



ARAIB

ARAIB/AIR-0908

AIRCRAFT SERIOUS INCIDENT REPORT

COCKPIT WINDSHIELD CRACKED IN FLIGHT

KOREAN AIR

A330-300, HL7551

70 NM WEST OF THE INCHEON INTERNATIONAL AIRPORT

30 NOVEMBER 2009



8 June 2011

**AVIATION AND RAILWAY ACCIDENT INVESTIGATION BOARD
MINISTRY OF LAND, TRANSPORT AND MARITIME AFFAIRS
REPUBLIC OF KOREA**

According to the provisions of the Article 30 of the Aviation and Railway Accident Investigation Act of the Republic of Korea, it is stipulated;

The accident investigation shall be conducted separately from any judicial, administrative disposition or administrative lawsuit proceedings associated with civil or criminal liability.

And in the Annex 13 to the Convention on International Civil Aviation, Paragraphs 3.1 and 5.4.1, it is stipulated as follows;

The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability. Any investigation conducted in accordance with the provision of this Annex shall be separate from any judicial or administrative proceedings to apportion blame or liability.

Thus, this investigation report issued as the result of the investigation on the basis of the Aviation and Railway Accident Investigation Act of the Republic of Korea and the Annex 13 to the Convention on International Civil Aviation, shall not be used for any other purpose than to improve aviation safety.

In case of divergent interpretation of this report between the Korean and English languages, the Korean text shall prevail.

Aircraft Serious Incident Report

Aviation and Railway Accident Investigation Board. Cockpit Windshield Crack, Korean Air, A330-300, HL7551, 70 NM west of the Incheon International Airport, 30 November 2009. Aircraft Serious Incident Report ARAIB/AIR-0908. Seoul, Republic of Korea

Korea Aviation and Railway Accident Investigation Board (ARAIB) is a government organization for independent investigation of aviation and railway accident, and the accident investigation shall be carried out based on the Aviation and Railway Accident Investigation Law of the Republic of Korea and the Annex 13 to the Convention on International Civil Aviation.

The objective of accident or incident investigation of the Korea Aviation and Railway Accident Investigation Board is not to apportion blame or liability but to prevent accidents and incidents.

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Cockpit windshield cracked in flight

Korean Air

Airbus Industries, France

A330-300, HL7551

70 NM west of the Incheon International Airport

Latitude: N37°24 ' 13 " , Longitude: E125°39 ' 05 "

30 November 2009, at about 15:34 (06:34 UTC)¹⁾

Executive Summary

On 30 November 2009 at about 15:34, a Korean Air A330-300 (Registration HL7551, hereinafter referred to as "HL7551 aircraft") performing flight KE955 from the Incheon International Airport, Republic of Korea to the Istanbul International Airport, Turkey, was climbing out of 25,000 feet. At that time, a severe cracks occurred on the inside of the windshield²⁾ of the captain's side with a sound "Puck", and finely broken pieces of glass dropped down. So the captain gave up continuing the flight to the destination and returned to the Incheon International Airport. 168 passengers and 15 crew were on board the HL7551 aircraft, but there was no injuries due to this event.

The Aviation and Railway Accident Investigation Board determines that the causes of this serious incident was that 「As the windshield has been used for a long period, the silicone pressure seal was torn due to wear. An arcing occurred on the braid wire of the windshield heating system due to a double insulation failure. And eventually two structural plies have cracked due to a high overheating in the vicinity of the lower braid wire of the heating system.」

As a result of this investigation, the Aviation and Railway Accident Investigation Board make two safety recommendations to Airbus Industries, France.

1) Unless otherwise indicated, all times in this report are Korea Standard Time (KST, UTC+9)

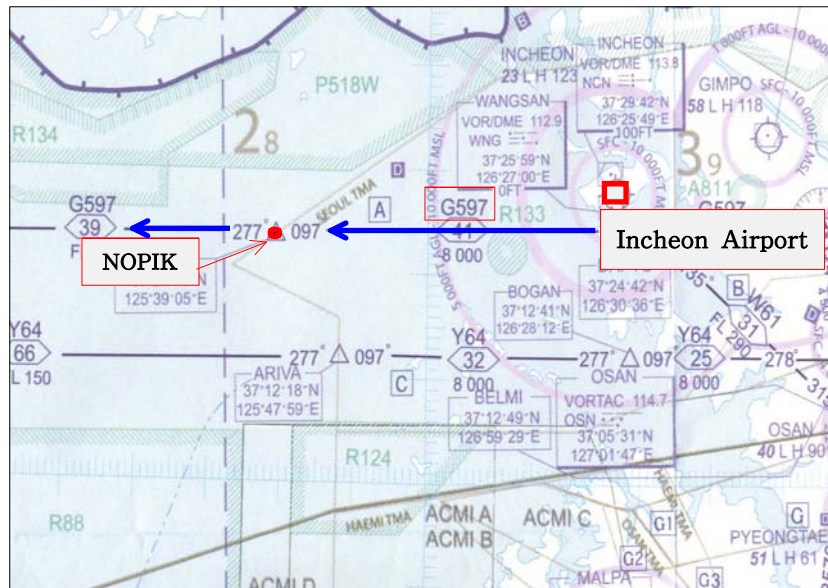
2) A windshield is made up of three-ply glass. The outer glass takes impact, and the middle and inner glass take structural load and cabin pressure.

1. Factual Information

1.1 History of Flight

The HL7551 aircraft departed the Incheon International Airport for the Istanbul International Airport, Turkey at about 15:00 on 30 November 2009. At 15:34:04, when it was climbing out of 20,000 feet on G597 airway, "L WSHLD HEAT" warning was displayed.

The flight crew executed the procedures displaced on ECAM³⁾ for the "L WSHLD HEAT" warning and continued to climb, and when they passed near a waypoint NOPIK (altitude 25,000 feet) at 15:35:05, a cracks so serious as to make it difficult to look ahead occurred on the inner glass of the windshield (L1 windshield) on the captain's side along with a sound "Puck."



[Fig. 1] Place where the incident occurred

So the captain discontinued to climb, handed over the control to the first officer, and started an emergency descent to 10,000 ft with a clearance of the air traffic controller. But, at 15:35:32, immediately after the descent was started, pieces of the inner glass windshield were broken finely with a sound "puck" and dropped down.

3) ECAM (Electronic Crew Alert Monitoring System): a device for displaying references about flight on a display unit

Because the aircraft landing weight exceeded the maximum landing weight at that time, after the flight crew carried out the procedures for the overweight landing, the first officer performed an autoland on the runway 33L of the Incheon International Airport.

1.2 Injuries to Persons

Injuries	Crew	Passenger	Others
Fatal	0	0	0
Serious	0	0	0
Minor / None	15	168	0

1.3 Damage to Aircraft

As shown in [Photo 1], a serious cracks occurred on the inside of L1 windshield.



[Photo 1] L1 windshield damaged

1.4 Other Damage

Not applicable

1.5 Personnel Information

1.5.1 The Captain

The captain (age 51, male) held a valid Airline Transport Pilot License⁴), A330 type rating⁵), Class 1 Medical Certificate⁶), Radio Operator Certificate⁷), and Level 4 in English Proficiency. His total flying time was 7,590 hours including 4,935 hours on A330, 1,450 hours as captain, 135 hours for the latest three months and 47 hours for the latest one month.

He completed a proficiency check on 4 September 2009 and a line check on 17 September 2009. He took a rest at home for 72 hours before the Flight 955 on 30 November 2009.

1.5.2 The First Officer

The first officer (age 38, male) held a valid Commercial Pilot License⁸), A330 type rating⁹), Class 1 Medical Certificate¹⁰), Radio operator certificate¹¹), and Level 4 in English Proficiency. His total flying time was 2,901 hours including 641 on A330, 173 for the latest three months and 56 hours for the latest one month.

He completed a line check on 19 October 2009 and a proficiency check on 28 November 2009. He took a flight simulator training on 27 November 2009, had a proficiency check on 28th, and took a rest at home on 29 November.

1.6 Aircraft Information

1.6.1 Aircraft History

The HL7551 aircraft was manufactured¹²) by Airbus Industries in April 1997, was

4) Qualification number: 2332 (Issued on 28 May 2009; passed on 4 March 2004)

5) Obtained on 10 July 2000

6) Certificate number: 111-0030 (Expiry 31 July 2010)

7) Certificate number: 96-34-1-0211(Issued on 17 October 2005)

8) Qualification number: 6444 (Passed on 5 April 2007, issued on 26 May 2008)

9) Obtained on 23 May 2008

10) Certificate number: 103-2207 (Expiry 30 June 2010)

11) Certificate number: 07-34-2-0026 (Issued 14 February 2007)

12) Manufacturing number: 172

introduced and registered¹³⁾ by the Korean Air on 30 May 1997, and had held a valid Airworthiness Certificate¹⁴⁾.

Its total flight time was 37,178 hours, and the number of takeoff and landing was 16,344 cycles. The HL7551 aircraft had an ISI check¹⁵⁾ on 9 July 2007, A check¹⁶⁾ on 28 September 2009, and C¹⁷⁾ check on 21 October 2009.

1.6.2 Weight and Balance

The weight and balance data of the HL7551 aircraft was as follows;

- Zero fuel weight (ZFW)..... 144,771 kg (Maximum 168,970 kg)
- Takeoff fuel (TOF)..... 68,811 kg
- Takeoff weight (TOW)..... 213,582 kg (Maximum 217,000 kg)
- Trip fuel (TIF)..... 61,553 kg
- Landing weight (LDW)..... 152,029 kg (Maximum 179,000 kg)
- Landing weight Center of Gravity (LDW C.G % MAC): 25.1 % MAC
 - ※ Limit Range: 13.2 % ~ 32.1 % MAC

1.6.3 Windshield

1.6.3.1 Windshield Information

The information regarding the damaged windshield (hereinafter referred to as "pre-mod windshield") is as below;

- Manufacturer: Saint-Gobain Sully, France (hereinafter referred to as "SGS")
- Part number: SPSA340-2-4-1A
- Serial number: 2883
- Manufacturing date: June 2002
- Mounting date: 29 June 2004

13) Registration number: 97-20

14) Number: AS05023 (29 December 2009)

15) ISI (Internal Structure Inspection): Maintenance activity for checking the condition of aircraft structure at a cycle of 5 years

16) A check: Maintenance activity for checking the aircraft systems at a cycle of 600 flight hours

17) C Check: Maintenance activity for heavy repair checking the aircraft systems at a cycle of 18 months

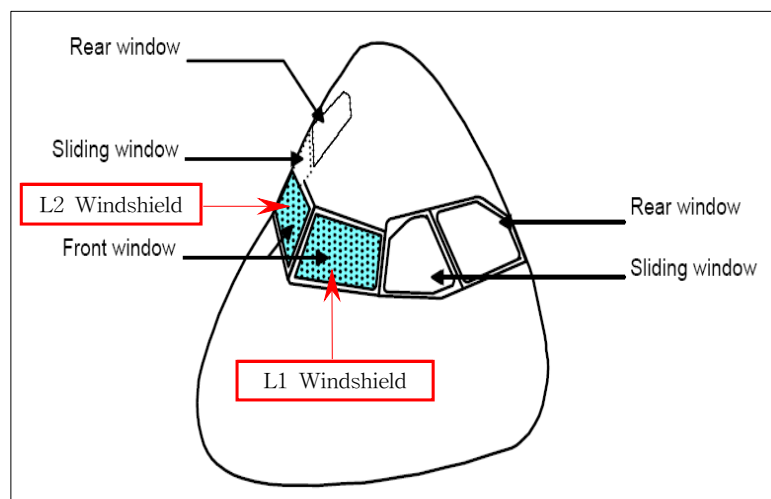
- Flight hours: 19,236 hours
- Flight cycles: 7,481 cycles

The pre-mod windshield is not produced anymore by the Saint-Gobain Sully, the new design products¹⁸⁾ (hereinafter referred to as "new design windshield") are currently produced, in which the routing and the protection of the two power braids have been improved. But there is no AD (Airworthiness Directive) applicable to the pre-mod windshield, which are still possible to be used on aircraft.

The Korean Air's A330 aircraft have equipped with the products of two (2) manufacturers / three types of part number¹⁹⁾, only four (4) of A330 aircraft equipped with the pre-mod windshield, which is the same type as the damaged windshield. The Korean Air has been keeping all three types of windshields as the spare parts.

1.6.3.2 Windshield System

The cockpit windshields play a role of enduring the wind and preserving the cabin pressure while the aircraft is flying, and is mounted as shown in [Fig.2]. The edge of the windshield is covered with the silicone pressure seal so as to ensure correct fitting of the windshield into the cockpit window frame and to ensure the air pressure insulation.

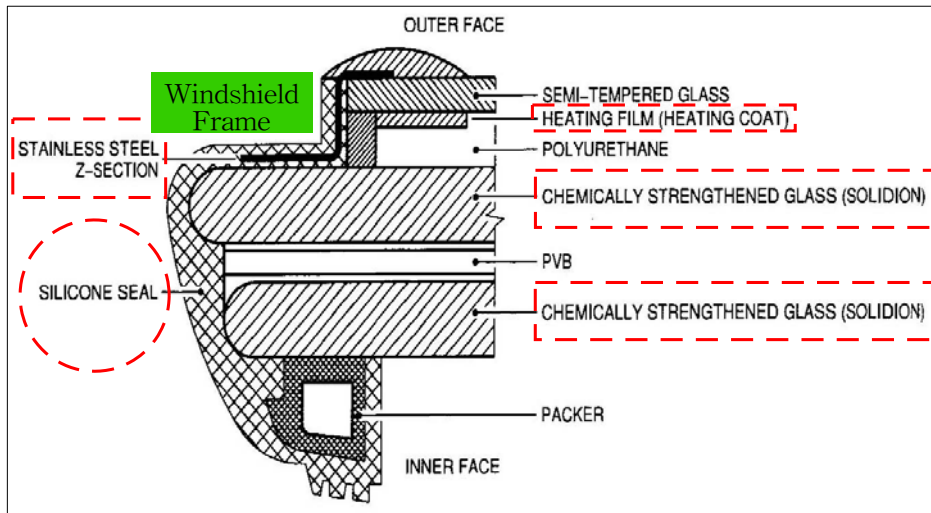


[Fig. 2] Location of windshield

18) Part number: SPSA340-1-5-2 (Because the detailed material regarding to the new design contain SGS's proprietary information, it shall not be disclosed.)

19) Two companies: PPG and SGS, Three types of Part number: one of the PPG product, two of the SGS (a pre-mod and a new design)

As shown in [Fig. 3], the windshield is made of three-ply (outer, middle and inner) of glasses. On the outside is thermally strengthened glass, and beneath it is heating film for the windshield heating. And so as to endure the cabin pressure in flight, there are two plies of thick chemically strengthened glass, and between them is a thick PVB (Polyvinyl Butyral) to play a role of buffer.



[Fig. 3] Composition of Windshield Layers

The outer glass takes external shock and the inner glass takes the load of the structure. Therefore, when a cockpit windshield or window is cracked in flight, the flight crew must apply the QRH 2.30 (Cockpit Windshield/Window Cracked) procedures which requires to reduce the maximum Flight Level and reduce the differential pressure to 5 psi as shown in [Fig. 4].

COCKPIT WINDSHIELD/WINDOW CRACKED					
- MAX FL	.....	230			
- CAB PRESS MODE SEL	.....	MAN			
- MAN V/S CTL	.....	AS RQRD			
Set the cabin altitude, according to the table below.					
ΔP = 5 PSI	FL	100	150	200	230
	CABIN ALTITUDE	0	3000	6000	8000
● When starting the final descent :					
- CAB PRESS MODE SEL	.....	AUTO			
<i>Note : If sufficient visibility is not granted for approach, consider AUTOLAND. If AUTOLAND is not available, consider opening the sliding window on the PF's side, after cabin depressurization. To manually depressurize the cabin :</i>					
- CAB PRESS MODE SEL	.....	MAN			
- MAN V/S CTL	.....	FULL UP			
<i>Due to the increased noise level, pay particular attention to visual warnings.</i>					

[Fig. 4] 「Cockpit Windshield/Window Cracked」 procedures

And it is noted that if sufficient visibility is not granted for approach, consider AUTOLAND. If AUTOLAND is not available, consider opening the sliding window on the PF's side after cabin depressurization, then land manually.

According to the information of Airbus Industries, a test has been positively performed and has shown sufficient residual strength to sustain pressurization with the two structural windshield plies broken during a time sufficient to land the aircraft safely in the conditions requested by procedures above.

1.6.3.3 Windshield Inspection and Defects

The inspection of A330 windshields is carried out by a method of a detailed visual inspection based on the check card at every A check and C check. The Maintenance Manual of the manufacturer define the in-use limits of acceptable defects²⁰⁾ for the windshield, a windshield has to be replaced if it exceeds²¹⁾ a defined limit. But the silicone seal of the windshield was inside the windshield retainer, so it is difficult to discover unless it is demounted. If the windshield retainer is demounted, the retainer can be re-used but the silicone seal may be damaged due to the retainer removal.

On the Korean Air's A330 aircraft were mounted two companies products (three kinds of windshield), and the windshield replacements for defects had occurred average 10 times a year in last three years. But there was no defect by the torn of the silicone seal such as this serious incident. There was no problem on a pre-mod windshield up to now even though it had been mounted on year 2001, but a windshield had been replaced only a week after its delivery even though it was a new design windshield.

According to the information from Airbus Industries, the similar events on the A330/A340 family which have been reported to Airbus (6 cases in total including this case, from which 3 led to two structural plies cracked) have shown a large dispersion in terms of the flight hours / flight cycles. Those events ranged from 6,000 to 25,000 flight hours and from 900 to 9,000 flight cycles, and occurred from 2 to 7 years after delivery.

20) The kind of defects: Delamination, Bubbles, Yellowing discoloration, Micro flakes, Burning, Line cracks, Laminar cracks, Scratches, Splinters, Electrical defects, Edge seal damaged, Terminal block or plug damaged, Weather-seal

21) "On condition" - Maintenance

1.7 Meteorological Information

The weather²²⁾ at the time of HL7551 aircraft's takeoff was wind 310° / 6 knots, visibility 10 km, no clouds, temperature 8°C, barometer 1,024 hPa, and clear skies with no clouds also on the airway. At the time of event, VMC (visual meteorological condition) prevailed in the area where HL7551 was flying, and no turbulence and precipitation were reported.

1.8 Aids to Navigation

Not applicable

1.9 Communications

Not applicable

1.10 Aerodrome Information

Not applicable

1.11 Flight Recorders**1.11.1 Cockpit Voice Recorder**

The HL7551 aircraft equipped with a solid state cockpit voice recorder that was manufactured²³⁾ by the L-3 Communications, and can record up to two hours. The ARAIB utilized the recording data from the time when the windshield crack was perceived to the time when the emergency landing was completed.

1.11.2 Flight Data Recorder

The HL7551 aircraft equipped with a solid state flight data recorder that was manufactured²⁴⁾ by the Honeywell, and can record at least 25 hours. The ARAIB utilized for the investigation the data recorded from the time when the windshield crack was perceived at first to the time when the emergency landing was completed.

22) Information "G"(14:00)

23) Part number: S200-0012-00, serial number: 01589

24) Part number: 980-4700-042, serial number: 2690

At the time when the windshield crack occurred, the altitude was 25,736 feet and the ambient temperature was -34.5°C , the landing weight exceeded the maximum landing weight, but a recording of hard landing was not found.

1.12 Wreckage and Impact Information

As shown in [Photo 2], there were serious cracks on the middle and inner plies of the L1 windshield, and the finely broken pieces of glasses were dropped on the floor of the cockpit.



[Photo 2] Damaged windshield (L1)

1.13 Medical and Pathological Information

The HL7551 aircraft flight crew held a valid Class 1 Medical Certificate, and it was stated that they had not taken any un-permitted medication or alcoholic beverage before the flight.

1.14 Fire

Not applicable

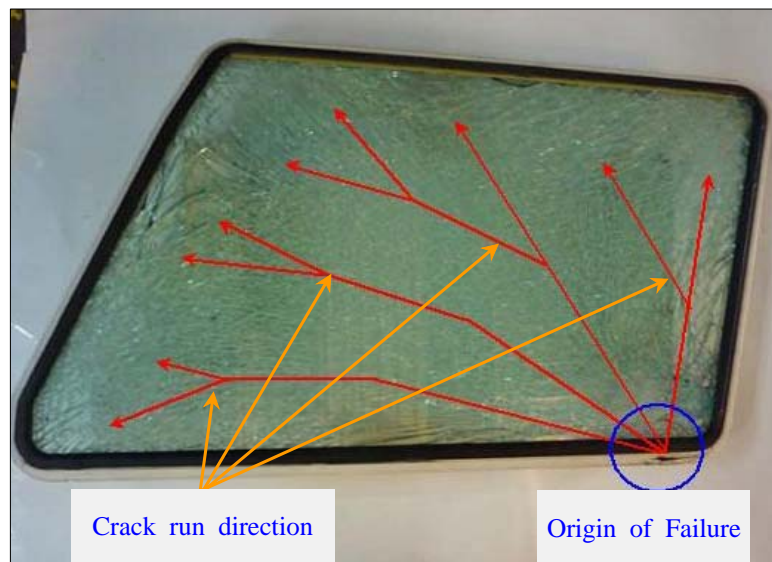
1.15 Survival Aspects

Not applicable

1.16 Test and Research

The ARAIB sent the damaged windshield to the manufacturer Saint-Gobain Sully, France, and a close inspection was conducted under the supervision of the BEA of France at the request of the ARAIB.

As shown in [Photo 3], the windshield crack ran from the inside bottom corner, and as shown in [Photo 4], the silicone pressure seal at the inside bottom corner was torn due to wear as it has been used for a long time, and it was found that there was electric arcing inside.

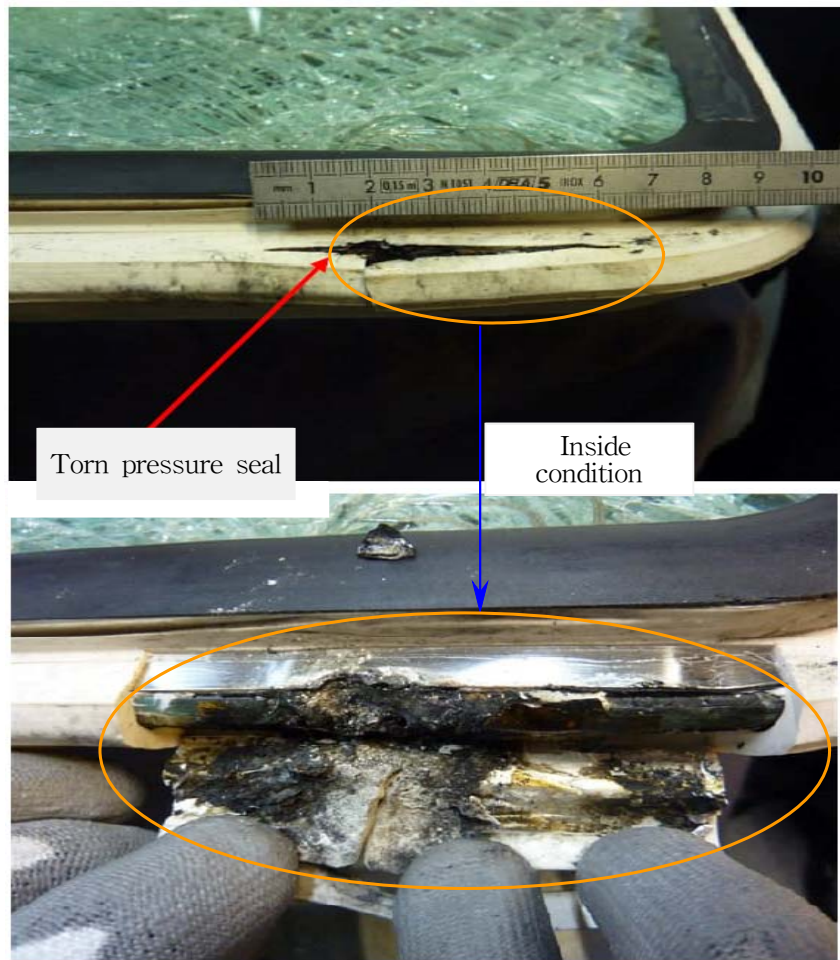


[Photo 3] windshield Crack pattern

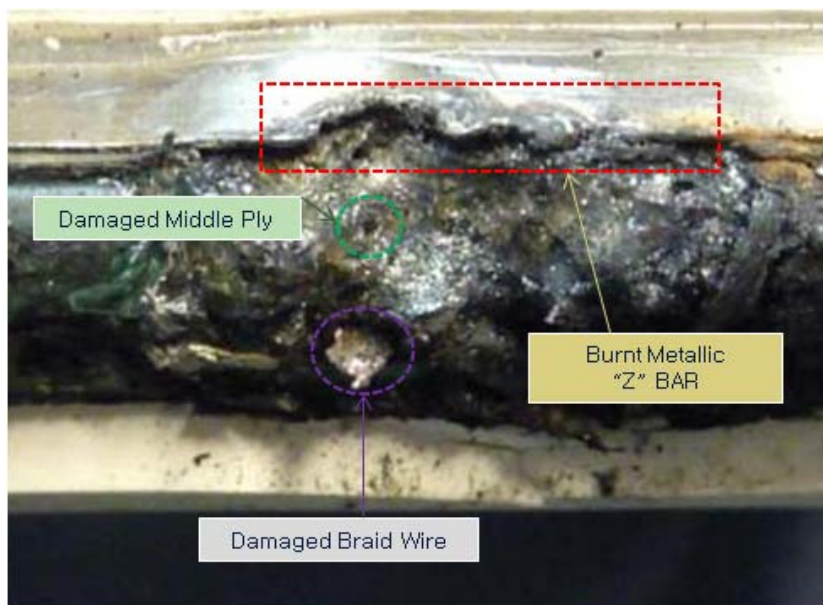
As shown in [Photo 5], the edge of the middle and inner structural plies has been strongly damaged (pieces of glass are missing) by a very high overheating, the metallic "Z" bar and the braid wire have been partially burnt in the vicinity of the overheating.

It was concluded that an arcing occurred due to double insulation failure²⁵⁾ between the braid wire and the metallic "Z" bar, and two structural plies have cracked due to a very high overheating in the vicinity of the lower braid wire of the heating system beneath the metallic "Z" bar.

25) Double insulation failure: ① Silicone pressure seal cut, and loss of insulation between metallic "Z" bar and aircraft structure ② Loss of insulation between lower power braid wire and metallic "Z" bar



[Photo 4] Location of the damaged silicone seal



[Photo 5] Damaged part of the silicone seal

1.17 Organization and Management Information

Not applicable

1.18 Additional Information

Not applicable

2. Analysis

2.1 General

The HL7551 aircraft's flight crew were certified and qualified, and took appropriate rest prior to the flight. And no medical factors which might have adversely influenced their performance, were found.

The aircraft held a valid airworthiness certificate and the flight was conducted within the regulatory limitations of the weight and balance. Any maintenance factors that could have contributed to this incident were not found.

It was appropriate that the flight crew immediately made an emergency descent and then returned to the Incheon International Airport when the inner glasses of the windshield became seriously cracked.

2.2 Examination results of the damaged windshield

According to the examination results of the Saint-Gobain Sully and the BEA, the silicone pressure seal was torn due to wear as the windshield has been used for a long period, an arcing occurred due to double insulation failure between the power braid wire and the metallic "Z" bar, and two structural plies have cracked due to a high overheating in the vicinity of the lower braid wire of the heating system beneath the metallic "Z" bar.

It was confirmed that the causes of the windshield cracks was identical with five previous events, from which two led to the rupture of the two structural plies, which occurred previously on the A330/A340 family, and this windshield design has been modified already through the improvement of the routing and the protection of the two power braids of the heating system in March 2009 according to the modification proposal by the SGS. So, for reason of this, the pre-mod windshield is not produced anymore, and the improved new design is currently produced.

2.3 Windshield Inspection and Management

The Korean Air carry out the inspection of windshields by the method of detailed visual inspection based on the check card at every A check and C check. The HL7551

aircraft received A check on 28 September 2009, and C check on 21 October 2009. But the torn portion of the seal was not discovered in those checks.

The only mean to check any damage of the silicone seal is to perform a visual inspection and the silicone pressure seal is inside the retainer, therefore, it is necessary to demount the retainer in order to inspect the silicone pressure seal. But because a removal of the retainer would induce a possible damage to the silicone pressure seal, it is not used for the windshield inspections in the line. Therefore, it is judged that there is no method to visually check the silicone pressure seal in the periodic checks.

The pre-mod windshield of the SGS has a failure mode that the windshield structure plies could crack by a double insulation failure. For the reason of this failure mode, it is not produced anymore, the improved new design windshield is currently produced. Airbus Industries systematically proposes the post-mode windshield in the IPC (Illustrated Parts Catalog) for any new order. The new design is systematically used for new manufactured windshield and for overhaul and is embodied on aircraft delivered from July 2009.

Since there is no AD (Airworthiness Directive) applicable to the pre-mod windshield, it is still possible to be used on aircraft, and a numerous pre-mod windshields are still mounted on the A330/A340 aircraft all over the world. On the Korean Air's A330 aircraft, both types of windshields were mounted, Korean Air has been still keeping the pre-mod windshields as spare parts.

A test has been positively performed and has shown sufficient residual strength to sustain pressurization with the two structural windshield plies broken during a time sufficient to land the aircraft safely in the conditions requested by FCOM procedures.

The FCOM contains suitable procedures for Cockpit Windshield/Window Cracked. And, as a matter of course, there is no doubt that such a windshield failure mode could not directly result in any kind of accident. But since it is not appropriate that the aircraft fly with such a failure mode windshield(s), it needs to be replaced the pre-mod windshields (SPSA340-2-4-1A) with the windshields that such a problem has been resolved, as soon as practicable.

3. Conclusions

3.1 Findings

1. The HL7551 aircraft's flight crew were certified and qualified, and took appropriate rest prior to the scheduled flight. And no medical factors which might have adversely influenced their performance, were found.
2. The aircraft held a valid airworthiness certificate and the flight was conducted within the regulatory limitations of the weight and balance. Any maintenance factors that could have contributed to the incident were not found.
3. At the time of event, VMC (visual meteorological condition) prevailed in the area where HL7551 was flying, and no turbulence and precipitation were reported.
4. The inspection of A330 windshields is carried out by a method of detailed visual inspection based on the check card at every A check and C check. The Maintenance Manuals of the manufacturers define the in-use limits of acceptable defects for the windshield.
5. The silicone seal of the windshield was inside the windshield retainer, so it is difficult to discover unless it is demounted. If the windshield retainer is demounted, the retainer can be re-used but the silicone seal may be damaged due to the retainer removal.
6. The pre-mod windshields are not produced anymore by the Saint-Gobain Sully. But it is still possible to be used on aircraft, and there is no AD (Airworthiness Directive) applicable to the pre-mod windshield.
7. The routing and the protection of the two power braids have been improved in the new design windshield. The pre-mod and the new design windshields are currently mounted on the Korean Air A330 aircraft together, and the Korean Air has been still keeping the pre-mod windshields as spare parts.
8. When the cockpit windshield is cracked in flight, there is not further damage to the windshield if the differential pressure is reduced to 5 psi.

9. In the QRH of A330 aircraft, the procedures, which reduce the differential pressure to 5 psi when the cockpit windshield is cracked in flight and land the aircraft with a insufficient visibility due to the windshield cracks, are defined.

3.2 Causes

The Aviation and Railway Accident Investigation Board determines that the probable cause of Cockpit Windshield Crack, Korean Air, A330-300 was, that 「As the windshield has been used for a long period, the silicone pressure seal was torn due to wear, and as the result, an arcing occurred on the braid wire of the windshield heating system due to a double insulation failure, and eventually two structural plies have cracked due to a high overheating in the vicinity of the lower braid wire of the heating system.」

3.3 Comments of the BEA, France

In accordance with the ICAO Annex 13, Paragraph 6.3, the ARAIB exchanged opinions on the draft Final Report with the BEA, France, and the Report was amended accordingly. Since, however, not all of their comments were able to be accommodated, with the agreement of the BEA received on 5 April 2011, it was decided to append them in this Report.

4. Safety Recommendations

As a result of an investigation into the serious incident of the Korean Air's A330, HL7551 occurred at 70 NM west of the Incheon International Airport on 30 November 2009, the Aviation and Railway Accident Investigation Board makes the following safety recommendations;

To Airbus Industries, France

1. Provide operators with the information that 「If a windshield is used for a long period, the silicone pressure seal could be torn due to wear, an arcing could occur on the lower braid wire of the windshield heating system due to a double insulation failure, and eventually two structural plies of the windshield could crack due to a high overheating in the vicinity of the lower braid wire of the heating system.」 (AIR0908-1), and
2. In consideration of the point that it is not appropriate to fly with such a failure mode, take suitable measure(s) for the pre-mod windshields (SPSA340-2-4-1A) to be replaced with the windshields that such a problem has been resolved, as soon as practicable. (AIR0908-2)

Appendix : Comments of the BEA, France**1.6.6.3 Windshield Inspection and Defects****ARAIB's sentences**

On the Korean Air's A330 aircraft were mounted two companies products (three kinds of windshield), and the windshield replacements for defects had occurred average 10 times a year in last three years. But there was no defect by the torn of the silicone seal such as this serious incident. There was no problem on a pre-mod windshield up to now even though it had been mounted on year 2001, but a windshield had been replaced only a week after its delivery even though it was a new design windshield.

BEA's comments

It does not seem pertinent to present windshield incidents during the last three years as they have no relation with the HL7551 event and concern 2 types of manufacturer. It does not bring any element for the comprehension of the HL7551 event. We propose that ARAIB sentences above should therefore be removed from the report.

2.3 Windshield Inspection and Management**ARAIB's sentences**

The FCOM contains suitable procedures for Cockpit Windshield/Window Cracked. *And, as a matter of course, there is no doubt that such a windshield failure mode could not directly result in any kind of accident. But since it is not appropriate that the aircraft fly with such a failure mode windshield(s), it needs to be replaced the pre-mod windshields (SPSA340-2-4-1A) with the windshields that such a problem has been resolved, as soon as practicable.*

BEA's comments

Please note that the test, which has been positively performed and written now in the ARAIB report, showed sufficient residual strength to sustain pressurization with the two structural windshield plies broken during a time sufficient to land the aircraft safely in the conditions requested by FCOM procedures (FCOM Abnormal and Emergency

procedures 3.02.80). This procedure requests the crew to reduce the differential pressure to 5 PSI (345mbar). In addition, this pre-mod is already certified by the airworthiness authority (EASA), and obviously regarding this test and the certification, it is also inappropriate to say that 「since it is not appropriate that the aircraft fly with such a failure mode windshield(s), it needs to be replaced the pre-mod windshields (SPSA340-2-4-1A) with the windshields that such a problem has been resolved, as soon as practicable.」 Consequently, we suggest that ARAIB sentences in italic should be removed and replaced by:

「As a matter of course, there is no doubt that such a windshield failure mode could not directly result in a rupture of the third external ply of the windshield if the FCOM procedures are applied.」

4 Safety Recommendations

ARAIB's sentences

1. Provide operators with the information that 「If a windshield is used for a long period, the silicone pressure seal could be torn due to wear, an arcing could occur on the lower braid wire of the windshield heating system due to a double insulation failure, and eventually two structural plies of the windshield could crack due to a high overheating in the vicinity of the lower braid wire of the heating system.」 . (AIR0908-1)
2. And, in consideration of the point that it is not appropriate to fly with such a failure mode, take suitable measure(s) for the pre-mod windshields (SPSA340-2-4-1A) to be replaced with the windshields that such a problem has been resolved, as soon as practicable. (AIR0908-2)

BEA's comments

We suggest that these 2 recommendations above from ARAIB should be removed and replaced by:

1. Provide all operators with the information about the HL7551 windshield event and the fact that if a windshield is used for a long period, the silicone pressure seal could be torn due to wear, an arcing could occur on the lower braid wire of the

windshield heating system due to a double insulation failure, and eventually two structural plies of the windshield could crack due to a high overheating in the vicinity of the lower braid wire. A test has been positively performed and showed sufficient residual strength to sustain pressurization with the two structural windshield plies broken during a time sufficient to land the aircraft safely in the conditions requested by FCOM procedures (FCOM Abnormal and Emergency procedures 3.02.80). This procedure requests the crew to reduce the differential pressure to 5 PSI (345mbar).

2. Provide all operators with the information that the design of the pre-mod windshields (SPSA340-2-4-1A) has already been modified through the improvement of the routing and the protection of the two power braids of the heating system in March 2009. The pre-mod windshield is always certified but is not produced anymore and the improved new design windshield (SPSA340-1-5-2) in the IPC (illustrated Parts Catalogue) is currently produced. Airbus systematically proposes the post-mod windshield in the IPC for any new order. The new design is systematically used for new manufactured windshield and for overhaul and is embodied on aircraft delivered from July 2009 (from MSN1033).