# CHAPTER 33

# ELECTRICAL SYSTEM

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# CHAPTER 33

# ELECTRICAL SYSTEM

## 33-00 Description

**CAUTION**

The installation of electrical devices can affect the accuracy and reliability of the electronic tachometer.

The electrical system includes a 14-volt, 60 ampere alternator (standard, 70 ampere optional), battery relay, alternator control unit and 14-volt battery.

The battery is in a fiberglass container normally located on the lower left steel tube frame. An optional location is in the nose under the upper console. Some R22 HP models may have the battery in the left-seat baggage compartment.

Circuit breakers are located on the ledge just forward of the forward left seat. The breakers are marked to indicate their function and amperage and are of the push-to-reset type.

The master battery switch, located on the console, controls the battery relay which disconnects the battery from all circuits except the tachometer and the clock. The tachometer and clock receive power directly from the battery via a Clutch switch terminal.

The alternator control unit (ACU) senses system voltage at the ammeter shunt via a remote sense wire. The ACU has three functions: it regulates alternator output voltage to maintain a battery voltage of 13.4–13.9 volts, warns of low-voltage by illuminating the ALT warning light if voltage decreases to 12.55–12.95 volts, and protects against over-voltage by shutting off alternator field if voltage increases to 15.75–16.25 volts.

The clutch actuator circuit incorporates a low-amperage fuse, in addition to its circuit breaker, to prevent a motor overload from tripping the circuit breaker and turning off the clutch light prematurely.

The lighting system includes the anti-collision light, navigation lights, landing lights, post and internal lights for the instruments and an overhead map light. Landing lights are wired through the clutch switch, turning the lights off when the clutch switch is disengaged. Warning lights on the instrument panel include clutch, low oil pressure, low fuel, main rotor and tail rotor gearbox chip lights, main rotor gearbox over-temp, low rotor RPM light, low voltage, rotor brake (if installed), governor off and starter on.

The gage cluster includes an ammeter and oil pressure, oil temperature, cylinder head temperature, and main and auxiliary fuel quantity gages. Included on the gages circuit are the carburetor air temperature and outside air temperature gages. The map light is also on the gages circuit as a “back-up” in the event of a short and failure of the lighting circuit.

33-00 Description (continued)

The tachometer is an electronic engine and rotor dual tachometer. The sensor for the engine tach is breaker points in the magneto on the left side of the helicopter. A Hall Effect sensor for the rotor tachometer senses the passage of two magnets on the main rotor gearbox input yoke. The signals from these sensors are conditioned by solid state circuits inside the dual tachometer. Each tachometer circuit has a separate circuit breaker and is completely independent of the other. They can be powered by either the alternator or the battery and receive current from two redundant sources. Power to the tachometer is interrupted only when the master battery and alternator switches are off and the clutch switch is disengaged.

33-10 Battery

NOTE

Refer to Concorde Battery Corporation's Owner/Operator's Manual, and Instruction for Continued Airworthiness for battery maintenance procedures.

**CAUTION**

To minimize risk of electrical discharge: When disconnecting battery, disconnect negative (ground) cable from battery first, then the positive cable. When connecting battery, connect positive cable to battery first, then the negative (ground) cable.

**A. Disconnecting Battery**

1. Verify battery switch is off.
   a. Aft Battery: Remove engine left side skirt, as required. Remove cotter rings and wing nuts to release rods attaching battery box assembly to lower frames. Remove cover.
   b. Nose battery: Open upper console and remove battery box cover.
2. Remove hardware securing negative (ground) cable to battery negative terminal.
3. Remove hardware securing positive cable to battery positive terminal.

**B. Removing and Installing Battery**

If removing battery, disconnect battery per Part A, and carefully remove battery. If installing battery, position battery in battery box, and connect battery per Part C.

**C. Connecting Battery**

1. Verify battery switch is off.
2. Connect battery cables. Special torque terminal bolts as noted on battery label and torque stripe per Figure 2-1.
3. Install cover.
   a. Aft Battery: Install wing nuts and cotter rings to secure rods attaching battery box assembly to lower frames. Verify security. Install engine left side skirt, if removed.
   b. Nose battery: Secure upper console.

## 33-20 Clutch Actuator

After the engine is started, it is coupled to the rotor drive system through vee-belts which are tensioned by raising the upper drive sheave. An electric actuator, located between the drive sheaves, raises the upper sheave when the pilot engages the clutch switch. The actuator senses compressive load (belt tension) and switches off when the vee-belts are properly tensioned. The clutch caution light illuminates whenever the actuator circuit is energized, either engaging, disengaging, or re-tensioning the belts. The light stays on until the belts are properly tensioned or completely disengaged.

Belt slack during engine start should be adjusted such that blades begin turning within five seconds of clutch engagement. Excessive slack may cause belts to jump out of sheave grooves during start. Periodic readjustment by a mechanic may be required as belts wear in service.

A fuse located on or near the test switch panel prevents an actuator motor overload from tripping the circuit breaker. If the fuse blows, the actuator motor will stop but the clutch caution light will remain illuminated. An open circuit breaker removes power from both the motor and the light. With an open circuit breaker, no belt tensioning will occur, and the light will not function to indicate an abnormal condition.

**CAUTION**

Never take off while clutch caution light is on.

## 33-30 Lighting System

A red anti-collision light is installed on the tailcone and is controlled by the strobe switch. Position lights are installed on each side of the cabin and in the tail and are controlled by the nav lights switch. Post and internal lights (earlier aircraft) or a light at the top of the windshield (later aircraft) illuminate the instruments. Instrument lighting is active when the nav lights switch is on and lighting is dimmed via the knob above the nav lights switch. An overhead map light mounted on a swivel is controlled by an adjacent switch. The map light may be used for emergency lighting of the instrument panel.

Two landing lights are installed in the nose at different vertical angles to increase the lighted area. One landing light switch controls both lights and is located on the cyclic center post.

NOTE

Landing lights operate only when clutch actuator switch is in the engage position.

NOTE

Continuous operation of landing and position lights in flight is recommended to promote collision avoidance.

## 33-40 Audio System

A voice-activated intercom/audio system is standard and is controlled by a small control panel above the avionics stack. The ICS volume knob controls intercom volume but does not affect radio volume. The VOX squelch knob is used to set the threshold volume at which the intercom is activated. When the VOX knob is turned fully clockwise, keying is required to activate the intercom. Later intercom systems include a music input jack located on the circuit breaker panel. This input is muted when the intercom is active, when transmitting, and during reception of radio signals.

Headset jacks are located in the ceiling near each seat. The cyclic grips are equipped with either transmit and intercom buttons or trigger-style intercom/transmit switches. For the trigger-style switch, the first detent activates the intercom and the second detent transmits. An additional intercom button is located on the left-hand floor or seat support.

Earlier R22s are equipped with an intercom system that operates in either push-to-talk (PTT) or hot mic modes. A toggle switch to the left of the cyclic center post is used to change modes. In PTT mode, the intercom is activated using the intercom buttons.

Audio control panels from several manufacturers are offered as options in place of the standard intercom system. Pilots should consult the manufacturer's operating instructions if an audio panel is installed.

## 33-50 Dual Tachometer

An electronic engine and rotor dual tachometer is standard. Engine tachometer signal is provided by magneto breaker points. Rotor tachometer signal is provided by two magnetic senders at the main gearbox drive yoke. Each tachometer is on a separate circuit with its own circuit breaker. With battery and alternator switches off, the tachometers continue to receive power from the battery through a bypass circuit as long as the clutch actuator switch is in the engage position.

> NOTE
>
> Do not stow helicopter with clutch switch engaged. The tachometers are powered with the clutch engaged and will discharge the battery.

### A. Adjustment

1. The early model A792-1 Dual Tachometer is pre-set at the factory and is not adjustable in the field. For repair or adjustment, the unit must be returned to Robinson Helicopter. (No adjustment screw on early models.)
2. The A792-2 Dual Tachometer is pre-set at the factory. Slight variations between rotorcraft may require readjustment of rotor side of tachometer. To adjust tachometer:
    a. Remove screws that fasten instrument face panel to upper console and carefully pull panel aft.
    b. Ground run helicopter at 104% indication on the engine tachometer. Adjust the rotor tachometer to read 104%. On back of tachometer, turn the adjustment screw clockwise to increase and counter-clockwise to decrease rotor tachometer indication (1/8 turn changes indication approximate 1%).
    c. Reinstall instrument panel.
    d. If tachometer cannot be adjusted, replace or return to Robinson Helicopter Company for repair.

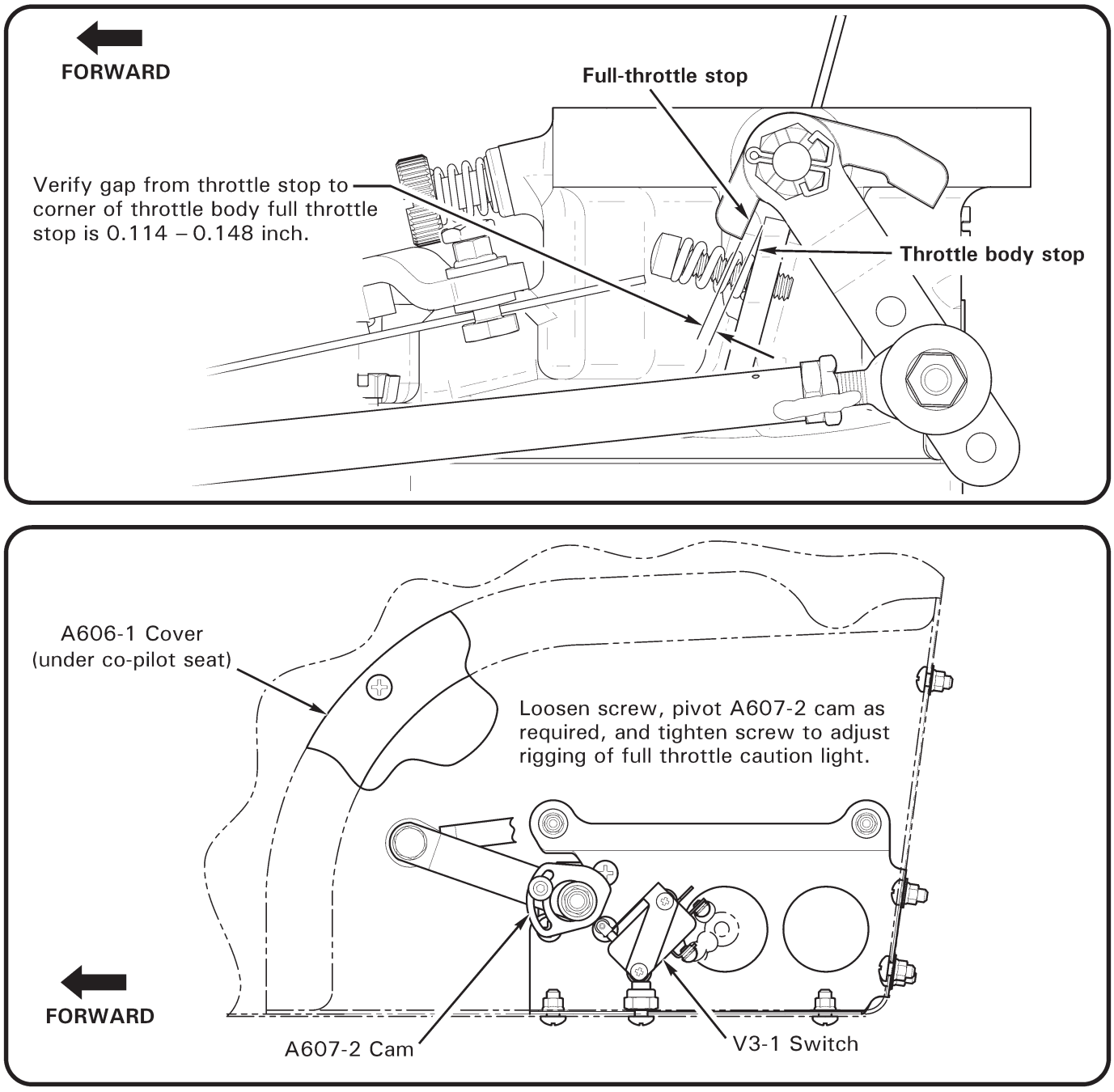


FIGURE 33-1 FULL THROTTLE CAUTION LIGHT RIGGING CHECK

## 33-60 Warning and Caution Lights

Warning and caution lights include clutch, main gearbox over-temperature, main and tail gearbox chip, starter on (later aircraft), low fuel, low RPM, alternator, low oil pressure, rotor brake, governor off, carbon monoxide (aircraft with cabin heater), and full throttle (later aircraft). The clutch light indicates that the clutch actuator is operating. The low RPM light and horn indicate rotor RPM at 97% or below. The low oil pressure and low fuel lights are actuated by sensors in those systems and are independent of the gage indicators. The alternator light warns of a possible alternator failure. The governor-off light indicates the RPM governor is switched off.

The main and tail gearbox chip detectors are magnetic devices located in the drain plug of each gearbox. When metallic particles are drawn to the magnets they close an electrical circuit, illuminating the caution light. Metal particles may be caused by a failing bearing or gear, thus giving warning of impending gearbox failure. The main gearbox over-temp light is actuated by a temperature switch located near the input pinion.

The carbon monoxide light is actuated by a sensor above the pilot's heater outlet and indicates elevated cab in carbon monoxide levels.

The full throttle light is activated by a switch in the throttle linkage and indicates that the engine is near full throttle.

### A. Full Throttle Caution Light

1. Rigging Check

   a. Turn fuel shut-off valve off.

   b. Turn battery switch on. Raise collective full up and slowly rotate twist grip open until full throttle caution light just illuminates.

   c. Refer to Figure 33-1. Verify gap from throttle stop to corner of throttle body full-throttle stop is 0.114–0.148 inch. Adjust as required per step 2.

   d. Lower collective & turn battery switch off. Turn fuel shut-off valve on.

2. Switch Adjustment

   a. Refer to Figure 33-1. Raise collective full up, rotate (throttle) twist grip as required, loosen screw, and pivot A607-2 slotted cam (in throttle linkage, under co-pilot seat) so V3-1 switch activates when throttle stop is approximately 0.130 inch from corner of throttle body full-throttle stop. Tighten screw.

   b. Perform rigging check per step 1.

## 33-70 Carbon Monoxide Detector

The carbon monoxide (CO) detector, if installed, indicates elevated cabin CO levels. CO is an odorless, toxic gas present in engine exhaust which causes headaches, drowsiness, and possible loss of consciousness. CO levels may become elevated due to an exhaust leak or exhaust recirculation during prolonged hovering.

The CO detector system consists of a sensor above the pilot's heater outlet and a caution light. A system check (light flashes twice) is performed each time power is switched on. A sensor malfunction is indicated by a continuing flash every four seconds.

If the caution light illuminates, shut off heater and open nose and door vents as required to ventilate the cabin. If hovering, land or transition to forward flight. If symptoms of CO poisoning (headache, drowsiness, dizziness) accompany caution light, land immediately. Have exhaust system inspected before next flight.

Many chemicals can damage the CO sensor. Avoid use of solvents, detergents, or aerosol sprays near the sensor. Temporarily tape off openings in top and bottom of sensor housing when cleaning cabin interior.

## 33-80 Emergency Locator Transmitter (ELT)

The Emergency Locator Transmitter (ELT) installation consists of a transmitter with internal battery pack, an external antenna, and a remote switch/annunciator. The transmitter is mounted to the upper steel tube frame and is accessible through the aft, upper cowl door. The remote switch/annunciator is located left of the cyclic stick.

The ELT is operated by a switch on the transmitter and a remote switch in the cockpit. The transmitter switch has been secured in the AUTO or ARM position at installation and should always be in this position for flight. The remote switch/annunciator is a three position switch with indicator light. This switch should also be in the AUTO or ARMED (middle) position for flight. With both switches set to AUTO/ARM, the ELT will begin transmitting when subjected to a high "G" load. When the unit is transmitting, the red indicator light illuminates.

Moving the remote switch to ON activates the transmitter. Use the ON position if an emergency landing is imminent and time permits.

If the ELT is inadvertently activated, use the RESET position of the remote switch to stop transmission and reset the unit. The red indicator will extinguish when unit is reset.

| NOTE |
| --- |
| Earlier aircraft may have ELT installations without remote switch. |

For more detailed instructions on ELT operation, maintenance, and required tests, refer to manufacturer's instructions supplied with the unit.

## 33-90 Low Rotor RPM Warning System

### A. Horn Adjustment

When the collective is raised 0.2 to 0.4 inches (measured at grip) above fully down, the low-rotor RPM warning unit must activate the low-rpm warning horn and low-rpm light at 97% to 96% rotor RPM; horn and light must turn off above 96% to 97% rotor RPM.

The low rotor RPM warning unit is inside the upper console mounted on the left vertical panel. Some older helicopters may mount the unit on the right side, or ty-rapped to upper console's main wire bundle. Adjustments are made by turning an exposed screw on warning unit, accessible by removing a black-plastic plug from a 3/8-inch diameter hole on the left vertical panel. The A569-1 warning unit's (potted circuit board type) adjustment screw sensitivity is approximately 1/16 turn per 1% change. The A569-5 warning unit's (metal box type) adjustment screw sensitivity is approximately 2 turns per 1% change. If warning unit cannot be adjusted to above values it must be replaced.

## 33-100 Alternator Output Voltage Adjustment without A942-1

To check or adjust the output voltage:

1. Connect a voltmeter to "I" terminal of voltage regulator and ground with helicopter running and read voltage (13.2 to 13.8 volts).
2. Output voltage may be adjusted using range screw on voltage regulator.

## 33-110 Troubleshooting

### A. A569-5 Low Rotor RPM Warning Unit

Perform following tests prior to replacing A569-5 low rotor-rpm warning unit:

1. Verify:
   a. Low RPM light bulb is functional.
   b. Master switch off.
   c. Full-down collective.
   d. Horn circuit breaker in.
2. Access and disconnect both horn and A569-5 low rotor-rpm warning unit from airframe electrical wiring.
3. Turn Master switch on and verify Horn circuit breaker remains in. If Horn circuit breaker pops then -70 wire is shorted to ground; repair as required. Turn Master switch off.
4. On the warning unit's airframe electrical connector, install a jumper between wires -70 & -75.
5. Turn Master switch on and verify Horn Start circuit breaker remains in. If Horn Start circuit breaker pops then a short-to-ground exists in -75 wire and/or collective activated V3-1 switch; repair as required.
6. Fully raise collective and verify Horn Start circuit breaker remains in and Low RPM light illuminates. If Horn Start circuit breaker pops then a short-to-ground exists in -76 wire and/or -78 wire and/or collective-activated V3-1 switch; repair as required. If Low RPM light does not illuminate then collective-activated V3-1 switch is faulty or mis-adjusted and/or an open exists in -70, -75, or -76 wires.
7. Slowly raise and lower collective fully several times while simultaneously manipulating throttle. Verify Horn Start circuit breaker remains in and Low RPM light remains illuminated whenever collective is raised. If Horn Start circuit breaker pops then a short-to-ground condition is occurring in -70, -75, or -76 wires and/or collective-activated V3-1 switch due to collective movement. Check for pinched/rubbing wiring and repair as required.
8. Turn Master switch off. Connect horn to airframe wiring.

33-110 Troubleshooting (continued)

**A. A569-5 Low Rotor RPM Warning Unit (continued)**

9. Turn Master switch on. Raise collective and verify horn activates and has consistent tone. If Horn Start circuit breaker pops then horn is faulty and/or -78 wire is shorted to ground; repair as required. If horn fails to activate then -79 wire is open or horn is faulty; repair as required. If tone is inconsistent then horn is faulty and/or poor connections exist; repair as required.

10. If A569-5 warning unit has starter lockout circuit enabled (warning unit's 9-pin connector plugged into airframe harness), also perform following steps:

11. Check A999-1 master radio relay current draw:

    a. Master switch off and belt tension actuator fully disengaged.
    b. Disconnect A569-5 low-rpm warning unit's 9-pin connector and place an ammeter in series (positive lead on pin 7) between pins 7 and 8 on airframe side of connector.
    c. Master switch on, Horn Start and Clutch Start circuit breakers in, avionics off, rotor brake released, mixture at idle cut-off.
    d. Select key switch to Start position and crank engine. Note and record current draw at ammeter while cranking engine. Select key switch to Off position.
    e. Disconnect 582 wire at tab on starter solenoid and isolate connector (do not let it ground). Select key switch to Start position. Note and record current draw at ammeter; current should be 94-156 milliamps and a buzzing sound should be heard from the starter vibrator. Select key switch to Off position.

12. Check starter circuit:

    a. Master switch off and belt tension actuator fully disengaged.
    b. Disconnect A569-5 low-rpm warning unit's 9-pin connector and jump pins 7 and 8 on airframe side of connector.
    c. Master switch on, Horn Start and Clutch Start circuit breakers in, rotor brake released, mixture at idle cut-off.
    d. Select key switch to Start position and crank engine. If engine does not crank there is a problem in the starter circuit. If engine cranks then there is a problem in either the A569-5 unit or the sense circuit.

33-110 Troubleshooting (continued)

**A. A569-5 Low Rotor RPM Warning Unit (continued)**

13. Check A596-5 sense circuit:

    a. Master Switch on.
    b. Momentarily engage clutch and verify Clutch light illuminates then disengage clutch completely.
    c. Master switch off.
    d. Disconnect A051-1 actuator's black four-pin connector. Ground airframe-side plug's pin 1 thru a #330 (post light type) lamp.

    **CAUTION**

    Failure to ground pin 1 thru a #330 lamp (such as direct grounding) may result in wiring damage.

    e. Verify less than 200 ohms (20 ohm nominal) to ground at pin 4 and at pin 5 on ship side of A569-5's 9-pin connector.
    f. Master switch on.
    g. With A569-5 unit connected to airframe harness, verify voltage does not exceed 0.5V from pin 4 to ground and from pin 5 to ground.
    h. Master switch on, Horn Start and Clutch Start circuit breakers in, rotor brake released, mixture at idle cut-off.
    i. Select key switch to Start position and crank engine. Failure of engine to crank indicates problem in A569-5 unit.

14. Upon successful completion of preceding tests the A569-5 low rotor-rpm warning unit may be replaced and adjusted per § 33-90.

33-110 Troubleshooting (continued)

**B. General**

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| No electrical power | Battery terminals corroded | Clean terminals. |
| | Bad or no ground | Clean ground path. |
| | Tripped circuit breaker | Check circuit, if circuit checks ok, reset circuit breaker. |
| | Low battery voltage | Check battery. Recharge if necessary. |
| | Low or no alternator output | Check alternator belt tension, wiring, and alternator control unit. |
| | Bad wire or terminal | Replace. |
| Engine cranks slowly, but will not start | Low battery voltage | Service or replace battery. |
| | Insufficient drive belt deflection | Adjust actuator down-limit screw. |
| | Corroded or dirty battery or starter terminals | Clean terminals. |
| | Bad starter relay, wires or terminals | Replace defective parts. |
| Engine cranks but will not start | Bad ignition switch | Replace switch. |
| | Bad starting vibrator | Repair or replace vibrator. |
| | Incorrect retard timing | Adjust retard magneto internal timing. |
| Starter fails to operate | Rotor brake engaged | Release rotor brake. |
| | Low battery charge | Check and recharge if necessary. |
| | Circuit breakers tripped | Reset both HORN START and CLUTCH START circuit breakers. |
| | Actuator not fully disengaged | Engage actuator momentarily, then fully disengage. |
| | Loose connections | Check all wiring (refer to wiring diagram). |
| | Defective wiring | Check all wiring (refer to wiring diagram). |
| | Starter motor - burned winding or bad brushes | Repair or replace starter. |

33-110 Troubleshooting (continued)

**B. General (continued)**

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| Discharged battery | Battery worn out | Replace |
| | Charging rate not set correctly | Reset |
| | Standing too long | Remove and recharge battery |
| | Equipment left on accidentally | Remove and recharge battery |
| Starter - Low cranking speed | Same electrical causes as listed under “starter fails to operate” | Same remedies as listed under ”starter fails to operate” |
| Battery life is short | Impurities in electrolyte | Replace battery |
| | Low charging rate | Adjust voltage regulator |
| Battery runs out of electrolyte | Too much water added to battery and charging rate too high | Drain and keep battery at proper level and adjust voltage regulator |
| Excessive corrosion inside container | Spillage from overfilling | Use care in adding water |
| | Vent lines leaking or clogged | Repair or clean |
| | Charging rate too high | Adjust voltage regulator |
| Battery consumes excessive water | Charging rate too high (if in all cells) | Correct charging rate |
| Alternator fails to supply charging current with engine operating | Alternator defective | Replace |
| | Voltage regulator defective | Replace |
| | Overvoltage relay defective | Replace |
| | Alternator switch defective | Replace |

33-110 Troubleshooting (continued)

**B. General (continued)**

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| Starter kicks back while cranking; may cause broken starter or starter ring gear | Retard breaker contact in engine left magneto pushed out or no connection between lead and magneto contact | Measure retard breaker lead connection. Must be 0.609 in. ± 0.10 in. There must be a small amount of springback which into magneto. |
| | Incorrect ignition vibrator wiring | Trace ignition vibrator wiring from ignition switch to magneto. Correct as required. |
| | Bad ignition switch (See RHC Service Letter R22 SL-29) | Replace ignition switch |
| | Bad ignition vibrator | Replace vibrator |
| | Incorrect internal magneto retard breaker timing. Engine left magneto | Correct as required. Consult TCM Aircraft Products literature. |
| | Impulse coupling starting assist | Replace impulse coupling with ignition vibrator starting assist. RHC KI-4. |

33-110 Troubleshooting (continued)

## C. Clutch Actuator Electrical Troubleshooting

| TROUBLE | CLUTCH LIGHT | | PROBABLE CAUSE |
|---|---|---|---|
| | ON | OFF | |
| Disengaged actuator will not engage | X | | Motor assembly seized |
| | X | | Motor fuse blown (1½-amp) |
| | X | | Open circuit in motor wiring |
| | X | | Overtravel switch assembly tripped |
| | | X | No voltage at circuit breaker |
| | | X | Circuit breaker tripped |
| | | X | Spring switch open (normally closed) |
| | | X | -88 wire not grounded |
| Engaged actuator will not disengage | X | | Motor assembly seized |
| | X | | Motor fuse blown (1½-amp) |
| | X | | Open circuit in motor wiring |
| | X | | Overtravel switch assembly tripped |
| | | X | No voltage at circuit breaker |
| | | X | Circuit breaker tripped |
| | | X | Up limit switch stuck (normally closed) |
| | | X | -88 wire not grounded |
| Clutch light flickers in flight | | | Actuator column spring uncalibrated |
| | | | A190 drive belts mismatched |
| | | | Lower drive sheave improperly torqued |
| | | | A184 or A181 bearing running rough |
| Clutch light comes on for 1–6 seconds in flight | | | Normal operation of actuator as it retensions drive belts |
| Clutch light comes on for more than 6 seconds in flight | | | Drive belts stretched beyond limit of actuator over-travel switch. Belts must be replaced. |
| | | | Actuator overtravel switch activated by outside force |

33-110 Troubleshooting (continued)

**D. Electrically Powered Instrument Calibration Values**

Using Vibrex 2000 balancing equipment (or similar) capable of displaying ± 1 rpm resolution and calibrated within one year, verify tachometer accuracy per following tables. Connect equipment in accordance with §§ 10.221 and 6.240 (use photocell instead of Strobex per Figure 6-4A). Operate aircraft at noted tachometer indications and verify engine and rotor rpms as specified. Tachometer needles are 1% wide.

**A792-x Dual Tachometer**

| Tachometer indication | Engine RPM | Rotor RPM |
|---|---|---|
| 97% | 2471-2476 | 494-495 |
| 100% | 2548-2552 | 509-510 |
| 104% | 2649-2655 | 529-530 |

The rotor tachometer may be adjusted per § 33-50. No other adjustments are permitted. If tachometer does not meet accuracy tolerance then it must be replaced or returned to RHC for repair.

**A058-5 Carb. Air Temp. Probe**

0° = 89.68/91.08 ohms
15° = 95.67/98.07 ohms
16° = 96.10/98.50 ohms
17° = 96.54/98.94 ohms
18° = 96.97/99.37 ohms
19° = 97.40/99.80 ohms
20° = 97.83/100.23 ohms
21° = 98.27/100.67 ohms
22° = 98.70/101.10 ohms
23° = 99.13/101.53 ohms
24° = 99.56/101.96 ohms
25° = 100.00/102.40 ohms

**A604-2 Carb. Air Temp. Gage at 13.7 Vdc;**

77.40 ohms = -30° ± 2°C
81.73 ohms = -20° ± 1.75°C
86.05 ohms = -10° ± 1.5°C
90.38 ohms = 0° ± 1°C
94.71 ohms = 10° ± 1.5°C
99.03 ohms = 20° ± 1.75°C
103.36 ohms = 30° ± 2°C

Example: Replacing the carburetor air temperature probe with a ¼ to 1-watt 100-ohm resistor should result in an indication of approximately 21°C (measure exact resistor value & refer to above). A probe dipped in a Styrofoam cup full of crushed ice and water should indicate 90.38 ohms resistance per above table. Probe installation torque is 3 to 4 inch-pounds; over-torquing probe will result in damage.

33-110 Troubleshooting (continued)

**D. Electrically Powered Instrument Calibration Values (continued)**

Following instrument cluster gages are calibrated at 20 to 25 degree angle from horizontal.

Fuel level senders should have 90 ± 2 ohms resistance when fully up (full fuel) and 0 to 0.5 ohm when fully down (no fuel). Perform fuel sender calibration per § 12.410 whenever sender is replaced, or if factory-set fuel gage potentiometers have been disturbed. On backside of each fuel gage are "Null" and "Gain" potentiometer screws, covered with aluminum tape pressed against the screw heads to prevent rotation. "Null" potentiometer is adjusted so gage indicates empty at 0.7 ohm sender circuit resistance; "Gain" potentiometer is adjusted so gage indicates half at 42 ohms sender circuit resistance. Calibration values are:

**Fuel Quantity Gages 6246-00473 (14V)**

| | | |
|---|---|---|
| 0.70 ohm | = E (empty) -1, +0 | pointer width |
| 21.20 ohms | = 1/4 full ± 1 | pointer width |
| 42.00 ohms | = 1/2 full ± 1 | pointer width |
| 67.50 ohms | = 3/4 full ± 1 | pointer width |
| 90.00 ohms | = F (full) ± 1 | pointer width |

**Ammeter 6246-00468 (14V)**

| | | |
|---|---|---|
| -104 mV | = -70 amps ± 1 | pointer width |
| -52 mV | = -35 amps ± 1 | pointer width |
| 0 mV | = 0 amps ± ¼ | pointer width |
| +52 mV | = +35 amps ± 1 | pointer width |
| + 104 mV | = +70 amps ± 1 | pointer width |

**CHT Probe 3080-38 (14V)**

| | |
|---|---|
| 200°F | = 745 ohms |
| 475°F | = 38 ohms |
| 500°F | = 32 ohms |

**CHT Gage 6246-00088 (14V)**

| | | |
|---|---|---|
| 745 ohms | = 200 degrees F | ± 1 pointer width |
| 110 ohms | = 350 degrees F | ± 1 pointer width |
| 34 ohms | = 500 degrees F | ± % pointer width |

**Oil Pressure Sender B308-1 (14V)**

| | |
|---|---|
| 0 psi | = 5-13 ohms |
| 29 psi | = 48-57 ohms |
| 58 psi | = 84-94 ohms |
| 87 psi | = 119-131 ohms |
| 115 psi | = 145-161 ohms |

**115-psi redline Oil Pressure Gage 6246-00647 (14V)**

| | | |
|---|---|---|
| 9 ohms | = 0 psi | ± 1 pointer width |
| 46 ohms | = 25 psi | ± 1 pointer width |
| 84 ohms | = 55 psi | ± 1 pointer width |
| 131 ohms | = 95 psi | ± 1 pointer width |
| 152 ohms | = 115 psi | ± 1 pointer width |

33-110 Troubleshooting (continued)

**D. Electrically Powered Instrument Calibration Values (continued)**

**Older, 100-psi red line Oil Pressure Gage**
**6246-00089 (14V)**

| | | |
|---|---|---|
| 0 psi | = | 10.0 ohms |
| 25 psi | = | 46.5 ohms |
| 60 psi | = | 90.0 ohms |
| 90 psi | = | 125.5 ohms |
| 100 psi | = | 137.0 ohms |

**Oil Temperature Sender**
**A760-1 (14V)**

100°F = 497 ohms
150°F = 179 ohms
200°F = 72 ohms
250°F = 34 ohms

**Oil Temperature Gage**
**6246-00090 (14V)**

903.5 ohms = 75°F ± 1 pointer width
100.0 ohms = 180°F ± 1 pointer width
36.0 ohms = 245°F ± 1 pointer width

## 33-120 Electrical Load Analysis

To calculate the total electrical load for a specific helicopter, identify all items of equipment installed on the helicopter from the table below and sum the corresponding continuous and intermittent loads.

Maximum continuous alternator load is given in the table below:

| System Voltage | Alternator Rating | Maximum Continuous Load |
|---|---|---|
| 14V | 60 amp | 54 amps |

Intermittent loads are provided for reference.

Alternately, the electrical load may be measured directly at the battery output terminal with the alternator switched off and all other equipment turned on. The measured load may be scaled by the ratio of battery voltage to nominal system voltage to obtain a value that is compared with the alternator load limit.

**WARNING**

**Field (non-factory) installation of electronic equipment can be hazardous. Due to the compactness of the console and tunnel containing the controls and wire bundles, installation of any additional wires can interfere with flight controls. Electronic tachometers, warning systems, and navigation equipment essential to flight are sensitive to interference from other electrical devices. The reliability and accuracy of the tachometers is essential for safe operation of the helicopter, and installation of an electrical device not tested and approved by RHC may result in a hazardous condition.**

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **MAIN BUS** | | | | | |
| ESSEX BATTERY RELAY | 1 | 0.75 | 0.75 | 0.75 | 0.75 |
| KISSLING BATTERY RELAY | 1 | 0.35 | 0.35 | 0.35 | 0.35 |
| ALTERNATOR FIELD | 1 | 2.40 | 2.40 | 2.40 | 2.40 |
| AVIONICS RELAY | 1 | 0.13 | 0.13 | 0.13 | 0.13 |
| ENGINE GAGE CLUSTER | 1 | 0.60 | 0.60 | 0.60 | 0.60 |
| HOURMETER | 1 | 0.03 | 0.03 | 0.03 | 0.03 |
| CARB AIR TEMP | 1 | 0.13 | 0.13 | 0.13 | 0.13 |
| AMMETER | 1 | 0.50 | 0.50 | 0.50 | 0.50 |
| DIGITAL OAT GAGE | 1 | 0.15 | 0.15 | 0.15 | 0.15 |
| MAP LIGHT | 1 | 0.00 | 0.58 | 0.00 | 0.58 |
| WARNING LIGHTS | 8 | 0.00 | 0.08 | 0.00 | 0.64 |
| FULL THROTTLE CAUTION LIGHT | 1 | 0.00 | 0.08 | 0.00 | 0.08 |

33-120 Electrical Load Analysis (continued)

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **MAIN BUS (continued)** | | | | | |
| RPM GOVERNOR MOTOR | 1 | 0.00 | 1.50 | 0.00 | 1.50 |
| BELT TENSION ACTUATOR | 1 | 0.00 | 1.20 | 0.00 | 1.20 |
| AUX POWER PLUG (MAX) | 1 | 10.00 | 10.00 | 10.00 | 10.00 |
| HEATER BLOWER | 1 | 7.50 | 7.50 | 7.50 | 7.50 |

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **TACH BUS** | | | | | |
| DUAL TACHOMETER (E) | 1 | 0.10 | 0.10 | 0.10 | 0.10 |
| DUAL TACHOMETER (R) | 1 | 0.10 | 0.10 | 0.10 | 0.10 |

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **LIGHTS BUS** | | | | | |
| POSITION LIGHTS (L, R, & AFT, INCANDESCENT) | 3 | 2.20 | 2.20 | 6.60 | 6.60 |
| POSITION LIGHTS (L & R, LED) | 2 | 0.25 | 0.25 | 0.50 | 0.50 |
| POSITION LIGHT (AFT, LED) | 1 | 0.30 | 0.30 | 0.30 | 0.30 |
| OVERHEAD PANEL LIGHT | 1 | 1.00 | 1.00 | 1.00 | 1.00 |
| POST LIGHTS | 7 | 0.08 | 0.08 | 0.56 | 0.56 |
| INSTRUMENT LIGHTS | 4 | 0.20 | 0.20 | 0.80 | 0.80 |
| LANDING LIGHT RELAY | 1 | 0.20 | 0.20 | 0.20 | 0.20 |
| LANDING LIGHTS (INCANDESCENT) | 2 | 7.70 | 7.70 | 15.40 | 15.40 |
| LANDING LIGHTS (HID) | 2 | 2.90 | 9.52 | 5.80 | 19.04 |
| ANTI-COLLISION LIGHT & POWER SUPPLY | 1 | 3.20 | 3.20 | 3.20 | 3.20 |
| ANTI-COLLISION LIGHT (LED) | 1 | 0.90 | 4.00 | 0.90 | 4.00 |

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **AVIONICS** | | | | | |
| KY197A COM | 1 | 0.80 | 5.20 | 0.80 | 5.20 |
| GTR225B COM | 1 | 0.59 | 5.31 | 0.59 | 5.31 |
| GNS430 COM/NAV/GPS | 1 | 2.44 | 8.40 | 2.44 | 8.40 |
| GTN650 COM/NAV/GPS | 1 | 2.65 | 6.97 | 2.65 | 6.97 |
| KX155 OR KX165 NAV/COM | 1 | 0.70 | 8.50 | 0.70 | 8.50 |

33-120 Electrical Load Analysis (continued)

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **AVIONICS (continued)** | | | | | |
| KR87 ADF | 1 | 1.24 | 1.24 | 1.24 | 1.24 |
| KN63 DME | 1 | 1.21 | 1.21 | 1.21 | 1.21 |
| GARMIN TRANSPONDER | 1 | 1.10 | 3.10 | 1.10 | 3.10 |
| GARMIN RADIO NAVIGATION INDICATOR | 1 | 0.41 | 0.41 | 0.41 | 0.41 |
| KING RADIO NAVIGATION INDICATOR | 1 | 0.08 | 0.08 | 0.08 | 0.08 |
| MARKER BEACON | 1 | 0.50 | 0.50 | 0.50 | 0.50 |
| KCS55A HSI | 1 | 3.23 | 3.23 | 3.23 | 3.23 |
| RADAR ALTIMETER | 1 | 1.45 | 1.45 | 1.45 | 1.45 |
| AA12S AUDIO CONTROL | 1 | 1.00 | 1.00 | 1.00 | 1.00 |
| GMA 350H AUDIO CONTROL | 1 | 0.80 | 1.50 | 0.80 | 1.50 |
| ASPEN 1000H EFD | 1 | 4.80 | 4.80 | 4.80 | 4.80 |
| ATTITUDE HORIZON (MECHANICAL) | 1 | 0.54 | 1.40 | 0.54 | 1.40 |
| ATTITUDE HORIZON (LCD) | 1 | 0.20 | 0.20 | 0.20 | 0.20 |
| TURN COORDINATOR | 1 | 0.70 | 0.70 | 0.70 | 0.70 |
| DIRECTIONAL GYRO | 1 | 0.44 | 1.40 | 0.44 | 1.40 |
| PA/SIREN CONTROL | 1 | 0.05 | 0.05 | 0.05 | 0.05 |
| PA/SIREN SPEAKER | 1 | 7.70 | 7.70 | 7.70 | 7.70 |
| ICOM IC-M412 MARINE TRANSCIEVER | 1 | 1.50 | 5.50 | 1.50 | 5.50 |
| KENWOOD TK-7160 OR TK8160 FM TRANSCIEVER | 1 | 1.00 | 8.00 | 1.00 | 8.00 |
| KENWOOD TK-7180 OR TK8180 FM TRANSCIEVER | 1 | 1.00 | 9.00 | 1.00 | 9.00 |
| YAESU FT-8800R FM TRANSCIEVER | 1 | 0.50 | 8.00 | 0.50 | 8.00 |
| VERTEX VX-2200 FM TRANSCIEVER | 1 | 2.50 | 11.00 | 2.50 | 11.00 |

| EQUIPMENT | QTY | CONTINUOUS AMPS EACH | INTERMITTENT AMPS EACH | CONTINUOUS TOTAL | INTERMITTENT TOTAL |
|---|---|---|---|---|---|
| **OTHER EQUIPMENT** | | | | | |
| STARTER RELAY | 1 | 0.00 | 15.00 | 0.00 | 15.00 |
| STARTING VIBRATOR | 1 | 0.00 | 2.50 | 0.00 | 2.50 |
| STARTER MOTOR | 1 | 0.00 | 200.00 | 0.00 | 200.00 |
| CLOCK, STANDARD | 1 | 0.02 | 0.02 | 0.02 | 0.02 |
| CLOCK, DIGITAL | 1 | 0.00 | 0.00 | 0.00 | 0.00 |

## 33-130 Governor System for R22 Helicopter S/N 4825 & subsequent

### 33-131 A760 Temperature Senders

#### 33-131-1 A760-1 (Single) and A760-3 (Dual) Oil Temperature Senders

**A. Description**

A760-1 Oil temperature sender (single) is for use with the B144-3 (14V) instrument cluster. A760-3 oil temperature sender (dual) is for use with the B144-5 (10–32V) instrument cluster.

**B. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**C. Removal**

1. Remove left side engine cowling.
2. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
3. Using backup wrench, remove nut securing C049 harness assembly's wire terminal to A760 oil temperature sender stud.
4. Cut and discard lockwire securing sender to thermostatic oil cooler bypass valve. Remove sender from D723-1 adapter assembly.

**D. Installation**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install gasket supplied with A760 oil temperature sender, and sender, in D723-1 adapter assembly. Special torque sender to 300 in.-lb and torque stripe per Figure 2-1. Safety sender to thermostatic oil cooler bypass valve using 0.032-inch diameter lockwire.
3. Attach C049 harness assembly's wire terminal to sender; using backup wrench, install nut securing wire terminal to sender. Special torque nut to 20 in.-lb and torque stripe per Figure 2-1.
4. Install left side engine cowling. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

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## 33-131-2 A760-2 Cylinder Head Temperature (CHT) Sender

### A. Description

A760-2 Cylinder head temperature sender is for use with the B144-5 (10–32V) instrument cluster. 3080-00038 cylinder head temperature probe is for use with the B144-3 (14V) instrument cluster.

### B. Schematic

Refer to Figure 14-39 for A024 electrical system schematic.

### C. Removal

1. Remove right side engine cowling.
2. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
3. Using backup wrench, remove palnut and brass nut securing C049 harness assembly's -34 wire terminal to A760-2 or 3080-00038 cylinder head temperature sender/probe stud (one brass nut remains on stud). Discard palnut.
4. Remove sender/probe from cylinder head (forward, RH [#4]).

### D. Installation

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install gasket supplied with A760-2 or 3080-00038 cylinder head temperature sender/probe, and sender/probe, in cylinder head (forward, RH [#4]). Special torque sender/probe to 70–80 in.-lb and torque stripe per Figure 2-1.
3. Calibrate cylinder head temperature gage per Part E, as required.
4. Attach C049 harness assembly's -34 wire terminal to sender/probe. Using backup wrench, install brass nut securing wire terminal to sender/probe; tighten nut. Install new B330-2 palnut; tighten palnut. Torque stripe per Figure 2-1.
5. Install right side engine cowling. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

33-131-2 A760-2 Cylinder Head Temperature (CHT) Sender (continued)

**E. Calibration**

NOTE

C691-1 Circuit board assembly must be installed on B144 instrument cluster to perform calibration. For earlier helicopters, order and install KI-249 CHT Gage Calibration Kit, as required (refer to R22 Service Letter SL-73).

1. Turn battery switch off and pull all circuit breakers.
2. Remove right side engine cowling, as applicable.
3. Using backup wrench, remove palnut and brass nut securing C049 harness assembly's -34 wire terminal to A760-2 or 3080-00038 cylinder head temperature sender/probe stud (one brass nut remains on stud). Discard palnut.
4. Open instrument console for access to back side of CHT gage in B144 instrument cluster.
5. Refer to Figure 33-2. Adjust resistance decade box to 32 ±0.4 ohms and verify resistance with multimeter. Alternately, a 32.0 ±0.4 ohm resistor may be used instead of decade box. Connect a low-impedance (<1 ohm) test lead to one terminal on decade box and clamp opposite end of lead to hexagonal body of CHT probe; do not connect lead to center conductor of sender/probe. Connect -34 wire to remaining terminal on decade box.

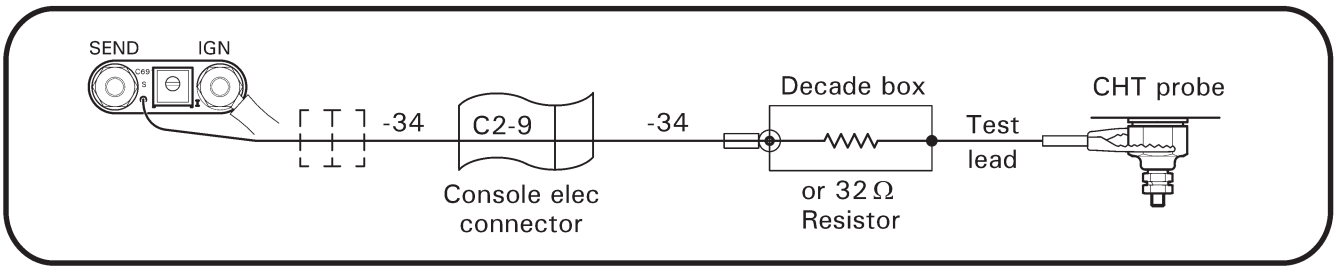


FIGURE 33-2 CYLINDER HEAT TEMPERATURE GAGE CALIBRATION

6. Refer to Figure 33-3. Push in GAGES 2-amp circuit breaker. Turn battery switch on and observe CHT gage. Adjust potentiometer screw on C691-1 circuit board assembly until gage indicates within limits shown with console in closed position (CHT probe resistance is 32 ±0.4 ohms at 500° F).
7. Cut small square of A701-1 aluminum tape sized to fit potentiometer face. Apply tape to potentiometer and press tape tight against adjustment screw to prevent rotation (pressing with a pencil eraser works well). Verify CHT needle has not moved. If movement is noted, remove tape and repeat step 6 as required. Turn battery switch off.

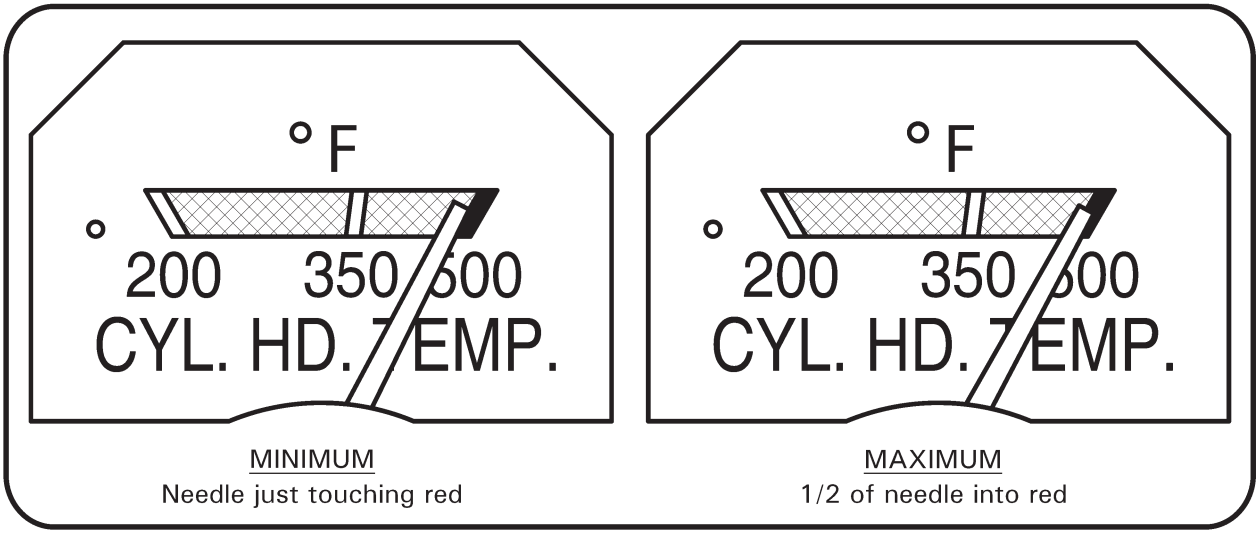


FIGURE 33-3 CYLINDER HEAT TEMPERATURE GAGE CALIBRATION

33-131-2 A760-2 Cylinder Head Temperature (CHT) Sender (continued)

**E. Calibration (continued)**

8. Close and secure instrument console. Push in all remaining circuit breakers.
9. Attach C049 harness assembly's -34 wire terminal to sender/probe. Using backup wrench, install brass nut securing wire terminal to sender/probe; tighten nut. Install new B330-2 palnut; tighten palnut. Torque stripe per Figure 2-1.
10. Install engine side cowling.

## 33-132 A760-4 Outside Air Temperature (OAT) Sender

### A. Description

The A760-4 OAT sender is the data input for the D270-1 governor/engine monitoring unit; the B341-2 OAT sender is the data input for the B341-1 OAT gage.

### B. Schematic

Refer to Figure 14-39 for A024 electrical system schematic.

### C. Removal

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Cut and discard ty-raps as required and disconnect A760-4 OAT wiring from airframe harness at connectors; remove hardware securing ground wire. Using backup wrench, remove nut and lockwasher securing sender probe to cabin.

### D. Installation

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install lockwasher and nut securing A760-4 OAT sender probe to cabin. Using backup wrench, special torque nut to 18 in.-lb. Verify security.
3. Connect OAT sender wiring to airframe harness at connectors; install hardware securing ground wire. Verify security. Install ty-raps as required to securing wiring; cinch ty-raps until snug without overtightening and trim tips flush with heads.
4. Install forward belly panel. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

## 33-133 A024 Electrical System Installation

Refer to Figure 14-39 for A024 electrical system schematic.

## 33-134 A060-14 Audio System Installation

Refer to Figure 14-40 for A060-14 audio system schematic.

33-135 C143-1 Hall Effect Sensor Assembly

**A. Schematic**

Refer to Figure 14-39 for A024 electrical system schematic.

**B. Removal**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Remove engine left side cowling.
3. Cut and discard ty-raps as required and disconnect C143-1 hall effect sensor assembly wiring from airframe harness at connectors.
4. Remove engine-supplied hardware securing sensor assembly and engine-supplied gasket to engine; remove sensor assembly and gasket.

**C. Installation**

1. Turn battery switch off & pull GOV (2 amp) circuit breaker on circuit breaker panel.
2. Install engine-supplied gasket and C143-1 hall effect sensor assembly on engine and install engine-supplied hardware. Special torque nuts to 96 in.-lb. Verify security.
3. Connect sensor assembly wiring to airframe harness at connectors and install ty-raps, as required. Cinch ty-raps until snug without overtightening and trim tips flush with heads.
4. Install engine left side cowling. Push in GOV (2 amp) circuit breaker on circuit breaker panel.

33-136 C822-1 Audio Control (Garmin GMA 350HC) Installation

Refer to Figures 14-47 & 14-48 for C822-1 audio control installation schematic.

## 33-137 D270-1 Governor Controller and Engine Monitoring Unit (EMU)

Refer to § 8.230 for D270-1 governor controller maintenance procedures. Refer to the EMU Technician's Guide and EMU User Guide online at www.robinsonheli.com for data access.

Later aircraft are equipped with an Engine Monitoring Unit (EMU), which is a digital recording device within the engine RPM governor control box. The EMU continuously monitors engine and rotor speed, engine oil temperature, and cylinder head temperature.

EMU status is indicated by an amber light located in the right-side baggage compartment on the aft seat support panel. The EMU requires approximately ten seconds to complete a self-test after the aircraft battery is switched on. Once the self-test is complete, steady illumination of the light means normal EMU operation. A slowly flashing light (once every two seconds) or no light means there is a fault in the EMU's senders or circuitry. A fast flashing light (four times per second) indicates the EMU has detected an exceedance. EMU data can be downloaded to a computer with the appropriate software. A fault or exceedance should be investigated and the indication reset by a qualified mechanic prior to the next flight. Current exceedances may be reviewed (but not reset) using the Robinson EMU App on an Apple iPad (download the EMU App from www.robinsonheli.com or from the Apple App Store).

The EMU is intended to be used only as a maintenance aid. It remains the pilot's responsibility to report any observed exceedances.

## 33-138 F793-1 Audio Alert Box

### A. Schematic

Refer to Figure 14-39 for A024 electrical system schematic.

### B. Removal

1. Turn battery switch off and pull all circuit breakers.
2. Open instrument console for access to F793-1 audio alert box.
3. Loosen screws securing audio system harness receptacle to alert box connector and disconnect receptacle from connector.
4. Remove hardware securing alert box to keel panel and remove alert box.

### C. Installation

1. Turn battery switch off and pull all circuit breakers.
2. Open instrument console.
3. Install hardware securing F793-1 audio alert box to right side keel panel; verify security.
4. Connect audio system harness receptacle to alert box connector and tighten screws. Verify security.
5. Close and secure instrument console. Push in all circuit breakers.

## 33-140 Lycoming Electronic Ignition System (EIS)

Later aircraft are equipped with a Lycoming Electronic Ignition System (EIS) single module magneto replacement. The EIS installation replaces the left starting magneto (and starter vibrator). The remaining right magneto provides redundant ignition, which eliminates the need for a back-up battery system (required on dual module EIS installations).

Refer to Lycoming SI 1569, current revision for instructions for continued airworthiness for EIS modules. SI 1569 also provides instruction for module internal timing and module-to-engine timing for single (and dual) EIS installed.

## 33-150 Audio Alerts

All R22 helicopters have a low-RPM horn which sounds when rotor RPM is below 97%. The horn is muted when the collective is fully down. On earlier aircraft, the horn is provided by a speaker in the side of the instrument console. On later aircraft, a tone generator in the audio system provides the horn through crew headsets.

Later aircraft include a high rotor RPM alert through the headsets. A warble tone (high/low tone) indicates rotor RPM is approaching 110%. A test button on the instrument panel permits pre-flight or in-flight testing of the high-RPM alert.

Additional audio alerts may be provided in the headsets depending on optional equipment installed, such as terrain and traffic warnings.

## 33-160 Cockpit Camera

An optional video camera may be installed in the cabin ceiling. The camera records 4K video, intercom audio and radio communications, and GPS position both internally and to a removable flash drive. Recording starts automatically when the battery switch is turned on and stops when it is turned off.

Recording to the flash drive can be stopped or audio muted using the record and audio switches on the front of the camera housing. A switch in the down position turns off the associated function. Do not remove the flash drive while a recording is in progress as this will corrupt the video file. To remove a flash drive when the helicopter battery switch is on, first stop the recording using the record switch.

A blue flashing light on the camera housing indicates video is being recorded to the flash drive. A green steady light indicates the camera is powered and operating normally. The green light will change to an amber flashing light if an internal camera fault is detected, in which case video may not be recorded.

Video can be viewed on a Windows PC or Mac by removing the flash drive from the camera, inserting it into a USB port on a computer, and double clicking on the desired video file. Video is recorded in sequential 4 GB files with each file approximately 25 minutes in length. Video files are labeled HELICAM_xxxx.MP4, where xxxx is a sequential number. GPS position and altitude are recorded to files labeled HELICAM_xxxx.GPX on the flash drive, and are optionally displayed in the upper left hand corner of the video. A 128 GB flash drive (one supplied with each helicopter) will record approximately 13 hours of video. When full, the earliest video file is overwritten with the latest recording.

33-160 Cockpit Camera (continued)

> NOTE
>
> Flash drives used with the camera must meet the criteria described in the Cockpit Camera User Guide in order to function reliably.

Complete instructions are provided in the Cockpit Camera User Guide on the Robinson website https://robinsonheli.com. The guide also provides camera lens cleaning instructions, additional playback suggestions, instructions for visualizing GPS data, setting user preferences, updating camera software, and video post-processing and troubleshooting tips. User options include on screen display of time & date and/or GPS position, time zone and daylight saving time status, and units for on screen display of GPS altitude.

**A. Removal**

1. Turn battery & camera switches off.
2. Using a backup screwdriver, remove (2) B340-4 nuts and associated washers & spacers securing F039-1 camera assembly to cabin.
3. Cut & discard ty-raps securing wiring. Disconnect F714-2 antenna assembly from camera assembly and disconnect wiring at connectors. Remove nut securing -1858 ground wire terminal to ground stud.
4. Mark headset jacks for re-installation. Remove dress nuts and/or screws securing each headset jack to camera assembly and remove camera assembly from helicopter.

**B. Installation**

1. Connect F039-1 camera assembly electrical wiring at connectors. Lock connectors using MS3367-4-9 ty-rap. Cinch ty-rap until snug without over-tightening and trim tip flush with head.
2. If applicable, install dress nuts securing each D746-3, or -4 harness to camera assembly. Align keyway facing aft within 5° and special torque dress nuts using MT640-1 key per § 23-33.
3. Install A142-5 screws wet with B270-20 adhesive securing TJ-120 jacks to camera assembly. Special torque screws per § 23-33.
4. Install nut securing -1858 ground wire to ground stud. Connect F714-2 antenna assembly to camera assembly.
5. Install hardware and spacers securing camera assembly to cabin. Verify security.
6. Refer to cockpit camera user guide online at https://robinsonheli.com. Verify camera function and video image is approximately level.
7. To adjust video image loosen (2) NAS1352-04-4 screws securing lens. Rotate lens clockwise to rotate video image counterclockwise or rotate lens counterclockwise to rotate video image clockwise. Tighten screws. Repeat steps 3 and 4 as required.

33-160 Cockpit Camera (continued)

**C. Battery Replacement**

1. Remove camera assembly per Part A steps 1 & 2.
2. Gently separate RV-BATT-LIPO500 battery connector from circuit board.
3. Pull tab on 1024A38 tape to release battery. If battery is secured using A701-7 tape, use a plastic razor blade to separate battery from F039-1 camera assembly housing. Remove old tape and clean mating surfaces using an alcohol wipe.
4. Install new 1024A38 tape on battery and secure battery to camera assembly. Carefully connect battery to circuit board.
5. Install camera assembly per Part B steps 5 thru 7.

33-170 Overspeed Protection

An engine start-up overspeed protection circuit is standard electrical equipment on R22 ship S/N 4825 & subsequent.

R22 S/N 4825 thru 4880 factory installed circuit activates when A792-5 dual tachometer [internally] grounds pin 2 for 3s-5s.

R22 S/N 4881 & subsequent factory installed circuit activates when D270-1 governor controller [internally] grounds pin 12 (of 44-pin connector) for 3s-5s.

Engine start-up overspeeds typically occur if a start is initiated with the throttle open.

The start-up overspeed protection circuit is only active during the following conditions:

| R22 S/N 4825 thru 4880<br>Refer to A024 Revision BR schematic | R22 S/N 4881 & subsequent<br>Refer to A024 Revision BU schematic |
|---|---|
| A792 Engine rpm is above 90 ± 3% | D270 Engine RPM is above 85% ± 3% |
| A792 Rotor rpm is below 50 ± 10% | D270 Rotor RPM is below 50% ± 10% |
| Clutch switch is Disengaged i.e. wire -66 is routing power to wire -3003 | |

Start-up overspeed protection occurs when dual tachometer or governor [internally] grounds wire -3002, activating F695-9 overspeed relay's coil and in turn grounding both magnetos' p-leads.

During flight, the start-up overspeed relay is disabled because the clutch switch is in the Engage position.

No periodic maintenance of the start-up overspeed protection circuit is required.

**The start-up overspeed protection circuit cannot prevent all engine overspeeds.**

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