Seeing The Light: Sizing Up Universal Light Guides For Medical Instruments

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glass made of ideas

Commodity products are easy to overlook. We expect them to be there for us and to work without fail. Yet a hose is a hose is a hose.

But in the theater of medical diagnostics, such commodity products – the supporting players of "the show" – contribute to a result that can't be taken for granted: the health and safety of the patient. As such, they warrant a closer look.

One such "commodity" product is the **Universal Light Guide**, a workhorse of medical diagnostics that enables the high performance of high-end medical equipment such as endoscopes, the instruments of discovery that enable physicians to see, detect, diagnose and operate on parts of the body so challengingly shielded from light.

The Universal Light Guide, aptly named because of its "Swiss army knife"-like adaptability, connects an array of front-line scopes to a broad spectrum of light sources, effectively dispatching light from its source to where it is needed. But beneath this effortlessness, wrapped in a layer of non-descript grey sheathing, is a core of fiber-optic innovation.

A closer look at this core reveals a universal truth about light guides: they are not all created equal. With scope performance and patient outcomes on the line, it's time to give this supporting player its moment in the spotlight.

The 'Three Cs' (and a 'D') of Universal Light Guides

So, what should buyers and practitioners be looking for in a Universal Light Guide? Remember the "4 Cs" of diamond buying – sorry for any engagement-ring purchasing flashbacks! – carat, cut, color, and clarity? Well, it's a bit like that.

When checking how one light guide stacks up against another, look closely at the metrics that determine illumination and overall device performance: clarity, color, compliance, and durability.

Clarity – The constant refrain from users of all scopes and other diagnostic equipment is "More light, please!" Glass, namely fiber-optic bundles, delivers this key requirement in quantity and quality.

Dating back to the 1950s and the discovery of glass fibers' ability to transmit light effectively from a source to a target area, the use of fiber optics to deliver light quickly, effectively and, heat free has grown across sectors. In the medical-device field, fiber has distinguished itself on the merits of bringing the visible-light band beautifully to where doctors need it most – in the hard to illuminate spots in the body they need to see to make their diagnoses or perform precision treatments.

Comprised of tens of thousands of glass fibers, each with a diameter less than that of a human hair, these fiber bundles not only make quick work of delivering the visible-light band seamlessly, but they do so with great flexibility and are lightweight, making universal light guides practical, versatile, and easy to use.

And what makes the quality of their illumination so good? The answer is in the glass.

Today, SCHOTT glass is *the industry source* for high quality glass, meaning that no matter which company makes the light guide you are currently using, there's a good chance SCHOTT glass is inside. Additionally, SCHOTT has the inside track on selecting the best glass for its light guides, providing them a built-in clarity and color advantage.

Color – Just as glass quality impacts light clarity, ensuring targeted areas receive the clearest light in the most copious quantities, it also ensures color fidelity.

Physicians looking inside the body make their diagnoses based on what they see, so color rendition is critical. SCHOTT ensures there is nothing in its glass that will absorb light – enhancing clarity – and that it's balanced for wavelength – keeping colors true. Different glasses transmit or absorb different wavelengths of light in different ways. The silicate-based multicomponent glasses SCHOTT uses for this type of cable are optimized for the visible range, approximating sunlight.

Fiber bundles not balanced for wavelength can create a "color shift," making it difficult for physicians to trust what they are seeing. With SCHOTT Universal Light Guides, red means red, yellow yellow, and blue blue, ensuring the doctor sees what is really there.

Compliance – The third "c" in our light-guide quality matrix is compliance. While the lead in glass has evaded RoHS (restriction of hazardous substances) mandates to date – glass is just too prevalent today for a sweeping retraction of all glass products containing lead – that may not last. SCHOTT is on the cutting edge of developing lead-free fiber, which is available today (see GOF 70 fiber information below) for organizations eager to advance their environmental stewardship while future-proofing their illumination products from regulatory changes.

Durability – It's a fact of life: Universal Light Guides need to be cleaned. And while the glass fibers in them are durable, any light guide can only be autoclaved so many times. New developments on this front, In the form of the GOF70, increase the number of times the guide can be cleaned by a factor of 3-5X, reducing total cost of ownership.

With these parameters in mind, let's look at how the SCHOTT A2 Fiber Light Guides compare with the SCHOTT PURAVIS® GOF70 Guides:

			Hot-fused Version „HF“	Epoxied Version „EP“
Optical Data	Fiber Type		PURAVIS® GOF70	SCHOTT A2 Fiber
	Numerical Aperture	Theoretical value at 587 nm	NA = 0.55	NA = 0.64
	Eff. acceptance angle (2α)	@ V(λ) and 1 m length	~ 70°	~ 83°
	Transmission	Acc. to DIN 58141 Part 2 @ 546 nm and 3 m length	> 70 % (typical value)	> 55 % (typical value)
Mechanical Data	Sheathing		Non-stick silicone sheathing /w metal reinforcement	Non-stick silicone sheathing
	Min. bending radius		50 mm	50 mm
Operating Temperatures	Operational long-term	Entire length	+10°C ... +40°C	+10°C ... +40°C
	Operational long-term @ Optical End Surface	Input end (Light source)	350°C	200°C
		Output end (Endoscope)	150°C	150°C
	Transportation and Storage		- 20°C ...+ 60°C (Non-condensing)	
Re-processing	Cleaning & Disinfection	Cleaning, disinfection and sterilization approved according to ISO 17664	Manual & machine-made chemical cleaning and disinfection	
	Autoclaving		@ 134°C, 3 bar, 10 min. > 100 cycles	
	Plasma Sterilization		Low temperature plasma sterilization (STERRAD 100S)	
Medical Device Approvals	Designed and manufactured according to ISO 13485 requirements for medical use		Yes	Yes
	ROHS		Compliant without exemption	Compliant with exemption

Comparing the A2 and GOF70 Universal Light Guides: Value and TCO

A key difference between the A2 and GOF70 Fiber Guides is the first is epoxied, while the second is hot-fused. With the A2, tens of thousands of glass fibers are joined together so they can be ground and polished at the end – the delivery point of the illumination – a process which in turn secures the device from allowing fluids to leak in. High-temperature epoxies are used to join the fibers together and keep them from melting or burning. This type of epoxy-binding is the industry standard.

The process for binding the GOF70 fibers is different. In this case, the fibers are melted together, i.e., “hot fused,” to give the product maximum temperature resistance. This protection is of growing importance as doctors deploy high-intensity light sources, such as Xenon, for their illumination needs. Epoxied versions can’t withstand this heat – hot-fused versions can and do.

Beyond the bindings, the differences that mark these two guides delineate the very good from the great. The A2 is well liked in the industry, providing strong transmission rates, consistent clarity and color rendition, good durability, and “compliance with exemption,” meaning that until RoHS standards change for lead in glass, you’ll be fine with the A2.

And so will your finances. Affordably priced, the A2 is the standard bearer of the “value” category in Universal Light Guides. And, armed with SCHOTT’s best glass, it outperforms the competition at the same price point.

While entry price is an important dimension of “value,” so is total cost of ownership. That’s one area where the GOF70 shines, providing a 3-5x durability advantage (i.e. it can be autoclaved 3-5 more times) over the A2 and other like guides. But the biggest differentiators of the GOF70 over the A2 and others in that category are performance based. As mentioned above, the GOF70 is compatible with the highest-intensity light sources practical for endoscopy, and its transmission rates, clarity and color performance, and lead-free composition propel it to the front of the pack.

Beyond the spec sheet, sometimes the best indicator of a product’s quality is to see who uses it, and the adoption of SCHOTT Universal Light Guides by market-leading OEMs – makers of high-end endoscopes and other medical devices – speaks volumes, as does their prevalence in U.S. and European markets.

The Decision is Yours

Universal Light Guides are an enabling technology whose always-on support of medical diagnoses and surgical procedures contributes greatly to patient health and safety. While typically viewed as a “commodity product” by purchasing departments, these light-moving tools leverage decades of fiber-optics innovations and best practices. They are also continuing to evolve, keeping pace with advances in light sources and end-use devices, as well as new environmental demands. Seeing them in this light, balancing performance, value, and total cost of ownership, will help you make the right pick.

About SCHOTT Lighting and Imaging

SCHOTT Lighting and Imaging develops, manufactures, and distributes fiber optic components for light and image transmission. Our portfolio comprises flexible and rigid components as well as hybrid products based on LED and fiber optic technology. We have been providing customized solutions to medical instrument manufacturers and working in medical applications for more than 50 years and have 130 years of experience in specialty glasses and materials. Our PURAVIS® high-performance glass optical fibers are ideal for many fluorescence-based diagnostic instruments because of their extremely long lifetimes, high color uniformity and light output, and improved transmission in the near-UV range.

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