

RIPPLE TANK - with rippler & kit

Cat: SW3430-001 with illuminator, rippler & kit.

GENERAL DESCRIPTION:

The ripple tank is used to investigate wave motion in a shallow trough of water to understand how various types of waves behave. The basic principles which apply to the water waves in the ripple tank also apply to light, sound and radio waves.

SW3430-001



Physical size:

Weight: kg

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**The unit consists of:**

- 1x. Tank with glass bottom and folding legs.
- 1x Ripple generating unit with inbuilt speed control (connects to any standard laboratory supply, up to 12V.AC/DC.)
- 1 pr. cables and plugs for Ripple Generator.
- 1x. Set of 'dippers' of various shapes to fit the Ripple Generator.
- 1x. Set of 'barriers' to place in the water to disturb ripples.
- 1x. Rail for supporting the Ripple Generator (fits to tank).
- 1x. Rail for supporting Light Source (fits to tank).
- 1x. Illuminating light source, cable and plugs (12V.AC/DC).
- 1x. White faced screen to view wave images.

Using an Electronic Stroboscope: (Not included in standard kit)

A Xenon Stroboscope (IEC Cat: LB3808-001) may be used as a light source above the ripple tank. It may be held or mounted above the ripple tank instead of the standard simple light source for certain experiments.

When using the Strobe light to illuminate the tank, synchronize the frequency of the Strobe flash with the frequency of the waves so that they appear stationary on the white faced screen placed on the bench beneath the tank. The synchronising frequency is the highest Strobe frequency which appears to 'stop' the waves without creating a double image. Alternatively, using the Stroboscope, observe the ripple generator itself. When it appears to have stopped oscillating, this is the synchronised frequency.

Features of the IEC Ripple Tank:

This IEC design can be used as either a normal ripple tank on the bench or a ripple tank for use with an overhead projector (projector not supplied in the kit). The adjustable legs are long enough to support the tank above the Fresnel lens of the standard models of overhead projector used in most schools. The tank can rest on the screen of the overhead projector, but it is better if it is supported on its own adjustable legs to avoid unwanted vibration from the projector's cooling fan.

The tank is corrosion resistant and is provided with sturdy fold-away legs for compact storage. Each leg has individual height adjustment. The tank itself has 'Beached' sides so that waves are absorbed and not reflected from the sides back into the tank. The tank has a strong glass bottom panel because plastic materials scratch easily and do not retain a flat clear surface over the life of the equipment.

The tank is complete with various mounting guides for the illumination support and the rippler support frames. Except for a simple power supply, ancillary equipment is not required to operate the IEC ripple tank.

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**Notes on Operation:**

See sketches for the arrangement of the tank and light together with information on the principle of projection of the wave images. Note that the best results are obtained if the water in the tank is not too deep.

The conventional arrangement for the ripple tank is to place the illuminator above the water and project the ripples down on to the white screen resting on the bench below the tank. The kit contains an illuminator support frame that locates in the grooves provided half way along the length of the tank. The illuminator is held against the tip of this frame by the rubber ring fitted to the illuminator body (see illustration) so that it projects an image of the ripples in the water downwards on to the table top. Using this method, clarity and definition is usually better than that obtained when using an overhead projector.

With the light above the tank, the variations in depth caused by the waves form convex and concave 'lenses' which focus the light as bright and dark bands on the white screen.

For the 'Refraction of Waves' experiment, a thick glass slab (not supplied as part of the standard kit) is placed in the water to provide both a deep and very shallow water depth. For effective results, a large difference in the two water depths is required (about 10:1) and low frequency waves are the most effective.

Using an Overhead Projector:

CAUTION: IF AN OVERHEAD PROJECTOR IS USED, AVOID SPILLAGE. ANY WATER SPLASHED OVER THE SIDES OF THE TANK MAY BE BLOWN BY THE COOLING FAN ON TO THE HOT GLOBE OF THE PROJECTOR. DAMAGE TO THE PROJECTOR MAY OCCUR.

The Fresnel lens, which is the surface of an overhead projector, concentrates a converging beam to focus the light to the 'periscope' lens. Hold a sheet of paper over the square OHP Fresnel screen and raise it slowly towards the 'periscope' lens. Note the size of the brightly illuminated part of the paper. The periscope lens focuses the opaque object on the Fresnel screen to the wall screen, but when a ripple tank is used on an overhead projector, there is no opaque object. It is the variation in the depth of the water in the tank which creates the image you can see. If the water is not too deep, the variations in depth, due to the waves, causes the water thickness to vary relative to the original depth maybe in the ratio of 2:1. Thus, when using an overhead projector, the shallower the water the better are the images.

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THE VARIABLE SPEED RIPPLE GENERATOR. The generator may behave as:

- A straight wave generator of variable frequency.
- A two point source generator, with or without adjustable phase delay between the two points.
- A multiple point source generator for illustrating single slit diffraction.

The Ripple Generator body is clamped to a special support rail, which is held over the tank by sliding it into the desired set of grooves provided along the sides of the tank. The correct height is set by adjusting the locking collars on the two short legs of the support rod. The generator can be locked on the support rod at either of two positions which are 90° apart (see sketch).

The Ripple Generator consists of a small electric motor which is gear driven to a double ended output shaft which carries two cams. These cams can be twisted by the fingers relative to one another so that they drive the two side plates up and down either exactly in unison (in phase) or by some angle out of phase. If one plate achieves highest point at the same time as the other plate achieves the lowest point, they are then 180° out of phase.

Speed Control of the Rippler Generator (Rippler):

The Ripple Generator may be connected to the terminals of any Power Supply set between 6 and 12V.AC or DC. The 12V Light Source of the ripple tank can be connected to the same power source. Several Generators may be connected to the same power source so that several ripple tanks can run from the one 12V.AC or DC power source.

A knob on the rippler's body permits control of the rippler speed. The current supplied to the rippler motor is controlled so that motor damage due to high voltages and high speeds is eliminated. If the rippler appears to be operating too slowly, check for tightness or jamming in the rippler. Be sure the side plates can slide easily and the rubber band retaining the side plates is not too tight. When the rotary cam is turned by the fingers, everything should move very freely.

OLDER MODEL RIPPLERS: For older models without speed control, the motor can be connected directly to the power source, but be careful, to avoid motor damage, **the voltage applied must be DC only and must not exceed 3 Volts.**

The Attachments for the Ripple Generator: (see sketches)

Lock the generator on the support rod so that the moving side plates are parallel to the support rail. The rubber band around the body of the generator holds the side plates gently but firmly in place. The Wave Length (or frequency) of ripples may be varied by adjusting the motor speed control knob on the generator.

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The **Straight Wave Generator** is a flat aluminium sheet partly folded along one edge. This attaches to the face of the sliding side plate by a thumb screw (see sketches).

For best results adjust the height of the generator so the Straight Wave blade is *just* touching the water surface at its extreme low point of travel. It is recommended that it be set so that the water is *just* disturbed at each dip. If greater water displacement is required, the straight wave generator may be inverted so that the sloping face pushes forward a larger volume of water on each thrust than the plain edge. The blade should enter the water evenly along its whole length. Carefully adjust for a level blade then clamp the screw firmly.

USEFUL HINT: A SMEAR OF DETERGENT WIPED ALONG THE EDGES OF WAVE MAKERS AND BARRIERS WILL PERMIT THE WATER TO WET THEM MORE EFFECTIVELY AND IMPROVE THE CLARITY OF THE IMAGES.

For **Several Points Sources**, clip several of the plastic point source mouldings along the length of the Straight Wave Generator so that several points *just* dip into the water simultaneously. Their separation is adjusted to vary the relationship of Source Separation and Wave Length (see sketch). The Frequency or Wavelength of the ripple may be altered by adjusting the motor speed.

Multiple Point Source Generation is useful in explaining the phenomenon of Single Slit Interference Patterns. The plastic strip with a 'saw tooth' edge is mounted to the generator instead of the straight line aluminium wave maker.

For **Two Fixed Point Sources**, one of the plastic point sources provided is slid firmly on to one of the short straight portions of the bottom edge of a side plate of the ripple generator and another point source is fitted to the other leg of the SAME side plate. The two point sources move up and down into the water simultaneously.

For **Adjustable Phase Wave Generation** from two point sources, the generator is unclamped from the support rod and turned through 90° so that the cams are now parallel to the support rod (see sketch).

The plastic point source mouldings are then fitted to the lower edges of *opposite side plates* and the phase relationship between them can now be adjusted by rotating the two plastic cams on the shaft which alters the phase between the movement of the two side plates.

The rotational phase relationship between the cams can be seen by observing the alignment mark on the end of each cam and it may also be observed by examining the relative heights of the two sliding side plates. Please be careful when adjusting these cams so they do not press against and rub against the body of the ripple generator. If they rub, the shaft may become stiff to rotate and the ripple generator may not achieve the correct speeds.

Performing Experiments:

Ripples created by the ripple generator proceed across the water in the tank and usually require interruption to cause various ripple patterns for demonstrating certain physical laws. These laws include Reflection, Refraction, Interference and so on. The devices used to interrupt or reflect the ripples are called Barriers. They are placed in the tank as shown in the following sketches.

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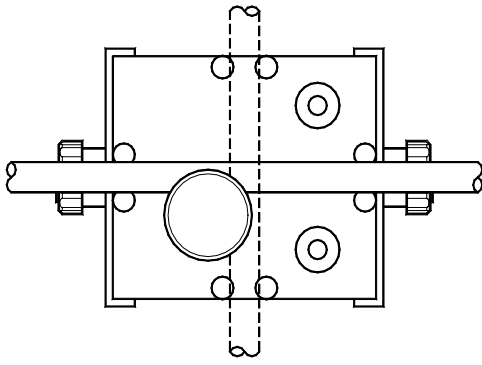


Fig 1

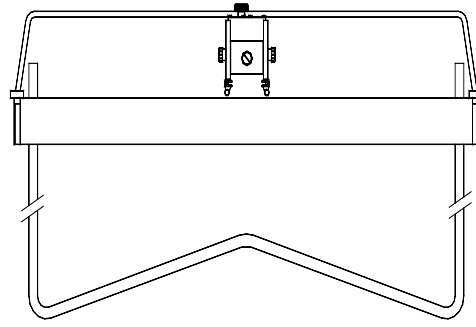


Fig. 2

Fig. 1 shows ripple generator clamped to the support rod (looking from the top). The generator can clamp to the rod also at 90° around.

Fig. 2 shows ripple tank assembly with ripple generator mounted on its support rod. Note the two cams protruding from the side plates. These cams can be rotated relevant to one another to set the phase between them.

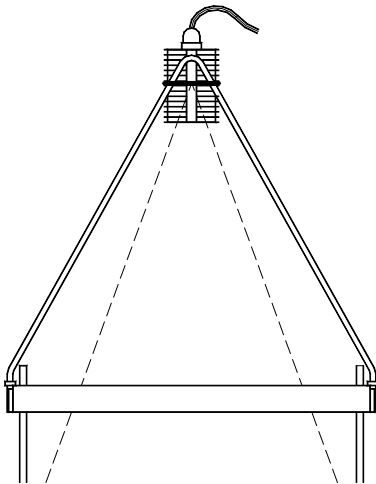


Fig. 3

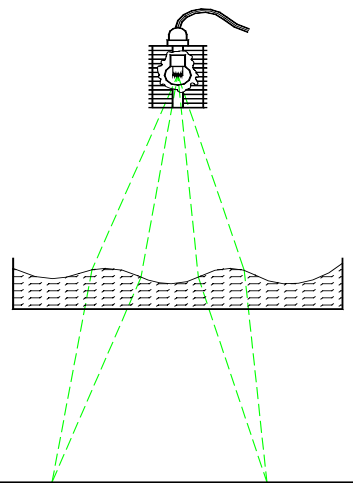


Fig. 4

Fig.3 shows a ripple tank assembly with the Illuminator attached to its support frame by the rubber ring. It is positioned approximately over the centre of the tank. The Illuminator connects to any 12V.AC/DC power source and the images are viewed on the flat white screen which is positioned on the table under the ripple tank.

Fig 4 shows the rays of light passing through the waves which behave like lenses. This effect causes a focussing of the light on each wave and bright and dark bands of light are seen on the white screen.

NOTE: Shallow water always provides a better image resolution than deep water.

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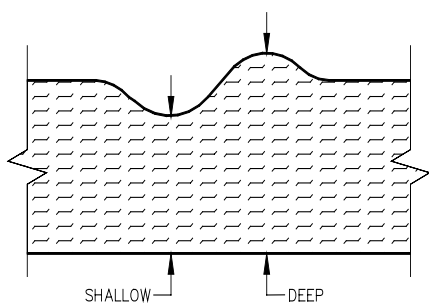


Fig.5

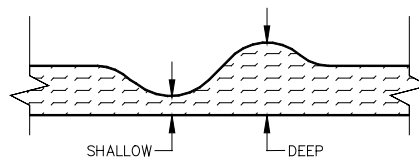


Fig. 6

Figs. 5 & 6 show that shallow water provides a greater *proportional* variation in water depth than deep water. Therefore shallow water provides better images than deep water. For best results, keep the water depth in the ripple tank to a practical minimum.

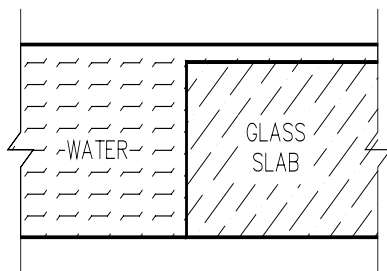


Fig. 7

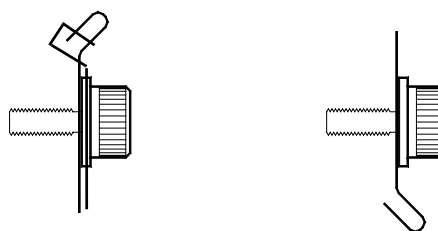


Fig. 8

Fig. 7 shows that for REFRACTION experiments, there must be a *very large difference in water depth*. Also lower frequency waves give better results than higher frequencies. When a thick glass slab (not supplied in standard kit) is placed into the tank to create a large difference in water depth, be sure the water is *just* covering the glass.

Fig. 8 shows the straight aluminium rippler with the thin edge downwards for thin straight ripples and with the folded thick edge downwards for large ripples.

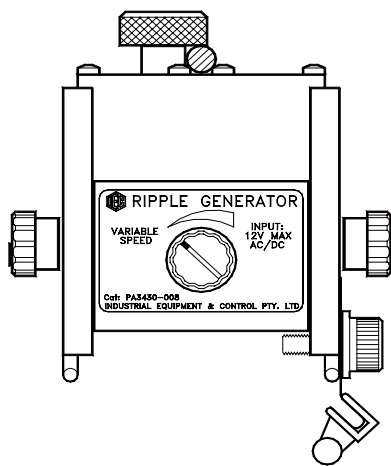


Fig. 9

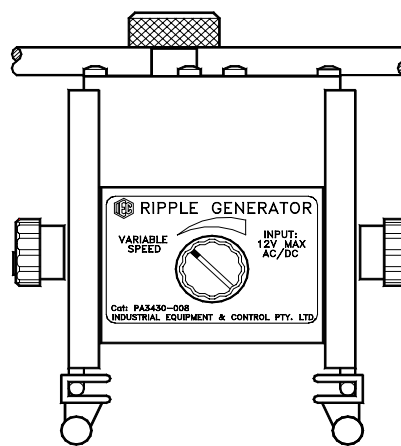


Fig. 10

Fig. 9 shows the ripple generator and its speed adjustment knob fitted with a straight sheet rippler with one or more point source tips fitted. All point sources dip into the water at the same time to create a multiple point source.

Fig. 10 shows ripple generator and its speed adjustment knob with a separate point source fitted to opposite side plates to permit the adjustment of phase between them. This provides two point sources with adjustable phase.

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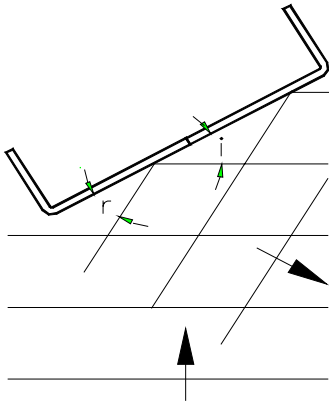
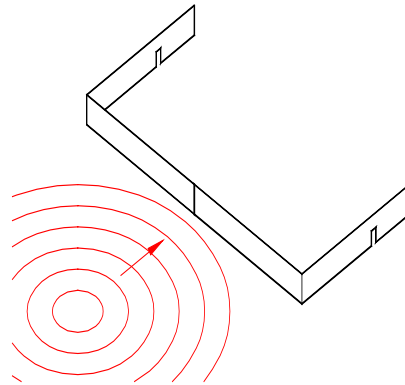
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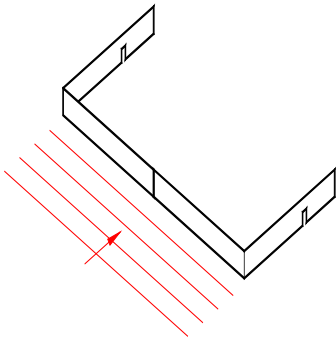
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REFLECTIONS FROM A STRAIGHT BARRIER:

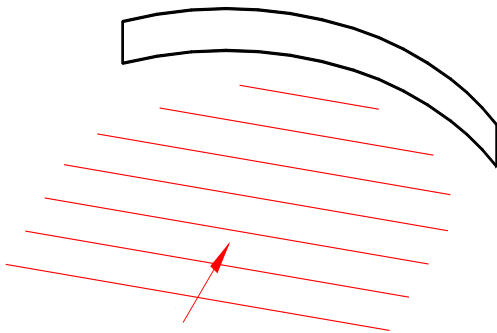
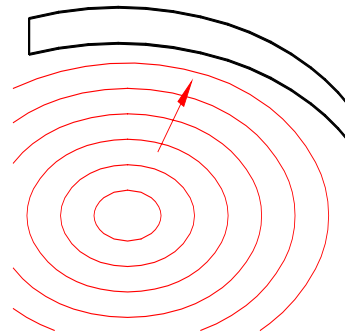
The following sketches show straight line and point source ripples approaching the barriers. The reflected ripple is to be examined by the student.

**Fig.11****Fig.12**

Straight ripples approaching an angled barrier and circular ripples to a straight barrier.

**Fig.13**

Straight ripples to reflect from a straight barrier.

REFLECTIONS FROM A CURVED BARRIER:**Fig. 14****Fig. 15**

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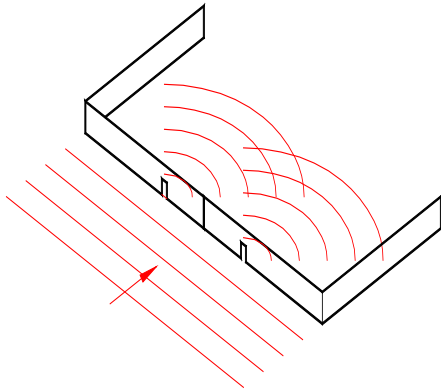
DOUBLE OR SINGLE DIFFRACTION AND INTERFERENCE:

Fig. 16

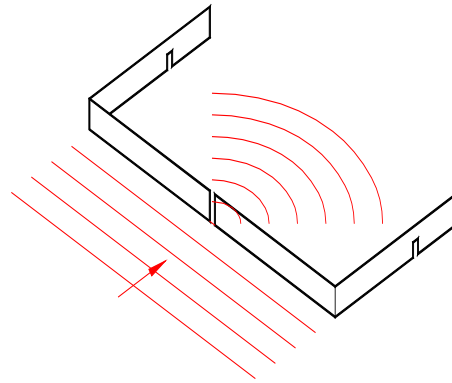


Fig. 17

Double and Single slits are formed by placing the barriers as shown above.

The interference pattern formed by the two slits is clearly seen in the image.

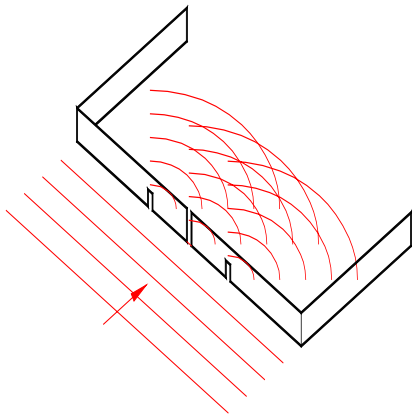


Fig.18

Triple slits are formed by leaving a 5mm gap between the two barriers.

If a barrier is required without slits, use the plain legs of each 'L' shaped barrier and position them so that the tips touch together. See Fig. 13.