

# The 'IEC' Laserview Kit of Shapes



## HL1985-001 LaserView Shapes

HL1985-001 full kit of 6 shapes & 2 bars, in kit box

HL1985-100 set/6 prism and lens shapes only, in kit box

HL1985-200 set/2 straight and curved Light Guide bars only, in kit box

### Contents:

The 'IEC' LASERVIEW full kit of shapes contains the following:

- 1x Light Guide, straight bar 250x20x10mm thick
- 1x Light Guide, curved bar 250x20x10mm thick
- 1x Rectangular block 75x45x12mm thick
- 1x Half Round block 75x40x12mm thick
- 1x 45°x45°x90° prism 85mm base x 12mm thick
- 1x 60°x60°x60° prism 62mm sides x 12mm thick
- 1x 30°x60°x90° prism 85mm longest side x 12mm thick
- 1x Bi-convex lens 60mm long x 12mm thick
- 1x extra space is allowed in the packaging for small laser device to be stored.

|               |            |            |              |
|---------------|------------|------------|--------------|
| Length: 310mm | Width: 200 | Height: 47 | Weight: 750g |
|---------------|------------|------------|--------------|

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### Description:

When light is passed along certain materials, it is held inside the material and almost zero light is lost through the sides. Materials that do this are called 'Light Guides'. Very small guides as small as wires are called 'Opto Cables' and are used to carry information inside a light beam over very long distances. Telephone and TV signals are carried along 'Opto Cables' instead of copper wire and also computer communications to printers and other equipment. This kit will demonstrate why the light is held captive and the light beam can be seen inside the material. The two long bars of special plastic are designed to show the path of Laser light along a long slim length to study the way light travels along optical cable. Internal reflection is easily seen and dispersion of the laser beam upon exiting the bar can be studied. It can be demonstrated that light can travel without loss around corners if the light guide is curved. This is how the light travels along opto cables as they twist and turn like wires. There is a limit how sharp the corner can be and this also can be demonstrated. The other six shapes are from the 'Hodson' Light Box Kit. These have been produced from special plastic to permit the laser beam to be visible internally. Ray paths through the blocks are easy to see and the various internal and external reflections easily identified. A large range of optical experiments can be devised by using the booklet supplied with the 'Hodson' Light Box & Optical Kit. Note that any laser can be used to view the beams, including the low cost 'key ring' type lasers available at the markets or laser 'pointers' used in lectures. The stronger the laser beam, the brighter are the rays. The kit provides a space to store a small 'key ring' type laser, but it is not normally supplied with the kit.

### Personal Safety Using Lasers:

Laser beams are very intense and can harm the sensitive optical system of the human eye. Always be very careful when using or working around lasers. Lasers can be thousands of watts of power and are used to cut plastic and also to melt and cut steel up to 30mm thick ! For educational use, most lasers are below 3mW and will not harm human skin.

- **NEVER** look directly into a laser beam. Never look closely into the hole of the laser device even if it is off because someone could turn it on accidentally and **your eye can be permanently damaged**.
- NEVER look into a laser beam and do not stare into a beam coming from somewhere else.
- NEVER point a laser beam into anybody's face. Even if they are a long distance away, it can damage their eyes
- NEVER use any magnifying device to look at a laser beam directly or to look at the reflection of a laser beam from a surface.

### Using A Laser In The Classroom:

There are more rules for using a laser in the classroom:

- In the classroom, before turning on the laser, always point the laser into an area where nobody will be passing. If the area is busy, use a large piece of cardboard or curtain or similar to accept the beam and to stop the beam from travelling further where people may be.
- Try to keep articles that are metallic and shiny away from the area where a laser will be used. Try to eliminate the chance of random reflections. Look for jewellery, watches, bracelets, rings, metallic buttons and similar. Remember the reflected beam is almost the same intensity as the direct beam.
- NEVER leave a laser left ON in a classroom when unattended. When finished with the experiment, always turn it OFF before walking away.



## Simple Demonstrations:

- Take the 'key ring' laser or laser pointer and aim it into the end of the bar at an angle (not down the centre of the bar. See the laser beam bouncing back and forth in a 'zig zag' pattern as it passes along the bar.
- Change the angle you are holding the laser and notice the change in angle of the 'zig zags'. Notice that the light cannot escape from the sides of the bar and is captive inside the light guide.
- As the laser beam enters from the air into the plastic, notice that the beam bends slightly. Change the angle and notice the change in the bending. When light travels from one medium (air) into a more dense medium (plastic) it suddenly bends. If it passes from dense to less dense medium, it bends the other direction. This is caused by the 'Refractive Index' of a medium. You should have learned about this when using the 'Hodson' Light Box & Kit.
- Now use the curved plastic bar. See the light beam bouncing inside the bar and see how and why the light beam can pass around curves. Notice that the angles of the internal 'zig zag' changes as the curve changes.
- Take the various shapes in the kit and shine the laser beam into the shapes. If you have 3x laser pointers mounted side by side so you have 3 beams, the demonstrations inside the shapes can be much better. A 3x beam system can do many of the experiments done by the 'Hodson' Light Box but with more obvious rays and better viewing from a longer distance.

**NOTE: IEC will be adding a multi laser beam light source to its large range of Science and Physics apparatus. Keep in touch with your dealer for the latest news on its release. It will be operated either by battery, by power pack or by standard 12V.AC. PlugPak.**

## Explanations:

The internal reflecting of the light beam inside the plastic bar is the essential principle of the Optical Light Guide technology. The beam reflects from the INSIDE face of the plastic in the same way light reflects from the surface of a mirror. It is called 'Internal Reflection' and can be explored further by using some of the shapes.

By changing the angle that you hold the laser, it can be seen that internal reflection occurs up to a certain angle. When this angle is exceeded, the light breaks out of the surface to be lost.

This angle is called the 'critical angle'.

Take the rectangular block and point the laser so that the light beam passes through the width of the block and emerges from the rear edge of the block. Now change the angle so the emerging ray bends further away from the line of the laser ray. Finally the emerging ray will run along parallel to the rear face of the block and then it will not exit the block at all and it will be fully **internally reflected**. At this point, it has reached the '**critical angle**'.

There is always a very small amount of light lost when it 'zig zags' at the sharp corners of a rectangular shaped light guide. This is one of the reasons that optical cable is always round in shape.

## Optical Cables:

Real optical cables can be made of special plastics or glass. The material must be very clear because any particles or loss of clarity will lose light. They usually are flexible and consist of many very fine strands of optical fibre (each one is a light guide) and they are sheathed with a material to protect them and to keep them together in one bundle.

The sheathing material MUST HAVE a much **lower** 'Refractive Index' (sometimes called RI) than the RI of the light guide material itself. If the RI were the same, the light would travel from the light guide material into the sheath and would be lost.

In the case of these bars and shapes, the air around them is behaving as their sheath.

The most difficult area of optical fibres is in joining them so that there is minimum loss of light energy in the joins. The joining of optical fibres is a highly specialised job. Light beams can carry thousands



of times more information that metal wires and this feature makes them very suitable for carrying telephone conversations and TV signals. In addition, they are not electrically conductive and electrical 'interference' cannot occur in optical fibres. Electrical interference is what causes the distortion or crackling in sound sometimes when your equipment is close to other electrical equipment. Optical cables are not affected by lightening or by other electrical signal or electrical wires that are close by. Importantly, they can be used safely in dangerous locations where electrical sparks could cause fire or explosions.

### Refractive Index:

The following table shows the refractive indexes of various common materials:

| Material Refractive Index (Ri) |               |              |
|--------------------------------|---------------|--------------|
| Air 1.00029                    | Glass 1.4-1.8 | Acrylic 1.49 |
| Water 1.33                     | Silicon 3.5   | Diamond 2.0  |

Notice that the RI of acrylic is much higher than the RI of air and this is why the light beam internally reflects in the bars provided in the kit. To fully understand RI and to learn how to calculate the RI of acrylic or glass, refer to the experiment manual supplied with the '**Hodson**' Light Box & Optical Kit.

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Designed and manufactured in Australia

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