BAE SYSTEMS (Operations) Limited, Prestwick International Airport, Ayrshire, KA9 2RW, Scotland.

INSPECTION SERVICE BULLETIN
BAe 146 SERIES/AVRO 146-RJ SERIES AIRCRAFT
TRANSMITTAL FOR INSPECTION SERVICE BULLETIN REVISION

SERVICE BULLETIN No.ISB.21-150

DATE: 20-MAR-2001

MANDATORY

TITLE : AIR CONDITIONING - TO INSPECT ENGINE OIL SEALS, APU AND ECS JET PUMP AND AIR CONDITIONING PACK FOR SIGNS OF OIL CONTAMINATION.

REVISION : 2

DATE: 24-OCT-2002

ACTION

1. Remove and destroy Service Bulletin complete.

2. Insert Service Bulletin complete at Revision 2.

REASON

This Inspection Bulletin has been revised to include instruction to inspect the APU and APU bay for signs of contamination.

Table 1.

| All Pages | Inspection Service Bulletin revised to correct format, Revision 2 and date added to bottom of page. |
| Para 1 B. | Reason updated to explain inclusion of inspection of APU and APU bay for signs of contamination. |
| Para 1 C. | Additional operation (3) included to Description. |
| Description | 3 additional NOTES included referencing the APU and APU bay. |
| Para 2 C. | Identifying the relevant bleed source (introduction) and APU inlet ingestion of APU bay contaminants. |
| Accomplishment Instructions | Additional operation (3) as part of accomplishment instruction (E). |
| Para 2 J. | Additional operation (1) included to accomplishment instruction. |
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MANDATORY

TITLE : AIR CONDITIONING - TO INSPECT ENGINE OIL SEALS, APU AND ECS
JET PUMP AND AIR CONDITIONING PACK FOR SIGNS OF OIL
CONTAMINATION.

1. PLANNING INFORMATION

A. Effectivity
(1) Aircraft affected by this inspection are defined below:

ALL BAe146 100, 200, 300 Series

B. Reason

Incidents have been reported involving impaired performance of the flight crew. Investigations have been conducted to determine whether the events could have been caused by inhalation of an agent(s) resulting from oil and/or oil breakdown products leaking from the engine(s) or APU and contaminating the environmental control system. At this time, there is no substantiated evidence indicating that oil breakdown products can impair crew performance.

In the past, oil leaks and cabin/flight deck odours and fumes may have come to be regarded as a nuisance rather than a potential flight safety issue.

However whilst investigations are being carried out to determine the nature of any agents that may be released into the cabin environment and to define any necessary corrective actions, oil leaks and cabin/flight deck odours must be regarded as a potential threat to flight safety, they should not be dismissed as a mere nuisance and should be addressed as soon as possible.

This inspection bulletin has been revised to include inspection of the APU and APU bay for signs of contamination, to include details of an APU bay cleaning procedure and to include advice regarding identification of relevant air bleed sources.

C. Description

(1) Inspection of the inside of each air conditioning pack (Pack No.1 and Pack No.2) regenerative air ducts and air cycle machine for the presence of oil contamination.

(2) Inspection of an engine for signs of wet oil contamination.

(3) Inspection of the APU and APU bay for signs of contamination.

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NOTE: Wet oil in the engine or APU is defined as surface coverage which can be transferred to a metallic or plastic object. Staining, discolouration or grease/grime is not considered to be evidence of wet oil contamination.

NOTE: Unacceptable wet contamination of the APU bay is defined as surface coverage which can be transferred to a metallic or plastic object.

NOTE: Unacceptable soot contamination of the APU bay is defined as contamination which hinders the performance of normal maintenance activities associated with the APU for example the identification of electrical harnesses and plug idents, reading the APU hour meter Honeywell models only) and inability to locate the source of the contamination.

NOTE: Staining, discolouration or grease/grime is a normal level of APU bay contamination and is considered acceptable.

D. Compliance

The actions generated by this Inspection Service Bulletin are classified as MANDATORY by the U.K. C.A.A.

(1) Effective immediately whenever a cabin air quality problem is identified which is suspected of being associated with oil contamination of the air supply from the ECS packs, whether intermittent or persistent, inspect and rectify in accordance with para 2 of this Inspection Service Bulletin, using the flowmap logic Drawing 1. Inspection in para 2.B must be carried out even if no oil contamination is found during para 2.A inspection.

(2) Effective from 3rd April 2001, at the next and every subsequent A Check or within a maximum of 500 flights and repeated at a maximum 500 flight intervals, inspect and perform any rectification and cleaning in accordance with para 2 of this Inspection Service Bulletin, using the flowmap logic Drawing 1.

E. Approval

The technical information contained in this document has been approved under the authority of JAA Design Organization Approval No.CAA.JA.02034.

F. Manpower

(1) To inspect as defined in para 2.A - 2 man-hours.
G. Materials - Cost and Availability

Cost and Availability is by arrangement between the Operator and BAE SYSTEMS.

H. Tooling - Cost and Availability

Cost and Availability is by arrangement between the Operator and BAE SYSTEMS.

I. Weight and balance

Not affected.

J. References

Aircraft Maintenance Manual
AMM 21-50-11, AMM 21-50-17, AMM 21-50-47, AMM 21-50-51, AMM 72-00-00.

Component Maintenance Manual

All Operator Message
AOM 00/030V.

K. Publications affected

Not affected.

L. Electrical load data

Not affected.

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2.ACCOMPLISHMENT INSTRUCTIONS

WARNING: HYDRAULICS: PRIOR TO ENERGISING OR DE-ENERGISING AIRCRAFT ELECTRICAL BUSBARS:

MAKE CERTAIN:

- GROUND SAFETIES ARE IN POSITION.
- ALL PERSONNEL ARE CLEAR OF HYDRAULICALLY ACTUATED SURFACES.
- CONTROL LEVERS MATCH THEIR RELEVANT COMPONENT POSITIONS.
- TRAVEL RANGE OF HYDRAULICALLY ACTUATED SURFACES IS UNOBSSTRUCTED.

Observe all WARNINGS and CAUTIONS appearing in the Aircraft Maintenance Manual (AMM) referred to in this Inspection Service Bulletin.

A.General

The inspection and cleaning procedures outlined in this ISB address problems caused by oil contamination of the air supply from the ECS packs. It is imperative that the source of oil is identified. The accomplishment instructions should be carried out in accordance with the Flowmap Drawing 1, to prevent re-contamination. The accomplishment instructions define what must be done and the flowmap provides the logic of when to do them.

If a report of poor cabin air quality which is associated with oil contamination of the air supply from the ECS packs is made at an airfield where the inspections described in this section cannot be accomplished, it is permissible at the discretion of the flight crew with due consideration to the nature of the event to continue operation for the rest of the day, in order to get the aircraft to a suitable airfield where these inspections and rectification actions can be conducted.

NOTE: Flight crews should be reminded of the importance of donning oxygen masks if poor cabin air quality is suspected, and reminded of the importance of reporting smoke or smells as a technical defect (Ref. AOM 00/030V).

B.Inspection of both air conditioning packs (Pack No.1 and Pack No.2) regenerative air ducts for the presence of oil contamination.

(1) Disconnect the air conditioning pack regenerative air duct at the point it enters the reheater/condenser ("swan neck" refer to Aircraft Maintenance Manual AMM 21-50-17 Fig 201 Item 22 and AMM 21-50-17, page block 201 ) and remove jet pump (refer to Aircraft Maintenance Manual AMM 21-50-47, page block 201 ).

(2) Perform a visual inspection of the inside of both the

contaminated a/c can be operated
pax and FA are on their own
condenser regenerative air ducts, air cycle machine turbine (ACM) outlet and the jet pump ducts on each air conditioning pack for presence of oil contamination.

NOTE: It is important to distinguish between normal levels of contamination on the inside of the ducting and oil contamination. Dark, uniform coating on the inside surface of the ducting is acceptable. Oil contamination in a liquid or paste form is unacceptable.

(3) If no oil contamination is identified in para 2.B(2) during an 'A' check or 500 flight repeat inspection reinstall the jet pump in accordance with AMM 21-50-47

NOTE: Inspection 2.C MUST be conducted:

(a) Following any reported cabin air quality problems associated with oil contamination of the air supply (whether or not contamination has been identified in para 2.B(2)).

(b) If oil contamination has been identified in 2.B(2) during an inspection.

C. Inspection of Engines and APU.

Identifying the Relevant Bleed Source

In all instances both the APU and engine bleed air supplies should be checked for evidence of contamination. The APU can contaminate both ECS packs, BUT Engines 1 and 2 can only contaminate ECS Pack 1, and Engines 3 and 4 can only contaminate ECS Pack 2. Therefore where odour reports are identified during operation of a specific ECS pack the associated engine airs should be considered the "relevant" engine bleeds. For example, if an odour is associated with ECS pack 1 then the bleed systems associated with engines 1 and 2 are relevant.

Engine Sources

Oil contamination of the engine bleed air supply owing to:

Engine oil gallery diffuser pipe failure.
Engine shaft seal leakage - No.1 bearing seal.
Engine shaft seal leakage - No.2 bearing seal.
Engine shaft seal leakage - No.9 bearing seal.
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Cause

Engine oil gallery diffuse failure.
No.1 engine bearing seal/failure.
No.2 engine bearing seal/failure.
No.9 engine bearing seal/failure.

Identified by

Oil leaks in this area maybe evident by smoke in the exhaust on shutdown or draining from the combustor drain valves.

Oil may appear in the bleed band area. Check for oil wetness in the HP compressor. With reference to the AMM 72-00-00, page block 601 Engine Inspection/Check section, a boroscope examination can be performed to view oil telltale marks in the No.1 bearing area.

Check for heavy venting from the breather, leakage at the diffuser/combustor split line for evidence of oil drainage from the combustor chamber drain valves. No.2 seal leakage may also be evident by high bearing scavenge temperature.

Oil may appear in the bleed band area. Evidence of oil streaks from the fan exit guide vane weep hole and oil puddles at the '6 o'clock' position on the supercharger air seal.

NOTE: Engines 1 and 2 can only contaminate ECS pack 1, and engines 3 and 4 can only contaminate ECS pack 2.

APU Sources

Oil contamination of the APU bleed air supply owing to:

APU shaft seal leakage.
APU inlet ingestion of APU bay contaminants.

APU Shaft Seal Leakage

Cause

Failure of APU compressor seal.

Identified by

Compressor seal failure should be suspected if smoke is witnessed in the aircraft cabin when air is supplied by the APU.

Confirm by boroscope in accordance with Honeywell CMM 49-20-00.

Smoke or oil odour in the cabin on initial selection of air from the APU.

APU Inlet Ingestion of APU Bay Contaminants

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NOTE: Unacceptable APU bay contamination should be cleaned with reference to para J.

NOTE: The source of APU bay contamination should always be located and rectified to prevent further contamination of the APU bay. In extreme cases of bay contamination, it may be necessary to clean the bay and then operate the APU in order to locate the source of contamination.

NOTE: Typical APU bay contaminants are oil, fuel and exhaust soot. The APU bay can also become contaminated with de-icing fluid, hydraulic fluid and toilet fluid.

CAUSE

APU inlet plenum chamber seal leakage.

Identified by

APU

Check integrity of the sealing of the inlet plenum chamber to the APU. It may be possible to see staining and witness marks inside the APU at the inlet flange interface by using a 4mm boroscope inserted through the compressor plenum drain outlet.

APU inlet plenum chamber seal leakage

APU oil fill point leaks.

APU Generator Cooling Fan Leakage. Oil leaks past the cooling fan assembly seal can enter the APU inlet plenum and mix with the APU bleed air.

Identified by

All without mod

49-031-36115A

All with mod

49-031-36115A

Honeywell

Honeywell

Excessive oil consumption. Check the internal condition of the flexible duct connecting the APU cooling fan outlet to the oil cooler matrix for visible signs of oil deposits. In the case of high leakage, traces of oil will be evident on the outside of the airframe at the oil cooler matrix orifice.

Excessive oil consumption. Oil deposits within the APU bay opposite (on fire box wall) to the oil cooler air outlet.

APU exhaust flange seal failure. This can result in the leakage of APU exhaust gases into the APU bay. Gearbox vent air containing oil mist can discharge into the APU bay.

Identified by

Sooty oil deposits within the APU bay. Honeywell

Check the APU exhaust flange duct seal area for soot traces.

Oil deposits within the APU bay. Check the APU gearbox vent pipe outlet area Sundstrand for oil traces.
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Cause

Oil cooling fan drain position. Fan drain can lead to oil draining into the vicinity of the fan exhaust which then propels oil mist throughout out the APU bay. Gearbox vent tube obstruction can cause oil leakage through labyrinth seal.

Identified by

Oil deposits within the APU bay adjacent to cooling fan oil drain and opposite to the fan air outlet.

APU

Hamilton Sundstrand

NOTE: The APU can contaminate both ECS packs.

NOTE: If the inspection procedures identify oil leakage in one or more engines or in the APU, perform the requirements of para 2.D to 2.L.

NOTE: Requirement of para 2.D to 2.L must be conducted:

(a) If the inspection procedures 2.C were conducted in accordance with para.1.D.(1).

(b) If the inspection procedures 2.C were conducted in accordance with para.1.D.(2) AND any engine/APU wet oil contamination is found.

D.

Remove the affected engine(s) and/or APU and replace with a serviceable unit(s) before further flight and for each component in para 2.D(2) affected by oil contamination, remove the associated air conditioning pack in accordance with AMM 21-50-11, jet pump in accordance with AMM 21-50-47 and water injector (with associated pipe work) in accordance with AMM 21-50-51 and replace with serviceable unit(s) before further flight. The removed unit(s) may be made serviceable by performing the cleaning procedures outlined in 2.H.

E.

Continued service without performing all of the above defined engine, APU and air conditioning system equipment changes is only permissible under the following conditions.

(1) If oil contamination was found in only one regenerative air duct and oil leakage was confirmed in the engine or engines supplying the associated air conditioning pack, the aircraft may be operated with that air conditioning pack inoperative, provided ram air ventilation system is installed and operates normally. The aircraft must be operated in accordance with the electrical cooling restrictions for ground operation in high ambient temperatures.

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(2) If oil contamination was found in both regenerative air ducts and oil leakage was confirmed in the APU, the aircraft may be operated with the APU air supply inoperative provided; the APU air valve is confirmed closed, the APU AIR switch is selected OFF and placarded INOP, and alternative operational procedures are developed for the selection of engine air. Both air conditioning packs, jet pumps and water injectors (with associated pipe work) must be removed and replaced with serviceable units before further flight. The removed units may be made serviceable by performing the cleaning procedure as detailed in para 2.H. If unable to replace packs aircraft may be operated with both packs selected OFF provided both ECS pack 1 and pack 2 switches are selected OFF and placarded INOP, both pack valves are confirmed closed and providing the aircraft is operated in an approved unpressurised configuration.

(3) If no oil contamination was found in either regenerative duct and oil leakage was confirmed in the one or more bleed engine bleed or APU supplies, the aircraft may be operated providing that those bleed are selected off, and that the resulting bleed and ECS configuration is approved under the MMEL.

F. If oil contamination is found in para 2.B(2) for each component affected by oil contamination, remove the associated air conditioning pack in accordance with AMM 21-50-11, jet pump in accordance with AMM 21-50-47 and water injector (with associated pipe work) in accordance with AMM 21-50-51 and replace with serviceable units before further flight. The removed units may be made serviceable by performing the cleaning procedure as defined in para 2.H. If the inspection of para 2.C failed to identify any leaks the aircraft may then be put back into service without any engine or APU change but the inspection required in para 2.B must be accomplished within 50 flight cycles.

G. If no oil contamination is found in para 2.B(2) and extensive inspection fails to identify any leaks in the engine or APU, the aircraft may be put back into service without any engine or APU change but the inspection required in para 2.B must be accomplished within 50 flight cycles.

H. Cleaning Procedures

The removed jet pump must be cleaned in accordance with NGL CMM 21-50-35.

The removed water injector P/N 4342CD000 and associated pipe work must be cleaned in accordance with NGL CMM 21-50-30.
The following components from the removed air conditioning pack must be cleaned in accordance with NGL CMM 21-50-20.

Reheater/Condenser Heat Exchanger P/N 4684C000.
Water Extractor P/N 4685C000.
Air Cycle Machine P/N 1344D000.
Primary B/Secondary Heat Exchanger P/N 4756C000.
Primary A Heat Exchanger P/N 4754C000.
Plenum assembly P/N 1430D000.
Pack Ducts and Sleeves as required.

Clean any traces of oil contamination from the inside of the Regenerative air duct and also the stub duct at the jet pump connection at the rear pressure dome (frame 45) using Freon TF or Isopropyl Alcohol and a lint free cloth.

**NOTE:** The flexible sound attenuator ducts (e.g. XC5349 at frame 44) cannot be cleaned satisfactorily and should be replaced if heavily contaminated.

I. Refer to NGL CMM 21-50-20 and reassemble the air conditioning pack.

Reinstall the water injector and associated pipe work to the aircraft in accordance with AMM 21-50-51.

Reinstall the jet pump to the aircraft in accordance with AMM 21-50-47.

Reinstall the air conditioning pack to the aircraft in accordance with AMM 21-50-11 and test the air conditioning system as detailed.

J. The following procedure is applicable to both the Honeywell and HSPS APU installations of the BAe146 series of aircraft.

**NOTE:** APU bay contamination can under certain circumstances be ingested into the APU intake plenum. This ingested contamination can then be passed into the APU bleed air resulting in cabin odours.

**NOTE:** Typical contaminants of the APU bay are fuel, oil and APU exhaust soot. These contaminants can be removed by using a water based cleaning agent ref AVP 2-026.

Ensure that the APU is placarded inoperative on the flight deck.

Gain access to the APU bay.

Inspect bay for contaminants, the use of a black light will help
to illuminate oil residue.

**NOTE:** Typically, if the APU bay is contaminated, APU exhaust soot will be concentrated on the forward fire wall and the lower forward half of the APU itself. Oil and fuel contamination will generally be found around the mid to rear end of the APU bay particularly on the APU bay door.

Using a suitable cleaning agent (Ref AVP 2-026) clean contaminants from the walls of the APU bay including the APU bay door.

Any contamination of the APU itself including electrical plugs and harnesses should also be removed.

**NOTE:** BAE SYSTEMS recommends the use of a water based cleaning agent (ref AVP 2-026).

**NOTE:** The source of APU bay contamination should always be located and rectified to prevent further contamination of the APU bay. In extreme cases of bay contamination, it may be necessary to clean the bay and then operate the APU in order to locate the source of contamination.

Remove any residual cleaning agent paying particular attention to any electrical plugs which may have been wetted during the cleaning operation.

**NOTE:** It is permissible to use a pressure washer to remove contaminants and/or residual cleaning fluid providing an approved cleaning agent is used (Ref AVP2-026). If a pressure washer is used, the pressure must be limited to 50 psig and direct impingement of the spray on to electrical connectors should be kept to a minimum.

Start and run the APU for several minutes IAW AMM 49-00-00.
It is permissible to continue operation for the rest of the day, in order to get the aircraft back to a maintenance base for these inspections and rectification actions. (Crew Note ADM 0030V)

ACCOMPLISHMENT INSTRUCTIONS - GENERIC

1. Before next flight
   1. Inspect regenerative air ducts, ACM & jet pump ducts

2. Oil contamination found?
   Yes
   Replace or clean ECS packs and supply ducting
   No
   Inspect relevant Engines & APU for oil leaks

3. Leaks identified?
   Yes
   Dispatch notification for APU or Engine
   No
   Repeat inspection of regenerative air ducts

4. Rectly Leaks
   Yes
   Dispatch notification for APU or Engine
   No

Return to start

FLOWMAP LOGIC
DRAWING 1.
K. Close up

(1) Ensure work area is clean and clear of tools and miscellaneous items of equipment.

L. Documentation

(1) Report findings, including nil defects, using attached Inspection Report Sheet and questionnaire, to:

F.A.O. Continued Airworthiness Manager on FAX 7160.

Continued Airworthiness Manager,
BAE SYSTEMS Regional Aircraft SA,
3 Allee Pierre NADOT, B.P. 16,
31701 Blagnac,
Cedex,
France.

Fax +33 (0) 5 3460 7160

(2) Record the accomplishment of this inspection in the aircraft's technical records.

M. Closing Action

NOTE: The requirements of this Inspection Service Bulletin will be reviewed following BAE SYSTEMS analysis of the attached questionnaire.
3. MATERIAL INFORMATION

None.
APPENDIX 1

1. INSPECTION REPORT

A. Complete and return this form as detailed

OPERATOR: ______________________________

AIRCRAFT REGISTRATION: ______________________________

CONSTRUCTORS NUMBER: ______________________________

FLIGHT HOURS: ______________________________

LANDINGS: ______________________________

DATE INSPECTION PERFORMED: ______________________________

FINDINGS: ______________________________

To: Head of In-Service Engineering,
Customer Support,
BAE SYSTEMS (Operations) Limited,
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