

## Chapter 8 AIR CONDITIONING, BLOWING, ANTI-ICING AND NUCLEAR, BIOLOGICAL AND CHEMICAL PROTECTION SYSTEMS

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<i>* Refer to AP 101B-1202-1B, Cover 1, Sect 6, Chap 8</i>	

## Chapter 8A AIR CONDITIONING SYSTEM

(Completely revised)

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#### Introduction

1. With the exception of the changes described in this Chapter, the air conditioning on this aircraft is identical to that described in AP 101B-1202-1B, Sect 6, Chap 8.

#### Modification standard

2. This Chapter covers changes introduced by Mod 1733, 1800, 1809 and 1812.

#### DESCRIPTION

##### General

3. On installation of ARI 23300/63 (Mod 1733) and the inertial navigation system (Mod 1800) the cooling air ducting in the radio bay was modified to facilitate cooling of the V/UHF system equipment, and the inertial navigation unit (INU) and interface unit (IFU). The ground cooling air duct was also modified, to improve the circulation from the ground cooling trolley. A heat exchanger containing a heater block and overheat switch was installed between the main distribution duct and the INU with an inlet temperature switch located in the INU plenum. On embodiment of Mod 1809, control of the 28 V d.c. supply to the heater supplies control relay is transferred from the CAU isolation switch to the radio bay cooling override switch.

4. On post-Mod 1812 aircraft the original heat exchanger is replaced by a modified unit containing a heater block, overheat and outlet temperature switches, a mixer section and an electrically driven fan. There are also further modifications to the air supply ducting. Under normal operating conditions, these changes provide cooling of the INS equipment without the use of a ground cooling trolley or the need to run the aircraft engines. Details of the pre-Mod 1812 installation at pre and post-Mod 1809 standards are in Appendix 1 to this chapter. Details of the ducting arrangement are in Sect 13, Chap 8A.

##### INS cooling air supplies

5. During normal ground servicing operations, i.e. engines not running and cooling trolley not in use, cooling air is supplied to the INS by the fan in the heat exchanger, R-XM. The air is drawn from the ventral bay through inlet holes in the mixer section of the heat exchanger. This satisfies the INS cooling requirements under these ground operating conditions.

6. When cooling air is supplied from the aircraft air conditioning system during engine ground running (or from a ground cooling trolley) it is routed to the INS via the heater block in the heat exchanger. This air is supplemented by air from the ventral bay being drawn by the fan into the

mixer section through inlet holes. The heater block air outlet temperature switch in the heat exchanger mixer section and the INU air inlet temperature switch in the INU plenum are set at 30 deg C and interact to control the heater block supplies control relay. This ensures that no free water enters the INS equipment.

#### INS cooling control

7. Excepting the initial selection of the radio bay cooling override switch, M, which controls the 28 V d.c. supply to the heater supplies control relay, R-XL/D, the INS cooling system heater control circuit operates automatically. The circuit includes an altitude switch, R-XL/B, overheat switch D in the heater block and outlet temperature switch F in the heater block outlet (both in the heat exchanger, R-XM), and an inlet temperature switch, R-XN in the INU plenum. A relay supply indicator lamp, R-FE/B, with press-to-test facility is also provided. The cooling fan operates automatically when the INS is switched on, i.e. INCDU mode selector is in any position except OFF. Regardless of the condition of the heater control circuit, if air is available (at least one engine running) it will flow to the INU provided the CAU shut-off valve is in the open position.

#### Operation (Fig.1)

8. A 28 V d.c. supply from fuse F9 is routed via the contacts of the RADIO BAY COOLING OVERRIDE switch, C-K/1/M, at NORMAL, flamestat R-HL, the valve-open limit switch in the temperature control system shut-off valve actuator, R-HK, altitude switch R-XL/B, overheat switch D and outlet temperature switch F in the heat exchanger, R-XM, and the inlet temperature switch, R-XN, to the coil of relay R-XL/D. The supply is also connected to lamp R-FE/B which illuminates to indicate that 28 V d.c. is applied to the relay. When the relay is energized, 200 V, 3 phase, 400 Hz a.c. supplies from fuses 2A6, 2B6 and 2C6 are connected via the relay contacts to the heater elements. The fan is supplied with 200 V, 3 phase, a.c. from fuses 1A11, 1B11 and 1C11 via the contacts of relay R-XQ. This relay is energized by a 28 V d.c. supply from the IFU whenever the INS is switched on.

#### Note ...

A speed sensor incorporated in the cooling fan connects a 28 V d.c. supply from fuse B6 to the IFU when the fan speed is at, or above, 80 per cent of normal operating speed. This facility is provided for possible future use to provide a failure indication on the INCDU.

9. The INU cooling system has two distinct modes of operation, below an altitude of 18000 ft (approx) and above an altitude of 18000 ft (approx). Above an altitude of 18000 ft free water will not exist in the aircraft air conditioning system and heating of the cooling air is unnecessary.

- (1) In normal operation at altitudes below 18000 ft (approx), the contacts of outlet temperature switch R-XM/F and inlet temperature switch

R-XN open and close to operate the heater block supplies control relay, R-XL/D, and maintain the cooling air at the required temperature.

- (2) In normal operation at altitudes above 18000 ft (approx), the altitude switch is open, relay R-XL/D is de-energized and the heater supplies are disconnected.

#### Note ...

In either of the above operating modes, if for any reason the heater block temperature rises above 170 deg C, overheat switch D will open and de-energize relay R-XL/D to disconnect the heater supplies.

#### SERVICING

#### CAUTION ...

The radio bay cooling override switch in the navigator's cockpit must be selected to OVERHEAT at all times when radio bay cooling air is not being supplied from engine or external sources, otherwise damage to equipment will occur.

#### Ground cooling trolley

10. If for any reason, a ground cooling trolley is used, a.c. power must be applied to the aircraft and the RADIO BAY COOLING OVERRIDE switch in the navigator's cockpit must be selected to NORMAL. This ensures that the 28 V d.c. supply from fuse F9 is applied to the heater supplies control relay, R-XL/D, and that no free water enters the INU.

11. On disconnection of the ground cooling trolley, the RADIO BAY COOLING OVERRIDE switch must be reselected to OVERHEAT to prevent overheating of the INS cooling air heater block.

#### Note ...

During ground operation, if the outside air ambient temperature is in excess of 30 deg C, the radio bay door should be left open and INS operation should be limited to 30 minutes to avoid navigational performance degradation.

#### Engine running

12. During periods of engine running, the RADIO BAY COOLING OVERRIDE switch must be selected to NORMAL on engine start and back to OVERHEAT on engine shut-down.

#### Note ...

Under normal operating conditions the RADIO BAY CAU switch must be set at NORMAL.

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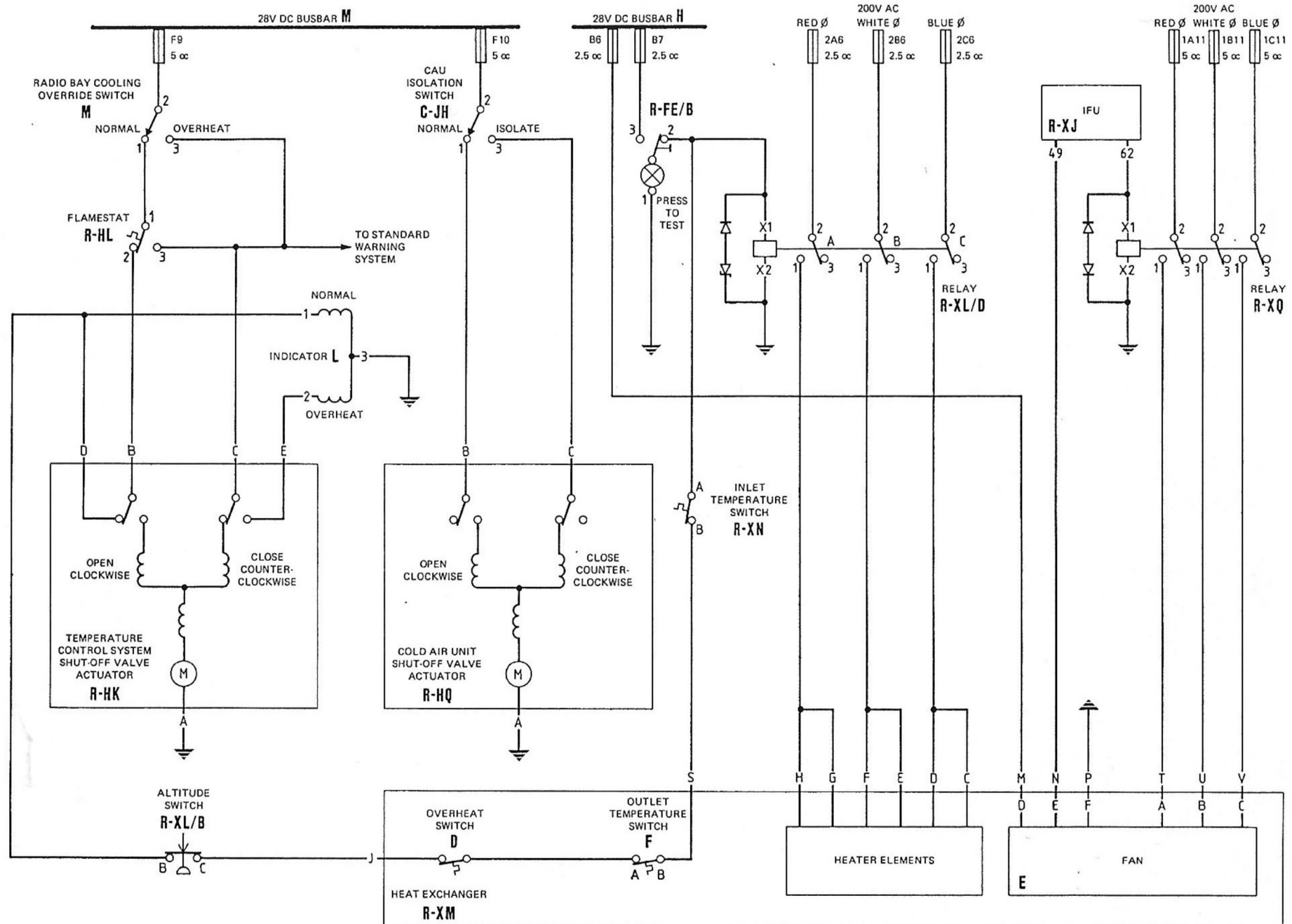


Fig. 1 Radio bay air-conditioning overheat protection - theoretical

► (Mod 1809 and 1812 incorporated) ◀



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## Appendix 1 INS COOLING (pre-Mod 1812, pre and post-Mod 1809)

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## DESCRIPTION

## General

1. On pre-Mod 1812 aircraft, cooling air for the INU must be supplied from a ground cooling trolley or by running the aircraft engines. The conditioning air to the INU is taken from the main distribution duct and routed via a heat exchanger, R-XM, to raise the cooling air temperature to a nominal 30 deg C, thus ensuring that, under normal operating conditions, no free water enters the INU. The ducting arrangement is illustrated in Sect 13, Chap 8A.

## INU cooling control

2. On pre-Mod 1809 aircraft, the 28 V d.c. to the INU heater supplies control relay, R-XL/D, is supplied from fuse F10 via the CAU isolation switch at NORMAL and the CAU shut-off valve actuator open limit switch, while, on post-Mod 1809 aircraft, the 28 V d.c. for the heater supplies control relay is supplied from fuse F9 via the radio bay cooling override switch at NORMAL, flamestat R-HL and the temperature control system shut-off valve actuator open limit switch. With the exception of the differences described the control circuits in pre and post-Mod aircraft are identical.

## Operation (Fig.1)

3. The 28 V d.c. supply from fuse F10 or F9 via the selected valve actuator control circuit (Para 2) is routed via altitude switch R-XL/B, overheat switch D in heat exchanger R-XM and inlet temperature switch R-XN in the INU plenum to the coil of the heater supplies control relay R-XL/D. With the relay energized, 200 V, 3 phase, 400 Hz a.c. supplies from fuses 2A6, 2B6 and 2C6 are connected to the heater elements. The 28 V d.c. supply is also connected to indicator lamp R-FE/B which illuminates to indicate that 28 V d.c. is applied to the relay. A press-to-test facility in the lamp connects an independent supply from fuse B7 to check the lamp serviceability.

5. The INU cooling system has two distinct modes of operation, below an altitude of 18000 ft (approx) and above an altitude of 18000 ft (approx). Above an altitude of 18000 ft, free water will not exist in the aircraft air conditioning system and heating of the air is unnecessary.

(1) In normal operation at altitudes below 18000 ft (approx), the contact of inlet temperature switch R-XN opens and closes to operate the heater block supply control relay, R-XL/D, and maintain the temperature of the cooling air.

- (2) In normal operation at altitudes above 18000 ft (approx), the altitude switch is open, relay R-XL/D is de-energized and the heater supplies are disconnected.

**Note ...**

*In either of the above operating modes, if for any reason the heater block temperature rises above 170 deg C, overheat switch D will open and de-energize relay R-XL/D to disconnect the heater supplies.*

**SERVICING**

**CAUTION ...**

Except in the event of an emergency condition arising, the following instructions must be strictly applied, otherwise damage to equipment may occur.

**Ground cooling trolley**

6. On pre-Mod 1809 aircraft when a ground cooling trolley is in use, power must be applied to the aircraft and the RADIO BAY CAU switch must be selected to NORMAL. This ensures that the 28 V d.c. supply from fuse F10 is applied to the INU heater supplies control relay, R-XL/D. The RADIO BAY COOLING OVERRIDE switch should be left at NORMAL. On shut down or disconnection of the ground cooling trolley, the RADIO BAY CAU switch must be re-selected to ISOLATE to prevent overheating of the INU cooling air heater block.

7. On post-Mod 1809 aircraft when a ground cooling trolley is in use, power must be applied to the aircraft and the RADIO BAY COOLING

OVERRIDE switch must be selected to NORMAL. This ensures that the 28 V d.c. supply from fuse F9 is applied to the INS heater supplies control relay, R-XL/D. The RADIO BAY CAU switch should be left at NORMAL. On shut-down or disconnection of the ground cooling trolley, the RADIO BAY COOLING OVERRIDE switch must be reselected to OVERHEAT to prevent overheating of the INS cooling air heater block.

**Engine running**

8. On pre-Mod 1809 aircraft during periods of engine ground running, the RADIO BAY CAU switch must be selected to NORMAL on engine start and back to ISOLATE on engine shut down. The RADIO BAY COOLING OVERRIDE switch must be left at NORMAL. On post-Mod 1809 aircraft during periods of engine ground running the RADIO BAY COOLING OVERRIDE switch must be selected to NORMAL on engine start and back to OVERHEAT on engine shut down. The RADIO BAY CAU switch must be left at NORMAL.

9. In order to ensure that the INU receives an adequate supply of cooling air during ground operation, the following procedures must be observed.

- (1) A ground cooling trolley must be used at all times that the equipment is switched on, including pre and post-engine running.
- (2) After engine start, one engine is to be set to 60 per cent Nh rpm.
- (3) The time limit for running at 60 per cent Nh rpm is 20 min. After that period the engine must be set to 72 per cent Nh rpm.

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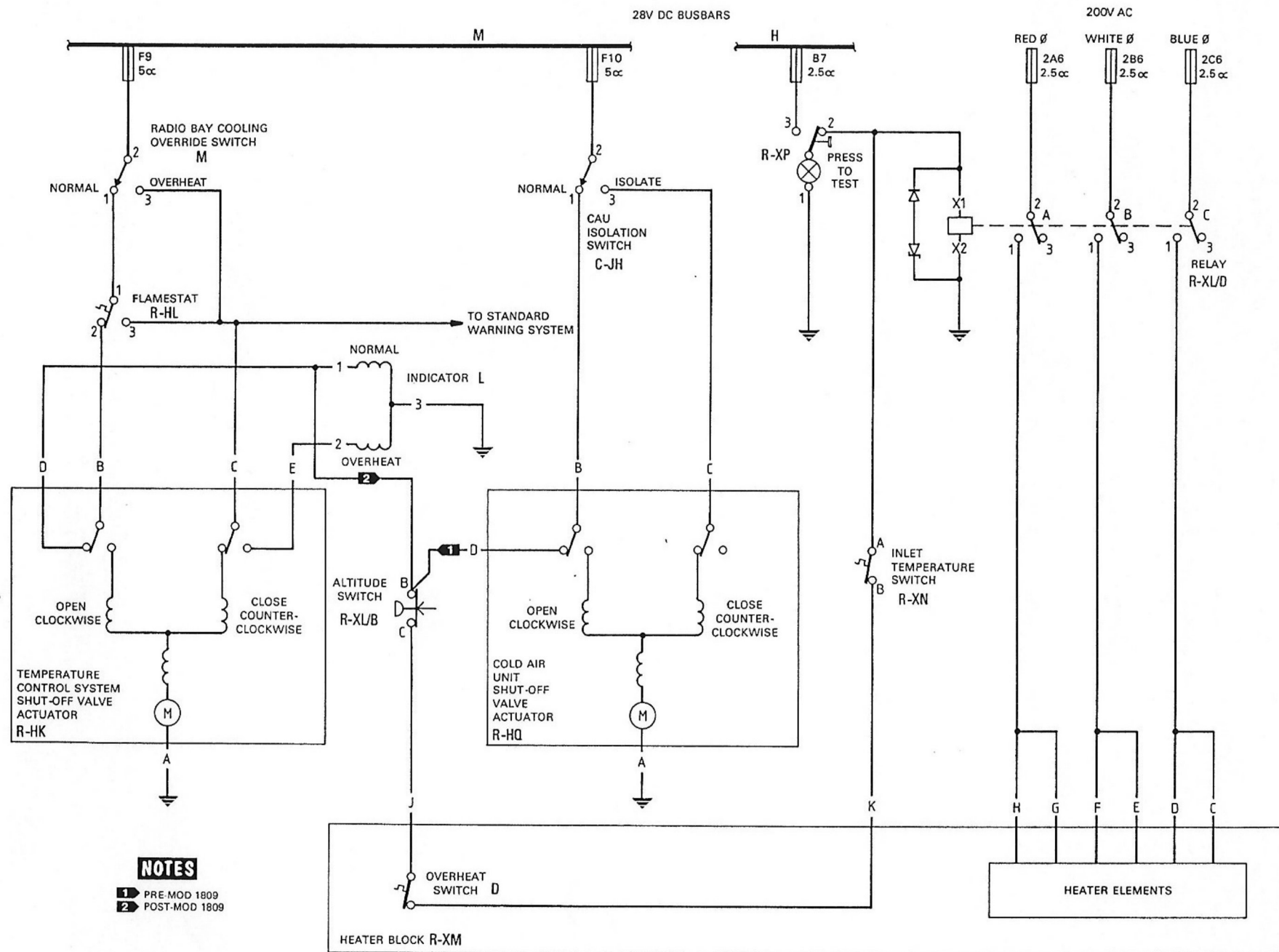


Fig. 1 Radio bay air-conditioning overheat protection - theoretical

► (Mod 1809 incorporated) ◀

## Chapter 8D NUCLEAR, BIOLOGICAL AND CHEMICAL PROTECTION SYSTEMS

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### Introduction

1. This chapter describes the electrical components and circuits of the Nuclear, Biological and Chemical (NBC) protection systems installed on post-Mod 1692 aircraft. The overall system is described in Section 13, Chapter 8B of this publication while wiring details and component location diagrams are in AP 101B-1202-10B1.

### Modification standard

2. This Chapter includes Mod 1692 and 1758.

## DESCRIPTION

### General

3. The aircraft installation consists of two separate air supply systems, which, with the exception of a master selector switch in the pilot's cockpit, are controlled by the individual crew members. With one further exception, hazard warning indication, the electrical components of the two systems are identical, each comprising a fan switch, a motor driven fan and associated voltage regulator unit, and a hazard warning unit. The pilot's hazard warning indication is via the standard warning system while the navigator's system includes a separate indicator module. The electrical components are described under respective headings in the following paragraphs.

### NBC role selector switch

4. This four-pole, pull-to-unlock toggle switch, C-MQ, is mounted in a bracket attached to the inboard edge of the pilot's starboard console. Labelled NBC ROLE, ON-OFF, the switch routes d.c. supplies to the pilot's and navigator's fan switches and to the hazard warning circuits. The switch is fitted with a spring-hinged guard which covers the toggle at the ON position.

### Fan control switches

5. The pilot's fan switch, C-MR, is mounted adjacent to the NBC role selector switch, and the navigator's fan switch, C-MS, is on the port auxiliary instrument panel, C-FJ. Each of these single pole, two-position switches is labelled NBC FAN, ON-OFF and routes supplies to the voltage regulator and hazard warning unit at the selected crew station.

### Fan assemblies

6. The two fan assemblies, which are identical, are housed in thermoplastic spiral casings. Each is driven by an integral 28V d.c. lightweight motor with a maximum current rating of 650mA.

### Voltage regulators

7. A voltage regulator in the fan circuit in each system maintains a stabilized voltage input to the fan motor. A variable potentiometer control enables adjustment of the output pressure of the related fan.

### Hazard Warning Units

8. A hazard warning unit in each circuit monitors the fan motor current level and initiates a warning in the event of a fault being detected.

### Warning indicator module

9. The warning indicator module, C-MC, is located on the air temperature indicator mounting panel on the port side of the navigator's cockpit. The indicator displays an illuminated caption 'NBC'. A press-to-test facility, which connects a test supply to the indicator from fuse M11 on panel C-Q, is incorporated.

## OPERATION (Fig. 1)

### General

10. Selection of the NBC role switch to ON extends separate 28V d.c. supplies from fuses C10 and B3 on panel C-J to the pilot's and navigator's fan switches, respectively. The switch also extends a supply from fuse B4 on panel C-J to the output relay contacts in the hazard warning unit at both crew stations. Subsequent selection of a fan switch to ON connects the supply from fuse C10 and/or B3 to the associated voltage regulator unit and hazard warning relay coil. In the event of a fault causing an increase or decrease in current beyond the preset parameters of the hazard warning unit, the relay in the affected unit de-energizes to connect the supply from fuse B4 on panel C-J to the appropriate warning indicator.

## SERVICING

### General

### WARNING ...

BEFORE ANY SERVICING IS CARRIED OUT IN OR AROUND THE CABIN, SAFETY PRECAUTIONS ON THE EJECTION SEATS AND CANOPY JETTISON SYSTEM, DETAILED IN AP 101B-1202-5A2 AND 5A3 MUST BE STRICTLY OBSERVED.

11. Servicing of the NBC protection system is confined to the replacement of the front and rear cockpit filter canisters and a leak rate and performance functional check at periods detailed in AP 101B-1202-5A1. On completion of servicing and/or removal and replacement of any of the system components a leak rate and performance functional check detailed in AP 101B-1202-5A3A is to be performed.

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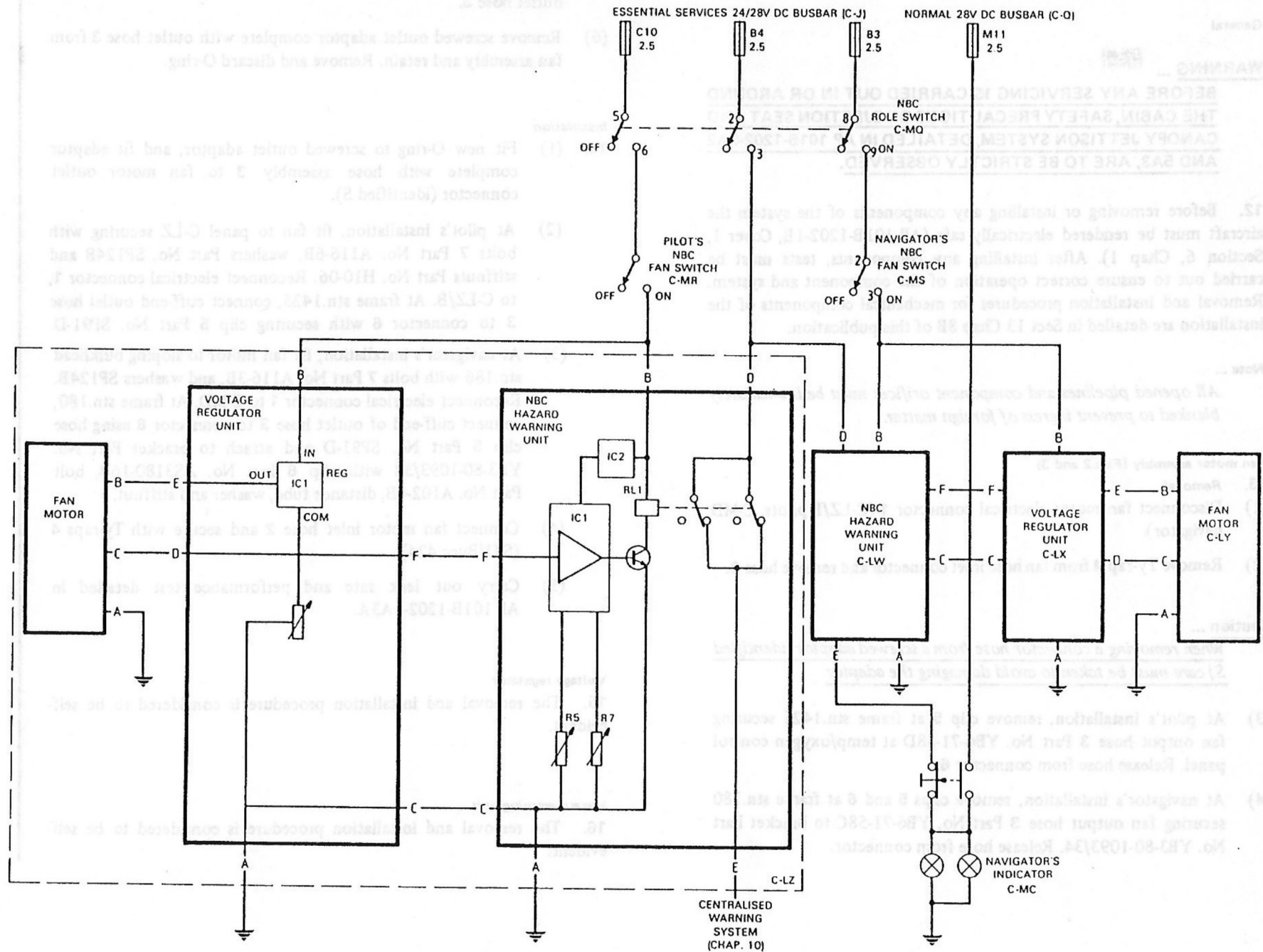


Fig. 1 NBC protection system - theoretical

## REMOVAL AND INSTALLATION

## General

**WARNING ...**

**BEFORE ANY SERVICING IS CARRIED OUT IN OR AROUND THE CABIN, SAFETY PRECAUTIONS ON EJECTION SEAT AND CANOPY JETTISON SYSTEM, DETAILED IN AP 101B-1202-5A2 AND 5A3, ARE TO BE STRICTLY OBSERVED.**

12. Before removing or installing any components of the system the aircraft must be rendered electrically safe (AP 101B-1202-1B, Cover 1, Section 6, Chap 1). After installing any components, tests must be carried out to ensure correct operation of the component and system. Removal and installation procedures for mechanical components of the installation are detailed in Sect 13 Chap 8B of this publication.

**Note ...**

*All opened pipelines and component orifices must be immediately blanked to prevent ingress of foreign matter.*

**Fan motor assembly (Figs.2 and 3)****13. Removal**

- (1) Disconnect fan motor electrical connector 1 (C-LZ/B pilots, C-MD navigator).
- (2) Remove Ty-rap 4 from fan hose inlet connector and remove hose 2.

**Caution ...**

**When removing a connector hose from a screwed adaptor (identified S) care must be taken to avoid damaging the adaptor.**

- (3) At pilot's installation, remove clip 5 at frame stn.1425 securing fan output hose 3 Part No. YB6-71-58D at temp/oxygen control panel. Release hose from connector 6.
- (4) At navigator's installation, remove clips 5 and 6 at frame stn.180 securing fan output hose 3 Part No. YB6-71-58C to bracket Part No. YB3-80-1093/34. Release hose from connector.

- (5) Release fan motor securing bolts 7 and remove fan complete with outlet hose 3.
- (6) Remove screwed outlet adaptor complete with outlet hose 3 from fan assembly and retain. Remove and discard O-ring.

**Installation**

14. (1) Fit new O-ring to screwed outlet adaptor, and fit adaptor complete with hose assembly 3 to fan motor outlet connector (identified S).
- (2) At pilot's installation, fit fan to panel C-LZ securing with bolts 7 Part No. A116-6B, washers Part No. SP124B and stiffnuts Part No. H10-06. Reconnect electrical connector 1, to C-LZ/B. At frame stn.1425, connect cuff-end outlet hose 3 to connector 6 with securing clip 5 Part No. SP91-D.
- (3) At navigator's installation, fit fan motor to sloping bulkhead stn.186 with bolts 7 Part No. A116-3B, and washers SP124B. Reconnect electrical connector 1 to C-MD. At frame stn.180, connect cuff-end of outlet hose 3 to connector 8 using hose clip 5 Part No. SP91-D and attach to bracket Part No. YB3-80-1093/34 with clip 6 Part No. AS3180-16B, bolt Part No. A102-4B, distance tube, washer and stiffnut.
- (4) Connect fan motor inlet hose 2 and secure with Ty-raps 4 (STI/Bucc 424).
- (5) Carry out leak rate and performance test detailed in AP 101B-1202-5A3A.

**Voltage regulator**

15. The removal and installation procedure is considered to be self-evident.

**Hazard warning unit**

16. The removal and installation procedure is considered to be self-evident.

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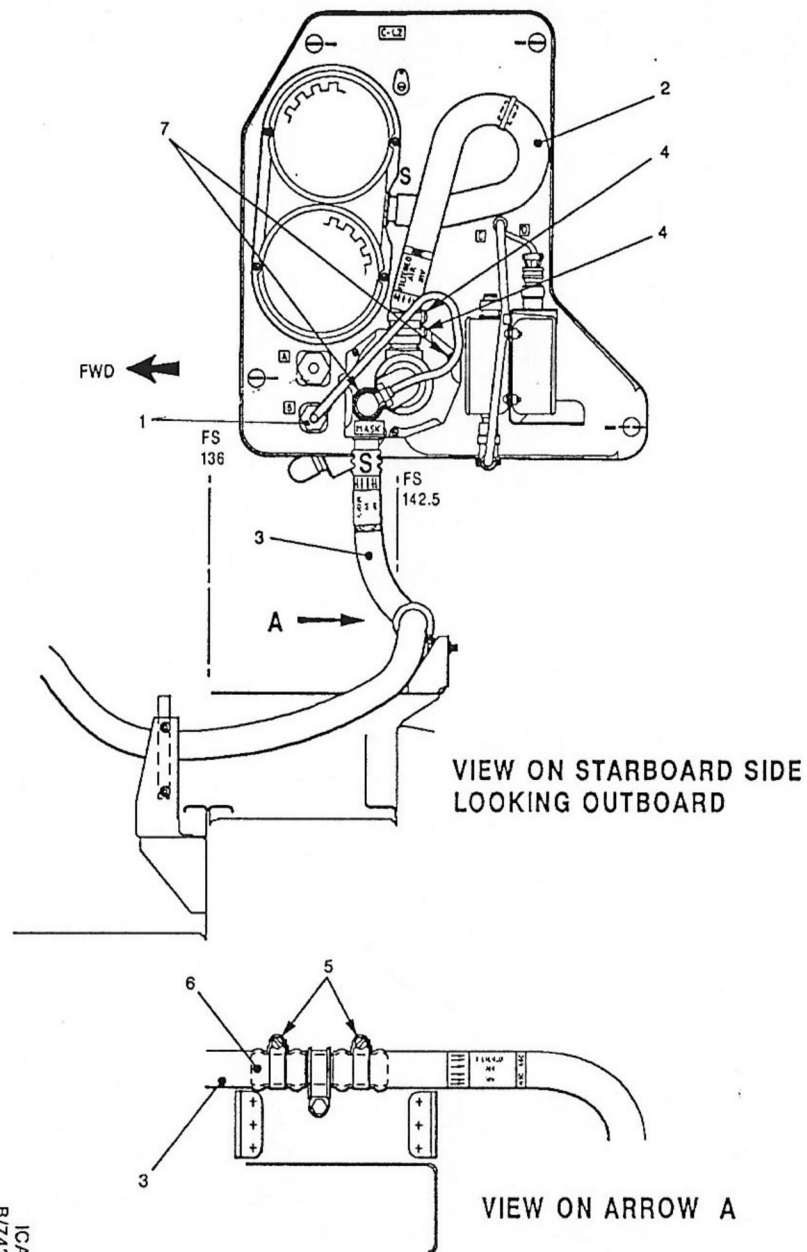
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Fig.2 Pilot's fan motor assembly — removal and installation

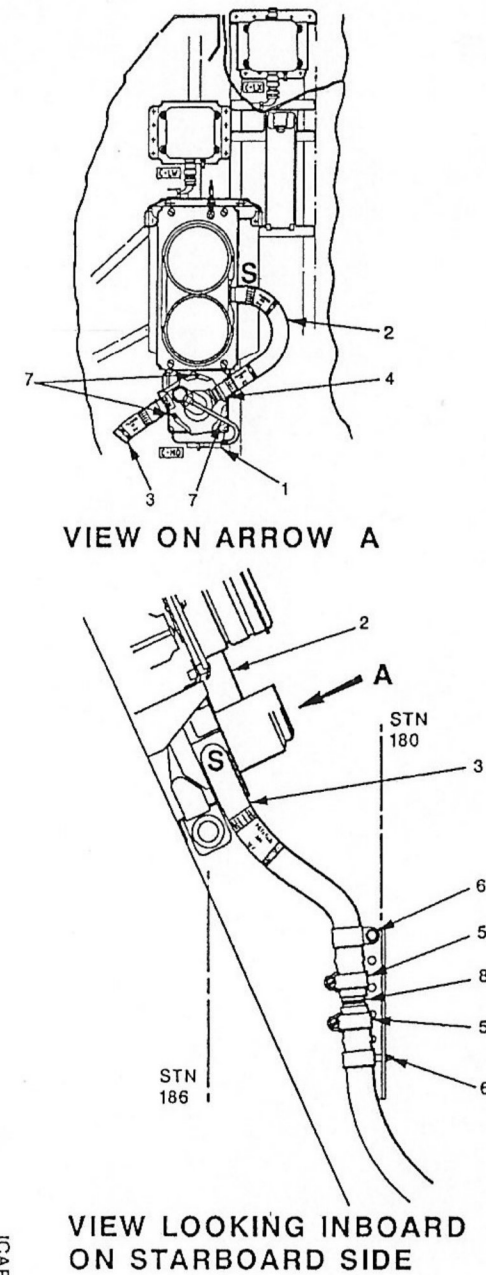
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Fig.3 Navigator's fan motor assembly — removal and installation