Fibre Optics Systems

Technical Information

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Swaro®Lite is a complete system

Light projector (here with 100 W halogen bulb). Glass fibre bundle and light outlets as faceted crystals, as optical lenses of crystal glass and as freely radiating fibre ends.

THE SYSTEM

Proceeding from the light source, glass fibre cables transmit cold light to the light outlets (Illust. 1) which is current-free, almost completely free of damaging UV and IR light components, and hence gentle and non-damaging on the eyes.

Except for replacing lamps occasionally, the entire system is - once installed - fully maintenance-free, its lifetime unlimited.

All Swaro®**Lite** components - light sources, glass fibres, outlets - are harmonised with one another down to the finest detail. Their composite application ensures the optimal quality of the entire system.

Swaro®**Lite** Lighting System

CRYSTAL ARCHITECTURE

THE LIGHT OUTLETS

- Faceted, pointed light outlets, half-round and fully round spheres of crystal for decorative light reflections
- Crystal panels as attractive, unique building components for ceilings, walls and furnishings
- Optical lenses and spots in a system-specific design for zoned room lighting and - for that very particular touch - non-damaging illumination of exhibits in all kinds of showcases
- Optical prisms as 'wallwashers' and for the illumination of wall objects
- Built-in lights for pictures and tapestries
- Then to round off the programme: freely radiating fibre ends for the formation of lettering and pictorial configurations consisting of rows of light points

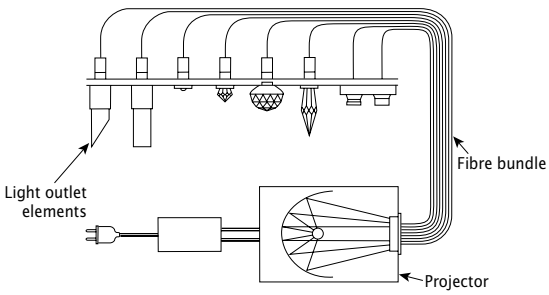

Illustration 1
The complex system:
Light projector (with transformer/power unit). Glass fibre bundle, diverse light outlets in a suspended ceiling

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THE LIGHT PROJECTORS

The central component of the light projectors is the cold light reflector (patent pending) of glass in the diameters of 65 mm and 125 mm.

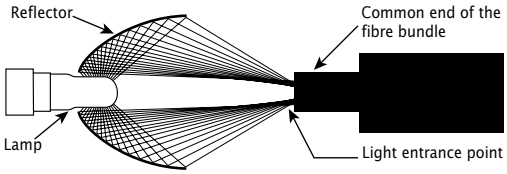

Illustration 2
Optical path of the specially formed Swaro®**Lite** reflectors. Utilisation of 89% of the available light.

Approximately 50 vacuum-coated layers of titanium dioxide and silicium dioxide ensure an extremely high surface reflection of 98%. The reflectors, which are transparent to thermal radiation without the use of infrared filters, allow gentle cold light to emerge from the end of the fibres. The use of titanium as a hard metal layer impervious to wear means, in terms of time and quality, that the reflector will function unlimitedly.

These advantages are reinforced by the computer-aided design of the reflector: its precisely focused optical path guides 89% of the light - uniformly distributed - into the glass fibres, out of which it is just as uniformly radiated.

THE GLASS FIBRES

Swaro®**Lite** utilises only fibres of the best optical glass.

Maximal transmission and colour fidelity as well as a high degree of absorption of the UV portion of the light - namely without use of expensive UV filters - are its quality criteria.

Like all optical light-guiding elements it too loses light with increasing length, while the portion of yellow light is intensified at the same time (Illust. 3).

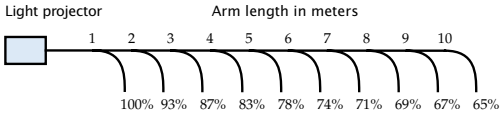

Illustration 3
Residual light values, dependent on fibre length

An applicable rule is that glass fibre cables are optimally suitable up to a length of 5 m and very suitable up to 10 m. In projects exceeding such lengths it is recommendable to continue with additional bundles.

Glass fibres are resistant to fluids - even aggressive ones - and also highly thermally resistant, from -15° to + 100°C. But above all: In contrast to other light guides, glass fibres are maintenance-free and unlimitedly efficient. Swarovski's constantly well-stocked warehouse of standardised bundles ensures quick deliveries. The procurement of project-specific individual bundles is always guaranteed.

ECONOMIC ASPECTS

In addition to the two- to threefold technical superiority of Swaro®Lite as a complete system, there are well-founded cost advantages:

- The special form of the reflector: a higher degree of utilisation, hardly any scattered light
- Cold-light coating of the reflector: no IR-filter necessary, unlimited lifetime of the reflector
- Absorption through glass fibres: no UV-filter necessary
- All system components are maintenance-free: no additional personnel costs, no new investments
- Glass fibres with a high degree of transmission in combination with carefully co-ordinated outlets: a maximal amount of light at the end point, even with use of the favourably priced halogen light projectors (Illust. 4).

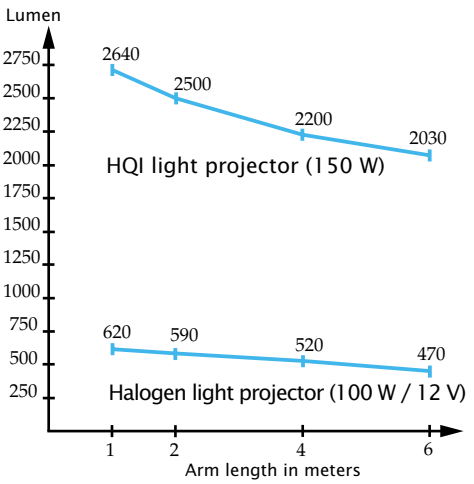

Illustration 4
Light values of the Swaro®**Lite** system

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FIBRE OPTIC LIGHTING SPECIFICATION

I. FLIGHT PROJECTORS

The light projectors are usually equipped with external transformers. The projector and transformer / ballast is connected by means of a solid but detachable plug connector (Wieland).

Reflectors

- Dichroitic cold-light reflectors of glass.
- Diameter 65 mm for halogen projectors, 125 mm for HQI projectors.
- Vacuum-coated with approx. 50 alternating reflective layers of titanium and silicium dioxide. This results in a surface reflection of about 98%. Transmission of thermal radiation is ensured without the use of IR filters due to this kind of vapor coating. The reflective layers are not subject to wear. When a lamp is changed - halogen or metal vapor lamp with a standard base - one changes only the lamp and not the reflector.
- Through the special design of the reflector, 89% of the amount of light radiated by the lamp is reflected. Light reaches the fibre coupling point in a uniformly distributed light intensity. This ensures a high degree of uniformity of radiation to the individual fibre ends (no ellipsoidal reflector).

Fan - HQI projector

- Axial fan with a functional range (ambient temperatures) of -10°C to +80°C.
- Power consumption 9.0 W - max. Volume flow 30 m^3/h.
- Optimally low noise level: Sound intensity unobstructed 18 dB(A). To hinder structure-borne noise, the fan is seated in a damping frame of rubber.
- Lifetime is min. 60,000 h at 40°C ambient temperature.

Fan - Halogen projector

- Axial fan with a functional range (ambient temperatures) of -20°C to +70°C.
- Power consumption 0.6 W - max. volume flow 33 m^3/h.
- Optimally low noise level: Sound intensity unobstructed 12 db(A). To hinder structure-borne noise, the fan is seated in rubber holding devices.
- Lifetime is min. 80,000 h at 40°C ambient temperature.
- Switchable fan speed.

Thermostat

The projectors 100 W halogen and 150 W resp. 70 W HQI are equipped with a thermostat.

Colour light projector

Colour wheels for automatic colour change, as well as effect disks are vacuum-coated glass. For reasons of durability, no painted glass or colour foils are used.

Colour light projectors with DMX control system, dimmable

The projectors have a colour, dimmer and strobe function and can be controlled via DMX 512. The projectors also have the possibility of a master/slave control function allowing connection of an arbitrary number of slave devices to one master device. Various automatic programmes are selectable for this mode; customer-specific programming is also possible. The programmed sequences can be stored in a DMX recorder on a memory card. The projectors are interconnected by means of a 5-pole XLR connector.

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II. HARNESSES

Mechanical and optical properties

- Fibres of the best optical glass. Insensitive to heat and UV radiation.
- Fibre arms are available in Size ¾, 1½, 3, 8, 14, 24, 36 (= optical Ø 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, 7.2 mm)
  Double Size = double amount of light
- Optical damping of the individual fibres: at 550 nm: ≤ 0.2 dB/m
- Transmission at 550 nm: length 1 m: 60%, length 15 m: 30%
  Transmission lengths up to 20 m possible due to the high transmission (and colour) properties.
- The glass fibres glued into the end ferrules are ground and polished. This minimizes dispersion effects and optimizes input and output coupling conditions.
- No danger of burning. Glass in not flammable.
  The sheathing material MEGALON® consists of halogen-free, self-extinguishing, PVC-free plastic. Complies with fire protection standards in:

Germany	VDE 0207
United Kingdom	BS 6724
France	NFC 32323

- Thermal stability at the common end: min. 200°C (no efficiency-reducing IR filter is necessary)
- If a uniform light and colour intensity of the individual arms is required - especially for showcases/museums and for the use of HQI projectors - the fibres are fine randomized at the common end (ratio 24:1)
- Bending radiuses of 5 to 60 mm, depending on the type. If these are maintained, there is no impairment of the optical properties.

III. UV FILTER

Special filter developed by the worlds leaders in crystal technology, Swarovski, particularly for museums and preservative situations for the suppression of critical spectral distribution even under 420 nm, with almost unnoticeable reduction of colour rendition.

The glass fibres themselves reduce pure reflector UV radiation by 57 %. For areas of application such as these, however, this is frequently insufficient.

Example:

1000 lx as a reference value, glass fibre bundle 2.1 m in length

Projector	100 W halogen	150 W HQI
UV radiation reflector	0.065 W/m²	0.116 W/m²
UV radiation at the end of the fibre	0.028 W/m²	0.050 W/m²
Reduction by	57%	57%
With a UV filter: UV radiation at the end of the fibre	0.003 W/m²	0.003 W/m²
Total reduction	95%	97%

With a QV filter there is consequently practically complete elimination of strain due to UV radiation! With use of conventional UV filters, the residual UV stress is higher by a factor of 3.5 - 5.

Colour temperature:

With QV filters unnoticeable 20° - 50°K, with commercially available filters visible 110° - 140°K.

Transmission loss in the visible range:

With QV filters 2%, with commercially available filters 3% - 6%.
(Referring to the total efficiency of the reflectors; the filter is glued to the bundle).

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IV. LIGHT FITTINGS

Decorative light fittings
Primary use in crystal starry skies.

Quality criteria:

- Full lead crystal with min. 30% iron dioxide (PbO), STRASS® quality
- Optical purity, i.e. free from bubbles, streaks and other inclusions, precisely machine-ground, finely polished
- In order not to disturb the ceiling configuration, the crystal element may not have any bore hole (i.e. no chandelier crystals)
- Glued into metal holding devices with invisible UV glue. The holding device is of gilded or nickel-plated brass. Galvanic separation: copper layer 8 µm, nickel layer 8 µm, gold layer 0.3 µm.
- To ensure optical transmission and precision, the UV glue must have the same refractive index as the crystal.
- The 'Swimming pool' version: Holding devices are additionally coated with a transparent coating of lacquer by means of electrophoresis; resistant to chlorine water vapor.

In the process of mounting, the holding devices of the outlet elements are pushed into mounting sleeves. This holds them stably in place, but allows them to be disconnected at any time from the mounting sleeve, thus being exchangeable. Mounting sleeves are made of metal or plastic, depending on structural requirements.
The fibre arms are prevented from sliding back into already closed ceilings by means of special fibre retaining clips.

Functional outlet elements

- Crystals and lenses, also of full lead crystal with at least 30% PbO, optically pure, i.e. free of bubbles, streaks and other inclusions
- Glued durably into the metal holding device with invisible UV glue (the UV glue must have the same refractive index as the crystal lens)

Crystal panels
A composite element of insulating glass consisting of:

- Front sheet of safety glass in the quality 'optiwhite' as the element bearing the motif. The motif is formed of crystals, facet-ground, Ø about 1.4 mm to 10.9 mm, crystal clear or vacuum-coated, glued with invisible UV glue, frequently combined with etched or sandblasted motifs
- Rear mirror sheet, white, gray, blue or green
- Spacers between the two sheets (usually lacquered)
- Inlet of the fibre optical light depending on the kind of panel either from the back - the fibre arms are held by means of glued-on metal sleeves - or from the sides - the fibre arms are held by a U-shaped plastic element (a so-called 'fibre comb') with bore holes at intervals of 10 - 20 mm.

Note:
Crystal panels without fibre optical illumination, i.e. irradiated only by ceiling spots, are also very attractive elements.

The lamp efficiency of the entire fibre optic system is at least 22% (HQI), resp. 25% (halogen). A measurement protocol from an independent institution can be provided if necessary.

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OPTICAL DATA

FUNCTIONAL LIGHT FITTINGS - LENS SYSTEMS AND OPTIC SPOTS

ARTICLE (Art.No. A.9942 NR ... ...)	DISPERSION ANGLE (from - to)	FIBRE DIMENSIONS in SIZE	EFFICIENCY
Standard lens system (NR 030 110) **and** **Spherical optic spot** (NR 020 800, 020 801, 020 803)	narrow beam: 2 x 6° wide beam: 2 x 19°	3 (Ø 2 mm)	0.88
	narrow beam: 2 x 13° wide beam: 2 x 19°	8 (Ø 3 mm)	0.87
	narrow beam: 2 x 9° wide beam: 2 x 21°	14 (Ø 4 mm)	0.86
	narrow beam: 2 x 17° wide beam: 2 x 24°	24 (Ø 6 mm)	0.85
	narrow beam: 2 x 15° wide beam: 2 x 20°	36 (Ø 7.2 mm)	0.78
Mini-lens (NR 020 700, 020 701, 020 703)	wide beam: (to the stop 2 x 16°	3 (Ø 2 mm)	0.86
	wide beam: (to the stop 2 x 15°	8 (Ø 3 mm)	0.86
	wide beam: (to the stop 2 x 18°	14 (Ø 4 mm)	0.86
	wide beam: (to the stop 2 x 26°	24 (Ø 6 mm)	0.85
	wide beam: (to the stop 2 x 26°	36 (Ø 7.2 mm)	0.85
Focussing lens system (NR 030 010) and **Focussing spot** (NR 020 810, 020 811, 020 813)	narrow beam: 2 x 10° wide beam: 2 x 20°	8 (Ø 3 mm)	0.83
	narrow beam: 2 x 11° wide beam: 2 x 24°	14 (Ø 4 mm)	0.83
	narrow beam: 2 x 18° wide beam: 2 x 27°	24 (Ø 6 mm)	0.82
	narrow beam: 2 x 20° wide beam: 2 x 29°	36 (Ø 7.2 mm)	0.81
Auxiliary lens system (NR 030 210)	narrow beam: 2 x 4° wide beam: 2 x 10°	8 (Ø 3 mm)	0.75
	narrow beam: 2 x 4° wide beam: 2 x 10°	14 (Ø 4 mm)	0.74

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OPTICAL DATA

FUNCTIONAL LIGHT FITTINGS - PRISMS AND PRISM SPOTS

ARTICLE (Art.No. A.9942 NR ... ...)	DISPERSION ANGLE (from - to)	FIBRE DIMENSIONS in SIZE	EFFICIENCY
Prism 0° (NR 011 200) **and**	narrow beam: 2 x 10° to the stop: 2 x 13°	8 (Ø 3 mm)	0.75
Prism spot 0° (NR 011 210)	narrow beam: 2 x 11° to the stop: 2 x 14°	14 (Ø 4 mm)	0.74
Prism 32° (NR 011 400)	narrow beam: 2 x 10° to the stop: 2 x 13°	8 (Ø 3 mm)	0.71
Prism spot 32° (NR 011 410)	narrow beam: 2 x 11° to the stop: 2 x 14°	14 (Ø 4 mm)	0.70
Prism 45° (NR 011 300)	narrow beam: 2 x 10° to the stop: 2 x 13°	8 (Ø 3 mm)	0.71
Prism spot 45° (NR 011 310)	narrow beam: 2 x 11° to the stop: 2 x 14°	14 (Ø 4 mm)	0.70
Spherical lens Ø 7.4 mm (NR 010 300, 010 302)	wide beam: 2 x 12° (to the stop	1.5 (Ø 1.5 mm)	0.89
	wide beam: 2 x 15° (to the stop	3 (Ø 2 mm)	0.89
	wide beam: 2 x 18° (to the stop	8 (Ø 3 mm)	0.89
	wide beam: 2 x 22° (to the stop	14 (Ø 4 mm)	0.88