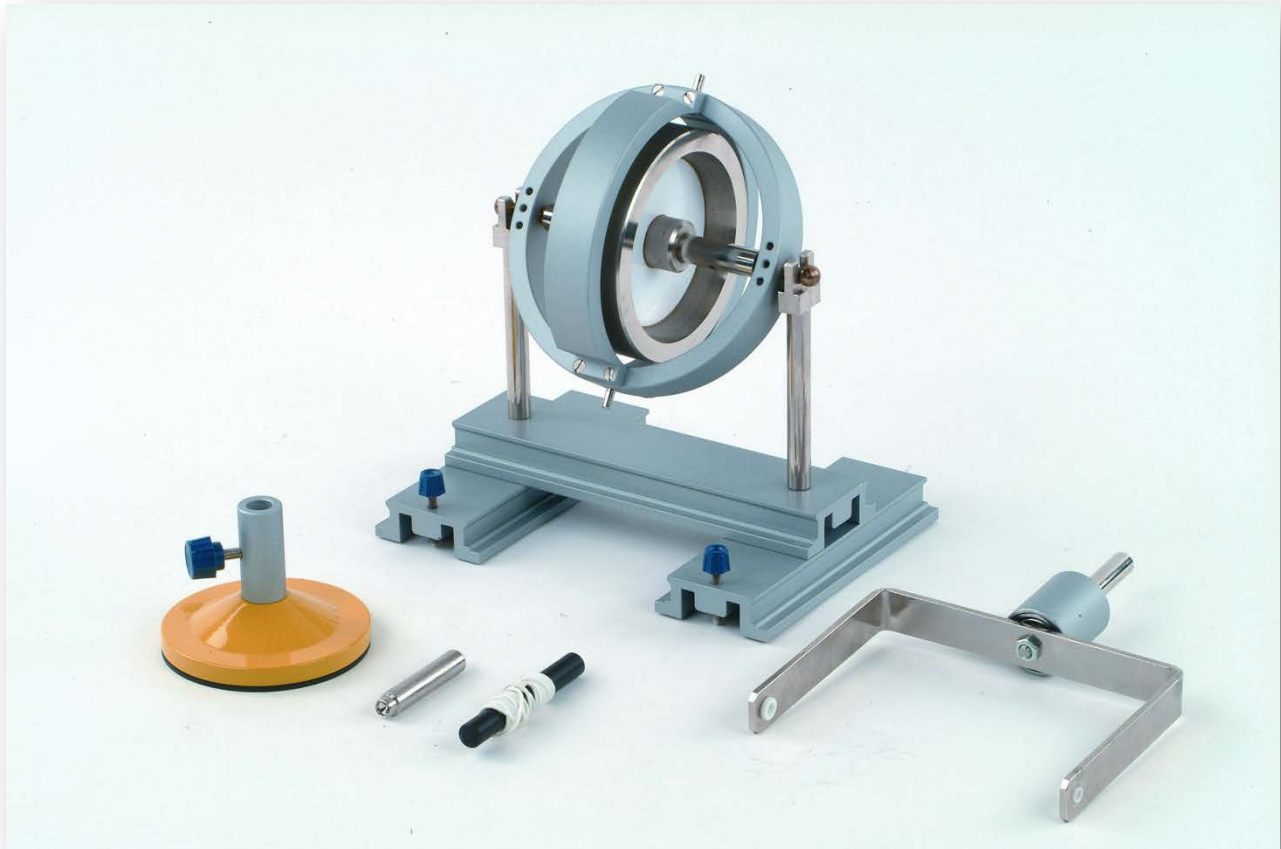


THE GYROSCOPE (HOW TO OPERATE)

MED 09.18a



Material

Item-no.	Qty.	Description
DM354-1K	1	Gyroscope, complete set consisting of:
	1	Support base with fork
	1	Gyroscope
	1	Y-piece with ball bearing
	1	Round base
	1	Support rod with bearing cup and cone
	1	Cord with handle
	1	Allen-key
		Grease

THE GYROSCOPE (HOW TO OPERATE)

MED 09.18a

Introduction

All the properties of a symmetrical gyro can be shown in a simple but impressive manner with the supplied gyroscope and the associated accessories.

When thinking of gyroscopes, one usually immediately imagines children's gyroscopes that fascinate with their astonishing movements. However these children's gyros are not suitable to easily explain those processes. Often these are made somewhat asymmetrical, provided with a specially shaped tip or the mass is not homogeneously distributed in them.

A first step towards the understanding the phenomena of gyroscopes is certainly dealing with a symmetrical gyroscope. This understanding should be given by the experiment instructions – let's find out about the basic behavior of a freely moving gyroscope and the precession movement of an "unfree" gyroscope.

In addition a few comments are made to show where symmetrical gyroscopes are used in everyday life.

Experiments

- | | | | |
|-----|---|-----|------------------------------------|
| 1. | The Gyroscope (freely moving) | 2. | Precessional motion of a gyroscope |
| 1.2 | General properties of a freely moving gyroscope | 2.4 | Hanging gyroscope |
| 1.3 | Application: Gyroscope compass | 2.5 | Gyroscope standing on a tip |
| | | 2.6 | Gyroscope standing on the hand |

Physical background

It was already mentioned that phenomena of gyroscopes are difficult to explain since the physical processes are not simple. This complex topic of Physics is not treated fully in this manual however references are always made to the physical foundations behind the experiment under consideration.

The law, which is the physical basis for all processes related to the rotation of rigid bodies, is the conservation of angular momentum in a closed system. This conservation of angular momentum will also prove to be fundamental in the explanation of gyroscope phenomena.

The following applies:

$$\vec{L}_{ges} = const.$$

The definition of the angular momentum must be used to determine the angular momentum of a rotating body. The following applies:

$$\vec{L} = I \cdot \vec{\omega}$$

I Moment of inertia of the body around the axis of rotation

$\vec{\omega}$... Angular velocity of the body

These connections serve as an explanation in the following experiments. A detailed and exact physical description of the subject of conservation of angular momentum has been omitted here since this is dealt with in detail in most physics textbooks.

THE GYROSCOPE (HOW TO OPERATE)

MED 09.18a

Device description

1. General information on using the gyroscope

When unpacking the supplied experimental material everything is already assembled.

The gyroscope consists of a rotating body and a frame, which is of a stable design for reasons of strength and to protect the rotating body or the bearing.

Nevertheless, those who experiment with the gyroscope should pay attention to a few points to ensure that the gyroscope works properly for a long time.

2. Using a pad / underlay

As already mentioned the gyroscope has a stable frame. Nevertheless you should use a pad when experimenting with the gyroscope. Two layers of thick corrugated cardboard or a blanket folded several times could serve as such. If the gyroscope "falls" (this can happen!) and you can no longer catch it in time, it bumps into the table and creates hollows and it is possible that the gyroscope crashes on the brass bearing (the two bearings protrude from the frame) , which is certainly not good for the gyroscope and is very likely to impair its good running properties.

3. How to start the gyroscope

Starting the gyroscope will happen in the specially designed rail stand material.

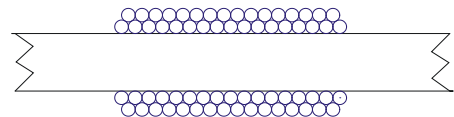
First place the gyroscope on its brass bolts in the fork of the support base; this is also the place where the gyroscope should be stored when it is still turning after an experiment or not used at all.

The gyroscope can be started with the help of the supplied cord; to do this place one end of the cord in one of two small holes in the axis of the gyroscope and wind the cord completely up on the axis. By pulling strong and evenly on the cord the gyroscope can be set into rotation.

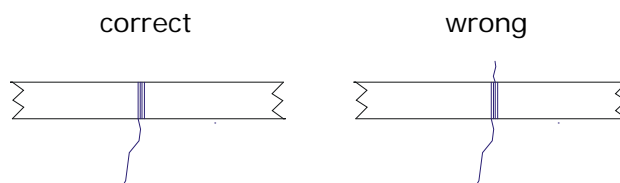
When pushing the cord through the hole in the axle, make sure that the cord does not stick out at the other end of the hole. Otherwise it may happen that the cord unrolls again after it has been completely unwound. In addition, the cord should be wound up as evenly as possible

Three steps are important when starting the gyroscope:

1. The cord must be wound evenly onto the axle very.
A cut through the axis with an optimally wound cord would look like this:



2. When pushing the cord through the hole in the axle make sure that the cord does not stick out at the other end of the hole. Otherwise it may happen that the cord winds up again after it has been completely unwound.



THE GYROSCOPE (HOW TO OPERATE)

MED 09.18a

3. While pulling on the cord make sure that you hold the gyroscope and the support base firmly as shown on the picture below:



Maintenance of the gyroscope

In principle the gyroscope has very good running properties due to its construction. Nevertheless after long periods of use it is necessary to lubricate the bearings.

In any case, the bearings should be readjusted as soon as bearing noises (the entire gyroscope "buzzes") can be heard.

To do this, simply loosen the Allen screws that fix the two brass bearings with the supplied key. Then the optimum distance can be set by screwing the brass bearings in or out. The axis should sit "firmly". However the bearings should only be turned so far that the gyroscope is not braked. Then the two Allen screws are tightened again to fix the two brass bearings again.