



MEMORANDUM FOR RECORD

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Eastern Region

Date: November 18, 2020
Subject: Brake and Antiskid Examination and Functional Testing
NTSB Case Number: ERA21LA036

On November 17, 2020, NTSB Investigator Daniel Boggs examined and tested the brake system and antiskid system on Raytheon 400, N456FL at Fernandina Beach Municipal Airport (FHB), Fernandina Beach, Florida.

The Hawker Beechcraft, Model 400/400A Maintenance Manual, Page 256-261, was used for the testing.

During the examination, Investigator Boggs, confirmed that the antiskid switch was in the "OFF" position and the emergency brake control lever was in the "OFF" position with its safety wire intact.

Also, during examination and functional testing of the brakes and antiskid system by Investigator Boggs, no anomalies were discovered with the brake or antiskid systems, and they operated normally per the functional testing guidance.

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BRAKE SYSTEM FUNCTIONAL TESTING

Functional testing of the brake system consists of three procedures: one without 1,500 psi (105.5 kg/cm²) hydraulic pressure (MANUAL BRAKE SYSTEM), one with 1,500 psi (105.5 kg/cm²) hydraulic pressure but with the anti-skid system inoperative (POWER BRAKE SYSTEM) and one with hydraulic pressure and the anti-skid system operational (ANTI-SKID BRAKE SYSTEM).

MANUAL BRAKE SYSTEM

NOTE: This portion of the functional test is responsible for verifying function of the brake system without 1,500 psi (105.5 kg/cm²) hydraulic pressure. Do not apply external hydraulic pressure to the brake system for this test.

- a. Install a pressure gage on the bleeder port of both main gear wheel brakes (Ref. Figure 201).
- b. Pull the parking brake handle. It should lock in the detent position.
- c. Apply pressure to the pilot's brake pedals two or three times until a firm reaction is felt.
- d. Apply moderate to high pedal pressure to the pilot's brake pedals.
 1. The left and right main gear wheel brake pressure gauges should indicate more than 300 psig (21.0 kg/cm²).
 2. Both brake pressures should be held after the brake pedals have been released.

NOTE: To release the parking brake handle easier, apply brake pedal pressure before attempting to stow the handle.

- e. Return the parking brake handle to its original position. Brake pressure shall decrease to less than 20 psig (1.5 kg/cm²) within a few seconds.
- f. Remove the pressure gauges from the bleeder ports and restore the brake system to its normal configuration.

POWER BRAKE SYSTEM

NOTE: The following procedure functionally tests the brake system with 1,500 psi (105.5 kg/cm²) hydraulic pressure available and the anti-skid system disabled. External hydraulic power must be applied to the system for this test.

- a. Install a pressure gauge on the bleeder port of both main gear brake assemblies (Ref. Figure 201).
- b. Ensure that accumulator air pressure is 900 ± 50 psig (63 ± 3.5 kg/cm²).
- c. Connect an external hydraulic power unit (3, Chart 1, 32-00-00) to the airplane and adjust hydraulic pressure to 1,500 ± 50 psig (105.5 ± 3.5 kg/cm²) at a flow rate of 3 to 6 gpm (11.35 to 22.7 liter/min).
- d. Connect 28 vdc external power to the airplane. Refer to Chapter 24-40-00.
- e. Ensure that the ANTISKID switch is in the OFF position.
- f. Apply pressure to the pilot's brake pedals. A decrease should be noted in both effort and pedal deflection (compared with the manual brake mode) to obtain more than 500 psig (35 kg/cm²) on the pressure gauges for the main gear brake assemblies.

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- g. Apply pressure to the copilot's brake pedals. A decrease should be noted in both effort and pedal deflection (compared with the manual brake mode) to obtain more than 500 psig (35 kg/cm²) on the pressure gauges for the main gear brakes.
- h. Engage the L GND SAFE circuit breaker and disengage the R GND SAFE circuit breaker. Place the ANTISKID switch in the ON position.
- i. Repeat Steps f. and g. and observe the system for the same results.
- j. Engage the R GND SAFE circuit breaker and disengage the L GND SAFE circuit breaker.
- k. Repeat Steps f. and g. and observe the system for the same results.
- l. Disconnect 28 vdc external power. Refer to Chapter 24-40-00.
- m. Remove the pressure gauges from the bleeder ports and restore the brake system to its normal configuration.

ANTI-SKID BRAKE SYSTEM

NOTE: The following procedure is performed with 1,500 psi (105.5 kg/cm²) hydraulic pressure available and the anti-skid system operational (Ref. Figure 201). This portion of the test verifies proper operation of the entire system to include all plumbing, components, controls and associated wiring. Not included in this functional check is the mechanical coupling of the hubcap drive clip to the wheel speed transducer, that requires a visual inspection as outlined under the WHEEL SPEED TRANSDUCER INSPECTION procedure.

ANTI-SKID RESPONSE CHECK

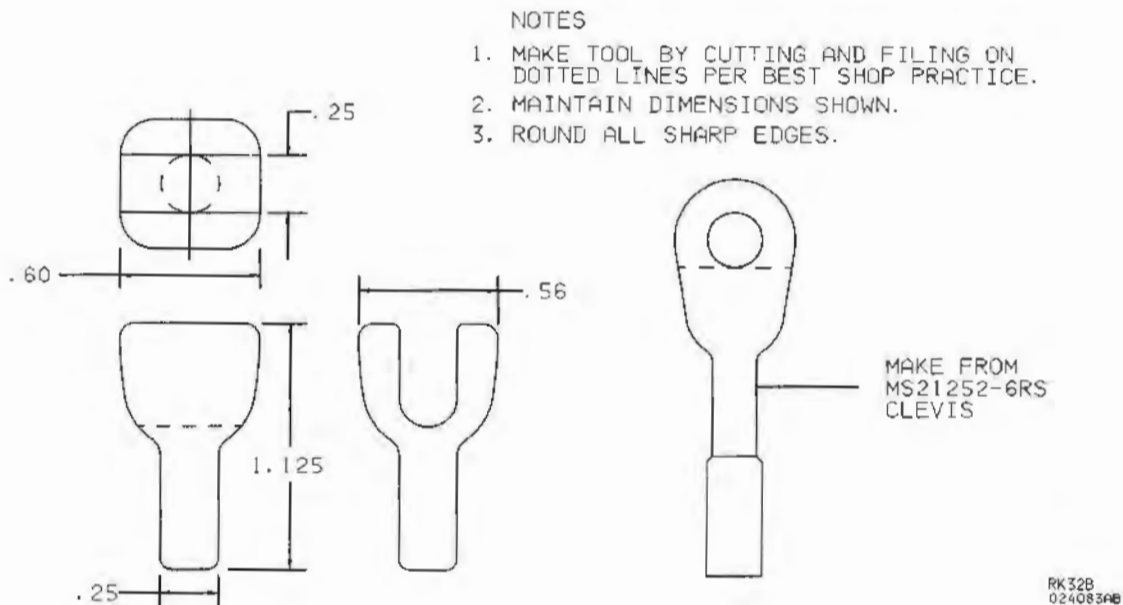
- a. Verify the following:
 - 1. Parking brake handle is stowed.
 - 2. ANTI-SKID circuit breaker is engaged.
 - 3. L and R GND SAFE circuit breakers are engaged.
 - 4. ANTISKID switch ON.
 - 5. Hubcaps removed from both main gear wheels.
 - 6. External electrical power applied to the airplane and the BATTERY switch ON.
 - 7. Airplane on the ground.
 - 8. An external hydraulic power unit (3, Chart 2, 32-00-00) is connected to the airplane and operating at 1,500 ± 50 psig (105.5 ± 3.5 kg/cm²) with a flow rate of 3 to 6 gpm (11.35 to 22.7 liter/min).
- b. Install a pressure gauge on the bleeder port of both main gear brake assemblies.
- c. Fully depress the pilot's brake pedals and maintain the pressure.
- d. Using a drill motor and the fabricated generator drive clip (Ref. Figure 223), mate the drive clip to the LH main wheel speed transducer and spin the transducer at approximately 400 to 1,000 rpm (direction of rotation is optional).
- e. Abruptly stop the rotation. Immediate pressure release of both brakes, followed by a gradual reapplication of pressure, should be noted.

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NOTE: This should occur within 15 seconds, but time is not critical.

- f. Release brake pedal pressure.
- g. Repeat Steps c. thru f. for the RH main wheel speed transducer.
- h. Fully depress the pilot's brake pedals and hold them depressed. Without rotating the wheel speed transducer, place the ANTISKID switch in the TEST position. Brake pressure should drop to zero.
- i. Place the ANTISKID switch in the OFF position. Brake pedal pressure should recover rapidly.
- j. Release brake pedal pressure.



Generator Drive Clip
Figure 223

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FAILURE DETECTION CIRCUIT CHECK

- a. Place the ANTISKID switch in the OFF position. The ANTISKID FAIL annunciator should illuminate.
- b. Place the ANTISKID switch in the TEST position. The ANTISKID FAIL annunciator should extinguish.

TOUCH-DOWN PROTECTION CIRCUIT CHECK

- a. Verify the following:
 1. Parking brake handle is stowed.
 2. ANTI-SKID circuit breaker is engaged.
 3. L and R GND SAFE circuit breakers are engaged.
 4. ANTISKID switch in the ON position.
 5. Hubcaps removed from both main gear wheels.
 6. External electrical power applied and the BATTERY switch ON.
 7. An external hydraulic power unit (3, Chart 1, 32-00-00) is connected and adjusted to $1,500 \pm 50$ psig (105.5 ± 3.5 kg/cm²) with a flow rate of 3 to 6 gpm (11.35 to 22.7 liter/min).
- b. Jack the airplane until the tires are off the ground. Refer to Chapter 07-10-00. Fully depress the pilot's brake pedals and hold them depressed. No pressure should be generated at the brake.
- c. Using a drill motor and the generator drive clip, mate the drive clip to the LH wheel speed transducer and spin the transducer at approximately 400 to 1,000 rpm. Brake pressure should not be applied to either brake.
- d. Repeat Step c. for the RH wheel speed transducer and monitor for identical results.
- e. Using the same method, repeat Steps b. and c., but spin both the LH and RH wheel speed transducers simultaneously at approximately 400 to 1,000 rpm. Brake pressure should be applied to both brakes.
- f. Disengage the L GND SAFE circuit breaker without spinning the wheel speed transducers. Brake pressure should be applied to the brake and reach 500 psig (35 kg/cm²) within five seconds (Ref. Figure 203).
- g. Release brake pedal pressure.
- h. Engage the L GND SAFE circuit breaker.
- i. Remove the pressure gauges from the bleeder ports and restore the brake system to its normal configuration.
- j. Lower the airplane and remove it from the jacks. Refer to Chapter 07-10-00.

PARKING BRAKE SYSTEM FUNCTIONAL CHECK (POWER MODE)

- a. Connect an external hydraulic power unit (3, Chart 1, 32-00-00) to the airplane and adjust the pressure to $1,500 \pm 50$ psig (105.5 ± 3.5 kg/cm²) at a flow rate of 3 to 6 gpm (11.35 to 22.7 liter/min).
- b. Install a pressure gauge on the bleeder port of both main gear brake assemblies.
- c. Place the ANTISKID switch in the OFF position.

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- d. Pull the parking brake handle until it locks in the detent position.
- e. Firmly depress pilot's brake pedals. Both brake pressures should be held after pedal pressure is released.

NOTE: To release the parking brake handle easier, apply brake pedal pressure before attempting to stow the handle.

- f. Push the parking brake handle in to the stowed position. Both brake pressures should be reduced to less than 20 psig (1.5 kg/cm²) after a few seconds.
- g. Repeat Steps d. thru f. with the ANTISKID switch ON. The results should be identical.
- h. Remove the pressure gauges from the bleeder ports and restore the brake system to its normal configuration.

EMERGENCY BRAKE SYSTEM FUNCTIONAL CHECK

- a. Install a pressure gauge on the bleeder port of both main gear brake assemblies.
- b. Ensure that pressure from the nitrogen storage bottle is in the green range as indicated by the pressure gauge on the copilot's instrument side panel.
- c. Place a container below the pneumatic pressure line vent (located at the LH nose cone louver) to catch any drainage.
- d. Slowly pull the emergency brake control handle. Brake pressure should rise above 700 psig (49 kg/cm²).
- e. Return the emergency brake control handle to the stowed position.
- f. Remove the pressure gauges from the bleeder ports.
- g. Perform air bleeding. Refer to POWER BRAKE BLEEDING procedure.

POWER BRAKE ANTI-SKID CONTROL VALVE FILTER CLEANING

There are seven filters installed in the power brake valve. The filters are internal to the unions installed in the power brake valve. Unions with an internal filter are identified with a red dot.

- a. Remove door 311EL to gain access to the anti-skid control valve.
- b. Remove all electrical power from the airplane.
- c. Remove hydraulic pressure from the brake system.
- d. Ensure that the brake accumulator pressure does not exceed the precharge of 900 ± 50 psig (63 ± 3.5 kg/cm²).
- e. Place rags under the power brake anti-skid control valve (5) to catch hydraulic fluid spilled during line disconnection (Ref. Figure 212).

NOTE: Plug or cap all ports and hydraulic lines immediately upon disconnection to prevent excess fluid leakage and system contamination.

- f. Tag and disconnect the electrical connector (6) from the anti-skid control valve (5).
- g. Tag and disconnect the hydraulic pressure line (1) from the accumulator at the anti-skid control valve (5).
- h. Tag and disconnect the hydraulic return line (2) from the brake reservoir at the anti-skid control valve (5).

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- i. Tag and disconnect the master cylinder lines (7) from the mixing valves at the anti-skid control valve (5).
- j. Tag and disconnect the hydraulic pressure lines (8) from the parking valves at the anti-skid control valve (5).
- k. Tag and disconnect the accumulator pressure line (9) from the anti-skid control valve (5).
- l. Procedures for the removal of the filter-unions and packings, ultrasonics cleaning of parts and installation of new packings and the filter-unions for the Power Brake Relay Valve are covered in the supplier section of Chapter 32-00-00 in the Model MU-300/400/400A Component Maintenance Manual.
- m. Connect hydraulic pressure lines (8) from the parking brake valves to the filter fittings on the anti-skid control valve (5) as tagged.
- n. Connect the master cylinder lines (7) from the mixing valves to the filter fittings on the anti-skid control valve (5) as tagged.
- o. Connect the hydraulic return line (2) from the brake reservoir to the union fittings on the anti-skid control valve (5) as tagged.
- p. Connect the hydraulic pressure line (1) from the accumulator to the filter fitting on the anti-skid control valve (5) as tagged.
- q. Connect the accumulator pressure line (9) to the anti-skid control valve (5) as tagged.
- r. Service the hydraulic reservoir. Refer to Chapter 12-10-00.
- s. Service the brake accumulator. Refer to Chapter 12-10-00.
- t. Bleed all air from the anti-skid brake system. Refer to MANUAL BRAKE BLEEDING procedure.
- u. Remove the rags and clean up any spilled hydraulic fluid.
- v. Connect electrical connector (6) to anti-skid control valve (5) and restore electrical power to airplane.
- w. Perform a functional test of the power brake anti-skid system. Refer to BRAKE SYSTEM FUNCTIONAL TESTING procedure.
- x. Install door 311EL.