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Ripple tank with LED light source

Ripple tank with LED light source, complete

11260-02

11260-88

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Fig. 1: Ripple tank with LED light source, complete 11260-88

Operating instructions

CE The unit complies with the corresponding EC guidelines

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1 SAFETY PRECAUTIONS

Attention!

- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Only use the instrument for the purpose for which it was designed.
- Only use the instrument in dry rooms in which there is no risk of explosion.
- Before applying mains voltage, ensure that the earth lead of the experimental set-up is properly connected to the mains earth lead. The mains plug is only to be plugged into a mains socket which has an earth lead. Do not use an extension cable without earth lead, as this would negate the protective effect.
- Check that your mains supply voltage corresponds to that given on the type plate fixed to the supplied power supply.
- Assemble the experimental set-up in such a way that the mains switch and/or plug connector of the instrument are freely accessible. Keep the ventilation slots of the experimental set-up free of any covering.
- Do not attempt to open the instrument.
- Take care that no liquids or objects enter in through the ventilation slots.
- Do not connect any other devices to the ripple tank.
- Caution: Separate the instrument completely from the electric mains before loosening, exchanging or removing any cable connection!
- Separate the instrument completely from the mains before filling or emptying the wave tray!
- Longer observation of the wave image under stroboscopic illumination can trigger epileptic seizures in endangered people.
- Do not stare directly into the glowing LED on purpose.

2 PURPOSE AND DESCRIPTION

The ripple tank serves for the generation and study of surface waves in water. It enables not only experiments that are characteristic for surface waves in water to be carried out, but also experiments that are analogous to those carried out on light waves. Many important wave optics laws can be clearly and simply demonstrated by means of water waves. The following describes how the ripple tank functions and how water wave portrayal is accomplished.

Water waves are generated by a mechanical vibration generator that is integrated in the ripple tank (loudspeaker principle). This generator can cause either a single plug or several plugs to be dipped into the water in the wave tray for the generation of circular waves, or a slide to be dipped in for the generation of flat waves with a frequency of between 5 Hz and 60 Hz. Periodic dipping causes surface waves to be created.

A green LED is fixed to the bottom of the ripple tank housing. This illuminates the wave tray from below and, due to the optical principle of shadow projection (Fig. 2), produces a representation of the water waves that is rich in contrast. Either continuous light or stroboscopic light can be used. Stroboscopic light allows the propagation velocity of the water waves to be slowed down to a complete standstill. Details on the use of stroboscopic light are given in section 4 “Handling”.

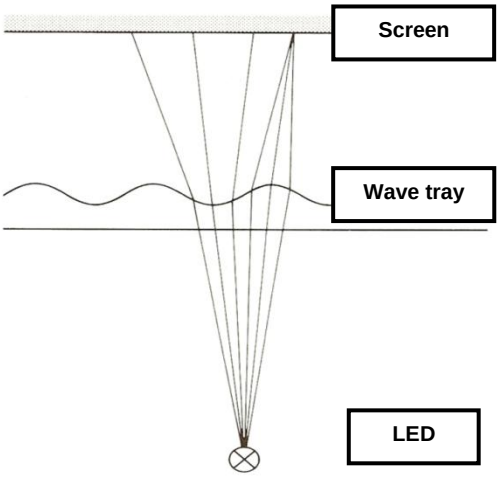

Fig. 2: The shadow projection principle – Light from a point light source passes through the wave tray and is partially subject to deflection according to the structure of the surface waves. This deflection generates a bright-dark pattern on a screen.

When the drawing table that is supplied by default is placed on the ripple tank, and a sheet of white paper is placed on the table, then the water waves can be observed on the sheet of paper.

No focussing optical elements are used in the portrayal of the waves. The creation of the portrayal results exclusively from the diffraction properties of the water surface.

Wave troughs make the light from the LED divergent, water crests make it convergent. Because of this, the wave troughs can be recognised as dark stripes on the observation surface (sheet of paper) and the wave crests as bright stripes. The result of this principle is a wave image that is sharp and rich in contrast. It must be noted here though, that a good image contrast is only given at small wave amplitudes. At larger amplitudes, the light rays emitted by the LED combine far before they reach the observation screen and diverge from each other again on the further long way to it. The result is the disappearance of the wave image. For this reason, the wave generator is equipped with an amplitude control element which ensures that the optimal generator amplitude can be set for each individual experiment.

3 FUNCTIONAL AND OPERATING ELEMENTS

3.1 Control panel

The ripple tank apparatus is equipped with a control panel with 14 keys (Fig. 3) and an LCD screen. In the following, an introduction is given to the adjustment possibilities and the wave generator required for the generation of water waves.

Fig. 3: The 14 keys control panel is situated on the top of the housing of the ripple tank.

1 Vib

Switches the vibration generator(s) on and off.

2 LED

Switches back and forth between the following settings of the LED:

- Continuous light
- Stroboscopic light
- Off

3 f

Pressing (+) increases, and pressing (−) reduces the frequency within the 5 Hz and 60 Hz range.

4 Δf

A difference in frequency between the vibration generator and the stroboscopic light can be set here. The two frequencies are equal in the default state, in which the waves are depicted as a stationary wave under stroboscopic light. A frequency difference can be set with the (+) and (−) keys to obtain a “slow motion” portrayal of the waves.

5 Δφ

A phase difference between the integrated vibration generator and an additional, external vibration generator (11260-10) can be set here. In the default state, the generator oscillates in phase. A phase difference of between 0° and 360° can be set in steps of 15°.

6 Amplitude

Pressing (+) increases the amplitude of the vibration generator (4 steps), pressing (−) reduces it.

7 Pulse

Pressing this key gives the vibration generator a single pulse which causes the plug to be dipped into the water just once. On releasing the key, the plug is brought back to the rest position. If the external vibration generator (*19*) should be connected, it will also be operated.

8 Reset

Switches the vibration generator and the LED off. All other settings stay at their current value to allow a quick restart of the ripple tank.

9 Cal int.

For calibration of the integrated vibration generator. The amplitude of the exciter can be set in a range from 80 % to 120 % – independent of the external vibration generator. If the amplitudes should vary, this enables a synchronisation of the amplitudes of the integrated and the external vibration generator.
First press the *Cal int.* key. Immediately after that use the (+) and (−) keys of the *Amplitude* selector (*6*) for fine-tuning. The calibration is kept even after a reset (*8*) or after unplugging the power supply (*11*).

10 Cal ext.

Same as (*9*) for calibration of the external vibration generator. The amplitude of the external exciter can be set independently of that of the internal exciter in a range from 80 % to 120 %.
First press the *Cal ext.* key. Immediately after that sue the (+) and (−) keys of the *Amplitude* selector (*6*) for fine-tuning.

3.2 Further functional elements

In addition to the control panel, the ripple tank has the following further functional elements (see Fig. 4, 5 and 6):

Fig. 4: Socket for the power supply (*11*) and sockets for the connection of the external vibration generator (*12*).

11 Connecting socket 12 V

For connection of the ripple tank apparatus to an external power supply (supplied by default). The socket is on the side of the housing.

12 Connecting sockets, external vibration generator

An external vibration generator with 4 mm plugs can be connected here. The polarity of the connection is of importance. To check polarity, the function *Pulse* (*7*) can be used. If both the internal and external vibration generators move down when the button *Pulse* is pressed, both will move in phase. Otherwise the polarity of the external vibration generator can be changed or the two vibrators work with a phase difference of 180°.

13 Wave tray

Waves are generated in the water filled in the wave tray. Plastic foam has been stuck to the inner sides of the wave tray. This allows an almost complete absorption of the water waves that hit the sides of the wave tray and thereby avoids unwanted wave reflections.

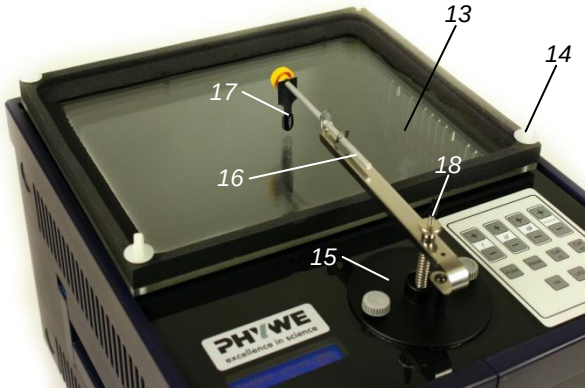

Fig. 5: Integrated vibration generator (*15*) with wave tray (*13*), holding rod (*16*), and plug (*17*).

14 Adjusting screws, 4 pieces

For horizontal alignment of the wave tray.

15 Integrated vibration generator

Serves to hold each type of exciter. By loosening the two adjusting screws in the base, the exciter can be rotated in plane.

16 Holding rod

Serves to mount and position the respective wave generator.

17 Wave generator

Serves to generate waves by dipping into the water while the integrated vibration generator is switched on.

18 Tensioning screw

For raising and lowering the wave generator to a suitable position in the water of the wave tray.

19 External vibration generator (accessory: 11260-10)

Can be used as second generator and is necessary for the “Doppler effect” experiment.

Fig. 6: External vibration generator (11260-10) with accessories, separately available.

4 HANDLING

This section describes how to put the water wave apparatus into operation and cause water waves to be generated. Please read this section carefully to avoid failure or improper operation.

Note: To protect the apparatus from damage, the vibration generator turns off automatically after 10 minutes of continuous operation. Experiments are not expected to take longer time in this operation mode.

4.1 Putting the ripple tank into operation

First connect the connecting socket (*11*) of the ripple tank via the provided power supply to the mains. The LCD screen lights up and the ripple tank is ready to use.

4.2 Filling the wave tray

First, the empty wave tray has to be placed on the ripple tank. Afterwards, it can be carefully filled with water. The wash-bottle supplied can be used to fill the wave tray. Fill the tray about three quarters high. After this, to have reflection of water waves at the sides suppressed, moisture the whole side-foam with a finger so that water can wet it.

Use the adjusting screws (*14*) to align the wave tray horizontally. To do so, we recommend that you look flat across the water surface and use the height of the water level at the different sides of the tray as reference. Now use the screws to bring the tray to about the same height on all sides and so to a horizontal position.

Attention!

When lifting the filled tray, the water tends to slop! Pay attention that no water enters the device.

We recommend using the wash-bottle or e.g. a sponge to finally remove the water while the wave tray is still resting on the ripple tank.

4.3 Cleaning

The cover plate and the wave tray of the ripple tank consist of acrylic glass. Please perform cleaning of the cover plate and the wave tray with suitable (i.e., non-abrasive) tissues without aggressive chemicals added.

4.4 Generation of circular waves

Fix the holding rod (*16*) with a single plug (*17*) to the integrated generator (*15*) and bring it to the middle of the wave tray. Turn the clamping screw on the generator until the plug is dipped into the water in the wave tray. Set to continuous light, to a frequency of between 5 Hz and about 20 Hz and to a small amplitude (1 or 2). Prepare the observation surface by placing a sheet of white paper on the drawing table situated over the wave tray. Darkening the room could be useful for better visibility of the wave image.

Should the wave image be distorted or unclear, vary the frequency *f* and/or the amplitude until a wave image is obtained that is similar to that shown in Fig. 7.

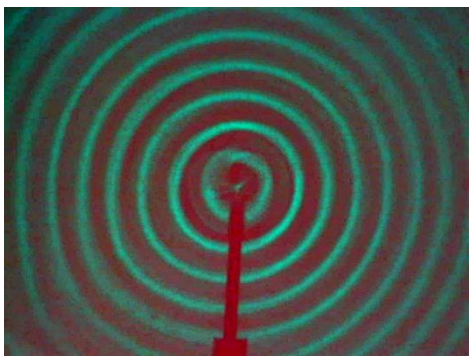

Fig. 7: Circular waves generated by the plug-shaped exciter.

4.5 Generation of flat waves

The generation of flat waves is somewhat more difficult, because it requires an exact alignment of the wave tray with the slide used. It could be necessary to add 1 to 2 drops of a soap solution to the water for better wetting. Do not exceed this amount, however, as then turbidity and foaming would occur and cause deterioration in the quality of the image.

Fix the holding rod with slide to the exciter and bring it to the lower end of the wave tray. The wave tray must now be correctly adjusted, as the slide must be exactly evenly immersed into the water. If this is not done precisely, the wave image will be distorted and unclear. See the information given on the correct adjustment of the wave tray in section 4.2 “Filling the wave tray”.

The slide must also be set to be horizontal. Therefore, fix it as horizontally as possible to the integrated exciter and tighten the clamping screw on the exciter further until the slide is held slightly above the water surface. Use the water surface as reference to adjust the slide to the horizontal position. Afterwards, turn the clamping screw on the exciter further until the slide is dipped into the water (about 1 to 2 mm). Set a frequency between 18 Hz and 25 Hz and choose a small amplitude as well as continuous light. A wave image should be obtained that is similar to that shown in Fig. 8.

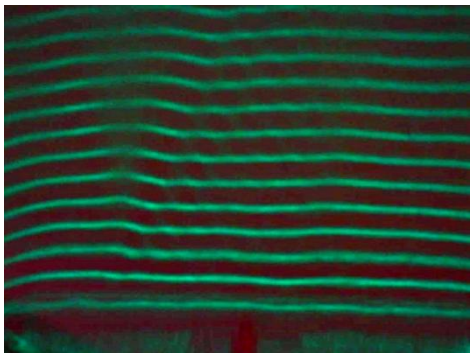

Fig. 8: Flat waves generated by the plane exciter.

Should the wave image be distorted or unclear, vary the frequency, the amplitude or the immersion depth. When no improvement in the wave image results, it could be possible that the slide is not correctly adjusted and therefore does not dip evenly into the water. In this case, align the slide as described above.

4.6 Usage of the stroboscopic light

The use of stroboscopic light is only instructed in those individual experiments in which it is required to reach the experimental target. All other experiments should first be carried out without stroboscopic light because stroboscopic illumination considerably changes the impression of the image, partially. Interference patterns can be far more impressively seen when continually projected than when under stroboscopic illumination.

In this context it must be considered that for continuous light, the human eye is only capable of recognizing the wave image in the lower frequency range. Because of this, we recommend that only frequencies of up to about 30 Hz be used under continuous light. Stroboscopic light should be used with shorter wavelengths (higher frequencies), so that wave propagation is slowed down and made visible to the human eye.

5 NOTES ON OPERATION

This high-quality instrument fulfils all of the technical requirements that are compiled in current EC guidelines. The characteristics of this product qualify it for the CE mark.

This instrument is only to be put into operation under specialist supervision in a controlled electromagnetic environment in research, educational and training facilities (schools, universities, institutes and laboratories). This means that in such an environment, no mobile phones etc. are to be used in the immediate vicinity. The individual connecting leads are each not to be longer than 2 m.

The instrument can be so influenced by electrostatic charges and other electromagnetic phenomena that it no longer functions within the given technical specifications.

The following measures reduce or eliminate the effect of such disturbances: Avoid fitted carpets; ensure potential equalization; carry out experiments on a conductive, earthed surface, use screened cables, do not operate high-frequency emitters (radios, mobile phones) in the immediate vicinity.

This instrument complies with Class A, Group 1 of the EN 55011 norm and it is only permitted to operate unlimitedly outside of residential areas. Should electromagnetic disturbances, despite the limitations of usage to a technical room of a school or other place of education, occur in a surrounding residential area, then it can be demanded of the operator that he or she carries out appropriate measures (e.g. screening, longer distance away from sensitive equipment, shorter operating principles, as short as possible connecting cables etc.) at his or her own cost.

6 TECHNICAL DATA

(typical for 25 °C)

Operating temperature range	5...40 °C
Relative humidity	< 80 %
Frequency	5…60 Hz
Vibration generator amplitude	1…4
Stroboscope frequency (Δ*f*)	−2.5…2.5 Hz
Phase difference	0…360°
Line voltage	110…240 V
Mains frequency	50/60 Hz
LED luminous flux, max.	285 lm
Dimensions (mm)	300 x 370 x 330 (W x L x H)
Tray area (mm)	280 x 210 (W x L)
Weight	approx. 5.7 kg

7 SCOPE OF SUPPLY

The “Ripple tank with LED light source, complete” (11260-88) is supplied with the following components:

Basic unit	11260-02
Power supply 12 V DC / 2 A	12151-99
Accessory set for ripple tank	11260-12
Drawing table for ripple tank	11260-13
Wave tray for ripple tank	11260-14

Fig. 9: Scope of supply of ripple tank with LED, complete 11260-88.

8 ACCESSORIES

Various experiments, such as the “Doppler effect” experiment, or demonstration of experiments via a mirror, require accessories. The following are available:

External vibration generator for ripple tank	11260-10
Demonstration set with mirror for ripple tank	11260-30

9 LITERATURE

Demonstration Experiments: Experiments with the ripple tank	16040-02

10 WARRANTY

We guarantee the instrument supplied by us for a period of 24 months within the EU, or for 12 months outside of the EU. Excepted from the guarantee are damages that result from disregarding the Operating Instructions, from improper handling of the instrument or from natural wear.
The manufacturer can only be held responsible for the function and technical safety characteristics of the instrument, when maintenance, repairs and alterations to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.

11 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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