CCU (COMBINED CONTROL UNIT) TEST RIG

INTRODUCTION

The Test rig is used for testing servo hydraulic actuator. It used for testing helicopter and fighter plane components. It is fully computerized system with the software which can control up to 120 testing sequence. There is also custom built report generation system. It can Test any servo hydraulic actuator used in aviation. It can perform following test:

- ▸ Frequency response Analysis.
- ▸ Simulate any load and profile for displacements.
- ▸ Measure cyclic test.

BASIC TEST RIG FEATURES:

The Key features of the Test Rig are:

- Ease of Operation
- User Friendliness
- Safety
- Ease of Maintenance
- Automatic & Manual Mode of Operation
- Automatic Report Generation/ Data Storage

The Test Rig is Fully Automated. The complete Test Schedule of the Test Components (Both **KAY-30B, PA-60B)** is implemented in the software and Test is automatically conducted step by step.

On the completion of the Test, Customized report is automatically generated.

Operator intervention is very minimal and limited to adjustments etc. only.
Test Rig can also be operated in Manual Mode, without any software control.

BASIC TEST RIG SPECIFICATIONS:

S. No.	Parameter	Range/Value
1	Working Fluid	Hydraulic Oil AMR-10-GOST.6754-53
2	Maximum Pressure which can be built up in the System	80 Kg/Cm^2
3	Working Pressure	60 - 65 Kg/Cm^2 in Check Mode
		42 - 73 Kg/Cm^2 in Functional Mode
4	Return Back Pressure	5 - 7 Kg/Cm^2
5	Hydraulic Fluid Temperature	Up to 80^0 C
6	Permissible Contamination Level	Up to count 12 of NAS 1638
7	Accumulator Nitrogen Pressure	30+/- 2 Kg/Cm^2
8	Leakage Measurement Range	0-2000 cc
9	Electric Motor Detail	10 kW, 1460 RPM, 3 Phase
10	Operating Principle	Software Controlled Hydro-Electro-Mechanical
11	Loading Springs Performance	
	For P$_{max}$	1850 Kg (K= 45, 62, 5 Kg/mm)
	For Running in Test	1500 Kg (K= 27, 42 Kg/mm)
12	Cooling	Chilled Water
13	Heating	Automatically through the Pump flow over Relief
14	Hydraulic System	Main System & Duplicate System

APPLICATION

- Testing and Adjusting of Combined Control Unit of MI8 Helicopter.

- The Test Rig is for carrying out acceptance, control & periodic test of Servo Units KAY-30B, PA-60B according to the specific Test Schedules of the components

TEST RIG LAYOUT & MAIN COMPONENTS

The complete Test Rig comprises of the following Sub Systems:

1. Hydraulics System
2. Mechanical System
3. Electronics, Instrumentation & Electrical System
4. DAS, Software & Control System

The Test Rig shall be installed in three parts:

1. Hydraulic Panel with Drip Tray & Work Bench
2. Hydraulic Power Pack which will be kept away from the Item-1 above.
3. Electronics/DAS Industrial Cabinet.

Hydraulics System:

Hydraulic System is as per the Hydraulics Circuit Diagram & Hydraulics Bill of Material.

It consists of **identical** Main System & Duplicate System. The System consists of a SS Test Panel with Drip Tray. Control apparatus, Levers, Hydraulic Supply/ Return Ports are mounted on this Panel. Measurement Gauges for Manual Testing are installed on the Panel.

The Drip Tray/Test Table/Test Panel has drawers on both sides for the operators to keep Fittings/ Spares/ Hydraulic Connectors/ Plugs and other necessities needed to connect the Test Rig Equipment's/ Components.

The Power Pack of the Hydraulic System is kept separate from the Test Panel to avoid Noise/ Vibration and related disturbances during the Testing.

Basic features of the Hydraulic System are as follows:
- All Tubing/ Fittings are of Compression Type & certified material SS 316 only.
- All wetted part of Hydraulic System is of SS 316 only.
- For all Connections (of the Test Components) with the Test panel SS 316 QCDC are provided on the Test Panel.
- Sampling Ports are provided for connecting Oil Quality Measuring Instruments.
- All Measuring Instruments/ Gauges have In Situ Calibration facility through Ports.
- All Selector valves are automatic and can be operated manually as well.

Hydraulic System Details:

The Pump Station, SS Tank with its accessories and Heat Exchanger of the Test Rig will be installed in the Hydraulic Bay located at one side of the room (may be in another room separated by a wall). The maximum distance between the Hydraulic Bay and control panel would be 10-30 meters approx. All electrical switchgears for the pumping station would also be placed near it in an enclosed steel cabinet (M.C.C). The SS 316 Hydraulic piping for these Pump Stations shall be brought to the Main Test Panel where all the Hydraulic components like Filter Banks, Valves, Accumulators etc., will be housed at the bottom.

1) **Hydraulic Operating Panel:**

    All Mechanical valves, controllers, bulkhead adaptors etc., for both the system will be located on this panel.

    Indicating panel is located on the top of this front control panel. All the indicating instruments viz., Pressure, Temperature etc., will be housed in it. The measuring flask where the working fluid will be physically passing can be housed at the middle and just above the hydraulic operating panel.

2) **Drip Tray:**

    Drip Tray of approx. size of 1800 mm X 500 mm X 50 mm depth will be located just below Hydraulic Operating Panel. The units to be tested will be kept on the tray with the mechanical fixtures and will be connected to bulkhead adaptor of the rig through flexible hose with QCDC. The top of the tray will be of stainless steel perforated sheet and will have drain valve at the bottom.

Mechanical System

Mechanical System consists of the Test Bench & Loading Springs for Load Generation as per the Test requirements.

The Test Unit mounting fixtures shall be attached at the Test Table (Above the Drip Tray).

Load Cells & LVDT (for displacement measurement) is provided for the measurements.

Electronics, Instrumentation & Electrical System:

The Test Rig is fully automated and also operates manually. To take care of the above detailed instrumentation is instrumented.

Parameters, which are to be controlled, measured and recorded in the Test Rig are - Pressure, Leak Rate and Temperature of operating fluid.
Load, Displacement is also to be me measured & recorded.

- Flow Rate (Leakage) of the working fluid is to be measured by digital flow indicator and the indication should be in cc/Min.

- Temperature of the working fluid at inlet and outlet of unit, at the heat exchanger is to be measured by Digital Temperature Indicator and the indication should in °C.

- Level of operating fluid in Tank of Test Rig is inspected visually on level indicator and Level Switches are provided for Low Level & High Level Indication.

- All Filters have Electrical Clogging Indication at the Panel.

- Load Measurement.

- Displacement Measurement.

- **Pressure Measurement and Control**

  Pressure shall be measured by Digital Pressure Indicator and through a Pressure Transducer. The pressure so measured is to be connected to the DAS also. Suitable snubber shall be provided before transducer to arrest pressure pulsation during measurement.

  Suitable Remote Controlled Pilot Operated Proportional Pressure Control Valves shall be provided for automatic Pressure Controls of the pressure in the system. Suitable adjustable pressure relief valves are to be provided in main line as well as in drain line.

  Pump shall be provided with automatic Pressure & flow control features built in it.

DAS, Software & Control System:

The Complete Test Sequence for both the Test Components shall be implemented in the software.

Basic Features of the software is given below:

The Software Screens/ Reports are customized as per the user requirement.

The customized software is developed on Lab View 8.1. The key specifications of the software are as follows:

The graphical application development software used in this application should have the following features.

a) The programming language uses icons instead of lines of text to create application. The application development should use data flow programming, where the flow of data determines execution in contrast to the text based programming language where instructions determine program execution.

b) There is a provision to build a 3D user interface by using a set of tools and objects.

c) The software is integrated fully for communication with hardware such as GPIB, VXI, PXI, RS-232, RS-485 and plug in DAQ device with the technologies such as MITE, PGIA, and STC etc.

d) The software has built in feature for connecting the application to the web using Web Server & software standards such as TCP/IP, Data Socket, DLL, and SQL. Networking and Active X.

e) The software has a true 32 bit compiler for faster execution of the application

f) The software has a profile window as a tool for analyzing as to how the application uses the execution time as well as the memory so that the areas can be identified for optimization.

g) The software will provide DAQ solution wizard for quick start up. The software should execute with multithreading features, de bugging features like break points, probes, single stepping modes, execution-highlighting etc.

Software Features

The Test Rig is fully computerized and the application software incorporates the basic minimum architecture as described below:

PC compatible hardware, COTS, Microsoft Windows 98 (or equal) Operating System, COTS

<u>SYSTEM OPERATION:</u>

The software function is basically categorized into two distinct modes of system operation.

- **System Maintenance Mode:** That includes calibration of sensors, system diagnostics, fault diagnostics etc
- **Test Part (UUT) Test Mode:** Test part Test Run mode during which the UUT – test part is undergoing the dynamic testing.

SYSTEM MAINTENANCE MODE:

The system maintenance mode comprises of certain functions that mainly consists of system setup routines. These routines are done either periodically (e.g.: calibration of sensors), or done on demand (e.g.: diagnostics, troubleshooting etc.).

SENSOR (TRANSDUCER) CALIBRATION:

The systems should allow calibration which includes Analog Input/Output and frequency Input / Output. In this mode, all sensors – pressure transducers, Load Cells, Displacement Transducers, flow meters, temperature sensors, etc. – are calibrated and stored in respective tables for use in the test run mode.

SYSTEM DIAGNOSTICS:

The software allows the user to perform System Diagnostics, Fault Isolation and Correction. The Fault Isolation will be done in a computer assisted mode – where various stimuli can be actuated and the responses displayed by the computer - or in a manual mode – where the application of stimuli is done by manual switches and the computer displaying the responses. This function is available for all the Data Acquisition points including Analog, Digital and Frequency Inputs/Outputs, Waveform generators, etc.

TEST RIG DIAGNOSTICS / TROUBLESHOOTING:

The Test Rig software allows the user to perform Diagnostics. It will enable the user to troubleshoot Analog and Digital Input / Outputs. When the test stand power is ON and the diagnostics mode is selected and Analog Input option is chosen, all applicable parameters shall be continuously monitored, measured and displayed in terms of volts, binary counts and engineering values.

TEST PART (UUT) TEST MODE:

This is the Main System Operation Mode. This function will encompass all the Run Time operations. This function is re-configurable and gives the user flexibility and operational efficiency:

AUTOMATIC MODE:

The operator is able to select a test part (UUT) from the 17" TFT TOUCH SCREEN Menu. The operator enters the applicable UUT serial number. The test stand 17" TFT TOUCH SCREEN will present the operator with various test paragraphs applicable to the selected UUT. The operator is able to select the test paragraphs in the order he wishes to test the UUT. Test Actions corresponding to each test paragraph are conducted automatically without any operator input for set points or for accept/reject. All sub-systems function in unison to achieve the required performance.

The software is single executable a state-of-the-art, user friendly, FAA friendly software and must work with standard PCs and operates under all versions of Windows and their natural successors with or without expensive peripherals and should follow all rules necessary to maintain full upward compatibility with future PCs and operating systems.

The software supports test stand operation in Fully Automatic and Manual modes.

The software supports at least 16 levels of password protection to enable various levels of authority and access to operation, programming, safety protection, and reconfiguration. The command structure shall be based on Standard English using standard Excel type spreadsheets for implementing test code.
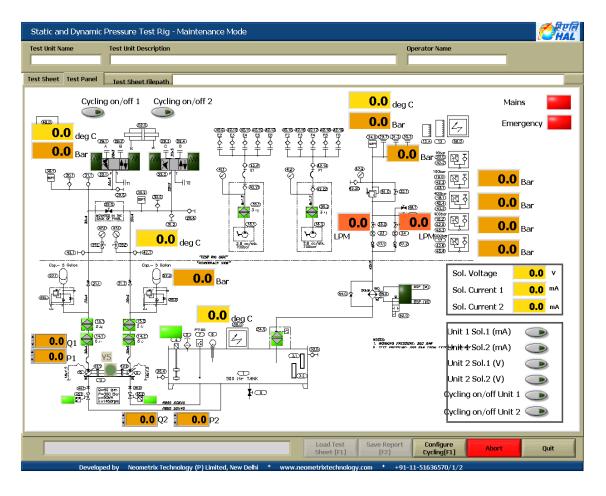
The software is user-friendly, color graphic, point-and-click operations and conforms to PC/Windows technology for easy operator training. It provides on-screen messages

provides on-screen messages and prompts so to make the test an interactive process further minimizing training needs. It supports up to two color displays, allowing simultaneous reading of test set point and measured test data.

Unit protection functions are built in. Each set point and measured parameter shall be checked continuously for safe operating range. The Protection set points allow three levels of action:

Some Indicative Software Screens (Not of this system) are given below for reference

Test Rig Software: Test Rig: Maintenance Mode
A typical Maintenance screen looks like the one below (This is an example taken from some other project)

Test Rig Software: Test Part (UUT) Test Mode
(This is an example taken from some other project)