



Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE INFORMATION REPORT

AIR 1155

Issued March 1973
Revised

AIRBORNE MONITORING OF COMMERCIAL TRANSPORT AIRCRAFT FLUID SYSTEM AND EQUIPMENT PERFORMANCE

1. PURPOSE AND SCOPE

To report on the justification, objectives and the progress of major development programs in the USA for airborne monitoring of commercial transport aircraft fluid systems and component equipment performance.

2. FAULT DETECTION METHODS

Aircraft maintenance has, since its conception, relied primarily on two methods of fault detection and isolation:

1. In-flight observation and reporting by flight personnel.
2. Ground operation or testing of airborne systems and equipment.

Both methods, even when combined to the optimum, are not always sufficient to determine the exact cause of trouble or locate a defective component.

A third method commonly known as AIDS (Aircraft Integrated Data System) analyzes airborne system's performance through various techniques of multi-parameter sampling. It has recently come into the picture and is showing significant promise for advancing the state-of-the-art in improved aircraft maintenance. Benefits of this newer method not only include detection and isolation of defective units or components, but the ability to predict impending malfunctions.

3. HYDRAULIC SYSTEM MONITORING INSTALLATION - TYPICAL

An example of a specific airborne hydraulic system and equipment monitoring and data collection system being incorporated in the design of a present day commercial jet transport aircraft is the Lockheed L1011 AIDS installation. Herein, the system and equipment performance will be compiled and analyzed from the collection of specific data relating the pressure, flow, time, position and miscellaneous quantitative measurements.

The following measurements of hydraulic system and components operation in the L1011 aircraft will be the primary parameters being collected for adjudging the performance level:

- a. Hydraulic System Pressure
- b. Hydraulic Pump Case Drain Flow
- c. Hydraulic Pump Case Drain Temperature
- d. Hydraulic Metered Pressure From Brake System
- e. Hydraulic Return Flow From All Power Flight Control Assemblies
- f. Nose Gear Steering
- g. Landing Gear In-Transit Time (Mains and Nose)

REAFFIRMED

JUL '92

CANCELLED

Aug. 1992



Documents

3. (Continued)

Suggested alternate measurements of system performance to supplement the primary data parameters in any commercial jet transport aircraft would include the following:

- a. Hydraulic Return Flow Temperature From Power Flight Control Assemblies
- b. Fluid Reservoir Quantity
- c. Fluid Reservoir Temperature
- d. Motorpump Electrical Current
- e. Engine Hydraulic Pump Case Drain Flow

The data collection of all parameters should be correlated with the aircraft's specific operational details such as altitude, flight speed, date, time and outside air temperature. Comparison of the hydraulic system/equipment data with predetermined maximum-minimum limits will develop an expeditious analysis of their performance and the degree of corrective action necessary to return a malfunctioning system or component to an acceptable operational level.

4. AIRBORNE MONITORING SYSTEM DEVELOPMENTS

- 4.1 Background: Non-routine aircraft maintenance is primarily concerned with performance. Its associated effort can be broken down into four areas of endeavor:

1. Establishing the fact that a malfunction or out-of-limit situation actually occurred.
2. Isolating the deficiency in system performance to a particular unit or aircraft component.
3. Replacing the defective unit or component.
4. Verifying that normal operation has been restored.

Improvements in aircraft maintenance techniques such as use of the subject system or component malfunction detection devices have the objectives of (1) assuring improved operational reliability, (2) reducing the time, cost and/or frequency of at least one of the aforementioned endeavors, and (3) developing a significant degree of operational economies by reducing the aircraft out-of-service time.

- 4.2 Power Plant Performance Monitoring: Development programs were inaugurated in the early 1960's principally for in-flight multi-parameter sampling of power plant operating performance. Since jet aircraft instrumentation already included a large number of sensors and transducers for engine and systems performance indication and measurement, it was relatively easy to connect the original design recorder systems in parallel with the existing aircraft instrumentation to collect the desired performance data.

Typical on-board instrumentation sensors and transducers that provided performance data for the original system designs were measurements of pressure, pressure ratio, position and indicators of speed, flow, temperature and fluid quantities.

- 4.3 Data Collection and Analysis Developments: Development of means to collect and analyze the recorded data for its end use in operational and maintenance needs are a necessary part of the overall monitoring system. Early programs utilized existing teletype and computer facilities to provide rapid transmission and analysis of the in-flight data once it had been collected on paper tape rolls or manually transcribed from the aircraft logbook data. Analysis of the data consisted mainly of comparing the recorded details with satisfactory operational limits for the equipment or system. The resulting corrective action was dictated by the results of the comparative data analysis.

- 4.4 Douglas DC-9 Monitoring System: The next evolutionary step for multi-parameter sampling and collection of equipment and system performance was inaugurated in January, 1966, on certain Douglas DC-9 aircraft. This installation supplemented the two-man flight crew by automatically sampling and recording engine and aircraft performance data during three flight modes: takeoff, climb, and cruise. This system has provided the building blocks for the more advanced systems being developed for future aircraft designs.