TM 140

Free and forced torsional vibrations

Description

- **investigation of torsional stiffness and torsional vibrations**
- **behaviour of two-mass and three-mass torsional oscillators**

Torsional vibrations are often observed in belt-driven systems. With appropriate excitation of resonances, large vibration amplitudes can occur, which can lead to strong loads on shafts and gears, potentially resulting in damage.

The TM 140 unit can be used to produce free and forced torsional vibrations and to study the effects of torsional stiffness, mass and damping on frequency and amplitude.

The core of the experimental unit is a metal torsion bar. Mass disks with different rotational inertias can be attached to the bar using clamping chucks. This allows a torsional vibration system to be created with up to three masses. The torsional stiffness can be adjusted by varying the effective bar length. An exciter unit driven by an electric motor is used to represent forced vibrations. The frequency can be adjusted and read on the control unit.

A damper makes it possible to set different degrees of damping. The torsional vibrations are picked up via rotary encoders on the bearings of the torsion bar and are available on the control unit as an electrical signal. All signals are also available via a USB port and can be transferred to a PC.

The GUNT software allows the signals to be recorded and analysed, for example recording a resonance curve or displaying the natural mode.

Learning objectives/experiments

- determine the torsional stiffness of a torsion bar
- determine the mass moments of inertia
- decay behaviour of torsional vibrations
- determine the damping in torsional vibrations
- forced torsional vibrations, resonance
- torsional vibration systems with multiple masses
  - two-mass torsional oscillator
  - three-mass torsional oscillator

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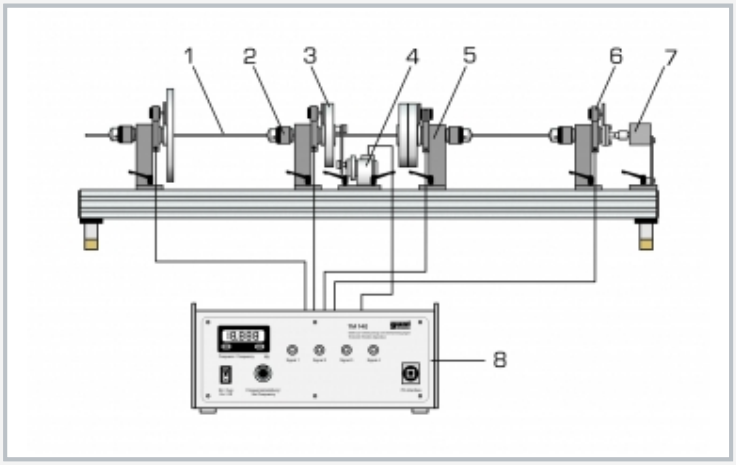
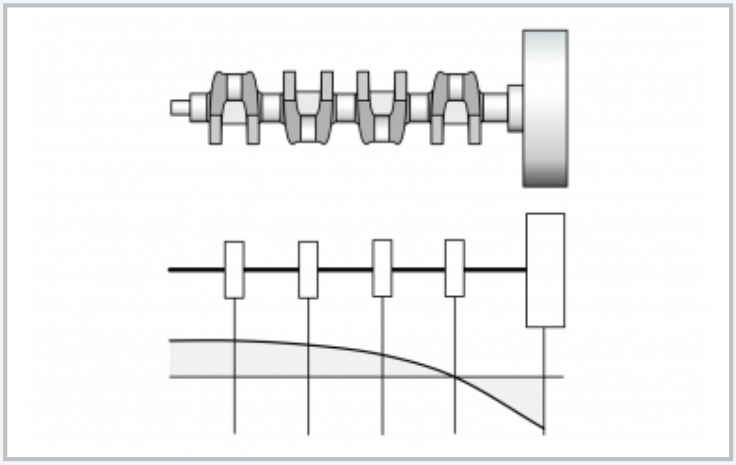
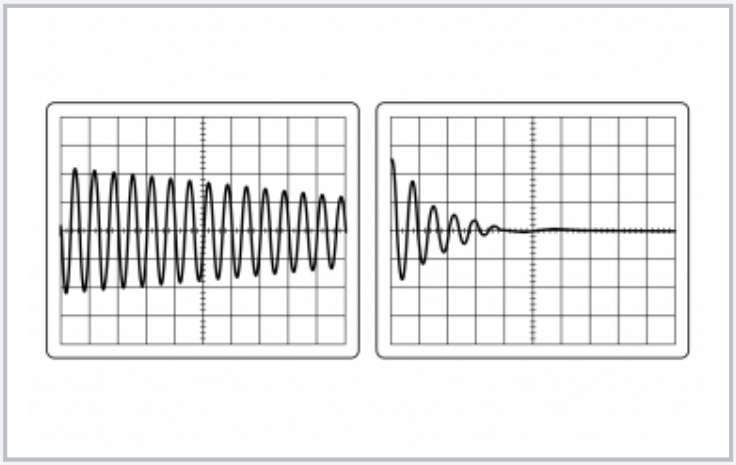


1 torsion bar, 2 clamping chuck, 3 mass disk, 4 exciter unit, 5 bearing unit, 6 rotary angle sensor, 7 damper unit, 8 display and control unit



Crankshaft as an example of a torsional oscillator



Example oscillograph: left – torsional vibration of a torsion bar with mass disk, weakly damped; right – the same vibration with strong damping

Specification

[1] experimental unit for investigating torsional vibrations and torsional stiffness
[2] 3 mass disks
[3] 4 freely positionable ball-bearing-mounted bearing units with clamping chucks
[4] sealed oil damper
[5] exciter unit with drive crank; exciter amplitudes 1,4°, 1,8°, 2,4°
[6] 4 rotary angle sensors, 0,03V/°
[7] electrical exciter control unit for setting and displaying the exciter frequency and for powering the rotary encoder
[8] GUNT software for data acquisition via USB under Windows 8.1, 10

Technical data

Torsion bar
- 1300mm
- Ø 6mm
- stainless steel

Rigidity: approx. 1,0Nm/rad/m

Mass disks
- Ø 150mm, approx. 2,7kg
- Ø 228mm, approx. 4,8kg

Exciter frequency: 1...20Hz

Damper coefficient: 0,25...3,5Nm/rad/s

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 1400x410x400mm
Weight: approx. 50kg

Required for operation

PC with Windows recommended

Scope of delivery

1 frame
4 bearing units
1 torsion bar
3 mass disks
1 exciter
1 rotational damper
1 display and control unit
1 set of cables
1 hexagon screwdriver size 4
1 GUNT software + USB cable
1 set of instructional material

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Optional accessories

020.30009	WP 300.09	Laboratory trolley