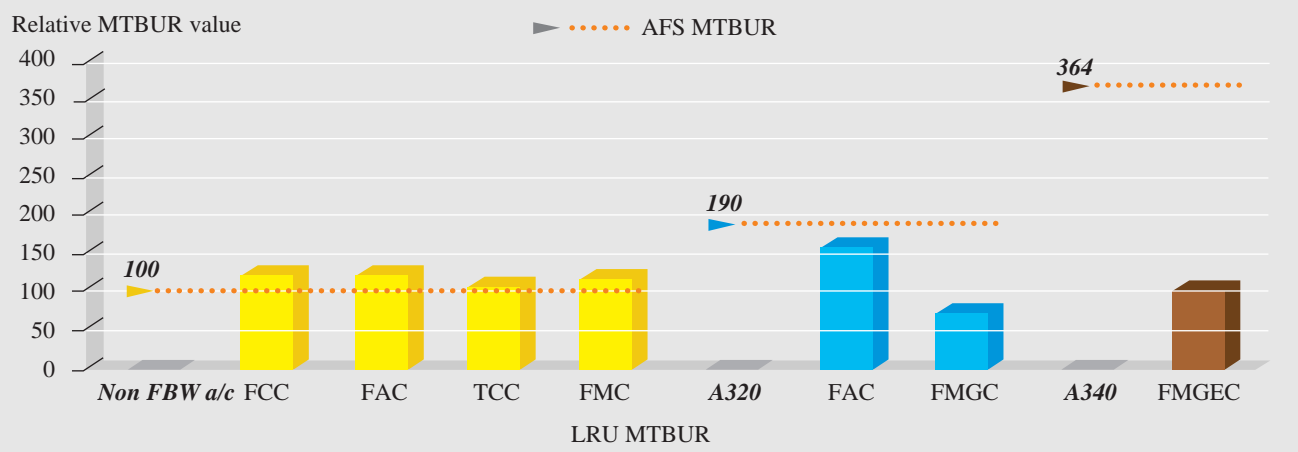
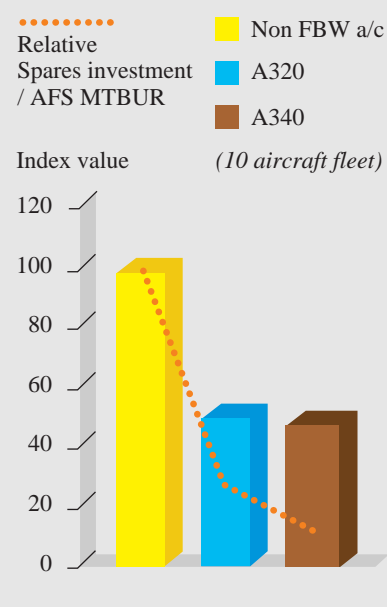


**Figure 10**  
AFS MTBUR COMPARED TO INDIVIDUAL LRU MTBUR



**Figure 11**  
AFS COST EFFECTIVENESS  
COMPARISON



However with eleven years of technological improvements the Auto Flight system MTBUR has increased quite dramatically from the non-FBW aircraft to the latest technology FBW aircraft, the A320 and A340.

The savings for a recommended spares investment in dollar terms as a result of the integration of AFS functions are considerable. The investment required for the AFS equipment for ten A340 or A320 being roughly half of that required for ten non FBW type aircraft. The advances made in component integration offsets the increase in price of the individual LRUs (Figure 10).

The cost effectiveness of the integration of the AFS can be measured by dividing the recommended spares investment figures by the AFS reliability i.e. Cost/AFS MTBUR. The results can be seen in the Figure 11.

The AFS fitted to the A320 is four times, and the A340 seven times, more cost effective than the pre-FBW aircraft and as fleet size increases this effect becomes more pronounced.

**PUNCTUALITY**

The turnaround time for rotatable and repairable spares is a combination of the transit time and the repair processing time.

**The transit time**

The transit time is dependent on the

two following factors:

- *The administrative efficiency of an airline* in realising that a spare has been removed, shipping the spare part out and then, when the spare part returns, placing it back on the shelf.
- *The speed and efficiency of the freight forwarder and Customs authorities* in importing/exporting and transporting the spare part will have an impact on the transit time. Airbus Industrie has been working closely with several major forwarders and logistics service suppliers to develop an off-the-shelf transit management programme. This will offer customers a choice of forwarder service with defined performance levels and terms.

**The repair processing time**

Airbus Industrie has taken the initiative with its proprietary parts repair turnaround time.

Airbus Industrie now guarantees a maximum of 15 calendar days repair time for its proprietary parts. This is backed up by a forward exchange at no additional cost should the repair time exceed this guarantee. The operator in this case is then only invoiced for the repair charges and not the exchange fee. This significantly reduces the level of inventory which needs to be stored to cover those "just-in-case" situations and moves away from the current industry 'standard' of guaranteeing average repair times.

**CONCLUSION**

Airbus Industrie is able to demonstrate that its aircraft families share large commonality in aircraft spares, enabling operators to reduce their operating costs. This has been achieved through aircraft design with maintenance in mind. Further, the fly-by-wire technology has lent itself to improving commonality by integrating the Automated Flight System Computers into a reduced number of LRUs, which share high commonality and reliability within the family groups. So, when it comes to aircraft spare parts, Airbus Industrie is glad to be called common, reliable and punctual.

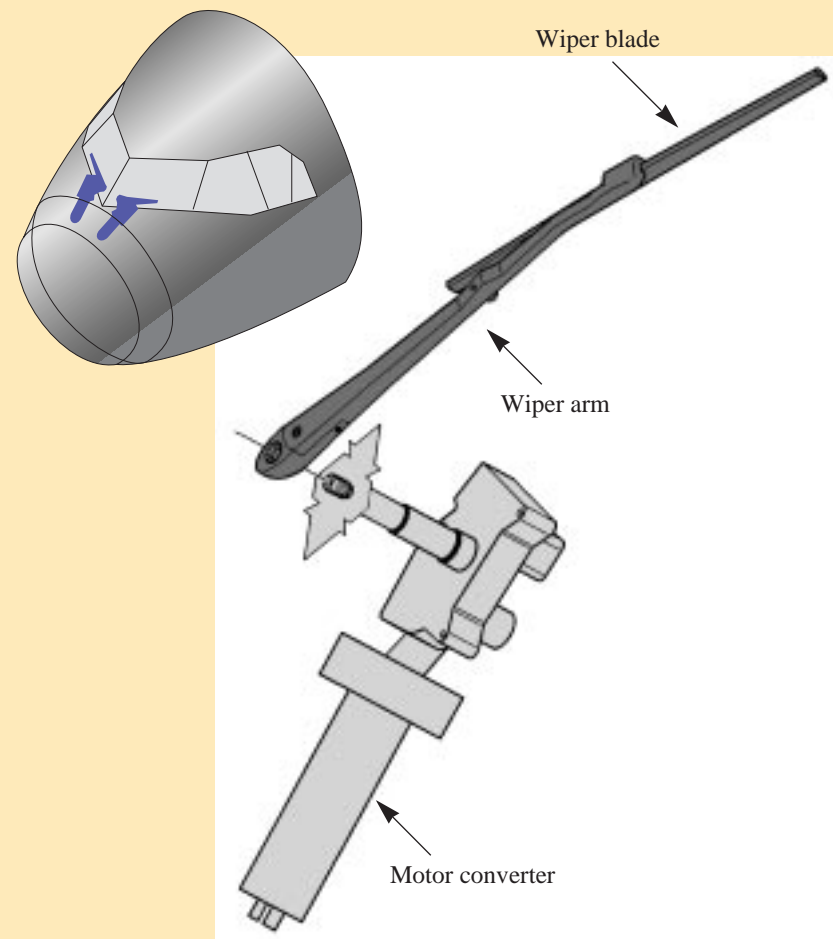
# COMBINING ENVIRONMENT PROTECTION AND WINDSHIELD RAIN PROTECTION ON AIRBUS AIRCRAFT

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Windshield rain protection provides the flight crew with a clear vision through the aircraft windshield when rain is encountered. The "Rainboe" rain repellent fluid, originally used on Airbus aircraft in addition to the basic windshield wiper system, has been phased out as part of the worldwide effort to protect the Ozone layer. Airbus Industrie has been actively working on alternative solutions and is now in a position to provide the operators with a choice of environmentally friendly rain repellent fluid or windshield hydrophobic coating. This combines maximum windshield rain protection with safe guards for the environment.

Figure 1  
WINDSHIELD WIPER SYSTEM



- WINDSHIELD WIPERS - THE BASIC RAIN PROTECTION SYSTEM

The basic windshield rain protection system on Airbus aircraft consists of two electrically operated windshield wipers, one on the Captain's side and one on the First Officer's side (Figure 1). The wipers can be operated independently and at low or high speed, depending on the level of the precipitation (Figure 2). An optional intermittent function is also available.

All Airbus aircraft are certified for operation without further windshield rain protection system.

- RAIN REPELLENT - AN ADDITIONAL FORM OF RAIN PROTECTION

All Airbus aircraft are also equipped with a so-called rain repellent system. This system allows spraying of a fluid onto the windshield outer surface when heavy rain is encountered (see Figure 3 on the following page).

The fluid can be sprayed independently on the Captain's side and on the First Officer's side. It temporarily modifies the surface tension on the windshield and, combined with the effect of the air flow caused by aircraft movement, prevents water droplets from adhering to the windshield outer surface.

Figure 2  
WINDSHIELD RAIN PROTECTION COCKPIT CONTROLS



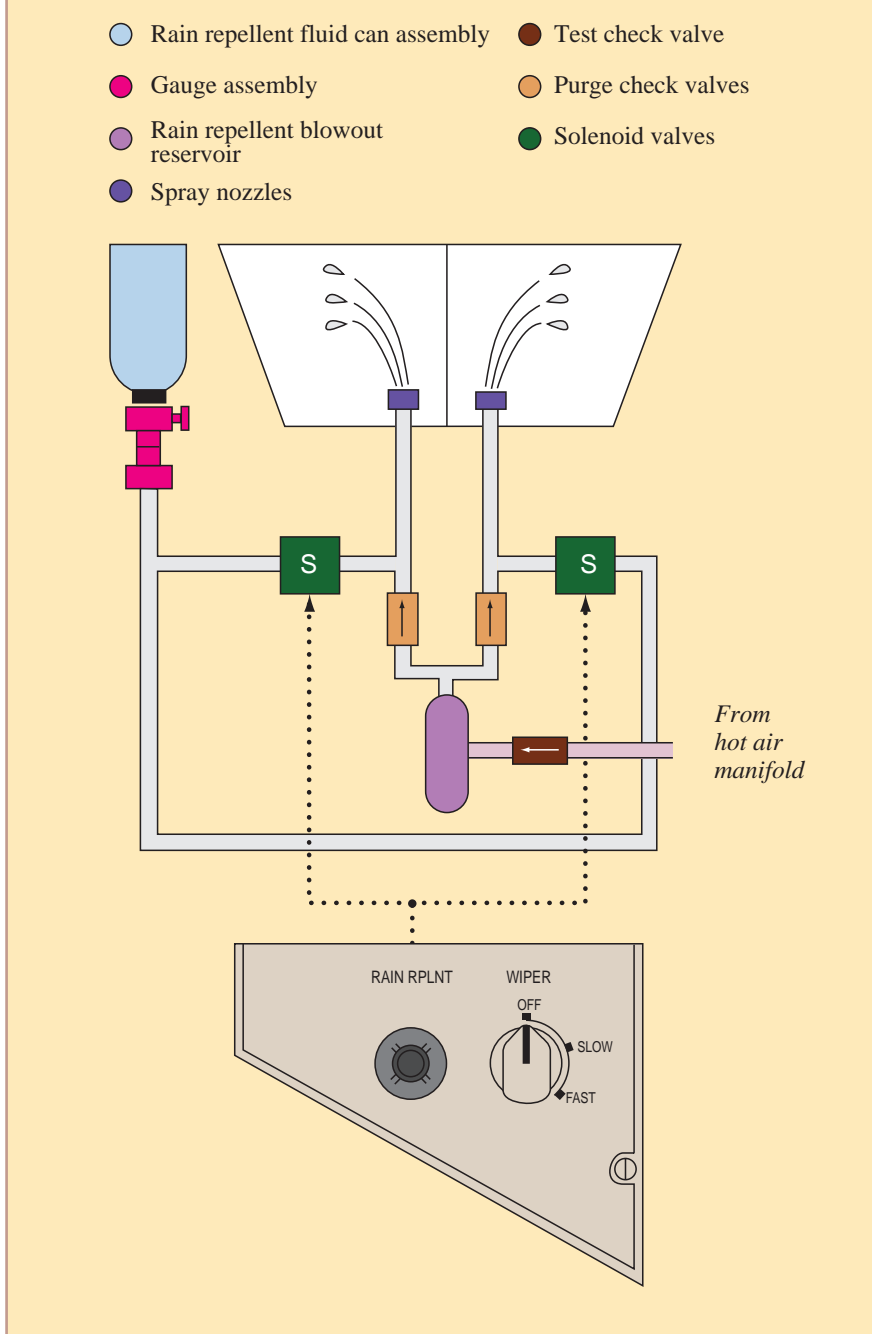
- RAINBOE - RAIN REPELLENT FLUID PHASE OUT

The 'Rainboe' rain repellent fluid originally used on Airbus aircraft and on all other jetliners equipped with a similar system contains CFC 113. This substance is a type of freon (Chloro-fluorocarbon). It is officially listed as an Ozone depleting substance by the Montreal Protocol which bans its production, import and export since 1st January 1996.

Since this date and in order to comply with the international agreements for the protection of the Ozone layer (Vienna Convention and Montreal Protocol), the 'Rainboe' fluid bottle is no longer installed on delivered aircraft. Airbus Industrie has nevertheless taken the option to leave the rain repellent system installed on the aircraft (electrically deactivated) whilst actively working with chemical manufacturers on the development of a new rain repellent fluid free of CFC.

Service Bulletins for all aircraft types were issued in January 1996 in order to allow 'Rainboe' fluid bottle removal and system deactivation on aircraft in service (refer to Table below for the applicable Service Bulletins and Modifications references).

Figure 3  
RAIN REPELLENT SYSTEM SCHEMATIC



Applicable Service Bulletins and Modifications references

'RAINBOE' RAIN REPELLENT FLUID DEACTIVATION

	A300	A300-600	A310	A319/A320/A321	A330	A340
MOD	11480	11480	11480	25419	44482	44482
SB	A300-30-0044 (1)	A300-30-6023 (1)	A310-30-2029 (1)	A320-30-1032 (1)	A330-30-3015 (1)	A340-30-4020 (1)

CFC FREE (LBFS) RAIN REPELLENT FLUID INSTALLATION

	A300	A300-600	A310	A319/A320/A321	A330	A340
MOD	11974	11974	11974	26963	45897	45897
SB	A300-30-0046 (2)	A300-30-6025 (2)	A310-30-2032 (2)	A320-30-1037 (3)	A330-30-3019 (3)	A340-30-4022 (3)

PPG 'SURFACE SEAL' COATING INSTALLATION

AIRBUS Service Information Letter 30-024 - Issued in July 1997

(1) SB issued in January 1996 (2) SB will be issued by end of 1998 (3) SB issued in July 1998

**NEW RAIN REPELLENT FLUID FREE OF CFC**

A new rain repellent fluid has been successfully developed. The product complies with all the existing regulations for the protection of the environment. Laboratory testing has confirmed its compliance with the existing toxicity requirements and its compatibility with the surrounding materials on Airbus aircraft (windshield, structure, paint).

The excellent rain repellent characteristics of the fluid and its endurance have been demonstrated by extensive

bench testing and flight testing (Figure 4). The fluid bottle can be installed on the aircraft with only minor modification of the existing rain repellent system.

Airbus Industrie is now preparing the introduction of the new fluid in production. Service Bulletins allow reactivation of the rain repellent system and installation of the fluid bottle on aircraft in service (Figure 5).

The rain repellent fluid bottle is supplied by Le Bozec Filtration and Systems (LBFS). Refer to the Table on the preceding page for the applicable Service Bulletins and Mod references.

**WINDSHIELD HYDROPHOBIC COATINGS - AN ALTERNATIVE -**

For those operators wishing to leave the rain repellent system deactivated, Airbus Industrie has also formally approved the use of the PPG Industries "Surface Seal" windshield hydrophobic coating on all Airbus aircraft types

The coating, which can be used without restriction on all types of windshields available on Airbus aircraft, consists of a treatment applied on the windshield outer surface in a liquid form. It dries out to provide rain repellent characteristics similar to those of the fluid.

The coating does not contain CFC and is therefore not subjected to the requirements of the Montreal protocol.

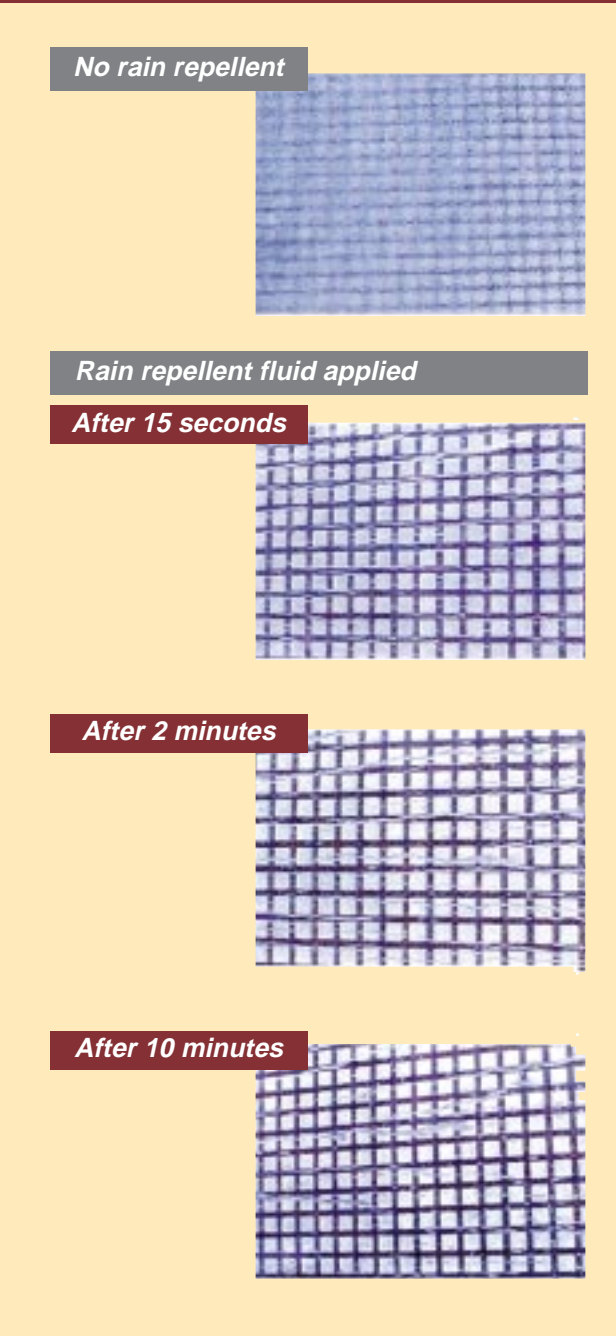
The treatment has a limited service

life and needs to be reapplied on a regular basis.

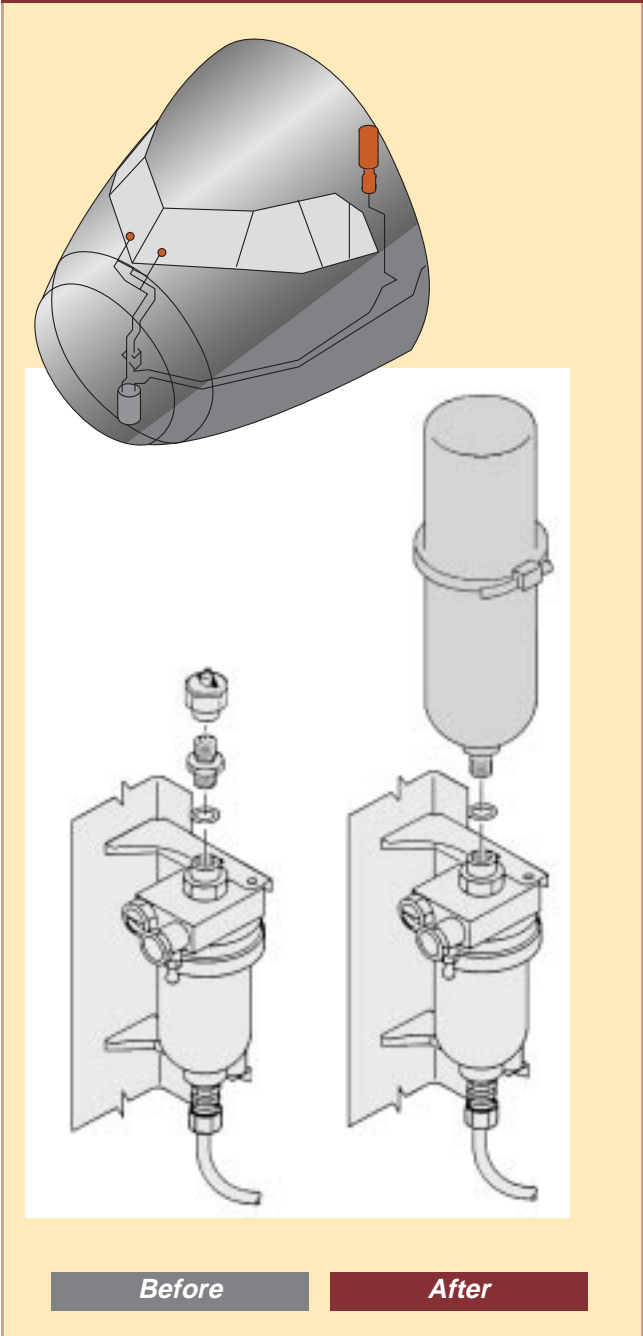
Airbus Service Information Letter 30-024, issued in July 1997, provides procurement and material information related to the coating, as well as recommendations for application and servicing. The content of this SIL is being incorporated in the Aircraft Maintenance Manual, Maintenance Planning document, Consumable Materials List and Tool and Equipment Manual in accordance with the normal revision planning set for each document and aircraft type.

Airbus Industrie is closely monitoring the development of other windshield hydrophobic coatings, which will also be incorporated in the SIL and in the aircraft documentation if their performance is found to be satisfactory on Airbus aircraft.

**Figure 4**  
CFC-FREE RAIN REPELLENT FLUID - ENDURANCE TESTING  
HEAVY RAIN



**Figure 5**  
CFC-FREE RAIN REPELLENT FLUID  
BOTTLE REPLACEMENT



**EFFECT OF RAIN REPELLENT OR HYDROPHOBIC COATING ON WATER DROPLET / WINDSHIELD CONTACT ANGLE**



**CONCLUSION**

The commitments of Airbus Industrie on the subject of windshield rain protection were twofold:

- To comply with the requirements of the Montreal Protocol on Ozone depleting substances.
- To provide Airbus operators with an alternative form of windshield rain protection, in addition to the basic wiper system.

These commitments are today achieved with the removal of the 'Rainboe' fluid from the Airbus aircraft and with the availability of two alternative forms of windshield rain protection for use on all Airbus aircraft types:

- A new rain repellent fluid,
- A windshield hydrophobic coating.

The needs of Airbus operators regarding windshield rain protection vary a lot, depending on local weather conditions, habits, operational and maintenance procedures.

Airbus Industrie strongly believes that the choice of fluid or coating now available provides the best response to these different needs.