



NTSB Party Submission

NetJets Aviation Inc.

Investigation: CEN14FA505

N322QS, Embraer Phenom 300s

Lone Star Executive Airport (KCXO)

Conroe, Texas

September 19, 2014

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1.0 Synopsis

Incident Details

On September 19th, 2014, about 0847 Central Daylight Time (CDT) an Embraer Phenom 505s, N322QS, experienced a runway overrun after landing at Lone Star Executive Airport (KCXO) in Conroe, TX. The flight was conducted under FAR Part 91 as a repositioning flight. The two flight crewmembers were the only occupants and were not injured during the event. The aircraft experienced substantial damage during the accident sequence and was subsequently determined to be an economic loss.

Executive Summary

As a party to the investigation, NetJets Aviation Inc. is submitting facts, conditions, and circumstances about the accident for consideration as the final report is developed. The content of the submission attempts to communicate the following: 1) The factors leading to the aircraft departing the runway. 2) The need for improvement in the certification standards related to wet runway performance data. 3) The effect of the use of the emergency brake to stop the aircraft.

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2.0 Factual Information

Meteorology

As stated in the factual report, rain began at the arrival airport at 0444 CDT and continued at moderate to heavy intensity from 0725 CDT until after the accident. Total rainfall between 0444 CDT and the time of the accident was 0.45 inch. The tower controller and the flight crew both stated that moderate to heavy rain was present at the time of landing. Winds were calm and visibility was reported at two miles. The clouds were reported at few clouds at 500 ft., and 10,000 ft. overcast. However, the flight crew reported that there was an overcast layer with bases at 1,000 ft.



Figure 1. Accident Aircraft during landing roll out.

Airport

Runway 01 at 5,000 ft. was the longer of the two runways available on the day of the accident due to construction that shortened the Runway 14 available landing distance to 4,123 ft. The

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runway is 100 ft wide, concrete, crowned at 1.5%, but is not grooved. A Notice to Airmen (NOTAM) reported the PAPI was out of service.

A survey of runway conditions on Runway 1 was conducted by the National Transportation Safety Board (NTSB) Office of Research and Engineering to which NetJets Aviation, Inc. (NJA) was a party. The survey evaluated runway macrotexture depth, runway cross-slope, and runway friction. The results of this survey indicated that the runway was built to design specifications and had runway friction values above the “Minimum Friction Level” and in many places close to the “New Design/Construction Friction Level” defined in AC 150/5320-12C. No water was standing on the runway during a 0.5 inch per hour rain event observed during the survey.

Performance Planning

Under 14 CFR 91.103, there is no regulatory requirement to have any landing distance safety margin in addition to the AFM wet landing distance. However, NJA elects to require for planning purposes that a flight operated under FAR Part 91 has a planned landing distance less than 80% of the available runway length. This is referred to as the factored landing distance. For the accident flight, wet landing distance was calculated at 2,927 ft. which resulted in factored landing distance of 3,659 ft. This was displayed on the flight release as the required landing distance.

The calculated wet landing distance figure was erroneous due to a performance computation system database error. The Embraer Phenom 300 Aircraft Flight Manual (AFM) wet landing distance required for the landing was 3,168 ft., which with the planning factor should have resulted a required landing distance of 3,960 ft. NJA identified and corrected this error after the accident.

NJA complies with FAA Safety Alert for Operators (SAFO) 06012 Landing Performance Assessment at the Time of Arrival, which recommends operators conduct a landing performance assessment (LPA) prior to landing by calculating the actual landing distance based on current conditions, and an adding a 15 percent safety margin to the resulting distance. The LPA distance is considered the required runway for landing. The purpose of the landing performance assessment is to add a safety margin to compensate for variability of pilot performance versus the flight test environment in which the AFM performance data was established. NJA had implemented LPA procedures prior to the accident.

For the accident flight, landing runway 01 with rain present, the AFM landing distance for a wet runway was 3,168 ft. There was no indication to the crew or the tower controller prior to landing that standing water may be present. The LPA resulted in the runway required of

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3,637 ft. Due to the aforementioned database error, the flight crew LPA calculation would have resulted in a required landing distance of 3,366 ft.

As discussed in the performance report, the flight crew did not discuss the landing performance assessment during the approach briefing, however post-accident both crewmembers stated that they had reviewed the LPA requirements prior to departure for a wet runway landing on Runway 01 and were familiar with the required distance.

Event Summary

The aircraft flew an approach to Runway 01 utilizing the Area Navigation (RNAV) Localizer Performance with Vertical Guidance (LPV) approach. The approach speed (V_{REF}) was calculated as 112 knots. Target airspeed per NetJets Standard Operating Procedures (SOP) is $V_{REF}+10$ knots, in this case 122 knots. Airspeed on the approach was maintained within the stabilized approach criteria outlined in NetJets Flight Operations Manual (FOM) of ± 10 knots of target airspeed.

Touchdown occurred 903 ft. from the approach end of the runway at an airspeed of 118 knots. The auto-spoilers deployed upon touchdown. The aircraft is not equipped with thrust reversers. The First Officer, who was the pilot flying, began braking and within six seconds of touchdown the flight crew commented about the lack of deceleration compared to their expectations for the conditions. This lack of deceleration led the pilot flying to believe the brakes were not functioning correctly and he subsequently engaged the Emergency/Parking Brake (EPB) to assist in stopping the aircraft.

The aircraft deceleration rate reduced with the activation of the EPB as the wheels locked due to the inhibition of the anti-skid system which occurs with EPB use. The locked wheel condition led to Reverted Rudder Hydroplaning on the wet runway, which greatly increased stopping distance required.

The aircraft departed the paved surface at the departure end of the runway, crossed an approximately 400-foot-long open field, went through a soil retention fence, and came to rest nose down in a creek bed, 28 seconds after touchdown.

The aircraft suffered substantial damage as a result of impact with the creek bed. There was no post impact fire and the flight crew was able to egress without issue.

Aircraft Performance

Aircraft performance was negatively impacted by three factors: touch down slightly faster than planned, the aircraft not decelerating as expected, and the flight crew's use of the emergency parking brake. The NTSB performance report estimated that the faster touchdown added 716

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ft. (18%) to the required landing distance; the aircraft not decelerating as expected per the AFM performance added 742 ft. (23%). The use of the emergency parking brake added more than 731 ft. (23%). As a consequence, the aircraft impacted the creek bed at a speed of approximately 40 knots.

Post-accident investigation showed that all aircraft systems functioned normally and human performance was as expected.

4.0 Analysis

The failure of the aircraft to decelerate as expected was examined in detail by the NTSB performance report. The performance report detailed the difference in aircraft deceleration rates by comparing the observed deceleration with known runway friction conditions to performance models, including the proposed Part 25.109(c) requirement model. Note: The Embraer Phenom is a Part 23 aircraft and not subject to regulatory standards regarding wet landing performance currently or in the proposed Part 25 standards.

The chart shown below from the performance report illustrates the difference in the models and actual performance of the aircraft. The NASA CFME model most accurately matched the aircraft performance in this event and has been validated in a number of other runway overrun events documented by the NTSB. The resulting difference between actual and expected braking performance on the wet runway was approximately 23 percent. This difference exceeded the LPA safety factor and directly contributed to the accident.

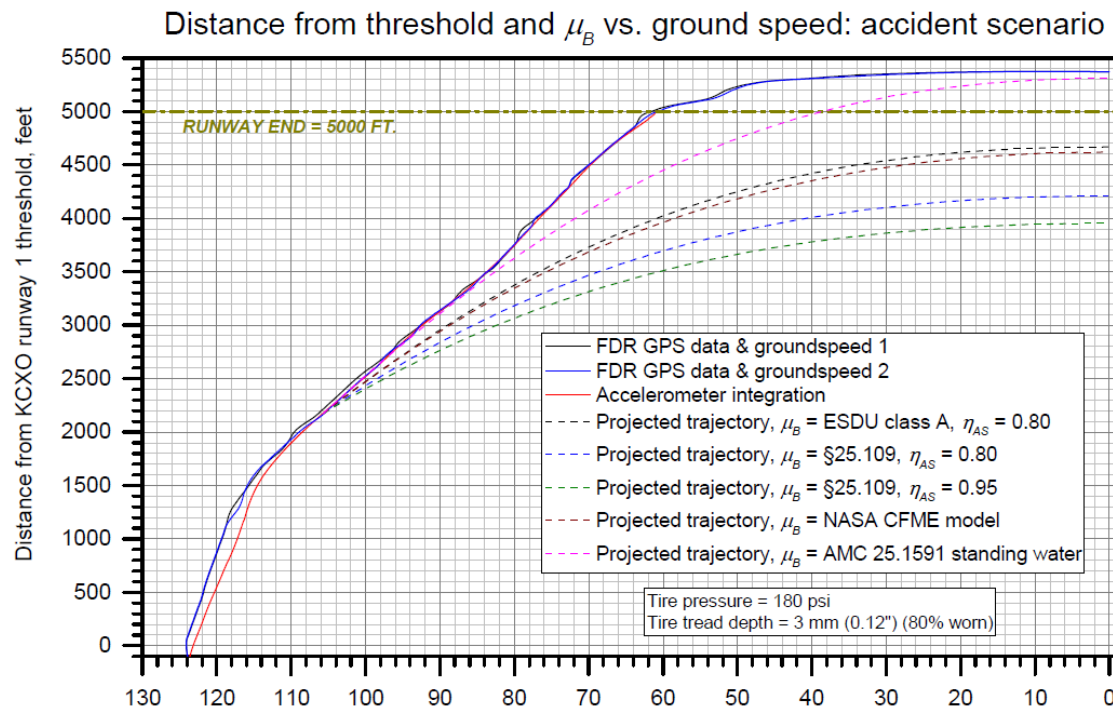


Figure 2. Landing distance performance actual vs. modeled

Flight crew performance impacted two of the factors in the increased landing distance: touch down speed and use of the Emergency Parking Brake. Neither of these factors are unique to this flight crew and could be expected as within the normal range of behavior exhibited by professional flight crews flying the Phenom or other aircraft types in similar conditions.

As discussed above, the NTSB performance report estimated that the faster touchdown added 716 ft. to the required landing distance and the use of the emergency parking brake added more than 731 ft. Given the AFM landing distance of 3,168 ft, neither of these factors alone or in combination should have resulted in the aircraft departing the runway surface. However, when combined with the increased distance due to less than expected landing performance, the stopping distance required exceeded the runway available.

Landing Performance Requirements

The requirements for landing distance performance calculation are defined in aircraft certification standards as outlined in 14 CFR 23.75 and 25.125. The Embraer Phenom 300 is a Part 23 certified aircraft. Neither Part 23 or 25 specify the method for which wet landing data should be calculated for certification purposes. The result is that no standards exist for the calculation of wet landing performance data as presented in the Aircraft Flight Manual (AFM).

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As stated in SAFO 06012, “Wet and contaminated runway landing distance data are usually an analytical computation using the dry, smooth, hard surface runway data collected during certification.” In the case of the Phenom 300, Embraer added a 25 percent safety factor over the dry landing distances rather than using any modeled or flight test data.

5.0 Conclusions

Several factors led to this overrun accident, including a slightly higher than desired speed at touchdown, use of the Emergency Parking Brake due to the flight crew’s perception that the aircraft was not decelerating adequately, and AFM wet landing distance calculations that were not sufficient for the existing conditions.

The first two factors: touchdown speed and use of the EPB are controllable by the flight crew and influenced through training. The final factor of standardized wet landing data performance is beyond the control of NJA or any other operator and thus is best addressed by the FAA requiring Part 23 and 25 certification standards to be based on a consistent model for wet performance such as outlined in the NTSB performance report. NetJets supports the conclusions proposed in NTSB performance report as an effective mitigation for this hazard.

6.0 NetJets Safety Enhancements

NJA recognized two (2) areas for safety enhancements within its control – touchdown speed and EPB use.

NJA determined that touch down speed is best managed proactively through a Flight Operational Quality Assurance (FOQA) program and education efforts directed at the flight crew group overall to highlight the effect of speed variance at touchdown on landing distance.

Emergency Parking Brake use was driven by the perception that the main brakes were not effective in stopping the aircraft and the Emergency Parking Brake would be more effective. The lack of anti-skid braking and the likelihood of locking the wheels with the EPB greatly increases the probability of skids which in turn greatly reduces braking performance such as in this event. The mitigation for this issue is emphasizing the importance of using normal anti-skid braking unless a brake failure is confirmed. NJA has educated all of its pilots on the impact of these factors in landing performance and has implemented a FOQA program to monitor the operation further areas of enhancement.

As a result of this accident NetJets implemented several enhancements to mitigate the hazards identified:

1. Developed a training module with NTSB approval to educate all pilots on the hazards identified during the investigation and the mitigations to prevent reoccurrence.

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2. Issued an Aircraft Operations Bulletin (AOB) regarding the use of the emergency brake system, cautioning crews to activate the emergency brake only when positive indication of failure of the normal braking system is received, such as a Crew Alerting System (CAS) message.
3. Issued Flight Operations Bulletin 15-06 – Landing Considerations for Wet Runways. The bulletin instructs crewmembers to determine if the runway has a treated (grooved or porous friction overlay). The crew is instructed to use the aircraft flight manual contaminated runway performance data for the lowest contamination depth when the following three conditions are met: 1) the runway does not have a treated surface, 2) thrust reversers are deferred or not installed, and 3) the airport is reporting rain or heavy rain.
4. Implemented a Flight Operational Quality Assurance Program to help identify precursors to these events prior to an accident or incident occurring.
5. Corrected database error resulting in incorrect landing distance being provided to flight crew.

7.0 Recommendations

1. NetJets recommends that the NTSB pursue the conclusions cited in the performance reports as the basis for a safety recommendation that Aircraft Manufacturers for Part 23 and Part 25 aircraft produce wet performance data based on performance models that accurately reflect aircraft performance in wet runway landing conditions for all aircraft.
2. NetJets recommends that the NTSB advocate for increased industry education for the risks of Emergency Parking Brake use when flight crews perceive inadequate braking without direct indications of brake system failure.