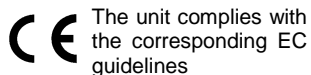


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## Operating instructions



The unit complies with the corresponding EC guidelines

Fig. 1: 11263-00 TESS Ripple Tank

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## 1 SAFETY PRECAUTIONS



Caution!

- Read these Operating Instructions carefully and completely prior to starting the instrument. This is essential for your own protection and to avoid damage to the instrument.
- Do not start up this instrument in case of visible signs of damage to it.
- Only use the instrument for the purpose for which it is intended.
- Use the ripple tank water wave device only with the supplied plug-in power supply unit.
- Always place the device on a stable and level surface.
- Do not look directly at the strobe LED.
- Unplug the power cable after use.
- Keep the tank and screen clean.
- Carefully remove and empty the water tank. Dry the tank and accessories.
- Only use soft cloths for drying, not paper towels.
- Avoid scratches on the tank and screen, these can affect the clarity of the wave display

## 2 PURPOSE AND CHARACTERISTICS

Compact ripple tank for carrying out experiments on wave physics:

- Reflection
- Dispersion
- Breaking
- Interference
- Diffraction

## 3 FUNCTIONAL AND OPERATING ELEMENTS

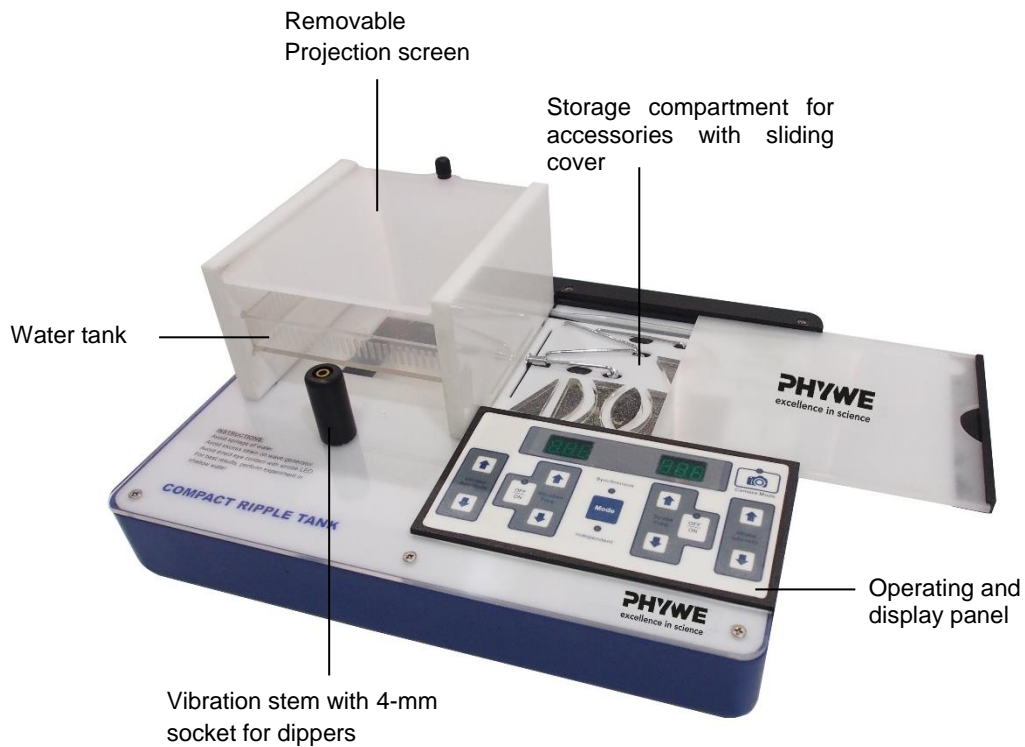
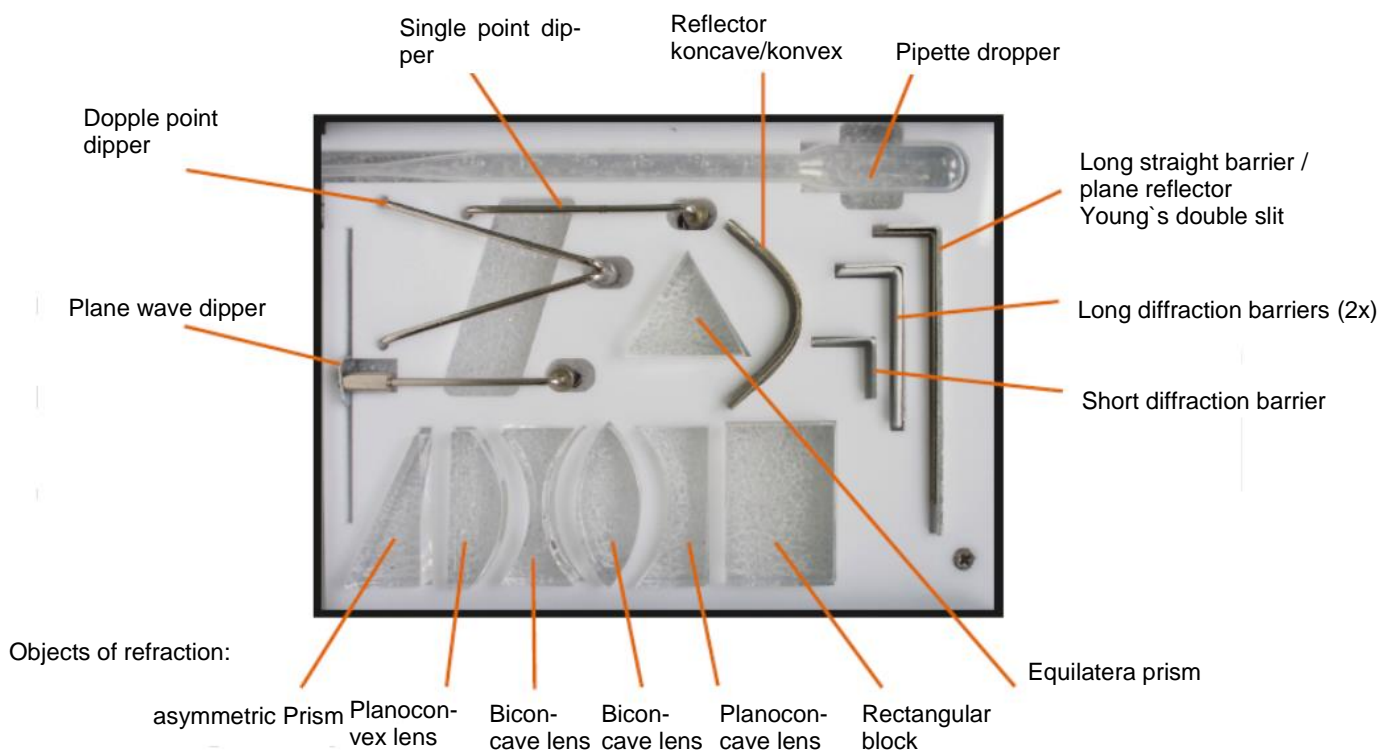


Fig. 2: Set-up



## Function of the display panel

Two LED displays show the frequencies of vibration and stroboscope in Hz.

### Vibration ON/OFF

Vibration frequency up/down

### Strobe ON/OFF

Strobe frequency up/down

The **mode** button selects the synchronized or independent mode.

By default, the vibration frequency and strobe frequency are set to 90 Hz.

In synchronized mode, the waves appear to be stationary. Both frequencies are changed simultaneously.

In independent mode, the two frequencies can be varied independently.

When the frequencies are close together, the waves appear to move across the screen in slow motion.

## Advanced functions

The up/down vibration amplitude varies the amplitude/height of the waves in the tank and has four levels.

The intensity of the stroboscope LEDs is varied up/down and has four levels.

The camera mode sets the water wave device to make it easy to view and record wave patterns with a USB camera and a computer or cell phone camera.



## 4 HANDLING

### Construction of the ripple tank

Place the unit on a flat surface and connect the power supply to the socket on the rear panel. Plug the mains adapter into a mains socket. Switch on the water wave device at the rear panel.

Now slide out the window to expose the water tank.

Open the accessory compartment by sliding the cover to the side.

Select a wave dipper (single, double or plane waver dipper). Insert the 4 mm plug of the dipper vertically into the oscillating rod.

Avoid any lateral application of force.

Pour clean water into the tank until the wave dipper just touches the surface - approx. 100 to 120 ml water.

While performing the experiments, it may be necessary to raise or lower the water level to achieve the best wave patterns.

With the pipette you can adjust the water level in small quantities.

Slide the viewing glass into its normal position.

Switch on the vibration and strobe by pressing the ON/OFF buttons.

By default the frequencies are synchronized. The waves are stationary.

Adjust the frequencies with one of the up and down frequency buttons.

Press the mode button to select the independent mode. You can now vary the frequencies independently.

A small difference between the frequencies allows you to see the waves slowly spreading across the screen.



### Using the ripple tank

The vibration amplitude up/down gives control over the wave height in the tank.

Adjusting the amplitude can make the wave patterns clearer in some experiments.

Strobe Intensity up/down gives control over the brightness of the strobe LED.

This can make the wave patterns clearer in some experiments.

Adjust the vibration amplitude, stroboscope intensity and frequencies to get familiar with the effects.

**Note:** The wave patterns on the screen are often not clearly visible up close. Increase the viewing distance to 0.5m.

### Research of wave phenomena

In all experiments the amount of water, the immersion depth of the wave excitors, the frequency parameters and the positioning of the objects play an important role. All values listed below are approximate values. The parameters should be varied within the scope of the experiments to achieve the best possible results. The water level should be around 100 ml for most experiments.

### Reflection

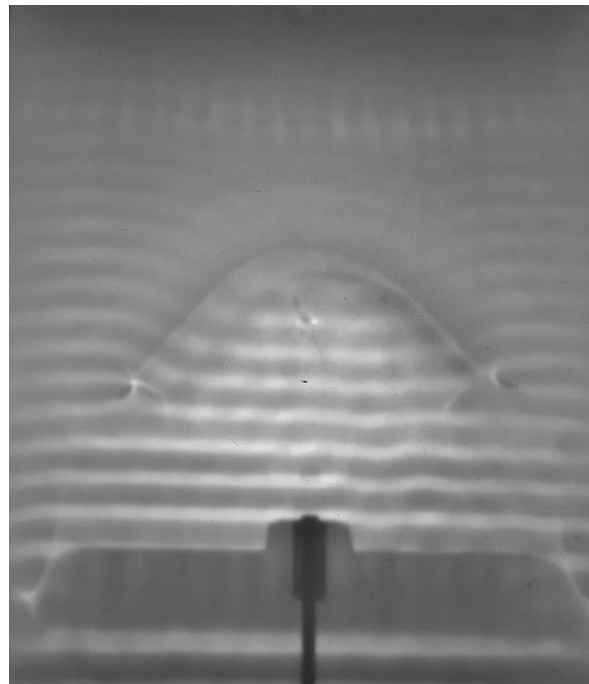
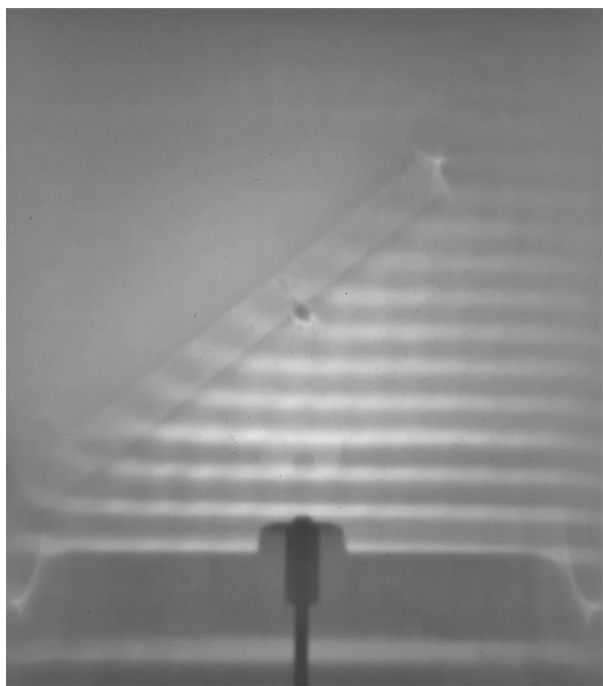
Insert the plane shaft exciter into the vibration shaft. Insert the straight barrier into the tank at a 45° angle in front of the shaft exciter. In Synchronized mode, set the frequency to 50 Hz.

Observe the incident and reflected wave fronts.

Switch to Independent mode and adjust the strobe frequency so that the incident waves move towards the sloping barrier.

Use a ruler and a protractor on the screen to measure the angles of incidence and reflection.

With the curved barrier the behaviour at convex and concave mirrors can be clarified.



### Refraction

Use water with a small amount of liquid detergent. Stir, but avoid bubbles. Insert the plane shaft exciter into the vibration shaft.

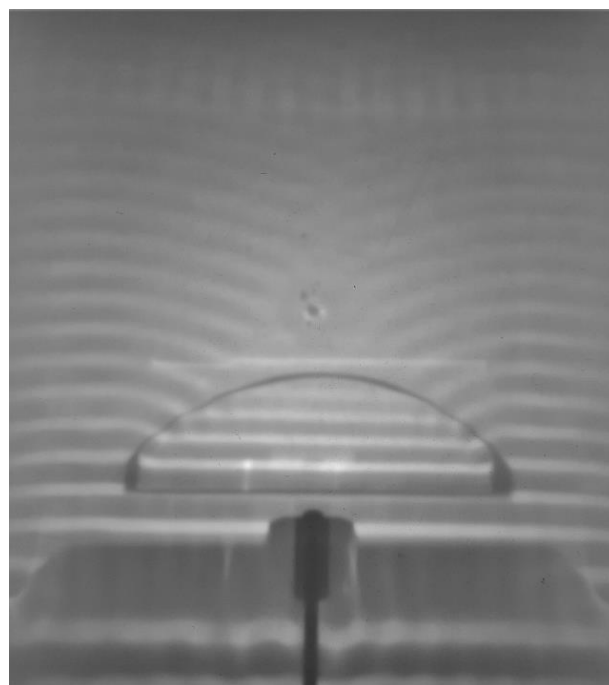
Insert the plano-convex lens into the water tank in front of the exciter, preferably in the lower half of the water tank, as shown.

The lens should be covered with a thin layer of water. This layer serves as a refractive medium.

Set the frequency to 60 Hz in "Synchronized" mode.

Adjust the water level with the pipette and adjust the frequency until the wave pattern is as shown in the example.

Observe the incident and refracted wave fronts.



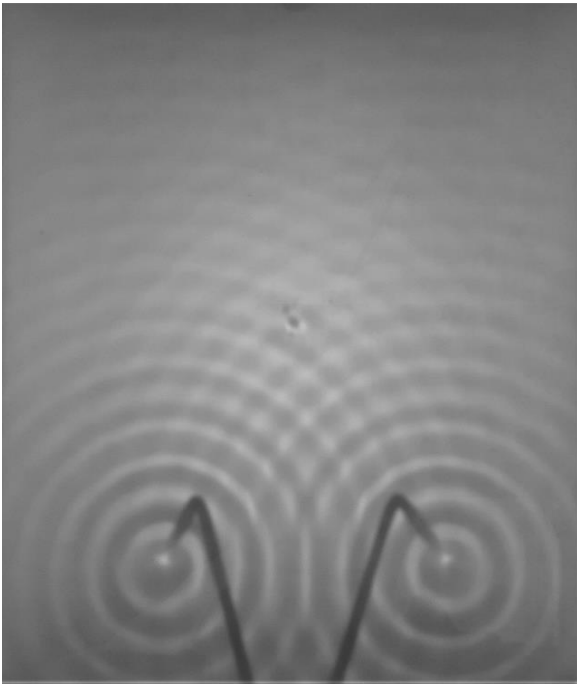
## Interference

Insert the double shaft exciter into the vibration shaft.  
In synchronized mode, use the frequency range 50 to 70 Hz

### Observe the interference pattern.

This is the result of the coincidence and interference of two identical circular waves.

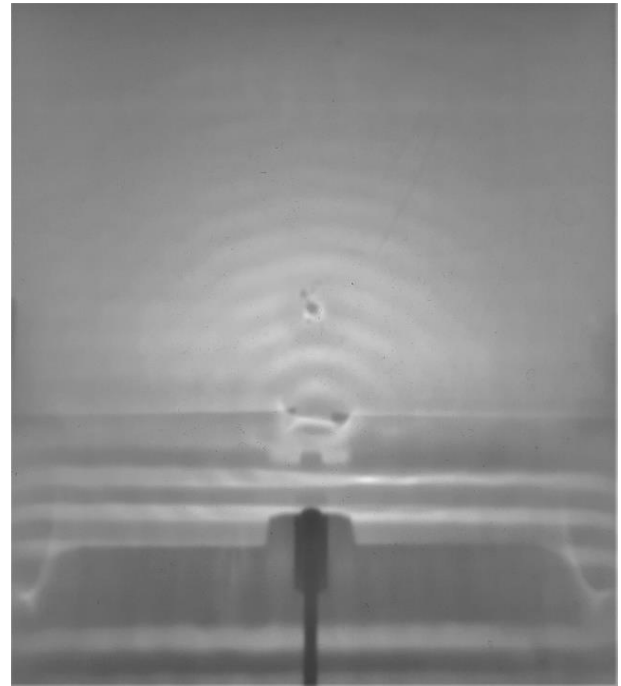
At some points in the tank a wave crest meets a wave crest and a "super wave" is created. At other points a wave trough meets a wave trough and a "super trough" is created. At other points, a wave crest meets a wave trough and these waves cancel each other out, leaving calm water behind. Since the waves are regular, the pattern of super waves/trough and calm water is regular.



## Diffraction

Insert the plane shaft exciter into the vibration shaft. Place the two L-shaped diffraction barriers in front of the shaft exciter with a narrow gap (3 mm) between them. If possible, place the slit in the lower half of the water tank. In synchronized mode, set the frequency to 60 Hz.

When the flat waves enter the gap, the water in the gap moves up and down at the same frequency. Because the gap is narrow, it acts as a point source of waves, which therefore propagate circularly. This is an example of diffraction, a characteristic of all types of waves. Adjust the width of the slit and adjust the frequency. You should find the most obvious diffraction when the slit is approximately equal to the wavelength of the incident waves

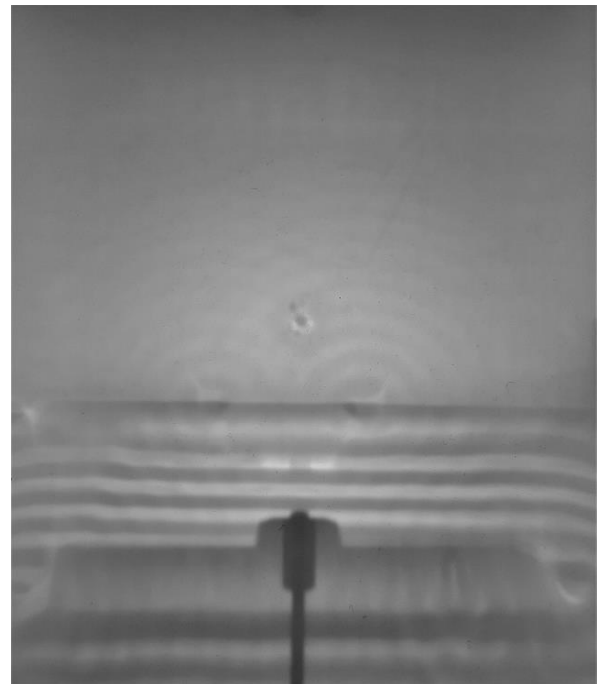


## Young's Double slit

Insert the plane shaft exciter into the vibration shaft.  
Insert the Young's double slot barrier in front of and parallel to the plane wave exciter and if possible in the lower half of the water tank.

In "Synchronized" mode, set the frequency to 60-70 Hz.  
When the plane waves arrive at the barrier, diffraction occurs at both slits. Two identical circular waves are created. When these circular waves propagate, they meet and overlap: they interfere.

The clearest wave pattern should be found when the wavelength of the incident waves is approximately equal to the width of the slit.



With a little skill, it is possible to identify places where constructive interference generates "superwaves". These radiate outwards in lines from a point between the two columns.

In between there are places where a wave and a trough destructively interfere to produce calm water. These also radiate outwards in lines.

### Camera mode

The control panel of the water wave device contains the button for the camera mode.

This enables the acquisition and display of wave patterns on a computer screen or a whiteboard.

The camera mode can basically be selected with a variety of common cameras with the following or similar specifications (especially standard smartphones of Kamara are suitable):

Optical resolution 640x480 or better

Frame rate (approx.) 30 Hz

### Setting up the camera

Connect the camera to the computer with a USB cable.

Open the recommended software for the camera.

Press the camera mode button.

Set the flash frequency to an integer multiple of the camera's frame rate. For example, if the frame rate is 30 Hz, set the frequency to 30, 60 or 90 Hz.

Select the Independent mode so that the vibrato frequency is increased by a few Hz to show moving waves.

Position the camera directly above the screen to get a clear rectangular image from the viewing screens.

### Note:

In Camera mode, the wave pattern is not visible on the screen. Wave patterns are only visible on the computer screen in Camera mode.

The flash frequency of the Ripple Tank has been synchronized with the camera's frame rate. For our experiments we used a Logitech camera (model C170).

## 5 EQUIPMENT AND TECHNICAL DATA

- Basis device
- Power supply unit
- Singel, double and plane shaft dipper
- Different barriers
- Concave and convex reflector
- Supply voltage: 110... 240 V
- Mains frequency: 50/60 Hz
- Dimensions: 31 x 25 x 14 cm
- Weight: 2.1 kg

## 6 WASTE DISPOSAL

The packaging consists predominately of environmentally compatible materials that can be passed on for disposal by the local recycling service.



Should you no longer require this product, do not dispose of it with the household refuse.

Please return it to the address below for proper waste disposal..

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