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CF-105

SYSTEMS MAINTENANCE

Report LOG/105/15

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1. INTRODUCTION

During the past months, the installation of the various components of the aircraft systems in the engine and duct bays has been carefully studied.

The frequent changes in equipment location which have been taking place up to now would have made any detailed analysis of maintenance problems somewhat premature, although several suggestions have been offered by this office and many have been adopted or are under consideration at the present time.

It now appears that the equipment installation is approaching its final form, and at this time, therefore, it has been decided to issue this report in order to record for all concerned such maintenance problems as this department has been so far able to foresee.

The conclusions reached in this report have been influenced to a certain extent by the many novel features of the C-105, e.g. the high pressures and temperatures in the hydraulic systems; the high temperatures anticipated in the equipment bays, the complete dependence of the pilot on the correct functioning of the hydraulic flying control systems; and the fact that much of the equipment is of new and untried design.

2. SYSTEMS

The systems with which this report is chiefly concerned are:-

(a) flying control hydraulics
(b) utility hydraulics
(c) fuel
(d) mechanical flying controls.

Detailed reports from the Design Department are available to those who may not be familiar with a particular system.

3. GENERAL MAINTENANCE

For the reasons given in (1) above, it is considered that for some considerable time after these aircraft go into service, all bays from Sta. 485 to 742 inclusive will be subject to daily inspection, for the purpose of checking compensator levels, pressure gauges, security of the many heavy components, and filters will be examined and functional checks will be made. At other times, components will have to be removed for bench tests, life-expiry replacement, or because of failure in operation.

3.1 Removal of Components

Recent observation appears to indicate that there is no component which cannot be removed through the various access doors provided, if sufficient time is available. However, the table attached to this report shows cases where it is not at present possible to remove one component without first removing another one. There is also a case where fuel lines have to be broken down in order to remove a hydraulic component. (Item C, Table)

Functional checks will indicate faulty components, and it will then be a question of time. This Office intends to ascertain times involved in the removal of components, as soon as engine shrouds or dummy shrouds are in place. With no shrouds, it is easy to take unwitting advantage of work-spaces which will eventually be unavailable.

In this connection, it should be remembered that the removal of one component in order to reach another greatly increases the probability of creating more trouble, e.g. leaks, admission of air and dirt.

3.2 Inspection

Visual inspection of components is reasonably good, except in some instances. The bank of pulleys at Sta. 621 on the bottom skin of the wing is not accessible from any door, in fact the pulleys are scarcely visible. It must be possible to feel cables to check for sufficient failure, and in this case it would be necessary to remove the forward flying control compensator to do this. Since control-cable inspections will in all probability be carried out at not longer than 25 hour intervals, this inaccessibility is considered unacceptable.

The main engine-bleed air-conditioning lines are completely inaccessible without first removing the engine shrouds. Fast warm-up from a possible -65°F to -900°F are likely to cause trouble in these lines.

3.3 Trouble Shooting

Hydraulics - With complex systems of this type leaks will be inevitable. A check reveals that hydraulic leaks have been a constant source of trouble on the CF100. At 4000 p.s.i., a leak will probably cover with oil, the components and structure of at least one bay including the bottom skin of the wing and the fuselage sides behind the engine shrouds.

This poses the problem of how to locate a leak in such a confined space when everything in sight is covered with oil; and the impossibility of cleaning up the mess without extensive removal of components.

If the top portion of the shrouds is not removable, there will be oil covered sections that cannot be cleaned.

Fuel - Fuel leaks in the bottom skin of the wing and at fuel pipe connections are presumably to be expected from time to time. The same problem arises as described above. In the engine bay only a few small areas are accessible and from the engine shrouds outboard to the fuselage sides, no inspection or maintenance is possible.

Engine Mounts - The difficulty of inspecting engine mounts is discussed in memo ref. 3658/48/J to R. Nash.

Fire Extinguisher Bottles - In the case of an accidental discharge, the cleaning-up required on the structure and equipment proposes the same problem as described for the fuel and hydraulic leaks.

In addition, the replacement of the fire bottles, necessitates the removal of considerable equipment and piping (see accompanying table, para. E and F). Many cases are known, at the plant and in service, where the fire extinguishers were discharged accidentally. A more detailed investigation is being carried out on the fire extinguisher situation at the present time.

4. CONCLUSIONS

With the present layout, proper inspection, servicing, and maintenance in the area of the engine bay is not a practical proposition, and efforts to accomplish such duties will lead to greatly reduced aircraft serviceability. This opinion is held most strongly by this department.

5. RECOMMENDATIONS

A concerted effort should be made by all concerned to provide proper access in the area under consideration, either by a new study of equipment layout, or by arranging to have at least some portions of the engine shrouds made quickly removable.

While it is not considered too practical to have to remove an engine and remove a large number of shroud attachment screws in the event of a hydraulic or fuel leak, it at least provides an answer to this problem. The time factor envolved is the main penalty.

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TO REMOVE:	PROCEDURE:
A. Main flying control twin filter head	1. Disconnect and slacken off 15 hydraulic lines. 2. Remove 4 holding bolts from bracket.
B. Overboard drain sump	1. Disconnect and slacken off 5 hydraulic lines. 2. Unbolt bottom end of fuselage strut, and swing aside. (It will be necessary to support fuselage floor before this is done.) 3. Remove 2 tunnel vents. 4. Remove 4 holding bolts.
C. Rear flying control compensator	1. Disconnect and slacken off 6 hydraulic lines. 2. Remove 2 fuel lines (Press) 3. Remove 2 tunnel vents. 4. Unbolt bottom end of fuselage strut, and swing aside. (It will be necessary to support the fuselage floor before this is done.) 5. Remove 1 holding bolt.
D. Front flying control compensator	1. Disconnect and slacken off 6 hydraulic lines. 2. Remove 1 holding bolt.
E. Rear fire bottle	1. Disconnect and slacken off 6 hydraulic lines on front compensator. 2. Remove 1 holding bolt. 3. Remove compensator. 4. Remove 2 hydraulic lines. 5. Remove bottle cooling jacket. ? bolts. 6. Disconnect and slacken off 3 fire extinguisher lines. 7. Disconnect 3 electrical connections. 8. Remove holding bolts.
F. Front fire bottle	1. Remove 5 hydraulic lines from utility pumps. 2. Remove nuts from 12 mounting studs. 3. Remove 2 utility pumps. 4. Remove bottle cooling jacket. 5. Disconnect and slacken off 3 fire extinguisher lines. 6. Disconnect 3 electrical connections. 7. Remove holding bolts.

G. Utility compensator	1. Disconnect and slacken off 5 hydraulic lines. 2. Remove 1 holding bolt.
H. Utility accumulator	1. Disconnect and slacken off 5 hydraulic lines to utility compensator. 2. Remove 1 holding bolt. 3. Remove compensator. 4. Disconnect 2 hydraulic lines. 5. Remove 4 holding bolts from brackets.
I. Control cables	Six pulleys in engine and flying control circuits are located on the bottom skin of the wing between Sta. 591 and 644. These are not accessible for cable inspection from any access door; in fact, they are not even visible. Access would involve removing the front flying-control compensator - item D above.
J. Fuel system air-pressure relief valve	1. Remove 2 tunnel vents. 2. Unbolt bottom end of fuselage strut (and probably top end too). (It will be necessary to support the fuselage floor before this is done.) 3. Disconnect 1 air-press line coupling. 4. Disconnect valve from line - 1 coupling.
K. Fuel system air-pressure regulator	As J above.

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