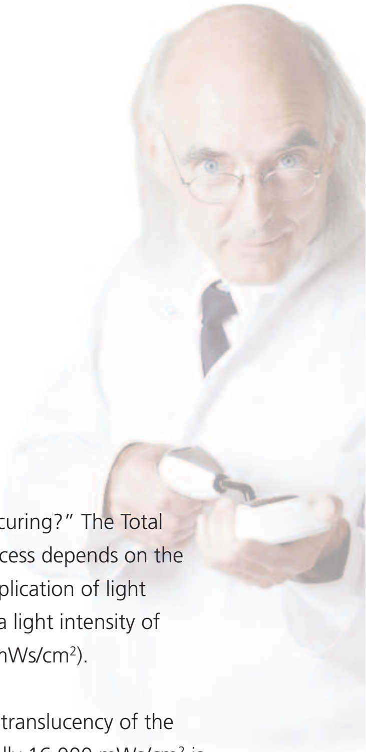
Is the light spectrum of the LED light similar to that of halogen lights?
If not, is a list of all incompatible materials supplied?
Am I using incompatible materials in my practice?

1,000 mW/cm²: the ideal value

Normal light is not enough to polymerize materials in the dental practice. For this process, energy-rich blue light is necessary. Already for direct restorations, an irradiance (commonly referred to as "light intensity") of at least 400 mW/cm² is required. The ideal value, however, is thought to be 1,000 mW/cm², in order to ensure that indirect restorations are also sufficiently cured when the irradiation takes place through the ceramic restoration or tooth substance. According to the Total Energy Concept, light intensities of more than 1,000 mW/cm² are necessary to provide adequate curing of composites in all sub-optimal but routine conditions in only ten seconds. If the light intensity is lower, the curing time is accordingly longer.

If the above prerequisites are not met, the composite or adhesive may be cured only insufficiently in deeper areas. Therefore, it is advisable to check the light intensity, which decreases in time, regularly. For that purpose, built-in or separately supplied radiometers or the integrating sphere are helpful tools.

Is the light intensity (at least) 1,000 mW/cm²?
Is a radiometer to check the light intensity available?



Light intensity

Total Energy Concept …

… or: "What curing time is required for successful curing?" The Total Energy Concept states that the light-curing process depends on the energy and is basically determined by the multiplication of light intensity and time (for example: 20 seconds at a light intensity of 800 mW/cm^2 = 20 s x 800 mW/cm^2 = 16,000 mWs/cm^2).

The required dose depends on the type, shade and translucency of the composite. As a general rule, a dose of maximally 16,000 mWs/cm^2 is required to adequately cure an increment of 2 mm – in some cases, the value might be lower. Based on this maximum value, various curing times can be calculated depending on the light intensity of the polymerization light used.

Total Energy Concept

$$\frac{\text{Dose}}{\text{Intensity}} = \text{maximum curing time}$$

Example bluephase:

$$\frac{16{,}000\ \text{mWs/cm}^2}{1{,}200\ \text{mW/cm}^2} = 15\ \text{sec}$$

Source: Koran P, Kürschner R, Effect of sequential versus continuous irradiation of a lightcured resin composite on shrinkage, viscosity, adhesion, and degree of polymerization; Am J Dent 10, 17–22 (1998)

Studies show:

Many lights do not keep their promises

Study conducted at the University of Mainz, Germany

Under the supervision of Prof. Dr C.-P. Ernst, co-workers of the Johannes Gutenberg University Mainz visited more than 300 dentists in the Rhine-Main area in 2005 to put the quality of curing lights in German dental practices to the test.

The light intensity of 660 curing lights used in the practices was analyzed in this field study. A particular feature of the test setting was that an integrating sphere was used. With this method, the absolute light intensity is measured very precisely.

What was striking about the findings was that one in two lights achieved a light intensity of merely 500 mW/cm², which is considered to be weak. Even more worrying was that most LED lights tested showed considerable fluctuations in the light intensity and even deviated considerably from the manufacturer's specifications. The majority of lights achieved only 70% of the indicated intensity.

Light intensity of LED curing lights

Unit	Manufacturer	Light intensity [mW/cm²]		Units with an intensity of < 70% of the value stated by manufacturer
		Value indicated by manufacturer	Mean value measured	
bluephase	Ivoclar Vivadent	1,100 (±10%)	1,066	0%
Smartlite PS*	Dentsply	950	927	0%
Mini L.E.D.*	Satelec	1,250	872	50%
FlashLite 1401*	Discus dental	1,400	859	88%
Radii*	SDI	1,400	825	86%
L.E. Demetron 1*	KerrHawe	1,000	699	67%
Elipar Freelight 2*	3M Espe	1,000	602	58%
Translux Power Blue*	Heraeus Kulzer	1,000	513	100%
Elipar Freelight 1*	3M Espe	400	231	88%

Light intensities indicated by the manufacturer and measured in the study

* Not a registered trademark of Ivoclar Vivadent

Source: C.-P. Ernst et al: Feldtest zur Lichtemissionsleistung von Polymerisationsgeräten in zahnärztlichen Praxen, DZZ 60 (2006) 9, 466 – 471

Study by the American Dental Association (ADA)

The American Dental Association conducted a similar study. The findings also showed that the actual intensity of the individual curing lights is often below the indicated value.

Such tolerances generally have to be compensated for by prolonging the curing times. However, users often do not know the precise intensity of the LED light they use. In too many cases, the corresponding information is missing.

The crucial factor is not the general light intensity, but the minimum intensity guaranteed by the manufacturer. This value can be found, for instance, in the instructions for use. Therefore, we recommend that you expressly ask the manufacturer for the minimum light intensity or check the light in question with a radiometer!

Unit	Manufacturer	Light intensity [mW/cm²]	
		Value indicated by manufacturer	Mean value measured
bluephase	Ivoclar Vivadent	1,100 (±10%)	1,076
L.E. Demetron II	KerrHawe	Ø 1,300	1,010
Epilar Freelight 2	3M Espe	1,000	673
Radii plus	SDI	1,500	635
Coltolux LED	Coltène	1,400	609
UltraLume LED5	Ultradent	>800	577
Smartlite IQ	Dentsply	900	544
FlashLite 1401	Discus dental	1,400	439

Source: ADA, American Dental Association: Professional Product Review, Vol. 1, Issue 2, Fall 2006

?

Is the minimum light intensity clearly defined, for instance in a statement regarding tolerance values in the instructions for use?

Inconsistent intensities …

… as a result of inconsistent quality

All manufacturers of polymerization lights for use in dentistry buy their LEDs from external suppliers. The quality of the light-emitting diodes available on the market can vary considerably. As the example of the world-leading supplier of blue power LEDs shows, the radiometric performance of the LEDs may be anywhere between 275 and 1,050 milliwatt. As the LED's radiometric performance has a direct influence on the light intensity of the polymerization light, significant differences between the actual light intensity and that indicated by the manufacturer may be found in some models.

It may therefore be that, instead of 1,050 mW/cm², only 275 mW/cm² become effective for curing a composite. As the individual light intensity can not be assessed in the daily routine, these extreme differences entail the risk of insufficient curing – with negative and immediately perceptible implications on the life span of a restoration.

BIN Code	Minimum radiometric performance (mW)	Maximum radiometric performance (mW)
N	275	355
P	355	435
Q	435	515
R	515	635
S	635	755
T	755	875
U	875	1050

(Data sheet of the world-leading LED manufacturer Lumileds Lighting, U.S., LLC, San Jose)

Due to production-related tolerances, the light intensity of the LED used may differ considerably. To ensure consistent successful curing, the selected curing time must be adjusted to the light output of the curing light used.

Interesting facts about the light probe

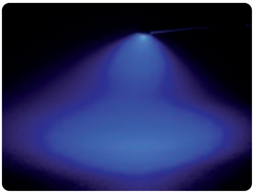
If a polymerization light is designed without a light probe and instead is equipped with an LED mounted at the front of the light-emission window, much of the intensity is lost due to scattering at a certain distance from the object to be cured. Fibreglass rods have proven themselves very adequate to reduce this loss due to scattering. These fibreglass rods consist of many individual glass fibres which are embedded in a protective glass case with a precisely defined light transmission.

This, however, does not eliminate the need to increase the curing times with increasing distance from the object to be cured. In the case of the popular turbo light probes, the effective energy decreases by up to 50% at a distance of 5 mm, which means that the curing time must be doubled according to the Total Energy Concept.

Given their outstanding light-scattering characteristics, parallel-walled (standard) light probes offer an advantage in this regard. The available energy is reduced by 50 % only at a distance of 9 mm.

Double curing time at a distance of …

LED mounted at the front



... approx. 2-4 mm

Turbo light probe

...approx. 5 mm

Standard light probe

... approx. 9 mm

Is the polymerization light designed with a parallel-walled light probe which consist of many individual glass fibres?

1, 2, 3 ... cured!

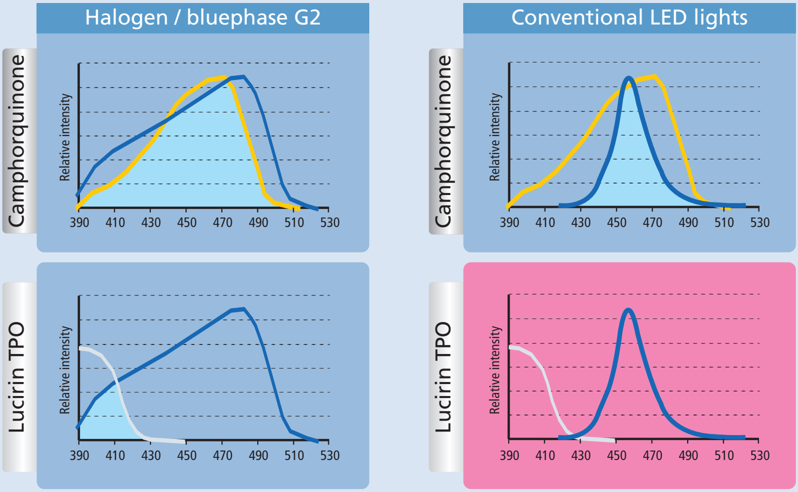
To summarize: Determining the required curing time in three steps

1

Check material compatibility

Not every conventional LED polymerization light is suitable to cure all light-curing materials.

Ask the manufacturer of your LED curing light whether it is compatible with the materials camphorquinone, Lucirin TPO and phenylpropanedion (PPD) – or ask the manufacturer of the composite which photoinitiators are contained in the composite.



Complete curing is only provided when the overlap (light-blue) between the emission spectrum of the light (dark-blue line) and the absorption spectrum of the photoinitiator (yellow/white line) is sufficient.

2 Calculate curing time

With the help of a simple equation you can easily calculate the curing time for composite restorations:

Total Energy Concept

$$\frac{\text{Dose}}{\text{Intensity}} = \text{maximum curing time*}$$

Example bluephase:

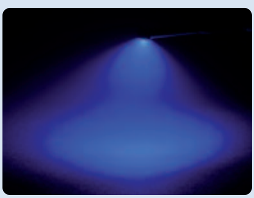
$$\frac{16{,}000\ \text{mWs/cm}^2}{1{,}200\ \text{mW/cm}^2} = 15\ \text{sec}$$

* applies to all conventional composites with a layer thickness of max. 2 mm and with the light probe placed directly on the restoration.

3 Take the distance from the object into account

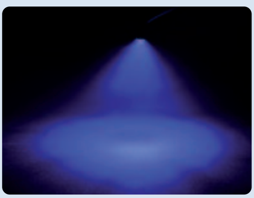
The curing time must be doubled if only 50% of the original intensity is available to cure the composite.

LED mounted at the front



... approx. 2-4 mm

Turbo light probe



...approx. 5 mm

Standard light probe

... approx. 9 mm

LEDs hot stuff!

Apart from sufficient curing, preventing damage to the tissue and the pulp is also a factor that needs to be considered. The blue light that is emitted is primarily energy. However, a part of the light energy directed at the tooth and gingiva is converted to heat. This holds true for any curing light, regardless of the type of light source.

Whether laser, plasma or LED lights are in use, they should always be used carefully and with the clinical common sense and knowledge. Under unfavourable circumstances, the irradiated tissue can be damaged if the light intensity is too high or if the tissue has been cured for too long.

Some like it hot – some DON'T

Heat is generated by the exothermic reaction and the irradiation energy during every polymerization; as a general rule, it can be stated that the higher the light intensity, the higher is the released energy and the perceived heat (and the shorter the required curing time). In order to prevent possible damage to the pulp or the soft tissue, polymerization lights should therefore always be used cautiously. The consensus in the scientific community is that the temperature of the pulp should not increase by more than 5.5°C (approx. 9°F). Manufacturers should be able to present the corresponding data regarding their product. More sophisticated LED lights additionally offer a choice between the full performance and a program with reduced intensity for sensitive areas.

? Are data regarding the heat development during polymerization available?

The required equipment for routine use

In the routine application, many other factors also play an important role for dentists. The polymerization light is the most-used product in the dental practice. Given this background, ergonomic factors are also relevant. Low weight and a balanced handpiece that allows a good grip are equally important. A cordless light offers maximum freedom of movement, and both dentist and patient are no longer bothered by the power cord. This, however, raises questions regarding the capacity and reliability of the battery. One of the main factors is the duration of continuous operation of the light. Nothing is more annoying than interrupting the treatment of a patient and therefore the procedure of the entire practice just because the battery is empty or the curing light needs to cool down for several minutes. In addition, special programs to reduce the shrinkage stress or heat development in areas near the pulp offer convincing advantages.

Design should suit your needs

LED lights are generally available in two versions: the pistol shape that is well-known from the halogen lights and the pen or bar shape. It is your choice which one you prefer. The pistol shape is not as futuristic and is often more comfortable to handle due to the balanced weight distribution as compared with pen-shaped lights. Generally, the weight and the angle of the light probe including the handpiece should suit the individual needs of the user. All of this has an influence on an ergonomic and comfortable use. If there are any selection keys, they should be easy to reach and easily readable.

Can I borrow the light for a day to test the ergonomic properties?

Modern batteries live longer

Due to their design, many LED lights are smaller and lighter than their halogen counterparts. As the power consumption is lower, LED polymerization lights can be efficiently supplied with power by a battery. The current standard is the lithium technology, which is very widely applied and used in billions of mobile telephones. Lithium-ion batteries are small and light, they have a long service life while the self-discharge rate is low, and they can be recharged in a short time. More than 500 charging cycles are possible – even many more if the battery is only partially discharged. Moreover, special protective circuits provide a high level of security.

The charger technology of lithium-ion batteries makes sure that there is no lazy battery or memory effect. This phenomenon causes older nickel-metal hydride and nickel cadmium batteries to lose part of their capacity prematurely and irreversibly. In other words: The lights still available today that use nickel-metal hydride batteries should be completely discharged before they are (completely) charged again. To prevent that time and capacity is lost, it is therefore recommended to completely discharge nickel-metal hydride batteries daily, if possible, and to recharge it overnight. Due to the comparably long charging times of several hours, the main switch must not be turned off. This requires a certain amount of discipline and entails regular monitoring – otherwise, it may be that the treatment of a patient may be delayed. It is only a matter of time until all manufacturers will change over to the newest state of battery technology. We therefore recommend that you pay attention to the type of battery used.

Battery

The lithium-ion or lithium-polymer batteries that are used in high-quality LED lights do not need to be entirely discharged. Frequent charging even increases the battery life considerably. As a general rule it is therefore advisable to place the light back in the charging base after every use. Modern lights display the currently available capacity, ideally using symbols on a display or at least with a light-emitting diode. A warning signal is sounded before the light switches off.

Is the light equipped with a lithium-polymer or lithium-ion battery? Is the capacity of the battery used – i.e. the operation time – sufficient when the battery is charged?

> *"It is a good idea to select a light that comes with an extra battery or optional AC cord."*
> **(The Dental Advisor, Vol. 21, No. 6, July/August 2004)**

Safety net for emergency operation

Nothing is more unpleasant than having to interrupt the treatment of a patient and therefore the entire work of the practice because the battery is empty. This raises the question of an "emergency mode" for situations when the practice team does not have time to recharge the battery and would like to carry out the treatment immediately. In such situations, there are generally two possibilities: First, an additional battery is supplied. Such an additional battery costs, and you must be sure that it is always charged and that it can be retrieved at any time. Secondly, there are innovative polymerization lights which offer the possibility to attach the handpiece to the power cord of the charging base. This allows the clinician to carry out treatments independently from the battery and at any time according to his/her requirements.

Is it possible to work without a battery which might be discharged (corded operation)?

Proper maintenance of the battery

Rechargeable batteries, being small power plants, require careful handling. In order to use a battery for possibly several years, the following tips might be helpful:

To prevent an irreversible deep discharge, nickel-metal hydride batteries must be recharged after three months at the latest and lithium-polymer or lithium-ion batteries after six months, if they have not been used in a long time.

Nickel-metal hydride batteries must be completely discharged before they are completely recharged. Lithium-ion batteries, however, can be discharged and recharged at any time. In order to prolong the battery life of lithium-ion and lithium-polymer batteries, it is even recommended to place the light in the charging base after every use.

Clean battery contacts free of dust and composite residue ensure good conductivity and therefore charging capacity at any time. The electric contacts should therefore be cleaned regularly – for example using a wipe dipped in alcohol or a cotton swab.

Ageing occurs in every type of battery, so that a decrease in performance is to be expected. Typically, lithium-polymer and lithium-ion batteries have lost about 30% of their original capacity after three years. This means that, instead of the 60-minute capacity, for instance, the battery can be used only for approximately 40 minutes.

Short glossary of battery terms

Battery

Rechargeable, also known as accumulator.

Capacity

The capacity of a battery corresponds to its stored energy and determines the duration of operation without recharging.

Cycle

The process of fully charging and discharging the battery once.

Deep discharge

Further discharge of the battery after the entire stored capacity has been used.

Energy density

Stored energy in comparison with the mass of the battery.

Lazy battery effect

Decrease of the available capacity if the battery is recharged before it is fully discharged.

Lithium-ion battery

Lithium metal oxide is the positive pole of a li-ion battery, carbon is the negative pole. This means: high energy density, very low self-discharge, no lazy battery effect.

Lithium-polymer battery

Lithium-polymer batteries provide the best performance that is available today.

Nickel-metal hydride battery (NiMH)

A metal alloy that stores hydroxide provides the negative and nickel alloys the positive charge in NiMH batteries. If such batteries are frequently recharged, they become susceptible to the lazy battery effect.

Self-discharge

Loss of the stored energy due to internal processes when the battery is not used. Self-discharge is temperature- and time-dependent.

Always with a fan

LED lights use up little space, they are energy-saving and have a long life span. These properties make them highly interesting also for use in dentistry. Like all electric parts, however, LEDs generate heat, which must be discharged, in order to prevent damage due to high temperatures or to prevent that the light prematurely fails to operate.

The developing heat depends mainly on the light intensity of the LED light used. Modern lights offer an intensity of 1,000 mW/cm^2 and more. Given this high performance, the best solution is to discharge the heat by means of a fan. If the light is not equipped with a fan, the housing or a special cooling unit must absorb this heat. During extended operation – when luting composites are polymerized for several minutes in the case of indirect restorations – the housing develops a perceivable heat. If a certain temperature is exceeded, it may happen that the light may be automatically switched off the prevent damage. If this happens, it takes several minutes until the light can be used again. If a fan is integrated, however, even high-performance lights can be operated without restrictions.

"Some of them [LED], especially the simpler versions, have significant draw-backs … [like] the inability to cure beyond 3-4 minutes."
(REALITY, Vol. 20, 2006)

"10-minute curing test … of continuous curing for halogen & LED lights … This is roughly the amount of time you would cure if you were luting 6-10 veneers at one time … from the facial and the lingual."
(REALITY, Vol. 20, 2006)

Active cooling mechanisms with a fan automatically discharge the heat that is inevitably developing. This allows an unrestricted use of the light.

Programs

If areas with only little residual dentin or areas close to the pulp are cured, polymerization should be carried out very cautiously, i.e., a reduced light intensity should be applied in order to prevent an excessive heat accumulation in the pulp or the soft tissue. If high-performance lights featuring intensities of 1,000 mW/cm² are used, it is advisable to cure restorations in the cervical area, adhesives and liners using a so-called "Low Power" program. High performance also means increased polymerization stress in the composite. In this case, it is helpful to use a light which offers a special program including various levels of intensity or a "Soft Start" program which increases the intensity during curing.

Is the light equipped with a fan for unrestricted continuous operation? Are special Low Power and Soft Start programs available?

Checklist

What should you look for when you purchase an LED light?	new bluephase
Is the light spectrum of the LED light similar to that of halogen lights?	Yes, due to the polywave LED (380 to 515 nm) specifically developed in-house
Is a comprehensive list of all incompatible materials supplied?	Not necessary, due to polywave LED
Is the light intensity (at least) 1,000 mW/cm²?	Yes, 1,200 mW/cm²
Is a radiometer to check the light intensity available?	Yes, bluephase meter
Is the minimum light intensity clearly defined, for instance in a statement regarding tolerance values in the instructions for use?	Yes, 1,200 mW/cm² ± 10%
Is the polymerization light designed with a parallel-walled light probe which consist of many single glass fibres?	Yes, a 10-mm light probe
Are data regarding the heat development during polymerization available?	Yes (see Scientific Documentation)
Can I borrow the light for a day to test the ergonomic properties?	Yes
Is the light equipped with a lithium-polymer or lithium-ion battery?	Yes, with a lithium-polymer battery
Is the capacity of the battery used – i.e. the operation time – sufficient when the battery is charged?	Yes, the operation time is 60 minutes
Is it possible to work without a battery which might be discharged (corded operation)?	Yes, due to Click & Cure
Is the light equipped with a fan for unrestricted continuous operation?	Yes
Are special Low Power and Soft Start programs available?	Yes

bluephase®

Licence to cure

LED for every use

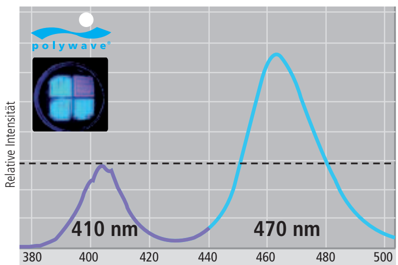
reddot design award honourable mention 2008

Dental PRODUCT SHOPPER BEST PRODUCT 2008

2009 THE DENTAL ADVISOR Top Light-curing Unit

The bluephase lights of the second generation set new standards in the dental practice with the **polywave® LED** specifically developed in-house.

Contrary to many conventional LED lights, the polywave LED covers the relevant broadband spectrum between 380 and 515 nm optimally – just like halogen lamps, which served as model for the bluephase. bluephase can therefore be used for all photoinitiators without any restrictions.



This is how it works: Turn around charging base; remove power cord; attach to handpiece; resume work as usual.

Every material due to polywave® LED

Due to the two different LEDs that are used – one with approx. 410 nm and the other approx. 470 dominant wavelength range – bluephase is suitable for all light-curing materials.

Every indication due to constant cooling

The invisible and noiseless fan allows a continuous operation – even when long-span indirect restorations are placed – without clinical limitations and eliminates annoying interruptions and waiting times.

Every time, due to Click & Cure®

Bothersome interruptions of the clinical procedures due to an empty battery are a thing of the past due to the tried-and-tested **Click & Cure** technology. The handpiece can be attached to the power cord of the charging base – it takes only one click.

The dental experts agree

Dr Andreas Kurbad
Germany

« I expect a polymerization light to fulfil the following requirements:
- *reliable and constant light intensity,*
- *short curing times,*
- *sufficient battery capacity and the corresponding cooling system.*

bluephase combines all these positive features in one product. »

Ulf Krueger-Janson
Germany

« It's great to use an LED unit which offers me a choice between various programs and a reliable light intensity of 1,200 mW/cm^2 ±10%.

Reliability is particularly important for all-ceramic restorations.

In addition, the controlled polymerization of modern composites is also ensured. »

Dr Anja Wenger
Switzerland

« The bluephase combines elegance with performance: It's very easy to use, cordless and virtually noiseless.

In the five years I have been using the bluephase I have never encountered any limitations in the polymerization of any direct or indirect restorations.

A very well-conceived piece of equipment! »

Prof Dr Claus-Peter Ernst
Germany

« So far, only the bluephase offers a light probe with a large diameter of 10 mm.

The best clinical results are therefore achieved with this light, as the surfaces to be cured are generally larger than 7 mm in diameter. The number of overlapping curing cycles is thus considerably reduced. »

Dr Gary Unterbrink
Liechtenstein

« The original bluephase offers consistent performance. It is cordless, programmable and powerful. After several years of heavy use and a thousand disinfections, it still looks good.

The new bluephase fills the last small gap with its different LEDs for all photoinitiators. Absolutely recommendable. »

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