

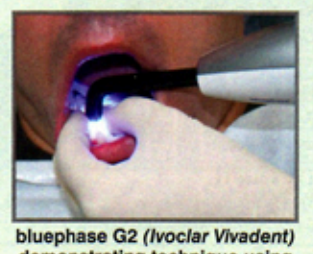
Save Time, Effort, and Money with Fast, New LED Curing Lights

Gordon and Paul's Clinical Bottom Line: The evolution of resin curing lights has been constant since their introduction in 1979. The most important recent changes have been the acceptance of fast resin curing by both clinicians and researchers, and the advent of more powerful LED lights which now rival the capabilities of plasma arc lights. It's time to re-evaluate the resin curing techniques you use, and it may be time to upgrade your lights.

There has been a paradigm shift away from measuring the energy that comes out of a curing light to what actually reaches the material being polymerized. Traditional test methods used for halogen lights with glass-fiber light guides do not always work well for curing lasers and plasma arc lights introduced in the 1990s or LED lights introduced after 2000 with their unique output and lens systems. Clinically, the effectiveness of a light curing procedure depends on many factors, including:

- The light's output power, spectrum, and tip design
- Cure time
- The resin chemistry and its photo-initiators
- Location and orientation of the restoration
- Tooth structure or materials that partially block the light
- The clinician's ability to aim and maintain the light on target

The continued trend toward higher intensity lights, short cure times, and fast polymerizing resin chemistries is potentially helpful to ensure adequate cure and to expedite the procedure. However, clinicians must use good judgment to account for the variables listed previously to ensure that sufficient energy actually reaches the resin.



bluephase G2 (Ivoclar Vivadent) demonstrating technique using fingers to align tip exactly perpendicular to the restoration for optimum energy delivery

The following report guides you by characterizing 20 LED curing lights using performance tests and measurements from the new MARC system and provides clinical tips for effective curing procedures.

CR Choice Lights



bluephase G2
Excellent combination of performance, features, and cost



ART-L5
Low cost and good performance



VALO
Excellent performance, best intraoral access, and no battery



SmartLite Max
Good combination of performance and features

Clinical Tips

- **Check output** frequently with a light meter to verify consistency.
- **Keep light tip clean** by covering with clear plastic (e.g. kitchen food wrap and a rubber band). Remove cured-on material with a scalpel blade and polish glass fiber guides with an extra-fine composite disk.
- **Disinfect light** between patients (tip, handle, and controls) with a proven high-ethyl-alcohol disinfectant (e.g. *Lysol I.C. Brand II*). Glass light guides can be autoclaved.
- **To ensure accurate aim**, the person performing the cure is advised to wear orange glasses and watch the process; others should avert eyes during exposure.
- **Position the tip as close as possible and hold it perpendicular to the resin.** Tilted alignment or movement significantly reduce the total energy delivered.
- **Light tips with an 80°-90° angle** that rotate 360° provide easiest intraoral access. Large tips (9-13 mm) generally provide best coverage.
- **LED incompatibility with some materials** still exists. Multiple LEDs, lower wavelengths, and higher output have reduced the problem, but clinicians should test cure materials prior to use in patients.
- **Use adequate cure time** to ensure complete polymerization. High-intensity, fast cures are generally accepted. Other curing modes (ramp, step, soft, pulse, etc.) are promoted for minimizing stress due to shrinkage; however, CR research shows that resin formulation has a greater effect on stress than light intensity.
- **Heating of pulp tissue** in deep preps or small teeth can occur with high intensity LED lights. To minimize risk, direct air over tooth while curing and/or segment the overall cure time pausing up to 3 seconds in between to dissipate heat.
- **Significantly longer cure times** may be required when curing through ceramic veneers and crowns; darker and more opaque shades; and some flowable and microfill resins. Don't cure increments thicker than 2 mm unless recommended by manufacturer and proven by testing (see *Clinicians Report March 2010 - New Resin Based Composites: A Shrinking Problem?*).
- **Lithium batteries** used in most cordless LED lights can be kept on the charger at full capacity without damage. Eventually, however, the batteries will fail and must be replaced.
- **Select lights with simple, intuitive controls.** Lights that clearly indicate the mode and time settings are easiest to use.

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The following chart shows key features of 20 LED and two control lights. Lights are listed in order of overall rating which was based on clinical ratings, ease of use, intraoral access, cure speed, compatibility with all materials, convenience features, and cost.

Brand Name Company	Cord or Cordless	Light Guide Size and Angle	Simple Controls	Cures All Materials	Evaluator Clinical Rating	Highest Intensity Mode & Timer Settings	Intensity from MARC (mW/cm ²)	Cure Time (2 mm layers of A2 shades)	Built-In Light Meter	Overall Rating
bluephase G2 Ivoclar Vivadent www.ivoclarvivadent.com	cordless (or cord)	9 mm glass fiber 70°, rotates	Excellent- Good	Yes broad spectrum	Excellent- Good	High: 5, 10, 15, 20, 30 sec also Low and Soft modes	1,540	3-4 sec	No	Excellent CHOICE
ART-L5 Bonart Medical Technology www.bonartmed.com	cordless (or cord)	7 mm glass fiber 45°, rotates	Excellent	Yes	Good	Fast: 5, 10, 15, 20 sec also Pulse and Ramp modes	1,620	3-5 sec	No	Excellent CHOICE
VALO Ultradent www.ultradent.com	cord	10 mm lens 85°, fixed	Good-Fair	Yes broad spectrum	Excellent- Good	Plasma: 3 sec also High and Standard modes	4,190	1-3 sec	No	Excellent CHOICE
SmartLite Max Dentsply Caulk www.dentsply.com	cordless (or cord)	11x6 mm lens 90°, rotates	Excellent- Good	Yes broad spectrum	Good	Boost: 5 sec also Standard, Ramp, and Pulse modes	1,330	4-8 sec	Yes	Excellent CHOICE
Elipar S10 3M ESPE www.3mespe.com	cordless	9 mm glass fiber 60°, rotates	Excellent	Yes	Good	Standard: 5, 10, 15, 20 sec, continuous also Tack-cure mode	2,060	3 sec	Yes	Excellent- Good
The Cure II Spring Health Products www.springhealthproducts.com	cordless	8 mm lens 75°, fixed	Good-Fair	Yes	Excellent- Good	High: 2, 4, 6, 8, 10, 12, 16, 20 sec also Low mode	1,610	3-5 sec	No	Excellent- Good
bluephase 20i Ivoclar Vivadent www.ivoclarvivadent.com	cordless (or cord)	7 mm glass fiber 60°, rotates	Excellent- Good	Yes broad spectrum	Excellent- Good	Turbo: 3, 4, 5 sec also High, Low, and Soft modes	3,120	2-3 sec	No	Excellent- Good
Blast-Lite First Medica www.firstmedica.com	cordless	7 mm glass fiber 50°, rotates	Excellent- Good	Yes	Good-Fair	High: 5 sec also Standard mode	4,280	1-4 sec	No	Excellent- Good
Demi Plus Kerr www.kerrdental.com	cordless	7 mm glass fiber 60°, rotates	Excellent	Yes	Excellent- Good	Standard: 5, 10, 20 sec	1,790	2-4 sec	No	Excellent- Good
Fusion DentLight www.dentlight.com	cordless (or cord)	10 mm lens 70°, rotates	Good-Fair	No	Excellent	Constant: 5, 10, 20 sec also Sequential and Half-Power modes	2,910	2-6 sec	No	Excellent- Good
Apollo LED 2000+ MicroDent-Apollo Dental www.mddentalinfo.com	cordless	7 mm glass fiber 45°, rotates	Excellent	Yes	Good-Fair	Standard: 3, 6, 9 sec	3,860	1-3 sec	No	Excellent- Good
MiniLED III SuperCharged Acteon North America www.us.acteongroup.com	cordless	7 mm glass fiber 45°, rotates	Good	Yes	Good	Fast: 3, 4, 5, 10 sec also Pulse and Step modes	3,170	1-3 sec	Yes	Excellent- Good
Coltolux LED Coltene Whaledent www.colteneusahledent.com	cordless	9 mm lens 60°, fixed	Excellent- Good	No	Good-Fair	Standard: 10, 20 sec	1,210	4-6 sec	No	Excellent- Good
Aurora S ⁺ Parkell www.parkell.com	cordless (or cord)	12 mm lens 80°, fixed	Good	Yes	Good-Fair	Turbo: 10 sec also Standard and Gel modes	1,730	3-5 sec	No	Excellent- Good
FLASHlite Magna Discus Dental www.discusdental.com	cordless	11 mm lens 55°, fixed	Excellent- Good	No	Good	Standard: 5, 10, 15, 20 sec	1,640	3-5 sec	Yes	Excellent- Good
FlashMax2 CMS Dental www.cmsdental.com	cordless	6 mm lens 90°, fixed	Excellent- Good	Yes	Excellent- Good	Standard: 1, 3 sec	5,840	2-3 sec	No	Excellent- Good
Silverlight GC America www.gcamerica.com	cordless	7 mm glass fiber 45°, rotates	Good-Fair	No	Good-Fair	Fast: 10 sec also Slow Rise mode	1,510	4-6 sec	Yes	Excellent- Good
Celalux 2 VOCO America www.vocoamerica.com	cordless	7 mm glass fiber 50°, rotates	Excellent	Yes	Good-Fair	Fast: 10, 20 sec also Soft Start mode	1,360	5-7 sec	Yes	Excellent- Good
Radii Plus SDI www.sdi.com.au	cordless	7 mm lens 70°, rotates	Good	No	Good-Fair	Standard: 10, 20, 30, 40, 50, 60 sec also Ramp mode	1,340	5-8 sec	Yes	Good
Translux Power Blue Heraeus Kulzer www.heraeus-kulzer-us.com	cordless	7 mm glass fiber 60°, rotates	Good-Fair	No	Good-Fair	Fast: 10, 20 sec also Slow Rise mode	1,010	5-7 sec	Yes	Good
Optilux 501 (halogen control) Kerr www.kerrdental.com	cord	7 mm glass fiber 50°, rotates	Good	Yes broad spectrum	Good-Fair	Boost: 5, 10 sec also Standard and Ramp modes	2,120	3-6 sec	Yes	Good
Sapphire (plasma arc control) Den-Mat www.denmat.com	cord	9 mm glass fiber 50°, rotates	Good	Yes broad spectrum	Good	Standard: 3, 5, 7, 9 sec	2,500	2-4 sec	Yes	Excellent- Good

Save Time, Effort, and Money with Fast, New LED Curing Lights (Continued from page 1)

CR Evaluation of Latest LED Lights

- The MARC System (see box below) was used to measure curing light spectrum, optimum intensity, and energy density.
- Speed of cure was found for A2 shade Filtek Supreme Ultra, Herculite Ultra, and Venus Diamond, as well as other shades and types of light-cure materials.
- Lab tests included beam collimation, width of cure, simulated heating of pulp, and battery life.
- Size, weight, light guide design, controls, and features were measured and rated.
- Clinical Evaluators rated intraoral access, aiming, ergonomics, controls, and ease of use.

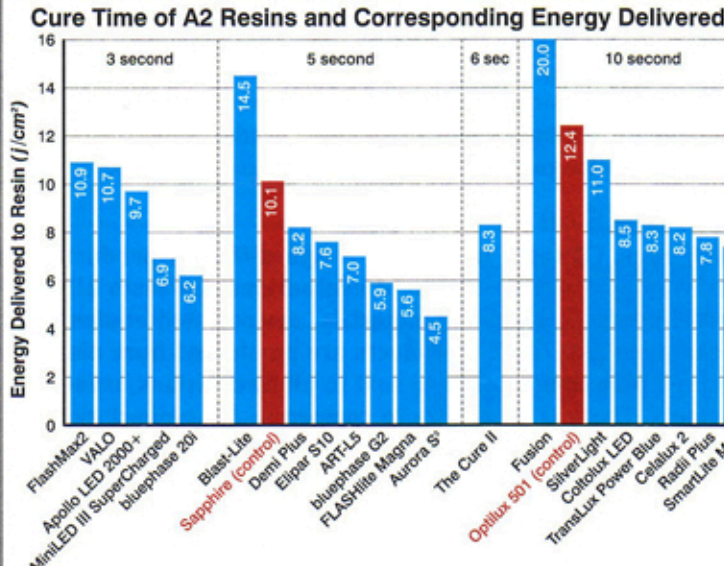
The MARC System: A New Way for Researchers to Measure Energy Delivery

MARC (Managing Accurate Resin Curing) consists of a spectroradiometer mounted in a dental mannequin with sensors in the anterior and posterior teeth. The computer and software have a simple user interface for collecting and displaying data. The system measures intensity, spectrum, and energy delivered to simulated restorations of different types and locations. It provides clinical feedback on light design, intraoral access, and operator technique and accuracy. Resin cure time and energy requirements can also be evaluated. MARC was developed by Dr. Richard Price at Dalhousie University Faculty of Dentistry and is available through BlueLight Analytics. For additional information, visit www.curingresin.com.



Curing light test using MARC

The following graph shows the energy delivered by each light in its highest intensity mode using its shortest timer setting required to cure all of the A2 resin shades tested.



Summary of graph:

- Higher intensity lights generally required less time to deliver the necessary energy (faster cure).
- Within each cure time, the higher bars represent lights that deliver more energy and have better cure potential.
- All 20 LED lights performed similar to or better than the halogen control (Optilux 501). 12 were similar to or better than the plasma arc control (Sapphire).
- The actual energy delivered varies depending on resin brand and curing light characteristics, including timer setting.

CR Conclusions: LED curing lights continue to increase in power. For direct resin curing, all lights were similar to or better than the halogen control and many were better than plasma arc. All lights were clinically useful and had an overall rating of good or better. Testing with the MARC system revealed the importance of good clinical technique (aim and steadiness). Lights with the overall best combinations of performance, features, and cost were: bluephase G2, ART-L5, VALO, and SmartLite Max.