


PHYWE Systeme GmbH & Co. KG  
Robert-Bosch-Breite 10  
D-37079 Göttingen

Telefon +49 (0) 551 604-0  
Fax +49 (0) 551 604-107  
E-mail info@phywe.de

## Operating instructions

 The unit complies with the corresponding EC guidelines.

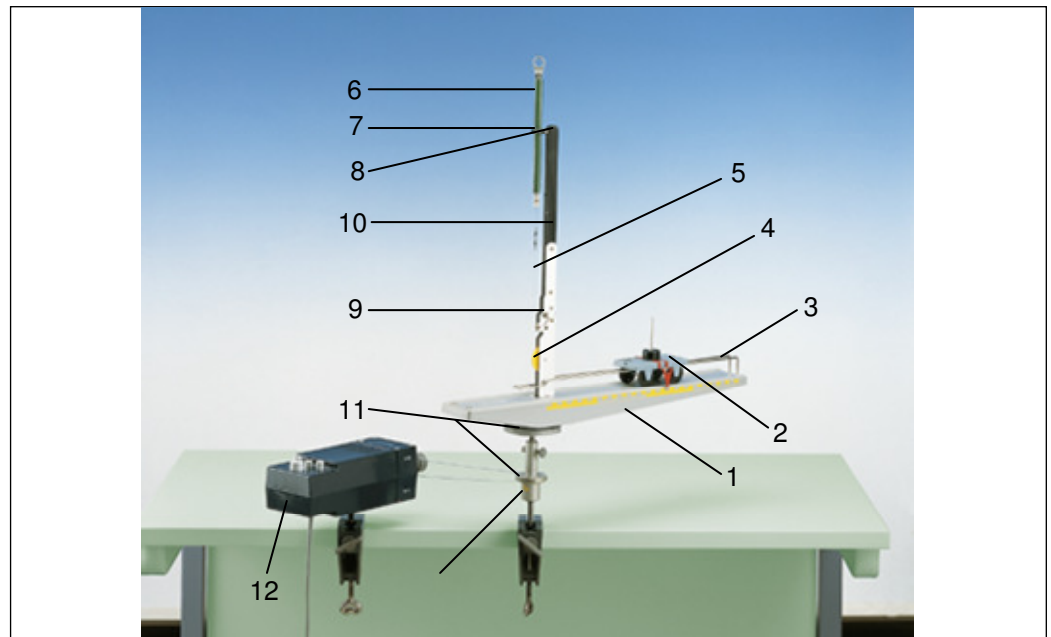


Fig. 1: Complete experimental set-up with the centrifugal force apparatus 11008-00

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## 1 SAEFTY PRECAUTIONS



**Caution!**

- Carefully read these operating instructions before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- 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 was designed.

## 2 PURPOSE AND CHARACTERISTICS

The centrifugal force apparatus serves, in combination with a motor, to measure and examine the centrifugal force resulting from the rotation of a body around a defined axis. The mass of the body (called a car here), the radius of the orbit and the angular velocity are hereby the variable factors. Fig. 1 shows the centrifugal force apparatus 11008-00 with the car 11060-00 positioned on it (these two pieces of equipment are available together under the single order number 11008-88). All other parts shown in Fig. 1 must be individually ordered (see section 6 „List of equipment“).

### 3 FUNCTIONAL AND OPERATING ELEMENTS

- 1 Track
- 2 Car (shown with the holding pin 03949.00 and slotted weight, 50 g, 02206.01 positioned on it). The mass of the car plus the holding pin is 50 g +/- 1 g. The exact value must be determined by weighing.
- 3 Holding bow to keep the car from flying off the track at high rotation speeds.
- 4 Guiding roller for the connecting thread (fishing-line)
- 5 Connecting thread for connecting the car (2) to a dynamometer (6).
- 6 Dynamometer (e.g. spring balance 1 N, 03060-01).
- 7 Dynamometer holder. One end is plugged into one of the holes (8) and the other end holds the dynamometer.
- 8 Holes into which the dynamometer holder can be plugged.
- 9 Locking pin for turning down the dynamometer holder arm (10). The hinge is freed by pulling the pin out as far as it will go and holding it out. The arm (10) can then be swung down by 90°. The locking pin re-engages in the new position.
- 10 Dynamometer holder arm. Can be turned down.
- 11 Grooves for power transmission from the motor and driving belt.
- 12 Motor  
**Caution!** Please observe the safety precautions given in the operating instructions for the motor used!
- 13 Bearing unit (in the bench clamp) for putting the track on.

### 4 HANDLING

#### 4.1 Warning



- It is imperative that you observe the safety precautions given in the operating instructions for the motor used when starting-up and operating the motor.
- We recommend that you use a socket with on/off switch for the power feed to the motor, so that you can easily switch the motor off if necessary.
- When using motor 11030-93, use only the electronic control, i.e. do not press the „13000 rpm“ button. Turn the revolution setting to „0“ before applying the operating voltage.
- Never put the axle of the track directly on the axle of the motor. The track and motor must be indirectly connected to each other via belts.
- The track must turn truly horizontally, otherwise the dynamometer reading may fluctuate considerably. If necessary, correct the footing of the bench clamp by partly inserting a piece of cardboard beneath it.
- Take great care that no person comes so near the apparatus that he or she could be hit by the rotating track.

#### 4.2 Fitting the car on

- Swing up the end of the holding bow (3) which is in the vicinity of the axis of rotation and push it towards the outer end of the track, so that the two ends of the bow come out of their anchorage. Pull the rods of the bow somewhat apart so that you can lift the bow up and over the dynamometer holder arm (10).
- Remove the holding pin from the car, then position the car on the bow so that the axles of the car are beneath the rods of the bow.
- Slide the car near to the open end of the bow. Pull the rods of the bow slightly apart so that you can swing it back down over the dynamometer holder arm (10).
- Insert the ends of the two rods into the appropriate holes in the end of the track, then exert slight pressure to lock the closed side of the bow on the pin below the guiding roller (4).
- Before starting an experiment, always check that the holding bow is correctly locked in position, even when the car has not been changed.

#### 4.3 Experiments with the dynamometer holder arm in the upright position.

The dynamometer holder arm (10) can accept a spring balance when it is in the upright position. The actual effective force can be read off during rotation. Please note that with this set-up, a change in force is always accompanied by a change in the distance of the car from the axis of rotation, and that this change in distance causes a change in the force. To obtain good, reproducible results, slide the spring balance as far upwards as possible at the start of the experiment and with the motor at a standstill. When this has been done, start the motor and, while the centrifugal force apparatus is revolving, slowly lower the spring balance until the car is at the required distance from the axis of rotation. Should the car be inadvertently moved out past the required distance, stop the motor, slide the spring balance up again and repeat this procedure.

#### 4.4 Experiments with the dynamometer holder arm turned down.

Turn the dynamometer holder arm (10) down after first having removed the dynamometer holder from it, if this is plugged into it. Lead the thread which connects the car to the dynamometer below the yellow guiding roller of the dynamometer holder arm. The Force sensor has the advantage that the measurement of the force causes no, or only very little, change in the distance of the car. Set the sensor up so that the thread is held horizontally and is not caught up in the turned-down dynamometer holder arm.



Fig. 2 Dependence of the centrifugal force on the radius of the orbit and the mass, measured with Cobra4.

## 5 LIST OF EQUIPMENT

Centrifugal force apparatus	11008-00
Car	11060-00
Holding pin	03949-00
Slotted weight 50 g, black (3x)	02206-01
Driving belt	03981-00
Fishing line, $l = 100$ m	02090-00
Bench clamp (2x)	02010-00
Bearing unit	02845-00

### Motors:

Laboratory motor, 230 V AC	11030-93
Gearing 30/1, for 11030-93	11029-00

or

Motor with gearing, 12 V DC	11610-00
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### Dynamometers:

Spring balance 1 N	03060-01
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or

Cobra4 Wireless Manager	12600-00
Cobra4 Wireless-Link	12601-00
Cobra4 Sensor-Unit Force	12642-00
Software measure Cobra4	14550-61

## 6 NOTES ON THE GUARANTEE

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.

## 7 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.

PHYWE Systeme GmbH & Co. KG  
Customer Service  
Robert-Bosch-Breite 10  
D-37079 Göttingen

Phone +49 (0) 551 604-274

Fax +49 (0) 551 604-246