

# Computer Testing System for Pumps

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## Abstract

Computer testing system for pumps is an automatic measuring and testing system by micro computer. There are two functions to this system:

1. Automatically controlling the testing processes. It includes controlling to testing devices, adjusting test points and starting or stopping the pump.
2. Automatically collecting and calculating the testing data. It includes the collection and calculation of the parameters to be measured, printing the testing reports and plotting the testing curves.

When using it the measuring accuracy may be improved and the time for testing may be compressed by use the system. So it is used widely on the world.

In this paper the basic construction and the work principle and the testing processes are described.

Key Word: Pump, Computer, Test, Measure, System

## Introduction

The testing for water pumps has very important position in its theory research and products designs. The application of the computer technology will take place a larger effect on the increase measuring accuracy and reduce number of testers and compressing the test time.

Since 1970, the research how to use computer technology in the pump tests has been doing in China. Today it is already solved successfully. The computer technologies have been applied widely in the manufactory and the theory researches and testing of water pumps. Now the automatic testing system, as complete sets of the equipment, has been provided to the pump's manufactory.

In the paper a typical automatically testing system in China — the PMS comprehensive testing system for water pumps will take for example. Its

configuration and functions and work principle and testing processes and test data procedure and etc. will be described

## **Constitution of the system**

The PMS comprehensive testing system for water pumps is used to check and acceptance tests for water pumps in the laboratory. The system is provided by Chinese Academy of Agricultural Mechanization Seines. It conforms to the international standard of ISO 3555-B class.

The system is comprised of a micro computer, display unit, printer, plotter, disk drive and two diskettes drives, sensors, instruments, the interface and software. It has two types— the open loop and the close loop. See the figure 1 and table 1 and table 2 and table 3.

The application programs of the computer make the testing system complete the various tests step by step. The programs are written by C or QBASIC languages.

The programs can be divided into three parts:

1. The set-up program is used to input the test conditions and rated parameters of the pump by key board.
2. The controlled program includes starting and stopping the pump to be tested, adjusting the test points and collecting the measured data.
3. The processing program includes calculating the tested data, plotting the tested curves and printing the tested reports.

## **Major technical specifications**

The applicability:

The 'PMS system ' is applicable to test for submersible pumps, deep well pumps, centrifugal pumps, mixed flow pumps and axial flow pumps in the laboratory.

The test items :

They are the performance test and the net positive suction head test of the pumps.

The unload test, the load test, the test of the temperature rise and the lock torque test of the motors.

The functions:

Control the test processes automatically.

Collect and calculate the test data automatically.

Print test reports and draw test curves

Analyze testing errors.

The measured parameters and the ranges: (See the table 1).

The measured total error:  $\leq \pm 1.1\%$

## **Work principle of the system and the basic test procedure**

486 micro computer is the center of the testing system. It controls the test procedure through the interface. Between the computer and the interface the command and data are conversed by the series communication interface RS-232.

The computer converses the information with the tester, records and save the test data and plot the test curves and print the test reports by the various devices.

The computer collects the test data through the interface, instruments and sensors. The computer controls the test procedure. The switch odder is changed into the action of the test devices from switch circuit board to silicon symmetrical switches or from D/A digital-analog conversion circuit board to controlled current or controlled voltage.

The test procedure is divided into the four periods:

### 1. The prepare period

In this period the rated parameters of the pump, the test item and conditions are input the computer by the key board.

### 2. The starting period

In this period the pump to be tested is turn around. The test system adjusts the valve to make the pump work under the rated flowrate.

### 3. The testing period

In this period the computer adjusts automatically test points from the zero point to a larger flowrate for the centrifuge pump or from a larger flowrate to a smaller flowrate for the mixed and axial pumps.

To every test point the computer sends the control commands of adjusting flowrate, then the valve is adjusted until the flowrate of the pump is in the required value. Then the computer sends the collecting command. After the test data is collected and calculated by the interface, it is transferred to the computer. The computer calculates and compare the test data simply, then save them into the disk and display them on the CRT.

### 4. Processing the data period

In this period the computer executes the processing program. The calculation test data, drawing the test curves, printing the test report will be completed.

## **Major specifications of the automatic testing system for water pumps in industry**

In China there are many water pump factories. Product's types and the test beds for water pumps are also difference, for example, there are the centrifugal pumps and the axial flow pumps and the deep well pumps and the submersible pumps and etc. There are the open test bed and close test bed. To different pump and test bed the parameters to be measured and test method to be used are also different. Therefore, the automatic testing system of water pumps to be used in industry must satisfy these different requires. Its major specifications are:

1. In the configuration of the hardware a mold construction as an “instrument--total line interface--micro computer” is applied. Its advantages are the system's functions and the measuring ranges are variable with different requires. It is very easy to expend and replace and maintain to the system. The same times , the calibrations of the system are very convenient. So that it is quarantined ,that the accuracy of the measured data may be trace to source.
2. The system should work very reliably. So it is applied in the circuit board design, that are various methods against interference, for example, the light-coupled circuit and locking signal circuit and etc.
3. The design method of the mold and construction is applied in the software.

A general data flow diagram of the program is in the figure 2. The tester-computer interactive dialog mode is applied in the software. All testing processes may be completed very easy according to the prompt in the dialog box of the screen. In the figure 3 a procedure flow diagram for typical testing processes of the PMS system is given. Various algorithms are included in the processes of the tested data of the pumps. There are the least-squares fit, spline fit and parabolic interpolation and statistics and etc.

Because these methods are applied so that the test errors and the curve fit errors may be reduced greatly and testing accuracy may be increased.

The PMS comprehensive testing system for water pumps is a typical test system for various vane pumps, which have above specifications. Now it has applied widely in the factory and institute of China.

## Conclusions

1. The automatic measuring and testing system for water pumps applies the computer technology in the production and the acceptance tests of the pumps. It may increase the test accuracy and compress the test period and reduce the number of the testers. So it is an advantage measuring and testing system.
2. It is recommend, that The automatic measuring and testing system for water pumps applies the mold constructions in the configuration of the hardware and the design of the software. So that It is very easy to expend and replace and maintain to the system.
3. The automatic measuring and testing system for water pumps is a measuring equipment. So the accuracy of the measuring results is very important for this system. In the design of the system it is considerable that the accuracy of the sensors an the instruments must be trace to source.
4. The PMS comprehensive testing system for water pumps is an advantage measuring and testing system. It can meet to various requires of the production in industry. It is used to check and acceptance tests for water pumps in the laboratory. Now it has applied widely in the factory and institute of China.

Table 1. The basic constitution of the computer and the interface

The micro computer system	The interface
the computer: IBM CPU: 80486 the communication interface : RS-232 the disk driver: > 500 M the diskette driver: 1.44M and 1.2M the printer: 24 dot or laser jet printer the plotter: 3#	Z80 CPU circuit board The circuit boards for the collection data The circuit boards for the control The power supply of the interface

Table 2 The measured parameters and ranges of the system

The measured parameters	measured ranges	note
voltage	0 ~ 500 V AC	The ranges are determined on the sensors used
current	0 ~ 5 A AC	
input power	1 ~ 500 V, 0 ~ 5 A AC	
frequency	50 or 60 Hz	
flowrate	0 ~ m <sup>3</sup> /h	
head	0 ~ MPa	
torque	0 ~ N.m	
rotary speed	0 ~ 3000 r/min.	
temperature of water	0 ~ 50 °C	
resistance	0 ~ 20 Ω	

Table 3 The sensors and instruments of the PMS system

parameters	sensors and instruments	accuracy (%)
the flowrate	LWGY turbo-flowmeters + ZN-A digital instrument	± 0.5
the pressure	1151 pressure transmitters + ZN-810 digital instrument	± 0.2
the rotary speed	light activated or electromagnetic sensor + ZN-C digital instrument	± 0.1
the torque	JC electromagnetic sensor + ZN-900 digital instrument	± 0.5
the input power and the voltage and the current	transmitters + digital instruments or ZN-2500 digital power meters	± 0.5
the resistance and the temperature	ZN-RT digital ohm & temperature meter	± 0.1

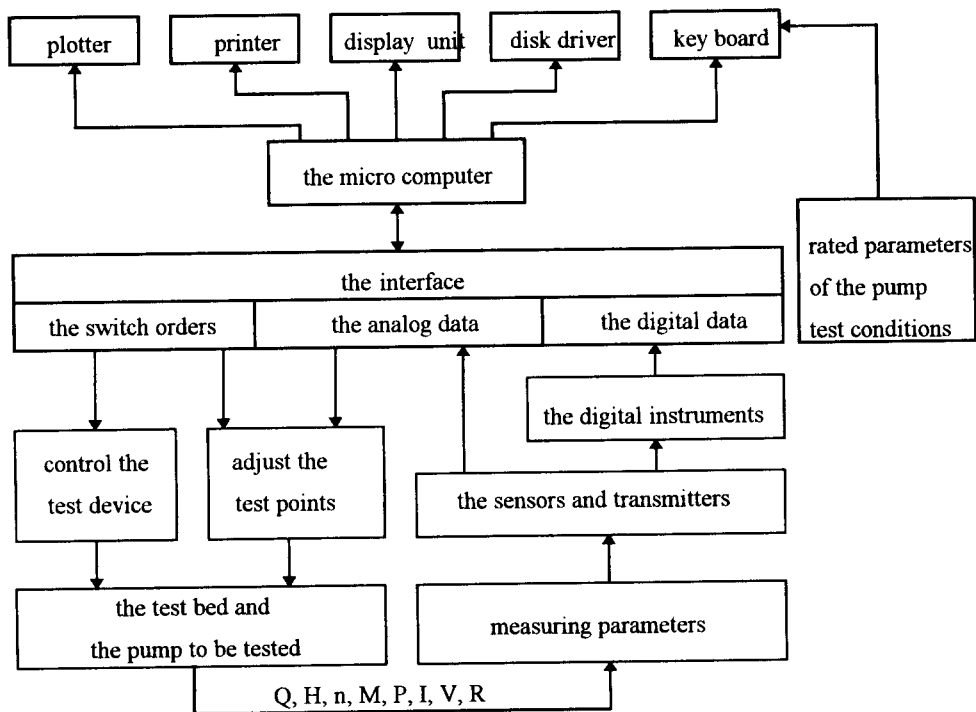


Fig. 1 The dispose diagram of the system

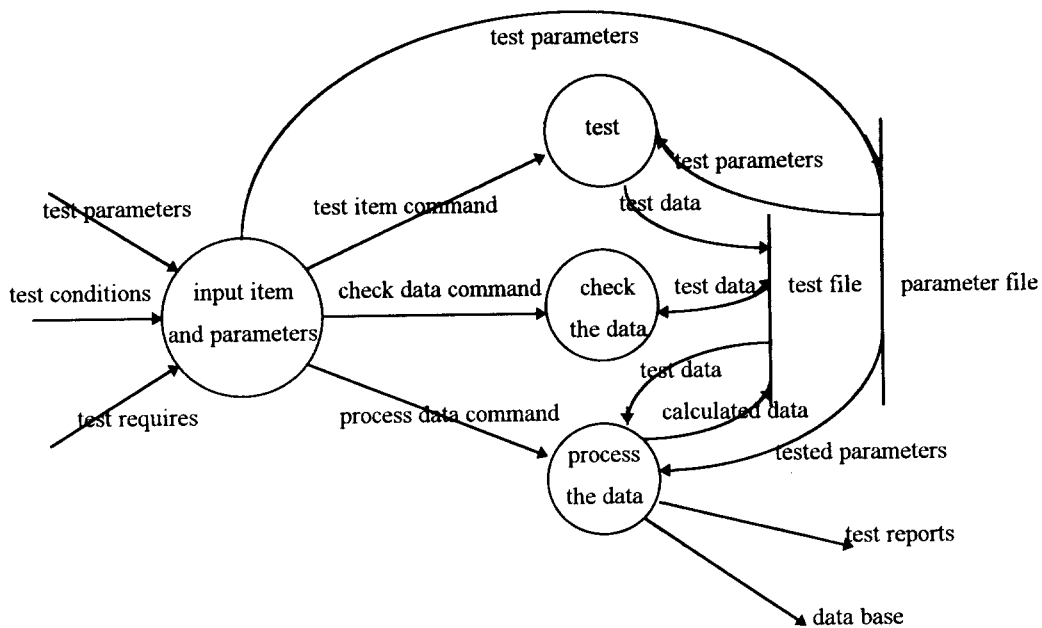


Fig. 2 The data flow diagram of the program

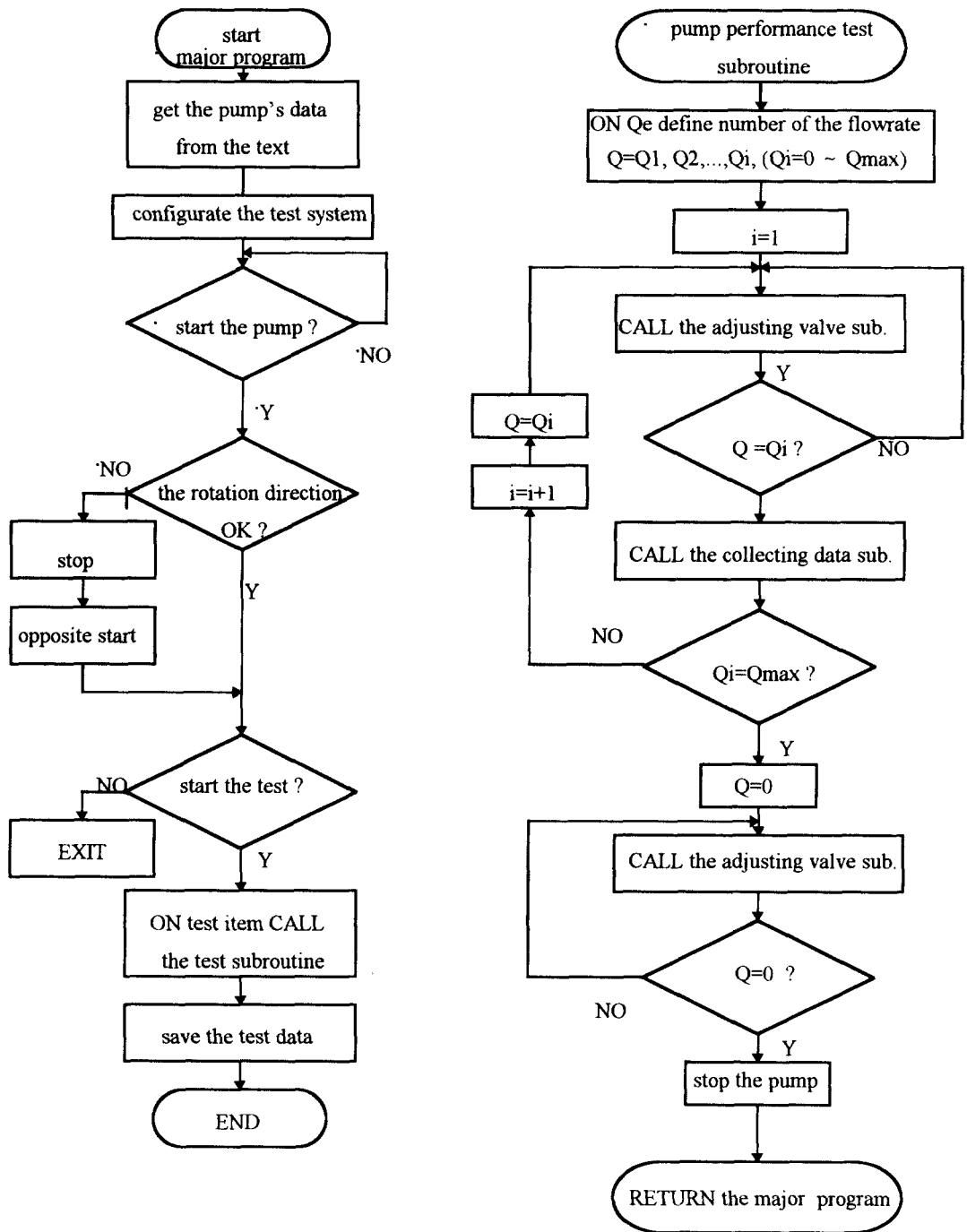


Fig. 3 The flow diagram for typical testing processes of the PMS system



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