

JBL

What Why - How?

CORRECT

Lighting for the aquarium and terrarium

WITH JBL SOLAR





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INTRODUCTION:



It should (hopefully) be a matter of general knowledge that providing the right care for the particular species of fish or animal in an aquarium is inseparably linked with the care of the living plants. Such plants must, of course, be true “aquatic” plants or at least plants which are naturally at home in marshy ground and are therefore adapted to surviving in water. Pathetic, sickly house plants, which are still sometimes to be found on sale, can never produce the same invaluable benefits as healthy, flourishing plants in an aquarium.

In order to be able to thrive, plants not only need the right nutrients (more details in What - Why - How? Book 6) but also energy in the form of light.

This short booklet describes how you can present the plants in your aquarium, as well as the other forms of life to be found there, “in the right light” using JBL SOLAR.



1. PHOTOSYNTHESIS, THE MOTOR DRIVING PLANT GROWTH

One quite unique process is responsible for the special benefits which living plants bring to an aquarium, a process which other living organisms lack - photosynthesis. In photosynthesis, plants use the energy of light to synthesise sugar and other carbohydrates from CO_2 and water. Sugar and carbohydrates make up the main components of plant mass. Oxygen is produced as a waste product, to the benefit of the fish. It is this process which is responsible for the oxygen in the earth's atmosphere, providing the essential conditions for animal life. The chemical "factory" in which this process takes place is the green colouring of leaves, known as chlorophyll.

We know, in the meantime, that it is not chlorophyll alone that is responsible for the life and growth of plants, rather a pigment system made up of a balance of several different pigments which all contribute to chlorophyll. In the course of evolution, plants have developed this complex pigment system to adapt to the prevailing light conditions, i.e. sunlight.

For this reason, the quality of aquarium lighting should be as similar as possible to sunlight in order to provide the best growing conditions for plants. Only flourishing plants are capable of providing fish and other living creatures in the aquarium with vital oxygen, breaking down nitrates and phosphates, providing hiding places for fish and reducing germs, to name but a few of the positive effects of healthy plant growth in an aquarium.



Crinum thaianum (onion plant) in its natural habitat

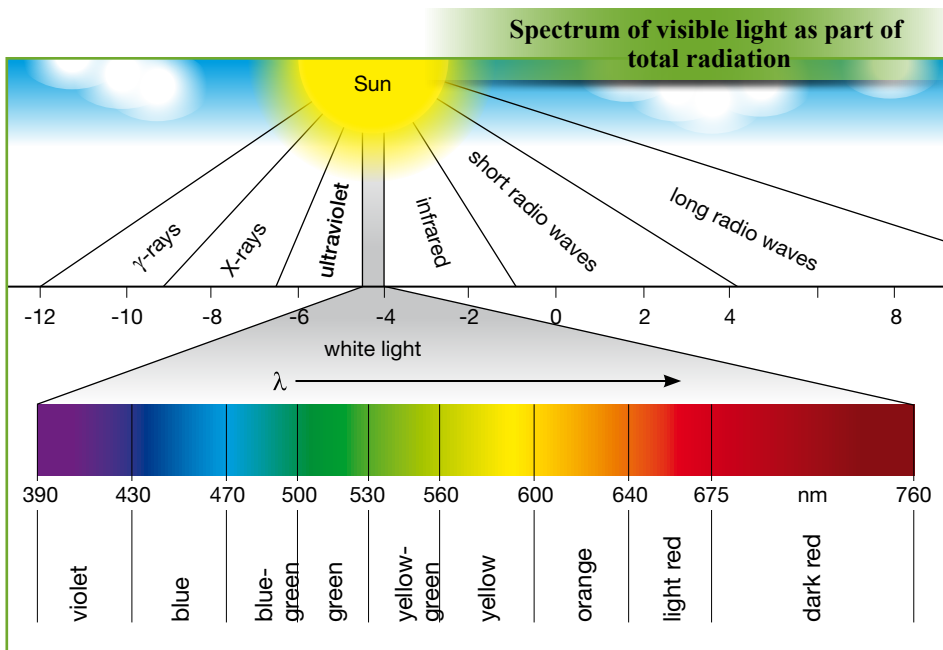
2. WHAT IS LIGHT?

Before we examine the light requirements of plants in greater detail, some basic principles of the phenomenon of light. The term „light“ is usually taken to refer to the section of the overall electro-magnetic radiation emitted by the sun which is visible to the human eye and is referred to as „white light“. This section includes the wave lengths from 390 to 760 nm (nanometers), bordering on infrared in the upper range and ultraviolet in the lower.

If white light is beamed through a prism, it is separated into its spectral colours, a phenomenon which is familiar in the form of a rainbow.

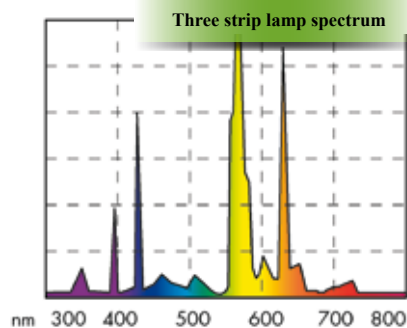
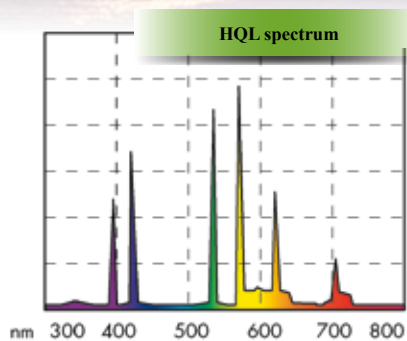
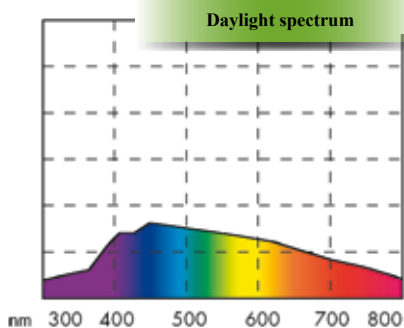
The spectral colours range from violet to blue, green, yellow, orange and dark red.

As everyone knows from their own observations, light at sunrise and sunset is redder, i.e. seems warmer, than during the day, when light seems to have a cooler, bluer tone. This is referred to in physics as the colour temperature, measured in Kelvin (K). The warmer the colour impression, the lower the colour temperature. The cooler the colour (the more pronounced the blue shades), the higher the colour temperature. In the course of a day this can range from 2500 K (sunrise / sunset) to 8000 K (midday).





We perceive the colours of an object that we view like the colours contained in the spectrum of light which illuminates the object. In daylight, which contains equal amounts of all spectral colours, objects, or in the case of an aquarium, fish and plants, appear in their natural brilliant colours. The colour temperature does not play a significant role. When lit by a light source which contains substantial gaps in the spectrum, e.g. HQL lamps, the fish and plants look like „grey blobs“ as we simply cannot see certain colours depending on the gaps in the spectrum.



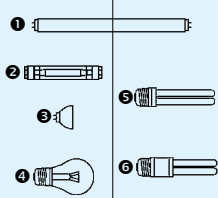
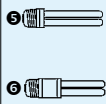
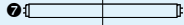
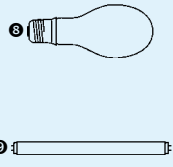
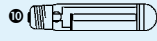
| Colour reproduction levels | | | | | |
|--|---|---|----|---|---|
| 1A | 1B | 2A | 2B | 3 | 4 |
|  |  |  | |  |  |
| 100 | 90 | 80 | 70 | 60 | 40 20 |
| Colour reproduction index R_a | | | | | |
| <ul style="list-style-type: none"> 1 full spectrum fluorescent tube 2 halogen metal vapour lamp 3 halogen bulb 4 bulb 5 3 strip fluorescent tube 6 compact fluorescent tube 7 standard fluorescent tube, white 8 mercury high-pressure lamps 8 standard fluorescent tube, warm shade 9 high-pressure sodium vapour lamps (FW4) 10 | | | | | |

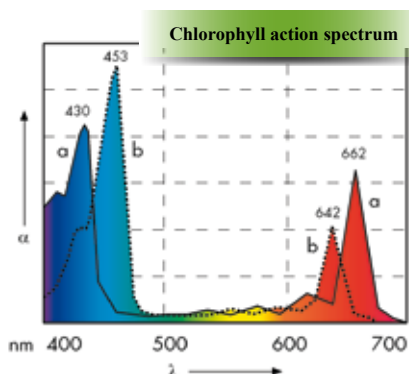
Table of colour reproduction levels / R_a - values

The colour reproduction levels (1-4) and the colour reproduction index or R_a value (20 - 100) are measurements of the colour reproduction quality of a light source. The English abbreviation CRI (Colour Rendering Index) is often used, too. The relationship between these two rating methods is shown in the illustration.

Sunlight, which has the highest (best) colour reproduction level, is taken as the basis. A light source for an aquarium or terrarium should have as high a colour reproduction level as possible, as plants and animals have adapted to this level over centuries of evolution.

3. LIGHT FOR PLANTS

All the text books on botany and plant physiology state that chlorophyll, the green colouring of leaves, has two maximum absorption peaks - in the blue and orange-red spectral areas. The belief that

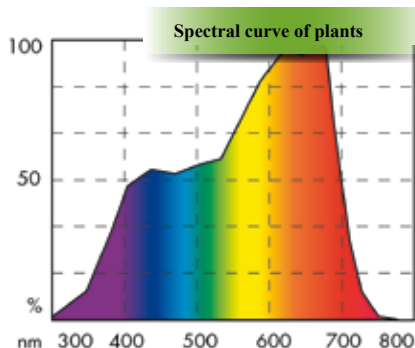


plants mainly require blue and red light for optimum growth has stemmed from this. This has led to the popularity of the widely known and commonly available lamps with strong elements of red and blue shades which bathe an aquarium in an unnatural, candy-coloured light. This light has the “advantage” that algae, that unwelcome acquaintance of all aquarium-keepers, thrives under these conditions. Algae is particularly good at making use of precisely this spectrum of light.

The fact that plants have other pigments in addition to chlorophyll has been overlooked. These pigments interact in a complex system and are capable of utilising light from the whole spectral range for growth. The individual spectral colours are not the only influence on photosynthesis, other factors play a decisive role e.g. vertical and horizontal growth, leaf colour, leaf size, to name but a few.

The plant spectral curve according to ELGERSMA, a result of experiments on numerous types of plants, clearly shows that all spectral colours of visible light, without exception, contribute to growth.

The plant spectral curve corresponds approximately to a colour temperature of 3500-4000 K, which represents the average of the daily cycle of sunlight almost exactly. After millions of years of adaptation to sun-



light, nothing else can really be expected. Lighting for an aquarium containing plants should therefore correspond as closely as possible to this plant spectral curve i.e. include the full spectrum with a colour temperature of approx. 3500-4000K. Light containing too much red will lead to over-long growth, whilst light with over-strong blue tones will cause squat growth.

4. ALGAE

The main topic for any long-suffering aquarium-keeper is unsightly algae, which usually grows far faster than the plants. Literature is full of recommendations for curtailing this troublesome growth. One of these is: place the aquarium as far away as possible from natural daylight. Anyone who experiments a lot with different shades of light learns to his cost that the plants need a certain length of time to adjust to each new lighting shade, (some never succeed and die). During this period of weak growth, the algae surges ahead.

As a “lesser” plant form, algae use the same process of photosynthesis, in principle, as higher plant forms. They also have several additional pigments in order to be able to utilise the whole width of the light spectrum. However, the pigment system of algae is considerably simpler in construction and is able to adapt more swiftly and easily to changes in the spectrum of light than the more complex pigment system of higher plants. For example, if daylight shines on an aquarium which is illuminated by a light that has gaps in its spectrum (e.g. three strip tubes, HQL), the plants have difficulty adapting their complex pigment system to the full spectrum of daylight. The algae are much faster to adapt and win the race.

However, if an aquarium is lit with light which includes the full spectrum of daylight, any daylight shining on the aquarium can be immediately utilised by the plants and algae has no advantage. It goes without saying that the other measures taken to care for the aquarium must still be aimed at restricting algae growth, e.g. by maintaining low nitrate and phosphate levels in the aquarium water.



5. THE CONSEQUENCE: JBL SOLAR LIGHT FOR THE AQUARIUM

With the SOLAR series of fluorescent tubes, JBL offers aquarium and terrarium keepers the opportunity for the first time to light their plants and animals with full spectrum light which meets their specific needs. In addition, fluorescent tubes with special, adapted spectrums provide the right light for specific conditions e.g. to light marine aquarium or to enhance the red shades in fish.

The JBL SOLAR range includes fluorescent tubes in the long-established and energy-efficient T8 technology with 26 mm tube diameter as well as the very latest high light-yield T5 technology with only 16 mm tube diameter.

The range includes 3 true full-spectrum fluorescent tubes JBL SOLAR TROPIC, SOLAR NATUR and SOLAR REPTIL, as well as three special fluorescent tubes JBL SOLAR MARIN DAY with 15000K colour temperature specially for marine aquariums, JBL SOLAR MARIN BLUE to enhance the blue spectral range for marine aquariums and JBL SOLAR COLOR to emphasise the red colour shades in freshwater fish.

What are the advantages of T 5?

T 5 is the latest development in the fluorescent tube sector. The new tubes are much more compact (only 16mm diameter) and give a far higher light yield than conventional fluorescent tubes in T8 technology.

Compared with conventional tubes, T5 tubes provide 150% light yield with only approx. 30% more energy consumption. Using reflectors, (JBL SOLAR Reflect Ultra) the light yield can be doubled again.

Due to the narrow diameter of the tubes, (16 mm) more T5 tubes can be used per area than T8 tubes. This advantage is used to the full in suspended lights. In this way the fluorescent tubes provide a higher level of light density than was previously possible.

As a result, aquariums which require a great deal of light, such as marine reef aquariums or Japanese-style plant aquariums, can be illuminated with fluorescent light at low energy costs. A further advantage is that less heat is produced than by HQI lamps, and the initial purchase costs are lower, too.

Another advantage is the fact that T5 tubes have double the service life of T8 tubes or HQI lamps. The nominal service life of T5 tubes is approx. 20,000 operating hours, which corresponds to about 4 years under average aquarium operating conditions.

As a gradual spectral shift takes place right from the beginning of the service life of fluorescent tubes, coupled with a slow loss of efficiency, we recommend replacing T5 tubes after 2 years' use in the interests of the plants and animals, (one year in the case of T8 tubes). T 5 tubes reach their highest light output at a higher ambient temperature than T8 tubes. T 5 tubes can only be operated in special lamp holders or lamps (covers) with electronic ballast and suitable fittings. The electronic ballasts ensure silent running without the annoying hum which often occurs with T8 tubes with conventional ballasts.

In its T5 technology JBL also offers the same tried and tested full spectrum of T8 tubes, which has been praised by specialist magazines as „optimal“ for plant growth. The following table shows the types, lengths and wattages available.

The table shows which tube is available in which technology.

| | T5 | T8 |
|-------------------------|----|----|
| SOLAR TROPIC | X | X |
| SOLAR NATUR | X | X |
| SOLAR COLOR | X | X |
| SOLAR MARIN DAY | X | X |
| SOLAR MARIN BLUE | X | X |



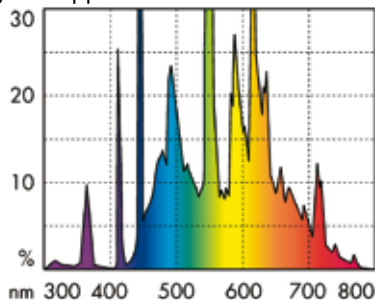
5.1 FULL SPECTRUM LIGHT FOR AQUATIC PLANTS

JBL SOLAR TROPIC AND SOLAR ULTRA TROPIC

■ Standard lighting for exceptional plant growth

■ Spectrum and colour temperature of 4000 K ideally meet the requirements of aquatic plants as shown in the plant spectral curve

■ Colour temperature of 4000 K corresponds to the average colour temperature of sunlight over the course of a day, or of light at approx. 10.00 a.m.



■ Provides ideal conditions for photosynthesis through full spectrum light, strongly inhibiting the growth of algae.

■ Best colour reproduction through 1A colour reproduction index (very good). Shows the full beauty of the natural colouring of plants and fish.

■ Individual control of lighting conditions possible through combination with JBL SOLAR Natur or SOLAR Color.

■ Long service life and reliable operation due to special long-life coating, Wolfram electrodes and inert gas filling.



JBL SOLAR TROPIC T8

| Art. - No. | Watt | Lenght |
|--------------|------|---------|
| 61610 | 15 W | 438 mm |
| 61611 | 18 W | 590 mm |
| 61612 | 25 W | 742 mm |
| 61613 | 30 W | 895 mm |
| 61614 | 36 W | 1200 mm |
| 61615 | 38 W | 1047 mm |
| 61616 | 58 W | 1500 mm |

■ 26 mm diameter tube with 10% less energy consumption and 10% more light yield than tubes of 38mm diameter.

■ Service life of 10,000 hours

■ Fits all commercially available aquarium hoods with T8 technology.

JBL SOLAR ULTRA TROPIC T5

| Art. - No. | Watt | Lenght |
|--------------|------|---------|
| 61761 | 24 W | 438 mm |
| 61681 | 24 W | 550 mm |
| 61762 | 28 W | 590 mm |
| 61763 | 35 W | 742 mm |
| 61682 | 39 W | 850 mm |
| 61764 | 45 W | 895 mm |
| 61765 | 54 W | 1047 mm |
| 61683 | 54 W | 1150 mm |
| 61766 | 54 W | 1200 mm |
| 61684 | 80 W | 1450 mm |

■ Only 16 mm tube diameter with 150% light output compared to regular T8 fluorescent tubes with the same spectrum with only about 30% more energy consumption.

■ Service life of 20000 operating hours

■ To operate, lights and light strips with electronic ballast control specially designed for T5 are required.

**T8**

26 mm

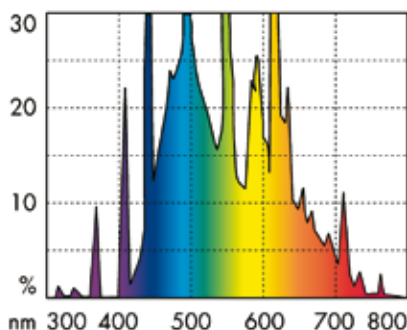
**T5**

16 mm



5.2 DAYLIGHT TUBE WITH FULL SPECTRUM FOR FRESHWATER AND MARINE ANIMALS

JBL SOLAR NATUR AND SOLAR **ULTRA** NATUR



■ Full spectrum with best colour reproduction through 1A colour reproduction index (very good): fish, invertebrate animals and plants are presented in their full, natural beauty.

■ Fresh, slightly blue light with colour temperature of 9000K, corresponding to the light at midday on a sunny day in a tropical region.

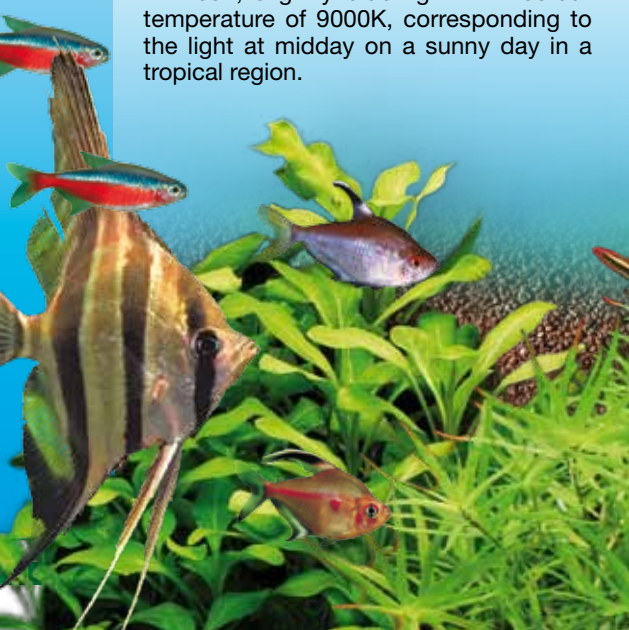
■ Promotes growth of higher marine algae and corals in saltwater through full spectrum light, simulating sunlight, with a colour temperature the same as that found in shallow water in the natural habitat.

■ Best possible light for fish and plants from sun-drenched waters e.g. rainbow fish, cichlids from Lake Malawi and Lake Tanganyika. Simulates light in shallow water in the natural habitat.

■ Provides ideal conditions for photosynthesis through full spectrum light, simulating sunlight, and strongly inhibiting the growth of algae in freshwater.

■ In freshwater, individual control of the lighting conditions possible through combination with JBL SOLAR Tropic or JBL SOLAR Color, and in saltwater with JBL SOLAR Marin.

■ Long service life and reliable operation due to special long-life coating, Wolfram electrodes and inert gas filling.



JBL SOLAR NATUR T8

| Art.- No. | Watt | Lenght |
|-----------|------|---------|
| 61630 | 15 W | 438 mm |
| 61631 | 18 W | 590 mm |
| 61632 | 25 W | 742 mm |
| 61633 | 30 W | 895 mm |
| 61634 | 36 W | 1200 mm |
| 61635 | 38 W | 1047 mm |
| 61636 | 58 W | 1500 mm |

■ 26 mm diameter tube with 10% less energy consumption and 10% more light yield than tubes of 38mm diameter.

■ Service life of 10,000 hours

■ Fits all commercially available aquarium hoods with T8 technology.

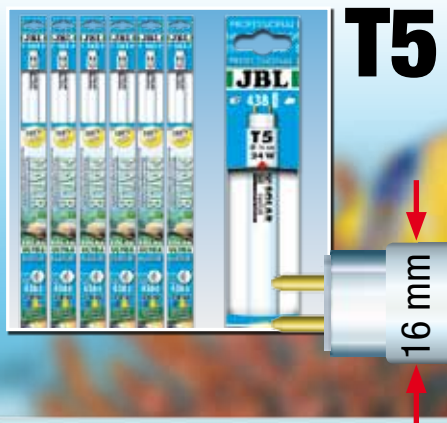
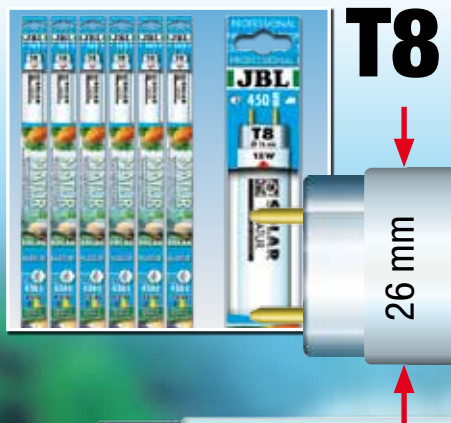
JBL SOLAR ULTRA NATUR T5

| Art.- No. | Watt | Lenght |
|-----------|------|---------|
| 61751 | 24 W | 438 mm |
| 61671 | 24 W | 550 mm |
| 61752 | 28 W | 590 mm |
| 61753 | 35 W | 742 mm |
| 61672 | 39 W | 850 mm |
| 61754 | 45 W | 895 mm |
| 61755 | 54 W | 1047 mm |
| 61673 | 54 W | 1150 mm |
| 61756 | 54 W | 1200 mm |
| 61674 | 80 W | 1450 mm |

■ Only 16 mm tube diameter with 150% light output compared to regular T8 fluorescent tubes with the same spectrum with only about 30% more energy consumption.

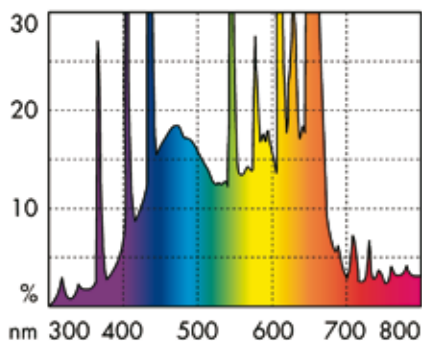
■ Service life of 20000 operating hours

■ To operate, lights and light strips with electronic ballast control specially designed for T5 are required.



5.3 FULL SPECTRUM LIGHT FOR INTENSIVE COLOURS IN THE FRESHWATER AQUARIUM

JBL SOLAR COLOR AND SOLAR ULTRA COLOR



■ Increased blue and red fractions of the spectrum enhance red, orange and blue shades of fish and plants.

■ Strong red and blue fractions with underlying full spectrum stimulate chlorophyll synthesis and photobiological processes in the plants.

■ Recommended in combination with JBL SOLAR Tropic or JBL SOLAR Natur.

■ Not recommended as only source of light due to risk of excessive algae growth.

■ Long service life and reliable operation due to special long-life coating, Wolfram electrodes and inert gas filling.

JBL SOLAR COLOR T8

| Art.- No. | Watt | Length |
|-----------|------|---------|
| 61620 | 15 W | 438 mm |
| 61621 | 18 W | 590 mm |
| 61622 | 25 W | 742 mm |
| 61623 | 30 W | 895 mm |
| 61624 | 36 W | 1200 mm |
| 61625 | 38 W | 1047 mm |
| 61626 | 58 W | 1500 mm |

■ 26 mm diameter tube with 10% less energy consumption and 10% more light yield than tubes of 38mm diameter.

■ Service life of 10,000 hours

■ Fits all commercially available aquarium hoods with T8 technology.

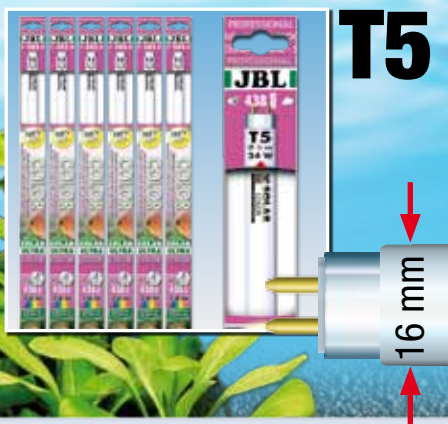
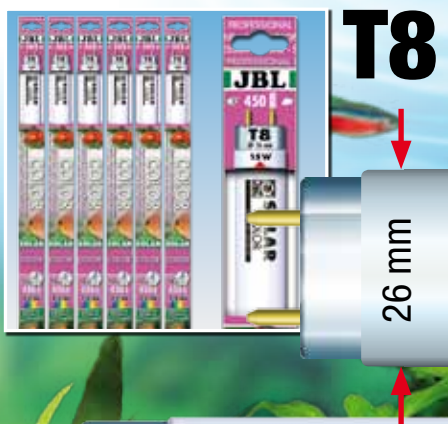
JBL SOLAR ULTRA COLOR T5

| Art.- No. | Watt | Length |
|-----------|------|---------|
| 61791 | 24 W | 438 mm |
| 61792 | 24 W | 550 mm |
| 61793 | 28 W | 590 mm |
| 61794 | 35 W | 742 mm |
| 61795 | 39 W | 850 mm |
| 61796 | 45 W | 895 mm |
| 61797 | 54 W | 1047 mm |
| 61798 | 54 W | 1150 mm |
| 61799 | 54 W | 1200 mm |
| 61800 | 80 W | 1450 mm |

■ Only 16 mm tube diameter with 150% light output compared to regular T8 fluorescent tubes with the same spectrum with only about 30% more energy consumption.

■ Service life of 20000 operating hours

■ To operate, lights and light strips with electronic ballast control specially designed for T5 are required.



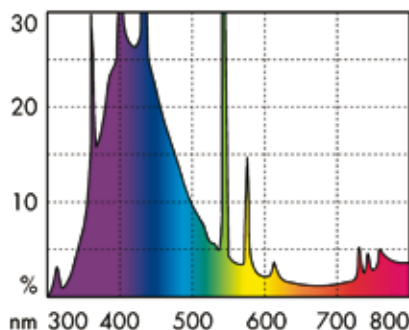
5.4 SPECIAL BLUE FLUORESCENT TUBE WITH ACTINIC SPECTRUM FOR MARINE AQUARIUMS

JBL SOLAR MARIN BLUE AND SOLAR ULTRA MARIN BLUE

■ Promotes coral growth by increasing the blue fraction of the spectrum, preferred by zooxanthellae.

■ Ideal lighting for marine aquarium in combination with JBL SOLAR Natur and SOLAR Marin Day. Colour temperatures of over 9000K can be created by wide range of combinations.

■ Suitable for use as night lighting to observe night-active fish such as catfish in freshwater aquariums.



■ Long service life and reliable operation due to special long-life coating, Wolfram electrodes and inert gas filling.



JBL SOLAR MARIN BLUE T8

| Art.- No. | Watt | Lenght |
|-----------|------|---------|
| 61641 | 18 W | 590 mm |
| 61642 | 25 W | 742 mm |
| 61643 | 30 W | 895 mm |
| 61644 | 36 W | 1200 mm |
| 61645 | 38 W | 1047 mm |
| 61646 | 58 W | 1500 mm |

■ 26 mm diameter tube with 10% less energy consumption and 10% more light yield than tubes of 38mm diameter.

■ Service life of 10,000 hours

■ Fits all commercially available aquarium hoods with T8 technology.

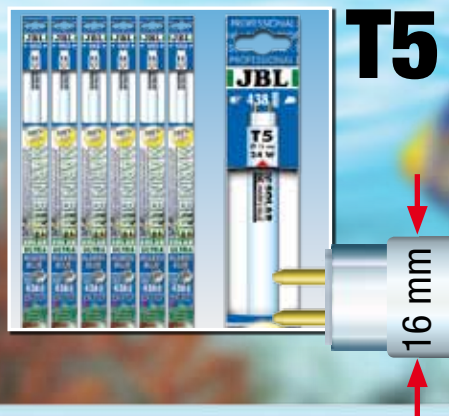
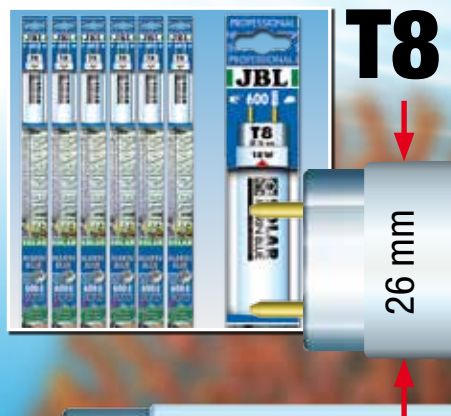
JBL SOLAR *ULTRA* MARIN BLUE T5

| Art.- No. | Watt | Lenght |
|-----------|------|---------|
| 61771 | 24 W | 438 mm |
| 61691 | 24 W | 550 mm |
| 61772 | 28 W | 590 mm |
| 61773 | 35 W | 742 mm |
| 61692 | 39 W | 850 mm |
| 61774 | 45 W | 895 mm |
| 61775 | 54 W | 1047 mm |
| 61693 | 54 W | 1150 mm |
| 61776 | 54 W | 1200 mm |
| 61694 | 80 W | 1450 mm |

■ Only 16 mm tube diameter with 150% light output compared to regular T8 fluorescent tubes with the same spectrum with only about 30% more energy consumption.

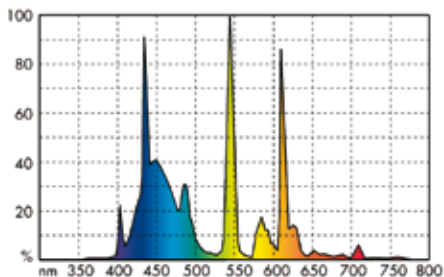
■ Service life of 20000 operating hours

■ To operate, lights and light strips with electronic ballast control specially designed for T5 are required.



5.5 DAYLIGHT TUBE FOR THE MARINE AQUARIUMS

JBL SOLAR MARIN DAY AND **SOLAR ULTRA MARIN DAY**



■ Cold white spectrum with a colour temperature of 15,000 K and a highlight yield, specially designed for lighting marine aquariums.

■ Supplies corals and other invertebrates (lower animals) with the necessary luminous energy for optimum growth. The particularly intensive range between 400 and 500 nm promotes zooxanthellae which are indispensable for the growth of many corals and other invertebrates.

■ Used in combination with **JBL SOLAR MARIN BLUE**, higher colour temperatures and fluorescent effects can be achieved as required.

■ Long service life and reliable operation due to special long-life coating, Wolfram electrodes and inert gas filling.



JBL SOLAR Marin Day T8

| Art.- No. | Watt | Lenght |
|-----------|------|---------|
| 61601 | 18 W | 590 mm |
| 61602 | 25 W | 742 mm |
| 61603 | 30 W | 985 mm |
| 61604 | 36 W | 1200 mm |
| 61605 | 38 W | 1047 mm |
| 61606 | 58 W | 1500 mm |

■ 26 mm diameter tube with 10% less energy consumption and 10% more light yield than tubes of 38mm diameter.

■ Service life of 10,000 hours

■ Fits all commercially available aquarium hoods with T8 technology.

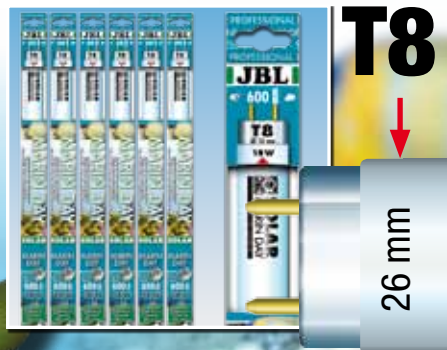
JBL SOLAR *ULTRA* Marin Day T5

| Art.- No. | Watt | Lenght |
|-----------|------|---------|
| 61771 | 24 W | 438 mm |
| 61691 | 24 W | 550 mm |
| 61772 | 28 W | 590 mm |
| 61773 | 35 W | 742 mm |
| 61692 | 39 W | 850 mm |
| 61774 | 45 W | 895 mm |
| 61775 | 54 W | 1047 mm |
| 61693 | 54 W | 1150 mm |
| 61776 | 54 W | 1200 mm |
| 61694 | 80 W | 1450 mm |

■ Only 16 mm tube diameter with 150% light output compared to regular T8 fluorescent tubes with the same spectrum with only about 30% more energy consumption.

■ Service life of 20000 operating hours

■ To operate, lights and light strips with electronic ballast control specially designed for T5 are required.



6. HIGH-PERFORMANCE REFLECTORS FOR OVER 100% MORE LIGHT FROM ANY FLUORESCENT TUBE

JBL SOLAR REFLECT

■ Double-ellipsoid reflector with polished surface for maximum light yield.

■ Computer-optimised shape gives greater light penetration depth.

■ For more light in the aquarium / terrarium

■ No light loss from dark underside to cover

■ Corrosion-resistant, sturdy high gloss aluminium

■ UV-resistant plastic clips, easy to fit

■ Optimised clip fastening makes (clip) changing easy.

| Art.- No. | T8 | T5 | For Tubes |
|-----------|-----|-----|-----------|
| 61730 | 15W | 24W | 438 mm |
| 61731 | 18W | 28W | 590 mm |
| 61732 | 25W | 35W | 742 mm |
| 61733 | 30W | 45W | 895 mm |
| 61734 | 36W | 54W | 1200 mm |
| 61735 | 38W | 54W | 1047 mm |
| 61736 | 58W | | 1500 mm |
| 61737 | | 24W | 550 mm |
| 61738 | | 39W | 850 mm |
| 61739 | | 54W | 1150 mm |
| 61740 | | 84W | 1450 mm |

■ Plastic corners protect against injury.

■ Adjustable: light can be individually directed by turning the reflector.

■ For all current T 8 and T 5 fluorescent tubes (26 and 16 mm diameter)





Captures scattered light and reflects it directly into your aquarium

Fluorescent tube with JBL SOLAR Reflect

*In light reflection the following applies:
the angle of incidence corresponds to the angle of reflection*



The radius of the computer-designed reflector profile of JBL SOLAR Reflect directs the reflected light at the angle of incidence around the fluorescent tube. The result: increased efficiency for your aquarium lighting.

Illustration



7. LIGHTING IN THE MARINE AQUARIUM



When lighting marine aquariums with conventional T8 fluorescent tubes, limits were quickly reached because the level of light produced was only adequate for relatively shallow aquariums and animals with comparatively low lighting requirements. The new T5 technology represents real progress, allowing sufficient light to be produced for corals and other invertebrates which need light to be successfully kept in aquariums with up to 60cm water.

The lower purchase price compared with HQI lamps is another advantage of T5 technology, which should also contribute to its growing popularity.

The T5 range from JBL offers all the types of lamps needed to provide marine animals with the specific light they require:

Corals and other invertebrates in the sea are home to zooxanthellae, single-celled algae, which provide their host organisms to a greater or lesser degree with nutrients through their photosynthesis. In the natural habitat of these creatures the light is more or less blue-toned depending on the depth. The zooxanthellae have adapted to this light. However, this light does not show any gaps in the spectrum. Blue-toned lighting with full spectrum and a colour temperature of 9000K and above is therefore the most suitable



lighting for a marine aquarium with corals and invertebrates.

A combination of the JBL SOLAR ULTRA NATUR, MARIN DAY and MARIN BLUE fluorescent tubes provides the ideal light for marine aquarium with up to 60 cm water.

Depending on the combination and number of the tubes listed above, colour temperatures of more or less over 9000K can be achieved.

8. TIPS FOR LIGHTING AN AQUARIUM

Lighting duration:

Lighting an aquarium for approx. 12 hours a day is considered the ideal length of time for plants and fish from tropical regions. Any special requirements of individual species regarding light intensity should also be taken into consideration. It is important to note that insufficient light intensity cannot be compensated for by extending the length of time an aquarium is lit. Taking a "lunch break" in the lighting exposure is unnatural and interferes with the biorhythm of the plants.

Lighting configurations:

In the case of an aquarium hood with only one tube, the requirements of the plants should always be the prime consideration, i.e. the best choice is JBL SOLAR Tropic. For hoods with more than one tube, the natural cycle of daylight can be simulated in both light intensity and colour temperature: e.g. starting the aquarium day with half or one third of the tubes switched on, switching the rest on after about 2 hours, and switching off again in the evening in reverse order.




Higher colour temperatures at midday can be simulated by combining the SOLAR Tropic and SOLAR Natur tubes, switching the SOLAR Natur tube on later, at midday, as described above.

Installing the lamp with the highest colour temperature as the first tube behind the front pane of the aquarium increases the impression of depth in the aquarium.

The following table is intended as a guideline and the recommendations apply to the selection of types of tube for specific use in freshwater.

For the reasons mentioned previously, we do not recommend JBL SOLAR Color as the sole source of light. It is only recommended for use in combination with SOLAR Tropic or SOLAR Natur.

*T= Tropic; N= Natur; C= Color
Order for more than one tube: from the front to the back*

| | 1 tube | 2 tubes | 3 tubes | 4 tubes |
|--|--------|---------|---------|---------|
|  mainly plants | T | NT | NTT | NNTT |
|  plants and fishes | N | NT | CNN | CNNT |
|  mainly fishes | N | CN | CNN | CNNN |

Service life:

All tubes in the JBL SOLAR series (T 8) and SOLAR ULTRA series have a service life of 10000 and 20000 hours, respectively. This corresponds to about 2 and 4 years of operating life in an average aquarium. In the interests of plants in freshwater and invertebrates in saltwater we recommend changing the tubes after one or two years, as the intensity of illumination decreases towards the end of a lamp's service life, distorting the spectrum. Replacing the tubes in good time avoids unnecessary adaptation problems for both plants and animals.

JBL's "Tube age check sticker" is a practical way of reminding you to change the tubes in good time. This is based on a similar principle to the German MOT sticker for cars. When a tube is purchased, the retailer places a sticker showing the recommended replacement date on the allotted space. You can then peel off the part of the sticker with the date and attach this in position near to the tube in question, as a reminder of when the tube should be replaced. The stickers are UV resistant and will not fade in the weak UV radiation which all fluorescent tubes emit.



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will be pleased to advise you and
recommend further literature.*

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