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### Aircraft accident investigation: recommendations for powerplant investigating team

Levy, G. G.; Cockshutt, E. P.

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#### **Publisher's version / Version de l'éditeur:**

<https://doi.org/10.4224/40003815>

*Laboratory Memorandum (National Research Council Canada. Division of Mechanical Engineering. Engine Laboratory); no. NRC-ENG-37, 1964-03*

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| FILE M49-10-5-1       |   | PAGE 1 OF 8     |
| PREPARED BY GGL & EPC |   | COPY NO. 27     |
| CHECKED BY EPC        |   | DATE March 1964 |

SECURITY CLASSIFICATION Open

SUBJECT Aircraft Accident Investigation - Recommendations for Powerplant Investigating Team

PREPARED BY G.G. Levy and E.P. Cockshutt

ISSUED TO

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LABORATORY MEMORANDUM

Page 2

Summary

A general outline of equipment required and procedures to follow during the early and subsequent stages of an aircraft accident investigation is given.

The recommendations apply specifically to the powerplants.

NATIONAL RESEARCH COUNCIL  
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LABORATORY MEMORANDUM

Page 3

TABLE OF CONTENTS

|  | <u>Page</u> |
|--|-------------|
| Summary  | 2           |
| 1. Field Kit   | 4           |
| 2. Special Points During Early Part of Investigation | 5           |
| 3. Hangar Operations                                 | 5           |
| 4. Pre-Strip Inspection                              | 6           |
| 5. Engine Stripping                                  | 6           |
| 6. Post Strip Inspection                             | 7           |
| 7. Special Investigations                            | 7           |
| 8. Interpretative Report                             | 7           |
| Sample Inventory Sheet                               | 8           |

NATIONAL RESEARCH COUNCIL  
DIVISION OF MECHANICAL ENGINEERING  
LABORATORY MEMORANDUM

Page 4

1. Field Kit

The following items should be assembled and packed in kit form and ready for use at short notice:

- (a) Pocket notebook for field notes.  
Bound book (8½" x 11") for use as diary.  
Bound book (8½" x 11") for photographs.  
Double sided adhesive tape.  
Pencils and ball-point pens.  
Supply of tags with marking pencils - wax and ink.
- (b) Compass.
- (c) 8 ft. steel tape.
- (d) Flashlight and spare batteries\* and bulb.
- (e) 35 mm camera with spare film\*.
- (f) Rubber boots, warm clothing and heavy leather gloves.
- (g) Ball of twine.
- (h) Pocket knife.
- (i) Pocket lens.
- (j) Tool kit - 6" and 8" adjustable wrenches, side cutters, pliers, screwdriver.
- (k) Plastic bags.
- (l) Fuel and oil sample cans (quart size).
- (m) First-Aid kit.
- (n) Chocolate bars\*.

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\*Perishable items may be added to the kit when required rather than stored ahead of time.

2. Special Points During Early Part of Investigation

- (a) Careful documentation, photography and surveying of location and attitude of major powerplant items (including depth at which parts are found).
- (b) Assessment of a/c impact angle.
- (c) Make arrangements for engine manufacturer and/or operator to provide serial numbers of all major powerplant components.
- (d) Request details of in-flight engine failures, pertinent to the type of engine under investigation, from F.A.A. or appropriate authority.
- (e) Where practicable, the powerplant team should not be directly concerned with the retrieval operations at the crash site, apart from an overall survey during the early stages. One or more members of the team should be available to identify powerplant parts as they are retrieved and to ensure that they are correctly documented.
- (f) Obtain complete powerplant parts list.
- (g) Inventorying of parts received from crater or scatter area should be made on a printed form with as simple a format as possible (see attached sample).

3. Hangar Operations

- (a) Handling equipment - 1 ton (minimum) mobile crane, forklift truck.
- (b) Washing facilities - water hose and steam generator.
- (c) Sorting of parts - this operation should be synchronized with structures and systems groups.
- (d) Major engine components should be set up in their correct relative attitudes to facilitate examination. Boxes should be available for the small loose parts.
- (e) Photograph parts in the "as-received" condition and again after cleaning.

Photographs should be captioned as soon as prints are available.

4. Pre-Strip Inspection

- (a) Detailed written description of the state of each engine, including angles of shafting, impact distortion, evidence of foreign material, i.e. wood, feathers, twigs, soil, etc. (take samples).

The write-up should preferably be done by the engine manufacturer's representative.

- (b) Look particularly for signs of punctured casings, in-flight rubs, and visual signs of over-temperature.
- (c) Note indications of rotation shown by bent compressor and turbine blades.
- (d) Make sketches of engines to show distortion pattern.

5. Engine Stripping

- (a) The engines should be stripped in the hangar if condition is such that normal disassembly procedures do not apply.
- (b) Tools required for stripping badly damaged engines: crow-bars, cold chisels, hammers, cutting torch, and hydraulic jack. When using a cutting torch, use should be made of water and asbestos blankets to minimize heat soak to critical parts. Adequate fire-fighting equipment should be available to deal with titanium or other fires.
- (c) Careful documentation of procedures and order of disassembly as well as identification and condition of parts is essential.
- (d) If engines are returned to manufacturer's plant for stripping, arrangements for quarantine and security must be worked out between the Investigating authorities and the manufacturer and formalized in writing before shipping the engines. In general, only authorized personnel should have access to the engines, and disassembly operations should be supervised at all times by Government personnel.

6. Post Strip Inspection

(a) The main objective of this inspection is to assess the extent of recovery of major engine parts, some of which were not accessible during the pre-strip inspection, and to determine whether there are signs of failure in these parts. These remarks apply particularly to major items such as compressor discs, turbine discs, main shafts, bearings and combustion equipment.

(b) Post Strip Report

This report may conveniently be made in tabular form to aid cross-checking from engine to engine of extent of recovery and condition of each item. Foot-notes may be added to describe parts or operations not included in the basic tables.

If a set of photographs is not to be attached to this report, an index should be provided to show what photographs are available and where they may be viewed.

7. Special Investigations

A Special Investigation is defined as the examination of a specific item, carried out away from the investigation area, by a person or organization not directly concerned with the accident investigation. The purpose is to acquire a factual report on a component which may require special equipment for dismantling or testing or when for some other reason it may not be convenient to carry out the operation in the hangar.

8. Interpretative Report

This report should summarize all the evidence obtained from the physical examination of the engines. From this evidence certain conclusions may be drawn, as, for instance, the probable rotational speed at impact, angle of impact etc.

A check list of major and minor failure possibilities should be included as well as a condition assessment of components.

An indication as to whether or not the engines were the prime or contributory cause of the accident should only be made if the weight of the evidence is indisputable.

Speculation should be avoided.

