



INSTRUCTION – PREHEAT INSTALLATION

Document No.: TNP2904 REV. C

Dated: FEB-09-2017

**TSP9CYL-2904 SERIES PREHEAT KIT
ON**



**Type 9RA Engines
R-985 Wasp Jr.
And
R-1340 Wasp**

PROPRIETARY DATA

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RECORD OF REVISIONS

When updated, this document is changed in its entirety.

REV	DATE	DESCRIPTION	BY	RELEASE
C	FEB-09-2017	Add tank capacity option & expand eligibility	DNE	
B	AUG-01-2016	Connector standardization & options § 3.6	GDO	DNE
A	MAR-28-2016	Initial release	GDO	DNE

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1. PURPOSE

The purpose of this instruction is to provide guidance for the installation of the Tanis Preheat Kit listed on the cover page of this document.

- The kit maybe installed in conjunction with airframe manufacturer's instructions (MM, SB or IPC) when available.
- It is the responsibility of the technician and/or maintenance/repair facility performing the installation to read this instruction, become familiar with all processes and resolve conflicting issues before proceeding.
- Final judgment regarding the proper installation and inspection details are the responsibility of the authority releasing the aircraft for service.
- Contact Tanis engineering for design change approvals.

Note: This instruction is for the installation of both 115 Volt and 230 Volt kits. Letters before and after the 4 digit drawing number are modifiers used for article configuration and maybe omitted in narratives. Example: TEP2653-115/40 = **Tanis Element with a Pin connector (2653) 115-volts / 40-watts.**

2. REQUIREMENTS

Installation, Maintenance, and Operating, Documents listed in Table 1, Section (§) 6.

Installation shall be:

- Accomplished by qualified technician or maintenance/repair facility
- In Accordance With (IAW) current regulatory requirements 14 CFR Part 23 and 33, AC 43.13-1 (as amended) Chapter 11: Routing, securing, tying, and clamping §§ 9 through 12, Grounding and bonding § 15, Wire marking § 16, and feed-through penetrations § 17
- IAW approved procedures set in place by the installing authority, and appropriate manufacturers Maintenance Manuals (MM)
- Performed in a clean environment under standard temperature conditions of 18°C / 65°F to 27°C / 80°F.
- Installation requires clear access to engine and engine oil tank
- Installation times vary due to a wide range of variables
- For global standardization and safety of operations shore power inlet is a non-locking blade type NEMA plug (Figure 2)
- Corresponding receptacle (outlet) connector is required on power extension cord (supplied for field installation with 230-volt kits). Approved outlets - TP02872-115, TP02829-230
- Specific operational requirements or existing equipment may require modifications and/or additional elements, reference section (§) 3.1 for listing of approved options

2.1 Materials

All components used in association with this kit shall be of aeronautical quality: AN, MS, MIL, NAS, NSN, etc.

- Installation requires additional hardware, consumables, finish-materials, brackets, lacing, and various MS21919 cushion clamps (Table 2).

- Pad element bonding sealant is sourced at time of installation for approved sealants reference instruction TN02788

2.2 Tools

Various standard aviation hand tools are required and are not supplied.

Required:

- Ohmmeter certified to traceable standards
- ¼ inch drive torque wrench or equivalent certified to traceable standards
- ¼ drive ½ inch Slotted Socket, TU02905-05 or equivalent

Suggested:

- Wire cutter/stripper
- Deutsch contact remover tool: DT-RT1 or equivalent
- Tanis 4-way indent crimp tool: TU02793
- Alternate crimp tool, DMC: AF8-TH163 or equivalent

2.3 Power

Power supply and shore power connection (extension cord) supplied by operator.

- Ground based power source capable of supplying or producing required voltage and load for duration of operation is required, commonly AC (alternating current)
- System design is for operation at plus or minus 10% of system voltage requirement
- Voltage and load requirements listed § 6, Table 3

3. Standards

All components are to be installed in a manner that allows for proper inspection and maintenance.

- (1) Installation is not to interfere with other systems such as engine or flight controls.
- (2) Wires and cables are to be supported by suitable cable ties, clamps, grommets, or other devices at intervals of not more than 6-inches apart except when contained in ducts or conduits.
- (3) Properly secure wires and cables so movement is restricted to the span between the points of support and not on the connectors.
- (4) Supporting devices should be of a size and type capable of supporting wires and cables securely without damage to insulation.
- (5) Adequately support and secure wire and connectors to prevent excessive movement in areas of high vibration.
- (6) Route wiring and cabling with enough slack to compensate for movement of shock mounts.
- (7) Route cable/wire in a manner that ensures system components are not in close proximity to high heat sources and use fire sleeve to protect wiring and connectors in questionable high heat areas.
- (8) Where practical route wires and cables above fluid lines, 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.

- (9) To compensate for routing options, it is acceptable to service loop, racetrack, shorten or lengthen, wires/cables by cutting and re-terminating with appropriate contacts, splice or connector.
- (10) Check for proper installation of engine to airframe ground strap bonding.
- (11) Modifications and alterations:
 - a. Sheet metal alterations (plug door and bracket installations), AC 43.13-1 (as amended) Chapter 4, Section 4 as needed. Rivet using appropriate rivets. For structural installations, rivet layout shall be patterned after a small patch, similar to Figure 4.16 of AC 43.13-1 (as amended). Assemble wet and seal A/R with PS 870 (PR 1422B-2) or equivalent OEM approved corrosive inhibitor sealant.
 - b. Composites alterations (plug door and bracket installations), follow approved airframe manufacturer procedures and reference AC 43.13-1 (as amended) Chapter 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).
 - c. AV/Cabin Heater installation, AC 43.13-2 (as amended) Chapters 1 and 2 for structural consideration and examples equipment mounting options (mounting is to be consistent with installation methods, techniques and practices for avionic components).

3.1 Options

Approved substitution, modifications, and add-ons:

- Battery Kit TSB2800 - Preconditioning battery reduces battery freeze point depression and allows for higher amperage outputs, proper charge, and increased battery life
- AV/Cabin Heater THP3094-500 - Preconditioning avionics allows for proper glass panel activation, reduces condensation, cold weather induced gyroscopic errors, and helps clear windows of frost, snow and ice
- Cable kits - AV/Cabin Heater and AC Outlet: TC03071, TC03159
- Flush plug - w/cap: TP02533-T-115, TP02822-T-230
- Door kits: TD02840 Single place, TD03097 2-place, or TD03152 2-place
- Circuit protection: Fuse kits - TU03141 or TU03141-B. Breakers - MS26574-10, MS3320-10, or Klaxon 2TC49-10 for 115V, W23-X1A1G-10 for 230V
- Power interruption - Sealed two circuit switch (off / on): MS35059-22 (8822K20)
- Firewall Connector Non-pressurized bulkhead disconnect kits: TU03030 14 pin, TU03125 6 pin (Class KT 5015 crimp type disconnect and bulkheads)
- Firewall Grommet – Non-pressurized firewall and bulkheads feed through kit: TG01056
- Connector disconnect - Non-pressurized kits: TU02968, TU03047, TU03127 (Class W 5015 crimp type disconnect)
- Contact Tanis Aircraft Products for additional options

4. DESCRIPTION


Preconditioning, commonly referred to as preheating, is performed while on the ground prior to flight.

- Increases engine life, reliability, and safety of operations
- Reduces maintenance, torque oscillations, thermal stress, warm up, and launch times
- System is self-regulating, does not operate in flight, and is not connected to or dependent on aircraft systems
- Heated components reach average state of thermal equilibrium in approximately six hours

4.1 Physical Attributes

Heat is applied through electrical resistance elements sized and shaped to fit various parts; Engine cylinder assemblies, accessory and propeller reduction gearboxes, and oil tank. Power is routed to elements through a dedicated shore power plug and wire assembly with power indication and Circuit Protection Device (CPD).

4.2 Operation

 **Caution:** Before connecting system to power after installation or maintenance perform Functional System Check in Section 7 and review Operating Guide (TPG0001).

4.3 Maintenance

Instructions for Continued Airworthiness (TCA0001), lists inspection and cleaning procedures. All processes are IAW aircraft/engine manufacturer's recommendations, and 43.13-1 (as amended) Chapter 11, Sections 1, 3, 4, 8, and 9.

Airworthiness Limitations section of the FAA specifies inspections and other maintenance required by 14 CFR Part 43.16 and 91.403, of the Federal Aviation Regulations unless an alternative program has been approved.

5. INSTALLATION

Referenced Documents, Tables, and Figures, located in § 6.

Note: Cable routing is suggested due to installed equipment and/or operating requirements, final installation may vary.

5.1 Overview

- (1) Review all instructions and documents listed in Table 1.
- (2) Weigh kit contents and intended installation hardware.
- (3) Locate power plug(s), junctions, and elements.
- (4) Route and terminate cabling with reference to cable kit wire diagram.
- (5) Record and retain documents as indicated in Operating Guide and ICA.
- (6) Complete, Functional System Check and Sign Off (§§ 6 and 7).

5.2 Technical Specifications


System and individual element values are listed in Table 3.

5.3 Weight and Balance

Weight kit and all installation hardware before installing.

- Approximate installed weights:
 1. Preheat system weight: 1.5 pounds (lb) / 0.68 Kilograms (Kg), use engine arm for C.G.
 2. Optional Battery heater: 1.0 pounds (lb) / 0.45 Kilograms (Kg), use location as installed for C.G.
 3. Optional AV/heater weight: 1.3 lb. / 0.6 kg, use location as installed for C.G.
- Record installed weight and arm calculation in Table 4 § 6
- New empty weight and corresponding C.G. location shall be calculated and entered into aircraft records

5.4 Elements

 **Caution:** Do not connect elements to power until completing Functional System Check § 7.

Operational requirements or modifications may require additional and/or alternate element(s) reference § 3.1.

- Verify individual element resistance before installing (Table 3)

Threaded fastener elements (Figures 1, 4, and 5):

Locate one in each cylinder head replacing intake tube fastener/bolt and torque using manufactures torque specification for location of installation.

- a) Requires minimum engagement of 11 threads.
- b) DO NOT ALLOW - Element to bottom out or to expose tip beyond three threads.
- c) DO NOT USE - Any type of clamp, lock washer, star washer, or split washer.
- d) DO NOT USE – Stainless steel, nuts, clamps, washers or spacers, of any type.
- e) USE ONLY - Steel or aluminum, nuts, flat washers and/or spacers, as required.
- f) SECURE ELEMENT LEAD - Within 3 inches or less from element, secure using appropriate clamp, cable-tie, or lacing.
- g) Secure with lock wire when required by manufacturer Maintenance Manual.

Pad elements (Figures 1, 4, and 5):

Locate with reference to instruction TN02788.

- a) Only locate using approved sealants.
- b) Elements must be in full contact through bonding sealant.
- c) When installing consider oil drip points, lead orientation, and cable routing.

Qty P/N Pad element location. Reference Figures in § 6.

- 2 TEP2650- Engine oil tank – Locate element(s) below nominal oil level, position leads down and route with oil lines when applicable.

Before locating tank element(s) verify operating capacity and install accordingly:

- a) 3 to 5.9 gallons locate one (1) element.
- b) 6 to 10 gallons locate two (2) elements, distance elements from each other as much as practical (opposite sides of tank).
- c) For installation on tanks outside of listed quantities, contact Tanis Engineering.

- 2 TEP2653- Crankcase element – Locate on lower aft side of crankcase, one left and one right of oil screen housing leads down.
- 1 TEP2653- Oil cooler element – Locate on bottom or side of cooler.
- 1 TEP2653- Scavenger sump element – Locate low on left or right side of scavenger sump near oil drain lead aft.
- 9 TTP2924- Cylinder element – Locate one per cylinder replacing intake fastener.
- * * Optional Battery and AV/Cabin Heaters supplied separately (§ 3.1).

5.5 Cable Routing

Referenced figures and tables located in § 6, drawings and documents listed Table 1.

Routing is suggested - variations in aircraft configuration may require deviation.

- Approved substitution and options listed in § 3.1.
- Leads supplied unterminated, cut, label, and terminate accordingly, reference Cable Kit - Wire Diagram drawing 02903 and § 3.

1. Shore power plug (power inlet) (Figures 2, 8, 9, and 10):

When locating plug consider safety of ground crew and ease of accessibility.

Reference individual component instructions for plug and indicator light (TN02070 and TN03039). Substitution, modifications, and add-ons listed in § 3.1 Options.

Use one of the following:

- a) Left engine cowl - Locate flush plug (supplied) in left side of cowl boot section just forward of firewall. May require field fabricated doubler reference drawing 2585 for example, or equivalent.
- b) Left engine cowl - Locate single door kit TD02840 (add-on supplied separately) and flush plug (supplied) in left side of cowl boot section just forward of firewall.
- c) Pilot side quarter panel - Locate single plug door kit TD02840 or dual plug door kit TD03152 (add-on supplied separately) on airframe in left quarter panel forward of pilot side door jamb (left side, aft of firewall), requires routing through firewall. Dual plug door configuration commonly used with optional AV/Cabin Heater and/or Battery Heat Kits.
- d) Flush plug with cap - Locate flush plug with cap TP02533-T-115 or TP02822-T-230 (substitution supplied separately) in same or similar location as above.
- e) Existing shore power connection – Locate in conjunction with existing bracket, and/or door. Record modification accordingly.
- f) Location and certification determined operator. Record modification accordingly.

Note: 230-Volt kits are supplied with power plug adapter (TP02829-230) for installation on extension cord supplied by the operator installation instructions listed in Table 1.

2. Circuit Protection Device (CPD) TU03141-B (Figures 3 and 10):

Locate CPD (dual fuse kit drawing 03141) near back side of plug in accessible location, on stiffener, or secure with doubler or door using appropriate hardware or rivets. Fuse holders from kit may be located in alternate bracket.

3. Ground:

Bond with plug using plug mounting hardware, or bond to engine or airframe, or use existing ground lug when available.

4. Indicator light TLP3039- (Figures 9 and 10):
Locate in visible location adjacent to plug reference TN03039.
5. Junctions (Figures 3 and 11, and drawing 02903):
Locate with clamps, cable ties, and/or lacing, in area that allows leads to reach corresponding elements.
J-A – Locate on airframe adjacent to plug and CPD, or on engine.
J-B, J-C, and J-D. Locate on engine with ignition harness tubing on backside of engine using mounting points when available.
6. Leads (Figures 1 through 11 and drawing 02903):
01 – Power lead, route from junction J-A through CPD to plug. Suggest installing sealed connectors in lead when plug is located in cowl, refer to Cable Kit - Wire Diagram drawing 02903.
02 – Indicator light lead, route from J-A with lead 01 to light.
03 - Engine junction power lead routed between J-A and J-B.
04 and 05 - Engine junction leads routed between J-B and J-C, J-C and J-D.
06 and 07 – Oil tank element leads routed from J-A to elements with oil line (lead 07 use as required dependent of tank capacity).
08 through 20 – Engine element leads routed from junctions J-B, J-C, and J-D. Route on aft side of engine with ignition leads, intake tubes, and oil lines to corresponding elements (9 threaded fastener elements located cylinder heads, 2 pad elements located on crankcase, and one pad element located on oil cooler).
7. Placard TU02615- (Figures 2, 8, 9, and 10):
Affix near shore power plug (alternately on inside or outside of door). Supplied placard may be substituted with field fabricated placard stating *Tanis Preheat System* and voltage requirement (115 Volt or 230 Volt).
8. Verify all connectors are connected and leads are secure.
9. Complete Functional System Check and Sign Off, §§ 7 and 8.

6. TABLES AND FIGURES

Table 1 - Installation, Maintenance, and Operating, Documents

Note: Record documents as indicated in Operating Guide and ICA.

2585	Drawing - Flush Plug Doubler
02904	Drawing - Preheat Kit Item List (-115 or -230)
02903	Drawing - Cable Kit Wire Diagram
03141	Drawing - Dual Fuse Kit (CPD)
TN02070	Instruction - Flush Plug
TN02788	Instruction - Bonding (elements)
TN02793	Instruction - Connector
TN02829	Instruction - Receptacle (supplied with 230-volt kits)
TN03039	Instruction - Indicator Light - 8mm
TNP2904	Instruction - Preheat Installation (this instruction)
TCA0001	Instructions for Continued Airworthiness (ICA)
TPG0001	Operating Guide

Table 2 - Clamp Reference.

Alternates: MS21919WCH / WCE, sizes vary by manufacturer, size for secure fit.

Size	MS number	Application
1/8"	MS21919WDG-2	1 - 2 wire
1/4"	MS21919WDG-4	2 - 3 wire
5/16"	MS21919WDG-5	8mm Indicator light
5/8"	MS21919WDG-10	2 contact connector
7/8"	MS21919WDG-14	3 contact connector and fused link
1"	MS21919WDG-16	4 lead junction
1 3/16"	MS21919WDG-19	6 lead junction (WCH-18)
1 1/2"	MS21919WDG-24	Circular shore power plug

Table 3 - Technical Specifications

Total preheat system and individual element values +/- 10%.

Note: Oil tank capacity varies, reference § 5.4 Elements.

115-volt kit (1 TEP2650 tank element): 6.4 Amps 730 Watts 18.1 Ohms

115-volt kit (2 TEP2650 tank elements): 7.4 Amps 850 Watts 15.6 Ohms

Qty	Part Number	Location	Wattage	Ohms
1 or 2	TEP2650-115/120	Engine oil tank	120	110.2
4	TEP2653-115/40	Crankcase, oil cooler, and scavenge sump	40	330.6
9	TTP2924-115/50	Cylinders	50	264.5

230-volt kit (1 TEP2650 tank element): 3.2 Amps 730 Watts 72.5 Ohms

230-volt kit (2 TEP2650 tank elements): 3.7 Amps 850 Watts 62.3 Ohms

Qty	Part Number	Location	Wattage	Ohms
1 or 2	TEP2650-230/120	Engine oil tank	120	440.8
4	TEP2653-230/40	Crankcase, oil cooler, and scavenge sump	40	1322.5
9	TTP2924-230/50	Cylinders	50	1058.0

Table 4 - Weight and Balance

Record installed weight, arm, and moment calculations.

For preheat system arm use engine arm, Optional AV/heater use location if installed.

	<i>WEIGHT LB (KG)</i>	<i>ARM IN (CM)</i>	<i>MOMENT IN (CM)</i>	<i>MOMENT WT x ARM/100 IN (CM)</i>
Engine Preheat System	+			
AV Heat Kit (Option)	+			
Battery Heat Kit (Option)	+			

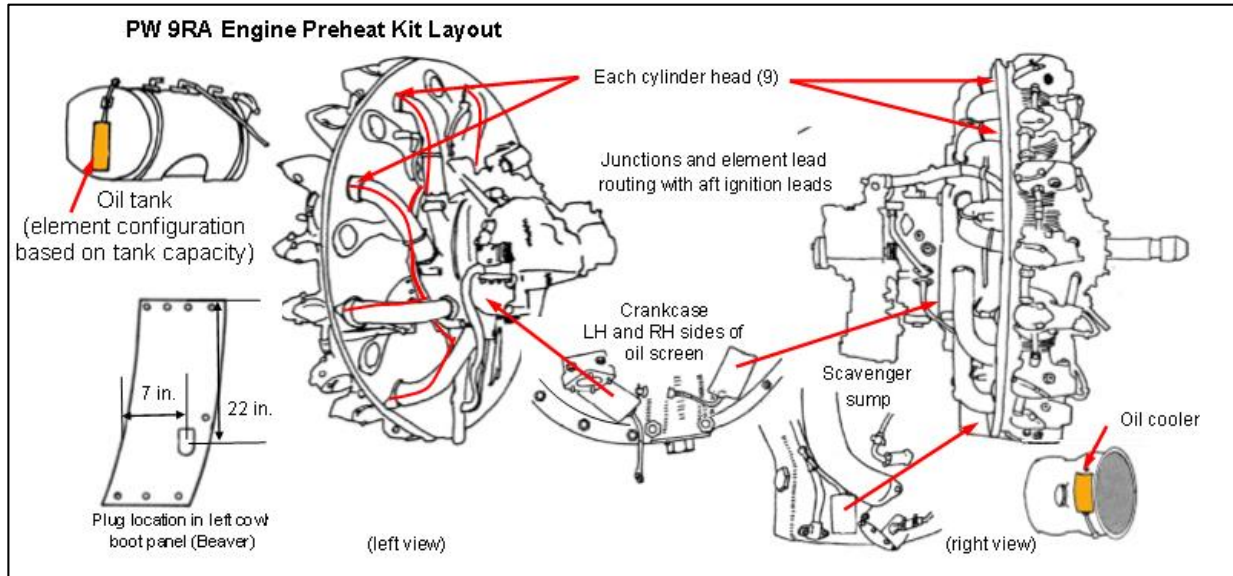


Figure 1 – Preheat kit layout:

Plug, CPC, and indicator light, commonly located in left cowl or quarter panel forward of pilot door, location to be determined by operator. Junctions and lead routing with rear cylinder ignition leads.

AV/Cabin and Battery Heaters supplied separately (reference Options § 3.1).

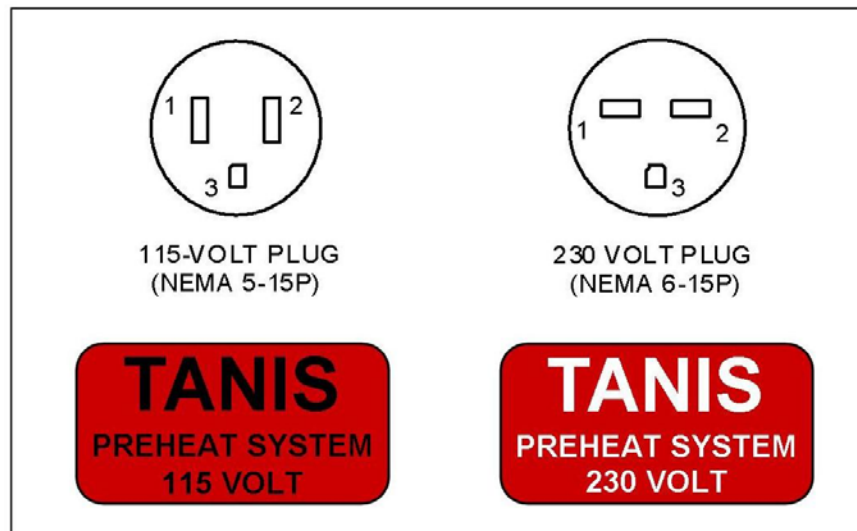


Figure 2 - Plugs and placards. Locate supplied placard near shore power plug, or on inside or outside of door. Alternate field fabricated placard with *Tanis Preheat* and voltage requirement (115 Volt or 230 Volt) may be used.

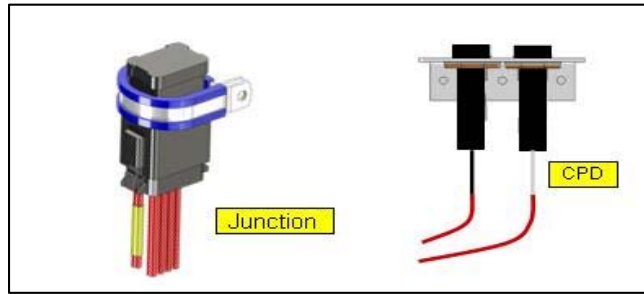


Figure 3 – Example of clamp positioning on junction, and CPD (Circuit Protection Device) TU03141-B dual fuse kit with bracket. When locating CPD secure in accessible location near backside of plug.



Figure 4 – Example of threaded fastener and pad heat elements.

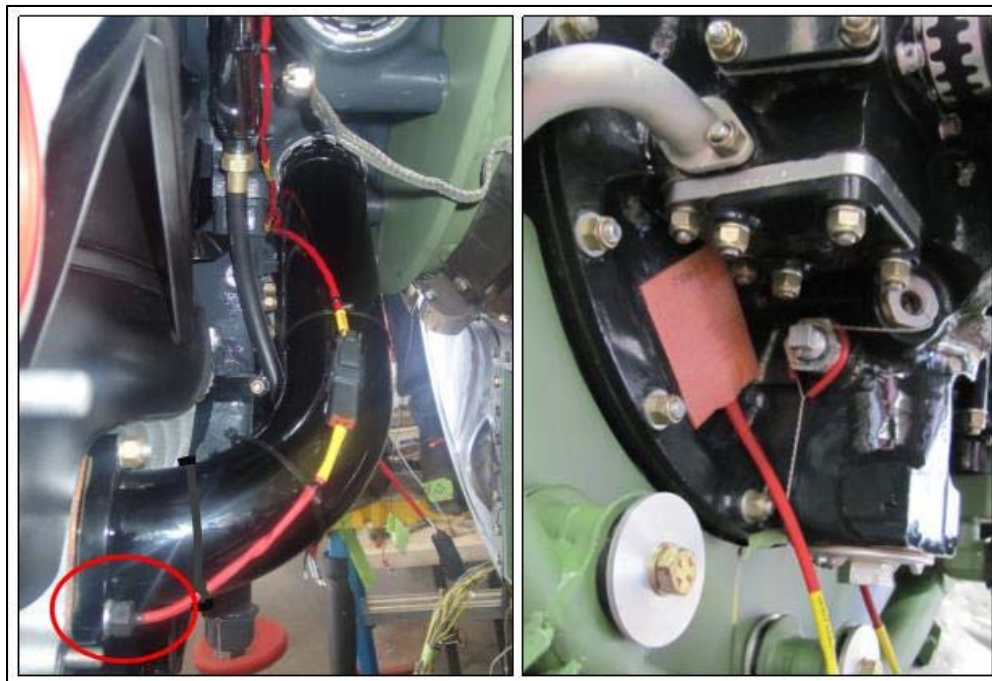


Figure 5 – Cylinder head and crankcase elements:

Cylinder assembly - Locate nine (9) TTP2924- threaded fastener elements, one per cylinder head, replacing one intake tube bolt, use only flat washer, verify element does not bottom out, and torque to factory spec for location of installation.

Crankcase – Locate two (2) TEP2653- pad elements on aft side of crankcase, common location shown, one left and one right of oil screen leads down.

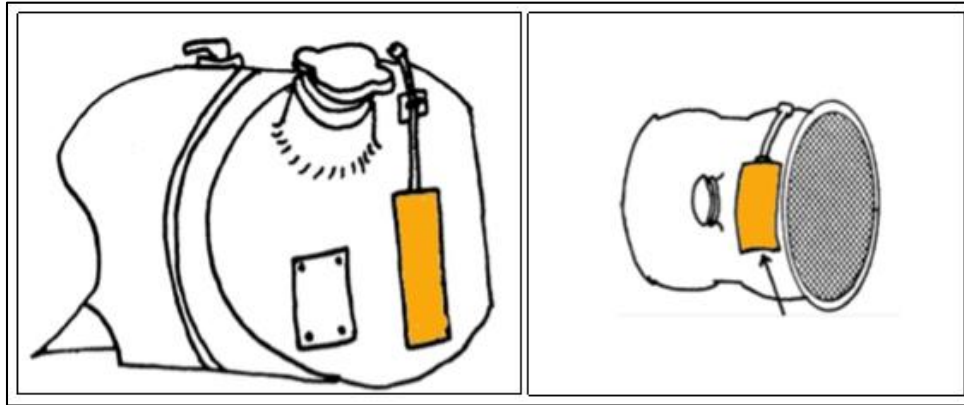


Figure 6 – Oil tank and oil cooler elements:

Note: Tank and cooler configurations vary, locate elements accordingly.

Oil tank element(s) TEP2650- Locate on tank (not on tank overlay bracket) below nominal oil level position lead(s) for routing with oil lines when applicable.

Note: Verify tank oil capacity and locate 1 or 2 elements:

- a) 3 to 5.9-gallon tank - Locate one (1) element.
- b) 6 to 10-gallon tank - Locate two (2) elements, distance elements from each other as much as practical (locate below nominal level opposite sides or ends of tank).
- c) For installation on tanks outside of listed quantities, contact Tanis Engineering.

Oil cooler element TEP2653- Locate on bottom of cooler and position for lead routing with oil line or other structure.



Figure 7 – Option: Example of battery heat kit TSB2800 (not supplied). Configure kit with reference drawing 02800 (Options § 3.1).

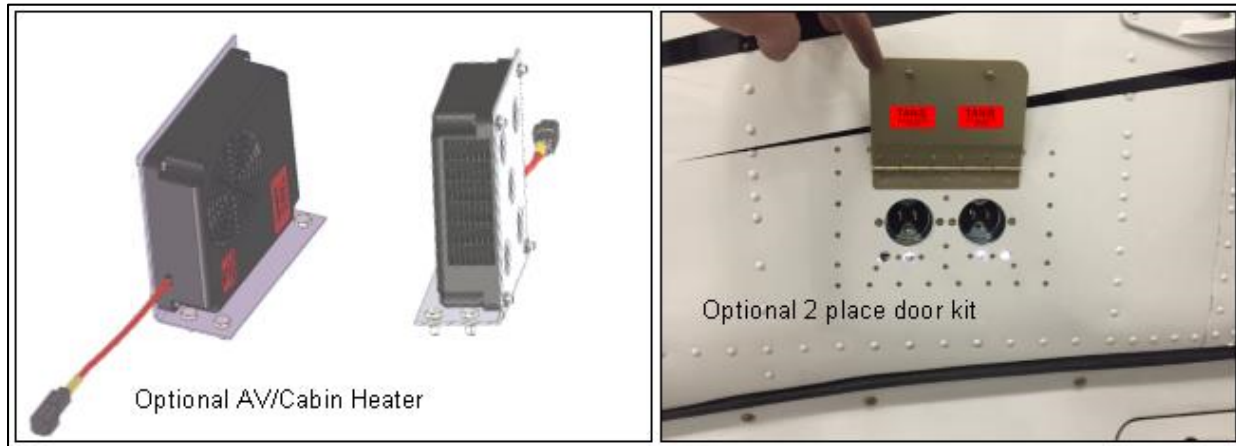


Figure 8 – Option: Example of AV/Cabin Heater THP3094-500 and dual plug door TD03152 (not supplied). AV heater for permanent installation or temporary seasonal use. 2 place door kit installed in place of single place, second plug powers AV heater and interior AC outlet, reference drawing 03159 (Options § 3.1).

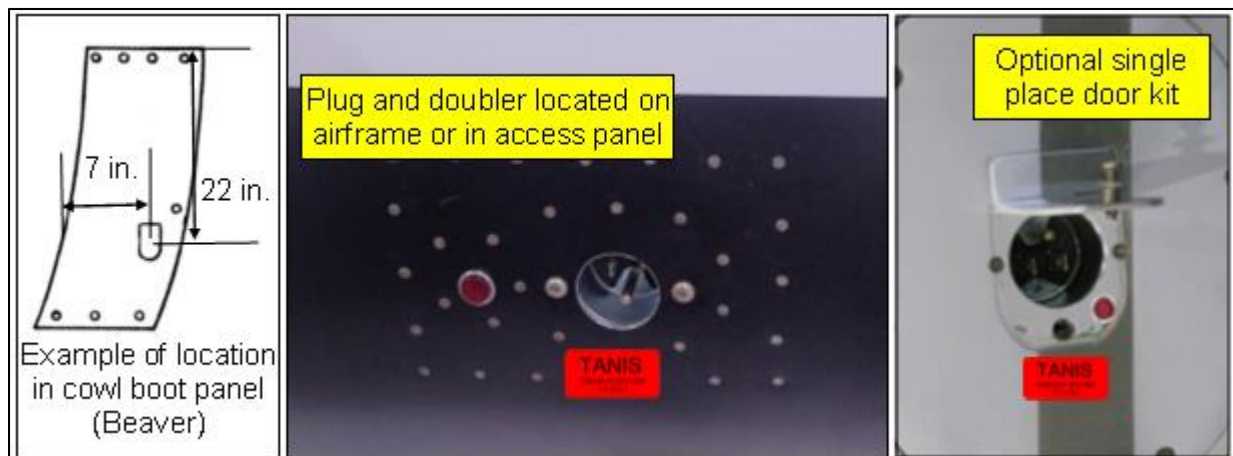


Figure 9 – Shore power plug: Locate supplied shore power plug on left side of aircraft, suggested location is just forward of firewall in boot section of left engine cowl, or just aft of firewall in quarter panel forward of pilot side door jamb. Image on left depicts optional single place door kit TD02840 (supplied separately). When locating plug consider safety of ground crew and ease of accessibility. Optional plug and plug door listed in § 3.1.

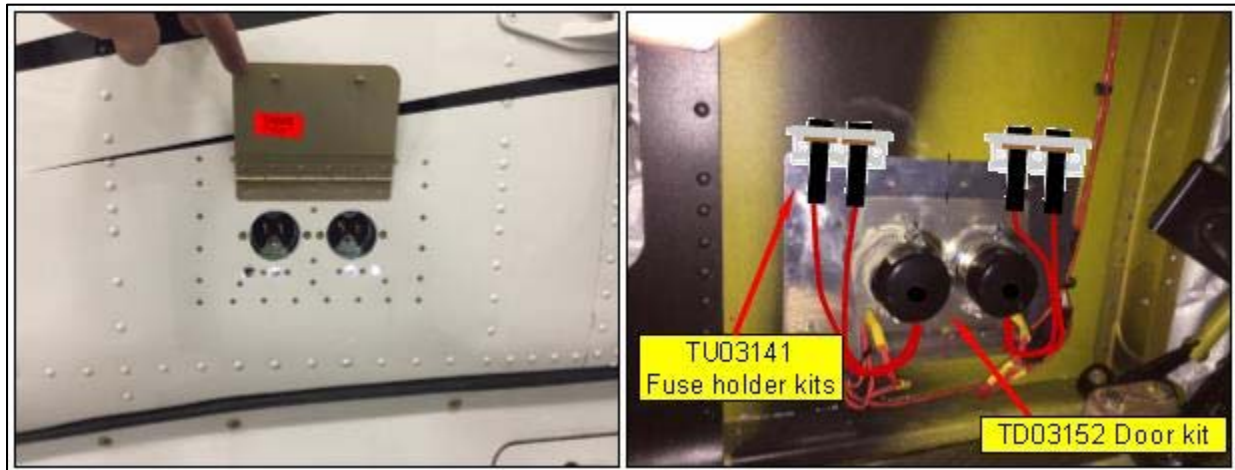


Figure 10 – Option: Example of optional 2-place plug door kit (TD03152 supplied separately). Suggested location for dual plug door is in left quarter panel just aft of firewall and forward of pilot side door jamb. Forward (left) plug powers engine kit and aft (right) plug powers optional AV/Cabin Heater.



Figure 11 – Examples for locating junctions and lead routing. Locate junctions on aft side of engine, secure with clamps, cable-ties, and/or lacing. Route leads between intake tubes and cylinder bases with ignition leads, individual element leads route on intake tube parallel to primer lines to cylinder head elements, and oil lines to oil tank and cooler elements.

7. FUNCTIONAL SYSTEM CHECK



Caution: Contact with hot element can cause 2nd degree burns.

- Ohmmeter certified to traceable standards required for the following checks.
- Before proceeding, verify system is not powered or connected to a power source.
- Review Operating Guide TPG0001
- Follow in sequence, record as indicated, and check off when completed.
- If a discrepancy is found, correct before proceeding to the next step.

[✓] Check as follows:

- 1) [] Verify installation is in accordance with kit installation instructions and element bonding sealant is cured.
- 2) [] Verify effected component fluid levels are at operational levels.
- 3) [] Verify engine and gearbox bonding (ground straps) are per OEM requirements.
- 4) [] Verify continuity between shore power plug ground pin 3 (Figure 2), engine, and airframe.
- 5) [] Verify there is no continuity between ground pin 3 and blades 1 or 2.
- 6) [] Measure resistance between blades 1 and 2 and record: _____.
- 7) [] Compare resistance figures recorded in steps 6 and 7 with values in Table 3.
- 8) [] Connect system to power (Plug-It-In).
- 9) [] Verify power indicator light is on (illuminated).
- 10) [] Within 30-minutes area adjacent to elements will start to feel warm. Check each element individually.
- 11) [] While system is warming up - freeze (0°C) battery thermal control - test battery heat element for heat. Element can be touched, as wattage density is low.
- 12) [] Complete/fill-in blanks as indicated on first and last pages of Operating Guide listed in Table 1, and file with POH/FM.
- 13) [] Complete/fill-in blanks as indicated in Instructions for Continued Airworthiness (ICA) listed in Table 1, and file with aircraft manuals and logs.
- 14) [] Update aircraft Weight and Balance (recorded in Table 4) and Equipment List.
- 15) [] Make a log entry to comply with 14 CFR Part 43.9 or other procedures set in place by the operator.
- 16) [] Complete and return Registration/Warranty Card and Sign Off § 8.

8. SIGN OFF

The undersigned found the system installed and operating correctly.

Date: ____ / ____ / ____

Preheat Kit

Part Number: _____

Serial Number: _____

Airframe

Manufacturer: _____

Model: _____

Serial Number: _____

Registration: _____

Engine

Manufacturer: _____

Model: _____

Serial Number: _____

System test performed by: _____

(Signature)

(Printed name, title and certificate number, if applicable)

***** NOTHING FOLLOWS *****