



INSTALLATION GUIDE

Subject: Regulatory guidance and technical information.

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RECORD OF REVISIONS

When revised this document is changed in its entirety.

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H	AUG-07-2023	Expand § 7.5 and D.14 to include Dielectric Grease p/n: TU03126 and add Connector Kit in § D.13 p/n: TU03398	DNE
G	MAR-04-2022	Ref AVF0001 § 5.1, add §§ 3.1 and 10.1.	DNE
F	NOV-24-2021	Add Cert and Record sections, plug bracket and AV to Appendix	DNE

Current revision approval:

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PROPRIETARY DATA

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ACRONYMS

A	Amperage	CG	Center of Gravity
AC	Advisory Circular or Alternating Current	Ch	Chapter
ACO	Aircraft Certification Office	CPD	Circuit Protections Device
AEG	Aircraft Evaluation Group	DER	Designated Engineering Representative
AFM	Aircraft Flight Manual	DC	Direct Current
AFS	Flight Standards Service	DRS	Dynamic Regulatory System
AFT	Afterward	EASA	European Aviation Safety Agency
AGB	Accessory Gearbox	EMI	Electromagnetic Interference
AIR	Aircraft Certification Service	EMS	Emergency Medical Service
ALS	Airworthiness Limitations Section	°F	Degrees Fahrenheit
AMM	Aircraft Maintenance Manual	FAA	Federal Aviation Administration
AMOC	Alternative Method(s) of Compliance	FAR	Federal Aviation Regulation
AN	Army – Navy	FCU	Fuel Control Unit
APU	Auxiliary Power Unit	FOD	Foreign Objects and Debris
A/R	As Required	FSDO	Flight Standards District Office
AS	Aerospace Standard	FWD	Forward
CIP	Conformity Inspection Plan	GPU	Ground Power Unit
CFR	Code of Federal Regulations		
°C	Degrees Celsius		

HEMA	Helicopter Emergency Medical Service	PSCP	Project-Specific Certification Plan
HUMS	Health and Usage Monitoring System	QA	Quality Assurance
IAW	In Accordance With	R&R	Remove and Replace
ICA	Instructions for Continued Airworthiness	RH	Right Hand/Side
ISO	International Organization for Standardization	RFC	Request for Conformity
LH	Left Hand/Side	RFM	Rotorcraft Flight Manual
MFD	Multifunction Display	§	Section
MIDO	Manufacturing Inspection District Office	SB	Service Bulletin
MEL	Minimum Equipment List	STC	Supplemental Type Certificate
MM	Maintenance Manual	Tanis	Tanis Aircraft Products
MOC	Method of Compliance	TBD	To Be Determined
MRGB	Main Rotor Gearbox	TC	Type Certificate
MS	Military Standard (MIL-SPEC)	TCCA	Transport Canada Civil Aviation
NAS	National Aerospace Standard	TCDS	Type Certificate Data Sheet
No.	Number	TIGB	Tail Rotor Intermediate Gearbox
OEM	Original Equipment Manufacturer	TLD	Top Level Drawings
P/N or p/n	Part Number	TRGB	Tail Rotor Gearbox
PC	Production Certificate	TSO	Technical Standard Order
PMA	Parts Manufacturing Approval	V	Voltage
PTC	Positive Temperature Coefficient	VAC	Voltage Alternating Current
		W/	With
		W	Wattage
		Wt & Bl	Weight and Balance

1. PURPOSE

This Installation Guide contains, regulatory guidance, descriptions, and technical information used in support of the installation, operation, and maintenance of Tanis Aircraft Products preconditioning systems. In addition, it includes approved options and subcomponent parts that are acceptable for use in repair, and/or expansion of primary systems. Data in this document is not intended to replace, substitute, or supersede FAA regulations, OEM manufacturer repair or maintenance instructions, or Tanis kit-specific installation instructions. However, it may be used when there are no other repair or maintenance instructions available.

This Installation Guide is also the primary document in a series of documents used to support Tanis kits for a listing of these documents refer to Section (§) 3.1.

2. LIMITATIONS

The installation of a Tanis system(s) does not change Airworthiness Limitations or existing environmental flight restrictions. In accordance with (IAW) FAA Order 8110.4, "The installer must determine whether this design change is compatible with previously approved modifications."

Previously approved changes include other major or minor changes to the type design approved under Title 14 CFR part 21, *Certification Procedures for Products and Parts*. Alterations or repairs to aircraft approved under Part 43, *Maintenance, Preventive Maintenance, Rebuilding, and Alteration*, should also be considered.

3. DOCUMENTS

To access documents, check revision level, or obtain additional copies, go to: <http://www.tanisaircraft.com/> or contact Tanis Aircraft Products' customer support. To access FAA-related documents refer to FAA Dynamic Regulatory System at <https://drs.faa.gov>

When referencing documents, FAA or otherwise, always use the latest revision level as amended.

When searching for instructions or other documents related to a part use the 4 primary numbers in the search. Letters before the numbers identify the part as Tanis and the numbers following it identify the voltage and or wattage.

3.1 1000 Series Documents

The 1000 Series Documents used in support the installation, operation, and continuing airworthiness of Tanis Aircraft Products preconditioning kits are as follows:

1. Installation Guide: TNG1000 (this document)
2. Operating Guide: TPG1000
3. Instructions for Continued Airworthiness (ICA): TCA1000

Note: The 1000 series Operating Guide and ICA may be used to replace or supersede Tanis kit-specific Operating Guide and ICA when data is recorded and retained as indicated in the documents.

4. DESCRIPTION

Preconditioning, or “Preheating” as it is referred to in colder climates, is a Best Practice safety procedure that warms up critical mechanical parts, fluids, and systems when the aircraft is not running, on the ground, and connected to external power.

Tanis preheat system(s) may be connected to power immediately after engine shutdown. Systems are designed to be operated continually between flights and/or plugged in 6 or more hours before departure.

Kits and subassemblies are available in 115V and 230V configurations. Both use the same installation, operation, and maintenance procedures. Heat is applied through electrical resistance elements. Power is routed through a dedicated shore power plug and electrical assembly that includes power indication and circuit protection. Typical circuit load $\leq 10A$ with 12A overload protection.

Systems are self-regulating, do not operate in flight, and are not connected to or dependent on aircraft systems. For a system to be of maximum benefit when temperatures are at or below $0^{\circ}C$ ($32^{\circ}F$) power is connected immediately after engine shutdown or 6 hours or more before departure. After 6 hours temperatures stabilize w/ a delta/rise above ambient of approximately $33^{\circ}C \pm 5$ ($60^{\circ}F \pm 10$). Avionics and cabin temperature delta above ambient vary.

Under extreme conditions when additional heat is required, insulated engine cowl and/or aircraft covers are used to increase temperature delta above ambient. Results vary depending on environmental conditions and cover design, expect a typical delta of upwards to 60% under calm no wind conditions.

- (a) Operation and regular use increase's reliability and safety of operations. In addition, preheating reduces maintenance and operating costs by reducing torque oscillations, thermal stress, warm-up, and launch times.
- (b) Installation eligibility is through the engine or airframe.
- (c) Engine kits preheat the engine, attached accessories, and fluids.
- (d) Turbine engine kits offer a second-order reduction in thermal stress in the C-section by decreasing peak temperatures and time of exposure.
- (e) Airframe-specific kits, preheat engine(s), critical fluids, driveline components, avionics, and batteries.
- (f) Modular AV/Cabin and Battery Heat Kits are included in specific airframe kits and available as an add-on to all other kits.

AV/Cabin Heat Kit. Preheating avionics reduces cold weather-induced gyroscopic errors, condensation, and the risk of display panel malfunction, failure, and long-term moisture-related damage. In addition, preheating the cabin increases the safety of operations by helping to clear windows of snow and ice.

Battery Heat Kit. Preheating batteries protects and extends battery life. Keeping them within specified operating temperatures above freezing, batteries remain capable of performing at rated capacity throughout all phases of operation.

5. CERTIFICATION

5.1 General

Tanis kits and subcomponent parts have Federal Aviation Administration - Part Manufacturer Approval (FAA-PMA) w/ eligibility for installation through PMA and/or STC.

To verify kit suitability Aircraft Verification form: AVF0001 may be requested.

Kits are also produced through a Request to Build process, refer to § 5.3.

5.2 Installation Record

This relates to the Installation of aircraft preheat systems that are externally powered and not connected to the aircraft's electrical system. These preheat systems do not function during flight. The consideration concerning the safety of the flight is that the preheating system neither interferes with functional equipment nor comes loose or detached and creates some other flight hazard. Installed systems do not have an appreciable effect on weight, balance, structural strength, reliability, operation, or other characteristics affecting the airworthiness of the product. The preheat system is installed on a non-functional, non-hazardous basis.

IAW 14 CFR §§ 21.93(a) and 21.319(a) classification for installation of a Tanis kit is a minor change when done IAW Administrator approved data; Tanis instructions, FAA AC 43.13-1B and AC 43.13-2B Ch1.

Installation is to be recorded IAW 14 CFR part 43 § 43.9, part 121, or procedures set in place by the operator. If installing STC'd kit and applying the STC, document the installation w/ FAA Form 337. In addition, record and retain installation data as indicated in Operating Guide and ICA, refer to §§ 3.1 and 11.

Part 121 Aircraft: IAW Part 121, § 121.367, Part 121 operators are required to follow their specific maintenance program one that includes repairs and alterations. For details, refer to Order 8300.16 Chapter 2. Field Approval Eligibility paragraph 2-1. f. and Chapter 3. Field and Data Approval Process and Data Approval, paragraph 3-1. a.

EASA - European Union Aviation Safety Agency: EASA Member States may install Standard Parts coming from the US when accompanied by evidence of conformity, Authorized Release Certificate FAA Form 8130-3, Airworthiness Approval Tag (FAA equivalent of EU form 1) and/or Certificate of Conformity (CofC)) as detailed in EASA Part-21 or EU/US bilateral agreement (BASA).

In addition, EASA Member States may perform the installation w/ reference to EASA CA-STAN Issue 4 Standard Change CS-SC204b and CS-SC801B (FAA AC 43.13-1B together with AC 43.13-2B Ch 1). Installation of external Powered Engine Preheater and EASA/CAA Form 123 Standard Change/Standard Repair (SC/SR) embodiment record.

TCCA - Transport Canada Civil Aviation: Documentation Required for the Installation of Parts onto Canadian Registered Aircraft.: Advisory Circular (AC) No. 571-024, 4.3 Parts sourced from an FAA approved Manufacturer or United States (US) Distributor.

- (1) New parts (excluding standard and commercial parts) received from a Federal Aviation Administration (FAA) Production Approval Holder (PAH), a Parts Manufacturing Approval

(PMA) holder or US Distributor should be accompanied by an Authorized Release Certificate (ARC) or Statement of Conformity (SofC).

- (a) The installer should have an FAA Form 8130-3, or a SofC issued by the PAH or PMA holder; or
- (b) The installer should have a certified true copy of the original signed FAA Form 8130-3 or a SofC issued by the PAH or PMA holder from a US distributor.

UK CAA – United Kingdom Civil Aviation Authority (CAA) trade and co-operation agreement includes provisions for accepting an authorized release certificate of airworthiness CAA Form 1 and/or FAA Form 8130-3 with provisions for installing within the UK from 1 January 2021 following Administrator approved data.

5.3 Request to Build

Preconditioning Kits and their associated parts and/or products may be made (fabricated) by using Request to Build form: RTB0001. Kits made using this form are produced IAW methods, techniques, and practices acceptable to the Administrator under 14 CFR Parts 21 and 43. For additional compliance guidance refer to AC 43-18, Chapters: 1, 6, and 7 (3) CAT 3 Part.

5.4 Design and Material Reports

Design and materials certification reports available through Tanis Aircraft Products' customer support: Preheat Systems Design and Materials Specifications, Document No: 80004 and Electrical Wiring Interconnect Systems (EWIS) Report No: 80010.

5.5 Installation Data Reference

Persons engaged in the installation, maintenance, and/or inspection of Tanis kits and subcomponent parts on an aircraft, engine, or appliance, should be familiar w/ this document, current manufacturer's maintenance manuals, and/or ICA and/or other methods, techniques, or practices acceptable to the Administrator. Including but not limited to 14 CFR Parts 43 and 65, subparts A, D, and E, part 25 Subpart H Aircraft EWIS, applicable airworthiness requirements under which the aircraft was type certified. The burden of provision for compliance w/ approved data falls entirely on the technician approving the aircraft for return to service.

Applicable data reference for use with Tanis kits and subcomponent parts:

- (a) AC 43.13-1B Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair (as amended) Ch 3 and/or Ch 4 § 4, for methods and techniques of retaining structural integrity and Ch 11 §§ 8 through 12, 15, and 17, of this AC for electrical routing, securing, grounding and feed-through penetrations.
- (b) AC 43.13-2B Acceptable Methods, Techniques, and Practices – Aircraft Alterations (as amended) Ch 1 for limit load factors, materials, workmanship, and fasteners, and Ch 2 §§ 202, 205, and 206, and Figures 2-1, 2-8, 2-9, and 2-10, for general, locating, fabrication, and reinforcement of supporting structure.
- (c) 14 CFR 25 Subpart H, Aircraft Electrical Wiring Interconnect Systems (EWIS).
- (d) AC 25.1701 (as amended) Certification of EWIS on Transport Category Airplanes.

- (e) FAA - EWIS Best Practices Job Aid 2.0.
- (f) AC 120-16 and FAA-H-8083-30, Maintenance programs, and procedures.
- (g) AC 120-27 Ch 1, FAA-H-8083-1 Ch 4 - 9, and FAA-H-8083-30 Ch 4, Weight and Balance.

5.6 Weight and Balance


Weigh the kit and all installation hardware before installing, or weigh the aircraft upon completion. Wt & BI, and the equipment list are to be amended as required under aircraft TC.

Refer to kit-specific instructions for Wt & BI information and sample calculation table Figure 9.8.

Pursuant AC 43.13-1 Ch 10, AC 120-27 Ch 1, and FAA-H-8083-1 Ch 9. Alternations and changes affecting either the weight and/or balance of the aircraft should be recorded in the aircraft log. Changes in the weight or location of the weight in or on the aircraft should be recorded whenever the weight change is at or exceeds the weights listed:

- 1.0 lb / 0.45 kg in small aircraft weighing 12,500 lbs or less.
- 5.0 lb / 2.3 kg in medium aircraft weighing more than 12,500 up to 41,000 lbs.
- 10 lb / 4.6 kg in large aircraft weighing over 41,000 lbs.

5.7 Operation

 **Warning: Only Operate** Tanis systems following instructions in Operating Guide: TPG1000.
Do Not connect or disconnect a “live” extension cord with the aircraft preheat plug.
Do Not use timers and/or thermostats, systems are self-regulating.

5.8 Best Practices

Best Practice Guidelines for When to Precondition/Preheat.

- +4.5°C / +40°F OAT and below, recommended.
- -6.5°C / +20°F OAT and below/windchill, industry established requirement.
- -12°C / +10°F OAT and below, in addition use insulated cowl cover(s) and/or cowl plugs.

5.9 Instructions for Continued Airworthiness (ICA)

IAW 14 CFR § 21.50 (b), an ICA is finished and made available, refer to §§ 1 and 3. Information for continued airworthiness is located in ICA: TCA1000 or kit-specific ICA. Note: Record and retain data as indicated in the ICA.

The ICA is FAA approved and specifies inspections and other maintenance required under 14 CFR Sections 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been approved.

6. MATERIALS

Parts used in the installation and continued airworthiness of Tanis kits and subcomponent parts are to be standard Aircraft quality parts conforming to established industry specifications; NAS, AN, MS, NA, FAA-PMA, MIL-spec, TSO-C148 (14 CFR Sec. 21.303(b)(4)). For “Standard Parts” interpretation refer to 14 CFR Part 21 Docket No: AIR-100-9601. For additional information on Tanis design and material specification refer to § 5.4.

Refer to Appendix § D for a listing of Standard Options, Parts, and Related Documents.

- Due to shelf-life limitations, pad element bonding sealant and solvent wipes are supplied separately. For sealant requirements refer to kit-specific instructions and/or Instruction: TN02788 or TNDC730.
- Required materials are listed in kit-specific TLD and installation instructions.
- Standard power plugs are non-locking blade-type NEMA configurations.
- 230V kits are supplied with corresponding plug receptacle (outlet) TP02829-230 for installation on operator-supplied extension cord refer to Instruction: TN02829.

7. ELECTRICAL SYSTEM

In electrical systems wired in parallel, the voltage across branch currents is equal to the source current, all leads supply the same voltage.

7.1 Technical Specifications

System and individual element values are located in the kit-specific instruction or are calculated by measuring ohms of resistance using Ohms law § 7.2.

7.2 Ohms Law

- (a) **Resistance** = **Voltage** squared, divided by **Wattage** ($V^2/W=R$).
- (b) **Wattage** = **Voltage** squared, divided by **Resistance** ($V^2/R=W$).
- (c) Element part number used to calculate ohms, last numbers after dash call out voltage/wattage ($V^2/W=R$).
- (d) System wattage measures the resistance between plug blades ($V^2/R=W$).
- (e) Element wattage measures the resistance between element contacts ($V^2/R=W$).

7.3 Circuit Protection (CP) Limitation


Circuit protection is supplied for each circuit on the load side of the shore power plug (inlet).

- (a) Typical circuit load $\leq 10A$ with 12A overload protection.
- (b) Circuit load not to exceed 80% or circuit protection device (CPD).
- (c) CPD not to exceed 12A, unless otherwise specified.
- (d) Plug load not to exceed 15A, unless otherwise specified.
- (e) Malfunction, fuse replacement, and breaker reset refer to § 10.

7.4 Grounding

The ground wire is attached to the aircraft structure with proper metal-to-metal bonding. Resistance of ground connection not to exceed .003 ohms, refer to Figure 9.5.

7.5 Power Plugs, Electrical Arcing, and Dielectric Grease Application

 **Warning: Do Not** connect or disconnect a “live” extension cord with the aircraft preheat plug. Before connecting or disconnecting preheat system or any other device, disconnect the extension cord from the power source. This reduces the chance of electrical arcing at the connection point on the aircraft.

The shore power plug (inlet) is to be hard-mounted and placarded with voltage requirements. Location and mounting methods vary by aircraft, for guidance and examples refer to Figures 9.1, 9.2, and 9.3, Appendix § A, and/or kit-specific instruction.

Note: After inspecting, cleaning, or replacing an aircraft shore power plug (inlet), the application of a thin layer of Dielectric Grease p/n: TU03126, DC 4, or equivalent that meets MIL-S-8660C, ASTM D-149, is recommended. Dielectric grease may be applied using a cotton-tipped swab or equivalent applicator completely coat the plug contacts (blades and ground pin). Dielectric grease helps to ensure the integrity of the connection by reducing electrical arcing, corrosion, and the formation of conductive paths at electrical interface points.

7.6 Extension Cord

For extension cord sizing and inspection requirements refer to Operating Guide: TPG1000. Before each use inspect the extension cord and its plugs. Look for cracks, damaged insulation, discoloration, loose or missing plug blades, and any indications of overheating or burning, especially on the power outlet end (the aircraft end that plugs into the preheat system plug (inlet) on the aircraft).

Note: For recommended Hard Service extension cord replacement plugs contact Tanis Aircraft Products' customer support.

7.7 Aircraft Plug (inlet)


Before each use inspect the aircraft power plug (inlet). Look for signs of arcing, carbon deposits and/or corrosion, loose or missing plug blades, overheating, discoloration, burning, or cracking. The extension cord outlet should fit positively and firmly on the aircraft preheat system plug (inlet) and should not be a “forced fit”.

Note: The presents of clear dielectric grease on the aircraft plug is normal. Periodic maintenance recommends the application of a dielectric compound on the aircraft plug contacts (blades, and ground pin) refer to Note § 7.5.

7.8 Power

External AC shore power and extension cord is supplied by the user. Power at the end of the extension cord is to be within +/- 10% of the voltage requirement (115V or 230V). For extension cord requirements refer to Operating Guide: TPG1000.

7.9 Heat Elements and Heaters


 **Warning:** Energized elements can cause 2nd and 3rd-degree burns.

Do Not Connect uninstalled heat element(s) to power.

Locate the elements IAW narratives and examples in kit-specific instructions.


- Measure the resistance of each element before installing.
- Listing of standard elements and related documents are listed in Appendix § D.
- For alternate or additional elements contact Tanis Aircraft Products' customer support.


Pad heat element Bonding Instructions: TN02788 and TNDC730

 **Do Not** cover the top of a pad element with sealant.

- Only Use approved bonding sealant.
- Requires surface cleaning and preparation.
- Elements must be in full contact through bonding sealant.
- Use only enough sealant to completely bond the pad element to the substrate and seal the edges.

Threaded Element Instructions: TN02771 (1/4-inch), TN02639 (M6), TN02905 (5/16-inch), and TN02634 (crankcase and sump fluid elements).

 **Do Not** allow a threaded element to bottom out or expose more than 3 threads at the tip.

 **Do Not** use any type of split, star, or lock washer of any type or material.

- Only space when required with flat alloy steel or aluminum washers and/or spacers.
- Torque with a certified wrench and appropriately sized tip tool, crows' foot, slotted socket, etc. refer to R&R existing fitting torque to OEM specification for the location of installation.
- Secure lead midway between element and connector.

AV/Cabin Heater: Configured for occasional use or permanent installation, refer to Figure 9.11. and Appendix §§ B and D.

Battery Heater: Configured per make and model, refer to Figure 9.10. and Appendix §§ B and D.

8. INSTALLATION

Kits are to be installed in a manner that allows for inspection and maintenance and must not be contrary to the airframe or engine manufacturer's data.

- Work is best performed in a clean environment under standard temperature conditions of 18°C / 65°F to 27°C / 80°F.
- Kit-specific instructions and/or manufacturer procedures may supplement instructions.

8.1 Overview

Review this document and kit-specific instructions when available.

- (a) Weight kit.
- (b) Install heat elements and shore plug.
- (c) Route the electrical system connecting elements to the power plug.
- (d) Inspect, Check, and Record, refer to § 11.3.

8.2 List of Special Tools

Standard Ohmmeter certified to traceable standards is required for installations and inspections.

Standard aviation hand tools are required and not supplied. Refer to individual kit instructions for kit-specific tools.

Suggested Specialty Tools (Appendix C.1):

- For threaded element installation: Quarter-inch drive torque wrench, or equivalent, and appropriately sized tip tool, crows' foot, slotted socket, etc.
- Deutsch contact remover tool: DT-RT1 or equivalent.
- Tanis 4-way indent crimp tool: TU02793 - Alternate DMC: AF8-TH163 or equivalent.

8.3 Electrical System Routing

Cable/Wire routing is suggested, final routing TBD, refer to § 5.5.

- (a) To compensate for routing, leads may be cut or spliced, service looped, race-tracked, shortened, or lengthened with the appropriate splice or connector.
- (b) Leads may be repositioned, in parallel, in junctions/terminal blocks.
- (c) When needed, to limit movement/slipping of cable ties use self-fusing silicone tape (SFT) under cable ties around connectors and/or cabling, SFT p/n: TU03076-05R, TU03076-10R, or equivalent.
- (d) Installation must not interfere with other systems such as engine or flight controls.
- (e) Wires and cables are to be supported by suitable cable ties, clamps, grommets, or other devices at intervals of not more than 6 inches / 15.25 centimeters, except when contained in ducts or conduits.
- (f) Properly secure wires and cables so movement is restricted to the span between the points of support and not on the connectors.
- (g) Supporting devices should be of a size and type capable of supporting wires and cables securely without damage to conductor insulation.
- (h) Adequately support and secure wires and connectors to prevent excessive movement in areas of high vibration.
- (i) Route wiring and cabling with enough slack to compensate for the movement of shock mounts.

- (j) Route cable/wire in a manner that ensures system components are not near high heat sources and use fire sleeves to protect wiring and connectors in questionable areas.
- (k) Where practical route wires and cables above and provide separation from fuel lines. Such wiring should be closely clamped and rigidly supported and tied at intervals such that contact between lines and related equipment would not occur in the case of a broken wire and/or a missing wire tie or clamp.
- (l) Check for proper installation of engine to airframe grounding strap(s) and bonding.

8.4 Alterations

Before starting any composite or sheet metal alteration refer to applicable kit and/or component installation instructions, refer to §§ 5 and 6 of this document, and the following:

- Determine whether added mass will not cause flexing and cracking of the skin, AC 43.13-2B Ch 1.
- Composite alterations. AC 43.13-1B Ch 3. Rivet using appropriate size blind rivets (Blind Cherry MS, CR, and NAS series aluminum or Monel), assemble wet and seal A/R with PS 870 or equivalent (MIL-PRF-81733). Note: Do Not buck rivets in fiberglass or composite panels or structures.
- Sheet metal alterations. AC 43.13-1B Ch 4, § 4. Rivet using appropriate rivets. For structural installations, pattern rivet layout after a small patch, similar to Figure 4.16. Assemble wet and seal A/R with PS 870 (PR 1422B-2) or equivalent OEM-approved corrosive inhibitor sealant.

9. FIGURES

Examples in this section are for reference, actual configuration may vary. For listing of available tools, standard options, and parts, refer to Appendix §§ B, C, and D.

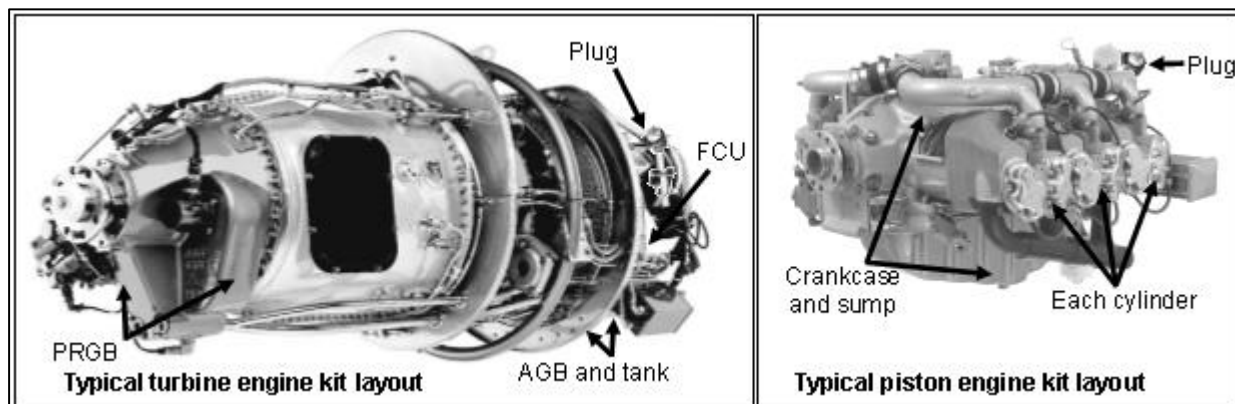


Figure 9.1. Engine and APU kits are eligible for installation through PMA or STC. Shore power plugs are typically located on the engine and accessed through an oil door or cowl opening. Engine, avionics, and battery kits can be operated from a single plug. For examples and options refer to Cable Kit Mod p/n: TC03321, Drawing: 03320, and Appendix §§ B and D.

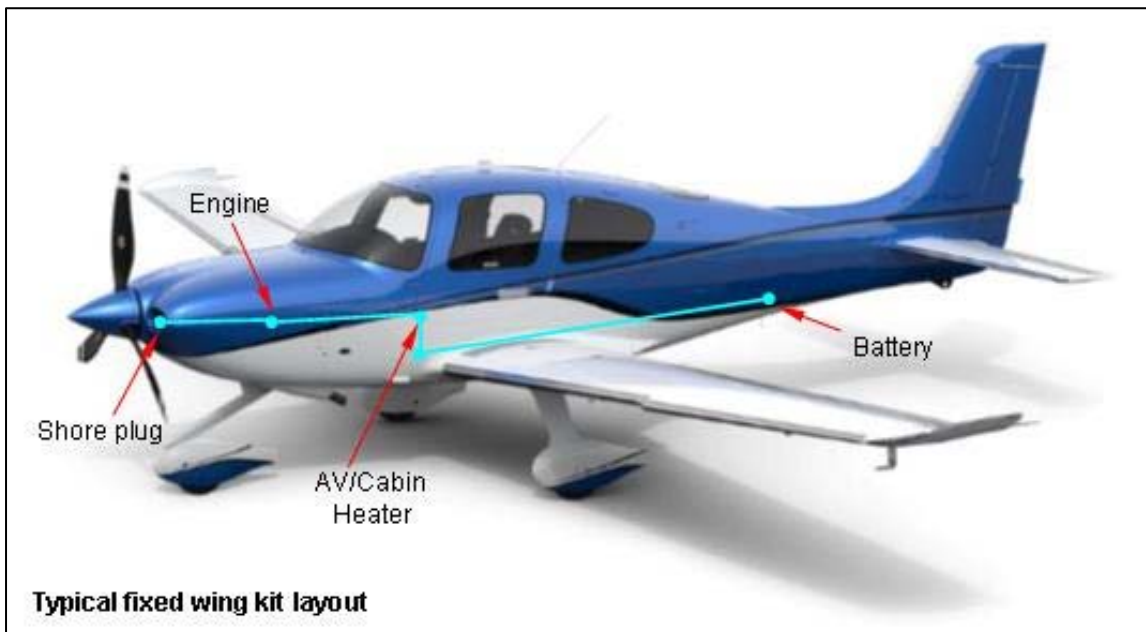


Figure 9.2. Fixed wing kits are eligible for installation through PMA or STC. Normal and transport category airplane kits vary by aircraft and operational requirements. Shore power plugs are typically located on the left side near the pilot door or accessed through the engine oil door or cowl opening.

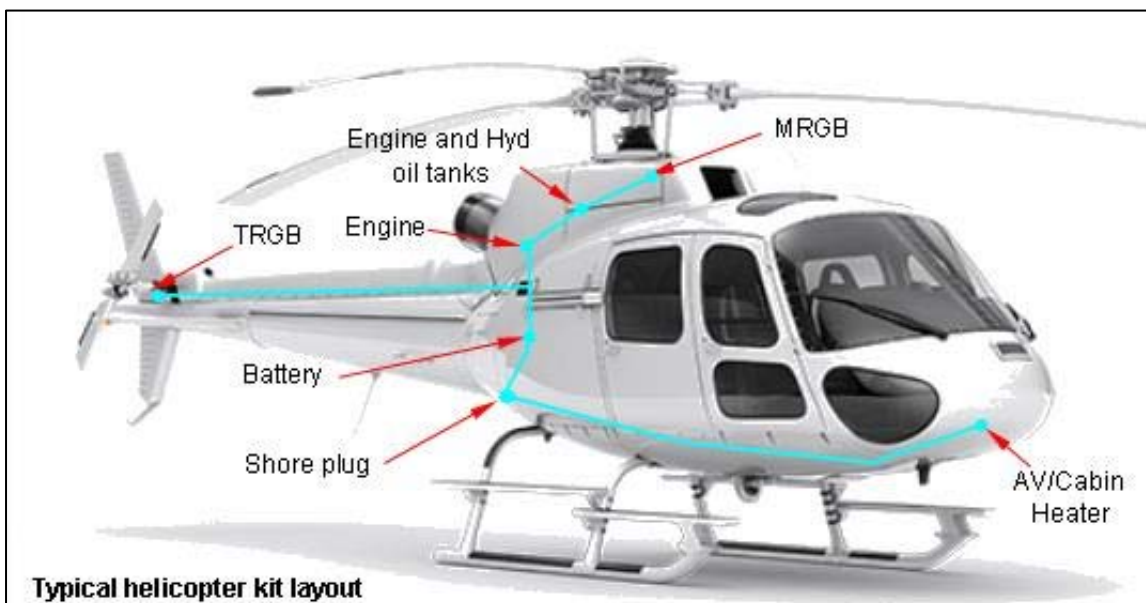


Figure 9.3. Rotor wing / Helicopter kits are eligible for installation through PMA, STC, or Tanis form: RTB0001 Request to Build. Configuration varies by airframe and application. Shore power plugs are typically located on the right-side tail section near the pilot door or accessed through the engine or cowl door opening.

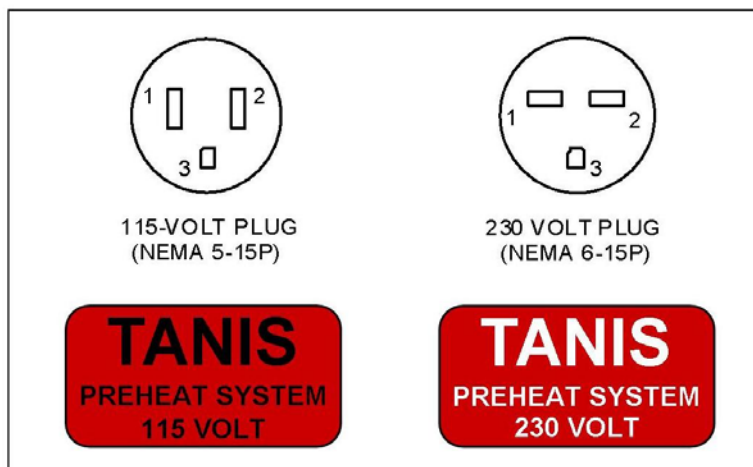


Figure 9.4. Plug and placard configurations. An alternate placard may be field fabricated stating: *Tanis Preheat and voltage requirement (115 Volt or 230 Volt).*

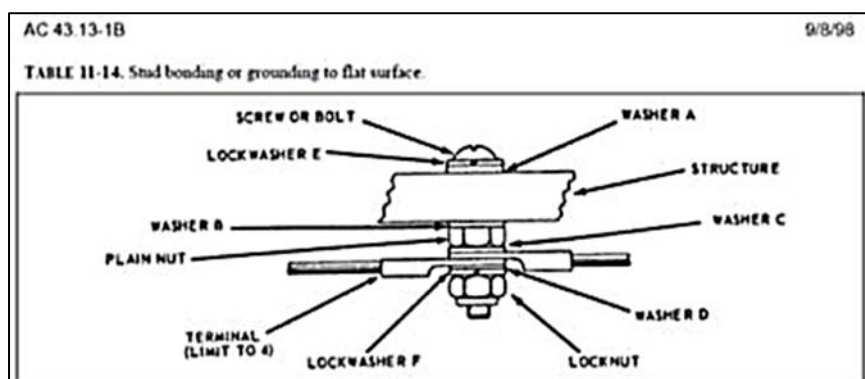


Figure 9.5. The grounding wire is attached to the aircraft structure, or engine, with proper metal-to-metal bonding attachment. Resistance of ground connection is not to exceed .003 Ohms. Standard bonding example reprinted from AC 43.13-1.

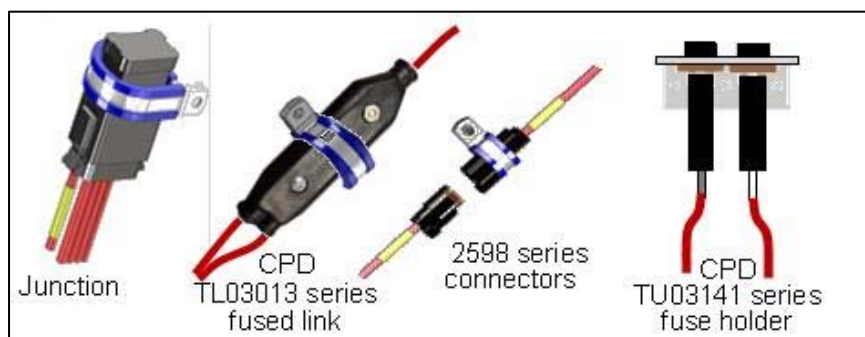


Figure 9.6. Examples of clamp locations on, junctions, connectors, and fused links. Components may be secured with cable ties, and/or appropriate lacing. Junctions are to be in serviceable areas, and CPD is to be in serviceable areas near the plug.

Size	AS/MS number	Application
1/8"	21919WDG-2	1 - 2 wire
1/4"	21919WDG-4	2 - 3 wire
5/16"	21919WDG-5	8mm Indicator light
5/8"	21919WDG-10	2 contact Connector
7/8"	21919WDG-14	3 contact Connector
1"	21919WDG-16	4 lead Junction
1 3/16"	21919WDG-19	6 lead Junction (WCH-18)
1 1/2"	21919WDG-24	Circular shore power plug

Figure 9.7. Clamp reference, AS or MS 21919 WDG, WCH, or WCE, size for a secure fit.

	<i>WEIGH LB or KG</i>	<i>ARM IN or CM</i>	<i>MOMENT IN or CM</i>	<i>MOMENT WT x ARM/100 IN or CM</i>
Preheat System	+			
AV/Cabin Heater	+			
Battery Heater	+			

Figure 9.8. Sample Wt. and BI calculation table. Recalculate, record and revise aircraft records.



Figure 9.9. Examples of heat elements. Type, size, shape, and wattage, vary by application.

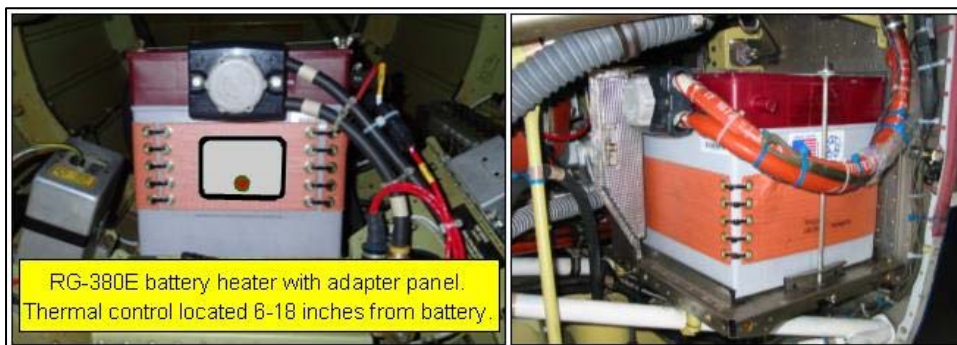


Figure 9.10. Battery heat kits are typically included in specific airframe kits and available as an add-on to all other kits, configured by make, and model. Refer to Drawing: 02800, Instruction: TN02800, and Appendix §§ B and D.

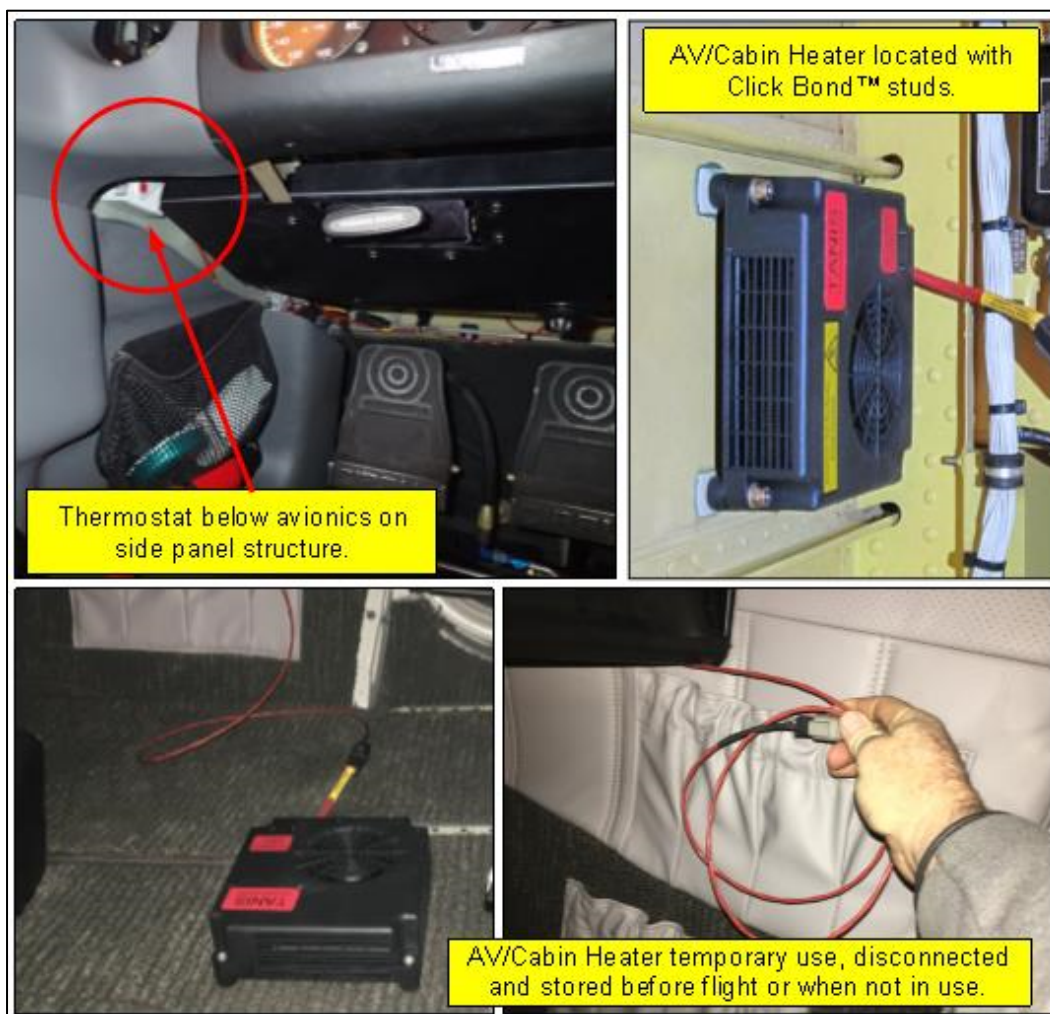



Figure 9.11. Example of AV/Cabin Heat Kit p/n: TU03323. The kit may be configured for occasional use or permanently installed. The heater is also available individually for occasional use as a space heater. For standard options refer to Appendix §§ B and D.

10. MALFUNCTION

 **Warning:** Perform troubleshooting and/or repairs with the system disconnected from the power source. For the Troubleshooting Guide, refer to Table 10.2.

- System descriptions and electrical values are located in the kit-specific installation instructions recorded, and retained with kit ICA: TCA1000.
- Elements and system electrical are visually inspected.
- System circuits are tested using an ohmmeter refer to Functional System Check § 11.


10.1 CPD (breakers and fuses)

Tripped circuit protection device (CPD) / blown fuse refer to Appendix, D.8. Common system fuse tube type 12A 1.25 x. 25 p/n: TU02848 ceramic. Alternates: Bussmann: ABC-12 ceramic tube fuse or AGC-12 glass tube fuse. Resettable breakers vary by application.

10.2 Table: Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	MAINTENANCE ACTION
System does not heat.	Circuit protection tripped or blown fuse.	Disconnect power, reset breaker or replace fuse, before reconnecting to power perform Functional System Check.
	Ground shore power cord not providing power.	Verify power source output and cord continuity. Connect cord and check cord outlet for proper voltage output.
	Wire broken to junction.	Disconnect power, perform Functional System Check and as required check circuits with ohm meter before connecting to power.
	Shore power plug damaged.	Repair and/or replace plug.
Power indicator light doesn't light when attached to shore power.	Circuit protection "blown".	Reset breaker or replace fuse.
	Voltage out of range.	Connect to appropriate power source.
System heats some, not all elements heating properly.	Defective element(s).	Check element with Ohmmeter.
	Voltage too far out of range.	Connect to better power source.
	Wire broken.	Check connections and wire to element.
Smoke or odor occurs on newly installed pad element(s).	Off gassing occurs normally from new elements.	Check element installation conforms with applicable instruction and voltage.
Smoke or odor occurs on system that has been installed for at least a month.	Heat element failing. (yellow/gray areas appearing on pad)	Disconnect power. Remove and replace heat element, check rest of system for proper installation.
	Heat element dirty / oily.	Disconnect from power and clean.
External power GFCI trips.	Moisture introduced to extension cord, electrical system, or element.	Check cords, connections, and system, for damage, if threaded elements are installed refer to GFCI troubleshoot guide 80013.

11. FUNCTIONAL SYSTEM CHECK

 **Warning:** Energized elements can cause 2nd and 3rd-degree burns.

Thermal imaging cameras and/or infrared devices may be used for validation of element or system operation. Due to variation in target emissivity reflected temperature values will vary from actual temperatures.

Required: Kit-specific ICA: TCA1000 and instructions for the kit being checked, Operating Guide: TPG1000, calibrated Ohmmeter, extension cord, and applicable external power source.

When a discrepancy is noted, correct it before proceeding to the next step.

* For plug pinouts refer to Figure 9.4. ** Skip when not installed, or test separately.

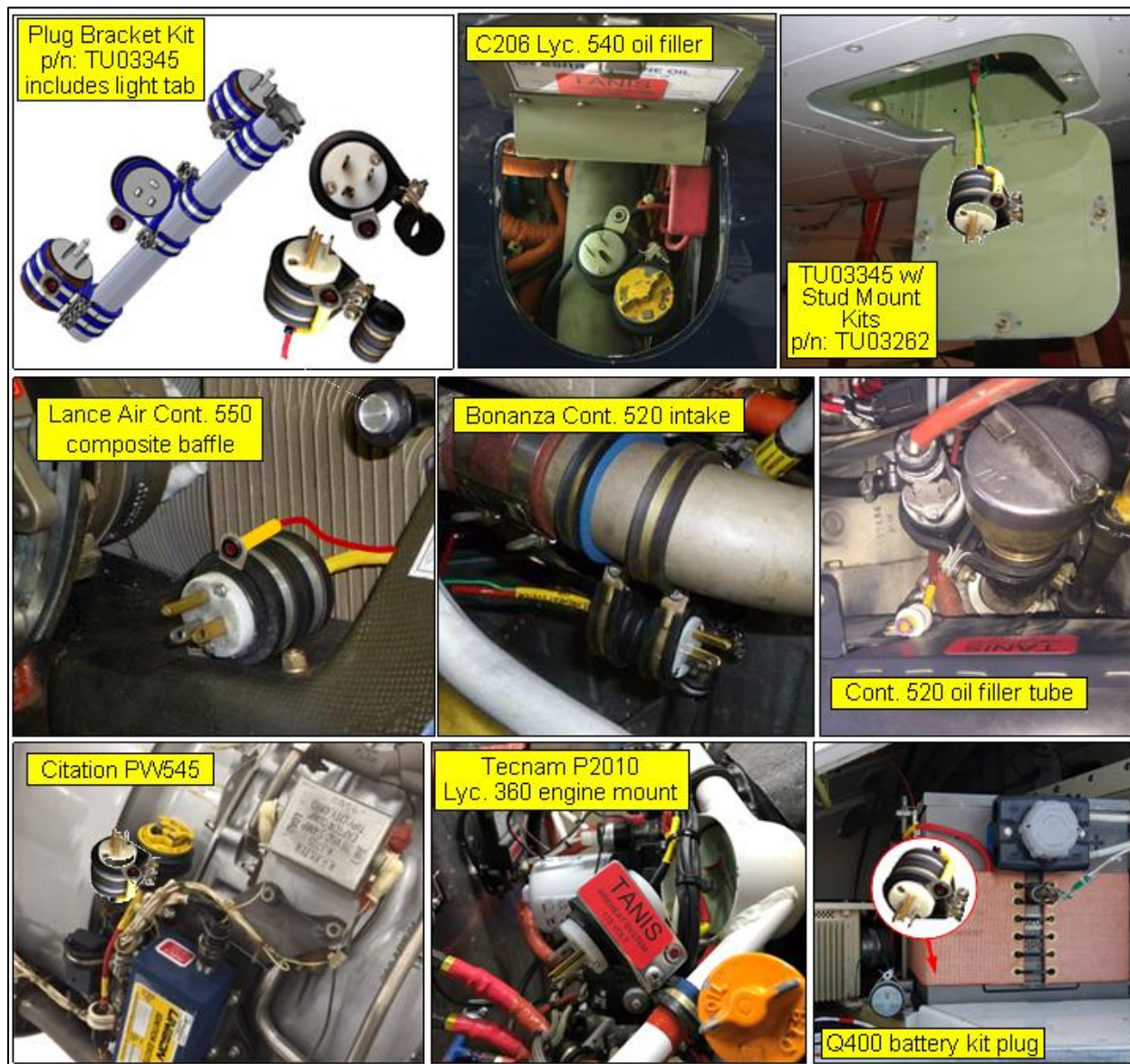
1. **Inspect:** Visually inspect and verify all parts are connected and secure and verify that affected component fluid levels are at operating levels.
2. **Check:** Measure resistance of system(s) with ohmmeter:
 - (a) * Check for continuity between shore power plug ground pin 3 and airframe.
 - (b) Verify the circuit is open between the ground pin 3 and blades 1 and 2.
 - (c) Measure resistance between blades 1 and 2 and compare the reading with values called out in the kit-specific instructions.
 - (d) Connect the system to power IAW Operating Guide: TNG1000. *Plug the extension cord (outlet) into the preheat system plug (inlet) on the aircraft first, then plug the extension cord (inlet) into the external shore power source.*
 - (e) ** Verify the system's power indicator light is on (illuminated).
 - (f) Within 30 minutes, check the areas near each element for heat.
 - (g) ** Thermal controlled heat element(s) battery or other: While the system is warming up freeze 0°C (32°F) thermal control (ambient air sensor) using icepack, circuit cooler spray, or other appropriate means. **Do Not** submerge in water and check element(s) for heat. Note: Cooling may take more than a minute to trigger the sensor.
 - (h) ** Forced air AV/Cabin Heater, check for audible fan and warm air circulation. When equipped with a thermostat cool below the set point and verify operation.
 - (i) When testing is complete unplug the extension cord(s) latch any open access doors and stow the extension cord in an appropriate location.
3. **Record:** IAW 14 CFR part 43 § 43.9, part 121, or other procedures set in place by the operator record the installation. In addition, if installing STC'd kit and applying the STC, document the installation w/ FAA Form 337 or other forms as applicable to the country of registration.
 - (a) Wt & BI and equipment list, amend as required under aircraft type certificate.
 - (b) Record and Retain Data as indicated in ICA: TCA1000 and Operating Guide: TPG1000.
 - (c) To complete the Registration/Warranty Card, go to:
<https://www.tanisaircraft.com/warranty-card-registration>

12. APPENDIX

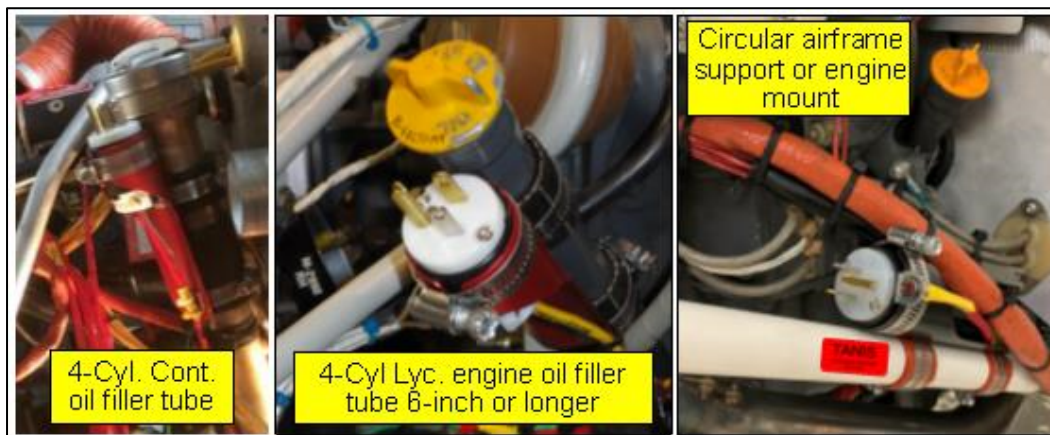
Contains examples for the following: Plug mounting, circuit diagrams for single plug operation, AV/Cabin and Battery Heat Kits, and listing of subcomponent parts acceptable for use in repair, and/or expansion of primary systems.

A. Plug Mounting Examples

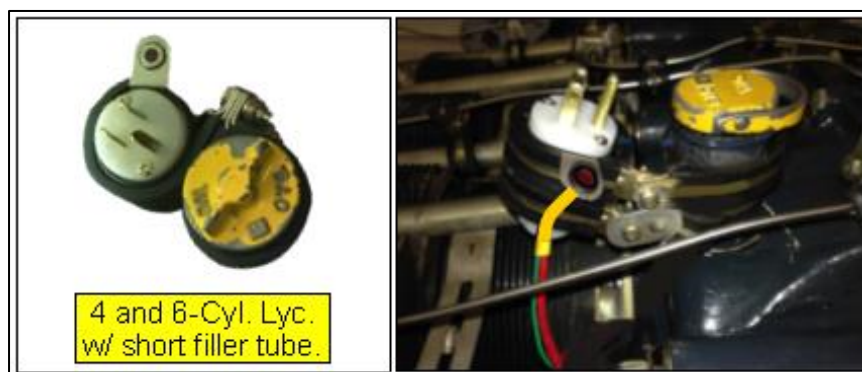
For additional plug and cabling options refer to Appendix §§ B and D.



A.1. Examples of Circular Plug Bracket Kit p/n: TU03345. The kit includes cushioned clamps, hardware, and a light tab. Plug and light supplied through NHA or separately. Refer to Instructions: TN03345 and TN02770.



A.2. Examples Plug Bracket Kit p/n: TU01062. The kit includes a circular plug bracket, clamps, SFT, and a light tab. Plug and light supplied through NHA or separately, TN01062.



A.3. Examples of Circular Plug Bracket Kit p/n: TU03300. The kit includes an offset plate, cushioned clamps, hardware, and a light tab. Plug and light supplied through NHA or separately. Refer to Instructions: TN03300 and TN02770.



A.4. Examples of Circular Plug Bracket Kit p/n: TU03017. The kit includes an angled plug bracket, cushioned clamps, hardware, and a light tab. Plug and light supplied through NHA or separately. Refer to Instructions: TN03017 and TN02770.



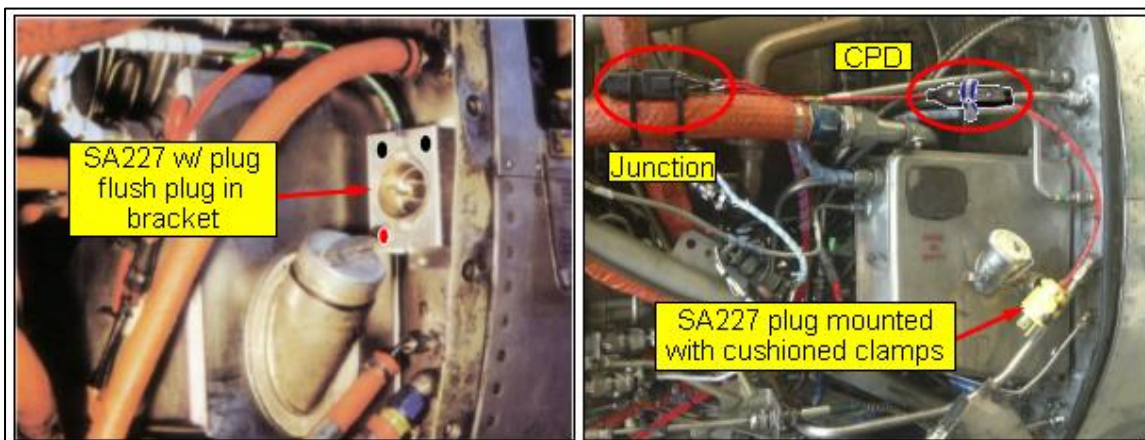
A.5. Examples of Flush Plug w/ Cap p/n: TP02533-T-115 or TP02822-T-230 in engine cowls and inspection covers refer to Instruction: TN02533. For additional plug options refer to Appendix §§ B and D.



A.6. Examples of flush plugs located on Baron and Bonanza refer to Instruction: TN02070 and TN02533. For additional plug options refer to Appendix §§ B and D.



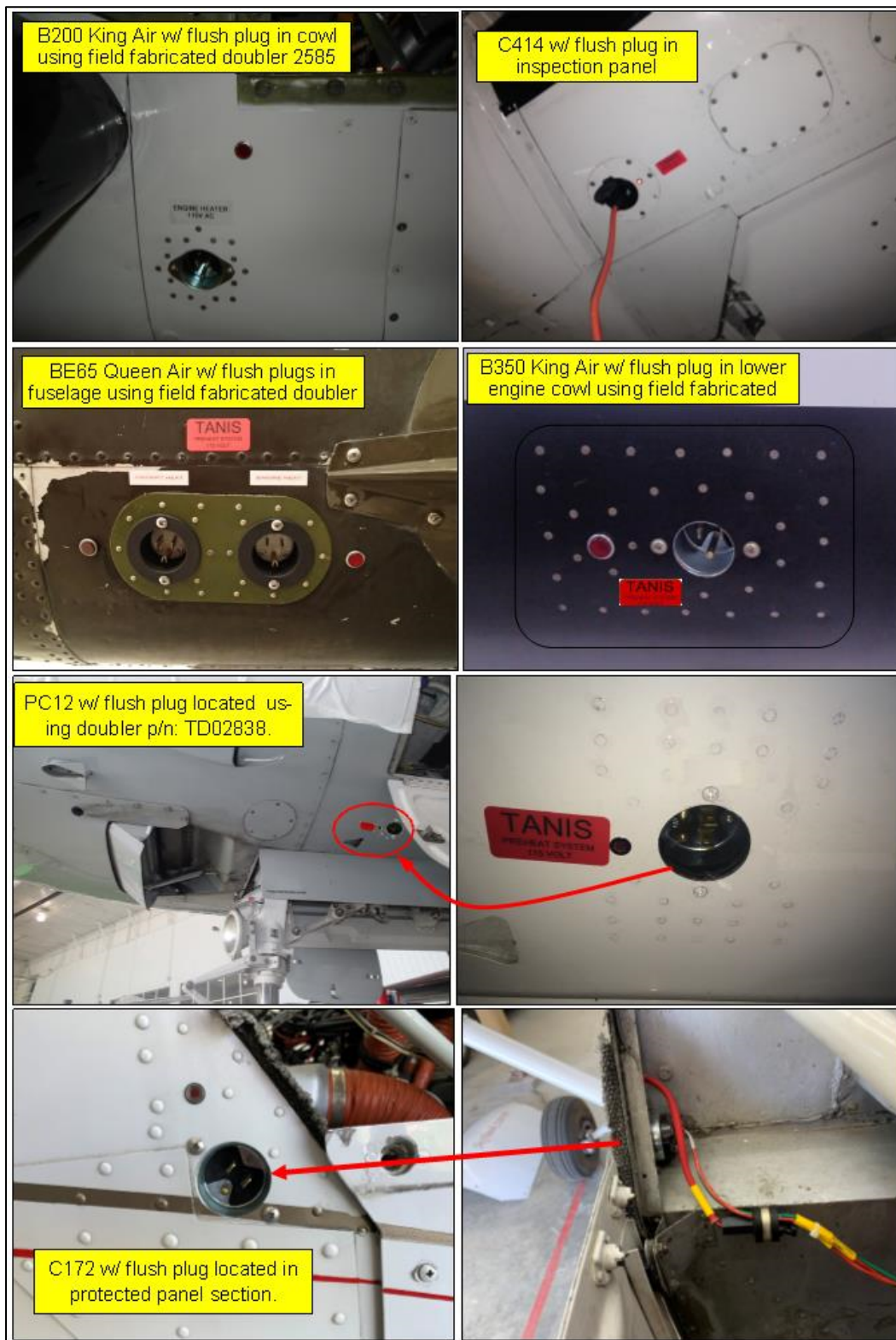
- A.7.** Example of Flush Plug p/n: TP02070-M-115 or TP02839-S-230, located on GPU plug housing. The bracket field is fabricated angled and positioned for access through the door, secured on the GPU connector with a circular clamp, or the bracket may be riveted to the GPU housing.



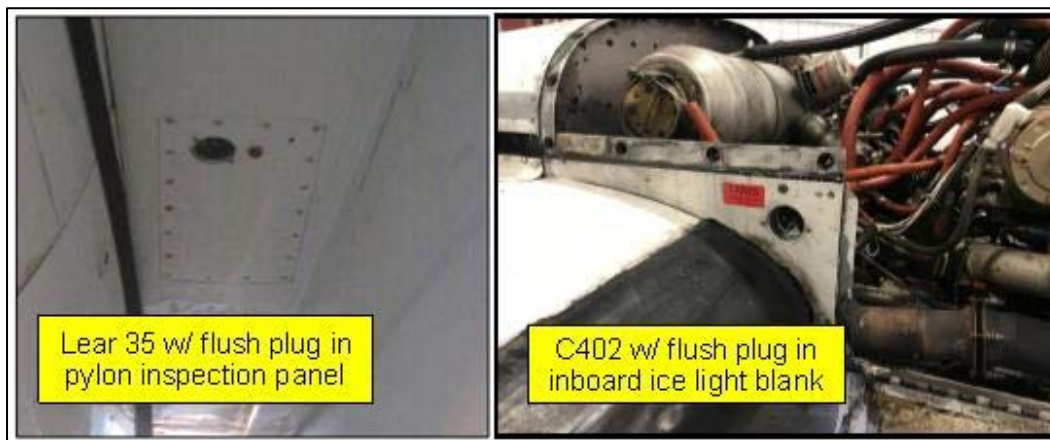
- A.8.** Examples of plugs located on Metroliner w/ Garrett TPE331.

Left: Flush Plug p/n: TP02070-M-115 or TP02839-S-230 w/ Fuse Kit p/n: TU03141, in field fabricated bracket TU02581 drawing: 2581.

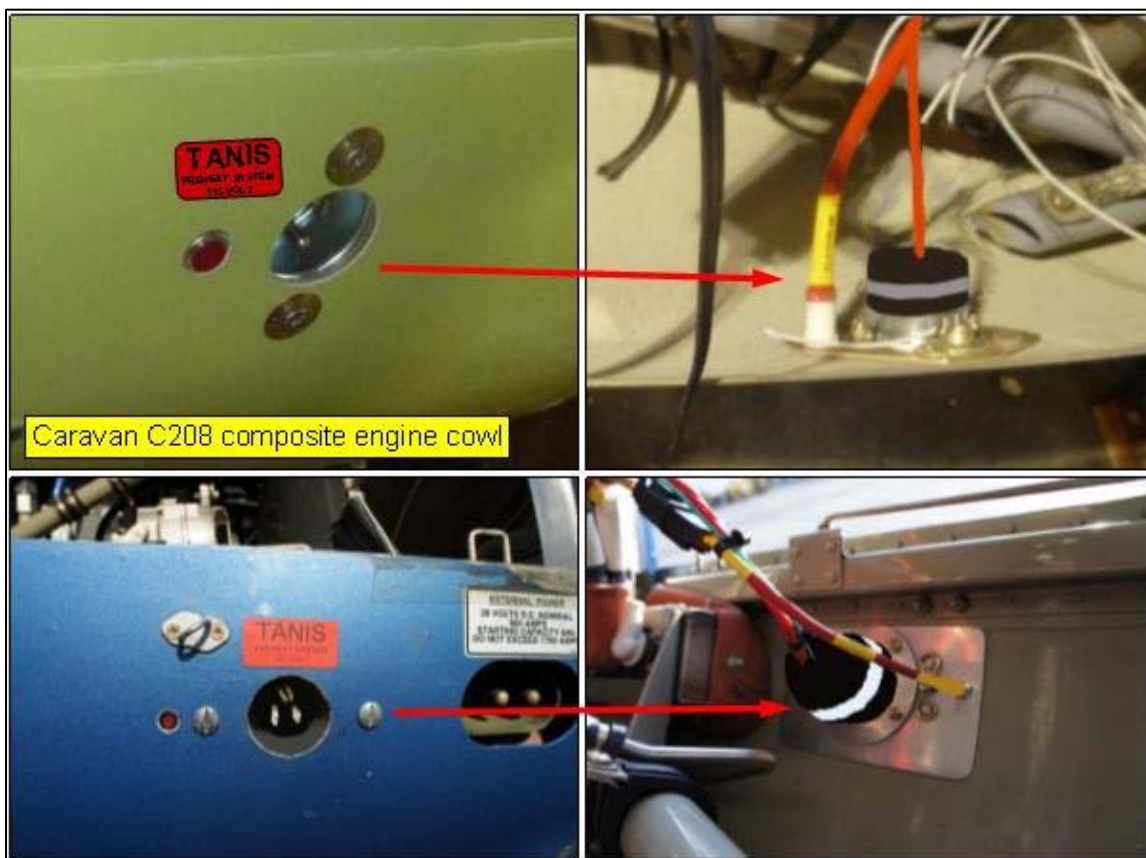
Right: Circular Plug p/n: TP02770-115 or TP02980 located with cushioned clamps.



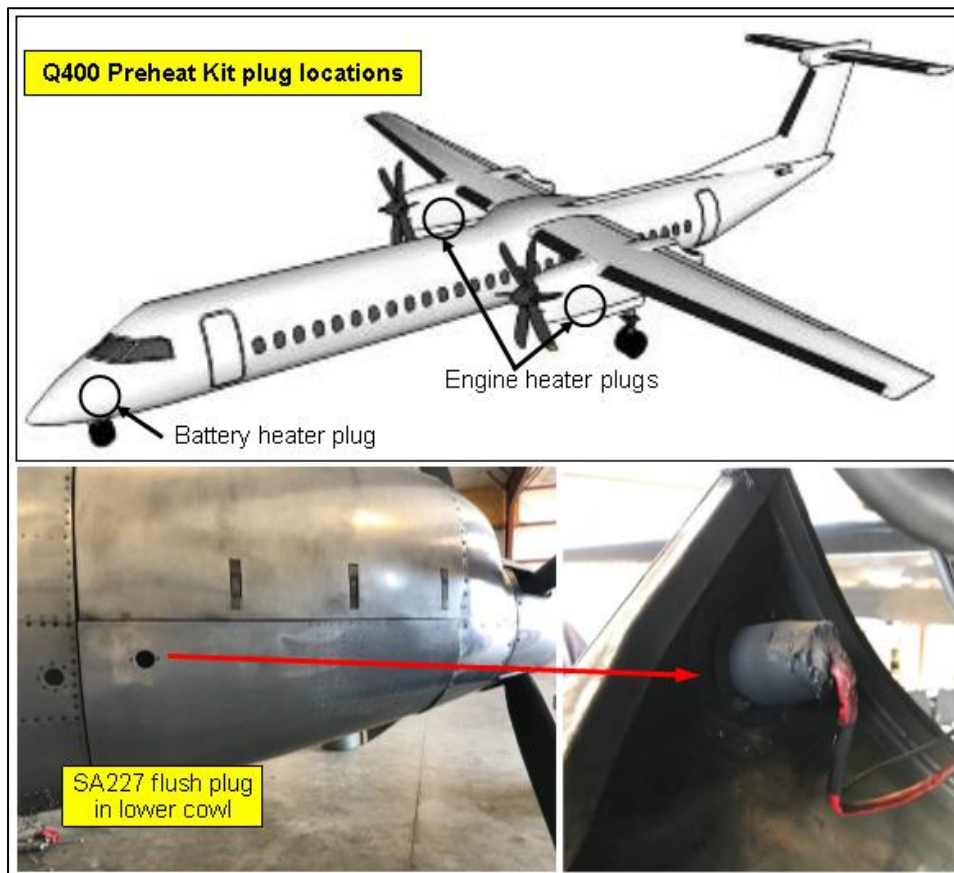
A.9. Examples of Flush Plug p/n: TP02070-M-115 or TP02839-S-230, located on single and twin-engine aircraft refer to Instruction: TN02070. Additional plug options refer to Appendix §§ B and D.



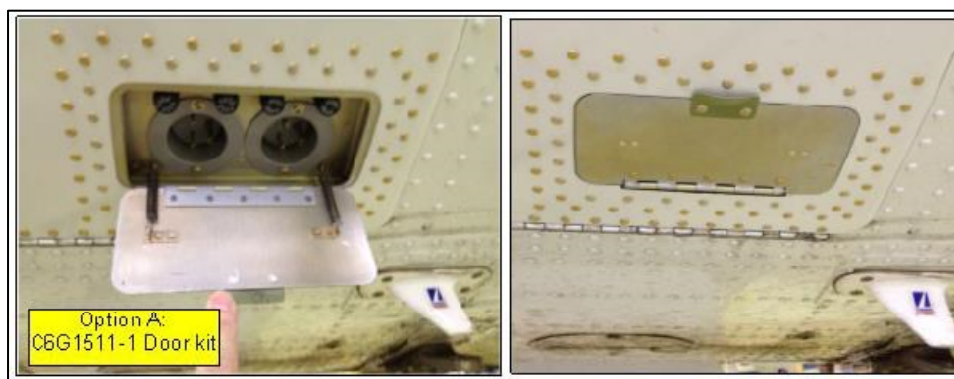
- A.10.** Examples of Flush Plug p/n: TP02070-M-115 or TP02839-S-230, located in an access panel and ice light blank. Single plug cabling options are available, refer to Appendix §§ B and D.



- A.11.** Examples of Flush Plug p/n: TP02070-M-115 or TP02839-S-230, mounted on field fabricated removable plate. Engine cowl match drilled. Plate secured to cowl with ¼-turn fasteners for removal during maintenance.



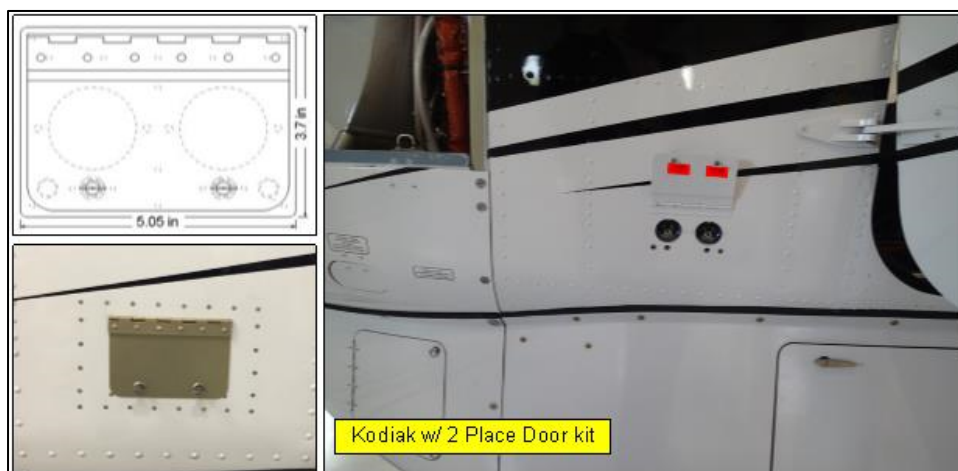
A.12. Examples of plug locations on twin-engine aircraft. Depending on the system loads kits may be operated through a single plug. For plug and cabling kit options refer to Appendix § B and D.



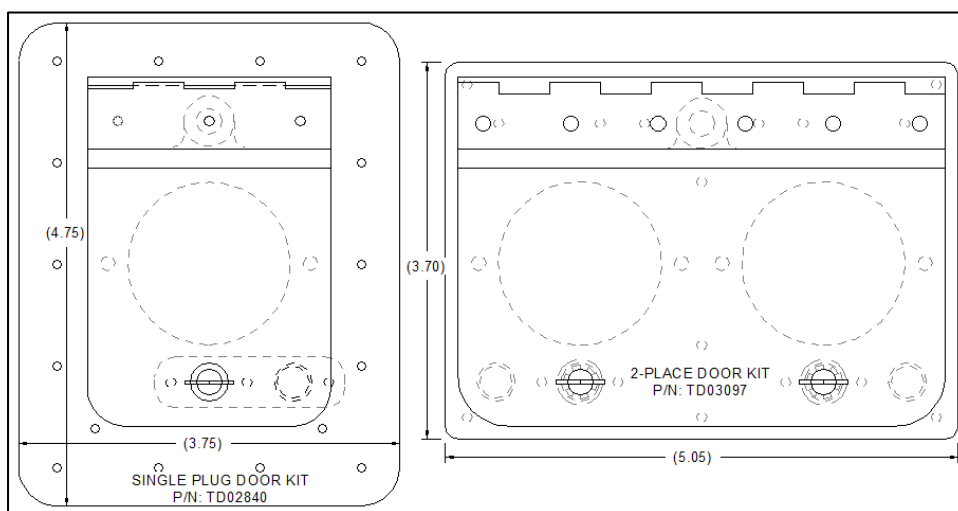
A.13. Example of Viking DHC-6 factory door kit. Single plug door kits and cabling options are available, refer to Appendix §§ B and D.



A.14. Example of 2-Place Plug Door Kit p/n: TD03097 located in composite panel. Single plug door kits and cabling options are available, refer to Appendix §§ B and D.

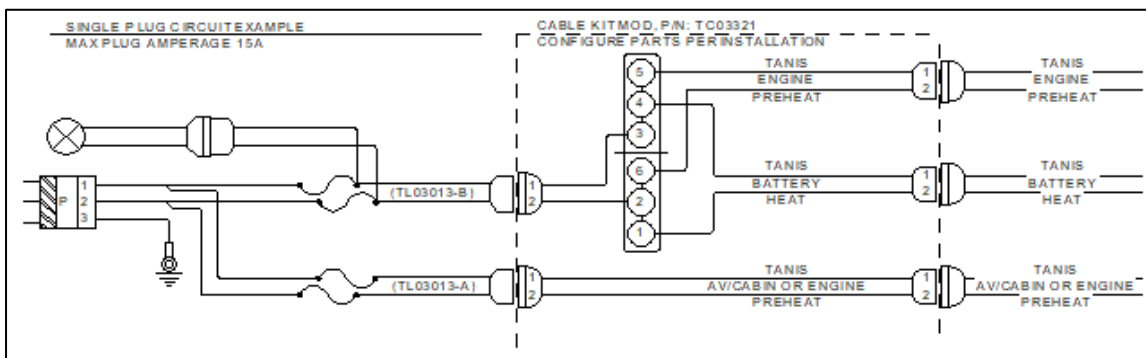


A.15. Example of 2-Place Plug Door Kit p/n: TD03152 located in sheet metal panel. Single plug door kits and cabling options available, refer to Appendix §§ B and D.

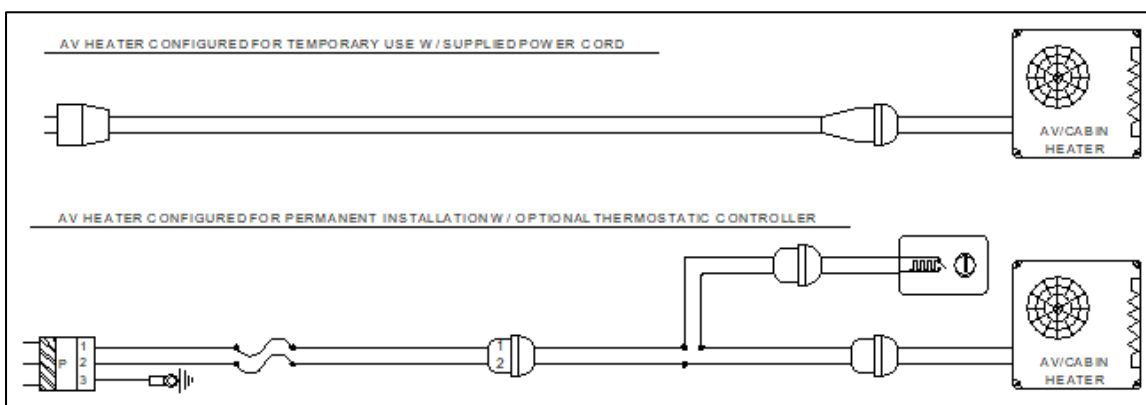


A.16. Single and 2-Place Door Kits, for additional options refer to Appendix § D Table D.16.

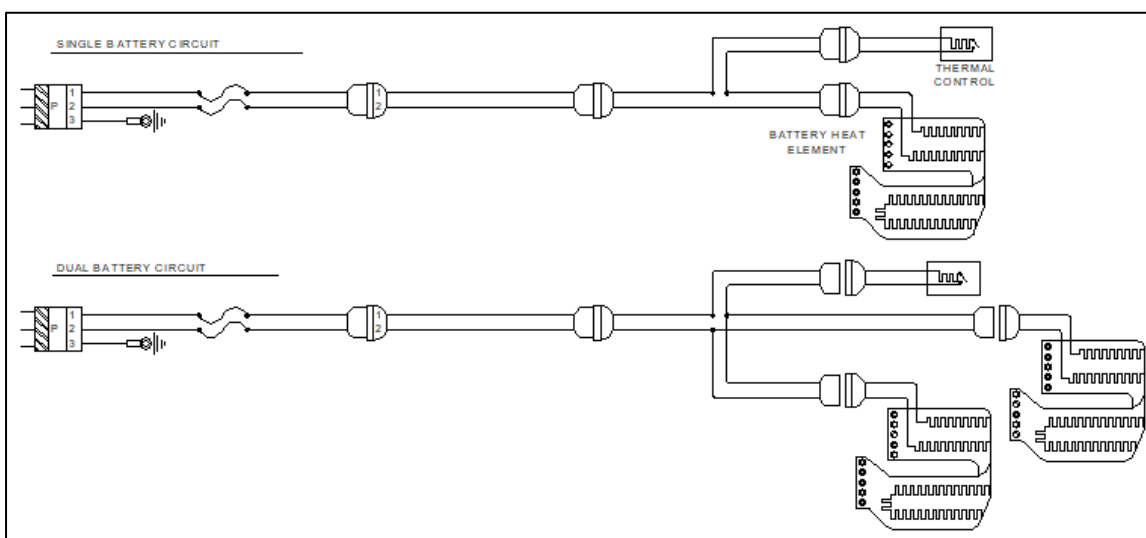
B. Circuit Diagrams



B.1. Example of single plug circuit using Cable Kit Mod p/n: TC03321. Refer to Drawing: 03320 and Appendix § D Table D.5.



B.2. Example of AV/Cabin Heater circuits. Refer to Drawing: 03322 and Appendix § D for additional options.



B.3. Example of Battery Heater circuits. Refer to Battery Heat Kit Instruction: TN02800, Drawing: 03116, and Appendix § D for additional options.

C. Specialty Tools

Suggested, available through Tanis or sourced separately.

C.1	Tool	Part No.	Related Document
	Contact Removal Tool	DT-RT1	TN02793 / TN03012
	4-Way Indent Crimp Tool for 16-22 AWG Wire	TU02793	TN02793 / TN03012
	Slotted Socket - ½-inch deep 6-sided ¼-drive	TSF3165	TN02771 / TN02905
	Slotted Socket - 11mm deep 6-sided ¼-drive	TSF3165	TN02639 / TN02905
	Certified Multi-Meter	Example: Fluke-83	TNG1000 / TCA1000
	Kill-A-Watt™ Monitor or other	Example: P3 International	

D. Standard Options and Parts

These Tables contain listings of standard options and parts and their related documents. Verify applicability before installation, § 2. Contact Tanis Aircraft Products for additional options.

D.1	AV and Battery Heaters	Part No.	Related Document
	AV/Cabin Heater 500W	THP3094-500	TN03094
	Cirrus SR20/22 AV/Cabin Heat Kit	TSF3165	TNF3165 / 03322
	AV/Cabin Heat Kit (AML PMA)	TU03323	TN03323 / 03322
	Battery Heat Kit	TSB2800	TN02800 / 03116

D.2	AV and Battery Heater Cable Kits	Part No.	Related Document
	AV/Cabin Heater Cable Kit (CPD 3141)	TC03159	TN03094 / 03059
	AV/Cabin Heater Cable Kit (10-ft (CPD 3013)	TC03164	TN03094 / 03164
	AV/Cabin Heater Cable Kit 15-ft (CPD 3013)	TC03164-15	TN03094 / 03164
	AV/Cabin Heater Cable Kit 25-ft (CPD 3013)	TC03164-25	TN03094 / 03164
	Battery Heater Cable Kit (CPD 3013)	TCB3116	TN02800 / 03116

D.3	AV and Battery Heater Controllers	Part No.	Related Document
	AV Thermostat (adjustable)	TLP3235	TN03235
	AV Thermal Control (set point 25°C)	TLP3251	TN03251
	AV Thermostat Kit (w/ control cable assy)	TU03238	TN03235
	AV Thermal Control Kit (w/ control cable assy)	TU03253	TN03251
	Battery Thermal Control (set point 5°C)	TLP3046-05	TN03046
	Battery Thermal Control (set point 10°C)	TLP3046-10	TN03046

D.4	AV Battery Heater Control Cables	Part No.	Related Document
	AV Control Cable Assembly	TC03246-A	TN03094 / 03322
	Battery Control Cable Assembly - Single	TL03217-C	TN02800 / 03116
	Battery Control Cable Assembly - Dual	TL03217-D	TN02800 / 03116

D.5	AV Heater Mounting Hardware	Part No.	Related Document
	Dual Lock Strip (8-each heater)	TU03239-02	TN03094
	Stud Mount Kit (4-each heater)	TU03262	TN03094 / 3262
	Adhesive Mix Kit (1-kit per 4-stud mounts)	CB92	TN02800 / CB200
D.6	Cable Kit (single & twin engine)	Part No.	Related Document
	Outlet Cable Kit (w/CPD 3141)	TC03071	03071 / 03141
	Single Plug Cable Kit	TC03321	03320
D.7	Cable and Wire	Part No.	Related Document
	Cable, 18-ga. 2-Wire M27500 260°C	22759-182	80010
	Wire, 18-ga. Green Ground	22759-181	80010
D.8	Circuit Protection	Part No.	Related Document
	CPD - Fused Link Kit	TL03013-AK	TN03013
	CPD - Fused Link Kit w/ Spare Lead	TL03013-BK	TN03013
	CPD - Fused Link	TL03013-A	TN03013
	CPD - Fused Link w/ Spare Lead	TL03013-B	TN03013
	CPD - Fuse Kit (panel type)	TU03141	03141
	CPD - Fuse Kit w/ Bracket (panel type)	TU03141-B	03141
	CPD Replacement Fuse - 12A ¼-in Ceramic	TU02848	TPG1000
	10A Circuit Breaker - 115V	MS26574-10	MIL-Spec
	10A Circuit Breaker - 115V	MS3320-10	MIL-Spec
	10A Circuit Breaker - 115V	2TC49-10	MIL-Spec
	10A Circuit Breaker - 230V	W23-X1A1G-10	MIL-Spec
D.9	Connector and Junction Kits	Part No.	Related Document
	Pin Connector Kit - 2 Contact	TCP2598	TN02793 / TN02598
	Socket Connector Kit - 2 Contact	TCS2598	TN02793 / TN02598
	Pin Connector Kit - 3 Contact	TCP2603	TN02793 / TN02598
	Socket Connector Kit - 3 Contact	TCS2603	TN02793 / TN02598
	Junction Kit 3-Lead	TCJ3106	TN03012
	Junction Kit 4-Lead	TCJ3008	TN03012
	Junction Kit 6-Lead	TCJ3012	TN03012
D.10	Contacts (connectors and junctions)	Part No.	Related Document
	Solid Pin Contact (min. order 6)	0460-202-16141	TN02793 / TN03012
	Solid Socket Contact (min. order 6)	0462-201-16141	TN02793 / TN03012

D.11	Elements, Pad Heat	Part No.	Related Document
	Pad Elements (refer to kit-specific TLD)	(vary)	TN02788 / TNDC730
	Standard 6-cylinder sump and crankcase (80W)	TEP2928-	TN02788
	Standard 4-cylinder sump (40W)	TEP2653-	TN02788

D.12	Elements, Threaded Heat (by series)	Part No.	Related Document
	Legacy CHT (3/8-24 x 1-1/4)	TTP2628-	TN02628
	Standard 4 6 & 8-cyl engines (1/4-20 x 1-1/8)	TTP2771-	TN02771
	Metric (M6-1.00 x 25 or 30)	TTP2639-	TN02639
	Dual Probe CHT (heater & grounded J-Type)	TTP2630-J-	TN02630
	Dual Probe CHT (heater & un-grounded J-Type)	TTP2631-UJ-	TN02631
	Dual Probe CHT (heater & grounded K-Type)	TTP2632-K-	TN02632
	Dual Probe CHT (heater & un-grounded K-Type)	TTP2633-UK-	TN02633
	Sump Screen Lyc. 4 6 & 8-cyl (1.0-20 x 1-5/16)	TTP2634-	TN02634
	Sump Screen Lyc. 480/541 (1.0-20 x 15/16)	TTP2842-	TN02634
	Standard SAE Radial & others (5/16-24 x 1)	TTP2845-	TN02905
	Wing sump Aero Commander & others (3/4-16)	TTP2899-	TN02634
	Standard SAE Radial & others (5/16-18 x 1-5/16)	TTP2924-	TN02905
	Metric Coolant Fitting, Austro (M18-1.5)	TTP2996-	TN02634
	Metric (M8-1.25 x 48)	TTP3006-	TN02905
	Standard SAE Radial & others (5/16-18 x 1)	TTP3011-	TN02905
	Sump Screen Lyc. 540/541 (1-1/2-18 x 9/16)	TTP3020-	TN02905
	Sump Fitting (1/2 - NPTF 7/8 hex head)	TTP3038-	TN02634
	Metric (M8-1.25 x 60)	TTP3229-	TN02905

D.13	Firewall and Bulkhead Passthrough Kits	Part No.	Related Document
	Firewall Grommet Kit (Part 23-1191/AC 20-135)	TG01056	TN01056
	Firewall Connector - 6-Contact (MS3450KT14S)	TU03125	03125
	Firewall Connector - 14-Contact (MS3450KT20S)	TU03030	03030
	Bulkhead Connector - 2-Contact (MS3450W12P)	TU03047	03047
	Bulkhead Connector - 2-Contact (MS3450W12S)	TU03398	03398
	Bulkhead Connector - 5-Contact (MS3120F14S)	TU02968	02968
	Bulkhead Connector - 5-Contact (MS3120F14S)	TU03127	03127
	Bulkhead Connector - 5-Contact (MS3470W14S)	TU03362	03362

D.14	Plugs, Receptacles, and Dielectric Grease	Part No.	Related Document
	Circular Plug (inlet) - 115V	TP02770-115	TU02770
	Circular Plug (inlet) - 230V	TP02980-230	TU02770
	Flush Plug Metal (inlet) - 115V	TP02070-M-115	TN02070
	Flush Plug (inlet) - 115V	TP02070-S-115	TN02070
	Flush Plug (inlet) - 230V	TP02839-S-230	TN02070
	Flush Plug w/ Cap (inlet) - 115V	TP02533-T-115	TN02533
	Flush Plug w/ Cap (inlet) - 230V	TP02822-T-230	TN02533
	Circular Receptacle (outlet) - 115V	TP02872-115	TN02829
	Circular Receptacle, Adapter (outlet) - 230V	TP02829-230	TN02829
	Flush Receptacle (outlet) - 115V	TP02873-115	TN02070
	Flush Receptacle w/ Cap (outlet) - 115V	TP02989-115	TN02533
	Flush Receptacle w/ Cap (outlet) - 230V	TP02988-230	TN02533
	Cabin Outlet Kit – 115V	TU03365-115	03366
	Cabin Outlet Kit – 230V	TU03365-230	03366
	Dielectric Grease	TU03126	MIL-S-8660C

D.15	Plug and Light Brackets, Tab, and Doublers	Part No.	Related Document
	Circular Plug Bracket Kit- Cont. 470/520 Sandcast	TU03017	TN03017 / 03017
	Circular Plug Bracket Kit - 4-Cyl. Oil Filler & others	TU01062	TN01062 / 1062
	Circular Plug Bracket Kit - Lyc. 540/541 (Oil Filler)	TU03300	TN03300
	Circular Plug Bracket Kit – Clamp Type	TU03345	TN03345
	Stud Mount Kit (2-ea. use w/ TU03345 and others)	TU03262	03262
	8MM Indicator Light Tab	TU03145	TNG1000
	Flush Plug Bracket Templet (field fab)	TU02581	2581
	Flush Plug Skin Doubler (field fab)	TU02585	2585
	Flush Plug Doubler (used with p/n: TD02840)	TD02838	02838
	Flush Plug Bracket Templet, Airbus (field fab)	TU02898	2595 / 02898

D.16	Plug Door Kits (std door kits)	Part No.	Related Document
	Door Kit - Single Place	TD02840	TN02840 / 02840
	Door Kit - 2 Place	TD03097	TN03097 / 03097
	Door Kit - 2 Place	TD03152	03152

D.17	Switches	Part No.	Related Document
	Door Switch (annunciator circuit)	TU03273	TN03273
	Switch - Power Interruption (20A 115-230V)	MS35059-22	MIL-Spec / 03320

**** NOTHING FOLLOWS ****