

# UNIVERSAL TEST STAND FOR RESEARCH OF AERONAUTICAL MULTI-POWER PATH GEAR DEMONSTRATORS

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## **Abstract**

*Gears used for the tests may be made of metal or plastic [1, 2, 5]. The stand has been designed in an open system and it is powered by a three-phase electric motor. The control is provided by a single-phase inverter with three outputs, which provides full speed control.*

*All components have been installed on a table equipped with T-slots in order to determine the optimal position of the drive and the tested gear.*

*The load of the stand is realized by an electromagnetic powder brake. Load torque of the gear depends on the supplied current. During the test, you can change settings such as speed or load torque. Torque meters installed on input and output of the demonstrator let you control the work of the whole gear. Values supplied by the torque meters (torque and speed) are recorded on a computer in real time (according to PC RTC) and archived by specialized software.*

*The software installed on your computer allows you to view results of the measurements. The possibility to control working time lets you precisely define the time intervals of various stages of the research. Using timer makes it possible to observe the current consumption of the transmission and helps to establish the research process. Thanks to data, recording you will know when the gear is damaged.*

*Tests at this stand allow for obtaining stable working parameters, and thus for obtaining not distorted, accurate results of the demonstrator operation. Changing the gear is exceptionally simple because of the use of sliding splined connections of the couplings. Separating couplings between which the gear is situated and unlocking, the terminal allows exchanging it.*

**Keywords:** *test stand, multi-power path gear, demonstrator*

## **1. Introduction**

This paper presents a universal test stand to carry out examination of aeronautical gear demonstrator [3, 4]. Gears used for the tests may be made of metal or plastic. A complete test stand was designed and manufactured for this purpose, with possibility of setting up and recording parameters.

## **2. Construction**

Figure 1 presents the designed model of the test stand.

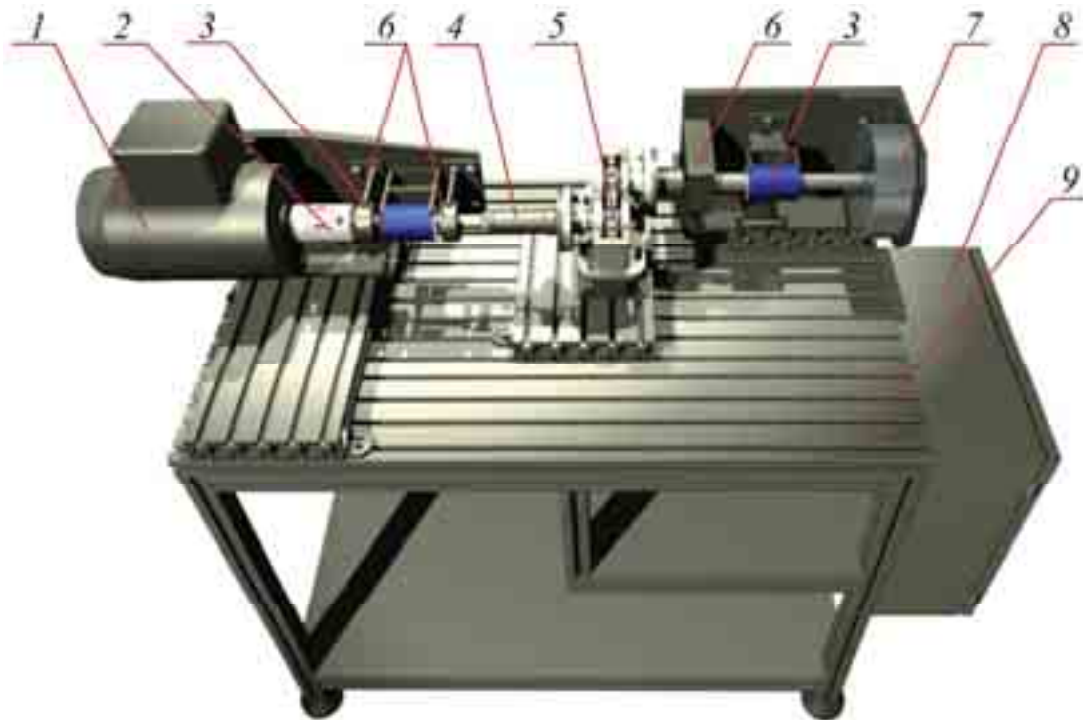


Fig. 1. Model of the test stand, 1 - electric engine, 2 - claw clutch, 3 - torque sensor, 4 - sliding clutch, 5 - tested transmission, 6 - support bearings, 7 - powder brake, 8 - control box, 9 - stand test table

The stand was designed in an open system. It is powered by a three-phase 0.75 kW electric motor (1). The control is provided by a single-phase inverter with three outputs, which is installed in the control box (8) assuring full control of engine parameters, such as; speed, “soft” start and stop. All components are installed on the table (9) with a T-slot in order to determine the optimal position of the drive and the tested gear.

Load is carried by an electromagnetic powder brake (7). Torque incriminating gear depends on the supply current. Changes in settings such as speed or torque incriminating you can change during testing gears. Changing gear (5) is extremely simple thanks to the use of sliding clutch splined connections. Pulling apart clutches between which there is transmission gear and unlocking the terminal allows exchanging the gear. Torque sensor (3) installed at the entrance and exit of the demonstrator allow to controls the work of the entire transmission. The values given by torque sensor (torque and speed) are recorded on a computer in real time (according to PC RTC) and archived by specialized software.

Powder brake (Fig. 2) [9] consists of two coaxial elements. The torque is transmitted by a specific ferromagnetic powder located between the body and the rotor whose apparent viscosity varies with the change of electromagnet coil power.

A standard torque sensor (Fig. 3) [8] was applied to measure torque in real time on static or bi-directional rotating shafts. The sensor is equipped with a power cord connected to the DVR. The sensor has very low power consumption, high stability for long-term measurements. It is equipped with a non-contact measurement system.

The values measured by the torque sensor are transmitted to the registrar of advanced power and torque (Fig. 4) [7]. Measured values can be read directly on the LCD display.

Diagram of connections and communication between sets is shown in Fig. 5

The inverter (Fig. 6) [6] is a frequency converter. This simple configuration device converts single-phase 230VAC input into the standard three-phase induction motor. Rpm can be adjusted by changing the frequency at the output of the inverter in the range of 0 Hz to 650 Hz. Recorder is connected to the programming interface that communicates directly with a PC.

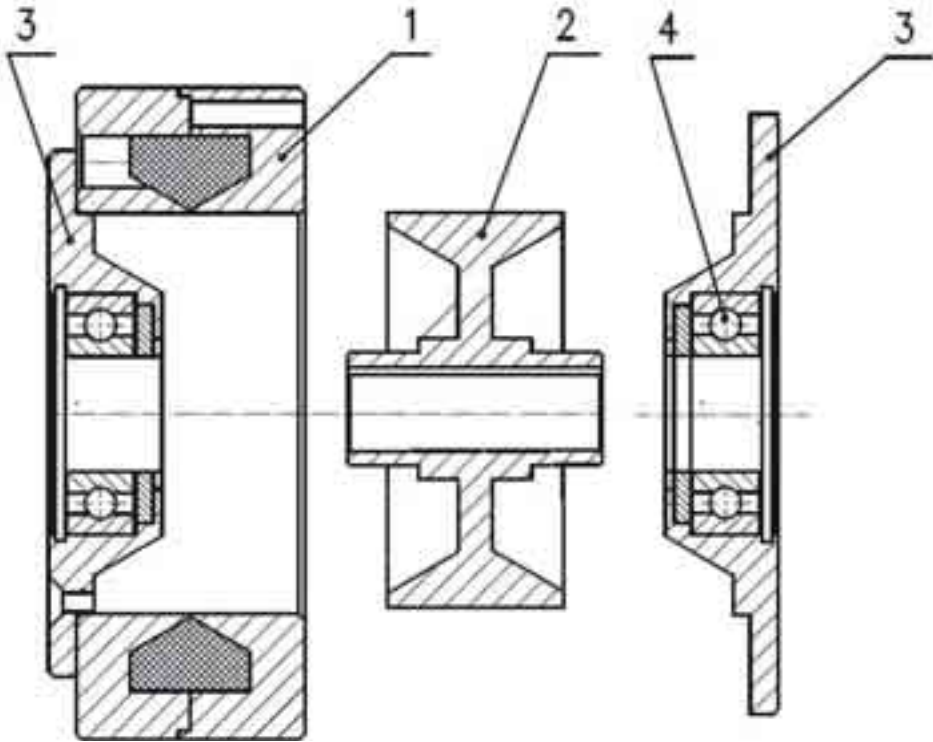


Fig. 2. Construction of the powder brake, 1 - body, 2 - rotor, 3 - cover, 4 - bearing



Fig. 3. Torque sensor



Fig. 4. Advanced Force Torque Indicator (AFTI)

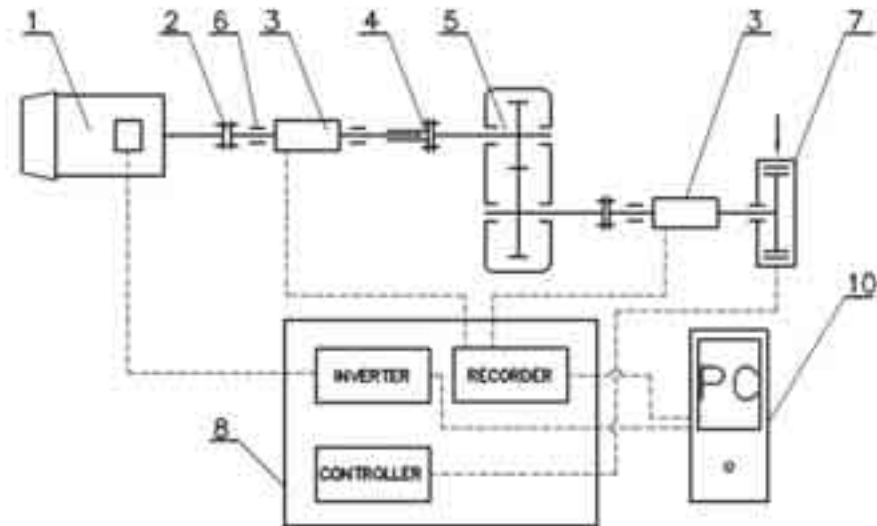


Fig. 5. Schematic diagram of the test stand: 1 - electric engine, 2 - claw clutch, 3 – torque sensor, 4 - sliding clutch, 5 - tested gear, 6 - support bearings, 7 - powder brake, 8 - control box, 10 – PC



Fig. 6. View of the inverter with the communication interface

The below picture (Fig. 7) shows the designed test stand.



Fig. 7. Test stand

### 3. Software and Data Acquisition

Parameter settings of work of engine are programmed and controlled by using the Drive ES - Starter V4.1 [6]. The program allows previewing the set of parameters and observation of the changes directly on the test stand. Emperor Lite program (Fig. 8) [7] is used for data acquisition and makes it possible to save and view t results.

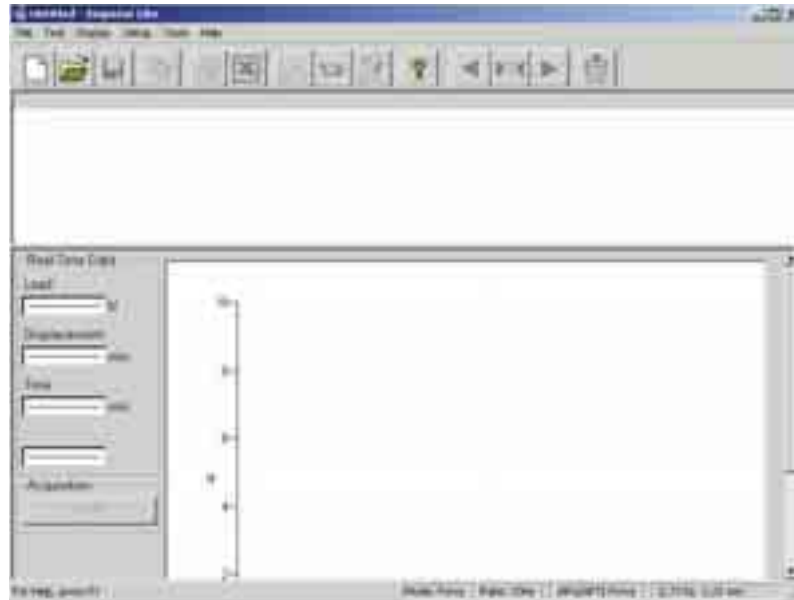


Fig. 8. The dialog box of Emperor Lite program

The measurement results are displayed in binary and graphical mode, allowing observing proceedings of gear wear and can determine the course of the examination process. Archived results can be edited at any time and subjected to further treatment. By data, storing it will be known when the gearbox will be eventually damaged. Additional hardware capabilities allow you to control the working time and specify the time intervals between various stages of tests.

### 4. Summary

Tests at this stand allow to obtain a stable operating parameters and thus to obtain undistorted, accurate results of work of demonstrator. Changing gears takes place in a short time and so does adapting to a different type of demonstrator.

### Acknowledgement

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