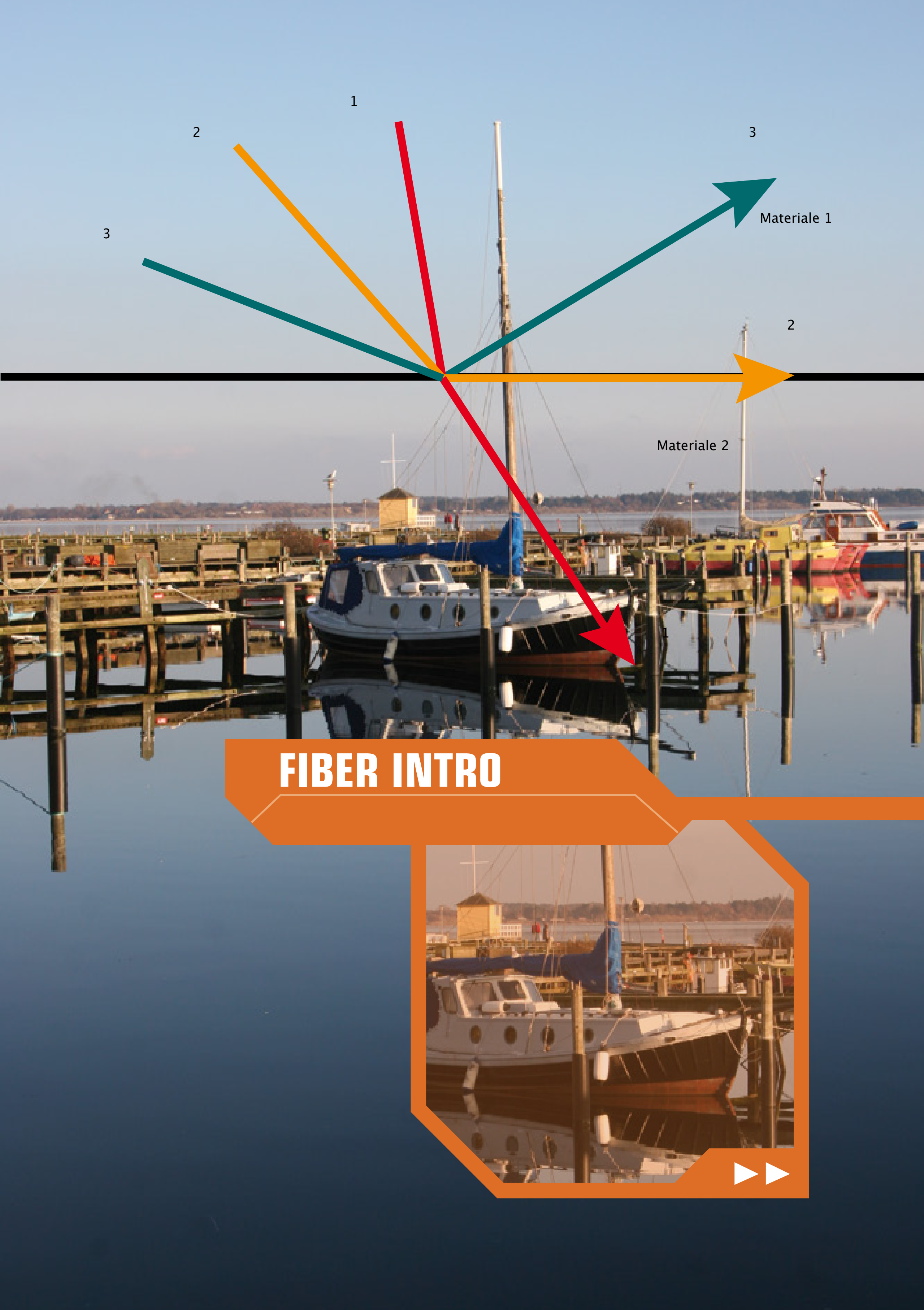
FIBER INTRO



Fiber Intro

What Is a Fiber Optic Signal?

Basically, an electrical signal is converted into a light signal in order to transmit the signal over long distances.

There are several parameters that makes a fiber more attractive than a copper connection, namely:

- Distance
- Speed
- Immunity to electrical noise
- Weight and lack of electromagnetic radiation

Disadvantages to fiber may be:

- High prices
- Not easy to handle
- Lack of training
- Waste and safety

However, these disadvantages have gradually become less significant, one by one. The prices are going down rapidlly, as a consequence of increasing market demand for fiber solutions.

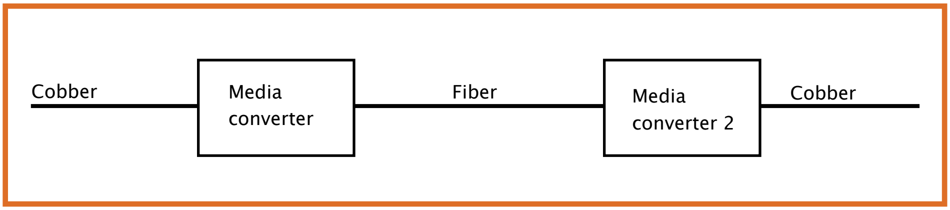
Fiber has become much easier to work with, and many ingenious and more mounting friendly components have turned up. It is my belief that we have only seen the beginning of this development.

Many fiber courses are held, and knowledge of fiber has also become part of the electrician training. There is a wide range of additional training offers as well as a few certification courses. This also helps, as products are used in a propper way.

The problem concerning waste has not become less, but that is a question of following some simple rules. Finally there is the problem concerning safety. We must look after ourselves, our colleagues, and our environment. The safety rules may be experienced as being troublesome, but mostly, they can be observed without greater difficulties. Regarding personal safety, you must remember, that you are responsible for your own and others' safety as well.

Figure 1

Typically, a fiber installation looks like this.



Fiber consists of a piece of glass (though you may find fiber types based on plastic). The glass is composed of two different types of glass, and it is constructed in such a way that the light remains in the centre of the fiber (core). An acrylic coating, enclosing the core/cladding, provides mechanical strength. The coating does not influence the optical properties. The purpose of the coating is entirely to protect the core against physical stress, blows, bends etc.

Figure 2

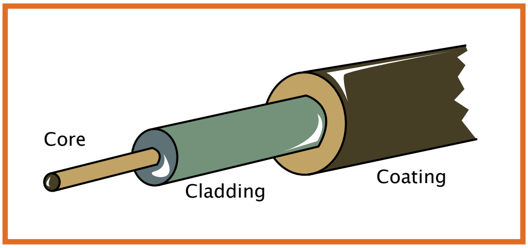


Figure 2 shows the fiber; the core in the centre is sheathed by the cladding and by the protective coating.

The light is reflected from the boundary between the core and the cladding. This total, internal reflection ensures a very small loss. The losses in a single mode fiber (will be dealt with later) are as low as 0,2 dB pr. km which means that half of the signal will be lost over a distance of appr. 15 km. Under certain circumstances this loss may be bigger, and one may easily loose half of the signal within a few hundred meters, if not handled correctly. This issue will be described later on in this guide.

Figure 3

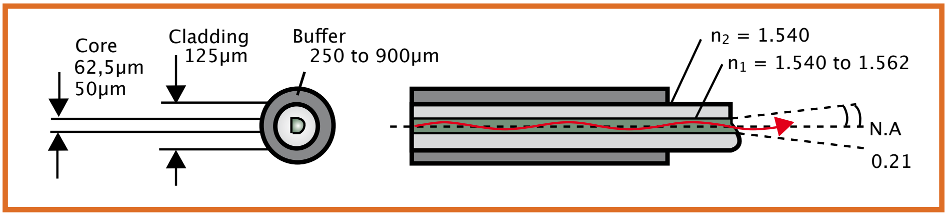
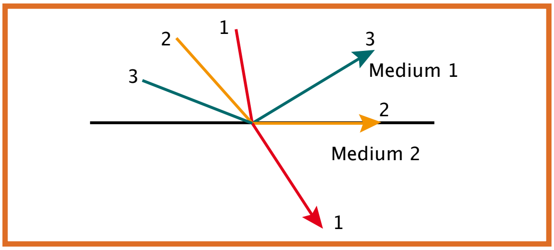


Figure 3 shows a piece of fiber in which light is reflected from the boundary between the core and the cladding.

In order to understand how fiber works you must know about the concept of index of refraction. Index of refraction is a number describing how much a ray of light is deflected, when it passes from one medium into another. In much the same way, when you go fishing, your fishing line seems to bend at the point where the line enters the surface of the water. This phenomenon is due to the change in refractive index of air and water.

It is the case that when a ray of light passes from one medium into another, it may either be reflected from the boundary, follow the boundary, or break through the boundary and pass into the new medium.

Figure 4



When a ray of light passes from one medium to another it may either break through the boundary (1), follow the surface of the boundary (2), or reflect (3).

Figure 5

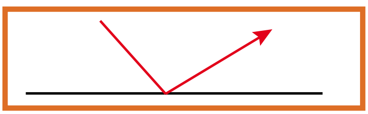
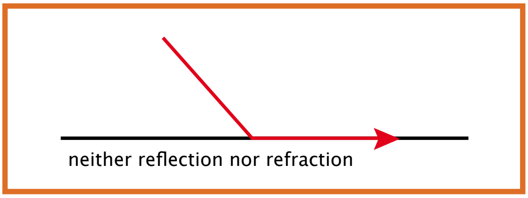


Figure 5 shows a ray of light being reflected from the boundary. In much the same way when you are gazing over a lake and see trees, buildings, boats etc. reflected from the surface of the water (figure 6).

Figure 6

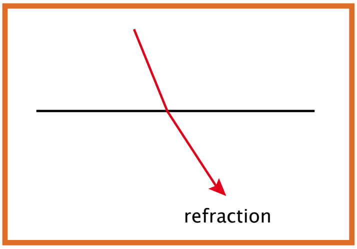
Reflection

Figure 7



At a certain angle the incoming ray of light will neither be reflected nor refracted. Instead the ray will follow the boundary of the medium.

Figure 8



In this case the incident light ray will be refracted, break through the boundary and continue into the other medium. If these laws of nature did not exist, we would never be able to see to the bottom of a water filled bath tub.

The above mentioned principles are not complicated, but with regard to fiber it is important that light enters the fiber at the right angle.

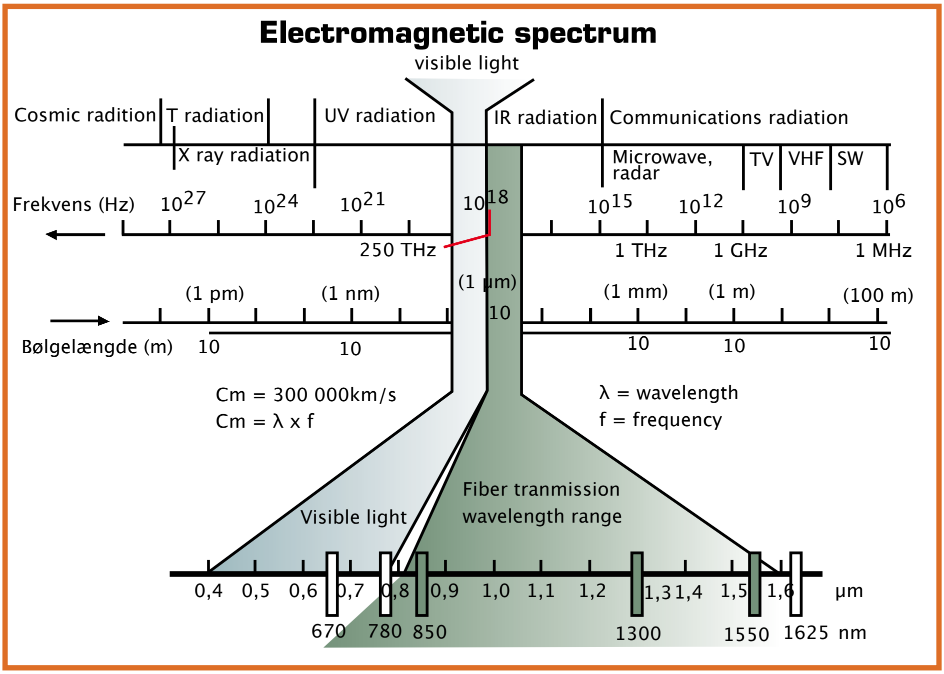
Furthermore, you must take care not to bend the fiber, otherwise you will see light coming out of the fiber which will result in considerable losses. Today, a standard fiber (not the cable) withstands a bend diameter of 60 mm minimum. Losses will occur if this diameter is exceeded.

The Light in a Fiber

Figure 9 illustrates the electromagnetic spectrum ranging from cosmic radiation to communications radiation. Visible light is located between UV (Ultra Violet) radiation and IR (Infra Red) radiation. For fiber optics, we use light in the infrared region, which has wavelengths longer than visible light, typically 850, 1300, and 1550 nm (850 nm and 1300 nm at multimode plus 1310, 1490, 1550, and 1625 nm at single mode).

Why do we use infrared light? Because the attenuation of the light is much less in the fiber.

Figure 9



Even so IR light is invisible to the human eye, it behaves in the same way as the visible light. When an IR light ray is transmitted through glass, a loss will occur, as well as a reflection, when the IR light enters or leaves the glass. However, light and fiber have been matched in such a way that losses will be very small.