Aviation Safety Council
Taipei, Taiwan

GE791 Accident Investigation

Factual Data Collection

Group Report

Maintenance Record Group

October 28, 2003

ASC-FRP-03-10-001

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I. Team Organization

Chairman：

James Fang
Aviation Safety Council

Members :

1. David Lee
   Aviation Safety Council
2. Arnold Wang
   Aviation Safety Council
3. Hudson Wang
   Civil Aviation Administration
4. S.S. Chang
   Trans Asia Airways
5. Mark Moore
   ATR Company

II. History of Activities

Date	Description
2002/12/21	Addressed VP and Managers of TNA Maintenance and Engineering Division that ASC requires all B22708 maintenance records. Reviewed 25 technical logbooks in 2002.
2002/12/23	Received and started to review maintenance records including: Aircraft Logbook, Technical Logbooks, Propeller Logbooks, Work Sheet of the Routine Checks, Airworthiness Directives, Service Bulletins, Aircraft Logbook and Propeller Logbooks of Gill Airways and maintenance records approved by CAA of UK.
2002/12/24	ATR Representative provided a list of the AD/SB, Service Letter and all Operator Messages for reference.
2002/12/26	Received and started to review Approved Maintenance Program, Continuous Airworthiness Maintenance Program, Maintenance Planning Document, Maintenance Review Board, ATR SB work sheet, ENGINEERING SB work sheet.
2002/12/27	Interviewed mechanic who performed transit-check and released B22708 on accident day.
2002/12/27 2003/01/05	Reviewed the work sheet of AD and SB, Aircraft Logbook and Technical Logbook. Verified TNA completed AD 83-ATR-108G1 (or FAA AD 96-09-28) on 1996/12/24
2002/12/30	Together with Mr. Marc Moore, ATR Structure Manager examined wreckage pictures in ASC.
2003/01/07	Together with AR of BEA attended TNA presentation of ATR72 Anti Icing / De-icing System by Engineer and observed ground test of de-icing boots at TNA hangar.
2003/01/08	Reviewed the damage condition and maintenance procedures of left hand wing tip de-icing boot referring SDR of B22708.
2003/01/09	Reviewed AD records concerning ATR 72 De-ice and Anti-ice system.
2003/01/13	Reviewed SB records concerning ATR 72 De-ice an Anti-ice

	system.
2003/01/21	Reviewed CAA Airworthiness Inspection Records In 2002
2003/06/20	Reviewed records of SB of B22708 and found no evaluation records of TNA engineering department to the SB of ATR72-30-1020 and ATR72-30-1039.

III. Factual Description

1.6 Aircraft Information

1.6.1 Basic Information

According to TNA maintenance records (see attachment 7-1), the B22708 maintenance works were completed in accordance with the TNA aircraft maintenance program. All the Airworthiness Directives(AD) were completed in compliance with CAA regulation.

Before the accident, there was no deferred item to the aircraft. The basic aircraft information was listed as table 1.6-1 below.

Table 1.6-1 Basic Information

No.	Item	Description
1	Registration Number	B22708
2	Type	ATR-72-200
3	Manufacturer	Avions De Transport Regional, France
4	Serial Number	322
5	Manufacturing Date	The third quarter of 1992
6	Delivering Date	1992/08/25
7	Operator	TNA
8	Owner	TNA
9	Main Deck Design	Bulk Cargo
10	Airworthy until	2003/02/15
11	Total Fight Hours	19,254：27
12	Cycles	25,529
13	Type and Date of Latest Heavy Maintenance	7C 2001/06/17
14	Type and Date of Estimated Next Maintenance check	8C / Before 19,501 hours
15	Hours at Each C Check	3,600Hours

This aircraft was delivered from Toulouse, France to Taipei, Taiwan in November 1992. It had been used as domestic passenger flight for six years before leased to Gill Airways, United Kingdom on October 15, 1998. It was registered as G-BXYV to service as a “COMBI” for three years in United Kingdom. This aircraft ferried back to Taiwan after the leasing contract terminated and changed the type certificate to be a bulk cargo aircraft. It was registered as B22708 again by CAA, Taiwan. The service history in Taiwan and UK was listed as table1.6-2.

Table1.6-2 Servicing history in Taiwan and UK

Description	**Date**
Manufactured Date	Third quarter of 1992
Date of Ferry flight from Toulouse	1992/09/24
Date of arrival at Taipei	1992/09 /28
Domestic flight in Taiwan	1992/10/06~1998/09/18
Date of ferry flight to Newcastle International Airport, UK	1998/09/22
Commercial Flight in Gill Airways	1998/10/15~2000/02/21
Date of ferry flight from UK to Taiwan	2001/12/30
Type certificate change in Taiwan to bulk cargo aircraft	2002/02/18~2002/12/21

Table 1.6-3 Heavy maintenance schedule **Check**	**Completed Date**	**Flight Hour**	**Flight Cycle**	**Done by**
1C	1993/08/31	1862:20	2746	TNA
2C	1994/06/25	3569:46	5537	TNA
3C	1995/08/22	5320:15	8524	TNA
4C	1996/03/12	7048:49	11584	TNA
5C	1997/05/13	9212:19	15293	TNA
6C	1998/02/20	10784:03	17998	TNA
1CFH/2CFH/2CCA	1999/11/15	13854	21037	GILL
1CFH/2CFH	2000/06/28	15054	22103	GILL
1CFH/2CFH	2001/06/21	16808	23997	GILL.
7C	2002/06/17	18088:08	24974	TNA

Table 1.6-4 Major Repair/Alternation List

Item	Date	Description
1	2002/02/22	ATR72 freighter conversion for class “E” freighter requirement
2	2001/03/17	Install Collins TCAS and 2 ATC mode S and Sextant VSI/TCAS on Collins radio NAV system
3	2002/10/07	Modification to passenger compartment interior

1.6.2 Engine Information

This aircraft used two PWC124B engines with the information as Table 1.6-3:

Table 1.6-4 PW124B Engine Information

Position	Serial No	Date of Manufacturing	Date of Installation	Flight Hours after installed	Total Flight Hours	Total cycles
1	124636	1993/03	2002/01/24	1,871:39	15,638:58	23,469
2	124420	1990/10	2002/08/26	693:05	18,605:52	29,076

1.6.3 Propeller Information

Two Hamilton Standard 14SF-11, 806660-1 propellers were installed and the basic information was listed as following：

Table 1.6-5 Basic information of propeller 806660-1

Position	Serial No	Manufactured by	Date of Installation	Time after Installation	Total Flight Hours	Total Cycles
1	MFG930320	Hamilton Standard, United Tech. Co.	2001/10/15	1,871:39	6,956:00	6,477
2	MFG930321	Hamilton	2001/10/15	1,871:39	1,901:51	917

		Standard, United Tech. Co.				

1.6.9 ATR 72 Anti/De-icing System Maintenance Record

According to TNA aircraft Maintenance Program, the wing de-icing boot was scheduled to be inspected each C check. The latest 7C check was completed on June 21,2001.

1.6.9.1 The AD of Anti/De-Icing System

The contents and performance of the AD in Anti/De-icing system of this aircraft were described as following：

1. CAA AD 83-ATR-108G (French DGAC AD 1996-207-031(B) R1) /USA FAA AD 96-09-28) was issued to improve the severe icing condition. This AD changed the operation procedures and the system design. It required the operator to revise the “Operation Limitations” and ”Operation procedures” of Aircraft Flight Manual before July 10,1996.also required to complete the following works before December 11,1996:

(1) Change the logic circuit of flap extension (SB ATR72-27-1039),

(2) Install the wider de-icing boots at both outer wing leading edges (SB ATR72-30-1023 & 57-1015 & 57-1016).

Reviewed the AD records of TNA and verified:

(1) This aircraft completed the SB ATR72-27-1039 on March 17,1996,

(2) This aircraft completed the SB ATR72-30-1023, ATR72-57-1015 and ATR72-57-1016 on December 2,1996,

(3) The TNA Engineering Department requested the Flight Operations Division to revise the Aircraft Flight Manual on May 23,1996. The Flight Operations Division responded and confirmed the revision of AFM completed on May 31,1996.

2. CAA AD 88-ATR-146B (French DGAC AD 1999-015-040(B) R1/ USA FAA AD 99-09-19) Requested to revise ATR72 AFM regarding the description of

severe icing condition:

(1) The AFM of ATR 72 had to be revised before May 4,1999 regarding the ”Operation Limitation”, ”Normal Procedures” and ”Emergency Procedures”,

(2) The revised contents in AFM should be incorporated in FCOM before May 16,1999.

The performance of this AD in UK and Taiwan were verified as below:

(1) Gill Airways, UK completed this AD on April 22,1999,

(2) TNA purchased from ATR the 14th edition (published on Sep 2000) AFM to comply with the requirement of AD.

Reviewed the revised procedures including the ”Operating limitations”, ”Normal procedures” and ”Emergency procedures” in AFM and found the revised procedures were complied with the AD requirement. The page 9 and 10 of chapter 2.04.05 of FCOM concerning the De/Anti-icing procedures were all revised in July 2000.

3. CAA AD 88-ATR-147A (French DGAC AD 1999-166-041(B) R1)

This AD concerning the aircraft design change in severe icing condition required to complete the following works before September 30,2001:

(1) Change the logic circuit of flashing ”Icing” light (SB ATR72-30-1034),

(2) Install the wider mid wing leading edge de-icing boots

(SB ATR72-30-1032R1 & 30-1033R1or 30-1037).

Gill Airways, UK completed the SB ATR72-30-1032, 30-1033 & 30-1034 on November 15,1999. SB ATR72-30-1037 was not applied to this aircraft.

4. CAA AD 90-ATR-153 (French DGAC AD 2001-045-054(B))

This AD was issued for revising the description of anti/de-icing system in AFM. It was required to revise the content of the ”Normal procedures” by issuing the 14 th edition revision of AFM before February 18, 2001.

Reviewed this AD record and found:

(1) Gill Airways, UK revised the AFM on January 31,2001,

(2) TNA purchased the 14th edition of AFM（Published in September 2000） during receiving this -returning aircraft from Gill Airways to comply with this AD requirement.

1.6.9.2 The SB Concerning the De/Anti Icing System

The SB concerning the De/Anti-icing system were described as below:

1. SB ATR72-30-1032 (Installed the extended de-icing boots) ,ATR72-30-1033(Installed the wider de-icing boots)and ATR72-30-1034(Change the logic circuit of ice detection light)were the contents of CAA AD 88-ATR-147A (DGAC AD 1999-166-041(B)) .According to the airworthiness records of CAA,UK and the work order number 000029 of Gill Airways on November 15,1999, those SB were all completed in accordance with the AD requirement.

2. The SB ATR72-30-1014 (Change the ice detection function) SB ATR72-30-1026 (Change number 1 and 2 wing leading edge de-icing boots), and SB ATR72-30-1030 (Change the pressure regulator and shut off valve of de-icing system) were optional SB and not applied to this aircraft after evaluated by TNA Engineering Department .

3. The SB ATR72-30-1027 (Avoiding the over heat to the painting of elevators and rudder horns) and ATR72-30-1028 (Avoiding the over heat to the painting of aileron horn) were the kind of recommended SB and not applied after the evaluation of the TNA Engineering Department.

4. The SB ATR72-30-1020 (Anti-icing valve seat heating) and ATR72-30-1039 (Avoiding the electricity leaking from propeller to damage the 15th bearing) were the kind of optional SB and not applied to this aircraft. The engineering evaluation records of these two SB were not provided by TNA.

1.6.9.3 Aircraft Logbook entries for De/Anti Icing System

The Aircraft Logbook entries from 2001/12/21 to 2002/12/21 were reviewed. The following Logbook entries identify the discrepancy and the work accomplished regarding to de/anti Icing System:

- Aircraft Log dated Jan 02, 2002, indicated that propeller de-icing system

block out for #1 engine. The propeller brush block assembly was replaced and function checked normal.

- Aircraft Log dated Jan 02, 2002, reported that propeller de-icing system block out for #2 engine. The propeller brush block assembly was replaced and function checked normal.
- Aircraft Log dated Jan 02, 2002, the dual airframe de-icing distribution valve was replaced for work order requires and function checked normal.
- Aircraft Log dated Jan 02, 2002, the de-icing regulator/shutoff valve was replaced for re-certification purpose. The function checked was normal.
- Aircraft Log dated Jan 09, 2002, indicated that propeller de-icing system block out for #1 engine. The propeller brush block assembly was replaced and function checked normal.
- Aircraft Log dated Apr 04, 2002, indicated that IEP light was out. The light bulb was replaced and illumination checked normal.
- Aircraft Log dated May 11, 2002, write-up that anti-icing propeller 2 fault was occurred. The item was deferred and MEL 30-61-1 was applied.
- Aircraft Log dated May 13, 2002, that anti-icing propeller 2 fault was closed due to replacement of the propellers.
- Aircraft Log dated May 18, 2002, indicated that anti-icing propeller 1 fault was occurred. The item was deferred and MEL 30-61-1 was applied.
- Aircraft Log dated May 19, 2002, that anti-icing propeller 1 fault was fixed due to replacement of the propellers.
- Aircraft Log dated Jul 08, 2002, found L/H air intake duct clamp was installed wrong direction. It was reinstalled and the item was cleared.
- Aircraft Log dated Aug 24, 2002, indicated that L/H wing outboard side boot was sustained impact damage during engine run-up in Macau. The whole leading edge boot was replaced and operation checked normal.
- Aircraft Log dated Oct 27, 2002, found #1 engine air intake broken at 6 o'clock position. The intake was replaced and function check normal.
- Aircraft Log dated Nov 18, 2002, indicated that #2 engine propeller de-icing system block brushes length less than 9 ㎜. The propeller brush block assembly was replaced and operation checked normal.

1.6.10 The TNA AD and SB Records Keeping

During reviewing the records of the AD and SB applied to B22708, investigators found that TNA maintained the records by following the procedures described in item 2-7,section 10, in Chapter 3 of Aircraft Maintenance Control Manual (AMCM published on April 10,1996). The TNA

Maintenance Manager expressed that the cover page of the work order sheet of AD and SB were kept on file but not the working procedures and parts replacement records before August 1997.

The Aircraft Maintenance Control Manual, AMCM published on August 13,1997 stated the processes of SB, SIL (Service Information Letter), AD and Engineering Order, EO but without stating the keeping time required. Before the year of 1997,TNA completed the AD and SB by following the procedures of ”The handling of AD and SB” that stated at item 2-7, section 10, in Chapter 3 of the AMCM approved by CAA. The AMCM stated:

1. *The engineer printed out the Work Order Sheet with the AD and SB attached and passed it to Principal Production Control, PPC. The PPC issued the work order to the Maintenance Shop and Quality Control Center, QCC.*

2. *After the work completed by the Maintenance Shop and QCC , the PPC made the record in Aircraft Logbook and returned the work order sheet to the Engineering Section.*

3. *When all the work applied to the aircraft completed, Engineering Section made two Engineering Authorization/ Modification sheet, one for CAA and one for his own copy.*

1.6.11 The CAA Regulation of Record Keeping

According to the Civil Aircraft Maintenance and Release Procedures revised on October 24,1995, it stated: the record keeping time unless described at other place, should be kept as a basic record, such as the Aircraft Logbook, for two more years after the termination of usage, phase out on the damaged aircraft, engine and propeller.

To alteration, configuration change or fabrication, the procedures of Civil Aircraft Maintenance and Release stated:

> *After completing the alteration, configuration change and fabrication works, not only the working records and references, but the major contents including work card number, file number, issued work sheet number, part number, serial number, type, component, description and alteration should be kept for two years in the*

Aircraft Logbook and Engine /Propeller Logbook for reference.

There was an order in the Airworthiness Inspector's Manual published on March 25,1996 describing the record keeping:

The Job Function 1& 2

- The inspection procedures at main and secondary base:

"B. Inspect the database of the operator: Verify that all the technical data are updated and can be retrieved. If the data is stored in microfilm, an available device of reading should be provided. If applicable, the technical data should contain: Procedures,

Operator's General Maintenance Manual, Manufacturer's Aircraft Maintenance Manual, Original Manufacturer's Propeller, Engine, Applied equipments and Emergency Equipments Manual, Original Manufacturer's Service Bulletin/Letter, Applicable CAA Regulation, Applicable AD, Applicable type certificate information and supplemental type certification, Approved Aircraft Flight Manual, Operator's Maintenance Record."

C. Review the aircraft maintenance record keeping mechanism to verify the following:

(1) All maintenance work were completed by following the maintenance manual

(2)Systematically provide the methods to retrieve the records for a reasonable long time

The JOB FUNCTION 5, Spot Inspection in Airworthiness Inspector's Handbook stated the items to be inspected as the following:

Maintenance Records

During performing the Spot Inspection, the inspector should notice the following records of AD including the dissemination control and procedures.

Procedures C. Prepare to inspect the following items:

The new regulation or AD that applied to the aircraft for inspection.

1.6.12 The CAA Airworthiness (Maintenance and Avionics) Inspection

1.6.12.1 The Organization of CAA Airworthiness Inspection

There are five inspecting groups in CAA to inspect the domestic airlines and repair stations. They are China Airlines Inspecting Group, EVA Airways Inspecting Group, General Aviation Inspecting Group, Repair Station Inspecting Group and Regional Airlines Inspecting Group. The Regional Airlines Inspecting Group inspects TNA. The Regional Airlines Inspecting Group is organized by a Chief Inspector, three airworthiness inspectors (including two Principal Maintenance Inspectors and one Assistant Maintenance Inspector) and two Avionic inspectors (including one Principal Avionic Inspector and an Assistant Avionics Inspector).The Regional Airlines Inspection Group will inspect the airworthiness of TNA, Far Eastern Air Transport, CAA and Official aircraft fleet.

1.6.12.2 The Duty of Maintenance/Avionic Inspector

Inspectors are the media of airworthiness inspection between CAA and TNA. The inspector has the accountabilities to ensure the maintenance, preventive maintenance and major alteration programs of TNA are all complied with CAA regulations.

1.6.12.3 The CAA Airworthiness Inspection

The CAA inspectors inspect the continuous airworthiness maintenance program and monitor the different phases of the maintenance work including the maintenance, engineering, quality control, training and program of reliability of the airlines by following the Inspector’s Handbook. It is required to assure the aircraft maintenance work including the maintenance manual, airworthiness, aircraft release, periodic maintenance, qualified human resources, tool and equipments are meeting the airworthiness standard and complied with the CAA regulations, the CAA approved manuals, programs and

procedures.

1.6.12.4 Airworthiness Directives （AD）Inspection of CAA

There is an Aircraft Design , Manufacturing and Certification Institute （ACI）established under the civil law by CAA. ACI will publish the AD in accordance with the CAA regulation. According to the 5.2.2 ,Chapter 4 of the Operating Manual of ACI(attachment 7-35), it describes：

> *5.2.2 The AD issued by the Civil Aviation Authority of the original aircraft manufacturer: After ACI received the AD from the foreign countries, ACI will examine the AD. The contents examined by ACI are the effective date, compliance time or period and the necessary to send a feed back report to CAA. The examined conclusion will be recorded in the content of the AD. CAA will issue the AD. When the AD is directly adopted from the foreign authority, there is no necessary to be approved by CAA for the ACI to issue the AD.』*

The job function 12 in Airworthiness Inspector Hand Book （Attachment 7-33）has established the procedures for CAA to perform the continuous airworthiness inspection to AD.

1.17.2 The TNA Organization of Maintenance & Engineering Division

The organization and human resources of the Maintenance & Engineering Division is shown on the chart 1.17-2. There are 91 CAA A/E license holders and 6 FAA A/P license holders in TNA.

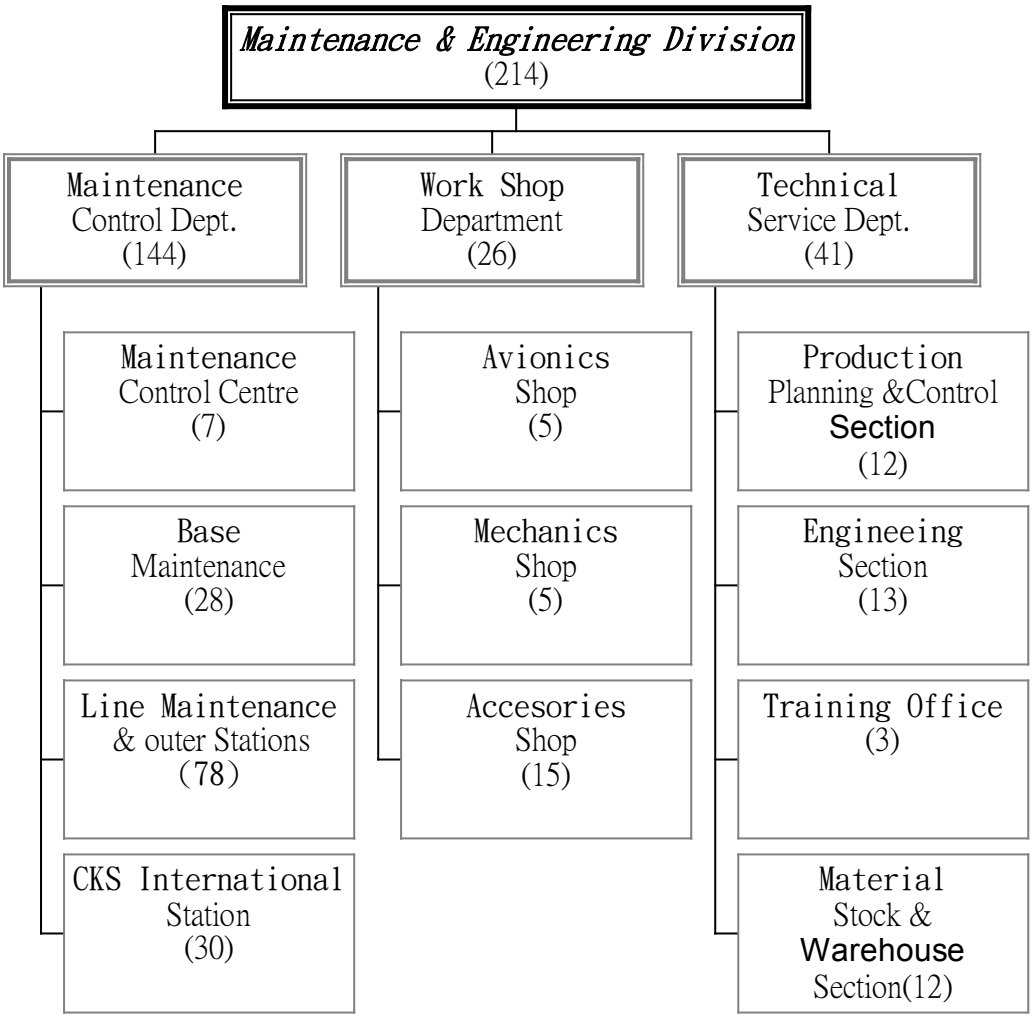

Figure 1.17-2 The Organization Chart of Maintenance and Engineering Division

IV. Attachment

7-1. Aircraft Log Book*2
7-2. No.1 Engine s/n 124636 Log Book
7-3. No.2 Engine S/N 124420 Log Book
7-4. Both Engine Original Log Book*2
7-5. Propeller S/N MFG930320 & MFG 930321 Log Book
7-6. GILL AIRWAYS Propeller Log Book*2
7-7. GILL AIRWAYS Aircraft Log Book
7-8. Acceptance Check and 5 A Check and 10 Y+10 CCA Check Work Order
7-9. TNA Completed AD* 12
7-10. A/C Delivery Data
7-11. Engine RAI Job Card*2
7-12. A/C Weight & Balance List and BSI Inspection Report*2 and SDR*4
7-13. GILL AIRWAYS Work Sheet 1~3 (15 Volumes)
7-14. GILL AIRWAYS Work Sheet 4 & Persevere Inspection*5(6 Volumes)
7-15. GILL AIRWAYS Work Sheet 5~9. (5 Volumes)
7-16. GILL AIRWAYS Work Sheet 10~13. (5 Volumes)
7-17. GILL AIRWAYS Certificate on Board and Technical. Log Book. (Oct/1998~Jan/2000 & Oct/2001~)
7-18. GILL AIRWAYS Technical Log Book.(Feb/2000~May/2001)
7-19. GILL AIRWAYS Technical Log Book *2.(Jun/2001~Sep/2001) and DD Files
7-20. UK CAA Approved Maintenance Schedule
7-21. GILL AIRWAYS Condition. Monitoring maintenance Program
7-22. GILL AIRWAYS MIPS Task Cards
7-23. Technical Log Book from Jan/16/2002 to Dec/15 /2002 (25 Volumes)
7-24. ATR-72 Maintenance Planning Data
7-25. ATR-72 Maintenance Review Board
7-26. ATR-72 Aircraft Continuous Maintenance Program
7-27. ATR-72 Maintenance Manual
7-28. ATR-72 Wiring Manual
7-29. ATR-72 Illustrated Parts Catalogue
7-30. PWC Engine Maintenance Manual
7-31. ATA 30 Service Bulletin* 10 and Airworthiness Directives*4
7-32. Aircraft Maintenance Procedural of the Civil Aeronautics Administration, 1995
7-33. Airworthiness Inspector’s Handbook of the Civil Aeronautics

Administration, 2000
7-34. TNA Aircraft Maintenance Control Manual, 2002
7-35. The Operating Manual of Aircraft Certification Institute

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