LIEBHERR
LIEBHERR-AEROSPACE TOULOUSE SAS

(FSCM) F1958

408 Avenue des Etats-Unis
B.P. 52010
31016 TOULOUSE Cedex - FRANCE

SERVICE INFORMATION LETTER

ATA SYSTEM: 21

TITLE: BOMBARDIER CL300

RAM AIR REGULATING VALVE
PNR 7084A010000

RARV TESTING PROCEDURES FOLLOWING "PACK COOL AIR FAIL" EICAS MESSAGE

APPLICABILITY: Ram Air Regulating Valve
PNR 7084A010000
All S/N

1. Purpose

The purpose of this Service Information Letter is to prevent unnecessary removals of the RAM AIR REGULATING VALVE (RARV) that follows a PACK COOL AIR FAIL Advisory Engine Indication and Crew Alerting System (EICAS) message.

2. Description and Operation

A. Description

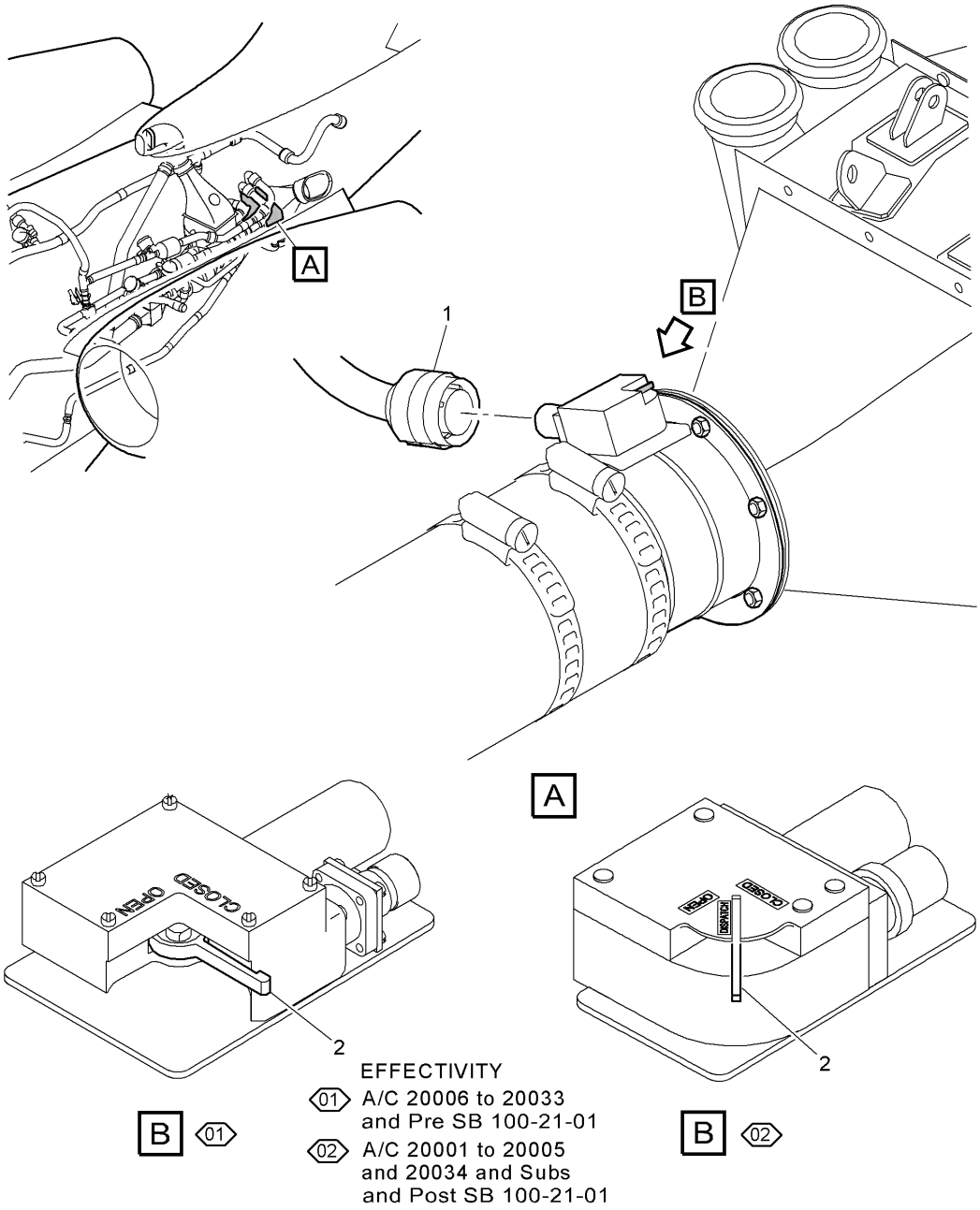
The RARV adjusts the ram airflow through the Dual Heat Exchanger (DHX) and the Pre-Cooler Exchanger (PCE). This adjustment changes the trim air temperature and pack inlet temperature.

The RARV is installed between the pack and the PCE. The upstream end of the RARV has a beaded end type flange and is connected to the plenum of the pack with a flexible sleeve. The downstream end of the RARV has a flange and is installed on the inlet header of the PCE with six bolts. The body of the RARV is made of aluminium alloy and has a 6 inch inside diameter. The RARV has a 5.1 inch diameter butterfly valve. The diameter of the butterfly valve is smaller than the inside diameter of the RARV body. This difference in diameter is necessary to make sure that there is ram airflow through the DHX and the PCE at all time. An electrical actuator (28 V dc) controls the butterfly valve. Two microswitches monitor the Full Closed and Full Open positions. The RARV has a manual lever. This manual lever is used to manually operate the butterfly valve during maintenance of the RARV.

- For aircraft 20006 to 20033, and PRE SB 100-21-01, the manual lever has 2 position indications (OPEN and CLOSED).
- For aircraft 20001 to 20005, 20034 and Subs, and POST SB 100-21-01, the manual lever has 3 position indications (OPEN, DISPATCH, and CLOSED).

The manual lever can also be used to temporarily deactivate the RARV when necessary:

- For aircraft 20006 to 20033, and PRE SB 100-21-01, the manual lever is set to the CLOSED positions to deactivate the RARV.
- For aircraft 20001 to 20005, 20034 and Subs, and POST SB 100-21-01, the manual lever is set to the DISPATCH position to deactivate the RARV.


A
B
1
A
OPEN
CLOSED
2
OPEN
CLOSED
2
EFFECTIVITY
01 A/C 20006 to 20033
and Pre SB 100-21-01
02 A/C 20001 to 20005
and 20034 and Subs
and Post SB 100-21-01
B 01
B 02

B. Operation

The Integrated Air System Controller (IASC) controls RARV. The IASC sends a command signal to the electrical actuator of the RARV to change the position of the butterfly valve. In normal operation, the IASC adjusts the RARV to get a pack inlet and trim inlet temperature between 100 deg C and 170 deg C.

When the RARV fails in the closed or open position, and the Hot Air Temperature Sensor (HATS) or Pack Inlet Temperature Sensor (PITS) senses a temperature of less than 90 deg C (with a confirmation time of 150 seconds), a PACK COOL AIR FAIL Advisory EICAS message comes on. The fault is recorded in the IASC Non-Volatile Memory (NVM) and sent to the Maintenance Diagnostic Computer (MDC).

3. RARV intermittent failure history and status

A. In-service experience

Higher than expected occurrences of intermittent PACK COOL AIR FAIL Advisory EICAS message are reported on the Challenger 300, mainly during descent and taxi phases. This message is only driven by the monitoring done by the two channels of the IASC #2 on the RARV, so that the related MDC message always reports a RARV failure.

Most of the time, the PACK COOL AIR FAIL Advisory EICAS message goes off when the flight phase changes (switching from engine bleed to APU bleed, engine throttle increase, holding, etc…). When RARVs are removed and sent to Liebherr for repair, most of the RARVs pass the return-to-service test successfully and no repair work is necessary. As a result, the RARV has a high rate of No-Fault Found (NFF) on the Challenger 300 fleet.

B. Troubleshooting and failure analyses

Analysis and testing were done conjointly by Liebherr Aerospace and Bombardier Aerospace for a more than two years. This analysis and testing includes:

- Complete disassembly of the RARV,
- Detailed material analysis of microswitches and motors,
- Performance of instrumented flight tests.
- Installation of a IASC and RARV on a test bench at Liebherr Aerospace to do an analysis of the RARV commands performance under all expected condition (low temperature, high butterfly valve loads, etc…).

Recently on an aircraft in-service, a RARV that had intermittent failures was found being stuck very near to the full closed position. The RARV failure cleared when the

manual lever was moved slightly by the mechanic, which was enough to release the valve from its stuck position.

For the first time, this failure was repeated on the Liebherr test bench and allowed to isolate the root causes of the intermittent failure. Analyses showed that the failure detection occurs as a conjunction of very small command steps sent by the IASC to the valve when the valve is reaching for the full closed position, therefore working under significant aerodynamic loads on the butterfly, causing the RARV to be stuck very near the full closed position.

Liebherr Aerospace is currently evaluating solutions to solve the issue.

C. Impact on system performance

The intermittent failure detection happens when the RARV operates near to the full closed position. On a performance standpoint, the impact of such failure does not affect the Environmental Control System (ECS) temperature control efficiency and accuracy. Therefore, the passenger comfort will not be affected by having the PACK COOL AIR FAIL Advisory EICAS message during a flight.

4. Procedures

The following procedure gives the operator a way to distinguish a truly failed RARV from an operative RARV subjected to the intermittent failure detection.

A. Case #1: The PACK COOL AIR FAIL Advisory EICAS message comes on during flight, and then goes off by itself.

In order to avoid unnecessary replacement of the RARVs and NFFs, LTS recommends:

(1) Do a Power-up Built In Test (PBIT) as follows:

(a) Remove the Electrical Power from the Aircraft (refer to AMM TASK 24-00-00-861-802).

(b) Connect Electrical Power to the Aircraft (refer to AMM TASK 24-00-00-861-801).

During the PBIT, the IASC does the following actions:

- Sends a closing command and waits until the butterfly valve gets to the Full Closed position,

- Sends an opening command to open the butterfly valve,
- Makes sure that the butterfly valve leaves the Full Closed position,
- Sends a closing command and waits until the butterfly valve gets to the Full Closed position,
- Makes sure that the butterfly valve goes to the Full Closed position.

The RARV is monitored in:

- Full Open position: A failure is detected by the IASC when it sends an opening command to fully open the butterfly valve, and the butterfly valve does not reach the Fully Open position (confirmation time 7 s and PBIT active).
- Full Closed position: A failure is detected by the IASC when it sends an closing command to fully close the butterfly valve, and the butterfly valve does not reach the Fully Closed position (confirmation time 7 s and PBIT active).

(2) If a failure of the RARV is detected, the PACK COOL AIR FAIL Advisory EICAS message comes on. Remove the RARV from the aircraft for further inspection or follow MMEL instruction to prepare for dispatch.

(3) If the PACK COOL AIR FAIL Advisory EICAS message does not comes on, there is no failure detected and the RARV does not need replacement.

B. Case #2: The PACK COOL AIR FAIL Advisory EICAS message comes on during flight and does not go off by itself. To avoid unnecessary RARV removal and NFFs, do the steps that follow at the first available opportunity:

(1) Open the aft equipment-compartment door 182GL (refer to AMM TASK 52-41-00-010-801).

(2) In aft equipment-compartment get access to the RARV and do the step that follows, as applicable:

- For aircraft 20006 to 20033, and PRE SB 100-21-01, set the manual lever to a position between the OPEN and CLOSED positions.
- For aircraft 20001 to 20005, 20034 and Subs, and POST SB 100-21-01, set the manual lever to the DISPATCH position.

(3) Do a Power-up Built In Test (PBIT) as follows:

(a) Remove the Electrical Power from the Aircraft (refer to AMM TASK 24-00-00-861-802).

(b) Connect Electrical Power to the Aircraft (refer to AMM TASK 24-00-00-861-801).

During the PBIT, the IASC does the following actions:

- Sends a closing command and waits until the butterfly valve gets to the Full Closed position,
- Sends an opening command to open the butterfly valve,
- Makes sure that the butterfly valve leaves the Full Closed position,
- Sends a closing command and waits until the butterfly valve gets to the Full Closed position,
- Makes sure that the butterfly valve goes to the Full Closed position.

The RARV is monitored in:

- Full Open position: A failure is detected by the IASC when it sends an opening command to fully open the butterfly valve, and the butterfly valve does not reach the Fully Open position (confirmation time 7 s and PBIT active).
- Full Closed position: A failure is detected by the IASC when it sends a closing command to fully close the butterfly valve, and the butterfly valve does not reach the Fully Closed position (confirmation time 7 s and PBIT active).

(4) If a failure of the RARV is detected, the PACK COOL AIR FAIL Advisory

EICAS message comes on. Remove the RARV from the aircraft for further inspection or follow MMEL instruction to prepare for dispatch.

(5) If the PACK COOL AIR FAIL Advisory EICAS message does not comes on, there is no failure detected and the RARV does not need replacement.

NOTE**:** All enquires affecting this document should be made to:

LIEBHERR AEROSPACE TOULOUSE SAS	
408, Avenue des Etats-Unis B.P.52010 31016 TOULOUSE CEDEX FRANCE	Tel : +33.(0)5.61.35.25.07 Telefax : +33.(0)5.61.35.29.29 Email: technical.services@liebherr.com