The Blackhawk 325 Amp Starter Generator offers improved engine starts over the factory offered 200 Amp starter generator, and 325 Amps of continuous power for the aircraft and specific payloads. These improvements are offered with no limitations for operating the aircraft, from ground to service ceiling.

The starter generator is mounted on the top of the accessory case at the rear of the engine. It is a 28 volt, 325 Amp engine-driven unit that functions as a motor for engine starting and as a generator for the aircraft electrical system. When operated as a starter, a speed sensing switch in the starter-generator will automatically shut down the starter, providing overspeed protection and automatic shutoff. The starter-generator is air cooled with an integral fan and ram air from the engine cowling.

**System Description**

The 325 Amp Starter Generator system operates in exactly the same manner as the stock 200 Amp system and the factory optional 300 Amp system. The 325 Amp Starter Generator produces faster spin-up of the gas generator due to its increased current capacity, resulting in lower starting ITTs. All procedures remain unchanged.

The cooling air blast tube is increased to 3” diameter and air remains taken from the oil cooler inlet. There are no additional air inlet(s) from the exterior of the cowling on the Blackhawk XP42A upgrade. The wire harness from the SG to the Electrical Power Distribution Box (EPDB) has been increased from the OEM 4 gauge (2 gauge for the optional 300 Amp system) to its present 0GA. The bus bars internal to the EPDB have been changed to permit use of MIL standard shunts in lieu of the OEM proprietary shunts. The original shunts were rated to 300A, the new Blackhawk shunts are rated to 500A. Lastly, the volt/ammeter has been changed to reflect the new current capacity. The overall system weight increases by 21.0 lbs. The increased overhang moment of the new Starter Generator is within the limits of the Starter Generator accessory pad and the increased power extraction has been evaluated and only affects operation when full available torque is not available (high, hot conditions).

This new 325A system does not have operational limitations; from an operational perspective, pilot should monitor ITT during ground operation. An increase of Ng from Low Idle to High Idle is prescribed if the displayed ITT approaches 750°C (PWC engine limitation). The full rated 325A electrical power capacity may be used during ground and flight operations.

**Performance**

As indicated in the previous sections, the full output of the Blackhawk 325 Amp Starter Generator is available for all operating environments, including both ground and air. This capability has been demonstrated in developmental and certification tests under the stringent conditions established by the Federal Aviation Administration for engine and engine
component cooling (Advisory Circular AC 23-8C, Chapter 3, Section 5.3). The test methodology prescribes an intense ground/flight profile, testing or empirically correcting data to the prescribed “100°F day”. For our tests, Blackhawk tested in an atmosphere that was at or above 100°F on the ground.

During the test, the Blackhawk test aircraft commenced the ground portion with application of the full starter generator output after battery top off (charging current below 10 Amps). The engine was set to high idle with the engine condition lever. Sitting directly crosswind to the prevailing wind, the aircraft was operated at full load in excess 0d 20 minutes.

After the ground run, the aircraft was climbed at the best rate of climb speed (V_Y) until service ceiling was reached. After a brief loitering at the service ceiling, the aircraft descended back to the airport and landed. During the descent, a level off and a simulated missed approach was included within the profile. All of these 3 condition were accomplished with the full 325 Amp load applied to the starter generator.

The starter generator and its cooling system behaved exceptionally well. At the end of this document are time history figures of the final cooling test. The temperature of five primary Starter Generator components was recorded, along with the cooling exhaust air temperature (Outlet). All primary engine parameters, along with air data and the electrical load state of the aircraft we also included. The significance of this test is best illustrated with the following table:

<table>
<thead>
<tr>
<th>Starter Generator Component</th>
<th>Peak Test Temperature °F</th>
<th>Component Allowed Maximum Continuous Temperature °F</th>
<th>Temperature Margin °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Bearing (A)</td>
<td>286.4</td>
<td>350</td>
<td>63.6</td>
</tr>
<tr>
<td>COM Bearing (B)</td>
<td>190.5</td>
<td>350</td>
<td>159.5</td>
</tr>
<tr>
<td>+ Brush (C)</td>
<td>381.3</td>
<td>450</td>
<td>68.7</td>
</tr>
<tr>
<td>- Brush (D)</td>
<td>369.3</td>
<td>450</td>
<td>80.7</td>
</tr>
<tr>
<td>Interpol Winding (E)</td>
<td>227.4</td>
<td>375</td>
<td>147.6</td>
</tr>
</tbody>
</table>

By test, the Starter Generator system of the Caravan demonstrates considerable temperature margin on all critical components for the 100°F day condition. Excess margin provides excess capability for age and for conditions potentially more severe than the test conditions.

**Future**

More performance potential is presently designed into Blackhawk Starter Generator system. The Starter Generator design used in our Caravan has successfully demonstrated 400 Amp output in FAA approved installations. Blackhawk has sized the components of the Caravan to carry and monitor a 400 Amp load. Blackhawk will soon be evaluating this capability and establishing the guidelines for use of the extra potential.

Beyond our Caravan installation, our 325 Amp Starter Generator is directly applicable to the Beech King Air 200 and 350 lines of aircraft. The Starter Generator system can provide the same benefit to those aircraft, including cooler, faster starts, and excess electrical power for additional needs.
## Starter Generator Comparison

<table>
<thead>
<tr>
<th></th>
<th>OEM Stock 200 Amp</th>
<th>OEM Optional 300 Amp</th>
<th>Blackhawk 325 Amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start ITT</td>
<td>----</td>
<td>----</td>
<td>100°C Cooler than OEM 200 Amp</td>
</tr>
<tr>
<td>Ground Operations</td>
<td>No Limitation up to 200 Amp</td>
<td>105 Amp limitation at low ground idle $N_G$</td>
<td>No Limitation up to 325 Amp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>170 Amp limitation at high ground idle</td>
<td></td>
</tr>
<tr>
<td>Flight Operations</td>
<td>No Limitation up to 200 Amp</td>
<td>250 Amp limitation if above FL180 and lower than 100 KIAS</td>
<td>No Limitation up to 325 Amp</td>
</tr>
<tr>
<td>Weight</td>
<td>----</td>
<td>+13.7 lb</td>
<td>+19.9 lb</td>
</tr>
<tr>
<td>Cable Harness Size</td>
<td>4 Ga</td>
<td>2 Ga</td>
<td>0 Ga</td>
</tr>
<tr>
<td>Total/Future Capacity</td>
<td>200 Amp</td>
<td>300 Amp</td>
<td>325/400 Amp</td>
</tr>
<tr>
<td>TBO</td>
<td>2000 hour claim, 400 actual</td>
<td>1000 hour claim, 400 actual</td>
<td>1500 hour “no touch”</td>
</tr>
</tbody>
</table>
Aircraft: Cessna 208B
Registration: N90GL
Engine: PT6A-42A
Date of Test: 10-Jul-14

Average Ground Ambient Temperature: 100.4 °F
Test Description: Cooling Climb Profile
325 Amp Starter Generator
Maximum Gross Weight
Aircraft: Cessna 208B  
Registration: N90GL  
Engine: PT6A-42A  
Date of Test: 10-Jul-14

**Cooling Climb Profile**

325 Amp Starter Generator  
Maximum Gross Weight

**Test Description:**

Average Ground Ambient Temperature: 100.4 °F

**Graphs:**

- Torque (ft-lb) vs. Time (sec)
- Needle Pressure (% NG) vs. Time (sec)
- Needle Pressure (% NP) vs. Time (sec)
- ITT (°C) vs. Time (sec)
- Oil Temperature (°C) vs. Time (sec)
- Oil Pressure (°C) vs. Time (sec)
- Fuel Flow (lb/hr) vs. Time (sec)
Aircraft: Cessna 208B
Registration: N90GL
Engine: PT6A-42A
Date of Test: 10-Jul-14

Test Description: Cooling Climb Profile
325 Amp Starter Generator
Maximum Gross Weight

325 Ambient Temperature: 100.4 °F