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CONFIDENTIAL

ROYAL CANADIAN AIR FORCE

DIVISION OF

AIR MEMBER FOR TECHNICAL SERVICES

DEVELOPMENT STUDY

PS13 FIRST PRELIMINARY MOCK-UP INSPECTION

MOCK-UP BOARD REPORT

REPORT DAEng - 47

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PS13 FIRST PRELIMINARY MOCK-UP INSPECTION

MOCK-UP BOARD REPORT

REPORT DAEng-47

Prepared by: S/L H.J.M. Londeau
Secretary
Mock-Up Board

Submitted by: W/C R.T. Hamilton
Chairman
Mock-Up Board

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AMTS/DAEng

Approved by: A/C G.G. Truscott
AMTS/CAE

File: S1035PS13-100

Date: 20 June 56

Preface

1 The Mock-up Board Report is issued on the authority of the Chief of Aeronautical Engineering. Details are given of the Assessment by the RCAF of the first preliminary mock-up of the PS13 engine (fitted with the Bendix electronic control system) being developed and produced for the RCAF by Orenda Engines Limited.

2 The contents of this report are not to be disclosed to anyone outside the RCAF without the prior approval of the Chief of Aeronautical Engineering.

SUMMARY

1 A Royal Canadian Air Force Mock-Up Board Inspection convened at Orenda Engines Limited on 11 June 56 to assess the first preliminary mock-up of the PS13 engine fitted with the Bendix electronic fuel control system. The Company submitted 24 change requests prior to the inspection and 7 requests were made by the inspection team.

2 The Mock-Up Board's findings were approved by the Chief of Aeronautical Engineering as categorized in Appendices "A" and "B".

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LIST OF APPENDICES

PS13 MOCK-UP BOARD

I INTRODUCTION

1 The PS13 two-spool turbo-jet engine is being developed and produced by Orenda Engines Limited in accordance with the requirements of Specification MIL-E-5007A and the Preliminary Model Specification EMS-8. The PS13 is scheduled to be fitted in the sixth CF105 aircraft and to power production CF105 Service aircraft.

2 The purpose of the First Preliminary Mock-Up Board Inspection of the PS13 engine fitted with the Bendix electronic control system was to:

(a) Provide early direction to the Company concerning RCAF requirements and enable changes to be incorporated prior to the installation mock-up inspection.

(b) Introduce RCAF design, operational and maintenance personnel to the engine at an early stage of development.

3 The Second Preliminary Mock-Up Board Inspection of the PS13 engine fitted with the Lucas hydromechanical fuel control system is scheduled for Sep 56.

4 The first preliminary mock-up was not fitted with afterburner nozzle and associated controls since the final configuration has not yet been fixed. Several other mock-up components are undergoing design change and a comprehensive list was submitted by the Company. Design changes submitted by the inspection team are shown in Appendix "A" and Company change proposals are tabulated in Appendix "B". Change requests tabled in Appendix "C" of DAEng Report 45, "CF105 Mock-Up Evaluation", which are pertinent to the PS13 installation are to be implemented by the engine contractor.

5 The Mock-Up Board convened on the 11 Jun 56 in Plant 2 of Orenda Engines Limited, Malton. The mock-up was assessed in accordance with Specification MIL-E-5007A, ANA Bulletin 406, and DAEng Report Number 46.

II COMPOSITION OF MOCK-UP BOARD

6 Board Members

W/C R.T. Hamilton	(Chairman)	AFHQ/DAEng

G/C	R.M.	Aldwinckle		AFHQ/DIEEng
W/C	J.N.	Brough		OC TSDs A.V.Roe
S/L	P de L	Markham		AFHQ/DMEng
S/L	J.H.	Cooper		AFHQ/DADR
S/L	G.M.	Sutherland		AMCHQ
S/L	G.L.	Ward		ADCHQ
S/L	H.J.M.	Londeau	(Secretary)	AFHQ/DAEng

7 Technical Advisors

W/C	E.P.	Bridgland	CO 12 TSU
S/L	E.J.	Grosz	AFHQ/DMP
S/L	L.J.	Sullivan	OC TSDs A.V.Roe
F/L	A.J.S.	Wright	AFHQ/DIEEng
WO1	E.H.	Rosselle	1202 TSD
WO2	W.G.	Wentworth	1202 TSD
Sgt	P.A.	Bell	1202 TSD

III DEFINITION OF CATEGORIES

8 Cat. 1 - To be evaluated on the second preliminary mock-up prior to the installation mock-up inspection on the CF105 aircraft.

Cat. 2 - To be incorporated in the installation mock-up on the CF105 aircraft. Some items may not require evaluation on the engine mock-up but are to be incorporated on production engines.

Cat. 3 - Changes of a nature requiring further study by the Company or the RCAF.

IV CONCLUSIONS AND RECOMMENDATIONS

9 The inspection team submitted 7 change requests for cateroriza-tion by the Mock-Up Board. These changes were supplemented by 24 design changes and investigations proposed by the Company.

10 The Chief of Aeronautical Engineering approved the change requests as submitted and categorized by the Mock-Up Board.

It is recommended that:

(a) The change requests, as categorized, be implemented.

(b) The relevant change requests tabled in DAEng Report Number 45, "The CF105 Mock-Up Evaluation", be incorporated in the PS13 Installation Mock-Up.

(c) Incorporation of design changes are to be reported to the Orenda Development Steering Committee and the mock-up is to be available for inspection from time to time.

MOCK-UP COMPONENTS UNDERGOING DESIGN CHANGE

SUBMITTED BY RCAF

E-1 - Electrical Cables

Submitted by:	1202 TSD
Change Desired:	Route and clamp electrical cables to avoid fuel, oil, and hydraulic lines and ensure maximum protection.
Reason:	Present cables are not adequately protected (refer Specification Mil-E-5088A).
Action:	Cat. 1

E-2 - Flow Lines

Submitted by:	AFHQ/DAEng
Change Desired:	Consistency in the method of support is recommended. A minimum number of lines should be supported by one line. A support should be present at all major changes in direction.
Reason:	To minimize the possibility of fluid line failures due to fatigue or wear.
Action:	Cat. 1

E-3 - Multi Connector Plugs.

Submitted by:	ADCHQ
Change Desired:	Extend potting material out from the multiple connector past clamp.
Reason:	To prevent the possibility of wire damage or breaking due to movement when connecting or disconnecting plug or from movement due to gaining access to nearby components.
Action:	Cat. 2

E-4 - Flow Control Unit Trimmers

Submitted by: AFHQ/DMEng

Change Desired: If trimming at full throttle (possibly with afterburning) is required, consideration should be given to positioning all trims in the same plane facing the technician.

Reason: This will make the job quicker and easier and reduce exposure to high noise levels.

Action: Cat. 3

E-5 Pipelines and Cables

Submitted by: AFHQ/DMEng

Change Desired: Avoid close proximity of lines as much as possible.

Reason: The close proximity of lines in many positions makes the possibility of rubs significant. This point should be watched very closely by the TSD.

Action: Cat. 1

E-6 - Oxygen System for Engine Relights

Submitted by: AFHQ/DADR

Change Desired: Quantity gauge required. Also a refilling connection and quantity gauge must be located in an easily accessible position preferably where other systems are being replenished.

Reason: Time saving on turn-around.

Action: Cat. 2

E-7 - Oil Filler Pipes

Submitted by:	1202 TSD Maintenance Appraisal Team (C105)
Change Desired:	Carry oil fill pipes through shroud similar to electrical connectors.
Reason:	Ease of filling. Saving of hours.
Action:	Cat. 2

Appendix "B" to
REPORT DAEng-47
Dated: 19 June 56

MOCK-UP COMPONENTS UNDERGOING DESIGN CHANGE

SUBMITTED BY ORENDA ENGINES LIMITED

E-8 - Nozzle Actuator

Change Desired: Design proposals for hydraulic and pneumatic nozzle actuation are being investigated. Both types of pneumatic actuation will require redesign of the aft shroud to provide the space envelope requested by the sub-contractors.

Reason: The operating temperatures of the present hydraulic units are limited and may cause trouble at supersonic speeds.

Action: Cat. 3 Note: PS13 Development Coordinating Committee to monitor.

E-9 - Hydraulic System

Change Desired: The spring loaded reservoir will be replaced by a hydraulic type energized by pump outlet pressure.

Reason: To improve reliability and efficiency.

Action: Cat. 2

E-10 - Hydraulic System

Change Desired: A hydraulic filter will be added

Reason: To minimize contamination and increase operational reliability.

Action: Cat. 2

E-11 - Hydraulic System

Change Desired: An overpressure relief valve will be added.

Reason: To avoid loss of hydraulic pressure and increase reliability.

Action: Cat. 2

E-12 - Hydraulic System

Change Desired: Refilling connection is required.

Reason: For maintenance. Similar connection as for re-oiling (E-14).

Action: Cat. 2

E-13 - Hydraulic System

Change Desired: Bleed locations and drains to be fixed.

Reason: Optimum layout desired for PS13 installation.

Action: Cat. 1 Note: To be monitored by PS13 Development Coordinating Committee and Mock-up to be available for inspection from time to time by the Maintenance Appraisal Team.

E-14

Change Desired: A single point dual port re-oiling connection is proposed for production engines.

Reason: To facilitate maintenance.

Action: Cat. 2

E-15

Change Desired: Replace the thermocouple flexible harness by a rigid type. A design investigation is also being conducted into a button connected harness and detachable probes.

Reason: To improve reliability.

Action: Cat. 3

E-16

Change Desired: Anti-icing regulating valve must be repackaged to meet envelope requirements. If future testing dictates the need for first stage rotor and stator anti-icing, additional connections will be required on the existing piping at the front frame and L.P. casing.

Reason: To meet CF105 installation requirements and provide adequate icing protection.

Action: Cat 2 Note: To be monitored by PS13 Development Coordinating Committee.

E-17

Change Desired: The fuel control electronic box is to be aircraft mounted in a controlled ambient zone and will require repackaging should this system be selected for the CF105 aircraft.

Reason: To meet CF105 installation requirements.

Action: Cat. 3

E-18

Change Desired: A combined oil, hydraulic, and fuel drain connection is required and should be located in the region of the combustion drain.

Reason: To reduce fire hazard.

Action: Cat. 2

E-19

Change Desired: The engine to airframe firewall is to be shifted aft.

Reason: To correspond with a revised seal location in the CF105 aircraft.

Action: Cat. 2

E-20

Change Desired: The oxygen system requires repackaging and relocation.

Reason: To meet the CF105 installation requirements and improve accessibility.

Action: Cat. 2

E-21

Change Desired: A design investigation is being conducted on afterburner controls which if introduced, would involve some repackaging of the unit.

Reason: To improve the reproducibility and metering accuracy of the controls.

Action: Cat. 3

E-22

Change Desired: After satisfactory qualification testing, teflon hose is proposed for production engines.

Reason: To increase operational reliability.

Action: Cat. 3

E-23

Change Desired:	The 16 port fuel distributor is to be repackaged.
Reason:	To give a better installation in CF105 aircraft.
Action:	Cat. 2

E-24

Change Desired:	The electric fuel starting pump is to be replaced by a hydraulic pump mounted on the front of the engine control unit and driven by the actuator pump.
Reason:	To reduce the electric power requirements and provide a lighter and more compact installation.
Action:	Cat. 1

E-25

Change Desired:	Flame tight seals are required between the engine casing and the tertiary seal and rubbing pads located at various points of the shroud.
Reason:	For fire protection and to protect engine components from chafing.
Action:	Cat. 2

E-26

Change Desired:	Insulation blanket required between the H.P. casing and the fuel control units.
Reason:	To protect the control units from compressor heat radiation.
Action:	Cat. 2

E-27

Change Desired: The fire detecting system is to be connected to the aircraft circuit through the electrical connectors on the tertiary shroud.

Reason: To facilitate engine installation and removal.

Action: Cat. 2

E-28

Change Desired: The air-to-air cooler is to be moved froward $\frac{3}{4}$ inches.

Reason: To meet CF105 installation requirements.

Action: Cat. 2

E-29

Change Desired: An unhanded angled power take-off is to be fitted.

Reason: To meet recent changes in CF105 installation requirements.

Action: Cat. 2

E-30

Change Desired: An improved design of the H.P. speed sensor and limiter is being investigated.

Reason: To reduce size and weight of this unit.

Action: Cat. 3

E-31

Change Desired: L.P. overspeed governor and tacho is to be moved from the intake frame to the front frame. Fitting of servo lines to the L.P. governor on the mock-up awaits this change.

Reason: To provide better accessibility at the bottom left 45° position.

Action: Cat. 2