

Model RBF-6000 Rotary Bending Fatigue Testing Machine



Applications:

This machine is suitable to test the rotary bending fatigue strength of ferrous metals and alloy materials under both room temperature and high temperature conditions, and determine the fatigue performance of metallic sample under a certain bending moment in the state of rotary. It is designed and manufactured fully according to the current standard ISO 1143: 2010 “method for rotary bending fatigue tests of metallic materials” and Standard ZBN71006-87 “Technical conditions of pure bending fatigue testers”.

The testing machine is usually used to test the bending fatigue limit δ -1 of metals under the action of symmetrical repeatedly alternating bending force. Accordingly the tension-compression fatigue limit δ -1p and torsion fatigue limit τ -1 can be determined by calculation according to experienced formula. The system has simple structure, easy to operate, stable & reliable. It is very popular at factories of aerospace and high school laboratories.

Main Technical Specification:

Model	RBF-6000
Bending moment range	0-60 Nm adjustable
Loading force arm	200mm
Relative error of force arm length	$\leq \pm 0.3\%$ (adjustable distance between left-right grip)
Test speed	1500-6000 r/min (25Hz-100Hz)
Co-axial of left and right claws	≤ 0.02 mm
Relative error of force arm length	≤ 0.02 mm
Static radial play eccentricity	≤ 0.02 mm
Dynamic radial play eccentricity	≤ 0.06 mm
Relative error of bending moment	$\leq \pm 0.1\%$
Relative error of bending moment Repeatability	$\leq \pm 0.1\%$

Counter Capacity	1 x 10 ⁹ times
Counter accuracy	±1%
Specimen diameter range	Dia. 9x90mm
Motor power	1 kW, 380V, 50Hz, 3 phases (3.5kW if with furnace)
Overall dimensions	1500 x 600 x 1300mm
Weight of load frame	600kg
Clamping system	Clamping fixture for room and high temperature test can be applied on dia. 9mm specimens, and front & rear clamping fixture adopt the clamping mode of elastic taper sleeve to realize the high precise match, and high temperature fixture is made of nickel based super alloy, meanwhile, spring clamp handling tool will be supplied with this machine.
Calibration & alignment system	Calibration system (including calibration frame, fixtures, tools, 1kN load cell with measuring meter) shall be supplied with this machine
Protections	Test times can be set freely and machine can be stopped automatically when it's upto the set valve; some other auto-power off protections when power failure, over-current, over-heating for furnace, specimen fracture etc
Computer + software (expandable function)	This machine can be expanded with computer and software, based on Windows program, it adopts virtual panel operating mode with easy operation to complete the control of whole system, data acquisition and storage etc. all test data of full test process, test conditions and all test status at different test conditions can be saved into software. Test data can be output into Word or excel for more process.



Structure:

This testing machine adopts four-point supporting loading structure, and consists of frame, AC high speed motor and driving system, measuring control system, loading weights, high temperature furnace system, grips for room and high temperature tests and safety guard device etc.

On the body frame, there mounted with motor and decelerator cabinet. The joint parts of main shafts are mounted on the body frame through four pieces of ball bearings. The ball bearings on the left side are fixed on the surface of guide plate, and the right ball bearings are put into the spherical groove of support. Under the body frame is located the loading/discharging device.

The joint parts of main shafts (See fig 1) are symmetry parts connected by plate. Shaft 5 is on the two sides of shaft socket 6, one end of which is fitted with ball-bearing 7 as a fulcrum, the other end is fitted with clamp 10 by rolling-pin bearing, acting as a loading point. The connecting plate and the pulling rod are connected by a slide axe. Inside the shaft socket there mounted two pieces of dual-row ball bearings 3, which is to support the main shaft 2. Inside the main shaft core there mounted the elastic clamps 1 to hold the specimen. Turn the screw 9 round to push in or draw out the spindle 8, thus the specimen 11 can be tightened or loosened.

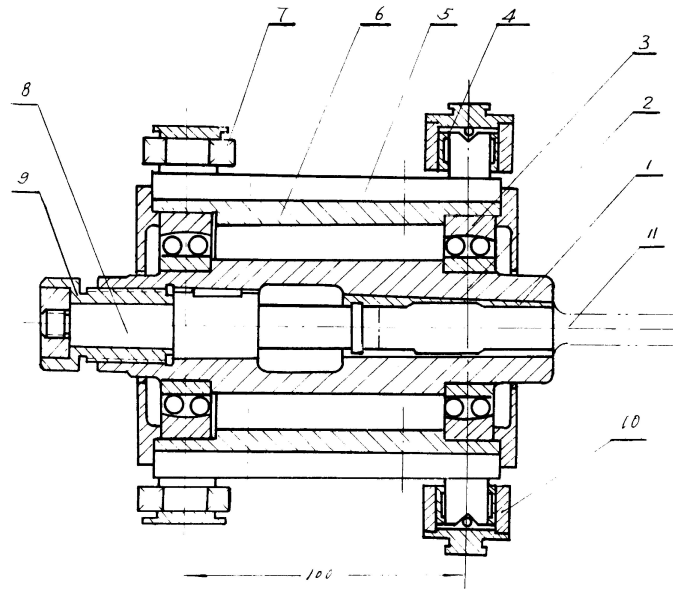


Fig. 1 Main shaft joint parts

The load on the specimen is applied directly by adding weights. The weight is hanged on the pulling rod passing by the screw rod. The pulling rod and the connecting plate are connected by spring, which ensure the stability of loading or discharging.

The loading/discharging unit is designed according to screw rod elevating theory. Turn the hand wheel to make the screw rod ascending or descending. When the screw rod is ascending at the position where it can support the top of the pulling rod, the screw rod supports all the load weight. While the screw rod is descending and divorced from the pulling rod, then the load weight is applied on both ends of the specimen.

The decelerator cabinet is composed by a group of worm gear & worm, whose function is to decelerate the revolutionary speed of the motor by 100 times and transmit to the counter. During the course of the test, the specimen is tightened; simultaneously the motor drive the main shaft through ball joint, decelerator cabinet, and connecting axe. Subsequently the specimen is rotating along with the main shaft, while the load is applied on both ends of the specimen through the pulling rod. Therefore a pure bending moment is evenly distributed on the working parts of the specimen. (See Fig. 2). Though the acting direction of the load is unchanged, the specimen is rotating all the time. Actually, the bending stress on each point of the specimen is alternative in the same speed along with the

specimen. (see Fig. 3). After hundreds of times alternative circles, the specimen is broken due to bending fatigue. After numbers of destroyed test, it can concluded the maximum bending stress of the specimen, under this bending stress & a stipulated basic circles the specimen will not be broken forever, that is the LIMIT STRESS. When the specimen broken, the right joint part of the main shaft will fall and push the STOP button, the motor will stop accordingly.

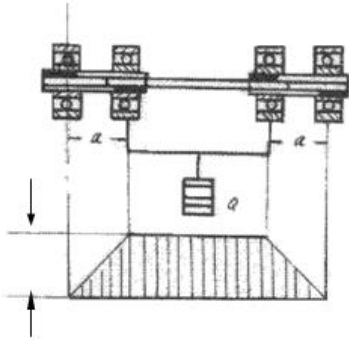


Fig. 2 Bending moment

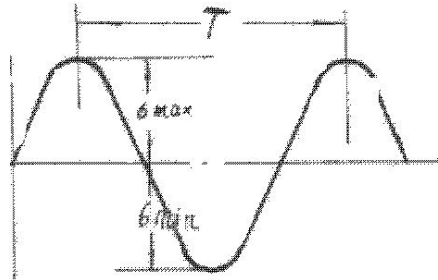
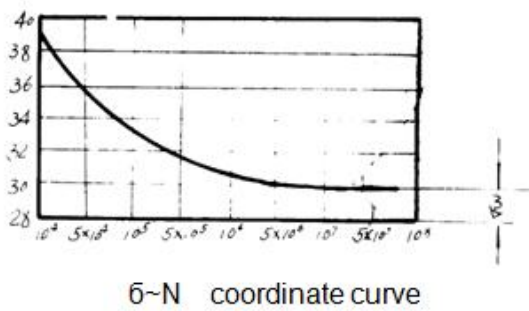
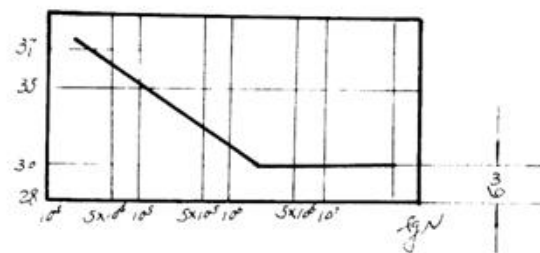


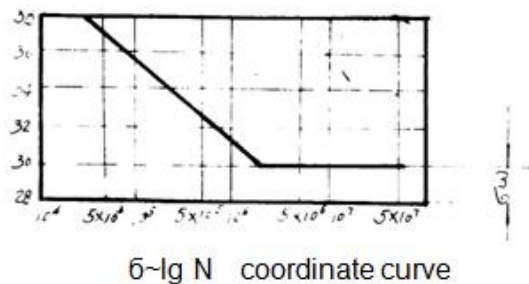
Fig. 3 Stress-Time Curve



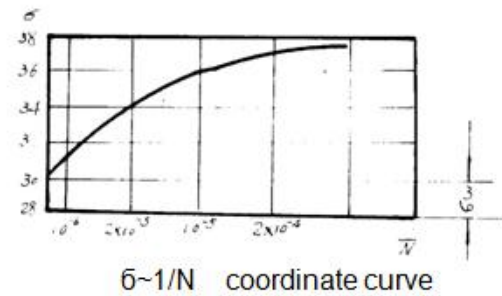
$\sigma \sim N$ coordinate curve



$\lg \sigma \sim \lg N$ coordinate curve



$\sigma \sim \lg N$ coordinate curve



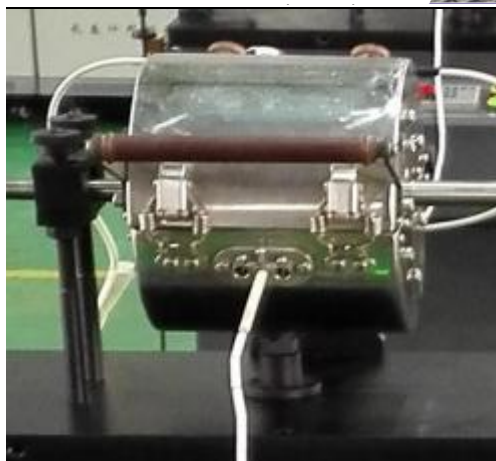
$\sigma \sim 1/N$ coordinate curve

Fig. 4 Fatigue Curves

Horizontal Split-type high temperature furnace (optional):

Application

This furnace is specially used for bending fatigue testing machine to complete high temperature test. It mainly consists of furnace body, temperature controller, high temperature grips etc. The temperature can be controlled automatically by PID Controller with high accuracy. Also it can make data communications with the computer.



These three zone resistance wire wound furnaces are of split construction to facilitate fast and easy loading of a pre-assembled specimen train. The case is constructed from stainless steel with aluminum and hardened insulation board end plates. Adjustable stainless steel latches keep the furnace halves locked together during use, but are then easily opened once testing is complete.

Principle of Operation

The resistance wire is wound on to recrystallized alumina tube in three independent zones to form the furnace element. This three-zone format allows the user to tailor the furnace temperature gradient, creating a uniform central zone. High-performance ceramic fiber insulation is used to reduce heat losses and provide fast heating rates. The specimen is heated through a combination of convection and radiation, dependent on the test temperature.

Main Specifications

Name	Specifications	
Furnace	Operating temperature	+300 to 1200°C;
	Specimen temperature range	+300 to 1000°C
	Temp. Accuracy	0.1°C
	Temp. Fluctuation	≤600°C: ±3°C 600~900°C: ±4°C >900°C: ±5°C
	Temp. Gradients	<15°C
	Temperature of furnace shell	<50°C
	Effective heating zone(mm)	>50mm
Heating element	Heating by Kanthal-AF electrical resistance with long working life and easy for changing, hot air recycling	
Temperature controller	With multiple segment programmable functions with RS-485 data communication interface	
Thermocouple	3 pcs of K type thermocouples with cold junction auto compensation and error of compensation less than 0.5°C	
Mounting mode	This furnace is mounted on frame and can be positioned and moved horizontally	

Self-tuning digital temperature controllers

Temperature control systems are designed for controlling the heat output of furnaces, chambers and ovens.

The systems may be configured for use with either a manual or automatic gradient adjustment. The control systems are compatible with all furnace systems offered as new equipment, and can be configured to operate nearly any furnace, chamber, or oven with any one of several different thermocouple types. Three-zone control systems are designed for heat-only furnaces with three separate zones of heating elements, and typically three different thermocouples to control those zones.

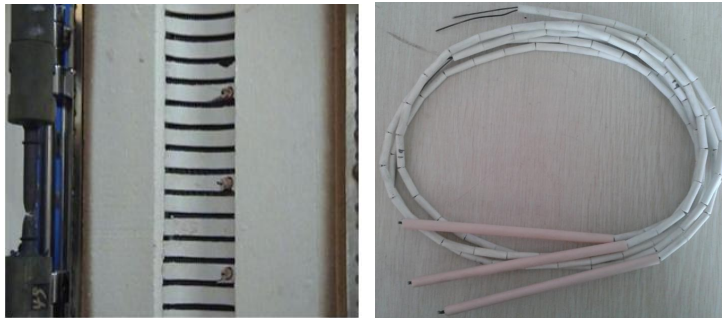
Typical systems consist of three controllers. Each controller independently controls the temperature of a furnace/chamber zone. Automatically controlled systems allow the user to program a set-point or test temperature, and the controller controls a zero-cross fired SCR to control the current to each zone. Manual systems use a single controller for temperature indication and control, while allowing the operator to adjust the gradient to each zone through use of three power-positioning potentiometers. Standard systems use Type-K thermocouples to monitor temperature either from the furnace wall or attached to the specimen.

Thermocouples:

Specimen monitoring thermocouples are used to provide the most accurate indication of the specimen temperature. A thermocouple consists of two dissimilar metals, joined together at one end, which produce a small voltage at a given temperature. When the thermocouple is heated, the voltage produced is approximately linear with temperature. Specimen monitoring thermocouples are either welded to the specimen or tied to the specimen using wire of the same material as one of the two leads of the thermocouple.

Most furnaces and chambers can be configured to be controlled by one, two or three specimen thermocouples depending on the control system used.

Selection of the thermocouple type is also dependent on the thermocouple measuring circuit. Proper wire and connectors must be used to maintain the accuracy of the thermocouples themselves.



Below photos are for reference:





