

Inside this Issue

The Film Revolver:
For PrecisionCut™ 1

Auto Tint Laws:
Installers' Burden 2

Tech Talk Follow-up:
IR Story Continues 3

Transition Lenses:
UV and Window Film 4

The BTU Meter:
Uses and Limitations 5

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LLumar Technical Updates
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Martinsville, Virginia USA

THE FILM REVOLVER: New from the PCS™ Team!

Ready access to any of four film rolls

We are extremely pleased to announce the availability in the US market, beginning in July, of a major enhancement to the LLumar PrecisionCut™ plotter system. Invented and fully designed by the PrecisionCut support team, the Film Revolver is a portable film storage and spindle system giving users of Graphtec plotters immediate access to four different film rolls. Auto film installers will find this especially helpful in speeding up the roll-change operation when cutting multiple films for a given vehicle.

Portability

Most importantly, the Film Revolver is attached directly to the plotter stand, making it as mobile as the plotter itself.

The Film Revolver kit is extremely easy to assemble, taking less than 15 minutes, requiring only an Allen wrench which is included in the kit. A short but complete installation instructional video is available online at www.llumartech.com and a DVD version is included in every kit shipped.

Models for all Graphtec plotters

Kits for all 6 Graphtec plotter models are available, as listed below with the kit part numbers:

FC5100— 40" - Part #10368302

FC5100— 60" - Part #10368298

FC7000— 40" - Part #10368297

FC7000— 60" - Part #10368296

FC8000— 42" - Part #10368295

FC8000— 64" - Part #10368294

In addition to these kits being designed

for each of these plotter models, with their various widths, each kit is fully adjustable to allow the use of any film roll width up to the nominal plotter width. The media rods are spring-loaded to permit rapid roll change-outs.



Cost

The price per kit is \$900. Always contact your CPFilms sales manager for product availability in your market region.

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AUTO TINT LAWS: Installers have Key Responsibility for Compliance

Variability in laws creates uncertainty

In every state in the United States, and in most countries in the world, laws regulating the visible light transmission, visible light reflectance, and color of installed window film (and related shading products) are on the books. Each jurisdiction has its own rules and the substance of these rules often varies from region to region, sometimes quite significantly. Responsibility for compliance can be at times ambiguous: Is it the installer or vehicle owner—or both—who can be held legally responsible where a violation is discovered? And what happens when a compliant vehicle is driven to another region where the tinting laws are different?

CPFilms wishes to remind all installers of what is too often “forgotten,” especially in these tougher economic times when we might think that “making the sale” is more important than any other issue. There are certainly many more important issues, including: 1) the physical safety of customers and others on the road who might be injured because of violators’ impaired vision, 2) the fact that installers and customers might *both* be legally culpable for violations, and 3) the potential for inciting legislators to enact far more restrictive (even prohibitive) laws that would injure the legitimate businesses of others in the industry and the interests of their customers.

Possible Scenario:

Consider this hypothetical case, familiar in some ways to most installers:

A customer, hearing from friends of the virtues of window films, walks into a professional auto film dealership. The manager shows the customer the various products and then explains their performance properties. The customer likes the appearance of the 5% limo film, and asks that the film be installed on the rear pane and all side windows of his car. The manager smiles, and without so much as a warning about legal restrictions, accepts the customer’s car keys and proceeds to have the installation done. Happily driving home two hours later, the customer is pulled over by the police and promptly cited—with only a warning this time and an order to have the film removed within 5 days.

He returns to the dealership three days later to ask that the film be removed and that products be installed that **do** comply with the law. The dealer replies, “Sure, but there will be a removal charge in addition to the full installation price.”

Personal and Professional Obligations?

The natural and appropriate questions are:

Didn’t the installer warn the customer about the illegality of the original installation? If he didn’t, isn’t the customer’s fault also the dealer’s? What does the law say about the service provider’s responsibility for infractions? Fundamentally, is there not an ethical, professional obligation for dealers to know **exactly** what the law specifies as it directly relates to their enterprises? What does it mean to be a “professional window film dealership” if the company does not make itself knowledgeable and fully inform its customers about what is and **is not** legally permissible? Shouldn’t a dealer make it his job to understand the tinting laws of adjacent states (or jurisdictions) regarding the status of “visiting” cars from those states, and inform his customers of legal restrictions? In the United States, why not post the IWFA State Law Summary



Having—and *using*—a visible transmission and reflectance meter can help assure you and your customers of legal compliance.

Chart for all employees and customers to see?

CPFilms has always advised abiding by state and local laws when installing film to automotive glass, and such an admonition appears on every box of its auto films. Every Technical Bulletin has a standard set of appended notes and warnings, first among them: **“CAUTION:** Tinted motor vehicle windows must comply with local laws. Dark tinting may reduce outward visibility during poor lighting conditions. Use care to avoid accidents.”

Disrespect for the Law can only result in problems with enforcement agencies, large fines, complex situations of personal accidents and injuries involving allegations (proven or unproven) of window film culpability, and consumer ill-will. It does nothing whatsoever to protect the long-term interests of film installers, their customers, and the larger industry.

CPFilms, as a provider of products that are by their very nature intended for protective, safety, and security purposes, wishes to actively encourage its dealers to protect themselves, their customers, and the industry by reading, thoroughly understanding, and observing their local laws. It’s the right thing to do, for every conceivable rational reason. Work through appropriate trade, legislative, and other legal channels to help correct or clarify unfair or unclear laws. If you feel the laws in your area are unfair or have no scientific basis, the International Window Film Association (IWFA) is a great place to start with inquiries about those laws or about ways to help make statutory restrictions more reasonable and helpful to you and your customers. ■

TECH TALK: Misunderstandings Continue about Infrared Radiation and “Heat”

QUESTION: Despite past discussions in this newsletter, I still need help explaining how UV, Visible, and Infrared light all generate heat. I am having trouble explaining to a PhD in physics that visible light *does* generate heat. He claims that fluorescent bulbs and LEDs generate “cold light,” light without heat, or much less heat than incandescent light. Also, in a related issue, is it possible to conclude that the shorter wavelengths (such as visible light) generate more energy than longer wavelengths as found in the IR region of the spectrum? I have already read the technical newsletters (issues #10 and 11) that explain all of this, but none of these articles was enough to convince this PhD in Physics.

ANSWER: It appears that the issue of “IR transmission” of window films simply will not go away easily. If it seems that these arguments generate more heat than light, we should remember the physical reality that it is only by heat that light is, in fact, generated at all. If this physicist is claiming that fluorescent bulbs do not generate heat, he is categorically mistaken. There is no such thing as “cold light,” except in a poetic sense. What makes the glow from florescent bulbs (and LED light sources) “**feel cooler**” (which your comment indicates he acknowledges) than incandescent bulbs is the fact that they emit far less of their energy in the IR band. LED (light emitting diode) lights, destined for greater use in the future, emit IR amounts that are barely measurable. Incandescent bulbs now generate about 80-90 percent of their radiant energy “glow” in the IR range.

First, remember that IR radiation is longer in wavelength and therefore penetrates more deeply in the skin to the temperature receptor nerves, where it is felt as heat more than, say, blue light. But this is **not** to say that the actual amount of heat energy in sunlight is greater in the IR region than in the visible range, or that IR “carries heat” but visible light does not. Not by a long shot. If there is no energy, there is no heat, and vice versa. Heat and energy are inter-convertible.

Regarding light bulbs, you can have as much visible light that is generated by an incandescent bulb by simply reducing the IR emission enormously (and thus feel cooler and save energy) by switching from an electrically heated filament to, say, a gas emission source such as

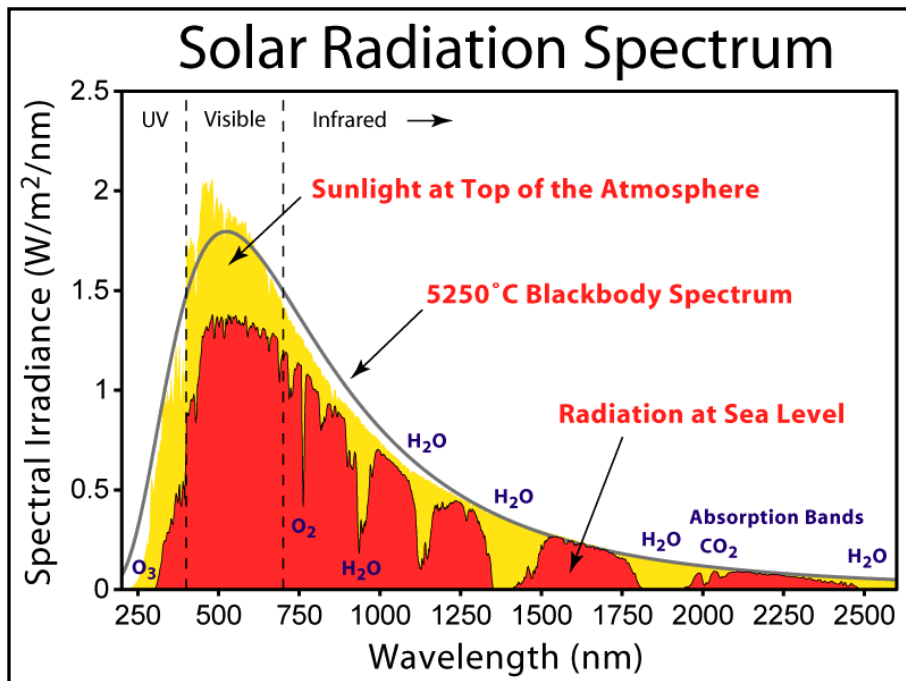
neon, which more selectively emits radiation in the blue/green/yellow wavelengths. (This is what the movement to compact fluorescent bulbs is all about—saving energy by not wasting it generating IR radiation.)

All of this business about incandescent bulbs vs. more efficient florescent bulbs vs. IR says nothing about the radiant energy content (heat) in the **solar spectrum** (see center chart), which is thoroughly discussed in issues 10 and 11 of this newsletter. The sun is neither a light bulb nor a fluorescent tube, in terms of the shape of its emission spectrum, though all three emit the same kind of radiation, just a different mix of frequencies and intensities. About 49% of the sun’s radiant (heat) energy reaching us is in the visible bandwidth, 49% in the IR, and the remaining roughly 2% in the UV bandwidth.

We are full circle: a film “not transmitting” any of the solar IR says nothing about what the actual total solar energy rejection is for a film product, because it says nothing about the absorption and re-radiation of IR, nor anything about what happens to the other wavelengths

of radiation impinging the glazing system. End of story, unless there are further questions.

On a final side note: Strangely, blue light is said to be “colder” than red-orange light (which is referred to as “warmer” on the color temperature scale). But blue light is much shorter in wavelength than red light and must be generated by hotter, more energetic sources. This sounds contradictory, but common language and terminology can never claim to be scientific



tifically accurate. Appearances are not always indicative of reality. For more than 50,000 years people thought the Earth was flat and that the sun rose in the morning. It never was and it never did, though common language said so because it seemed so “obviously” true. But it is not from “common sense” that we learned just how wrong we all were.

Please do re-read Issues 10 and 11 of the Technical Updates newsletter. We are happy to continue to try to better educate our dealers and customers about issues that are indeed complex and technical, but need to be understood better, and not just to make more intelligent decisions about product purchases, however important that certainly is.

(See also FAQ #220[US] or FAQ #201 [INT]) ■

FAQ: Photogray Glasses (Transition Lenses), UV light, and Window Film

QUESTION: Many of our customers have eye glasses that have photochromic (also known as "transition") lenses, chemically treated lenses that turn darker in UV light. In other words, the glasses will turn into "tinted" sunglasses when they are worn outdoors. We installed a LLumar film with 99.9% UV rejection in the customer's home and the client put these glasses near the window but the lenses still change slightly darker. As this LLumar film transmits only 0.1% of the UV, why do the lenses still change darker? Is it because the 0.1% UV can change the lens dark? Can you advise how to answer the customer's question? He believes the LLumar film is not working very well.

ANSWER: Our research indicates that the chemistry in transition lenses is primarily, but *not exclusively*, responsive in the UV band (UVA and UVB). Blue light also helps activate the chemistry for optical absorption. Remember: 99.9% UVA and UVB blockage is **not** 100%, and in absolute terms, the *amount* of UV that is transmitted in that 0.1%

varies enormously depending on weather conditions (how intense the sunlight is on a given day). An extremely small amount of UV can begin to activate the light-blocking chemistry and begin the darkening effect, **compounded by the very short wavelengths of blue (visible) light**. To show that a film blocking 99% (or less) UV causes transition lenses to darken more than a film that stops

99.9%, the customer should take two films with different UV rejection percentages and use each to cover one half of a lens and then expose it to direct sunlight. Note the difference in the density of the color change and speed of the reaction in the two halves of the same lens. The reaction speed will be enormously slower with both films. The difference in darkness will be very noticeable, too, though may take many minutes to see.

Some perceptive customers may notice that their lenses do not darken as much in their cars (filmed with a high performance LLumar product) as they do in their homes near their filmed windows. The explanation lies in these facts: The (unfilmed) glass typically used in

cars already blocks far more UV than standard glass used in residential windows. **Non-laminated tempered auto glass has roughly a 37% UV transmission, and standard single pane 3mm clear glass, often used in homes, has a UV transmission of about 71%.**

Laminated auto glass (used in nearly all windshields) is extremely effective at blocking UV because of the PVB interlayer, and often will block over 99% of the incident UV.

The point is this: the fact that transition lenses in their clear state will slightly darken behind filmed windows—and less in cars but more in homes—is **not an**

The behavior of transition lenses is not a reliable guide to UV film performance—for important *technical* reasons.

accurate indicator of the amount of UV (from 300-380nm) being blocked by the film, or that one of these films is more effective than another at blocking UV radiation. A calibrated UV meter is necessary for that. Transition lenses simply cannot be used as an accurate "metering device" to measure UV transmission.

The issue of the behavior of transition lenses, and the failure of our "common sense intuitions"

about what is going on, is another example of why we must rely on *independent laboratory measurements* of UV transition values (as well as the other film performance parameters).

Film performance measurements involve—indeed require—some very precise technical tools, scientific methods, and clearly defined concepts, and reinforce the need of dealers to educate themselves and their customers about increasingly technical matters. It also drives home the importance of comparing film performance on a level playing field, provided by independent standards and rating organizations, such as ISO and the National Fenestration Rating Council (NFRC). ■



THE BTU METER: Proper and Improper Uses

The BTU meter is a device that has been in use in the glazing and window film industry for decades, yet it is very difficult to find complete information on exactly how the device works, and therefore what its proper uses and *limitations* are. This article focuses directly on these questions, especially on what it does and does not measure—and what it *cannot* measure.

Let's begin with listing what this meter does not do:

1. It does not measure the solar heat gain coefficient (SHGC) nor the TSER of a film.
2. It does not always reliably determine which film "lets in" more solar heat than another, for reasons discussed below.
3. It does not in any way give reliable quantitative readings when used with an IR heat lamp, which emits over 90% of its energy in the invisible near IR band. Such lamps do NOT represent **sunlight**, which has roughly the same amount of radiant heat energy in the visible and IR regions of its spectrum.

The BTU Meter has these limitations because of what it is measuring, namely, the *approximate* level of solar energy intensity striking its sensor. It has a silicon photocell at the "business end," which does not respond with equal strength to all wavelengths of visible light and near infrared solar radiance. It is less sensitive to radiation at the blue end of the visible spectrum, and is not sensitive at all to solar radiation past about 1050-1100 nanometers, though IR from the sun extends out to about **2500 nm** (beginning at 780 nm).

Look carefully at the distribution of energy across the solar spectrum on the following page. The light green region represents the areas (400-1100 nm) to which the crystalline silicon cells in these BTU meters are sensitive. Note that this sensitivity is not entirely uniform. But the critical failure of the meters, clearly visible in the graph, is that they are blind to nearly 60% of the solar IR bandwidth.



BTU Meters can have analog or digital displays. Readings of solar energy intensity are given in units of *watts per square meter* or *BTUs per square foot per hour*. Sunlight's energy intensity on a clear sunny day is roughly 785-1000 w/m², or 250-350 BTUs/ft²/hr .

This is a most serious problem. Why? Newer "exotic" solar control films employing IR blockers reduce the transmission of IR in very different regions of the solar IR bandwidth. Two films may have the same VLT, but one of them may be very good at blocking IR from 900-1000 nm, another at longer IR wavelengths

where this meter is not sensitive, and still another more or less equally blocks IR across the solar IR bandwidth. The films may be equally good at blocking solar IR overall, but the meter would erroneously judge one film better than the others. This is why (among other scientific reasons) CPFilms and many of the most reputable film manufacturers now insist (some

having always insisted) on relying upon performance data that provides "Total Solar Energy Rejection" or the "Solar Heat Gain Coefficient." The latter term specifies the proportion of incident solar energy that is NOT rejected. This avoids biased measurement data that mislead customers about true overall film performance.

Another limitation of the meter is implied by what it *does* claim to measure, namely *incident* solar energy. This point is crucial: the meter does NOT measure how much solar energy is **absorbed** or **reflected** from the film/glass combination. It only gives a rough (sometimes very rough) measure of the solar energy that is *transmitted*, and then only in those wavelengths around the center of the visible/IR solar spectrum, not the blue end and not the IR beyond 1050 nm. Because

of this, the meter cannot give us any information about how much energy is indirectly conducted or reradiated into the room at longer far-infrared wavelengths.

Best Uses of the BTU Meter

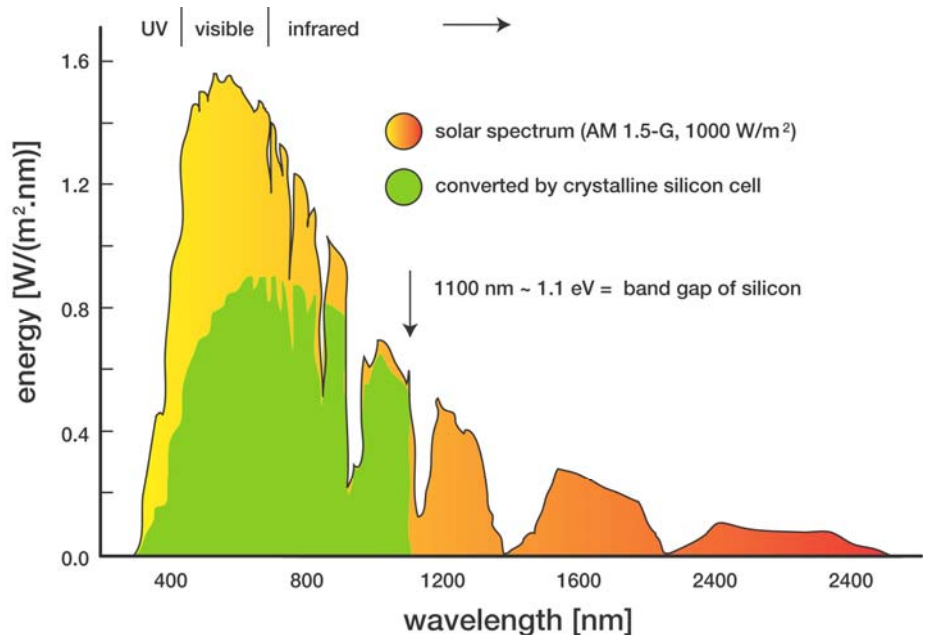
The BTU meter is best used for two simple tasks, both technical and sales-related.

- 1) Technically, the meter is an excellent way to determine whether or not a glazing system is a solar control "high-performance" unit, Low-E vs. Low-E² (or the newer Low-E³ glass from Cardinal). This is important to know to best determine the value of a given potential film installa- ▶▶

THE BTU METER: Proper and Improper Uses (continued)

► tion. Glass that already rejects a large percentage of solar energy will not be appreciably helped with solar heat gain reduction by adding a film—though improvement in glare reduction, maximizing UV protection, and increasing safety are very important added values. Customers should understand this. This matter was discussed in Issue 6, page 3, of this Newsletter.

2) Probably the best single use of the meter is to impress upon customers the important fact that a window film does not have to be visibly dark to be effective at controlling heat intrusion into a home or vehicle. Beyond this, the published performance numbers must be relied upon for the most accurate comparisons of product performance, especially those numbers confirmed by independent testing agencies. This is *especially* important when comparing the newer “IR” spectrally selective films, where **total** solar energy rejection (not just a small sampled region of the IR) is the real object of concern. ■



This chart shows the limitations of standard BTU meters which use crystalline silicon photo cells. The light green region represents the areas (400-1100 nm) to which the meter is sensitive. But even this sensitivity is not entirely uniform. A critical failure of the meters, clearly visible in the graph, is that they are blind to nearly 60% of the solar IR bandwidth.

“Growth through Knowledge”

Information is power, and the worldwide Technical Services Group of CPFilms provides the most comprehensive informational, instructional, and product support services of any window film manufacturer. Our purpose is to help empower you to grow your business by sharing with you information and practical wisdom you can directly use to help you better serve your customers. The right information can greatly improve your installation efficiency and more effectively inform your customers of the impressive uses, features, and benefits the world of LLumar films can provide.

Future issues are wide open to directly address your comments and questions, to better serve and support the growing international LLumar community. Let us know what topics you want to see addressed!

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