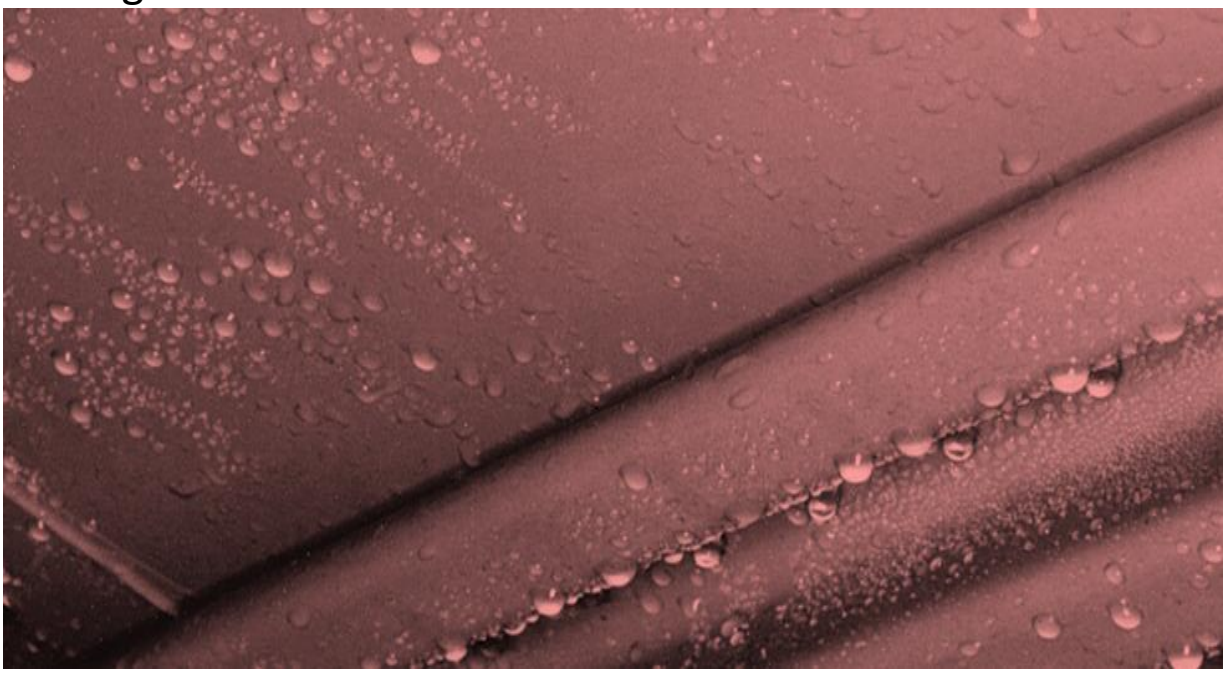
Anti-Condensation System Performance

This information is given to emphasis that it is essential that the Anti-Condensation System is activated during all aircraft flight phases, from power on to shut down.

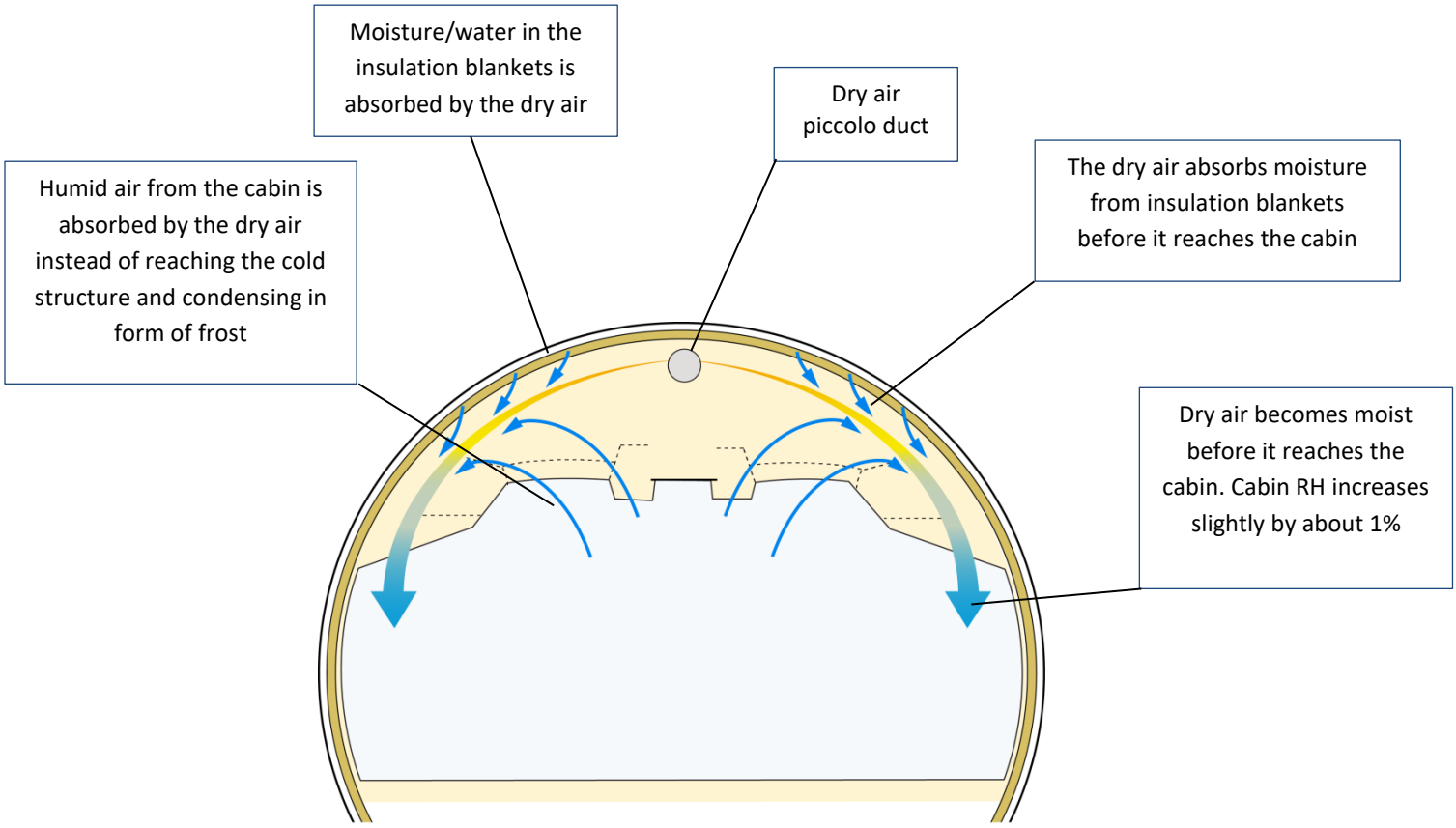
Fuselage Condensation Information



During cruise, the temperature on the inside skin of an aircraft fuselage is about -25°C. The cabin temperature is normally +24°C and, if the cabin relative humidity is 15%, the dew point (the temperature at which air becomes saturated with water vapor) of the cabin air is -4°C. As a result, the moisture is constantly deposited as frost.

During descent, the fuselage temperature steadily increases, causing the frost to melt. The water droplets land on top of the insulation blankets and penetrate to the insulation material inside. As this happens on every flight, the aircraft will gradually accumulate additional weight in the insulation blankets over time (1 liter of water weighs 1kg). Depending on the type of airline operation and geographical location, a narrowbody and a widebody aircraft can accumulate up to 300kg and 600kg of water respectively.

Fuselage condensation also causes other problems, such as long-term corrosion and reduced reliability of electrical components. By using the Anti-Condensation System, these problems can be eliminated.



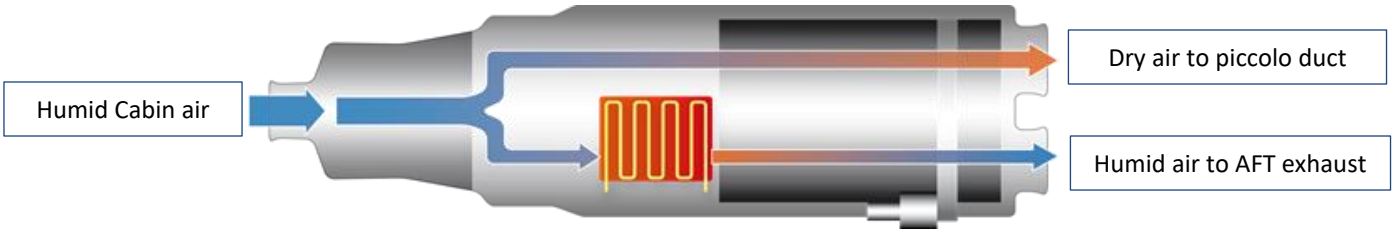
Anti-Condensation System Information

The CTT Anti-Condensation System ensures that there will be no condensation related problems in aircraft, even with a high-density configuration (each passenger exhales around 70g/hour of water vapor).

The Anti-Condensation unit is a dehumidifier, of the parallel flow absorption type. The active part is a glass fibre honeycomb rotor, impregnated with silica gel, which is contained inside a cylinder. Other components in the unit are a mixed flow fan designed for continuous operation, a heater, a geared rotor drive motor and a controller.

The airflow from the fan at the inlet side of the unit is divided into two separate airstreams. About 80 % of the total airflow passes directly through the rotor, where the humidity is absorbed by the silica gel, resulting in a dry (low water content) air stream, which leaves the Anti-Condensation unit through the dry air outlet.

The other 20 % of the airflow, the regeneration air, is routed through the heater before it passes through the rotor. The warm air will absorb the humidity in the rotor and then leave the Anti-Condensation unit through the regeneration air outlet. The rotor is slowly turned by a motor via a belt drive. This ensures that the rotor is regenerated continuously by the warm airflow, keeping the rotor absorption capacity at a high level.



The Anti-Condensation unit continuously produces a positive flow of dry air that is distributed through a piccolo duct routed along the whole length of the crown area to create a dry air barrier in this area. The dry air absorbs moisture from the insulation blankets and, at the same time, absorbs moisture from the cabin trying to reach the cold aircraft structure. The air eventually flows into the cabin through the ceiling splices. The system is designed to operate as long as there is power to the aircraft. This ensures that the intermediate space between the cabin and the fuselage is kept dry during the complete flight cycle.

Ground Operations

The Anti-Condensation System reduces the humidity level in the aircraft intermediate space during ground operations. This means that the aircraft has a lower humidity level than normal in the intermediate space on the ground and that there is also a drying effect on the insulation blankets.

Take off and Climb

When the doors are closed before take-off, the Anti-Condensation System will continue to reduce the humidity level in the intermediate space, which means there is minimal condensation in the form of frost that will occur on the inside of the fuselage during climb as it cools down with increasing altitude.

Cruise

As the Anti-Condensation System is activated during ground operations, take off and climb, it constantly reduces the humidity level in the intermediate space. Typical cruise altitudes are above most, if not all, of the water vapor in the atmosphere, thus no humidity enters the cabin as the air is refreshed. This means the system will now produce extremely dry air with a very low dew point that will significantly reduce the fuselage condensation. The system will also keep the insulation blankets dry.

Descent

During descent, relative humidity will slowly increase when approaching lower altitudes. At the same time, a large part of the structure is still be at very low temperatures. Therefore, it is essential that the Anti-Condensation System is active to produce dry air to minimise the fuselage condensation and to avoid 'rain in the plane' in the cabin.

Landing and Parking

When landing, the relative humidity in the cabin will be between 30-90% depending on location and season. The Anti-Condensation System will continue to reduce the humidity in the intermediate space to dry the inside of the fuselage and prevent water from entering the insulation blankets. When the doors are opened, a humidity shock will occur if the external conditions are much moister. The Anti-Condensation System cannot prevent this but it can significantly reduce the length/time of its effect before starting to reduce the relative humidity in the intermediate space ahead of the next flight.

Conclusion

Fuselage condensation is a problem that mainly occurs during cruise and descent but it is repeated on every flight as long as the aircraft is used. Therefore, to prevent fuselage condensation, 'rain in the plane', water accumulation in insulation blankets and to increase the reliability of electrical components in the most efficient way, it is essential that the Anti-Condensation System is powered and activated during the whole flight cycle, from start up to shut down.

Anti-Condensation System Applications

CTT Systems has more than 2,000 Anti-Condensation Systems in service, both as retrofits and OEM installations. For retrofit installations, the Anti-Condensation System is designed for Airbus A319, A320, A321, A330 and A340 and Boeing 737NG, 757, 767 and 777. Furthermore, the Anti-Condensation System is a BFE option for the Boeing 737-700/800 and an SFE option for the Airbus A350 and Boeing 787-8/9/10.

Cost Saving

An Anti-Condensation System can remove between 200-400kg of water from an aircraft!

This results in a significant cost saving on fuel as well as a reduced carbon footprint.

It will also significantly reduce maintenance costs due to corrosion and electronic failures.

A 200kg weight saving will reduce:

- **...fuel consumption by 21 tonnes per year**
- **...CO_2 emissions by 66 tonnes per year**

Based on an Airbus A320-200 or Boeing 737-800 aircraft.

- ANTI-CONDENSATION