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E-GS-20-0018 Rev A

Installation Instructions,

Flap/Slat Actuator Heater System,

Gulfstream G150

Aircraft S/N:_____

Revision Status

Rev.	Description	Approval	Date
IR	Initial revision.	L. Wilding	11/25/2020
A	Changes shown by blue text and change bars. §1: Added statement regarding document applicability. Table 2 & §4.3: Corrected circuit breaker pn. Table 6: Updated applicable revisions and release dates. Removed Table 7, §§ 9 & 10 regarding deactivation / reactivation. Removed §8 regarding continued airworthiness. Removed Appendix C, Wiring Diagrams.	D Rankin	11/28/2020

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ACRONYMS

A	Ampere
AC	Advisory Circular
AFMS	Aircraft Flight Manual Supplement
AMM	Aircraft Maintenance Manual
AWG	American Wire Gauge
CB	Circuit Breaker
CFR	Code of Flight Regulations
DC	Direct Current
DO	Document Order
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FS	Fuselage Station / Frame Station
F/S	Flap/Slat
FSAHS	Flap/Slat Actuator Heater System
FSHCU	Flap/Slat Heater Control Unit
GEN	Generator
GND	Ground
ICA	Instructions for Continued Airworthiness
LED	Light Emitting Diode
LH	Left Hand
MDL	Master Drawing List
MOD	Modification
PDU	Power Drive Unit
P/N	Part Number
PTT	Press-To-Test
REV	Revision
RH	Right Hand
SB	Service Bulletin
STC	Supplemental Type Certificate
VDC	Volt Direct Current
W&B	Weight and Balance

1 PREFACE

This document includes instructions that pertain to the installation of a Flap/Slat Actuator Supplemental Heater System (FSAHS). These installation instructions provide details related to installation of STC ST01075DE on all serial numbers of the Gulfstream G150 with Gulfstream Service Bulletins (SB) 150-27-169, 150-27-180 & 150-27-181 previously incorporated. The installation must be in accordance with the latest FAA approved revision of E-GS-20-0002, Master Drawing List, Flap/Slat Actuator Supplemental Heaters Gulfstream G150.

Minor variations between installations must be in accordance with the methods and processes identified in AC 43.13-1B, “Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair,” and AC 43.13-2B, “Acceptable Methods, Techniques, and Practices - Aircraft Alterations”.

When enabled, the FSAHS is designed to automatically cycle heat to all Flap/Slat actuators if the average temperature of any one of them is below 50° F (+15/-10), and to turn off all heaters if the temperature of any one is above 130° F. A thermistor installed on each actuator, is used to activate the heater system and ensure the system is not heating should the upper temperature limit of 130º F be sensed.

The system is enabled by an ON/OFF Switch installed on the center pedestal of the flight deck, within the reach of either pilot.

The G150 installation includes an automatic load shed feature, that will remove power from the system in the event of a loss of an engine generator.

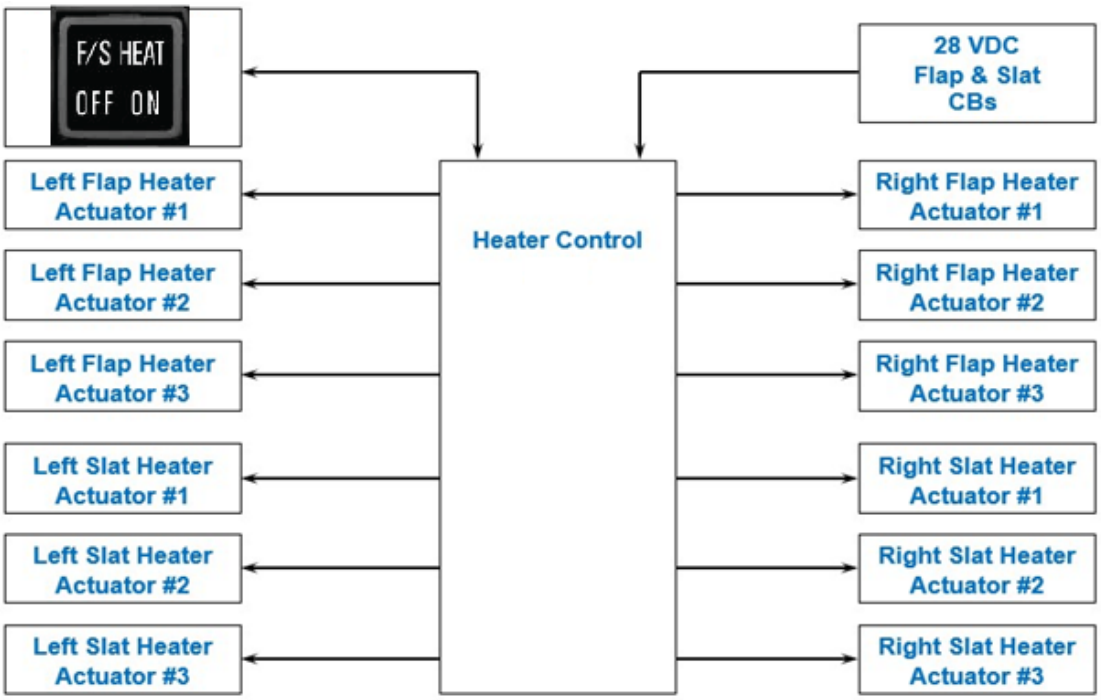


Figure 1: FSAHS Block Diagram

These instructions were created specifically to support installation of the FSAHS on the G150.

This reference document supports manufacturing planning only. All details presented within this document are consistent with those presented in the STC Master Drawing List. All final inspections and sign offs are to be completed to the STC design data.

1.1 Referenced Documents

Table 1: Reference Documents

Source	Document Number	Document Title	Revision	Release Date
Peregrine	E-GS-20-0002	Master Drawing List	C*	10/09/2020
	E-GS-20-0008	Instruction for Continued Airworthiness	IR*	10/09/2020

*Or latest FAA approved revision

2 EQUIPMENT DESCRIPTIONS

2.1 Existing G150 Flap/Slat System

The G150 flap and slat drive system is comprised of a Power Drive Unit (PDU), flexible drive shafts, and twelve linear ball screw actuators (3 per wing, 2 systems). Reference Figure 2 for the relative location of the actuators for each wing.

This STC does not modify the G150 Flap/Slat drive system including controls, indications, safety mechanisms or recommended lubrication maintenance procedures. The existing Flap/Slat actuators are modified by the installation of external supplemental heaters only.

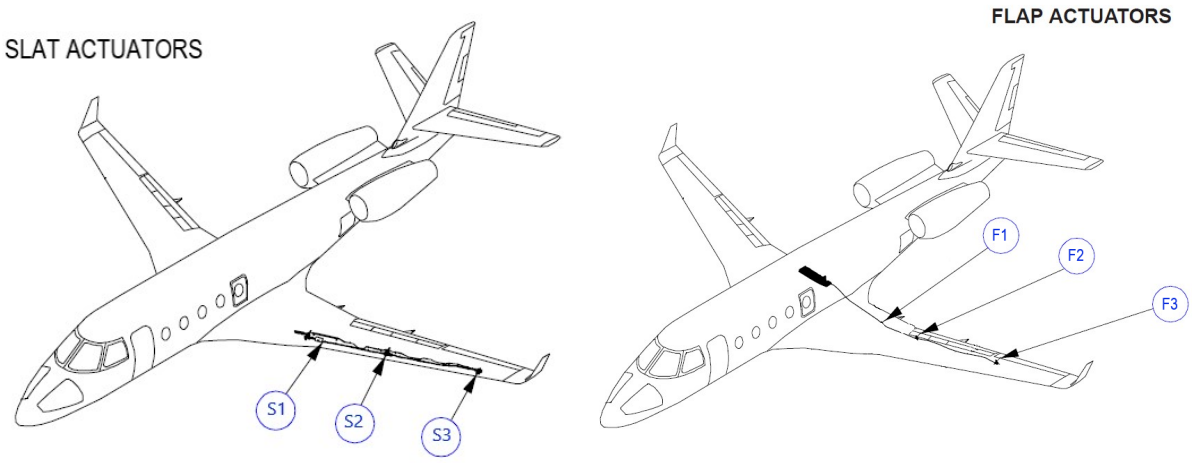


Figure 2: Flap/Slat Mechanical Components (Left Wing Shown)

2.2 Supplemental Heater System

This STC installs the components identified in Table 2. The Flap/Slat Actuator Heater System consists of a Control Box (FSHCU), six flap and six slat actuator heaters (12 total), a cockpit ON/OFF switch, circuit breakers, a relay, and various installation brackets.

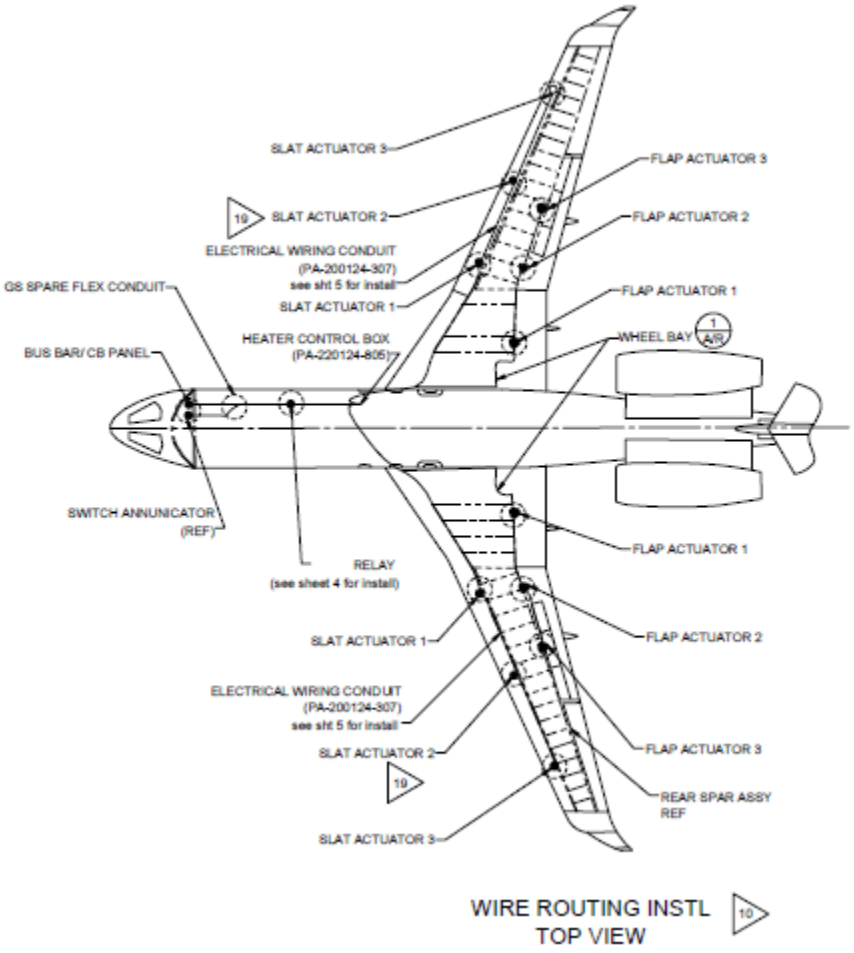


Figure 3: FSAHS Component Locations and Wire Routing

Table 2: Flap/Slat Actuator Heating System Components

Style	MFG	Part Number	Location
Flap Actuator Heaters	Cox & Company	PA-200124-807	Flap 1
		PA-200124-817	Flap 3
		PA-200124-827	Flap 2
Slat Actuator Heaters		PA-200124-806	Slat 3
		PA-200124-817	Slat 1, Slat 2
FSHCU		PA-200124-805	Belly Fairing
ON/OFF Switch	Vivisun	LED-41-14-EA3-E2N2P	Flight Deck Center Pedestal
Circuit Breakers	ETA	4120-IAI-15 or 4200-011-15	OVHD CB Panel
Heater Enable Relay	TE Connectivity	FC-325-8	RH Cabin Sidewall
Relay Mounting Bracket	Peregrine	PA-200124-303	RH Cabin Sidewall
Blocking Diode	Amphenol	TJSE20705	OVHD CB Panel
Control Box Mounting Brackets	Peregrine	PA-200124-321	Belly Fairing

Wrap-around, *cuff*-style heaters are mounted on the exterior of the actuators and secured with a stainless-steel band clamp. For ease of maintenance, the heaters are attached by mechanical means rather than by adhesion.

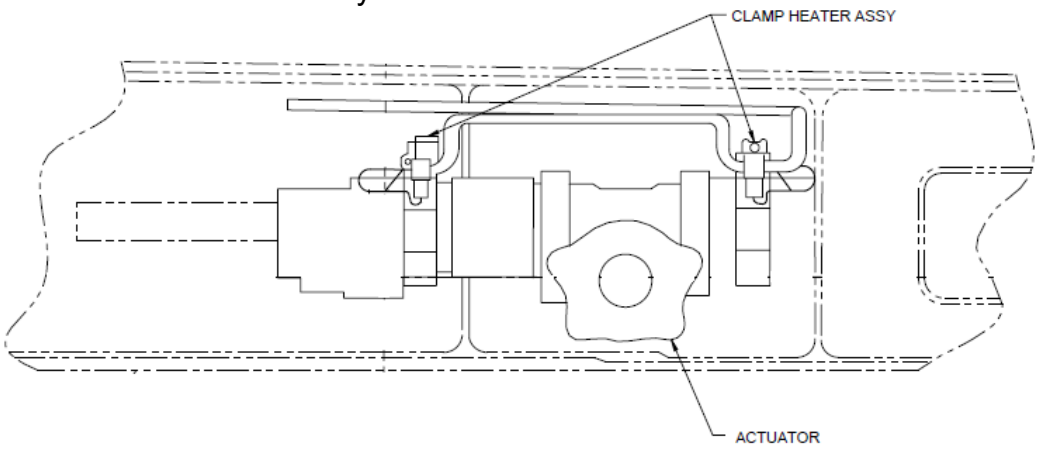


Figure 4: Actuator Heater (Typical)

2.3 Component Locations

2.3.1 Controller

The F/S Heat Controller (PA-200124-805) is mounted in the belly fairing near fuselage station (FS) 251 (Frame 25). The controller is mounted on the right side of the lower fuselage under the belly fairing. It is accessed by opening the emergency brake access door (141AB), (reference A in Figure 5).

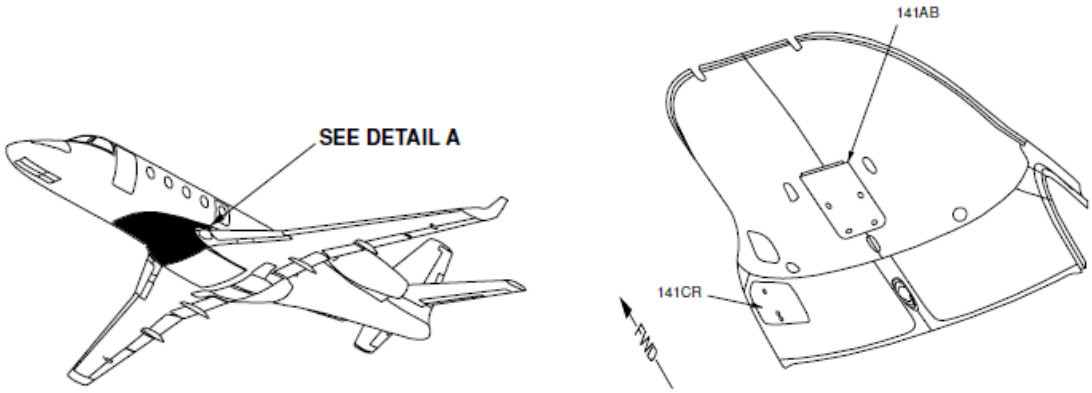


Figure 5: Control Box Location

The installation utilizes metal brackets to secure the controller to structure. Light Emitting Diodes (LED) on the control box indicate the status of the heater system. A Press-To-Test (PTT) switch is installed on the exterior of the controller to initiate a self-test of the system when the airplane is on the ground. The controller also performs a self-test at power up and at prescribed intervals during normal operation.

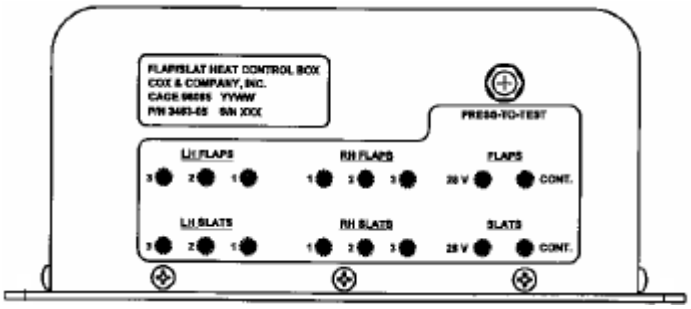


Figure 6: F/S Heat Controller

2.3.2 Flap Actuator Heaters

Heaters installed on the flap actuators are a “band clamp” or “cuff” style. Each heater consisting of two heating elements and a thermistor. The thermistor in each heater provides temperature data to the FSHCU to allow automatic cycling of the actuator heaters and ensures the upper limit of 130° F is maintained. Heaters are secured to the flap actuators at the locations shown in Figure 7.

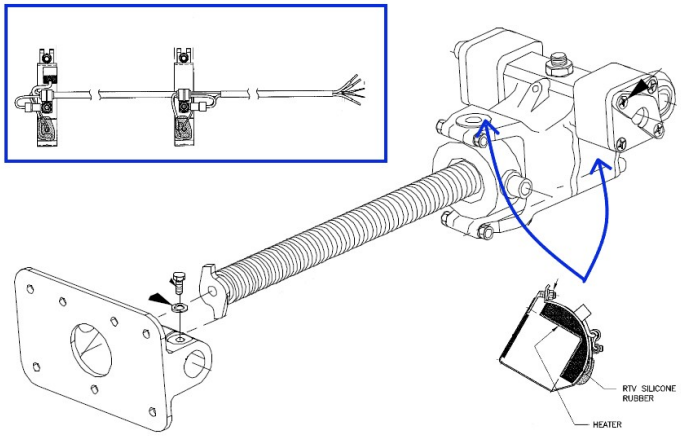


Figure 7: Flap Actuator Cuff Configuration

2.3.3 Slat Actuator Heaters

The slat actuator heating system requires “band clamp” or “cuff” style heaters for three slat actuators per wing. The mid-wing and inboard slat actuators is fitted with a heater consisting of two heater cuffs clamped at the location indicated in Figure 8. The outboard slat actuators (location F3) is fitted with one cuff in the location shown in Figure 9. Proper installation orientation of the heaters varies based on clearance and fit to the individual actuator. All heater cuffs contain an integral thermistor that provides temperature values to the FSHCU to allow for proper controls of the heating elements. The upper limit of the slat heaters, as set by the FSHCU, will also be 130 deg F.

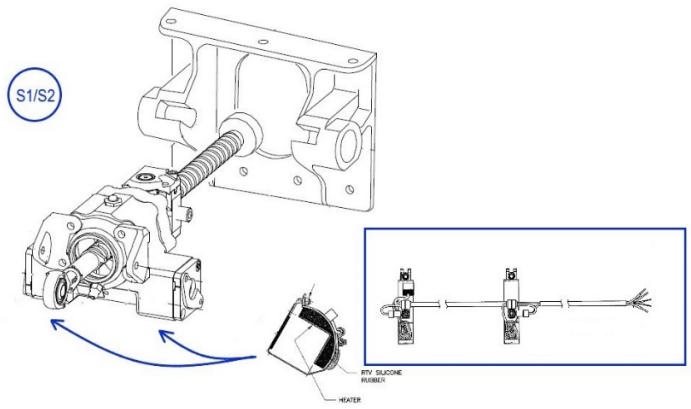


Figure 8: #1 Slat (Inboard) and #2 Slat (Mid) Actuator Cuff Configuration

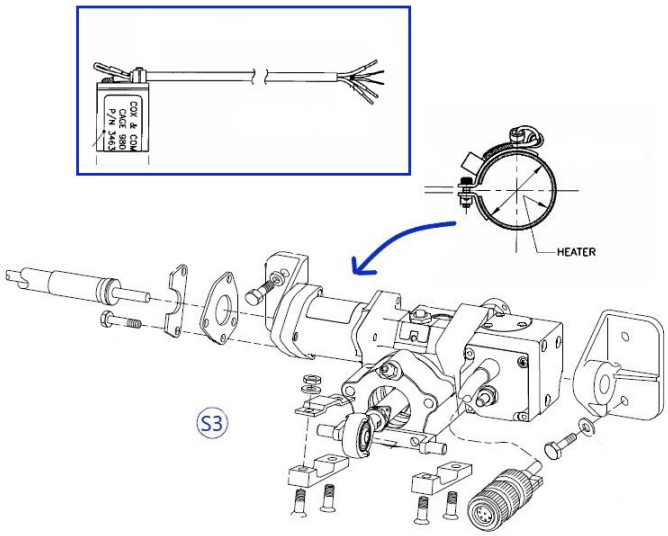


Figure 9: #3 Slat (Outboard) Actuator Cuff Configuration

2.4 System Power Source

The FSAHS receives power via two 15 A, CBs installed in the ICE PROTECTION section on the G150 Overhead CB panel. circuit breakers. One CB provides power to the flap heater channel and the other powers the slat heater channel.

The CBs receive power directly from the G150 distribution buses. The flap heaters are connected to the #1 (Left) distribution bus and the slat heaters are connected to the #2 (Right) distribution bus.

Power for the system is enabled via a new heater enable relay. This relay is only energized when both engine generators on-line and supplying power, otherwise, the system electrical load is automatically removed (shed) from the G150 buses. In addition, the flight crew can disable the system at any time using the Heater enable switch located on the flight deck.

The system is designed with an alternate power scheme for performing maintenance while the airplane is on the ground with both engines stopped.

Reference PA-200124-901, *Flap/Slat Actuator Heater System Wiring Diagram*, for additional details on the heater power circuit.

2.5 System Control Logic

The F/S controller has two separate channels; one controls the six flap heaters while the other controls the six slat heaters. The system is designed such that, at an ambient of 0° F, the average temperature of the actuator shall stabilize between 40° F and 65° F and and to turn off all heaters (flaps or slats) if the temperature of any one is above 130° F. The heater is rated to produce a temperature rise of at least 40° F.

2.6 ON/OFF Control

An ON/OFF switch is located in the cockpit for enabling the system.

Figure 10: F/S Heat Enable Switch

2.7 Relay for Ground Power

An enable relay is installed in the right sidewall to supply power at the controller. The relay requires 28 Vdc and a ground to operate. The ground signal is provided by the ON/OFF switch located the cockpit. 28 Vdc is provided by two independent sources.

1) With both engine generators on-line, relay power is supplied by the closed contacts of the R & L Generator (GEN) Fail Relays. In the event either generator fails, the respective relay opens, and heater power is removed.
2) For testing the system on the ground, the enable relay may be powered by selecting the Battery Master Switch to the “OVRD LOAD REDUCT” position. This selection allows the relay to be powered with no engines running.

Reference PA-200124-523, *Flap/Slat Actuator Heater Electrical Installation Drawing*, for additional details on the relay circuit.

3 PLANNING INFORMATION

3.1 Effective Aircraft

These installation instructions provide details related to installation on all serial numbers of the Gulfstream G150 with Gulfstream Service Bulletins (SB) 150-27-169, 150-27-180 & 150-27-181 previously incorporated.

3.2 Electrical Load Analysis

Electrical load change presented by the incorporation of this installation must be documented by the installer and require an amendment to the existing airplane electrical loads documents.

The electrical loads installed by this STC are listed in Table 3 (in-flight) and in Table 4 (on-ground). These values are to be used in completing the updated subject aircraft electrical loads analysis. It is the installer's responsibility to document any other added or removed equipment that is not part of this STC.

Power for the system is enabled via a new heater enable relay. This relay is only energized when both engine generators on-line and supplying power, otherwise, the system electrical load is automatically removed (shed) from the G150 buses. In addition, the flight crew can disable the system at any time using the Heater enable switch located on the flight deck.

Table 3: In-Flight Electrical Bus Load changes due to Installed Equipment

Equipment	Left Distribution Bus Loading Increase	Left Generator and No 1 MAIN Bus Loading Increase	Right Distribution Bus Loading Increase	Left Generator and No 1 MAIN Bus Loading Increase
Flap Actuator Heaters	11.26 A	11.26 A	-	-
Slat Actuator Heaters	-	-	11.26 A	11.26 A

The system is designed with an alternate power scheme for performing maintenance while the airplane is on the ground with both engines stopped. The system may be tested, using APU or ground power, by selecting the battery switch to the OVRD LOAD REDUCT position for performing this short duration test. The APU Generator will experience the following loads in Table 4 for approximately 15 seconds while performing the on-ground test of the FSAHS when the Press To Test (PTT) switch is depressed.

Table 4: On-Ground APU Generator Loads

APU Generator	Increase
L Main Bus Loads	11.26 A
R Main Bus Loads	11.26 A

3.3 Weight & Moment

Weight and balance change presented by the incorporation of this installation must be documented by the installer and require an amendment to the existing airplane weight and balance documents.

The information in Table 5 is provided to adjust the, serial number specific, Weight and Balance (W&B) documents following installation of the STC equipment.

Table 5: G150 Weight and Balance Data

Location - Components (added)	Qty	Weight in Pounds (lbs)	Arm in inches (in)	Moment Arm (in-lbs)
Cockpit – Circuit Breakers, Annunciator, and Wiring	1	0.25	125.20	31.30
Right Cabin – Relay and wiring	1	1.10	233.62	256.98
Lower Fuselage – Control Box and mount	1	3.98	256.68	1021.59
Wings – 12 Heater assemblies	1	2.40	310.00	744.00
Wings and Fuselage -Wiring Install	1	13.62	288.00	3922.56
Total of STC System Install		21.35	279.93	5976.43

3.4 Instructions for Continued Airworthiness

STC Document, E-GS-20-0008, *Instructions for Continued Airworthiness*, includes additional documentation for servicing, component replacement, system testing, and return to service instructions. Modification of an aircraft with the implementation of this STC obligates the operator to include the maintenance items identified within the ICA into their existing maintenance program to maintain the aircraft in an airworthy condition as specified by 14 CFR §43.16, *Airworthiness Limitations*.

3.5 Airplane Flight Manual Supplement

STC Document, E-GS-20-0009, *Airplane Flight Manual Supplement*, includes normal and emergency operating instructions.

4 EQUIPMENT INSTALLATION

The installation of this system is defined by the latest FAA approved E-GS-20-0002, Master Drawing List, *Flap/Slat Actuator Supplemental Heaters, Gulfstream G150*.

Table 6: STC Drawings

DWG NO.	DRAWING TITLE	EFF.	REV*.	STATUS/ RLS. DATE
MECHANICAL / INSTALLATION				
PA-200124-303	RELAY MOUNTING BRACKET	ALL	A	10/7/2020
PA-200124-307	ELECTRICAL WIRING CONDUIT	ALL	A	10/7/2020
PA-200124-321	FSAHS CONTROL BOX MOUNTING ASSEMBLY	ALL	A	10/1/2020
PA-200124-501	FSAHS COCKPIT ANNUNCIATOR SWITCH INSTALL	ALL	A	10/01/2020
PA-200124-503	FLAP SLAT HEATER CONTROL BOX INSTL	ALL	C	11/18/2020
PA-200124-505	FLAP ACTUATOR HEATERS INSTL	ALL	C	10/08/2020
PA-200124-507	SLAT ACTUATOR HEATERS INSTL	ALL	B	10/08/2020
PA-200124-509	OVERHEAD PANEL OVERLAY MODIFICATION	ALL	IR	9/18/2020
PA-200124-521	ELECTRICAL INSTL, WIRE ROUTING	ALL	C	10/08/2020
PA-200124-523	FSAHS ELECTRICAL INSTALLATION	ALL	B	11/09/2020
PA-200124-805	HEATER CONTROL BOX SCD	ALL	A	11/18/2020
PA-200124-806	CLAMP HEATER ASSEMBLY SCD (OUTBD SLAT)	ALL	A	11/18/2020
PA-200124-807	CLAMP HEATER ASSEMBLY SCD (OUTBD FLAP)	ALL	A	11/18/2020
PA-200124-817	CLAMP HEATER ASSEMBLY SCD (MID/INBD SLAT/FLAP)	ALL	A	11/18/2020
PA-200124-827	CLAMP HEATER ASSEMBLY SCD (MID FLAP)	ALL	A	11/18/2020
WIRE DIAGRAMS				
PA-200124-901	FLAP/SLAT HEATER SYSTEM WIRE DIAGRAM	ALL	C	10/08/2020

*Or latest approved revision

4.1 Control Box Installation

Reference PA-200124-503, *Flap/Slat Actuator Heater Control Box Instl* and PA-200124-321, *Control Box Mounting Bracket Assy* for control box installation details and location. The control box is installed in the belly fairing to the underside of the floor between Frame 25 and 26 by two mounting brackets (Figure 12) installed by match drilling to 7 existing rivets in skin for each bracket.

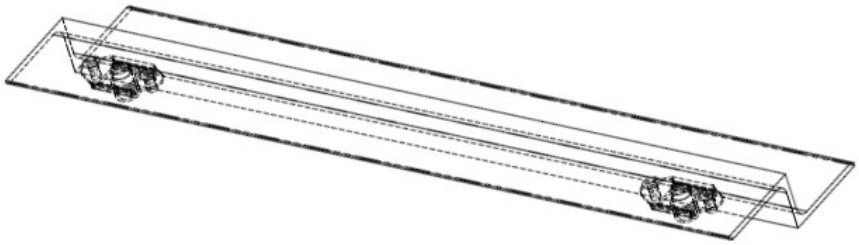


Figure 11: Control Box Mounting Bracket

The control box is to be positioned (Figure 12) such that the Press-To-Test button is accessed, and the control box annunciator lights are viewed through the emergency brake access door.

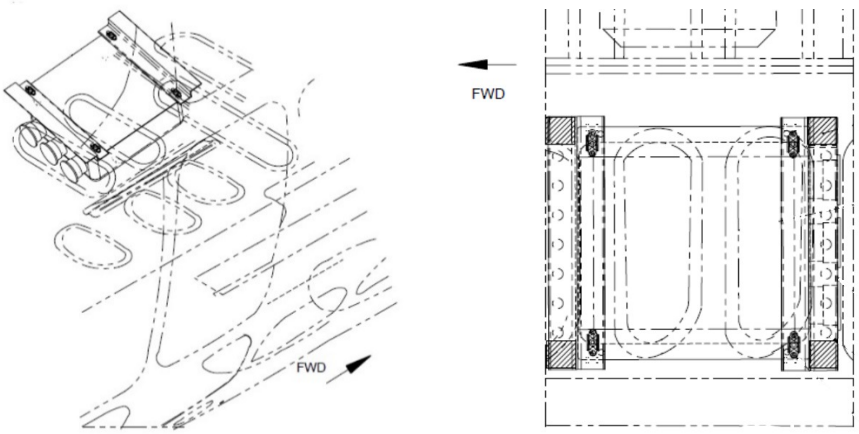


Figure 12: Control Box Installation

4.2 Cockpit Annunciator Installation

The cockpit annunciator switch is installed in the cockpit instrument pedestal. The switch can be installed in any appropriate and available panel in the aft area of the pedestal. Reference PA-200124-501, *Annunciator Instl (Mod)* for cockpit switch installation details and location.

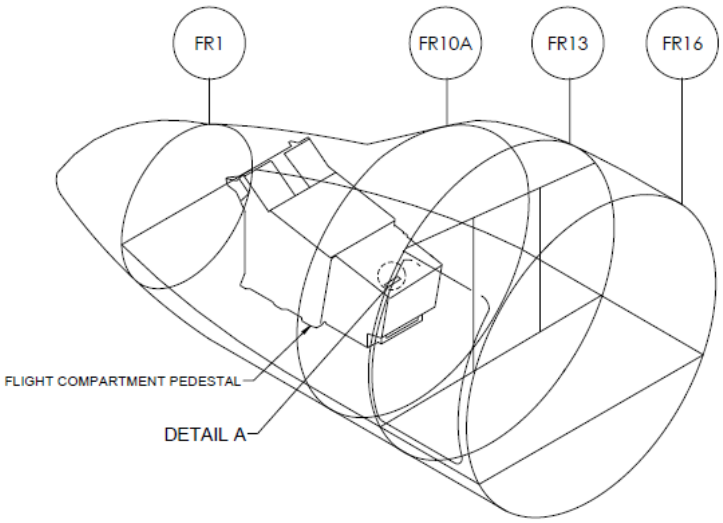


Figure 13: Switch Location on Cockpit Pedestal

Figure 14: F/S Heat Enable Switch

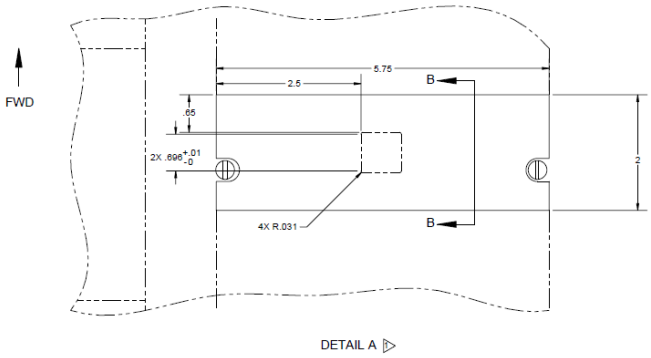


Figure 15: Pedestal Panel Modification

4.3 Circuit Breaker Installation

Two 15A circuit breakers, p/n 4120-IAI-15 or alternate p/n 4200-011-15 are installed in the cockpit overhead panel. Reference PA-200124-523, G150 Flap Slat Actuator Heater Electrical Installation Drawing for the electrical install of the circuit breakers.

4.4 Overhead Panel Modification

The cockpit overhead panel overlay is modified to indicate the location of the circuit breakers for the system according to the overlay modification drawing. They are marked “SLAT ACT HEAT” and “FLAP ACT HEAT”.

Reference PA-200124-509, *Overhead Panel Overlay Modification*, for modification of the overlay.

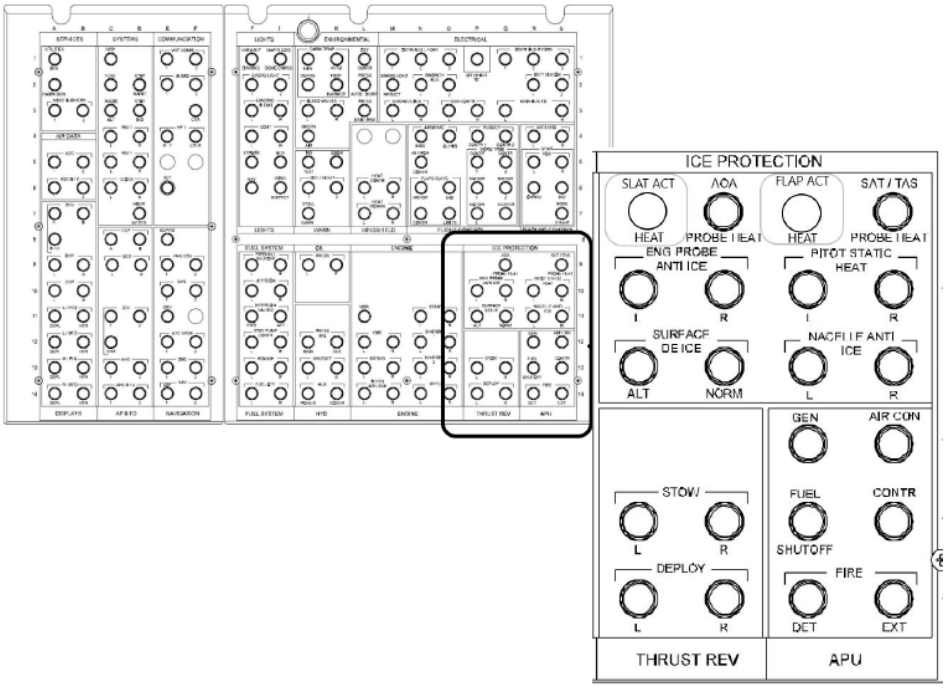


Figure 16: G150 Overhead CB Panel Mod

4.5 Relay Installation

The enable relay is installed in the right sidewall (FS 233.62) to supply power at the controller. It is installed by a bracket, PA-200124-303, *Relay Mounting Bracket*, to an existing rivet location on the frame and is covered by a heat shrink boot. Installation of the relay and heat shrink are described in PA-200124-521, *Electrical Instl, Wire Routing*.

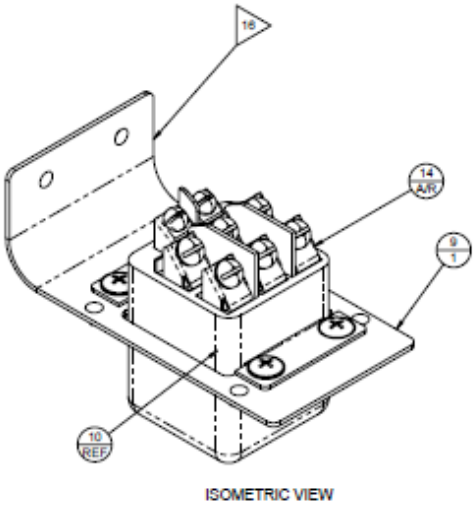


Figure 17: Relay and Mounting Bracket

Figure 18: Heat Shrink Boot on Relay

The ground power enable relay is installed in the aircraft side-wall utilizing bracket PA-200124-303. Refer to PA-200124-521 for installation instructions and location. The bracket is to be installed, if possible, adjacent to an existing attachment bracket. No new holes should be made in the frame for this installation. Locate an installation position which allows existing rivets to be drilled-out and rivets re-installed to install the relay bracket along with the existing equipment.

4.6 Heater Installation

Reference PA-200124-505, *Flap Actuator Heater Install* and PA-200124-507, *Slat Actuator Heater Install* for heater installation details. Gain access to the actuators by removing flap and slat parts as required. Heaters will be installed on 3 flap actuators (Figure 19) and 3 slat actuators on each wing.

4.6.1 Flap Actuator Installation

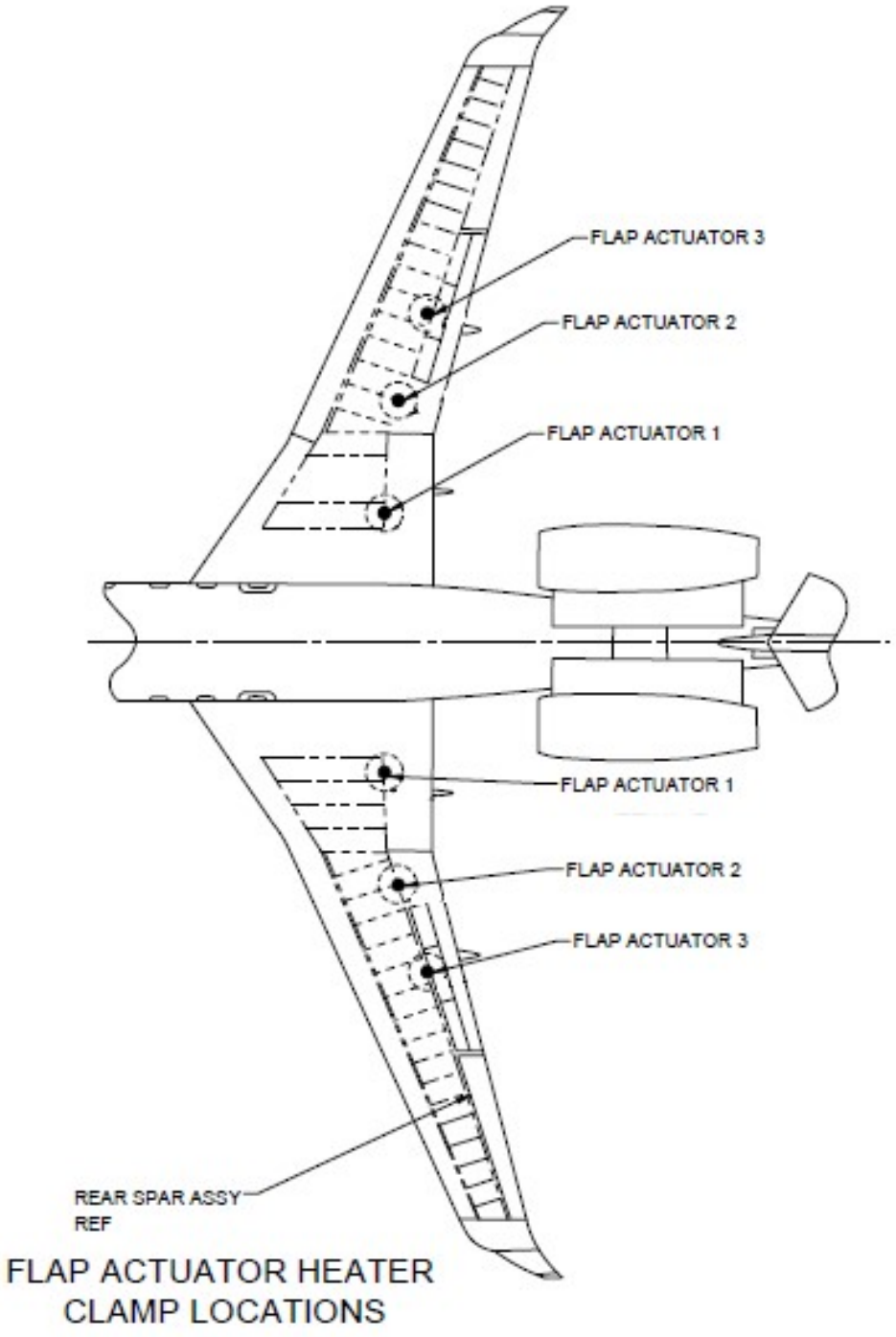


Figure 19: Flap Actuator Locations

4.6.1.1 Installation of Flap Actuator 3 (Outboard), Right Wing

Flap actuator #3 for the right wing (reference Figure 19) should be fitted with p/n PA-200124-817 as shown in Figure 20, with the wiring harness exiting the assembly to the outboard before continuing in the inboard direction of the system wire routing (see Section 5.2).

The clamp should be oriented such that the silicone heating element covers the aft and lower faces of the actuator with the clamp closure in the lower-forward position (Figure 21). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

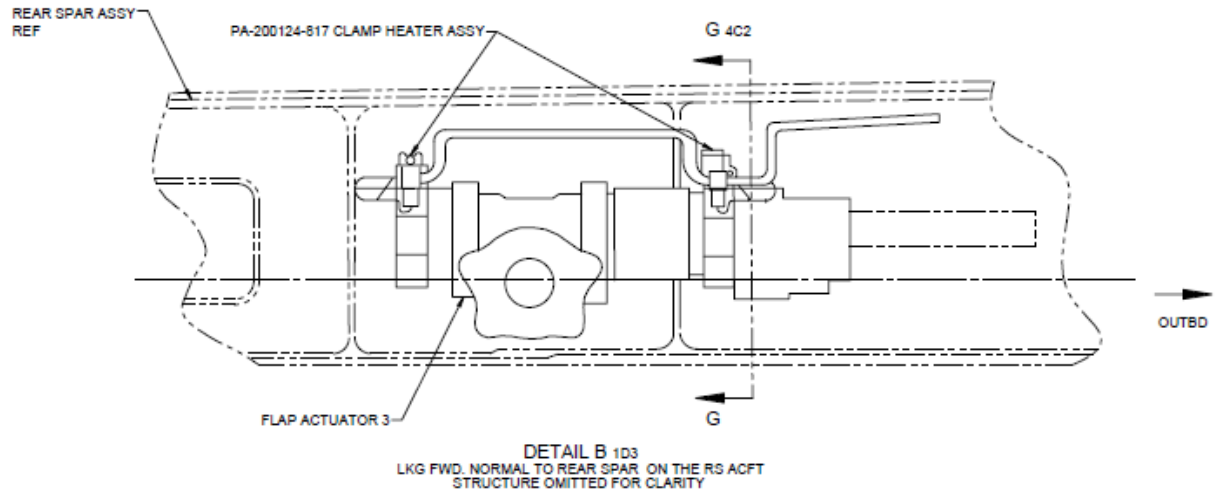


Figure 20: Flap Actuator 3, Right Wing, Looking Forward

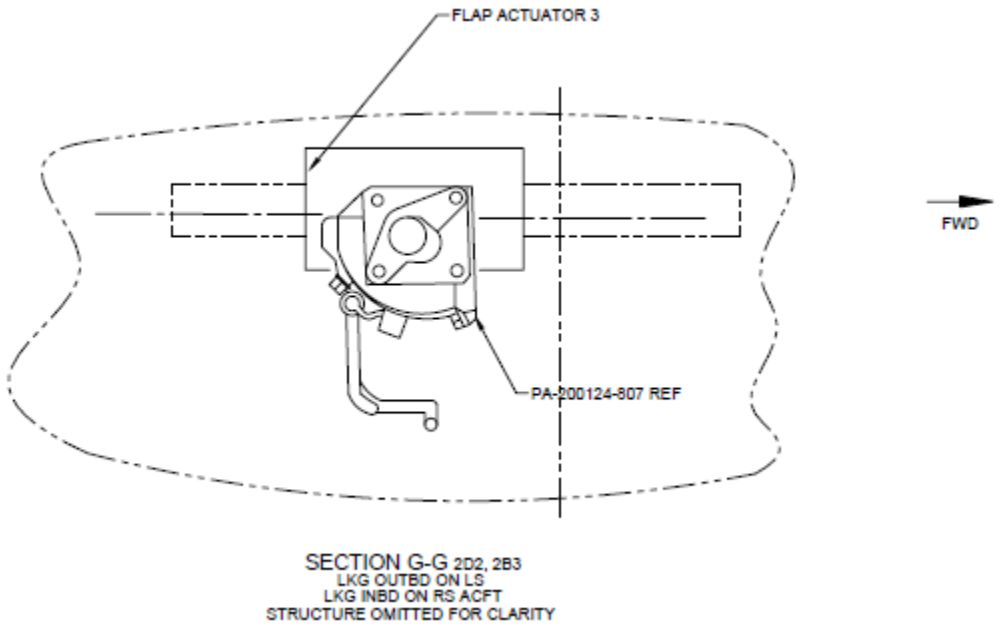


Figure 21: Flap Actuator 3, Right Wing, Looking Inboard

4.6.1.2 Installation of Flap Actuator 3 (Outboard), Left Wing

Flap actuator #3 for the left wing (reference Figure 19) should be fitted with p/n PA-200124-817 as shown in Figure 22, with the wiring harness continuing in the inboard direction to join the wire routing.

The clamp should be oriented such that the silicone heating element covers the aft and lower faces of the actuator with the clamp closure in the lower-forward position (Figure 23). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

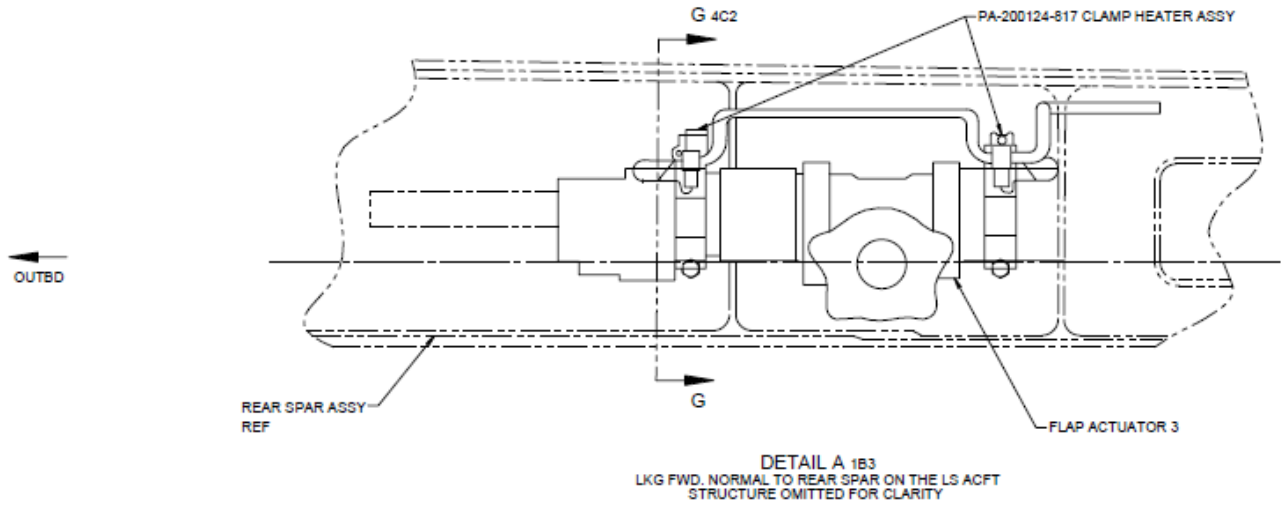


Figure 22: Flap Actuator 3, Left Wing, Looking Forward

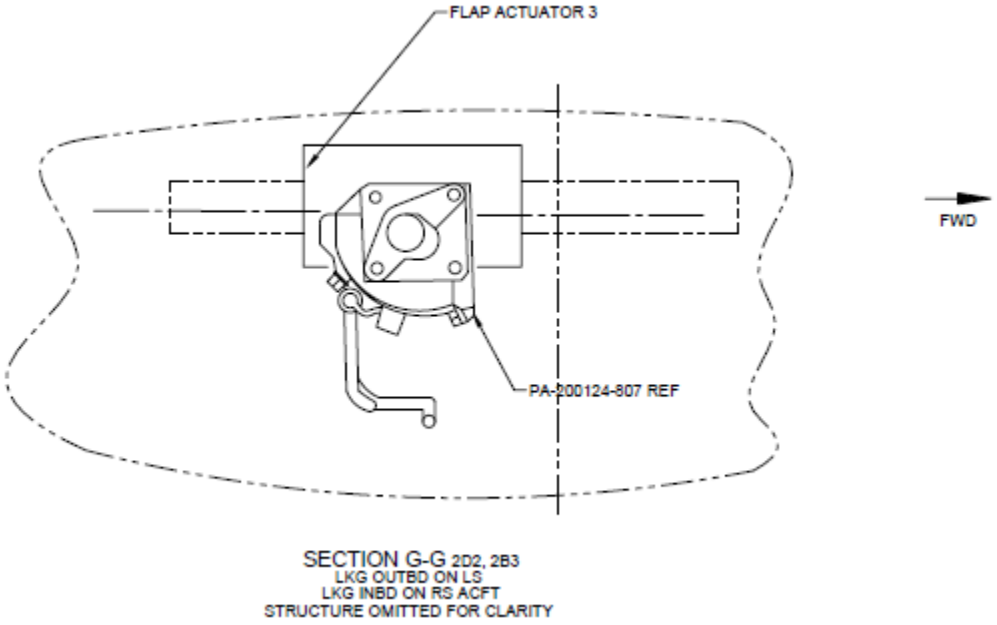


Figure 23: Flap Actuator 3, Left Wing, Looking Outboard

4.6.1.3 Installation of Flap Actuator 2 (Middle), Right Wing

Flap actuator #2 for the right wing (reference Figure 19) should be fitted with p/n PA-200124-827 as shown in Figure 24, with the wiring harness exiting the assembly to the outboard before continuing in the inboard direction of the system wire routing (see Section 5.2).

The clamp should be oriented such that the silicone heating element covers the upper and forward faces of the actuator with the clamp closure in the upper-aft position (Figure 25). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

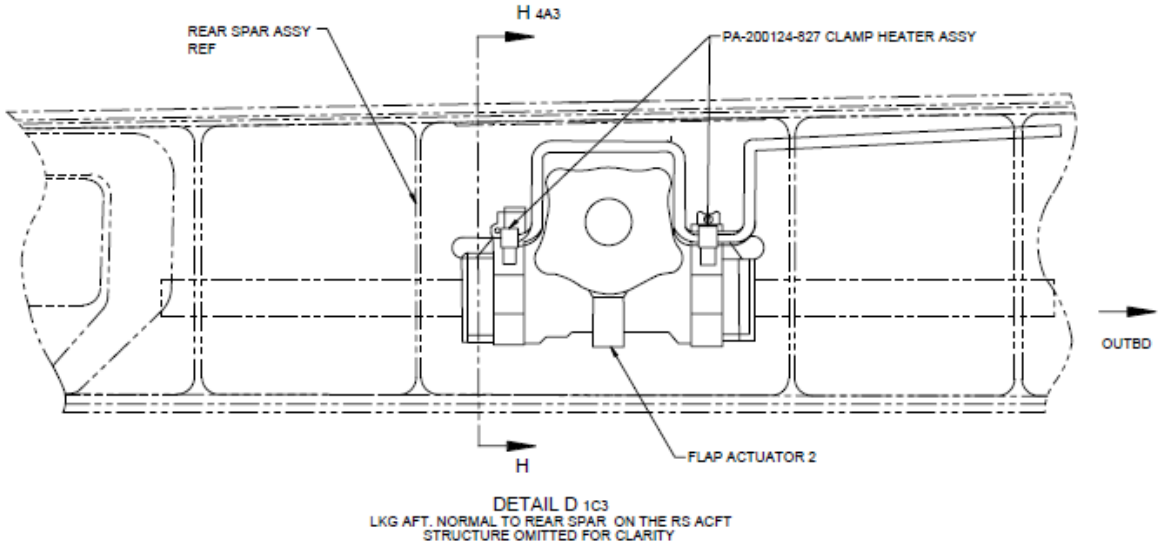


Figure 24: Flap Actuator 2, Right Wing, Looking Aft

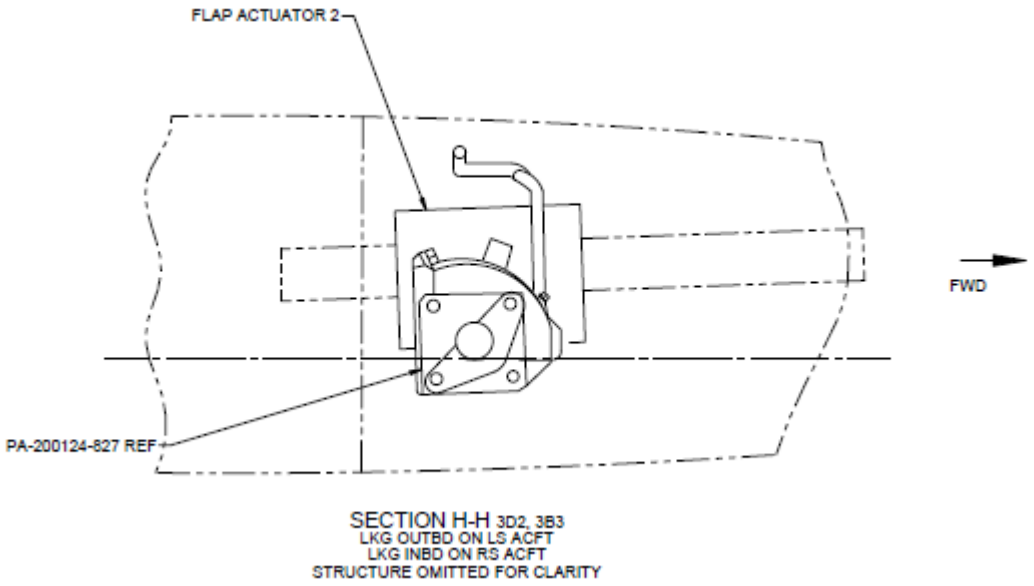


Figure 25: Flap Actuator 2, Right Wing, Looking Inboard

4.6.1.4 Installation of Flap Actuator 2 (Middle), Left Wing

Flap actuator #2 for the left wing (reference Figure 19) should be fitted with p/n PA-200124-827 as shown in Figure 26, with the wiring harness exiting the assembly to the outboard before continuing in the inboard direction of the system wire routing (see Section 5.2).

The clamp should be oriented such that the silicone heating element covers the upper and forward faces of the actuator with the clamp closure in the upper-aft position (Figure 27). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

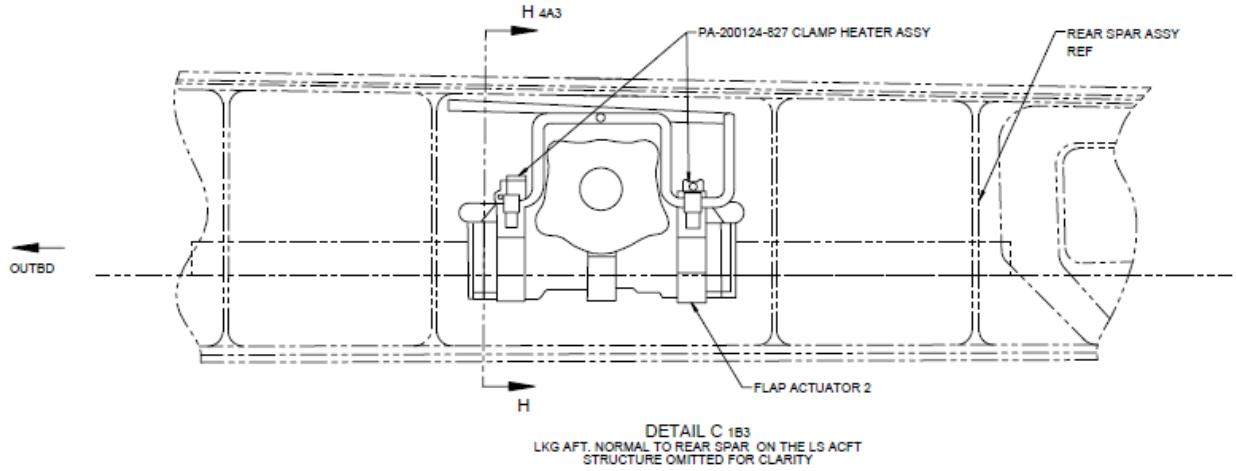


Figure 26: Flap Actuator 2, Left Wing, Looking Aft

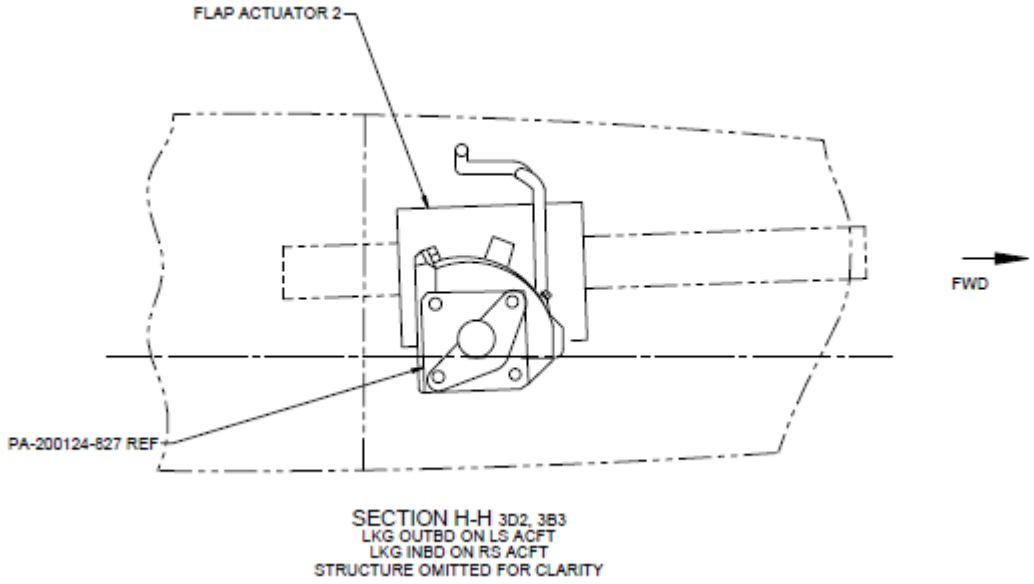


Figure 27: Flap Actuator 2, Left Wing, Looking Outboard

4.6.1.5 Installation of Flap Actuator 1 (Inboard), Right Wing

Flap actuator #1 for the right wing (reference Figure 19) should be fitted with p/n PA-200124-807 as shown in Figure 28, with the wiring harness continuing to the inboard.

The clamp should be oriented such that the silicone heating element covers the upper and aft faces of the actuator with the clamp closure in the lower-aft position (Figure 29). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

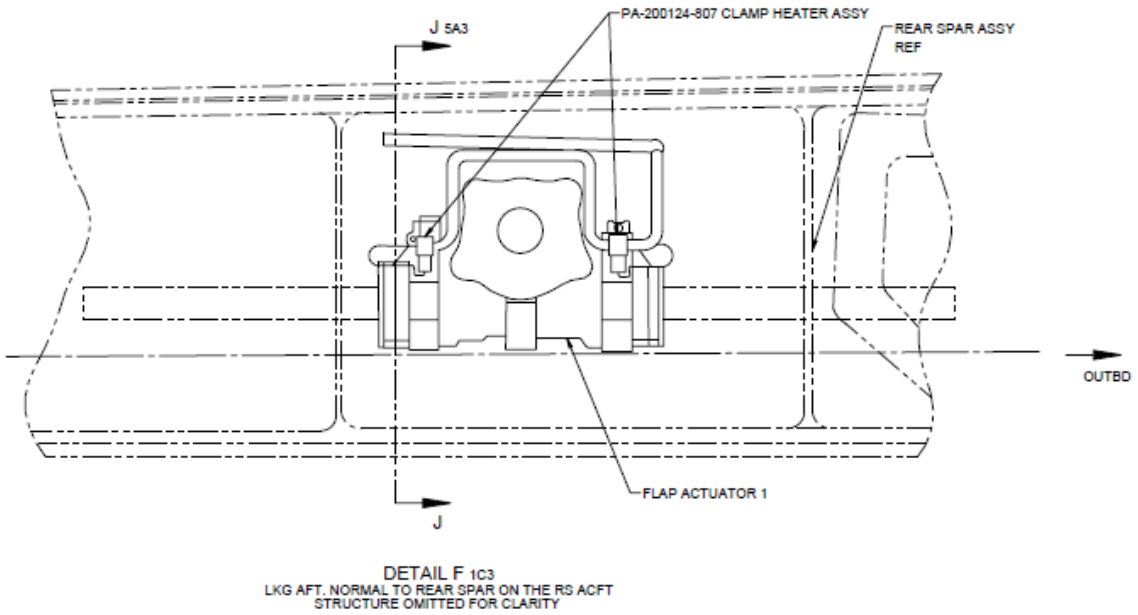


Figure 28: Flap Actuator 1, Right Wing, Looking Aft

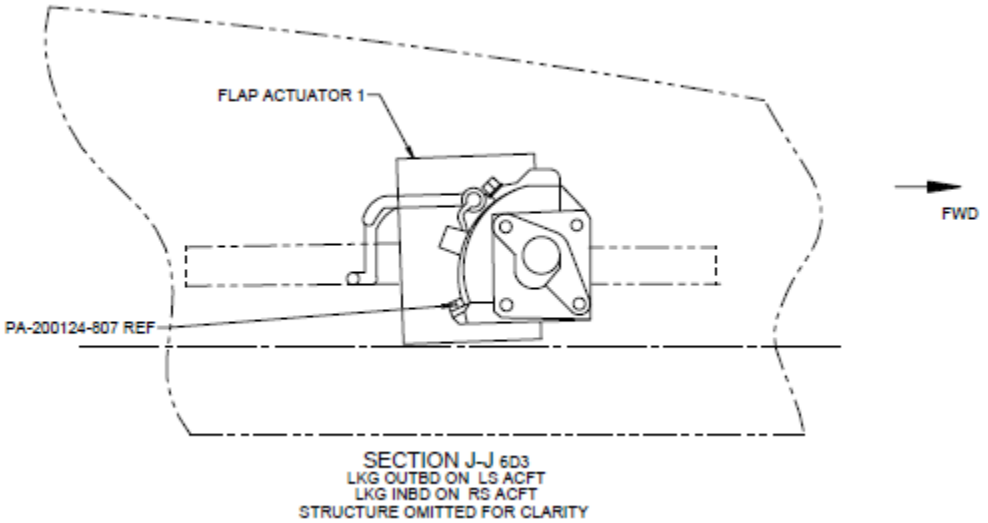


Figure 29: Flap Actuator 1, Right Wing, Looking Inboard

4.6.1.6 Installation of Flap Actuator 1 (Inboard), Left Wing

Flap actuator #1 for the left wing (reference Figure 19) should be fitted with p/n PA-200124-807 as shown in Figure 30, with the wiring harness exiting the assembly to the outboard before continuing in the inboard direction of the system wire routing (see Section 5.2).

The clamp should be oriented such that the silicone heating element covers the upper and aft faces of the actuator with the clamp closure in the lower-aft position (Figure 31). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

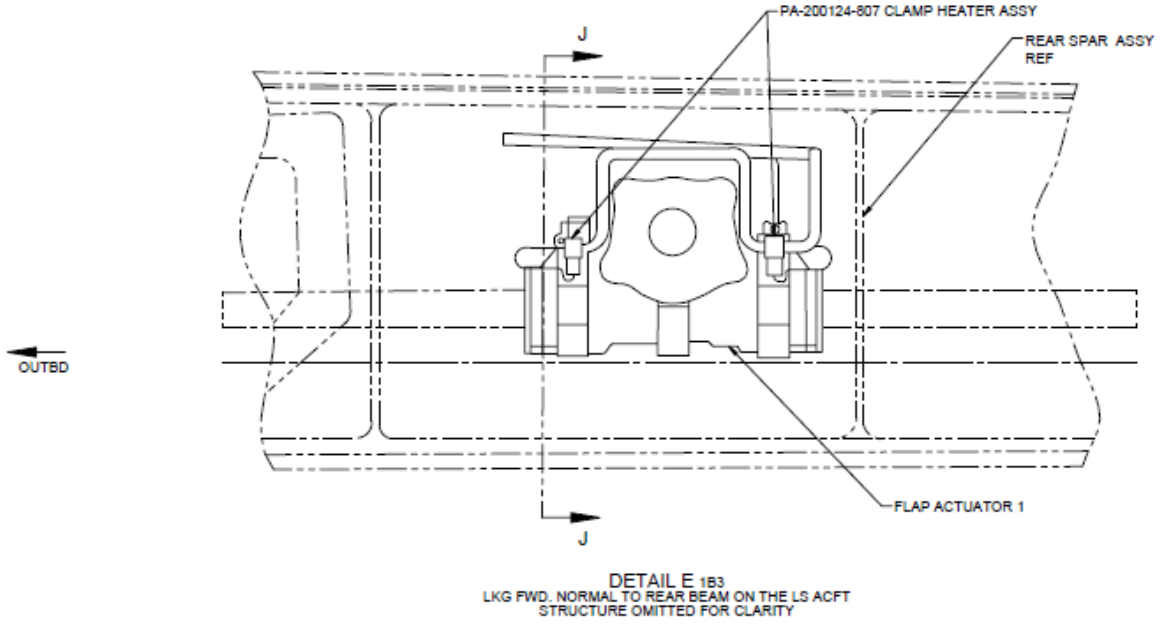


Figure 30: Flap Actuator 1, Left Wing, Looking Forward

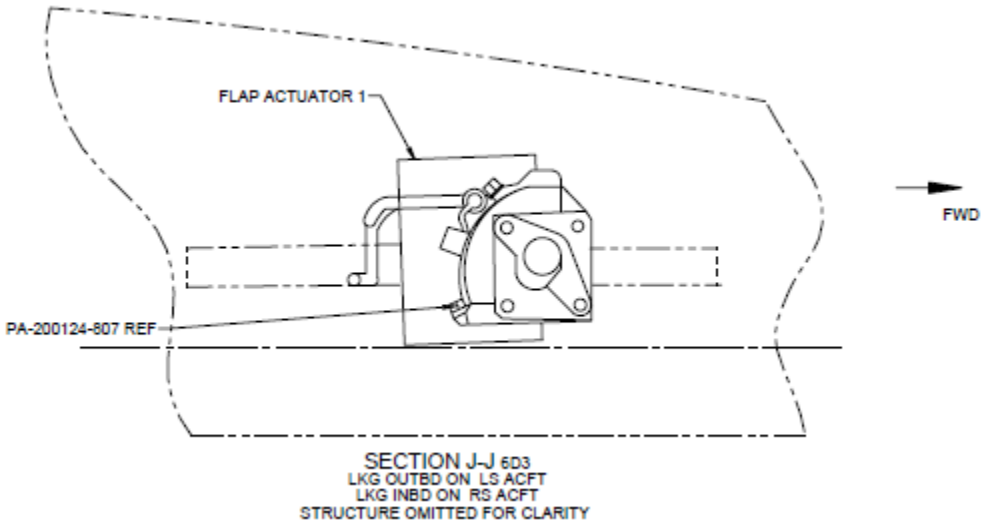


Figure 31: Flap Actuator 1, Left Wing, Looking Aft

4.6.2 Slat Actuator Installation

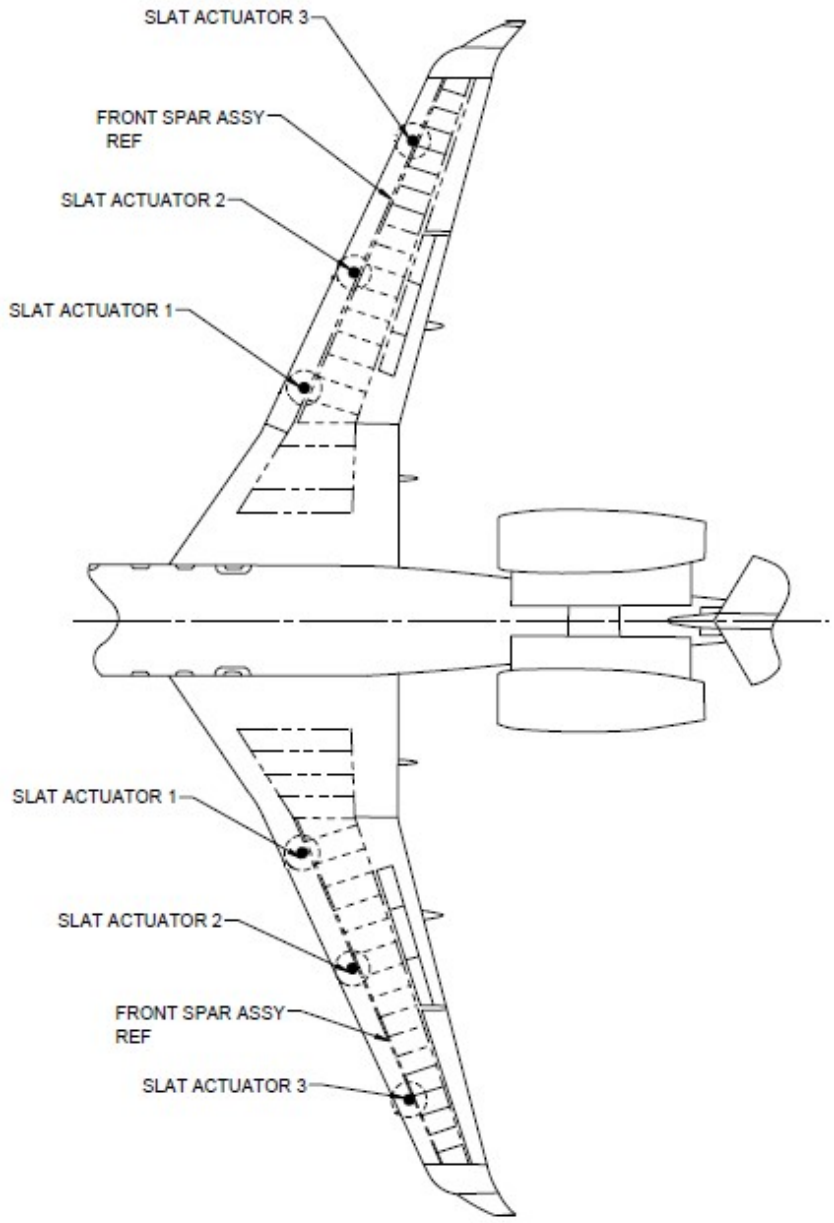


Figure 32: Slat Actuator Locations

4.6.2.1 Installation of Slat Actuator 3 (Outboard), Right Wing

Slat actuator #3 for the right wing (reference Figure 32) should be fitted with p/n PA-200124-806 as shown in Figure 33, with the wiring harness continuing to the inboard. Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

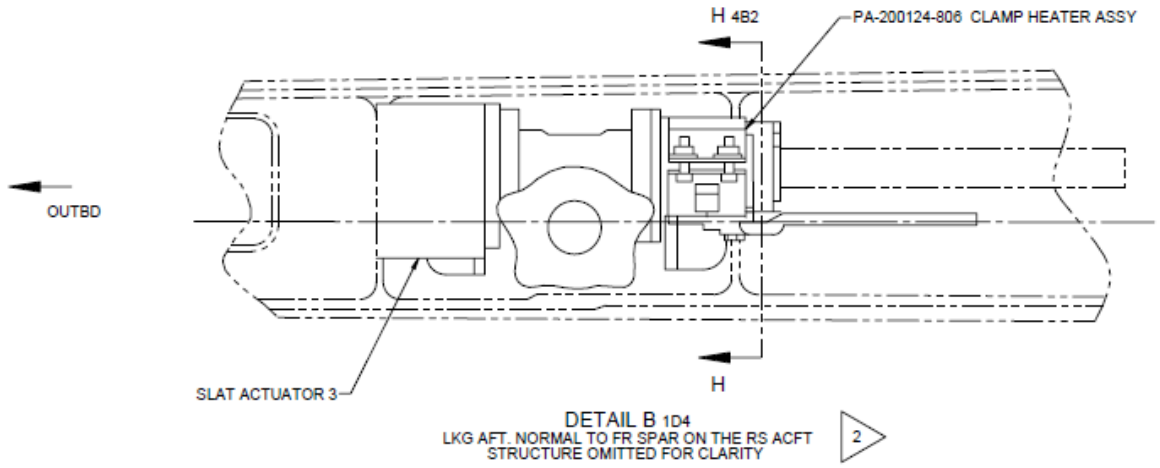


Figure 33: Slat Actuator 3, Right Wing, Looking Aft

4.6.1.2 Installation of Slat Actuator 3 (Outboard), Left Wing

Slat actuator #3 for the left wing (reference Figure 32) should be fitted with p/n PA-200124-806 as shown in Figure 34, with the wiring harness continuing to the inboard. Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

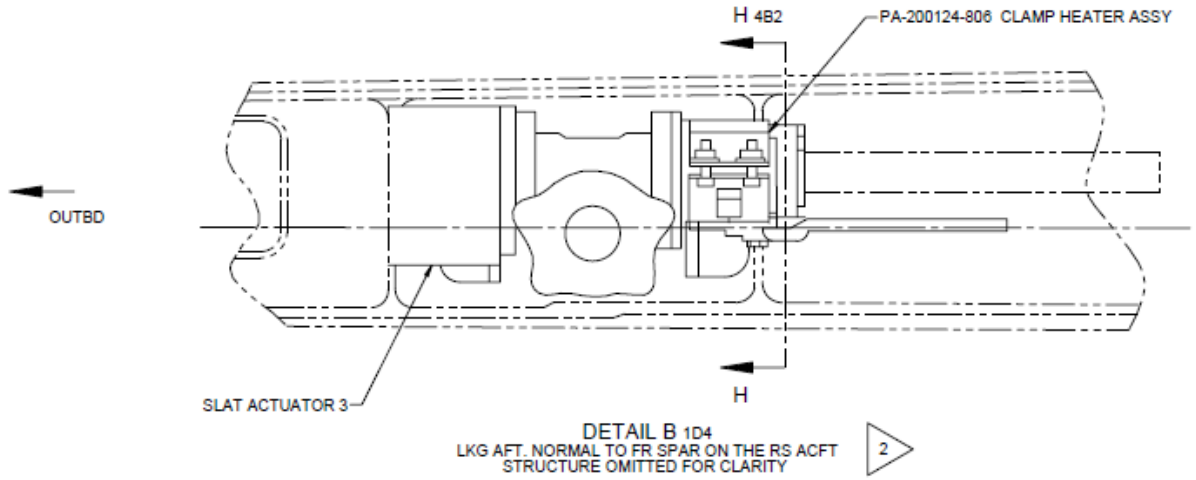


Figure 34: Slat Actuator 3, Left Wing, Looking Aft

4.6.1.3 Installation of Slat Actuator 2 (Middle), Right Wing

Slat actuator #2 for the right wing (reference Figure 32) should be fitted with p/n PA-200124-817 as shown in Figure 35, with the wiring harness continuing to the inboard.

The clamp should be oriented such that the silicone heating element covers the upper and forward faces of the actuator with the clamp closure in the upper-aft position (Figure 36). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

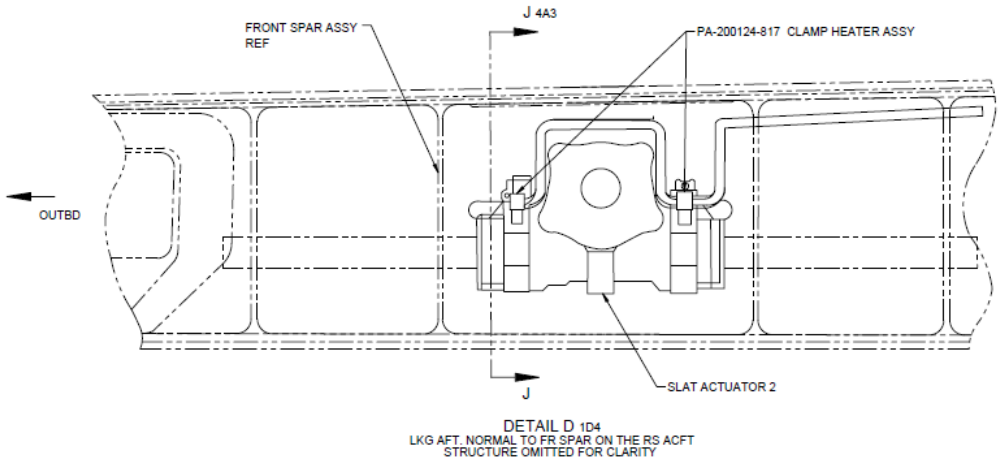


Figure 35: Slat Actuator 2, Right Wing, Looking Aft

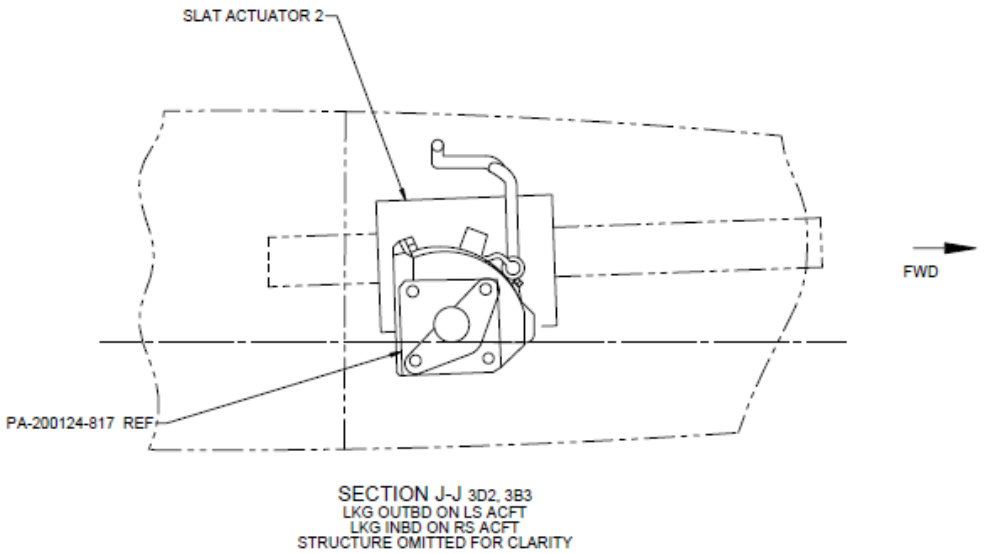


Figure 36: Slat Actuator 2, Right Wing, Looking Inboard

4.6.1.4 Installation of Slat Actuator 2 (Middle), Left Wing

Slat actuator #2 for the left wing (reference Figure 32) should be fitted with p/n PA-200124-817 as shown in Figure 37, with the wiring harness exiting the assembly to the outboard before continuing in the inboard direction with the system wire routing (see Section 5.2).

The clamp should be oriented such that the silicone heating element covers the upper and forward faces of the actuator with the clamp closure in the upper-aft position (Figure 36). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

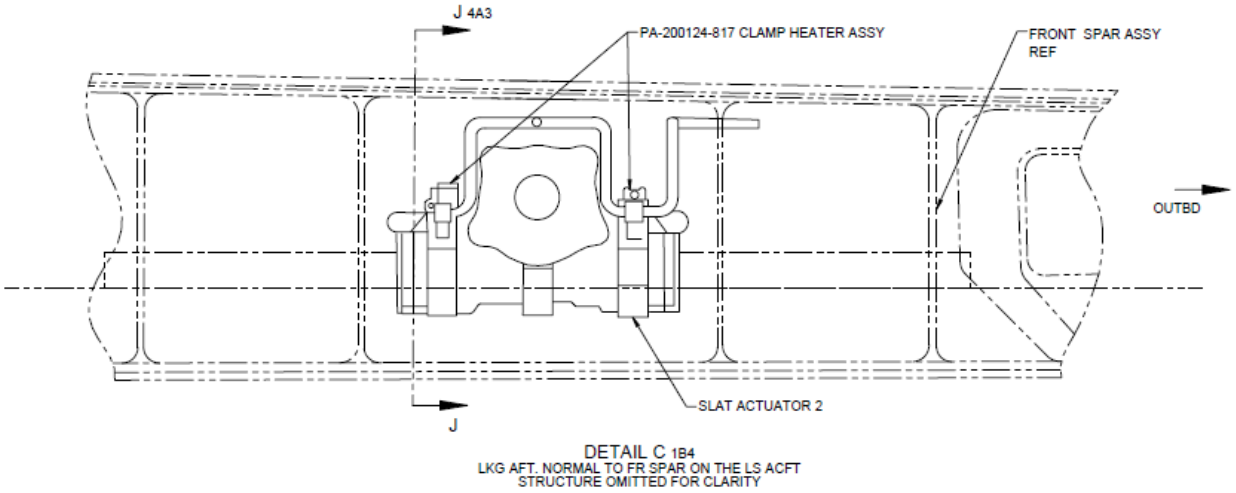


Figure 37: Slat Actuator 2, Left Wing, Looking Aft

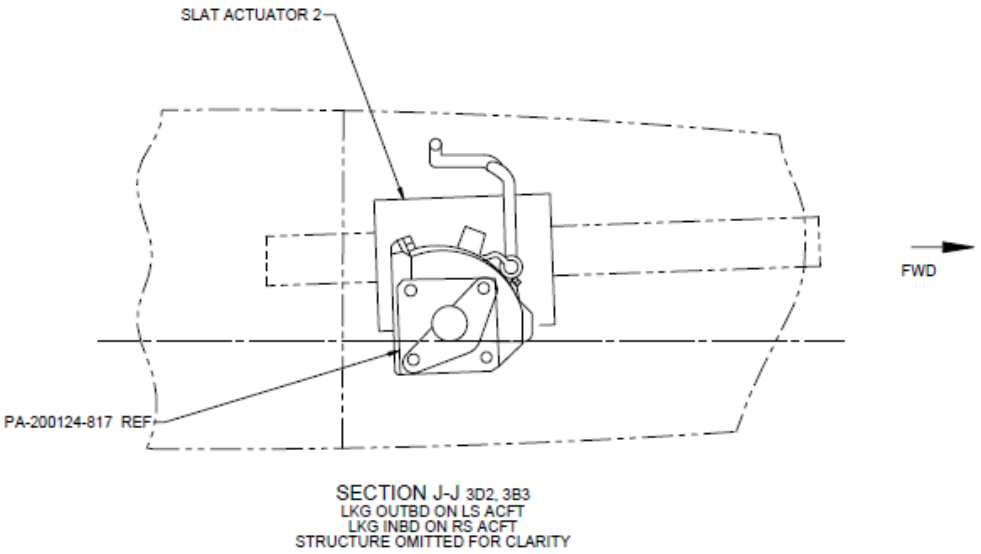


Figure 38: Slat Actuator 2, Left Wing, Looking Outboard

4.6.1.5 Installation of Slat Actuator 1 (Inboard), Right Wing

Slat actuator #1 for the right wing (reference Figure 32) should be fitted with p/n PA-200124-817 as shown in Figure 39, with the wiring harness continuing to the inboard.

The clamp should be oriented such that the silicone heating element covers the upper and forward faces of the actuator with the clamp closure in the upper-aft position (Figure 40). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

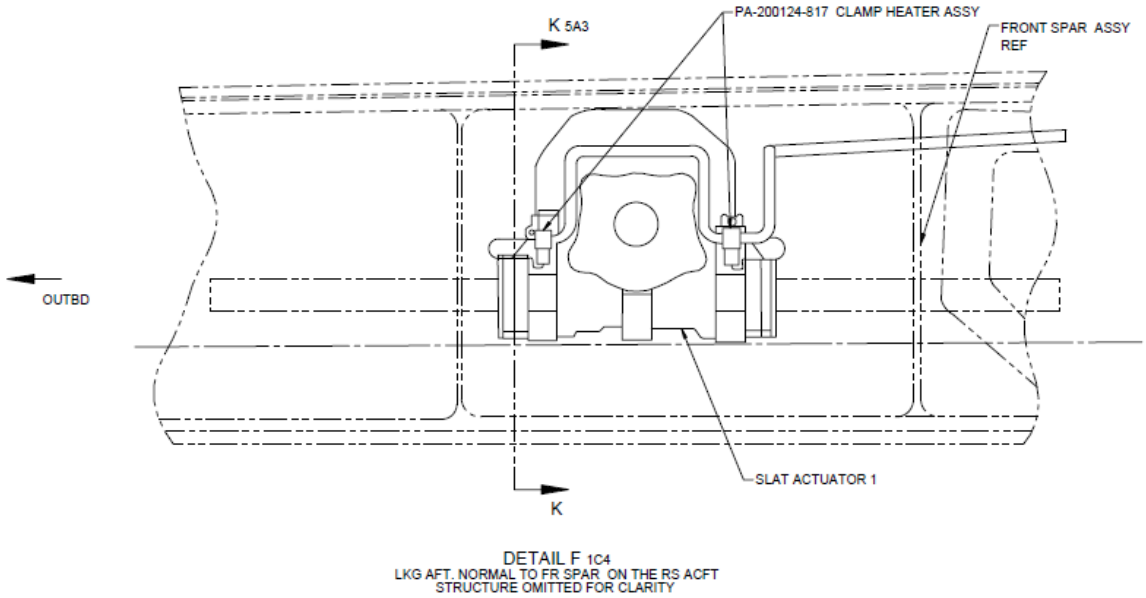


Figure 39: Slat Actuator 1, Right Wing, Looking Aft

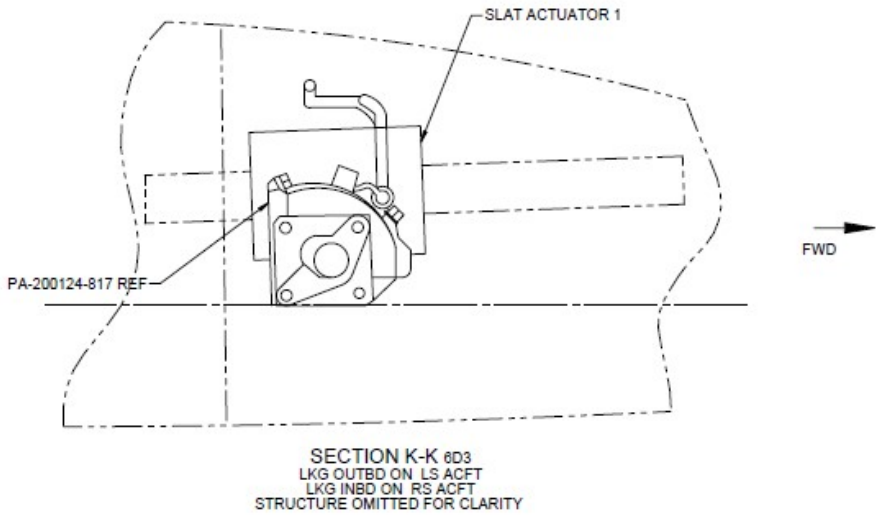


Figure 40: Slat Actuator 1, Right Wing, Looking Inboard

4.6.1.6 Installation of Slat Actuator 1 (Inboard), Left Wing

Slat actuator #1 for the left wing (reference Figure 32) should be fitted with p/n PA-200124-817 as shown in Figure 41, with the wiring harness continuing inboard.

The clamp should be oriented such that the silicone heating element covers the upper and forward faces of the actuator with the clamp closure in the upper-aft position (Figure 42). Torque the 6-32 self-locking nut to 9 ±2 in lbs, and secure with single-strand double-wrap 0.025 safety wire as specified.

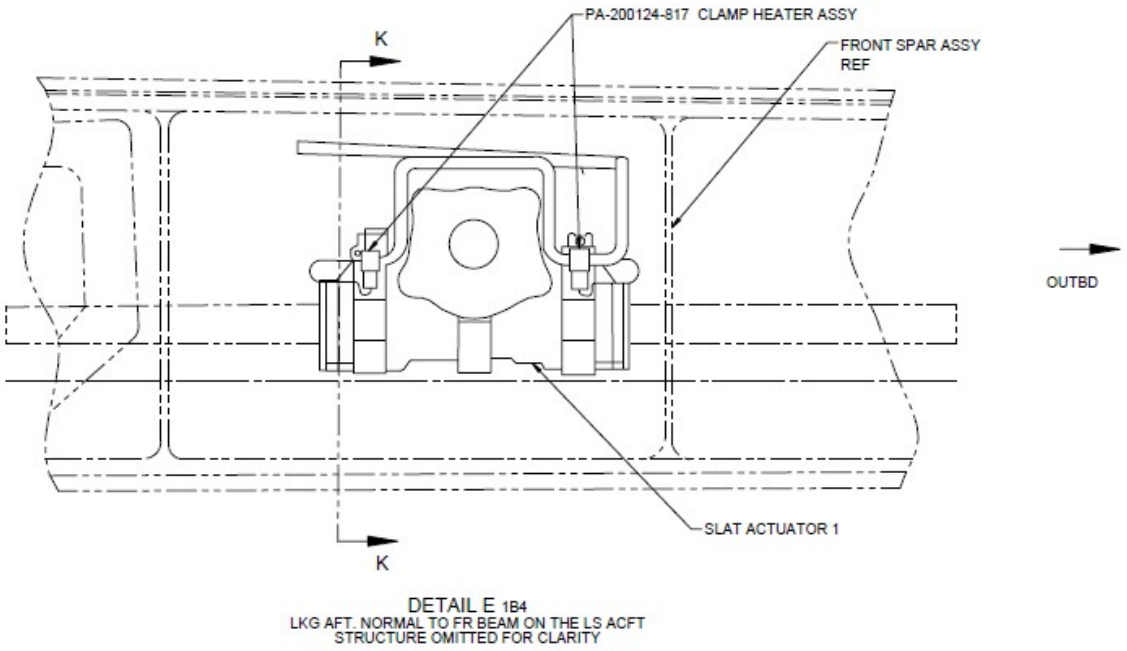


Figure 41: Slat Actuator 1, Left Wing, Looking Aft

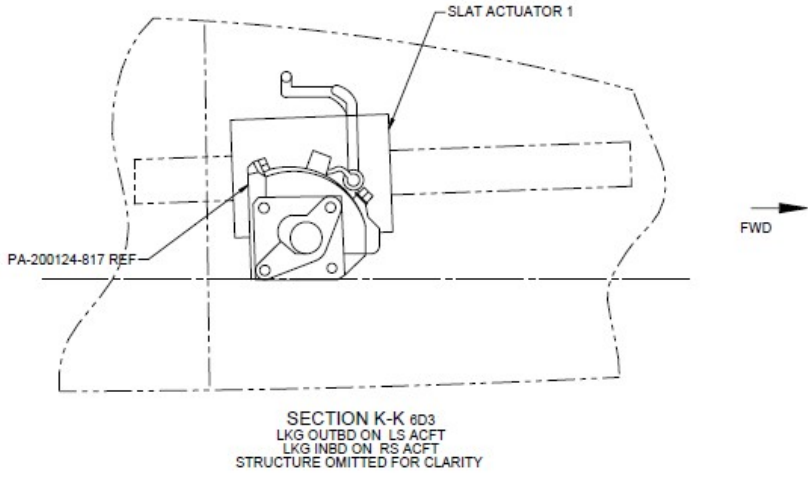


Figure 42: Slat Actuator 1, Left Wing Looking Outboard

5 ELECTRICAL INSTALLATION

5.1 Wiring Selection

Wiring allowed for the installation is presented in Table 7. This wiring has been shown to be compliant with the electrical system fire and smoke protection requirements of 14 CFR §25.853(a) and §25.869(a)(4) and its construction is suitable for the environmental characteristics of the installed areas.

Table 7: System Electrical Wiring and Cable

Specification	Use
MIL-W-22759/34-10-9	General purpose, aircraft, single-conductor 10 gauge wire
MIL-W-22759/34-16-9	General purpose, aircraft, single-conductor 16 gauge wire
MIL-W-22759/34-20-9	General purpose, aircraft, single-conductor 20 gauge wire
MIL-W-22759/34-22-9	General purpose, aircraft, single-conductor 22 gauge wire
MS27500/22SD2T23	Twisted, Shielded, Pair, 22 gauge wires

5.2 Wire Routing

Wiring must be installed according to the Gulfstream G150 Maintenance Manual, Chapter 20, *Standard Maintenance Practices* to the greatest extent possible. Reference Section 20-52-03, *Wiring Diagram Standard Practices* and Section 20-25-07, *Wire Routing.*

All added wiring should be grouped together (bundled) and installed within fire-resistant expandable sleeving of the appropriate diameter as defined in PA-200124-521, *Electrical Instl, Wire Routing* and PA-200124-523, *Flap/Slat Actuator Heater Electrical Installation Diagram*. Reference Section 20-52-03, *Wiring Diagram Standard Practices.*

PA-200124-521 identifies means of securing all wires and bundles installed by this modification along with any applicable installation notes. Bundles between components are to be routed adjacent to the existing G150 wiring and secured by means of clamping, tying or lacing. New wires follow established routing paths away from any flight controls or moving mechanical parts to ensure they do not restrict the movement of these parts at all times. The routing should avoid any pressure being applied to it which could crush the cable and cause the system to fail. New wires should also follow established routing paths away from flammable fluid areas. Running wires alongside and attaching it to an existing cable routing as far as practical will help keep the wire secure. For the wire bundles impacted for this system, observe a minimum bend radius of 10 times the diameter of the largest wire in the bundle.

The cable should also be secured to prevent it from being cut or chaffed due to vibrations during flight. If any existing aircraft wiring has been moved or loosened during the installation, these shall be secured prior to returning the aircraft to service. Conduits and lacing required to aid in this protection are defined in PA-200124-521.

Figure 43 and Figure 44 show the wire routing and supporting component locations.

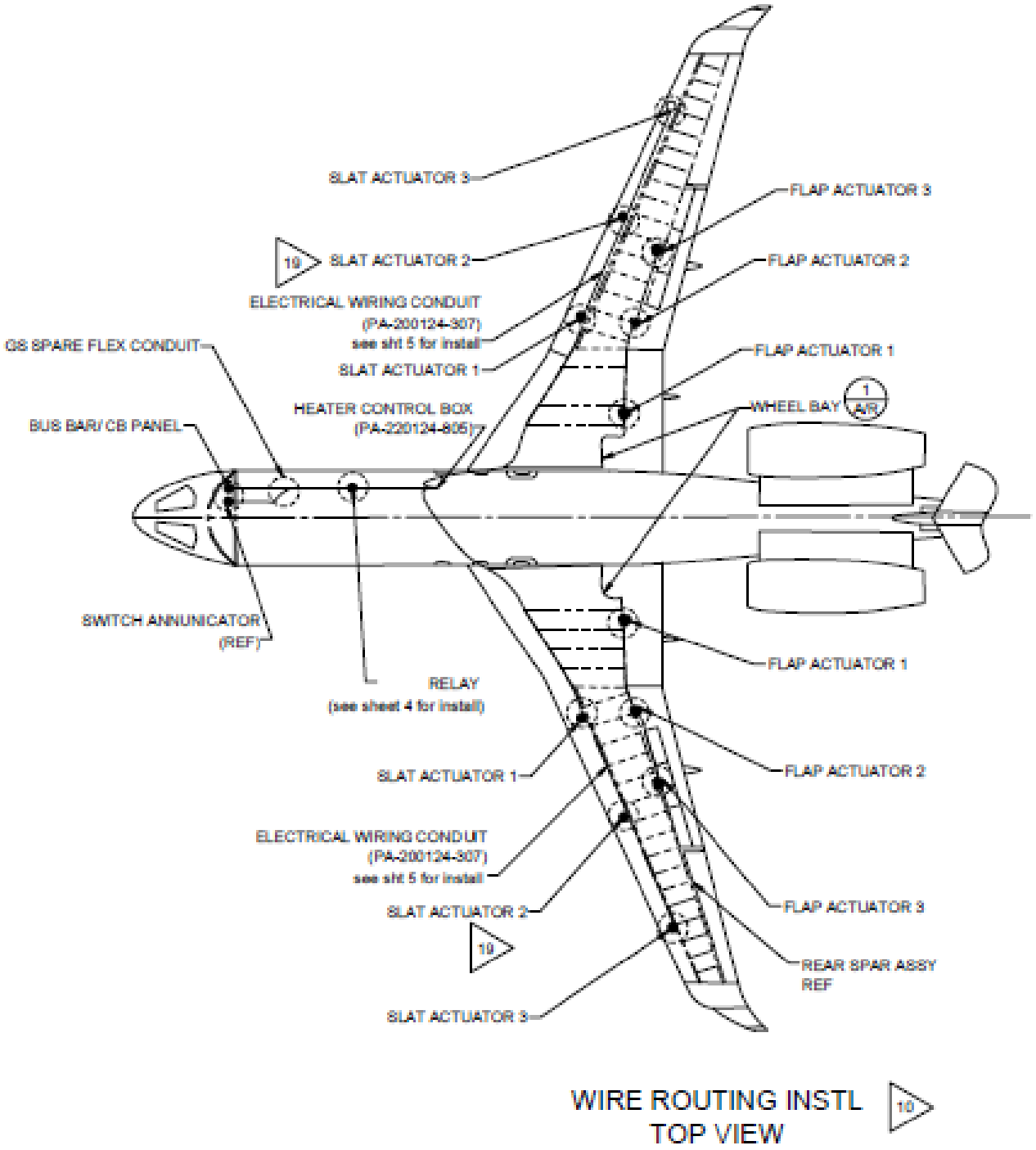


Figure 43: FSAHS Wire Routing

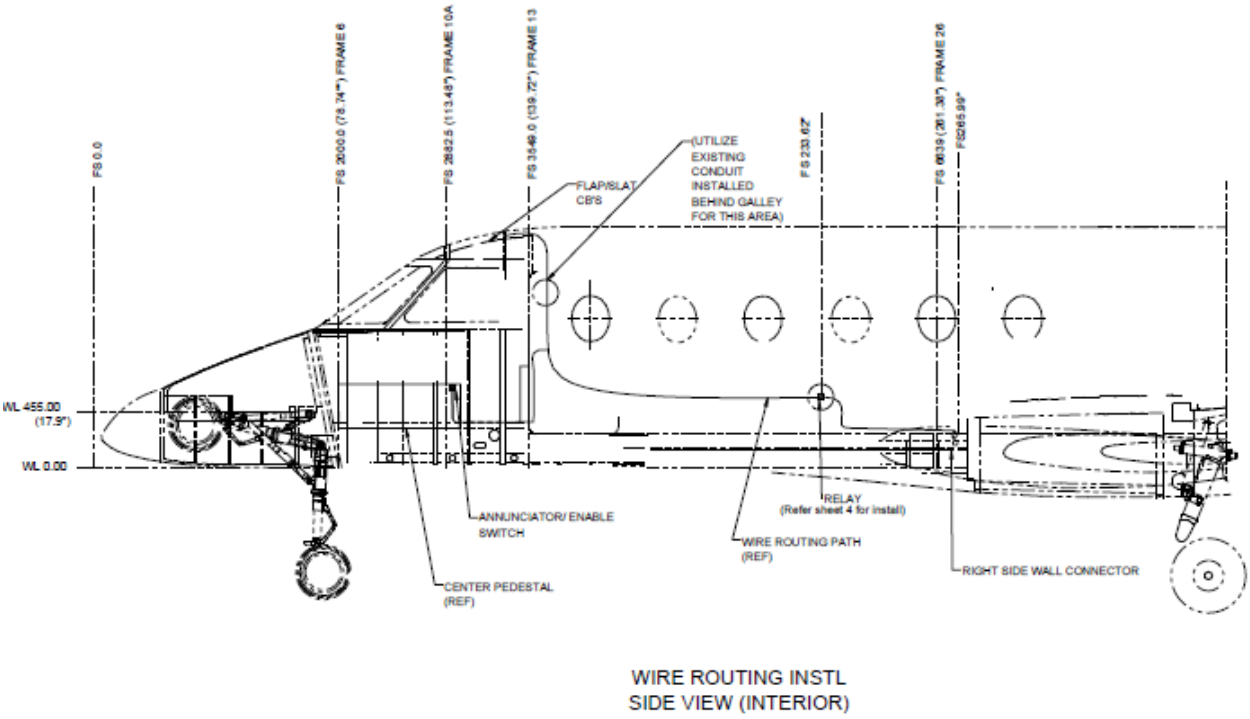


Figure 44: FSAHS Wire Routing, Aircraft Side View

An electrical wire conduit, PA-200124-307, is required to prevent chafing of wires in the wing leading edge. Installation instructions are included in PA-200124-521.

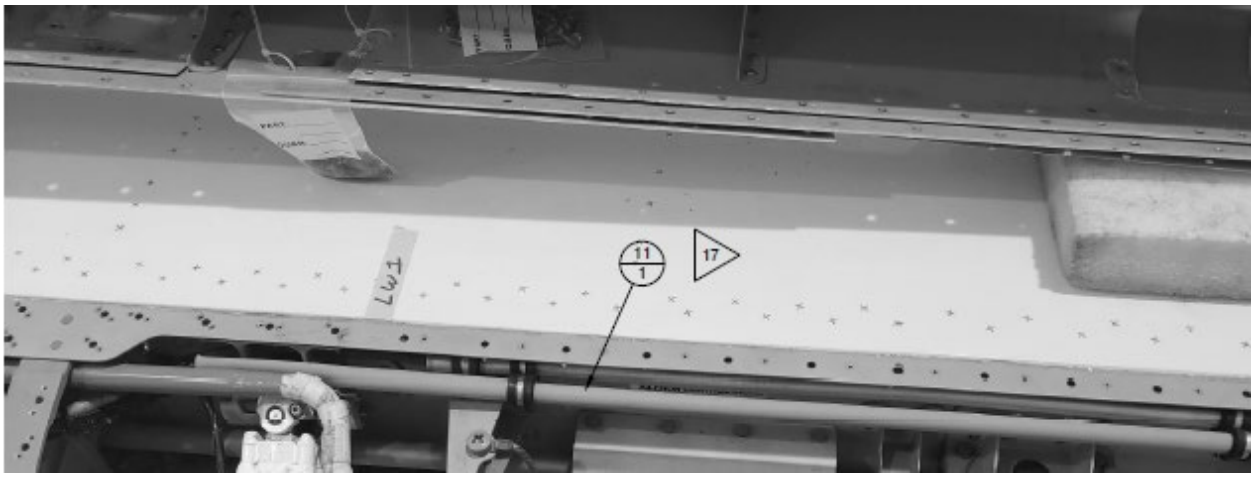


Figure 45: Electrical Wire Conduit for Leading Edge

In the leading edge, a lacing technique is used as defined in PA-200124-521 to secure wires to an existing bracket to allow clamping in an area with minimal clearance aft of the slat actuator, Figure 46. Also in this area and shown in Figure 46 is the bonding of the PA-200124-817 wire to the top of the actuator to prevent movement. This technique is called out in PA-200124-521.

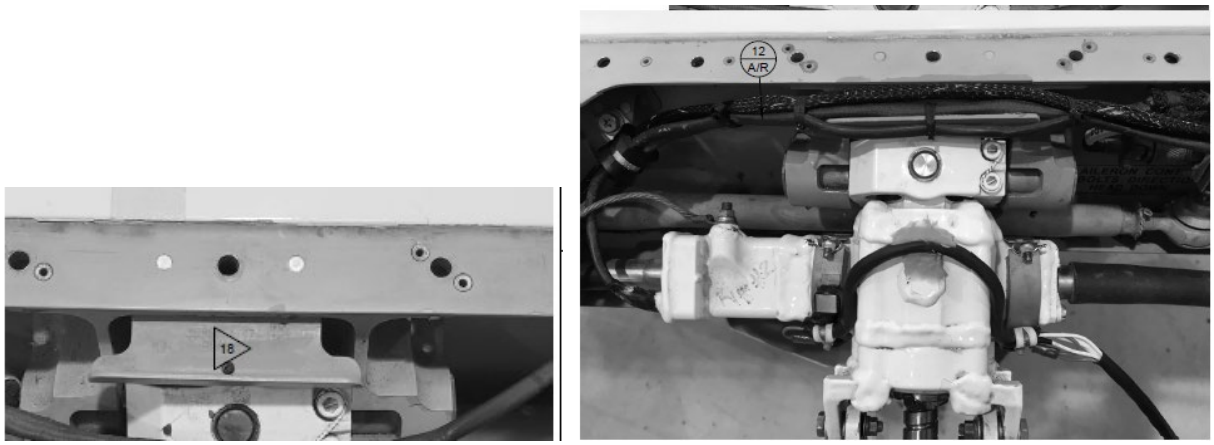


Figure 46: Lacing to bracket in leading edge

The ground power enable relay requires wire routing down the right-side wall. An existing spare conduit should be used to route the wire behind the cabin galley if the aircraft is so equipped.

5.3 Continuity Checks

After the wiring has been installed and terminated, a continuity check should be carried out to ensure that grounds and power are correctly wired for proper interconnection. This continuity check should also confirm that no shorts to ground exist on any non-ground wiring.

This is to verify nothing has been accidentally shorted during the installation or connected to the wrong pin positions before applying power which could damage the control box or aircraft wiring.

5.4 Materials

All materials that are added as part of this alteration have been selected to ensure that the design remains compliant with the electrical system fire and smoke protection requirements of 14 CFR §25.853(a) and §25.869(a)(4) and are qualified for airborne use. If alternative materials are utilized, the installer must ensure that the substitute material meets the same standards as that specified within this installation instructions document.

5.5 Electrical Connectors

Changes to connectors made in the incorporation of this installation must meet the standards set forth in the aircraft maintenance manual chapter 20 “Standard Practices”

5.6 Wire Diagrams

Wire connection diagrams are shown in Peregrine PA-200124-521 Rev C or later approved revision.

6 ACCOMPLISHMENT INSTRUCTIONS

A. Prepare aircraft for safe maintenance / modification as follows:

1. Remove all electrical power, turn all cockpit switches off and disconnect battery quick disconnects. Refer to AMM, Chapter 20.
2. Pull, tag and install safety clips on all circuit breakers (CBs) as noted in AMM, Chapters 31-44-01, and / or 34-42-01 and 34-52-01 and others as required to support equipment removed for maintenance access.
3. Using appropriate AMM procedures, remove equipment as necessary to gain access for the modification.

B. Modify aircraft wiring as follows:

1. Incorporate wiring changes per Peregrine PA-200124-523 Rev A or later revision.
2. Incorporate wiring routing per Peregrine PA-200124-521 Rev C or later revision. This will include utilizing PA-200124-303 Rev A or later revision, Relay Mounting Bracket and PA-200124-307, Rev A or later revision, Electrical Wiring Conduit.

C. Modify overhead CB panel as follows:

1. Install new CB's per Peregrine PA-200124-523 Rev A or later revision.
2. Modify panel overlay per Peregrine PA-200124-509, Rev IR or later revision.

D. Modify cockpit pedestal as follows:

1. Install new annunciator per Peregrine PA-200124-501 Rev A or later revision.

E. Install control box as follows:

1. Install new control box per Peregrine PA-200124-503 Rev B or later revision.
2. Utilize Peregrine PA-200124-321 Rev A or later revision mounting brackets for installation.

F. Install Actuator Heaters as follows:

1. Install flap heaters per Peregrine PA-200124-505 Rev C or later revision.
2. Install slat heaters per Peregrine PA-200124-507 Rev B or later revision.

E. Perform Continuity Checks

F. Reinstall all equipment removed to gain access.

G. Restore power to all equipment.

H. Functional testing.

1. Accomplish functional testing of the new equipment per Section 9 of this document.
2. Accomplish functional testing of any removed and re-installed equipment during this modification per the applicable section of the G150 MM.

7 SERVICING INFORMATION

7.1 Control Box

The F/S Heat Controller contains no line serviceable components. Maintenance of the Controller is “on condition” and requires no periodic checks, tests, inspections, and has no mandatory replacement intervals.

Should the Controller require repair or replacement, contact:

Peregrine
7385 S Peoria St Unit C4
Englewood, CO 80112
Tel.: (303) 325-3873
Email: info@peregrine.aero https://www.peregrine.aero/

7.2 Actuator Heaters

The Actuator Heaters contains no line serviceable components. Maintenance of the Controller is “on condition” and requires no periodic checks, tests, inspections, and has no mandatory replacement intervals.

Should the Heater require repair or replacement, contact:

Peregrine
7385 S Peoria St Unit C4
Englewood, CO 80112
Tel.: (303) 325-3873
Email: info@peregrine.aero

7.3 System ON-Off Switch Annunciator

There is no specific requirement for scheduled maintenance to be carried out on ON-OFF Annunciation switch.

Should the Annunciator require repair or replacement, contact:

Aerospace Optics, Inc.
3201 Sandy Lane, Fort Worth, TX 76112
Toll Free: 1 - 888 - VIVISUN
E-Mail: switches@vivisun.com

7.4 Maintenance Considerations

Particular attention should be given to clamping of wire harnesses in the wing leading and trailing edge areas. The system installation allows for the heater clamps to be secured to the actuator housing in a position that is clear of the moving actuator components. When servicing wiring to the heater clamps, ensure that the wiring is securely clamped clear of moving parts prior to aircraft return to service.

7.5 Software Requirements

This installation requires no software or software updates.

7.6 Troubleshooting Information

The controller performs a complete system test during every power on cycle and every thirteen minutes during operation.

The system can be manually tested using the Press to Test switch, Section 12.1.

System status is available by monitoring the LED indicators on the face of the control box (reference Section 12.1 for self-test instructions). Troubleshoot the system using the procedures identified in Table 8.

Table 8: Fault Reporting and Corrective Action

LED Description	Indication	Fault	Action Required
LH/RH Flaps/Slats	Green or off	None	None
LH/RH Flaps/Slats	Steady Red	Heater over-current, Heater low current, shorted heater or open heater	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Replace defective heater corresponding to the specific red LED.
LH/RH Flaps/Slats	Flashing Red	Open or shorted temperature sensor	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Replace defective heater corresponding to the specific red LED.*
Flaps/Slats 28v	Green	None	None
Flaps/Slats 28v	Off	Voltage is below 26vdc	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Check the DC voltage supply to the Controller
Flaps/Slats Cont.	Green	None	None
Flaps/Slats Cont.	Red	Open or shorted output device (power switch or relay)	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Replace the Controller

* Note: The temperature sensor is located within the heater assembly and cannot be replaced separately.

8 COMPONENT REMOVAL AND REPLACEMENT

This section identifies the maintenance procedures for replacing the FSAHS components identified in Table 2. The components are accessed by removing the appropriate panels identified on the following pages. Additional information can be found in the Gulfstream G150 Airplane Maintenance Manual (AMM).

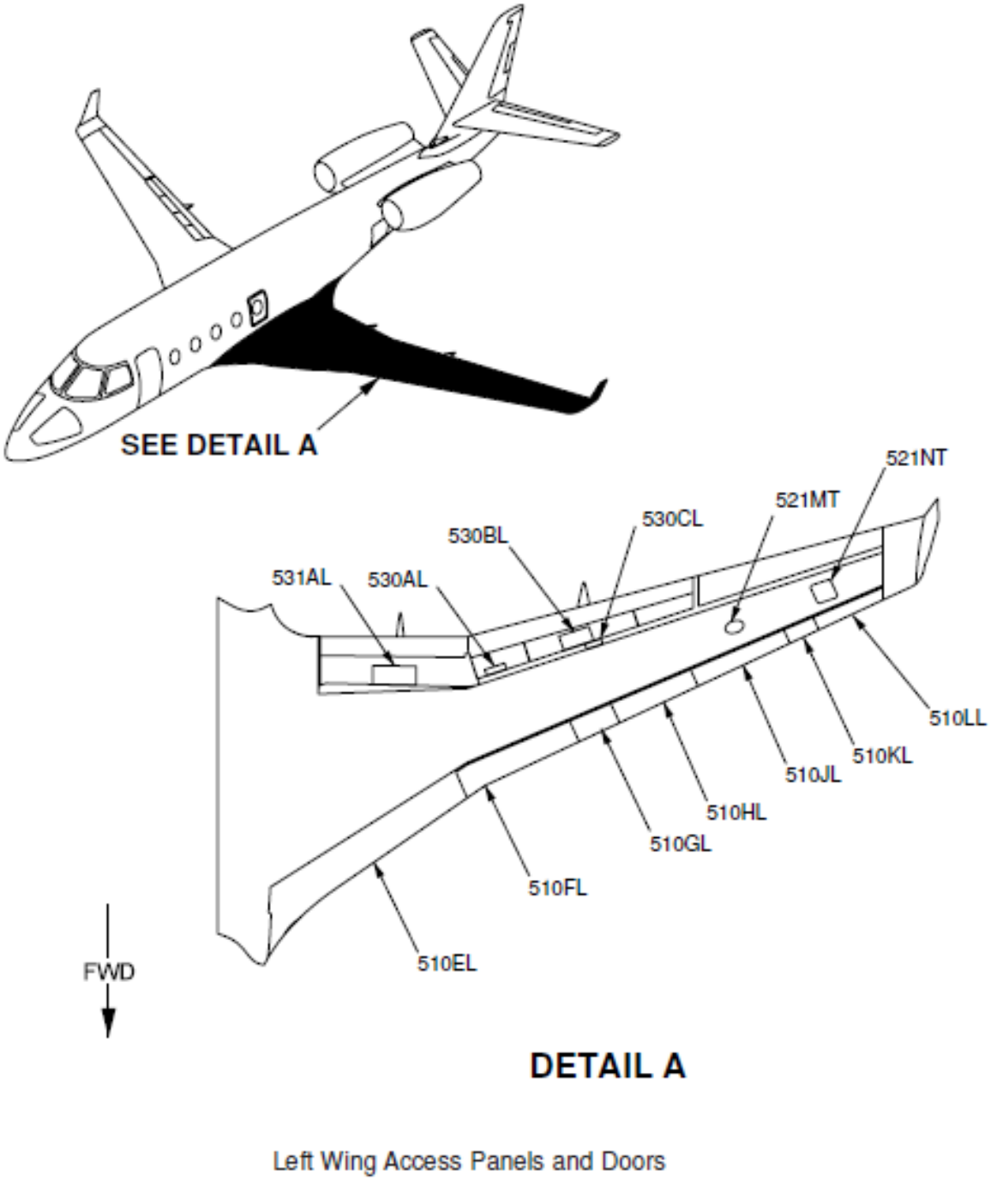
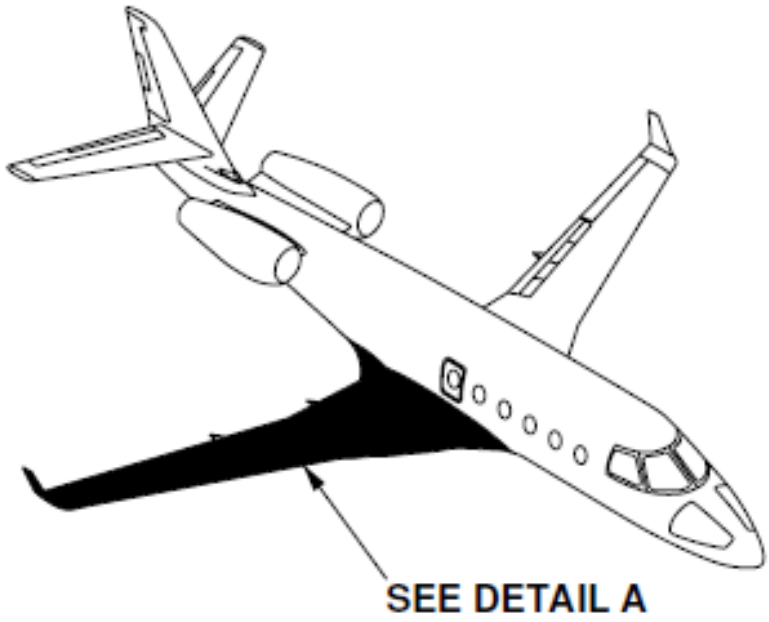
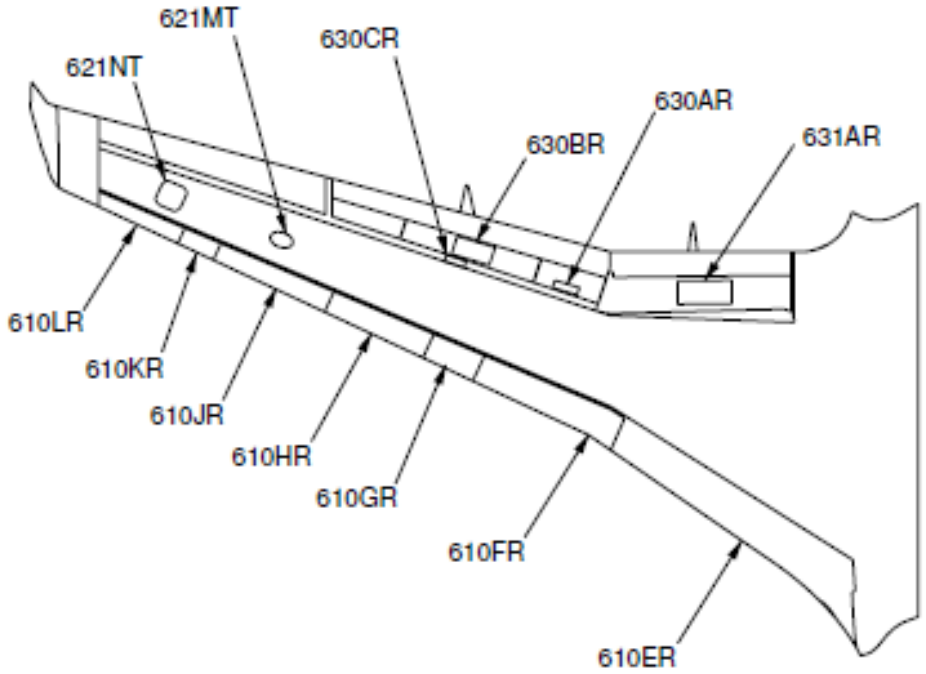


Figure 47: Left Wing Access Panels and Doors





DETAIL A

Right Wing Access Panels and Doors

Figure 48: Right Wing Access Panels and Doors

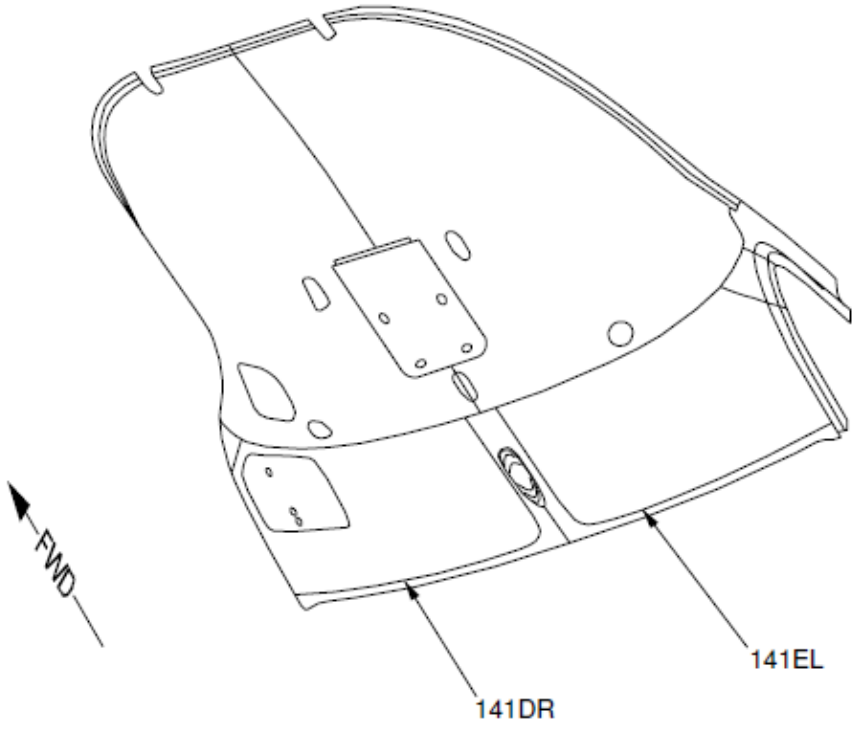


Figure 49: Forward Fuselage Fairing Access Panels

8.1 Heater Control Unit

Prior to removing the heater control box, all electrical power shall be turned off in order to prevent electrical shorts or electrical shock during the removal.

1. Remove the three circular connectors from the heater control box.
2. Remove the four 10-32 mounting bolts retaining the heater control box to the mounting brackets.
3. Remove the heater control box from the aircraft.

Installation of the new control box is the reverse order of the listed steps.

Return to service by per performing a self-test of the system as described in Section 9.

8.2 Actuator Heaters

Prior to removing the actuator heater, all electrical power shall be turned off in order to prevent electrical shorts or electrical shock during the removal of the component.

1. Disconnect the actuator heater from the aircraft wiring. The existing M81824-1-2 environmental splices will need to be removed.
2. Remove the actuator heater attachment hardware.
3. Remove the actuator heater from the aircraft.

Installation of the new Actuator Heater is the reverse order of the listed steps. Splice wire using M81824-1-2 environmental splices.

Return to service by per performing a self-test of the system as described in Section 9.

8.3 ON-OFF Annunciator Switch Removal and Replacement

Removal of the F/S Heat Annunciator Switch

- Master Power- Power Off.
- Carefully remove the annunciator switch lens cap by gently pulling the annunciator switch lens cap from the annunciator body.
- Carefully remove the lens cap from its hinged slide retainers.
- Loosen the two flat head screws on the annunciator body.
- Remove the slide retainer from the back of the annunciator body.
- Slide the annunciator out of the panel.
- Using tool M22885/108T8234, or similar, remove the electrical plug from the back of the annunciator body.

Installation of the F/S Heat Annunciator Switch

- Verify the annunciator switch that is to be installed in the panel is the same part number.
- Install the plug on the back of the new annunciator body.
- Slide the annunciator body back into the panel.
- Install the slide retainer onto the annunciator body.
- Tighten the two flat head screws that are on the annunciator body, ensuring they grasp the slide retainer.
- Carefully install the annunciator lens cap onto the hinged slide retainers.
- Carefully hinge the annunciator lens cap up and into the annunciator body.
- Return to service by per performing a self-test of the system as described in Section 9.

8.4 Return to Service Instructions

The system shall be tested for proper functionality after any of its included components have been replaced. See the complete system test in Section 9.2.

Note that the complete system test at the time of initial installation includes a test of the system, including a verification of electromagnetic compatibility.

The controller performs a complete system test during every power on cycle and every thirteen minutes during operation.

The system can be manually tested using the Press-to-Test switch. System status is available by monitoring the LED indicators on the face of the control box. See System Functional Test in Section 12.1.

9 SYSTEM TEST PROCEDURES

9.1 System Functional Test

A system functional test of the FSAHS is recommended every six months and may be performed at any time. This test is required after re-activation of the system. See Appendix A, for test matrix.

This System Functional Test is to be performed on the ground with the aircraft deriving power from a ground power unit. Access the FSAHS control box via the emergency brake access door.

For testing the system on the ground, the enable relay may be powered by selecting the Battery Master Switch to the “OVRD LOAD REDUCT” position. This selection allows the relay to be powered with no engines running.

The control unit contains Built-In-Test Equipment (BITE) that checks the integrity of the system. The test is performed at Power-on and periodically during normal operation.

A Press-To-Test switch on the face of the control box initiates the BITE when pressed and held for approximately 2 seconds. This allows for the system to be tested while the airplane is on the ground. System status/faults are confirmed by observing the color of the device LED. The system receives power from the 28 Vdc distribution buses when both generators are operating. To test the system on the ground, with the engines not running, the system can be powered by the auxiliary power unit (APU) or an external power cart.

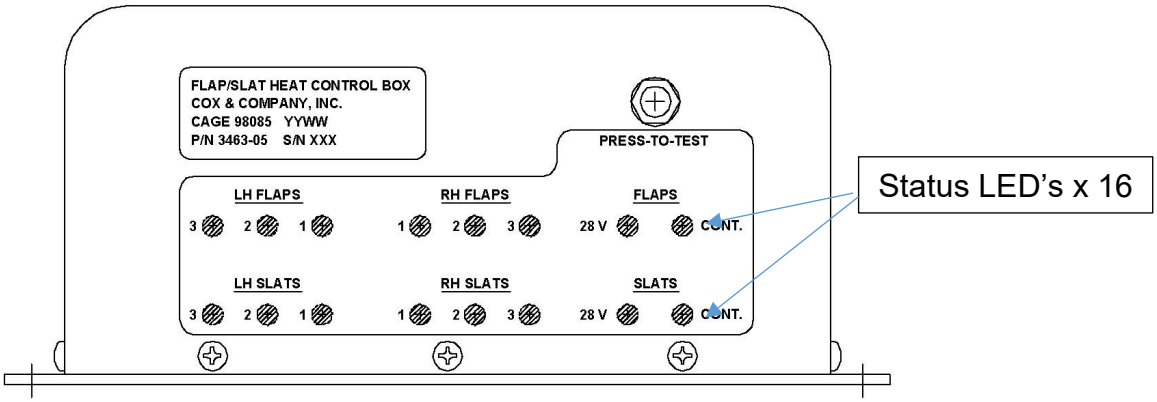


Figure 50: Control Box LED’s

9.2 Complete System Test with EMI

The complete system test is required following initial installation of the FSAHS or following replacement of any components of the FSAHS. Test 2, Heater Temperature Test is optional and may be used for trouble shooting. Tests 1 and 3 in Appendix B are required in order to verify proper operation of the system and no electromagnetic interference with other aircraft systems.

- Test 1: Aircraft Test Setup and Power Checks (Required)
- Test 2: Heater Temperature Test (Optional)
- Test 3: Electromagnetic Compatibility Testing

9.2.1 Test 3: EMI Tests (Recommended after initial installation)

Caution: This test is to be conducted in a ramp area suitable for engine operations, clear of other aircraft, buildings, and personnel. Prior to engine start, ensure that the immediate ramp area is clear of people, foreign objects, and any ground support equipment not associated with this test (e.g. tow bars). Ensure that these steps are completed with a pilot at the controls of the aircraft that is licensed to operate the aircraft.

a. Following the Aircraft Flight Manual (AFM), start the aircraft engine and switch to aircraft power. Establish a baseline of all aircraft systems operating in their normal modes of operation. For these operations, ensure parking brake is set and aircraft is pointed into the wind. Maintain the engine speed at idle setting. Monitor oil pressure and oil temperature during the ground run to ensure acceptable operating parameters.

b. Power on the Flap/Slat Heater system.

   - Ensure the instruments are showing attitude and heading information.

c. Ensure all additional ships avionics are powered and functional.

d. Ensure all radios (COM1, COM2, etc & NAV1, NAV2, etc) are active and receiving communications.

   Note: These procedures are repeated for all radios.

   a. COM 1: Set the frequency (see Table 9)

   b. Listen to the voice traffic (don't step on anybody). While monitoring the COM radios, verify that there is no noticeable interference present due to the addition of the Flap/Slat Heater System.

   c. Set the next frequency as listed in Table 5 and repeat Step b.

   d. Tune the VHF Nav radio #1 to the frequencies listed in Table 6

Note: Local Nav aids may be substituted for the suggested frequencies if available.

e. Monitor the power plant, fuel, and all other electric instruments. Record any anomalies that occur.

Table 9: EMI VHF Com Test Frequencies

Frequency
118.000*
127.000*
135.000*

Table 10: EMI VHF Nav Frequencies

Frequency
[Local ILS]

e. Repeat a to d for the COM 2 radio

f. Repeat step e. for the #2 VHF Nav radio.

Note: If any of the above frequencies are active frequencies in the local area or in the overlying controlled airspace, coordinate use of the test frequency prior to conducting transmissions for test.

Appendix A: SYSTEM FUNCTIONAL TEST

Test 1: Aircraft Test Setup and Basic Power checks.				
Required Equipment: Ground Power Unit (GPU)				
Step	**Description/Instruction**		**Results**	
1	Ensure all circuit breakers are engaged. Apply power to the ship with a ground power unit as specified in the Airplane Flight Manual (AFM)			
	Check that the ship powers up properly.		Pass	Fail
2	Ensure the Flap/Slat Control switch is set to “ON”, set Battery Master switch to ‘On’.			
	Gain access to the FSHCU unit.			
	Verify that the unit is de-powered.		Pass	Fail
3	Ensure the Flap/Slat Control switch is set to “ON”, set Battery Master switch to ‘Overload reduction’.			
	Gain access to the FSHCU unit.			
	Perform a self test at the FSHCU. Press the Test button for 2 seconds and observe the LED indicators. The 12 slat and flap LEDs should be green.	Verify that the self test is successful.	Pass	Fail
Notes:				

Appendix B: COMPLETE SYSTEM TESTS

Test 1: Aircraft Test Setup and Power Checks.				
Required Equipment: Ground Power Unit (GPU)				
Step	**Description/Instruction**		**Results**	
1	Ensure all circuit breakers are engaged. Apply power to the ship with a ground power unit as specified in the Airplane Flight Manual (AFM)			
	Check that the ship powers up properly.		Pass	Fail
2	Ensure the Flap/Slat Control switch is set to “ON”, set Battery Master switch to ‘On’.			
	Gain access to the FSHCU unit.			
	Verify that the unit is de-powered.		Pass	Fail
3	Ensure the Flap/Slat Control switch is set to “ON”, set Battery Master switch to ‘Overload reduction’.			
	Gain access to the FSHCU unit.			
	Perform a self test at the FSHCU. Press the Test button for 2 seconds and observe the LED indicators. The 12 slat and flap LEDs should be green.	Verify that the self test is successful.	Pass	Fail
Notes:				

Test 2: (OPTIONAL) Heater Temperature Tests			
Equipment: Ground Power Unit (GPU) (required), infrared temperature sensor (required), Can of compressed air (computer cleaning supply) (not required if ambient temperature is below 40°F)			
Step	**Description/Instruction**	**Results**	
1	With power applied to the ship by a ground power unit		
2	Extend the flaps so that the flap heater units can be viewed.		
3	Perform a self-test (Test 1 procedure and verify slat/flap lights are green.	Pass	Fail
4a	If ambient temperature is below 40°F the control box slat/flap LEDs will remain green and the heaters will warm the actuators.		
4b	If ambient temperature is above 40°F the control box slat/flap LEDs will turn off after the self-test. Apply compressed air to a thermistor on any heater component. This will cool the thermistor below 40°F, the heaters will warm and the control box LEDs will turn green.		
5	Using the infrared thermometer test the temperature of the red/orange silicone area of an actuator heater. Verify the heater component is above 80°F	Pass	Fail

Test 3: Electromagnetic Compatibility Testing			
Required Equipment: Handheld VHF Com			
Note: Ambient temperature must be less than 40°F or a compressed air can may be used to cool the heaters to activate the system during the tests. This may need to be repeated before each test.			
Step	**Procedure**	**Result**	
1	Move the aircraft to a location where the engines may be idled. Start both engines per AFM procedures.		
2	Verify heaters are on by observing green lights for all heaters on the FSHCU or activate them by cooling with canned compressed air.	Pass	Fail
3	Enable all VICTIM equipment listed in Table 11 . Monitor all Victim equipment for any interference related to operation. Record any anomalies in Table 11 .	Pass	Fail
4	Power down aircraft and equipment as specified in the AFM		
Notes:			

Table 11: EMI TEST RECORD

Chapter	Item (from MMEL)	System 1	
		Threat	Victim
21. Air Conditioning	Cabin Differential Pressure Gauge		
	Cabin Altitude Display		
	Cabin and Cockpit Temperature Control		
	Pressurization Controller		
22. Auto Flight	Autopilot		
	Yaw Damper		
	Trim Systems		
23. Communications	COM 1		
	COM 2		
	Pilot Audio Control Panel		
	Co-Pilot Audio Control Panel		
	Pilot Headset		
	Emergency Location Transmitter		
24. Electrical Power	Left Generator		
	Right Generator		
27. Flight Controls	Speed Brake Actuation System		
28. Fuel Systems	Fuel Quantity Indication		
30. Ice and Rain Protection	Windshield Anti-Ice (Bleed)		
	Engine Anti-Ice (Bleed)		
	Wing De-Ice Boot (Bleed)		
	Tail and Wing Root Electric De-Ice		
	Pitot and Static Heat		
	Temperature Probe Heat		
31. Indicating/Warning System	Master Warning / Master Caution		
	Annunciators		
32. Landing Gear	Antiskid System		
33. Lights	Anti-Collision (Strobe)		
	Position		
	Instrument Panel		
	Landing/Taxi Lights		
	Cabin Lights		
	Ground Rec (Beacon)		
	Windshield Ice Detection		
	Wing Inspection		
34. Navigation	DME		
	Weather Radar (Self-Test Only)		
	ADF		
	Marker Beacon		
	Transponder		
	Altitude Alerting		
	NAV 1		
	NAV 2		
	Glide Slope 1		
	Glide Slope 2		
	Compass		
	TCAS		
	TAWS		
	GPS and FMS		
49. APU	APU		
52. Doors	Cabin Door Monitoring System		
	Cabin Door Seal		
73. Engine Fuel and Control	Engine Synchronizer		
	Fuel Flow Indicating System		
77. Engine Indicating	Engine Indication (RPM, ITT)		
78. Engine Exhaust	Thrust Reverser		