

# TM 620

## Bending elasticity in rotors



### Description

- investigation of bending vibrations in rotors
- determine critical speeds
- positions of rotor bearing and rotating mass can be adjusted

Critical speed and resonance are phenomena that play essential roles in many machines and systems. In particular, resonance states with impermissibly high vibration amplitudes can occur in rotating shafts and rotors at certain speeds, which in some cases can even lead to destruction of the machine. To prevent this, the system is operated well above or below the critical speed and driven quickly through the critical speed range. Therefore, knowledge of critical speeds and vibration modes is important in the design and operation of machines with bending elasticity in their rotors.

The TM 620 experimental unit can be used to clearly demonstrate phenomena such as resonance, self-centring and vibration modes. The model-like structure of the experimental rotor as a thin, elastic shaft with rigid mass disks allows simple theoretical comprehension of the vibration phenomena that occur.

The influence of different parameters can be studied thanks to the free choice of bearing and disk arrangement. The limitation of the amplitudes at a rapid resonant cycle can also be demonstrated.

A three-phase motor drives a rotor shaft, onto which one or two masses may be fixed at various distances. The rotor shaft is mounted in two self-aligning ball bearings and connected to the motor via a flexible coupling. The electronically controlled speed can be selected via two potentiometers and is continuously variable. It is displayed on a digital display.

The positions of and distances to elements fixed onto the rotor shaft can be read on a scale mounted in parallel with the rotor.

A transparent protective cover and safety bearings immediately next to the masses ensure safe operation.

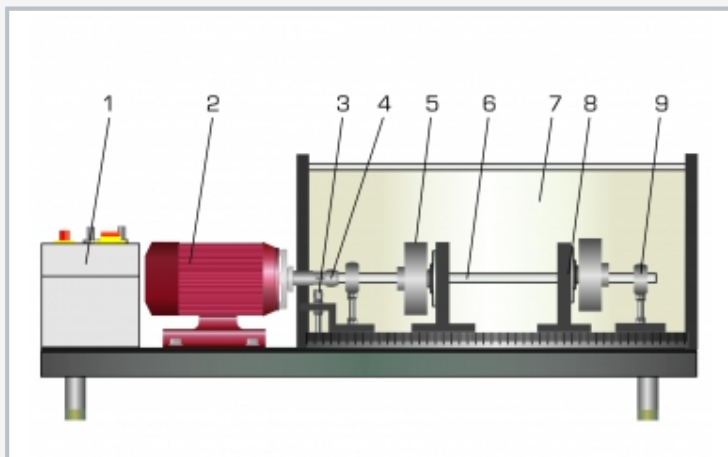
The measured values can be displayed and analysed on a PC using the optional TM 620.20 unit for data acquisition.

### Learning objectives/experiments

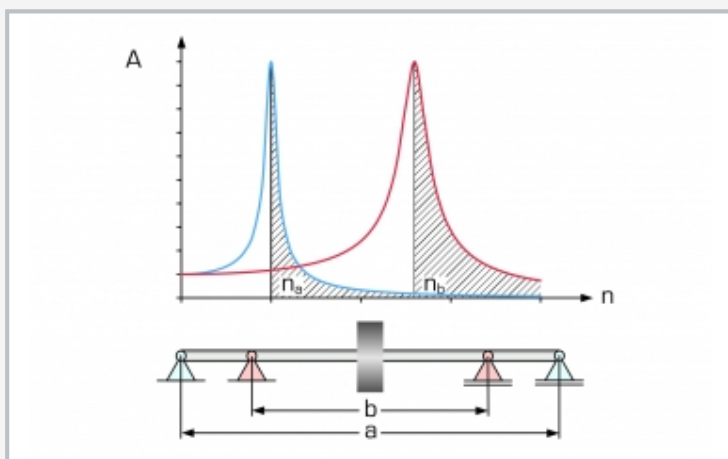
- investigate bending vibrations and resonance of a rotating shaft
- determine critical speeds with different arrangements of the bearing and masses on the rotor shaft and compare with theory
- investigation of the rotor's self-centring effect

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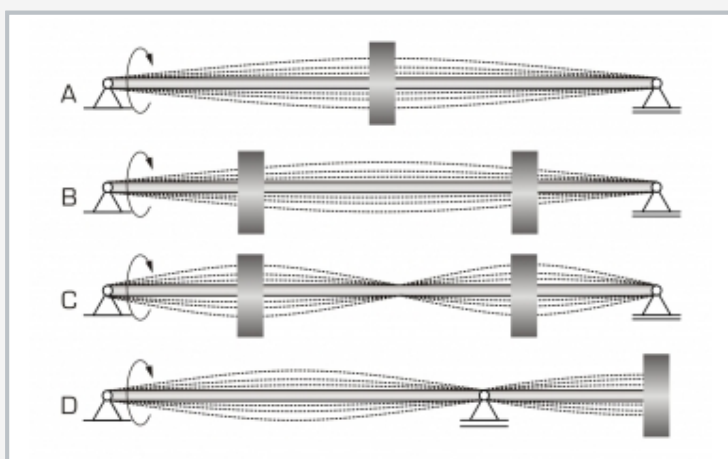
## Bending elasticity in rotors



1 switch box, 2 motor, 3 inductive speed sensor, 4 flexible coupling, 5 mass disk, 6 rotor shaft, 7 protective cover, 8 safety bearing, 9 self-aligning ball bearing



Reducing the bearing clearance increases the critical speed; A amplitude, n speed;  $n_a$  critical speed at bearing clearance a,  $n_b$  critical speed at bearing clearance b, shaded area: supercritical speed



Various arrangements for studying the critical speed:  
A one mass disk central position, B two mass disks at first critical speed, C two mass disks at second critical speed, D overhung mass disk

### Specification

- [1] investigation of bending vibrations and resonance in rotors
- [2] 2 self-aligning ball bearings to support the rotor shaft, positionable at any point
- [3] 2 masses to be secured at any point
- [4] safety bearing and transparent protective cover for safe operation
- [5] three-phase motor: 2 pre-selectable speed ranges; speed electronically controlled and continuously adjustable
- [6] digital speed display
- [7] system for data acquisition (TM 620.20) available as an option

### Technical data

Three-phase motor

- power: 0,25kW
- max. speed: 3000min<sup>-1</sup>

Rotor shaft

- L=500mm
- Ø=6mm
- high tensile steel

Mass 2x, disk-shaped

- m=965g
- Ø=80mm
- hardened steel

Rotor bearing

- 2x self-aligning ball bearings
- 2x safety bearings
- safety bearing play: ±3mm
- adjustable bearing clearance: 300...470mm

Measuring ranges

- speed: 300...3000min<sup>-1</sup>
- scale for measuring distance: 0...500mm

230V, 50Hz, 1 phase

230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase

UL/CSA optional

LxWxH: 1150x390x375mm

Weight: approx. 49kg

### Scope of delivery

- 1 experimental unit
- 1 set of instructional material

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Optional accessories

020.30009	WP 300.09	Laboratory trolley
040.62020	TM 620.20	System for data acquisition