INDIAN ADVANCED LIGHT HELICOPTER SPECIAL TEST INSTRUMENTATION

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1.0 Introduction

Flight Testing of the Advanced Light Helicopter (ALH) is being carried out with Test Instrumentation engineered around a Pulse Code Modulation (PCM) system. On-board magnetic tape recording for around 200 parameters and Telemetry for Tele-surveillance are part of the test package. While this is a standard configuration throughout the test phase, additional instrumentation is carried out to perform special tests on a need basis. In-flight testing of DC generators and Alternators is one of the special test conducted on ALH. DC load banks and AC load banks were designed, built and used for in-flight loading. Position Error Correction Measurements (PEC) were carried by employing true total pressure probe and static trailing bomb . Antenna radiation pattern measurements were carried out on-board in real time employing special instrumentation. A gadget with floatation switches was employed to evaluate the performance of a radar altimeter over water. Non-contact torque measurement was carried out to measure torque on the tail drive shaft. Electronic scanning system was employed to measure the air inlet distortion in engine compressor face. DGPS was employed to establish HV diagram and to evaluate CAT 'A' and CAT 'B' performance. This paper describes the instrumentation employed to carry out these special tests required for certification of the Advanced Light Helicopter.

2.0 Load Banks

The D.C. generators on the helicopter are to be loaded in flight to the tune of 400 amperes to evaluate the performance of the generator under various flight conditions. Load banks have been built using low value high wattage resistors. High current relay switching has been resorted to. The load banks have been aesthetically engineered for fitment on the skids of the helicopter. The D.C. load banks installed on the helicopter skid is given in Fig. 1. The load banks were installed on the ALH and the generator tests have been successfully completed.

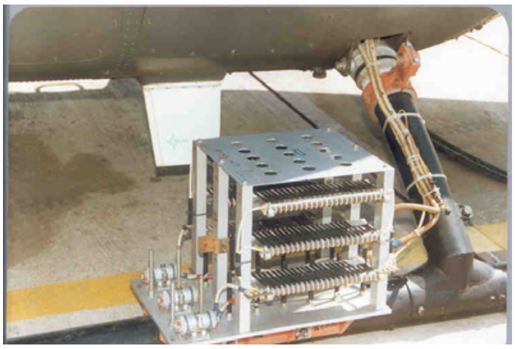

Fig.1.D.C. Load Bank

Like the D.C. generator, A.C. generator are to be loaded to their maximum. rating typically 10KVA and tested in flight. Load banks have been built using 1KW weather proof halogen lamps. These banks have been built to fit onto the skids of the helicopter. Relays are introduced in the electrical circuit to load the generator in steps. The picture of helicopter flying with the A.C.load banks is shown at Fig. 2.

The A.C generator tests have been successfully completed on ALH.

Fig.2. A.C. Load Bank

3.0 Position Error Correction (PEC) Evaluation System

The errors in the sensing of static and pitot pressures by the helicopter pitot-static probe needs to be measured. A block diagram of the system is given in Fig. 3.

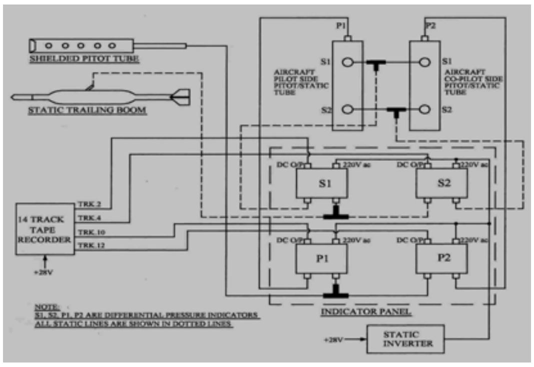

Fig.3.Block Diagram Of PEC System,

Evaluation of the errors boils down to measurement of the pressure differentials between true static pressure and helicopter sensor static pressure as well as true pitot pressure and helicopter sensor pitot pressure. To measure the true static pressure, a static Trailing bomb was designed and fabricated at HAL. The true pitot pressure was measured using a Rosemount high accuracy True pitot probe.

Low pressure gauges with precision digital display were deployed for obtaining the pressure differentials. The gauge also provides electrical output for recording 50 mbs and less. During the test, the static trailing bomb was hung from the helicopter at the depth of 100 feet to measure free undisturbed airflow static pressure. The true pitot was installed on the long boom tip outside the rotor downwash in the free smooth flow environment. Fig.4 shows the helicopter with the instrumented probes.

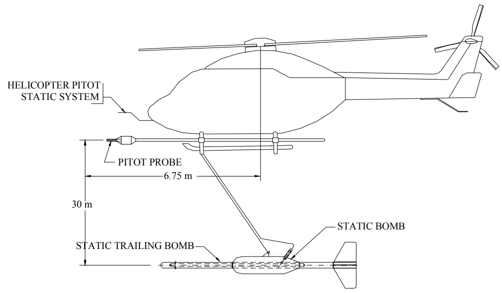

Fig.4. Instrumented ALH for PEC

4.0 On-Board Antenna Pattern Measurement system

Suitability and position of the antenna on-board the helicopter needs to be ascertained. This is being done by measuring the radiation pattern of the antenna. A system has been developed to obtain the antenna pattern in flight. A ground RF set radiates energy at selectable frequencies. On-board a receiver is connected to the antenna under test. The receiver provides the signal strength. A signal conditioner developed in-house takes Receiver output and Heading information and provides Sine and Cosine components of the signal. The data is fed to a XY plotter and the polar plot of the antenna is obtained in real time when the helicopter makes a complete rotation from 0 to 360°.

5.0 Hover Aid Over Water

Radalt assessment over water was done with a float switch mechanism. Float switch mechanism comprises two float switches separated by one feet in vertical height and housed inside a cylindrical casing open at both ends. These switches are coupled to two lamps in the cockpit. The lamps come ON corresponding to the switches that come into contact with the water. The helicopter is made to hover such that lower level switch is 'ON' and upper level switch is OFF. The gadget is depicted in Fig.5. The Helicopter hovering with the gadget is shown at Fig.6.

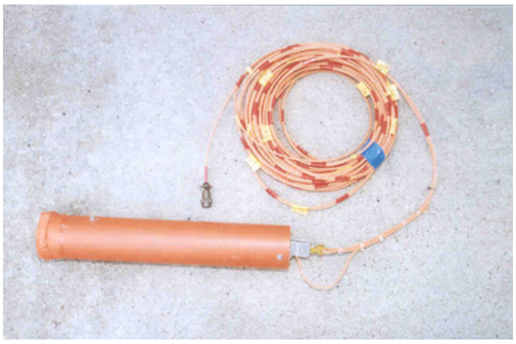

Fig.5. Hover Gadget

Fig.6. Helicopter With Hover Gadget

6.0 Non-contact torque measurement

The Tail Drive shaft was instrumented with strain gauges. A miniature signal conditioner was installed on this rotating shaft. An RF link was established for data transfer as well as for power supply transfer. The system worked satisfactorily. A picture is given in Fig.7.

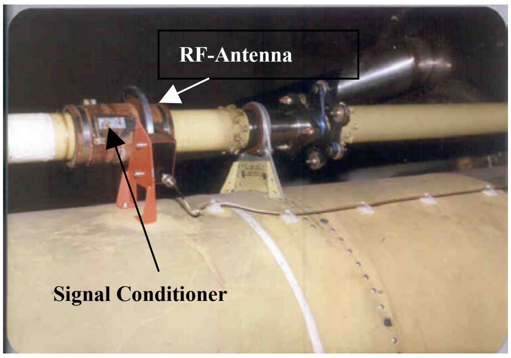

Fig.7. Non Contact Torque Measurement System

7.0 Air –inlet Distortion Measurement

An electronic pressure scanner with calibration facility was used for this measurement. Special purpose hardware to control the scanner was indigenously developed and successfully deployed during ALH flight-testing to measure the Air-inlet Distortion in front of the engine compressor face.

8.0 Differential GPS

Differential (DGPS) was employed successfully to carryout important and critical helicopter performance flights. While DGPS can be used for a variety of applications, it was primarily used in our programme to establish the H-V diagram and to evaluate the Take-off and Landing distance measurements for CAT 'A' & CAT 'B' performance. The DGPS system has an airborne segment and a ground GPS segment.

The ground segment was transmitting the error components in longitude, latitude and height parameters to the Helicopter. The corrected values were relayed back to the ground from the Helicopter. Special software has been developed to display and generate the helicopter height, velocity, distance with time plots as well as cross plots.

9.0 Conclusion

Flight Testing of ALH is being carried out with an instrumentation package built around a PCM system coupled with an On-board recorder and telemetry. Special instrumentation is necessary to conduct unique tests. These gadgets were designed, developed and built in-house resulting in cost and time benefits which are vital parameters in the development of any new programme.