

# TM 630

## Gyroscope



### Description

- properties of a guided gyro
- effect of precession

A gyroscope is used in aviation and the aerospace industry to stabilise the position or as a navigation tool in so-called inertial navigation. The basic element of a gyroscope is a rapidly rotating mass. A free gyro tends to maintain the position of its rotational axis in space independently of gravity. This property is exploited in the artificial horizon in the aircraft. If the gyro wheel is mounted in a gimbal, it is referred to as a guided gyroscope. If a force acts on a guided gyroscope perpendicular to the axis of rotation, the gyroscope exerts a moment: the gyroscopic moment. The rotation perpendicular to the axis of rotation is known as precession. A gyroscope therefore has three axes: the axis of rotation (spin axis), the precession axis (output axis) and the axis of the gyroscopic effect that triggers the gyroscopic moment (input axis). All are perpendicular to each other.

The TM 630 unit demonstrates the properties of guided gyroscopes. The moments caused by the precession can be experimentally determined.

The gyroscope is composed of a fly-wheel mass that is driven at high speed by an electric motor. The gyro wheel is mounted in a cardan frame. The frame can be rotated about the vertical axis by a second electric motor. This generates the precession of the gyroscope. By means of the precession, the gyroscope exerts a moment – the gyroscopic moment – about the horizontal axis. The gyroscopic moment causes deflection of the inner frame. The gyroscopic moment can be determined with a lever and a sliding weight.

The speeds of both electric motors for rotation and precession can be adjusted and are displayed digitally.

A transparent protective cover above the rotating arm ensures safety: operation is only possible when the protective cover is properly attached.

### Learning objectives/experiments

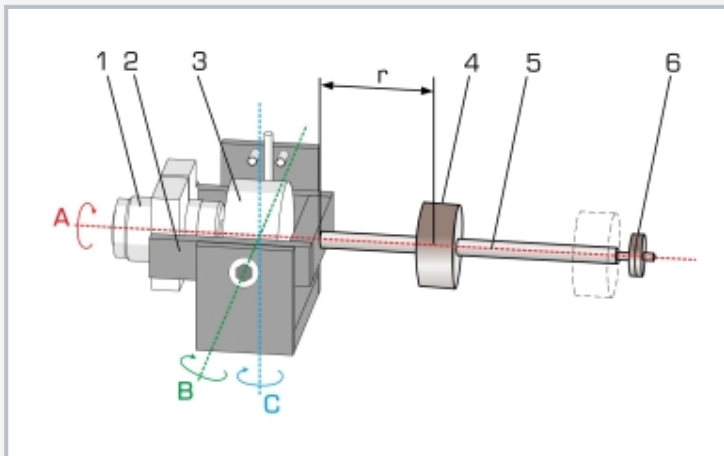
- experimental verification of the gyroscopic laws
- familiarisation with the three gyro axes
- calculation of gyroscopic moments
- study the effect of precession

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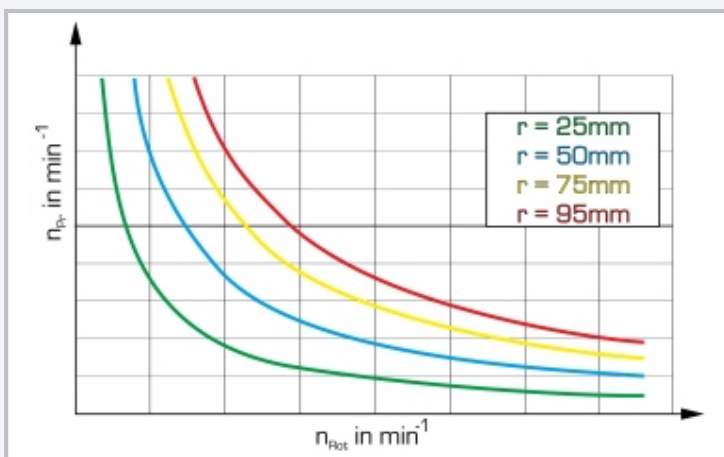
## Gyroscope



1 protective cover, 2 gyro drive motor, 3 speed displays and adjustment for of the horizontal gyro axis and the vertical precession axis, 4 gyroscopic flywheel mass, 5 lever, 6 sliding weight, 7 inner frame



1 drive motor, 2 inner frame, 3 gyroscopic flywheel mass, 4 sliding weight, 5 lever, 6 fine weights;  $r$  distance of the weight, A horizontal axis = spin axis, B rotational axis of the inner frame = axis of gyro effect, C vertical axis = precession axis



Curve of the precession speed for different gyroscopic moments  $n_{pr}$ , speed of the precession axis,  $n_{rot}$  speed of the rotational axis,  $r$  distance of the sliding weight (gives gyroscopic moment)

### Specification

- [1] familiarisation with a gyroscope
- [2] investigate a guided gyro
- [3] adjustment of the speed along the rotation axis
- [4] adjustment of the speed along the precession axis
- [5] determine the gyroscopic moment
- [6] digital display of speeds along the rotation axis and the precession axis
- [7] protective cover with release for the drive ensures safe operation

### Technical data

#### Gyro

- drive motor power: 3,6W
- moment of inertia of the gyroscope:  $375\text{gcm}^2$
- speed of the rotation axis:  $1000\text{...}6000\text{min}^{-1}$
- gyroscopic moment:  $0\text{...}61\text{Nm}$

#### Precession

- drive motor power: 19W
- speed of precession axis:  $5\text{...}63\text{min}^{-1}$

230V, 50Hz, 1 phase  
 230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase  
 UL/CSA optional  
 LxWxH: 420x400x310mm  
 Weight: approx. 22kg

### Scope of delivery

- 1 experimental unit
- 1 set of tools
- 1 set of instructional material

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Optional accessories

WP 300.09      Laboratory trolley