

AIRCRAFT STARTER MAINTENANCE MANUAL

P/N ST1007

STARTER MODELS

122NL	122NL/EC
149NL	149NL/EC
149NLR	149NLR/EC

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Thank you for purchasing a Sky-Tec* starter. We encourage you to read this manual thoroughly. It contains a wealth of information about how to properly install and maintain your starter so that it may give you many years of safe and reliable service.

Should you have a question regarding your starter that is not covered in the manual, Hartzell Engine Tech Product Support is ready to assist you. We may be reached at the following contact information:

Phone: +1.334.386.5400 (Option 1)

E-mail: techsupport@Hartzell.aero

Fax: +1.334.386.5450

Web: www.Hartzell.aero/contact/

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RECORD OF REVISIONS

Revision Letter	Issue Date	Page Revised	Description	Date
New	13 August 2025	N/A	New Release	13 August 2025
A	25 February 2026	All Chapters	Added 122NL, 149NL, 149NLR, and 149NLR/EC model information	25 February 2026
		pg. 1-2	§ 1.2.B, Added new model information	
		pg. 1-5	§ 1.9, Added new model information	
		pg. 2-1	§ 2.2.A, Added new model information	
		pg. 2-1	§ 2.4.D, Added new model information	
		pg. 2-2	§ 2.6, Added new model operational data	
		pg. 2-3	Figure 2.1, Updated image and figure title	
		pg. 2-3 thru 2-6	Figures 2.2A thru 2.2F, Added new model dimensions	
		pg. 3-1	§ 3.2.C(1), Added 12v information	
		pg. 3-2	§ 3.2.C(3), Added 12v information	
		pg. 5-1	§ 5.2.A(1)(b), Added 12v information	
		pg. 5-2	§ 5.3.B(3)(a), Added 12v information	
		pg. 6-4	Table 6.2, Added 122NL, 149NL, 149NLR, and 149NLR/EC models to IPL; Item 7, Added 12v motor assy and CCW assy	

AIRWORTHINESS LIMITATIONS

A.1 General Information

CAUTION!

THE AIRWORTHINESS LIMITATIONS HEREIN ARE THOSE MANDATED BY HARTZELL ENGINE TECH. THESE LIMITATIONS ARE THE MINIMUM REQUIRED TO MEET CONTINUED AIRWORTHINESS BUT MAY BE SUPERSEDED BY MORE STRINGENT REQUIREMENTS AS PUBLISHED BY THE FAA, AIRCRAFT, ROTORCRAFT OR OTHER MANUFACTURERS THAT USE THESE STARTERS IN THEIR APPLICATIONS. FAILURE TO OBSERVE THESE LIMITATIONS MAY COMPROMISE THE STARTERS OR THE APPLICATIONS THEY ARE USED IN.

A.2 Airworthiness Limitations Statement

- A. The Airworthiness Limitations section is FAA accepted and specifies maintenance required under § 43.16 and § 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

Airworthiness Limitation Revisions Log

Revision Number	Description of Revision

A.3 Life Limits

- A. The FAA establishes specific life limits for certain component parts as well as the complete starter assembly. Such limits require replacement of the identified parts after a specified number of cycles or hours of use.
- B. Additions of, or changes to, any life limit for starter components will be noted in the Airworthiness Limitation Revision Log.
- C. Life Limits
 - (1) Starter models and their component parts affected by this manual currently do not have any life limited parts.
 - (2) There are no new (or additional) Airworthiness Limitations associated with this equipment and/or installation.

CHAPTER 1 – INTRODUCTION

1.1 General Information

WARNING!

IMPROPER OR UNAUTHORIZED APPLICATIONS OF THE INFORMATION CONTAINED IN THE MANUAL MAY RENDER THE AIRCRAFT OR THE COMPONENT UNAIRWORTHY AND RESULT IN LOSSES, DAMAGES, OR INJURY TO THE USER.

DO NOT USE OBSOLETE OR OUTDATED INFORMATION. PERFORM ALL INSPECTIONS OR WORK IN ACCORDANCE WITH THE MOST RECENT REVISION OF THE APPLICABLE AIRCRAFT/ENGINE SERVICE OR MAINTENANCE MANUAL. INFORMATION CONTAINED IN THESE MANUALS MAY BE SIGNIFICANTLY CHANGED FROM EARLIER REVISIONS. USE OF OBSOLETE INFORMATION MAY CREATE AN UNSAFE CONDITION THAT MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

The accuracy and applicability of this manual has not been verified for any assembly, component or part not manufactured by Hartzell Engine Tech LLC (HET). Any use of the manual for other than its intended or implied purpose is prohibited. The use of the manual for the purpose of performing any installation, maintenance, replacement, adjustment, or inspection of any assembly, component or part not manufactured by HET is not approved, endorsed, or sanctioned by HET.

This manual has been approved by Hartzell Engine Tech LLC as the proper methods and procedures that FAA or other airworthiness authority Certificated Repair Stations and A/P Mechanics should use in the inspection and maintenance of HET starters.

No liability will be assumed by Hartzell Engine Tech LLC for actual, consequential, incidental or other types of damages directly or indirectly resulting from the unauthorized use of this manual for other than its stated purposes.

The liability for use of the authorized data herein for the maintenance, or return to service is limited to the specific terms and conditions stated under the applicable Limited Warranty in effect for each piece part, component, assembly or whole unit sold by HET.

Because of the numerous modifications, Supplemental Type Certificates (STC), Parts Manufacturing Approvals (PMA), or Form 337 Field Approvals that may apply, it is the responsibility of the repairman, mechanic, or maintenance facility to determine the proper engine or aircraft application of this starter assembly. Please refer to the appropriate aircraft Type Certificate (TC), Supplemental Type Certificate (STC), aircraft equipment list, maintenance manuals, and/or Log Book entries for determination.

When performing installation, maintenance, replacement, adjustment, or inspection of any HET assembly, component or part, it is imperative that the latest revision of this HET manual or other product support document be referenced. Reference the HET website to be sure you have the latest revision before performing any work. (<https://skytec.aero/aircraft-starter-support/maintenance-manuals/>)

All reasonable attempts were made to make this manual as complete and accurate as possible. If you have any questions, comments, corrections or require clarification of any information contained herein, please write to Hartzell Engine Tech LLC, 2900 Selma Highway, Montgomery, Alabama, 36108 USA. TEL +1.334.386.5400, FAX +1.334.386.5410, or <https://hartzell.aero/contact/>.

1.2 General Specification (manual)

- A. This manual uses ATA 100 identification as required. Principle units of measure used in the manual are U.S. units with International System of Units (SI) in parentheses.
- B. The 122NL, 122NL/EC, 149NL, 149NL/EC, 149NLR, and 149NLR/EC starter models are considered herein. Variations of these starters may be noted as applicable.
- C. All aircraft, rotorcraft, or engine applications are limited to the holder of the TC, STC, PMA or TSO and only at the date of that document publication or revision.
- D. Only approved, competent persons with the necessary skills may do maintenance tasks described in the manual. This may include a certified pilot doing “preventative maintenance” as defined in FAR 43, Appendix A, paragraph C with guidance from AC 43.12A of latest change.
- E. The manual describes maintenance on components as they are installed on aircraft and tasks that should be accomplished in a properly equipped service facility.
- F. Maintenance tasks and subtasks are referenced in the manual but will have no specific identification numbers.
- G. The manual contains: Description of operation, Troubleshooting, Instruction for Continued Airworthiness (ICA) and Maintenance information along with part numbers required for basic maintenance tasks.
- H. Changes and updates to this manual can be found at <https://SkyTec.aero/>. Revisions will be tracked and recorded in the Record of Revisions section of this document.
- I. Aircraft Application Guides for the starters can be found on the Sky-Tec website at <https://skytec.aero/aircraft-starter-support/application-information/>.

1.3 How to use the manual

- A. Make sure the manual contains information applicable to your aircraft, engine, or replacement starter. Look for the model number on the Title Page and if applicable, the part number of the replacement or superseded component.
- B. It is imperative that you read, understand, and observe all the applicable **WARNINGS** and **CAUTIONS** before you do any work on this component.
- C. Use only the sections needed, use the check section to determine what actions may be needed periodically and the maintenance sections for servicing the starter.
- D. If you need to identify a part or find a part number, refer to illustrations herein or the applicable aircraft or engine service or maintenance manual.
- E. Refer to the troubleshooting section to assure that the observed or reported condition lies with the starter.
- F. Fully test the starter per the instructions in this manual when running the aircraft. Utilize the aircraft and/or engine manufacturer’s service manuals and publications before returning the aircraft to service. Use the AFM or POH for aircraft operations.
- G. Some sections in this manual apply to all starters considered herein. Other sections will contain information specific to a particular starter model or variation of a model.

1.4 Measurements

The measurements given in this manual are taken from original manufacturing drawings.

1.5 Units of Measure

A. SI Units

A	Ampere
A · h	Ampere hours
g	Gram
N	Newton
N · m	Newton meter
V	Volt
°C	Degree Celsius
Ω	Ohm
W	Watt
Hz	Hertz
m	Meter
cm	Centimeter
kg	Kilogram

B. U.S. Units

ft	Foot
in	Inch
lb	Pound
lbf · in	Pound-force inch
lbf · ft	Pound-force foot
°F	Degree Fahrenheit

C. Multiplying Prefixes

μ	Micro
m	Milli
k	Kilo
M	Mega
p	Pico

1.6 Abbreviations

A. The abbreviations given below are used in the manual: (upper or lower case)

AFM	Aircraft Flight Manual
ATA	Air Transport Association of America
DEG	Degree
EMI	Electro Magnetic Interference
FAA	Federal Aviation Administration (USA)
IAW	In Accordance With
IPL	Illustrated Parts List
HET	Hartzell Engine Tech LLC
MAX	Maximum
MIN	Minimum
NO.	Number
N/A	Not Applicable
PMA	Parts Manufacturing Approvals
P/N	Part Number
POH	Pilots Operating Handbook
REF.	Refer To
S/N	Serial Number
STC	Supplemental Type Certificate
TBO	Time Between Overhaul
TC	Type Certificate
TIS	Time In Service
VOM	Volt Ohm-Milliammeter

1.7 Definitions

A. This paragraph defines the warnings and notifications used in this manual. **WARNINGS** place critical attention to use of tools, materials, procedures, or limitations, which must be followed without deviation to avoid injury to the technician or other persons. **CAUTIONS** place immediate attention to use of tools and procedures which must be followed to avoid injury, damage to equipment and/or facilities. **Notes** call attention to procedures which make the job easier.

B. The following are basic definitions of the terms used herein: (as related to this manual)

AMMETER: The device for measuring current in amperes.

ARMATURE: Rotating electro magnet used to create a magnetic field.

BRUSH: Device for conducting current to the commutator. It is a composite carbon block which includes a spring and lead.

BRUSH HOLDER: Device that retains multiple brush assemblies and is comprised of a holder, contacts, and terminals.

COMMUTATOR: Converts AC current to DC current and ensures the torque acting on the armature is in the same direction.

EMI: Electro Magnetic Interference. A disturbance in the radio-frequency spectrum that is generated by an external source that affects electrical devices or circuits by electromagnetic induction, electrostatic coupling, or conduction.

FRONT HOUSING: Part of the external housing which contains the components of the starter. This end has structure typically used for mounting. It may also be referred to as the Drive End Housing or D.E.

INSULATOR: Component that does not allow electricity to flow through it easily. Insulators do not allow electricity to flow through them easily because the electrons in their atoms do not move easily from atom to atom.

MULTIMETER: Device for the measurement of voltage, current, or resistance.

OPEN: Electrical term for a complete disruption of a conductive path in an electrical circuit. Will read infinite resistance.

REAR HOUSING: Part of the external housing which contains the components of the starter. It may also be referred to as the Commutator End.

RFI: Radio Frequency Interference. Electromagnetic energy in the radio-frequency spectrum. Electrical interference may be created by arcing between the brush and commutator during operation.

SHORT: Common term for an electrical circuit that allows a current to travel along an unintended path with no or very low electrical impedance that can be seen using an Ohmmeter, resulting in an excessive current flowing through the circuit which becomes an undesirable condition.

TEST BENCH: Device so constructed as to allow testing of the starter or component parts.

TERMINALS: Studs, screws or other devices that provide connections for electrical power.

VOLT/OHM METER: Device for the measurement of voltage or resistance.

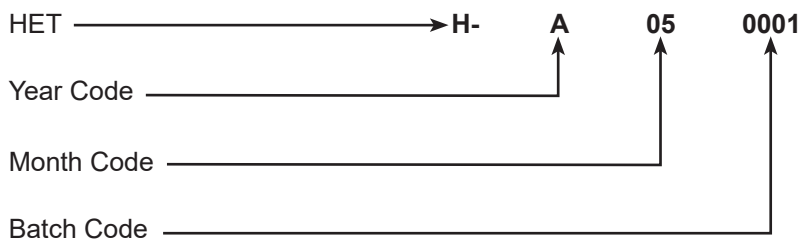
1.8 Disposal

- A. The starter assembly is designed to allow for re-use of many starter sub-assemblies and components. Disposal of unairworthy parts and assemblies as well as required replacement parts should be as follows: Rejected parts should be tagged and scrapped per FAA requirements. Any part deemed unairworthy must be rendered unusable prior to discard.

1.9 Model Identification

122NL	122NL/EC
149NL	149NL/EC
149NLR	149NLR/EC

1.10 Serial number Identification



Example above: 2026, May, first unit of the month (batch). The year code advances one letter in alphabetical order for each succeeding year.

1.11 Warranties

- A. Hartzell Engine Tech LLC (HET) offers a Limited warranty with each new or rebuilt starter assembly or component (parts) it sells through its distribution system. **NO expressed or implied warranty exists** when repairing, or rebuilding any assembly or component using this manual except as it may apply to any new HET replacement part purchased. If you suspect that any warranty applies to the starter assembly, it must be returned through an authorized HET distributor in a manner prescribed by that specific distributor. The affected starter must be received by the factory fully assembled and not altered in any way for disposition by the HET warranty department. **(Warranty shall be denied for any starter received altered, modified, or disassembled.)**

- B. The HET Limited warranty policy in affect for your starter was delivered with the unit at the time of purchase. (As the Warranty policy is revised from time to time, you must check the policy delivered with your unit for specific terms and conditions should a warranty condition occur. If needed for reference, obtain the most current policy by visiting our website at <https://hartzell.aero/>.

1.12 Storage and Shelf Life

A. Recommended Storage

When storing a new starter, there are two categories to consider, short term storage or a long term storage on or off the aircraft. Short term storage will be considered as storage up to but not exceeding thirty-six (36) calendar months. Long term storage picks up at thirty-six (36) calendar months but does not exceed twelve (12) calendar years. There is no special environment required except the storage space should be clean and covered.

Short term, if on the shelf, requires only that the unit be kept in it original packaging. If unit is being stored on the aircraft, start engine using starter at an interval of sixty (60) days.

Long term, if on the shelf, requires that the starter be removed from the packaging and examined on an annual basis. Remove from the plastic bag as originally packaged and discard the bag as long term use may allow condensation in bag. (If bag contains a desiccant and color does not indicate moisture, unit may be kept in original bag.) If removed from bag, wipe or lightly spray outside with preservative oil and wrap tightly with a waxed type paper. Place back into original shipping container.

If it is anticipated or determined that the aircraft will be in a long term storage situation, as soon as practicable, wipe and spray the outside of the starter with preservative oil, start engine using starter at an interval of sixty (60) days. (Engine must start to unwind adapter spring.)

B. Shelf Life

All starters have a shelf life of up to, but not to exceed twelve (12) calendar years at which time the unit must be replaced. (Does not express a warranty.)

CHAPTER 2 – DESCRIPTION OF OPERATION

2.1 General

- A. Sky-Tec starters listed herein are designed as lightweight, direct-mounting, and energy-efficient. These starters reduce current draw which attributes to the long life of the starter. The internal gear drive multiplies armature torque and employs a slip disc clutch design for kickback protection.

2.2 Basic Component Description

- A. The principle components of NL, NL/EC, NLR, NLR/EC starters described herein are (1) mount assembly (2), drive assembly (3), idler gear and clutch assembly, and (4) solenoid/motor assembly, see Figure 2.1.

2.3 Technical Purpose

- A. The purpose of the aircraft starter is to convert electrical power to mechanical power in order to start the engine. The starter rotates the engine until the engine is able to operate under its own power.
 - (1) The battery is the source of electrical power whenever the BAT Master Switch is ON and is the source of power for starting the aircraft.

2.4 Physical Detail

- A. The mount assembly (1) provides the mounting flange for attachment of the starter to the engine and supports the bearing through which the pinion shaft protrudes to expose the pinion gear.
- B. The solenoid/motor assembly (4) is the rotating element of the starter. It's comprised of a shaft upon which are mounted a lamination stack, conductors that form the winding and a commutator to which the windings are electrically connected.
- C. Brushes, located in the solenoid/motor assembly (4), provides a rotating connection through which the armature assembly may be electrically energized.
- D. Basic dimensions for the 122NL series starters are found in Figures 2.2A, Figure 2.2E, and 2.2F.
- E. Basic dimensions for the 122NL/EC series starters are found in Figures 2.2A thru 2.2C.
- F. Basic dimensions for the 149NL, 149NL/EC, 149NLR, and 149NLR/EC series starters are found in Figures 2.2D thru 2.2F.
- G. Starting motor pinions are specifically designed to match the engine ring gear for proper mesh and cranking performance. It is therefore important to ensure correct tooth count of ring gear. One quick and easy way is to use HET's ring gear check gage (Figure 2.3). Running correctly matched gears will guarantee proper engine cranking speed and service life for your starter.

CAUTION!

TO PREVENT DAMAGE TO THE STARTER AND/OR THE ENGINE FLYWHEEL RING GEAR, ENSURE THE STARTER'S PINION GEAR TOOTH-COUNT MATCHES THE ENGINE FLYWHEEL RING GEAR TOOTH-COUNT.

2.5 Theory of Operation

- A. When the starting circuit is energized, battery current is applied to the starting motor terminal. At the same time, current flows to the starter solenoid causing the solenoid armature to extend axially and close the internal electrical contacts. Current flows to the starter motor and extends the pinion gear for engagement with the engine flywheel ring gear.

B. Starter motor engagement occurs when the pinion gear meshes with the flywheel ring gear. On the engine is a flywheel with a ring gear attached around its edge. This flywheel is fitted to the end of the crankshaft. On the starter, the pinion is designed to fit into the grooves of the ring gear. The starter motor is powered by the solenoid, which helps to push the starter gear forward to mesh with the engine flywheel. As the starter motor spins it turns the flywheel, which turns the crankshaft to initiate the first engine combustion cycle. As soon as the engine starts, the pinion disengages from the flywheel and remains dormant until the next starting event is requested.

2.6 Operational Data

A. 122NL

Rotation	CW
Weight	9.3 lbs
Voltage	12 volts
Power	2.7 kW

B. 122NL/EC

Rotation	CW
Weight	9.3 lbs
Voltage	24 volts
Power	2.2 kW

C. 149NL

Rotation	CW
Weight	9.3 lbs
Voltage	12 volts
Power	2.7 kW

D. 149NL/EC

Rotation	CW
Weight	9.3 lbs
Voltage	24 volts
Power	2.2 kW

E. 149NLR

Rotation	CCW
Weight	9.3 lbs
Voltage	12 volts
Power	2.7 kW

F. 149NLR/EC

Rotation	CCW
Weight	9.3 lbs
Voltage	24 volts
Power	2.2 kW

G. Duty Cycle

- (1) 10 seconds of power (start), 20 seconds cool down (rest) for up to 6 starts.
- (2) 30 minutes cool down before next start attempt.

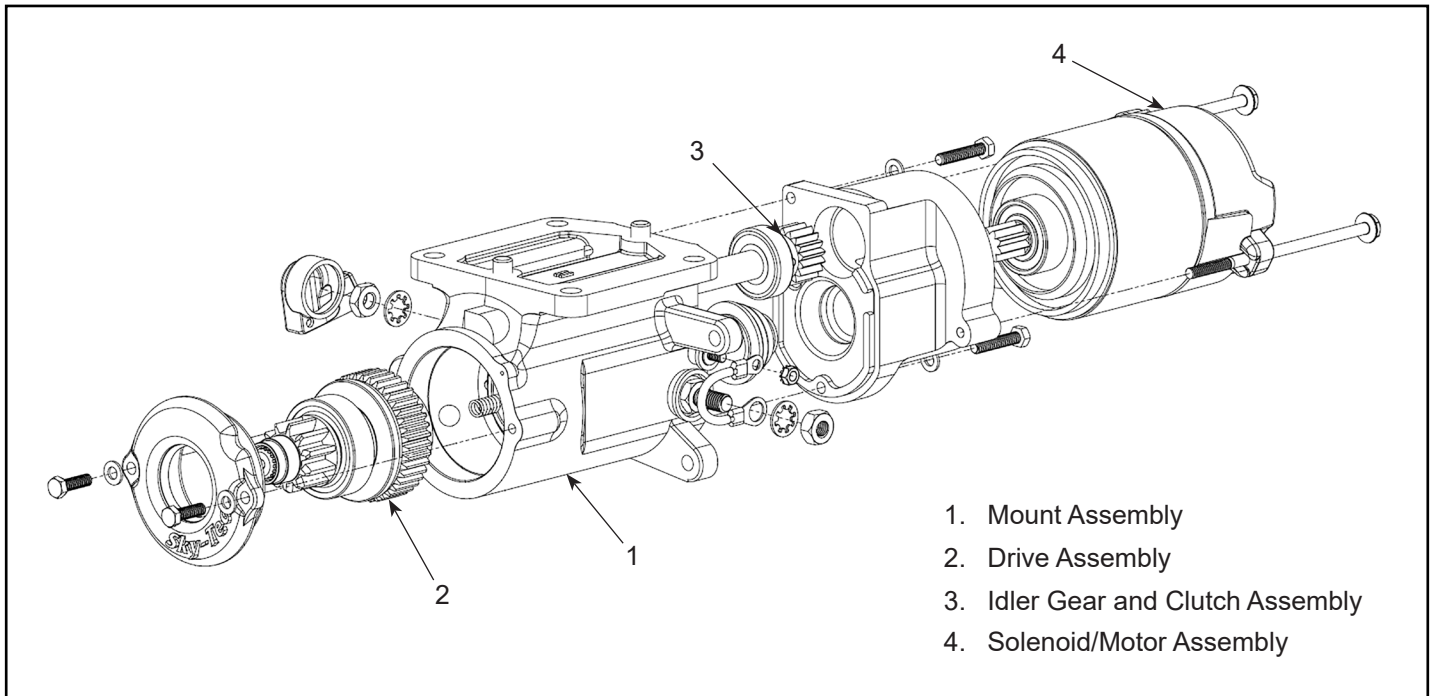


Figure 2.1 – Typical Starter Basic Components, All Models

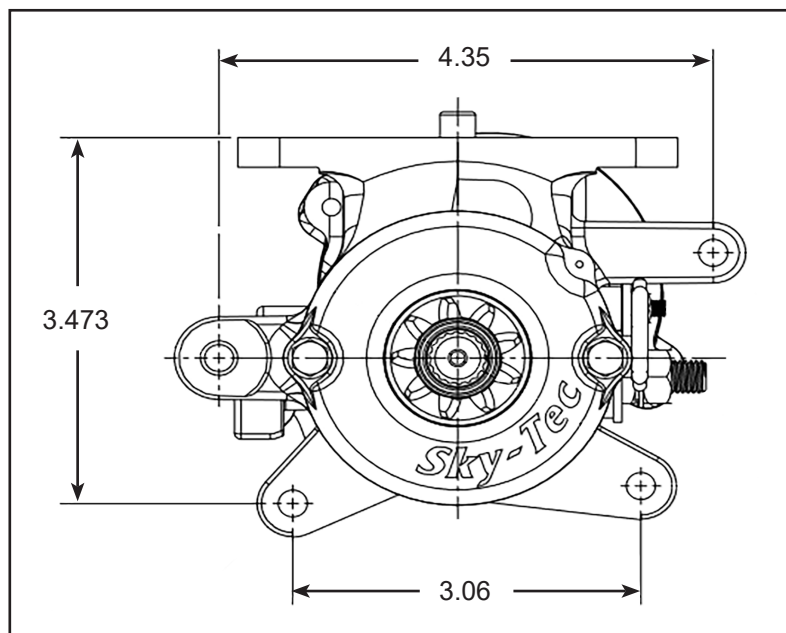


Figure 2.2A – 122NL and 122NL/EC Dimensions - Typical

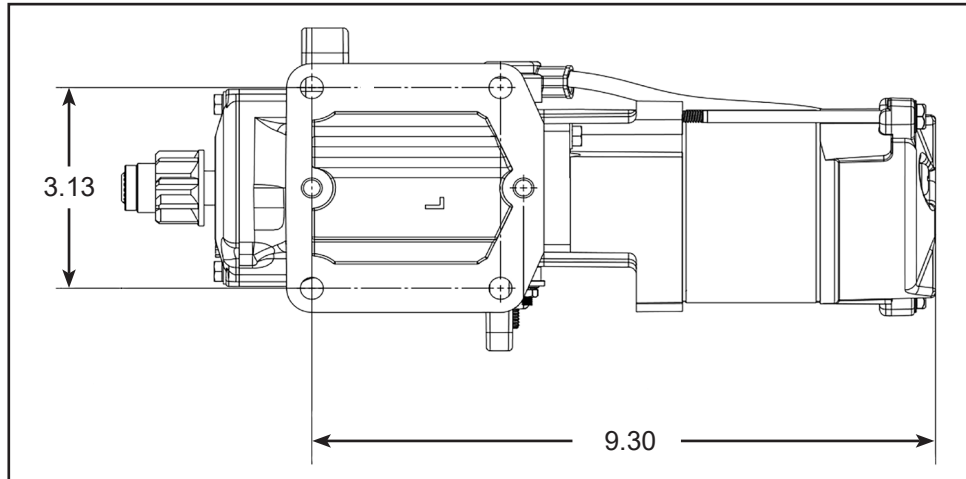


Figure 2.2B – 122NL/EC Dimensions - Typical

NOTE: Figure 2.2B is for model 122NL/EC only. See Figures 2.2E and 2.2F for the remaining 122NL model dimension information.



Figure 2.2C – 122NL/EC Dimensions - Typical

NOTE: Figure 2.2C is for model 122NL/EC only. See Figures 2.2E and 2.2F for the remaining 122NL model dimension information.

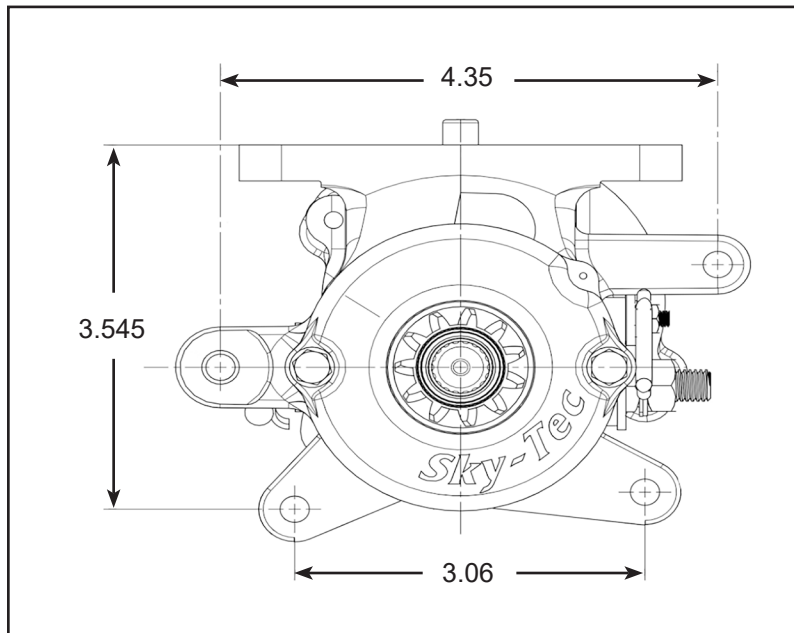


Figure 2.2D – 149NL, 149NL/EC, 149NLR,
and 149NLR/EC Dimensions - Typical

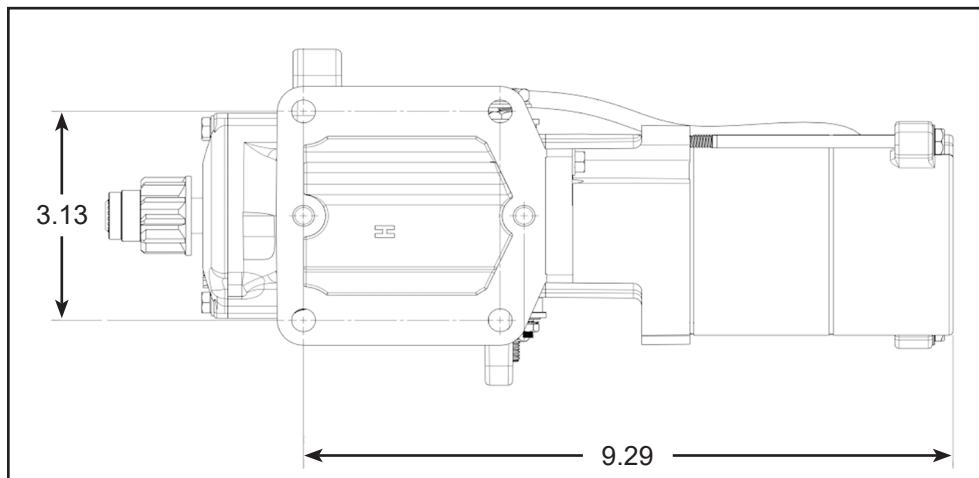


Figure 2.2E – 122NL, 149NL, 149NL/EC, 149NLR,
and 149NLR/EC Dimensions - Typical

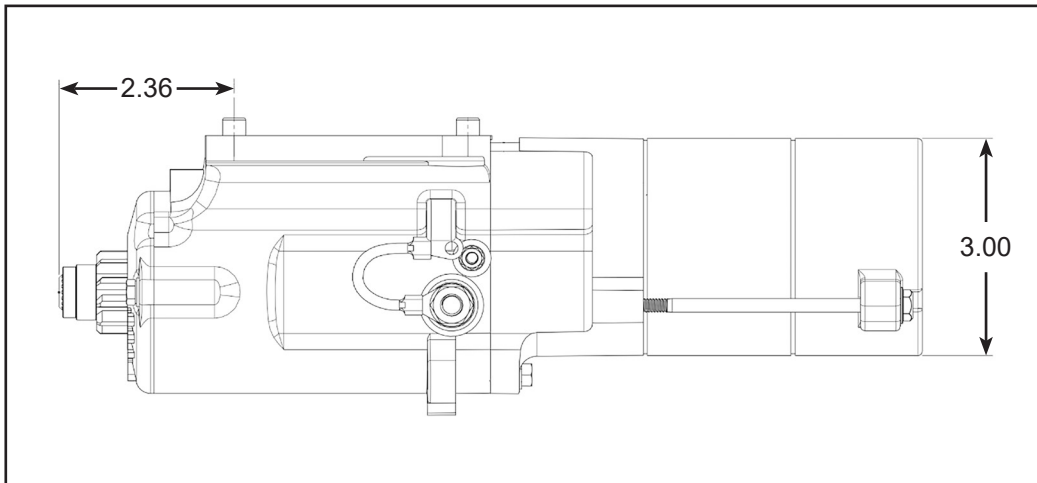


Figure 2.2F – 122NL, 149NL, 149NL/EC, 149NLR,
and 149NLR/EC Dimensions - Typical



Figure 2.3 – Ring Gear Check Gage

NOTE: Contact Hartzell Engine Technologies' Product Support Team to acquire a ring gear check gage.

CHAPTER 3 – TROUBLESHOOTING

3.1 General

- A. It should not be assumed that the starter is at fault prior to employing proper troubleshooting procedures. The overall objective of troubleshooting is to find the cause of trouble and take corrective action to prevent a recurrence.
- B. This section provides general troubleshooting procedures for the starter assembly for unscheduled maintenance and for possible fault detection prior to maintenance activities. It gives procedures to follow to determine the best course of action prior to replacing the starter. Upon determination of fault(s), refer to CHAPTER 5 – TESTING for applicable test procedure(s).

3.2 Procedure

WARNING!

WHEN SERVICING THE STARTER, GREAT CARE AND CAUTION MUST BE TAKEN TO AVOID HAZARDOUS SITUATIONS. THE STARTER, WHEN MOUNTED ON AN AIRCRAFT OR ROTORCRAFT, PRESENTS A PHYSICAL HAZARD FROM PROPELLERS, ROTORS AND OTHER ROTATING DEVICES.

NOTE: It is required to reference the aircraft or rotorcraft AFM or POH as well as the applicable service or maintenance manual as required.

- A. Visually inspect the starter and starter system components for frayed and/or burnt wiring and loose connections. Correct any defects noted. See Figure 3.1 for component diagram.
- B. Perform the following:
 - (1) Ground the magneto P-leads by connecting an electrical conductor from the P-lead terminal to the airframe ground. This will prevent the magneto from making a spark.
 - (2) Set fuel mixture to the Lean Cut-Off position.
 - (3) Set electrical boost pump to the OFF position.
 - (4) Set fuel selector valve to the OFF position.
- C. Perform the following resistance/voltage checks using a VOM to determine where in the system the problem is originating. Refer to Figure 3.1 for items A thru C.
 - (1) Connect the VOM between the negative and positive post of the battery (A) and record the voltage reading. Voltage reading should be a minimum of 9 volts on a 12/14 volt battery and 18 volts on a 24/28 volt battery. If the battery voltage is low, refer to the applicable aircraft/engine maintenance manual to recharge or replace the battery.
 - (2) Connect the VOM probes between the airframe and the housing of the starter (B). Record the resistance reading. Maximum resistance allowed is 0.2 ohms. If greater than 0.2 ohms, investigate the engine to airframe ground.

WARNING!

THE FOLLOWING STEP ENERGIZES THE MASTER AND STARTER RELAYS THAT WILL CAUSE THE PROPELLER TO ROTATE. REMAIN CLEAR OF THE PROPELLER TO PREVENT PERSONAL INJURY OR DEATH.

- (3) Energize the master switch and connect the VOM probes between the input terminal of the starter and the airframe ground (C). Turn the magneto switch to the START position, energizing the starter solenoid. Voltage reading should be a minimum of 9 volts on a 12/14 volt battery and 18 volts on a 24/28 volt battery while the starter solenoid is energized. If the voltage is low, refer to the applicable aircraft/engine maintenance manual to further troubleshoot associated starter system components.

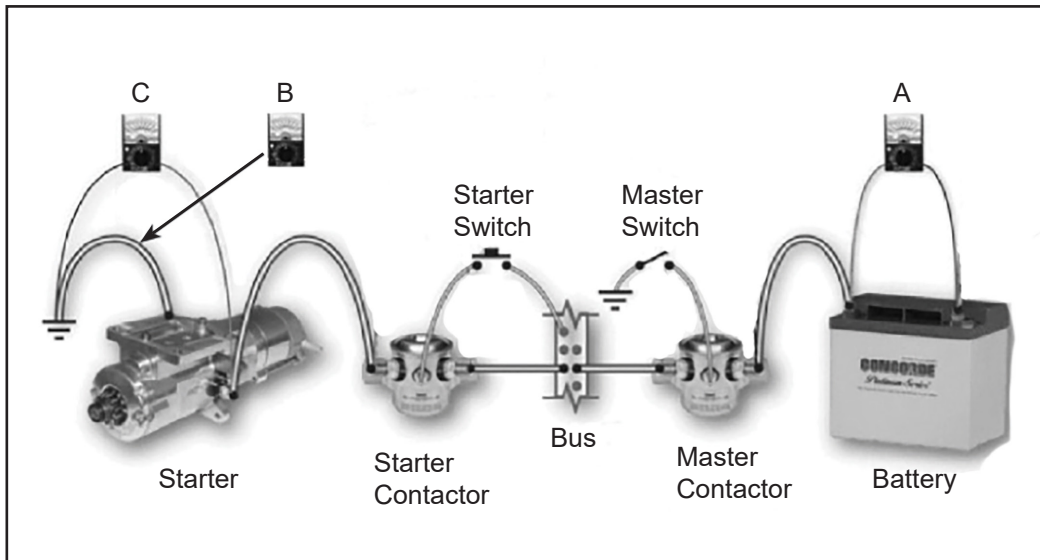


Figure 3.1 – Typical Starter Troubleshooting Diagram

3.3 Troubleshooting Starter – Shear Pin

- A. In the event the starter motor is energized but the propeller is not engaged, the shear pin that prevents damage to the starter motor during a kickback may be sheared. Refer to § 6.3 for Shear Pin Replacement Instructions.

CHAPTER 4 – CHECK

4.1 General

- A. This section defines the various checks and inspections needed to assure reliable and safe operation of the starter while in service. They are listed in hours for time in service (TIS) or in calendar time, whichever are applicable and are the first to occur when offered a choice. Some maintenance is one time initial and others are recurring.
- B. HET recommended maintenance and checks including TIS may be superseded by the aircraft or engine manufacturer's established time limits and schedules based on experience and/or unique requirements under engine or airframe Type Certificate.
- C. Basic scheduled maintenance events are summarized as follows:
 - (1) 10 hours TIS
 - (2) 100 hours TIS
 - (3) 500 hours TIS
 - (4) Time Between Overhaul (TBO)

4.2 Inspection Checks

- A. 10 Hours TIS (one time)
 - (1) Perform an initial check of the starter assembly. Check starter assembly mounting on the engine for security. Check the attach bolts per the engine service manual. Check for signs of overheating or electrical arcing. If noted, determine cause and correct. Make sure the starter assembly is clear of interference with any airframe structure. Check power terminal hardware for tightness and insulators for condition.
 - (2) Inspect the starter pinion gear and engine flywheel ring gear for signs of damage (wear, chipping, etc). Negative indications could mean improper pinion gear to ring gear match. Refer to Textron Lycoming Service Instruction No. 1447A for proper starter to ring gear alignment.
- B. 100 Hours TIS (each 100 hours thereafter or each annual/event, the first to occur)
 - (1) Check for corrosion at power terminal. If present clean and coat terminal with Dow Corning DC-4 or equivalent. Check for signs of overheating or electrical arcing, if noted, determine cause and correct. Check power terminal hardware for tightness and insulators for condition.
- C. 500 Hours TIS (each 500 hours thereafter or each two years, the first to occur)
 - (1) Remove the starter and check the starter for damage and condition. If damage has occurred, replace the starter and/or ring gear as required. Check all terminal hardware and insulators for serviceable condition. Re-install starter using applicable manuals.
- D. Time Between Overhaul (TBO)
 - (1) Replacement is based on the condition of the starter. Replacement time may vary based on cooling, electrical load, and general service. When published, the aircraft OEM TBO shall supersede this HET recommendation.
 - (2) The starter should be replaced at 2,700 hours of engine operation, when a major overhaul of the engine is performed, or if servicing is required.

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CHAPTER 5 – TEST

5.1 General

- A. This chapter outlines the no-load test to determine the condition of the starter removed for scheduled and unscheduled maintenance. Refer to the procedures given in CHAPTER 3 – TROUBLESHOOTING, prior to applying any test for maintenance.

5.2 Testing

A. Equipment

- (1) Standard and special tools used in this chapter are limited.

(a) Standard tools

- Standard mechanic's hand-tools
- Torque wrench in-lb (N·m)
- Safety gloves
- Protective goggles (eye protection)
- Ear Plugs (hearing protection)
- Safety shoes
- Protective cotton apron
- Air compressor (shop air)

(b) Special tools

- Voltmeter (0 to 30 VDC)
- Ammeter, 0 to 100 Amp
- Momentary switch, 100 Amp. rating
- Starter test bench, if removed to test (12/24 volt, 0 - 100 A)

- (2) Instruments

- Multimeter (Simpson 260 or Fluke 87) or equivalent with accuracy 1%

B. Test conditions

- (1) Ambient temperature: 70 °F to 80 °F (21 °C to 27 °C)

C. Precautions

- (1) Regular maintenance must be accomplished per this manual and per the applicable aircraft and/or engine service manuals and publications. In addition, observe the following precautions:
- (a) **DISCONNECT THE BATTERY** before connecting or disconnecting test instruments (except voltmeter), or before removing or replacing any unit or wiring. Accidental grounding or shorting at the starter, ammeter, or accessories, will cause severe damage to the units and/or wiring.

5.3 Starter Bench Testing (no-load)

CAUTION!

PRIOR TO BEGINNING THESE PROCEDURES, REFER TO AND OBSERVE THE PRECAUTIONS LISTED IN § 5.2.C. BENCH TEST PROCEDURES MUST BE PERFORMED BY AN APPROPRIATELY RATED MECHANIC IN AN ADEQUATELY EQUIPPED FACILITY.

A. Starter Test Conditions

- (1) The preferred method to test the starter is by using a commercially available starter test bench (rated up to 24 volts, 0 - 100 A), however the procedures below are also considered adequate for testing purposes.
 - (a) The starter is to be at room temperature 70-80 °F (21-27 °C) before beginning the test.
 - (b) The starter is not to be run for longer than 10 seconds for each test.

B. Test Set-up

- (1) Fabricate the test set-up as shown in Figure 5.1.

CAUTION!

OBSERVE CAUTION TO PREVENT DAMAGE TO THE POWER TERMINAL OF THE STARTER. WHEN CONNECTING THE POWER SOURCE LEAD TO THE POWER TERMINAL OF THE STARTER, HOLD THE BOTTOM NUT WITH A 13MM WRENCH WHILE TORQUING THE TOP NUT TO 75-80 LBF-IN.

- (2) With rheostat at zero, press the momentary switch to apply the applicable voltage to the starter.
- (3) Increase the rheostat to apply the applicable voltage to the starter.
 - (a) 12v models - 3 volts D.C. Verify starter motor turns while power is applied (5 secs max)
 - (b) 24v models - 9 volts D.C. Verify starter motor turns while power is applied (5 secs max)
- (4) Verify solenoid strokes pinion gear for ring gear engagement.

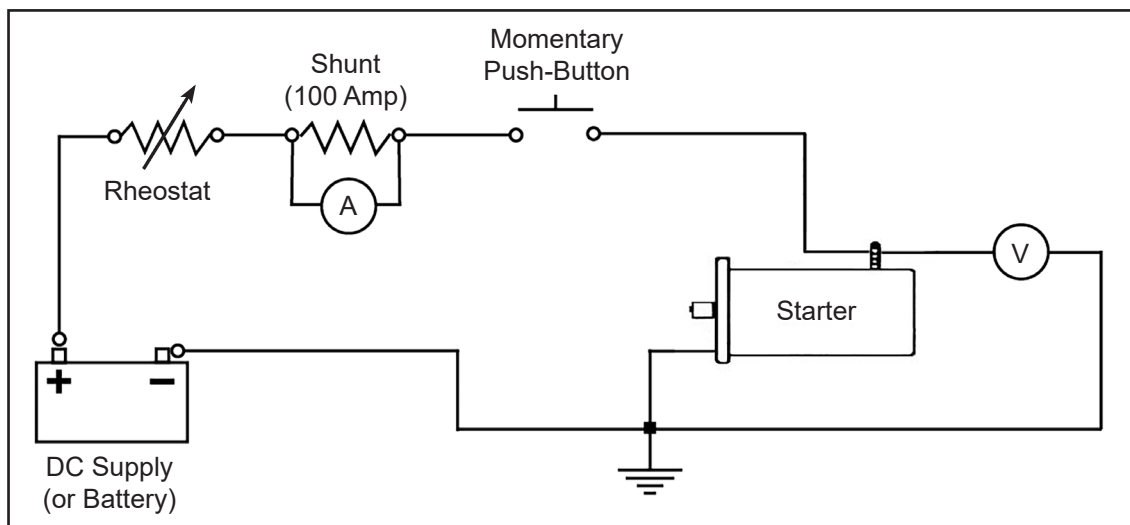


Figure 5.1 – Starter Test Set-up

CHAPTER 6 – MAINTENANCE

6.1 General

- A. This chapter contains information regarding recommended maintenance for all starters listed in this manual. These recommendations assure reliable and safe operation of the starter while in service.
- B. The starters found herein are an accessory designed to be a replacement component. HET recommends a replacement starter as the most economic means of repair.
- C. Ensure to follow the troubleshooting guide outlined in CHAPTER 3 – TROUBLESHOOTING prior to replacing the starter.

6.2 Torque Specifications

CAUTION!

APPLYING TORQUE BEYOND THE VALUES SET IN TABLE 6.1 MAY SEVERELY DAMAGE THE STARTER. EXCEEDING THESE VALUES MAY REQUIRE OVERHAUL OR REPLACEMENT OF THE STARTER.

Table 6.1 – Dry Torque Specifications		
ST2005-25H	M5 Hex Head Screw	55 - 60 in-lbs
ST2308	M8 Nut	75 - 80 in-lbs

6.3 Installation on Aircraft

- A. Install the starter in accordance with the latest aircraft/engine maintenance manual and service instructions.

WARNING!

AIRCRAFT ENGINES USING A FUEL INJECTION SERVO WITH A TOP MOUNTED 90° FUEL FITTING MUST ENSURE THE STARTER POWER-LEAD BOOT IS POSITIONED BETWEEN THE 90 DEG. FUEL FITTING AND THE STARTER HOUSING. REFER TO FIGURES 6.1 AND 6.2.



Figure 6.1 – Improper Starter Installation

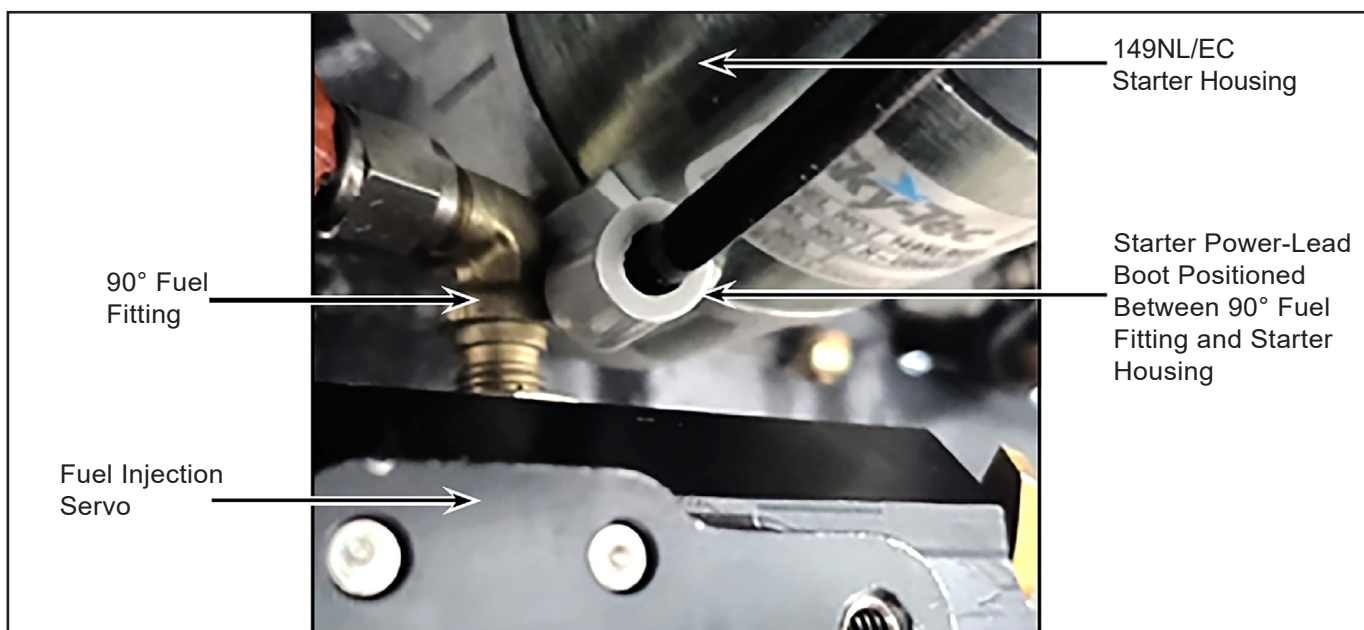


Figure 6.2 – Proper Starter Installation

6.4 Shear Pin Replacement Instructions

NOTE: The index numbers in parentheses in the following steps refer to items called out on the exploded view in Figure 6.3 and are for reference only.

- A. Remove starter from aircraft.
- B. Lift and slide the insulating boot (1) back along the motor lead. Remove M8 hex nut (2) and washer (3) using 13 mm wrench. Remove motor lead from stud.
- C. Remove M5 hex head screws (5) and washers (4) using 8 mm wrench.
- D. Separate solenoid section (6) from motor section (7). Ensure solenoid plunger (8) remains inside solenoid section.
- E. Extract lay shaft (9).
- F. Tap out old shear pin (10) from lay shaft (9) and replace with new spare shear pin from the top of solenoid section (6) or with HET P/N ST4301 or with Spirol CLDP .156x.750 MCK.
- G. Reassemble starter.
- H. Apply high strength thread lock compoint and torque M5 hex head screws (5) and washers (4) IAW Table 6.1.
- I. Torque M8 hex nut (2) and washer (3) IAW Table 6.1.
- J. Slide and reseal insulating boot (1).
- K. Reinstall starter on aircraft per applicable aircraft/engine maintenance manuals and service documents for starter removal and installation instructions.

6.5 Illustrated Parts List

A. Illustrated Parts Breakdown

- (1) The following HET starter assembly parts are available from authorized Hartzell Engine Tech Distributors: Item numbers marked with Δ are required replacement parts any time they are removed from the starter assembly.

B. Annotations

- (1) N/A - Not Applicable to this assembly number.
- (2) A/R - As Required.

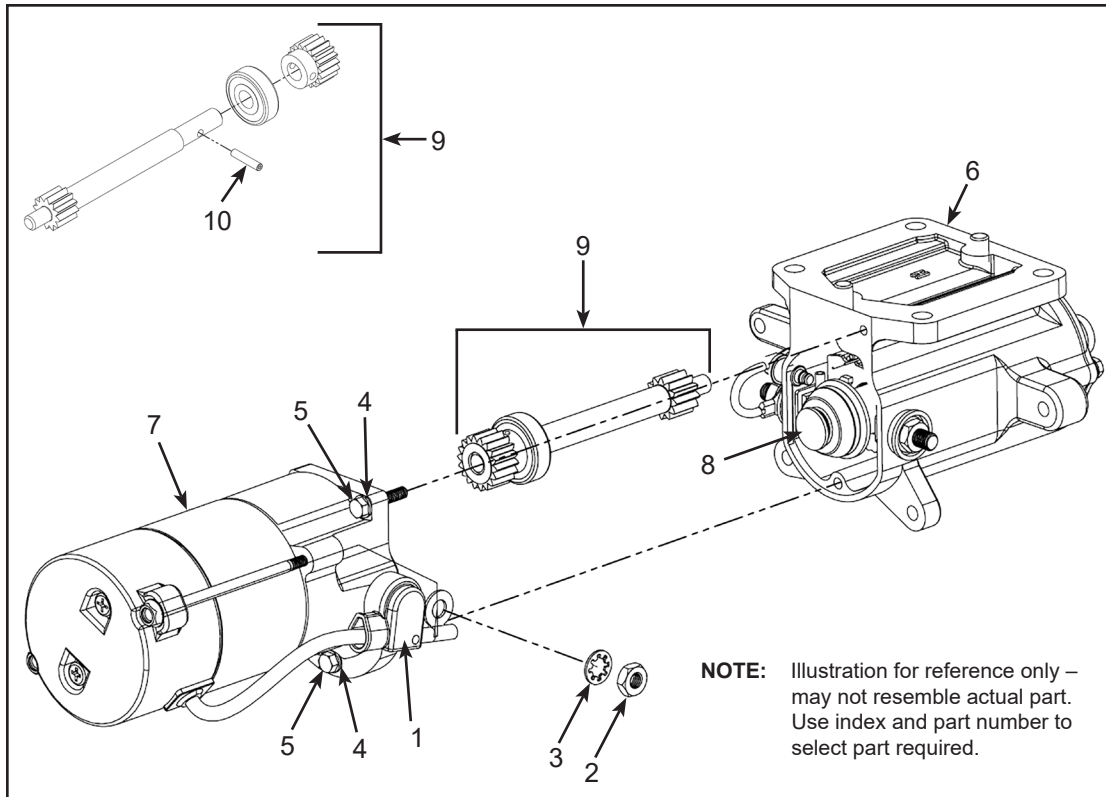


Figure 6.3 – Typical 122NL/EC and 149NL/EC Starter

Index Number	Item P/N	Description	Starter Assembly Part Number									
			122NL	122NL/EC	149NL	149NL/EC	149NLR	149NLR/EC				
1	–	BOOT, LEFT MOTOR LEAD	1	1	1	1	1	1				
2	ST2308	M8 HEX NUT Δ	1	1	1	1	1	1				
3	ST2208-IT	WASHER, INTERNAL TOOTH LOCK Δ	2	2	2	2	2	2				
4	15-2022	FLAT WASHERS Δ	4	4	4	4	4	4				
5	ST2005-25H	SCREW, M5 HEX HEAD Δ	2	2	2	2	2	2				
6	–	SOLENOID HOUSING ASSY. MOUNT	1	1	1	1	1	1				
7	–	MOTOR ASSEMBLY, 12v CW	1		1							
	–	MOTOR ASSEMBLY, 24v CW		1		1						
	–	MOTOR ASSEMBLY, 12v CCW						1				
	–	MOTOR ASSEMBLY, 24v CCW							1			
8	–	PLUNGER	1	1	1	1	1	1				
9	–	LAY SHAFT SUB-ASSEMBLY	1	1	1	1	1	1				
10	ST4301	SHEAR PIN	2	2	2	2	2	2				

Δ Replace with new whenever parts are removed.

Table 6.2 – Starter Models 122NL, 122NL/EC, 149NL, 149NL/EC, 149NLR, 149NLR/EC

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