

Part I—Description and Management of Systems

Chapter 12—Anti-Icing and De-Icing Systems

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1 General

(a) A thermal anti-icing system provides protection for the leading edges of the wings and fin, and for the engine air intakes. Hot air from the engines and cold air from individual intakes are mixed and pass along the inside of the skin and are then exhausted to atmosphere.

(b) In the engine, thermal anti-icing is provided for the compressor entry guide vanes and bullet by means of hot air from the HP compressor through an on—off electrically-operated valve. This anti-icing air exhausts into the forward fire zone.

(c) The anti-icing system can be controlled either manually or automatically, the controls being grouped on a panel at the rear of the starboard console. The same controls operate the compressor anti-icing valves. Post-Mod. 1091, separate engine anti-icing control switches are provided.

(d) A fluid de-icing system is used to clear ice formation on the windscreen and bomb-aimer's window. The fluid tank is pressurised from the pneumatic system.

(e) Provision is made for automatic ice detectors.

Anti-Icing Systems

2 Wing and engine anti-icing system

(a) Hot air, branched from each half of the supplies to the cabin heating system, is fed to a hot-air valve at the root of each wing.

(b) Cold air for the system is supplied by a cold-air intake on each side, below the engine air intake. The intake area can be varied by an electrically-operated flap, to control the amount of cold air mixed with the hot air.

(c) The mixed air is passed along ductings inside the skin, round the engine air intake leading edges and the engine air intake separator, and along the leading edge of the wing.

(d) The heating air from the engine air intakes is exhausted through an electrically-operated extractor flap on the lower skin of the air intake, while the air from the wing duct flows rearwards through the wing to exhaust through a louvre on the underside of the outer wing.

◀ (e) An overheat switch operates at 165°C to close the hot-air valve.

3 Fin anti-icing system

(a) The fin anti-icing system, at present inoperative, is similar to the wing system. Hot-air supplies, from the line that supplies the bomb-bay heating system, are mixed with cold air from the twin intakes in the dorsal fin. The cold-air intake area is varied by an automatically-operated butterfly valve.

(b) The mixed air is passed along ducting in the leading edge of the fin and is exhausted through louvres on either side of the fin surface.

4 Anti-icing controls

(a) General

The anti-icing controls are grouped together on a panel at the rear of the starboard console. One group of controls is for the port wing and engines, one for the fin (which includes the ram air intake for the cooling pack, at the starboard side of the rear fuselage) and one for the starboard wing and engines.

(b) The controls for each group consist of the following:

An AUTO—OFF—MANUAL double-pole switch (E/18)

A temperature gauge, reading from 0-200°C (E/19)

A manual heat control switch (E/20), labelled INC—DEC, spring-loaded to the central position.

In addition to operating these controls, the ENGINE AIR switches must also be OPEN before hot air can be supplied to the engine air intakes, fin (when operative) and wing anti-icing systems.

(c) Airframe anti-icing

(i) When the AUTO—OFF—MANUAL switch is put to AUTO, the variable cold intake and extractor flaps open fully and the opening and closing of the hot-air valve and the cold-air supply are controlled by sensing elements to maintain a skin temperature of approximately 10°C.

(ii) When ice detectors are installed, selecting AUTO will put the system under control of the detectors and anti-icing action will only take place when icing conditions are imminent.

(iii) When MANUAL is selected, the variable cold intake and extractor flaps open fully. The manual heat control switch must first be held to INC until the temperature reaches $140 \pm 5^\circ\text{C}$; it can subsequently be adjusted as required to maintain the correct temperature.

(d) Engine anti-icing

(i) When either AUTO or MANUAL is selected, the engine compressor anti-icing is also switched on. It is switched off when OFF is selected.

(ii) This applies whether the ENGINE AIR switches are OPEN or SHUT and, should circumstances require, compressor anti-icing without wing and air intake anti-icing can be selected with ENGINE AIR switches SHUT.

(iii) Mod. 1091 introduces separate guarded switches for engine anti-icing. They are single-pole ON-OFF switches, one on either side of the manual heat control switches.

5 Use of the engine anti-icing system

(a) In cold damp weather ($+3^\circ\text{C}$ or below and with 90% or more humidity, or visibility less than 1,000 yards), immediately before take-off, run the engines at 60% RPM or more for one

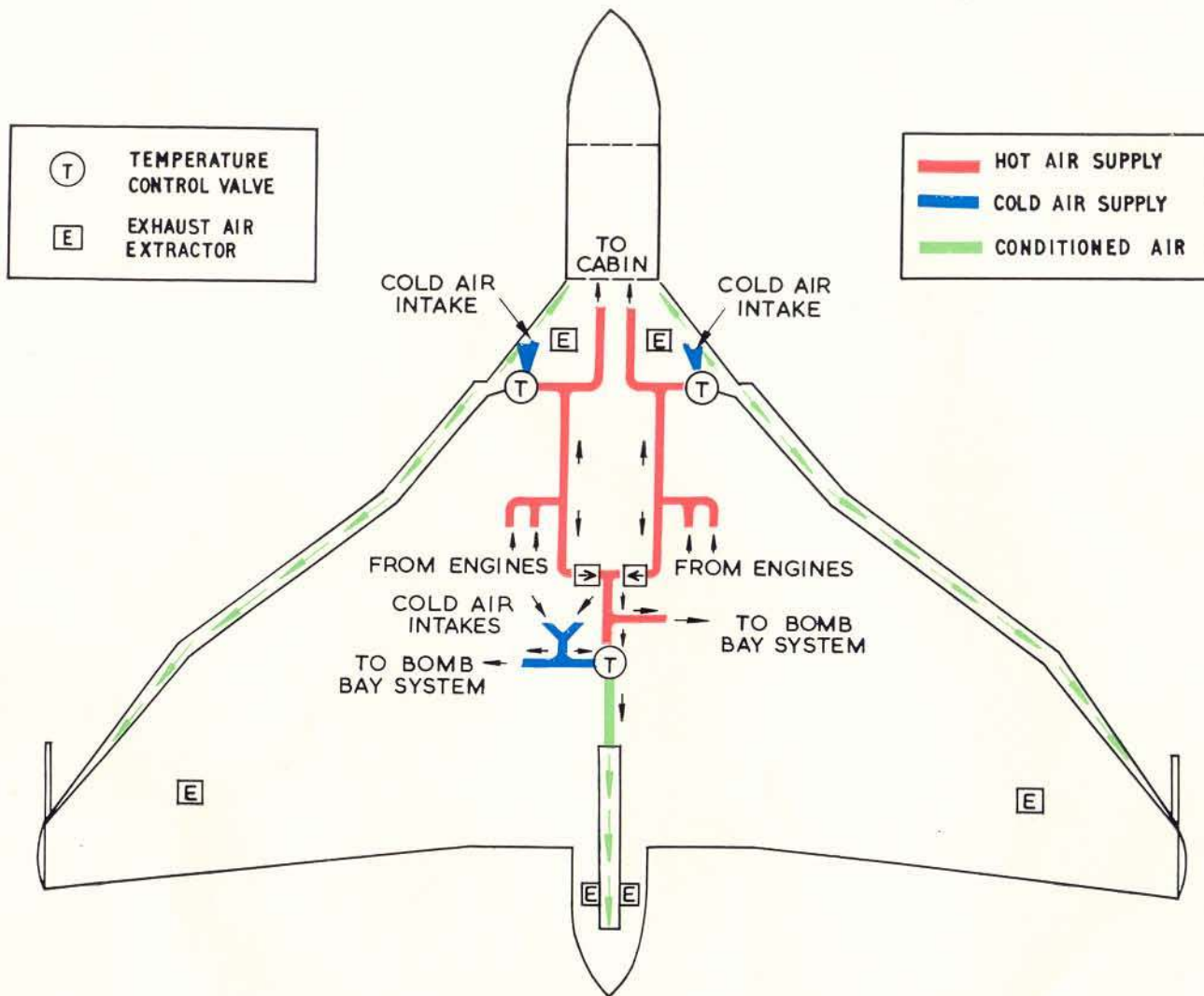


Fig 1 Anti-Icing System

RESTRICTED

minute with PORT and STBD WING AND ENGINE anti-icing switches at AUTO (engine anti-icing switches ON, Post-Mod 1091) and take-off with the switches at this position. When clear of icing after take-off move the switches to OFF. The ENGINE AIR switches must be SHUT for this operation in order to comply with para. 6(a) below. The system must not be switched on before the engines are started.

NOTE: On certain aircraft the fuses have been removed and the system will not operate in AUTO. In these cases the system must be operated manually.

(b) Should icing conditions be met with in flight, switch the PORT and STBD WING AND ENGINE anti-icing switches to AUTO (engine anti-icing switches ON, Post-Mod. 1091) and ensure that the engine speed is not below the recommended minimum of 55%.

If engine speed is below the recommended minimum, ice may form on the compressor blades, breaking away spasmodically to enter the engine with a consequent risk of flame-out. Engine speeds below the recommended minimum may, however, be used for periods not longer than two minutes.

6 Use of the airframe anti-icing system

NOTE: Pending further trials the system is only cleared for use when Mods. 686, 777 and 940 are embodied, and the wing duct blanks introduced by Mod. 1144 are removed. *Part of Mod. 686 blanks off the fin anti-icing system.*

(a) To avoid possible overheating and damage to the ducting the system should not be used on the ground, as under these conditions the heat dissipation from the leading edge is small.

(b) The system is designed to prevent the formation of ice and must be switched on before entering icing conditions, whenever icing conditions are anticipated or forecast, or if a rapid build-up of ice is noted on the windscreen or windscreen wipers.



(c) Control of the thermal anti-icing system

To bring the system into operation check:

ENGINE AIR switches . . . OPEN (No. 2 engine only below 10,000 ft.)

If icing conditions are forecast or if there is a build-up of ice on the windscreen or windscreen wipers, however, all four engine air switches should be selected OPEN.

ANTI-ICING CONTROLS

switches PORT and STBD.—AUTO.*
TAIL FIN—OFF.

* MANUAL if fuses have been removed (see Note to para. 5(a))

(i) The co-pilot should monitor the temperature gauges. At 80% RPM the temperatures should stabilise at 120°-140°C. Below 10,000 feet the temperatures may be lower. If this temperature is not maintained the system concerned should be selected to MANUAL and INC. heat selected until a satisfactory reading is attained.

(ii) The system is designed so that, should the auto-system fail, a temperature-sensing element closes the hot air valve if the mixed air temperature rises above 155°C. However, if a temperature of 175°C is exceeded the system concerned should be selected to MANUAL and DEC heat selected.



4 (iii) *Below 10,000 feet*

When all the engine air switches are OPEN, engine RPM must not exceed 80%. If more than 80% RPM is used, then Nos. 1 and 4 engine air switches must be selected SHUT. In this case, as Nos. 2 and 3 engine air supplies are restricted, the anti-icing is ineffective. ▶

De-Icing Systems

7 Windscreen de-icing system

(a) A fluid system for de-icing the pilot's windscreen and the bomb aimer's prone station window is supplied from a tank containing 12 galls of de-icing fluid fitted inside the aircraft nose on the starboard side. Access to the tank is through a hinged door on the starboard side of the metal nose. The tank is divided into two compartments, the front compartment supplying the windscreen and the rear the bomb aimer's window.

(b) The tank which is fitted with a relief valve is pressurised from the pneumatic system, the air pressure providing the flow of de-icing fluid via a solenoid-operated valve for the windscreen, and via another solenoid-operated valve for the bomb-aimer's window. A schrader valve is fitted near the filler cap to permit the pressure in the tank to be released when required.

8 Windscreen de-icing controls and operation

(a) *Windscreen supply*

The windscreen supply is operated by the W/SCREEN DE-ICING switch (E/17) marked NORMAL (up)-OFF-EMERG, on the starboard console. Operation of the switch to either the NORMAL or EMERGY positions energises a solenoid-operated valve, permitting fluid to pass to two windscreen sprays. Fluid is sprayed on the windscreen at the rate of 44 pints/hr at the NORMAL and 73 pints/hr at the EMERGY position. (Mod 708 embodied).

(b) *Bomb-aimer's prone station window supply*

The bomb-aimer's prone station window supply is operated by the DE-ICING switch on the bomb-aimer's oxygen, intercomm and bomb release panel at his prone station. This switch is the same type as that used for the windscreen supply, with similar rates of flow for the NORMAL and EMERGY positions. Operation of the switch to either the NORMAL or EMERGY positions energises a solenoid-operated valve permitting fluid to pass to a spray tube situated immediately forward of the bomb-aimer's prone station window.

Electrical Supplies

9 Electrical supplies

The anti-icing systems use 115-volt AC from No. 3 inverter and also 28-volt DC. The de-icing systems use 28-volt DC.

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