

FZG Gear Test Machine Operating Instructions AIC-5182



OLA-FZG5182



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I.Applications and Scope of Use

1.1 Primary Applications

This machine is designed for evaluating the scuffing load-carrying capacity of gears or lubricating oils.

The test bench consists of the following key components:

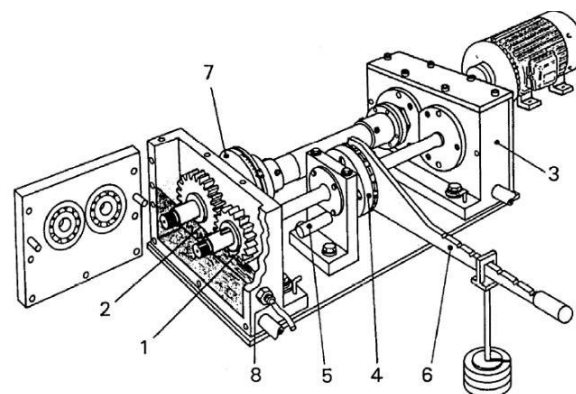
- Main Unit: Comprising the base, power source (motor), drive gearbox, torsion shaft, test gearbox, water cooler, torque-loading fixture, torque-loading device, level gauge, heating unit, temperature sensors, oil drain system, and torque speed acquisition sensors.
- Torque Loading System
- Oil Lubrication System
- Cooling Water Circulation System
- Electrical Control Cabinet

1.2 Scope of application

This machine can meet the following test standard

- GB/T 13672-92
- GB/T 13672-92
- SH/T 0366-1992
- ASTM D5182-97(2014)

II.Principle Diagram



- | | |
|---------------|---------------------------|
| 1 Test Pinion | 5 Locking Pin |
| 2 Test Wheel | 6 Load Lever and Weights |
| 3 Slave Gear | 7 Torque Measuring Clutch |
| 4 Load Clutch | 8 Temperature Sensor |

FIG.1

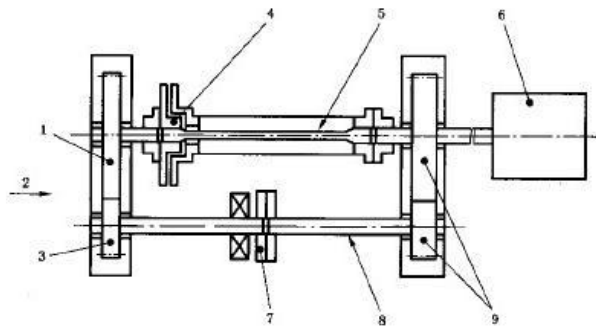


FIG.2

1-Big gear	2-Operation direction	3-Samll gear
4-Torque sensor part	5-Spindle 2	6-Drive motor
7-Loading clutch	8-Spindle 1	9-Test companion gear

III.Main Technical Specifications

3.1 Automation and safety control system: The instrument should be controlled by a computer and a control panel. The computer has a software system that can edit and display the test methods and parameters in real time, and can switch according to the standard with one key; the control panel can integrate the power emergency stop control switch, motor control switch, alarm indication, heating, cooling, time reset, speed selection, temperature control, time, number of revolutions and other control switches and instruments.

3.2 Driving motor parameters: 1450/2880r/min , power not less than 5.5kW at 1440r/min

3.3 Test force parameters: Maximum torque is 1kNm, maximum load level is level 13.

3.4 Timer: can automatically cut off the power supply of the motor after each level of test;

3.5 Heating and cooling device: temperature range 0~100°C, temperature control accuracy is $\pm 2^\circ\text{C}$;

3.6 Measurement error requirements:

- ① The accuracy of the micropitting level load test and the endurance test shall meet the requirements of NB/SH/T 0922-2016 standard;
- ② Repeatability: The lubricating oil load capacity test shall not exceed the load level 2 at a confidence level of 95% (the difference between two test results of the same sample measured continuously by the same operator using the same instrument in the same laboratory and in accordance with the same method);
- ③ Reproducibility: The lubricating oil load capacity test shall not exceed the load level 2 at a confidence level of 95% (the difference between two single, independent results of the same sample measured by different operators using different instruments in different laboratories and in accordance with the same method).

3.7 Standard gears approved by the testing standards: equipped with 2 pairs of C-GF gears for anti-micropitting test and A-type gears for gear machine test, 1 pair for debugging, and 1 pair as standard samples for testing.

C-GF gears are made of 16MnCr5 steel, with a tooth width of 14mm, and the gear surface is ground with Maag 0°. The surface roughness Ra in the involute direction is 0.4 microns~0.6 microns, with a precision of 5 levels and a modulus of 4.5°. A-type gears are made of 20MnCr5 steel, with a tooth width of 20mm, and the gear surface is ground with Maag 20°, with a precision of 5 levels and a modulus of 4.5°.

3.8 Working noise ≤ 110 decibels

3.9 Integral safety shield: the shield completely covers both the gearbox and the motor.

3.10 Technical parameter

Model	AIC-5182
Max. torque	1000N·m
Max. loading class	13 class
Temperature control accuracy	$\pm 2^{\circ}\text{C}$
Motor power	6.5/8kw
Motor speed	1450/2880 r/min
Gear box volume	1.25L
Heating power	0.5X3=1.5kw
Dimension	1650X450X1150mm

3.11 Power Supply

- Voltage: 380 V AC (tolerance: $\pm 10\%$ of rated value)
- Frequency: 50 Hz (tolerance: $\pm 2\%$ of rated value)

3.12 Installation Conditions

- Level installation required:
- Horizontal error ≤ 0.2 mm per 1000 mm (both longitudinal & transverse directions)
- Foundation must be rigid and stable

3.13 Ambient Environment

- Operating temperature: 10–35 °C
- No vibration, strong magnetic fields, or corrosive media present
- Relative humidity: $\leq 80\%$

IV. Structural characteristics and working principle

The machine adopts a closed-loop power structure, with load applied via a lever-and weight loading mechanism.

4.1 Loading method(as follows):

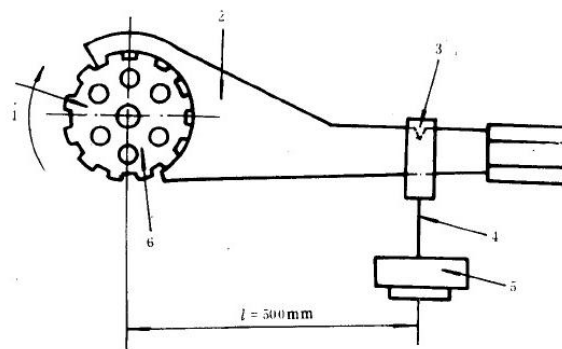


FIG.3:Loading diagram

1	Nominal torque for small gear T1	4	Weight pan
2	Loading lever	5	Weights
3	Weight pan knife-edge	6	Loading clutch



FIG.4:Loading real picture

V.Operation and Use

5.1 Lifting and Storage

When lifting the machine, attach the lifting ropes to the four lifting bolts on the tester. During transportation and storage, avoid strong magnetic fields, high temperatures, and high humidity. For long-term inactivity, apply anti-rust oil to all critical components.

5.2 Installation and Adjustment

Place the main unit on a level floor and install four anti-vibration leveling pads. Place a spirit level on the worktable; adjust the pads until the horizontal error of the worktable meets requirements in both longitudinal and transverse directions. It is recommended to place the main unit and controller separately or in the same room, with a distance of more than 3 meters. This reason is to isolate noise, which can reach a maximum of over 120dB. At the same time, to isolate the irritating odor generated by the test oil sample. After starting the testing machine, the operator should stay away from the main unit position.

5.3. Disassembly of experimental gears

Cut off the power supply of the main unit. Loosen all nuts on the loading clutch ratchet and check if the two flanges of the loading clutch can rotate independently relative to each other.

Attention: Do not insert the locking pin at this time. The main spindle should be able to rotate freely. Remove the top and side covers of the test chamber.

Attention: When disassembling the side cover, use the special accessory T-type screw, apply even force, and do not tilt the side cover, otherwise it will get stuck and difficult to disassemble. After inserting the locking pin, loosen and remove the round nut and other fasteners, then remove the centering gasket, and use a gear removal tool to remove the tested gear.

5.4. Install a new test gear

Using a gear installation tool, first install the large gear, and then install the small gear. When installing the small gear, do not fully push the gear first. Rotate the loading clutch to make one tooth of the small gear mesh with one tooth of the large gear, and then push the small gear to the final position. Then install round nuts, etc. Clean the gearbox according to the test method requirements.

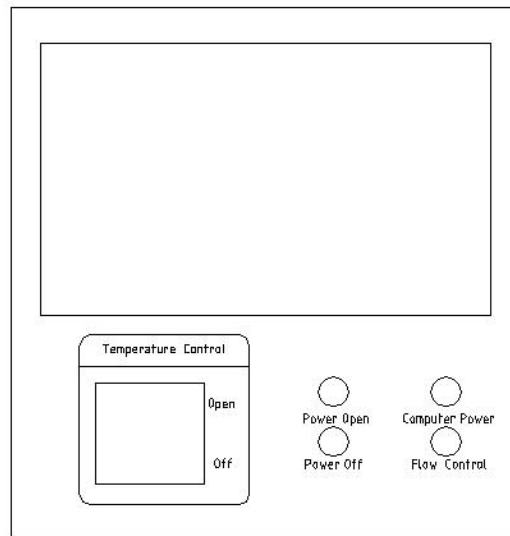
Attention: It is strictly prohibited to interchange the installation positions of the two gears! Gently tap the side cover with a rubber hammer, install the side cover on the gearbox, and tighten the 7 screws. Then install the cover and tighten the 6 screws.

Attention: Before installing the gear, it is necessary to confirm that the internal centering gasket has been installed in place.

5.5 Experimental Steps

Clean, prepare, and test according to the testing method standards. The conditions for different experiments are different and can be checked in test standard.

5.6 Electrical Operation



The control panel consists of three sections: computer display, temperature control unit, and button controls.

5.6.1. Computer Display

No adjustment is required for the display. For software operation, refer to the separate software user manual.

5.6.2. Temperature Control Unit

The temperature control unit includes a temperature controller and a toggle switch.

- **Toggle Switch:** Turn ON to power the temperature controller for normal operation. Turn OFF if heating/temperature monitoring is unnecessary.
- **Circulating Water Cooler:** Automatically starts/stops based on software-set temperature thresholds (no manual control needed).
- **Temperature Controller Usage:** Refer to the dedicated temperature controller manual for heating, temperature control, and measurement settings.

• Attention:

The heating, temperature control, and measurement units are all integrated into the gear chamber. The temperature controller directly controls the heater—if only temperature measurement is needed (without heating), set the target temperature below ambient temperature to prevent unintended heater activation.

5.6.3. Button Controls

The button section includes 3 buttons and 1 flow adjustment knob:

- **Power Buttons** (Left Side, Vertical Arrangement)

Top (Green Button) – "Power ON": Press to turn on the system (green light illuminates).

Must be activated before starting the computer software.

Bottom (Red Button) – "Power OFF": Press to shut down the system (red light illuminates).

Must be pressed before closing the computer software after testing.

- Computer Power Button (Top Right, Green, No Indicator Light)

Press to start the computer automatically.

To shut down the computer, use the Windows Start Menu (no button operation required).

- Heating Toggle Switch (Bottom Right)

Center Position – OFF

Left/Right Rotation – External Oil Tank Heating / Internal Test Chamber Heating After switching, refer to the real-time measurement values in the software interface for adjustments.

- Flow Adjustment Knob

Adjusts coolant flow rate as needed.

5.7. Loading Mechanism Operation

- Insert the locking pin and hang the loading lever on the ratchet of the loading clutch.
- Add weights (each weight is marked with its grade).
- After loading, tighten the nuts on the ratchet of the loading clutch to secure the two flanges (ratchets).
- Remove the weights and loading lever, returning the system to its pre-loading state.
- Remove the locking pin and cover the protective shield.
- **Attention:** When hanging the loading lever, select the ratchet groove carefully to ensure the upper edge remains within $\pm 20^\circ$ of horizontal deviation after loading. Before loading, ensure the locking pin is securely inserted. After loading, always remove the locking pin to prevent damage.

5.8. Torque Sensor Unit

- The machine uses a Japan-imported elastic coupling paired with a bidirectional torque sensor (max. capacity: 1000 Nm).
- The torque sensor measures torque and provides overload protection (auto-stop function).
- All data is transmitted via the data acquisition controller to the computer for software analysis.
- No manual adjustment is required during testing, so torque transmission details are omitted.

5.9. Automatic Protection for Tooth Breakage or Overload

The machine includes multiple safety stop functions, triggered by:

- Reaching preset test speed, rotation count, or test duration.
- Tooth breakage or abnormal load increase during testing.

The torque sensor monitors load changes in real time. If torque suddenly increases or decreases by 5–15% (adjustable based on conditions), the system triggers an alarm and automatic shutdown to protect equipment and personnel.

5.10. Circulating Medium System

- Oil Pump Control: Uses variable-frequency speed regulation to adjust the spray motor speed.
- Flow Measurement: A turbine flow meter monitors flow rate, adjusted manually via a control knob.
- Oil Return: An auto-suction oil return pump ensures continuous circulation.
- Dual-Pump System: Ensures efficient medium circulation.
- Cooling: The oil tank is equipped with an air-cooled radiator.
- Maintenance Access: Open the compartment door below the motor to inspect the oil tank and components.

VI. Maintenance and Service

1. Bearing and Oil Seal Replacement

After prolonged operation, worn or damaged bearings and oil seals must be replaced.

For gears: Follow the same procedure as gear removal/installation.

For other components:

- Dismantle the entire test chamber.
- Remove the bearing end cover to access and replace the bearings/seals.

2. Drive Gear Replacement

Although the drive gear's tooth width exceeds that of the test gear, tooth breakage may still occur.

If the drive gear fractures, both gears must be replaced.

Replacement Steps:

- Power off the machine.
- Loosen the 4 screws on the motor mounting plate and disconnect the motor from the coupling.
- Remove the screws on the motor coupling's flange to detach the coupling.

Note: The main shaft here is a tapered shaft, allowing easy disassembly without affecting precision.

- Drain the gear oil from the drive chamber.
- Replace the gears using the standard gear removal/installation method.

VII. Common Faults and Troubleshooting Methods

Fault	Possible Cause	Solution
Temperature controller displays max value	- Loose or disconnected PT100 temperature sensor wiring. - Faulty sensor.	1. Check sensor wiring. 2. Replace sensor if wiring is intact.
No heating	- Loose or broken heater wiring. - Heater damaged. - Dry heating (without oil immersion).	1. Check heater connections. 2. Replace heater if necessary. Note: Heating must be done under oil immersion—dry heating will damage the heater.
Motor fails to start	- Limit stop pin not removed. - Three-phase power supply issue. - Incorrect software settings.	1. Remove the limit pin. 2. Check power supply. 3. Verify software configuration.
Cooling water circulation fails to start	- No water supply (must be connected to tap water or pressurized circulating tank). - Faulty 24V solenoid valve. - Insulation pad damage near valve.	1. Ensure water supply is connected. 2. Check solenoid valve operation (listen for clicking sound). 3. Replace damaged insulation pad to prevent electrical interference.
Equipment casing has static electricity	- Improper grounding of the device or control cabinet.	1. Ensure proper grounding of the casing. 2. Operators should use a simple grounding wire.

VII.Package List

NO	Name	Material or Brand	Qty	Remark
1	Machine Base	HT-200	1 set	
2	Test Box	HT-250 grinding	1 set	
3	Test Gear 1	20CrMn	1 set	
4	Test Gear 2	20CrMn	1 set	
5	Deep groove ball bearings	Japan NSK	8 sets	Installed
6	Driven Gear 1	20CrMn	1 set	
7	Driven Gear 2	20CrMn	1 set	
8	Driven Box	HT-250 grinding	1 set	
9	Loading clutch	CHENDA	1 set	
10	Levers, weights	CHENDA	1 set	
11	Transmission shaft	SPECIAL MATERIAL	4 sets	
12	Coupling	CHENDA	1 set	
13	Drive motor	MEET 13 CLASS LOADING	1 set	(including inverter)
14	Cooling water system	CHINA	1 set	
15	Strong electric control system	CHENDA	1 set	Meter included
16	Computer	Lenovo WIN10	1 set	Genuine
17	Printer	HP	1 set	
18	Software	English for CL-100	1 set	
19	Loading gear tools	Tool	1 set	
20	Unloading gear tools	Tool	1 set	
21	T-screw	Tool	2 sets	
22	Combination kit	Be common	1 set	
23	17mm ratchet wrench	Using for loading	1 set	

Appendix I.Operation Steps of FZG Test Machine

1. Ratchet Nut Removal Procedure

Operate only when the main power is turned off. Open the protective cover, loosen all nuts on the loading clutch ratchet, and check whether the two flanges of the loading clutch can rotate independently relative to each other. Do not insert the locking pin at this stage. Ensure the spindle can rotate freely.

2. Removing the Top and Side Covers of the Test Chamber

When removing the side cover, use the dedicated accessory—a T-shaped screw—and apply even force. Avoid tilting the side cover, as it may jam and become difficult to remove. After inserting the locking pin, loosen and remove the round nuts and other fasteners, then take out the alignment shim. Use a gear removal tool to detach the tested gear.

3. Installing New Test Gears

Using a gear installation tool, first install the large gear, followed by the small gear. When installing the small gear, do not push it fully into position initially. Rotate the loading clutch to mesh one tooth of the small gear with a tooth of the large gear, then push the small gear to its final position. Install the round nuts and other fasteners. Clean the gearbox as required by the test method. The two gears must not be swapped in position!

4. Installing the Top and Side Covers of the Test Chamber

Gently tap the side cover with a rubber mallet, align it with the positioning pins, and secure it to the gearbox with seven screws. Then install the top cover and fasten it with six screws. Before installing the gears, ensure the internal alignment shim is properly in place.

5. Test Procedure

The control panel consists of three sections: computer display, temperature control, and buttons. The computer display requires no adjustment.

5.1 Turning On the Temperature Controller

The temperature control section includes a temperature controller and a toggle switch. Turn on the toggle switch to power the temperature controller, which will display and operate normally. If heating or temperature measurement is unnecessary, simply turn off the toggle switch. The operation of the circulating water cooler is automated and controlled by software settings—no manual intervention is required. For details on using the temperature controller and heating/measurement requirements, refer to the dedicated temperature controller manual. The machine's heating, temperature control, and measurement units are all located inside the gearbox. The temperature set on the controller determines whether the heater activates. To measure the medium or chamber temperature without heating, set the controller to a target temperature below room temperature to prevent automatic heating.

5.2 Turning On the Computer

The button section has three buttons. The upper and lower buttons on the left correspond to power on (green) and power off (red). After installing the test gears, press the power-on button (green light on), then launch the computer software.

5.3 Creating a New Test

Click the "New" button in the software to start a new test.

5.4 Entering Test Information

Fill in all required details, including operator name, sample batch number, and ID.

5.5 Selecting Test Speed

Choose a test speed, click "Motor Test" to check if the motor rotates normally, then stop.

5.6 Setting Test Duration and Torque Level

Configure the test time and the torque level to be applied.

5.7 Configuring Heating and Auto Start/Stop (Optional)

Set up heating and automatic start/stop operations if needed (skip if unnecessary).

5.8 Loading Mechanism Operation

Insert the locking pin, zero the torque display in the software, hang the loading lever on the loading clutch ratchet, and attach the weights (marked with their respective levels). After loading, tighten the nuts on the loading clutch ratchet to secure the two flanges (ratchets). Remove the weights and loading lever, returning to the pre-loading state. Remove the locking pin and reinstall the protective cover. When hanging the loading lever, select a ratchet groove such that the lever's upper edge remains within $\pm 20^\circ$ of horizontal. Ensure the locking pin is firmly inserted before loading and removed afterward!

5.9 Torque Sensor Inspection

The machine uses dual HBM torque sensors and imported flexible couplings with a maximum 1000 Nm torque sensor for measurement. The torque sensor measures torque and provides overload protection, with all data transmitted to the computer for analysis via the acquisition controller. No adjustments are needed during the test—only inspection is required.

5.10 Post-Loading Check

After loading, manually rotate the spindle several times with a tool to ensure no jamming and smooth rotation.

5.11 Closing the Protective Cover

Secure the protective cover.

5.12 Adding Lubricant

Fill the test chamber with lubricating oil or gear oil (ensure the drain valve is closed).

5.13 Optional: Gearbox Oil Spray

If needed, click "Gearbox Oil Spray" and set an appropriate flow rate (≤ 2 L/min).

5.14 Optional: Oil Circulation

If the above step is performed, click "Gearbox Oil Drain" to ensure oil circulation.

5.15 Starting the Test

Click "Start" to begin the test. The software will automatically record dual torque curves, temperature curves, time, speed, revolutions, and other data.

5.16 Noise Precautions

Wear noise-canceling earplugs for hearing protection.

5.17 Test Completion

The machine will stop automatically when the set test time or revolutions are reached, and the software's stop button will light up.

5.18 Saving Data

Click "Save" to store the data.

5.19 Exporting Reports

Click "Export Report" to save all data in Excel format for further analysis.

5.20 Unloading and Disassembly

Follow steps 1 and 2 to unload and disassemble the test gearbox.

5.21 Gear Inspection

Check gear wear and document findings (e.g., photos). Replace gears if necessary (repeat steps 3–4).

5.22 New Test Cycle

For additional tests, repeat steps 5.8–5.21.

5.23 Powering Off

Press the red button to turn off the main power.

5.24 Closing Software and Computer

Exit the software via the mouse, then shut down the computer from the start menu.

5.25 Final Checks

Turn off the machine's circuit breaker and clean the workspace.

!!! IMPORTANT !!!

Gear Tooth Breakage or Overload Protection:

The machine features multiple safety shutdown functions (e.g., test speed, revolutions, time). If abnormal conditions such as tooth breakage or sudden torque deviations (5– 15% from initial values, depending on settings) occur, the system will trigger an alarm and stop automatically to ensure equipment and personnel safety.

Shutdown Protocol:

After the test, always press the power-off button (red light on) before closing the software and computer.