DCA11MA076

Excerpts of Gulfstream Presentations of Roswell 1 and Flight 132

(14 pages)

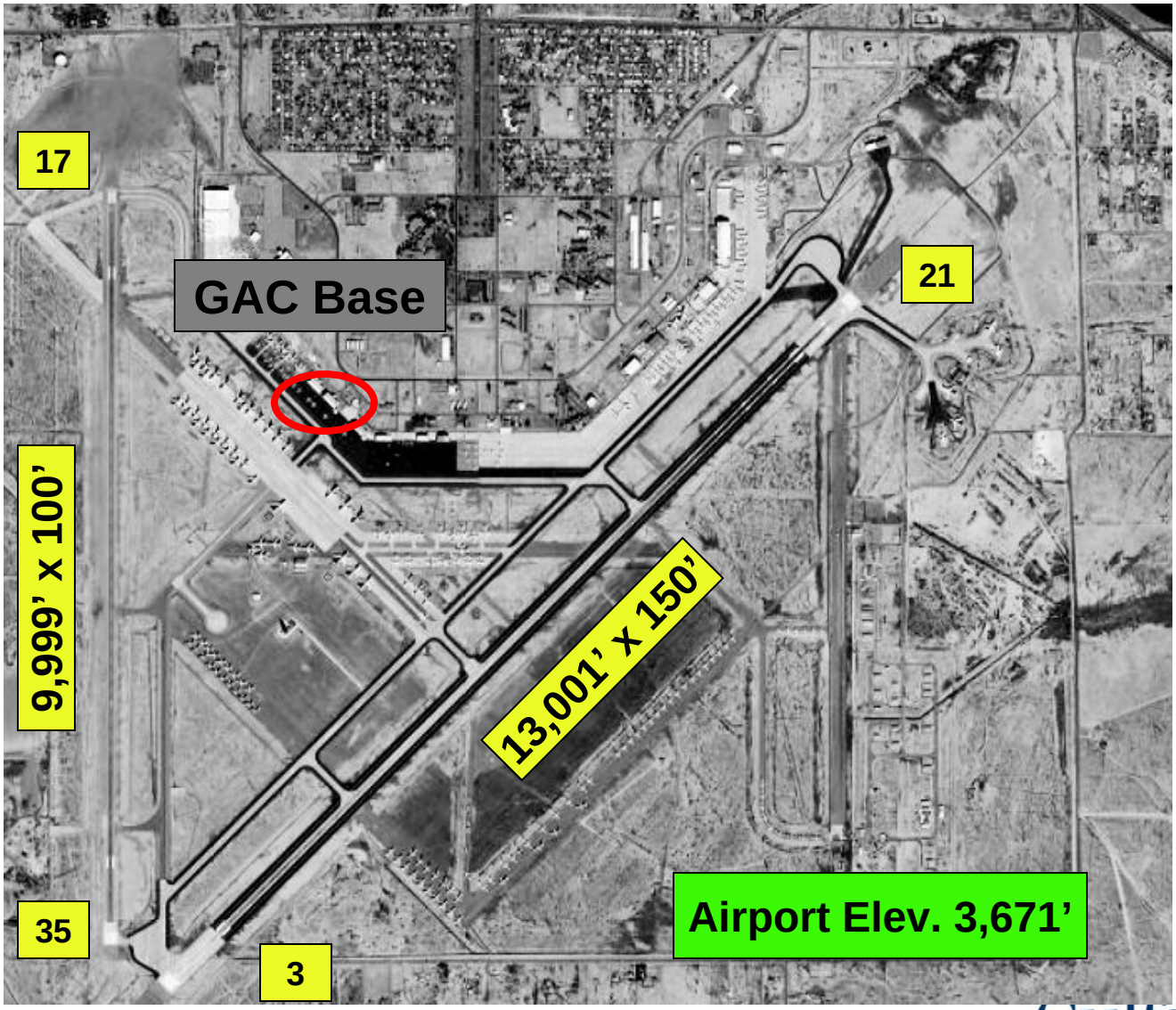
G650 Field Performance
Roswell, New Mexico

SN 6002

8 through 20 November 2010

Gulfstream

Roswell Industrial Air Center (KROW)



Gulfstream

Flight Test Events

- Crosswind Landings
- DV 1.6 and 1.4 Brake Testing
- AEO Takeoff Performance
- 1EO Takeoff Performance
- Vmu Testing
- Preliminary Landing Performance (3º Approaches to targeted touchdown descent rates)
- Miscellaneous Testing Up and Away
  - Engine Out Climbs
  - RAT Deployments
  - APU Starts
  - Engine Airstarts

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Vmu Definition and Regulatory Requirement

- CFR 14 §25.107 Takeoff speeds
- Definition: Vmu is the calibrated airspeed at and above which the airplane can safely lift off the ground, and continue the takeoff. Vmu speeds must be selected by the applicant throughout the range of thrust-to-weight ratios to be certificated.
- *Vr* may not be less than a speed that, if the airplane is rotated at its maximum practicable rate, will result in a Vlof of not less than 110 percent of Vmu in the all-engines-operating condition and not less than 105 percent of Vmu determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition.

Vmu Testing

- Tests consisted of two engine and single engine selected thrust to weight ratios.
- Target pitch attitudes were 7 to 8; 8 to 9; and 9 to 10 degrees.
- Buildup was used during each phase of testing with successively higher target pitch attitudes.
- Test technique consisted of:
  - *Holding the brakes while the target EPR was set and marked with masking tape on the throttle quadrant.*
  - *Full power was then applied followed by brake release.*
  - *The yoke was brought full aft at 60KCAS and the power was reduced to the target EPR setting by 60KCAS.*
  - *Aircraft was allowed to rotate while back pressure was released to catch the target pitch attitude.*
  - *The test was over as the airplane reached 100 feet AGL on the radar altimeter.*
- Risk Level is **HIGH**.
- Let's look at two videos and some data.

Lessons Learned

- The TSHA has been revised under minimizing procedures to reflect the following:

  Vmu testing will be approached in a build-up manner. Testing will begin at AEO high T/W conditions and proceed to the lower T/W conditions required. The number of required build-ups and repeat testing will be determined by the on-site test team. Additionally, the pilot flying shall have recent experience with the test maneuver or perform a build-up maneuver(s) before conducting the test condition.

A/C 6002 Flight 132 Rolloff Event
Post-Action Event Summary

07/19/2011

6002FLT132 Post-Event Actions

- **Performing Continued Takeoff (CTO) Testing at Roswell in March, 2011, a rolloff event occurred during a Flaps 20 OEI CTO.**
- **Test Configuration**
  - **Light Gross weight ~67.5k lbs, Fwd CG, Flaps 20, Pitch Target 9deg, Right Eng critical (reduced to IDLE for test)**
  - **First Flight CLAW Mode, Shaker set to 0.90 NAOA (no AOA-limiting)**
  - **Due to FCC issue, Yaw Damper was selected OFF for all flying.**

6002FLT132 Post-Event Actions

- **CTO Test Technique**
  - **Set power on both engines and release brakes**
  - **At V1-20kts (to allow engine to spool down prior to rotate), retard R Eng throttle to IDLE**
  - **At Vr-1.5kts, copilot calls “Rotate” and pilot initiates rotation**
  - **Capture target pitch attitude (9deg for test) and maintain until necessary to intercept and maintain V2**
  - **Adjust Pitch attitude to maintain V2 until 400ft AGL**
- **CTO Testing is intended to be the “line-pilot” takeoff technique to maximize takeoff performance**
- **Hazards on TSHA associated with loss of operable engine and loss of directional control**

TSHA-000084-Fld
Perf-Engine-Out TOs (OEI)

6002FLT132 Post-Event Actions

- **Rotation was initiated prior to “Rotate” call**
  - **Rotated at V1 instead of Vr**
- **Real-time comment by Copilot: “Way High, Way Early”**
  - **Referring to Pitch attitude and speed at rotation**
- **Test-day review of event data yielded decision to discontinue Takeoff Performance testing until YD was available**

6002FLT132 Post-Event Actions

- Meeting held 3/24/2011 to discuss Alpha Limiter and stall warning (shaker) functionality and set up for Takeoff Performance Testing.
  - Participants included Flight Sciences (Aero), CLAW and FTEs
- During meeting, sideline video of the FLT132 rolloff event was reviewed
- Outcome of the meeting was to have the shaker set to 0.90NAOA until 10ft AGL
  - Based on data available (Vmu CL primarily), this would provide ~1deg margin to In Ground Effect (IGE) stall angles
- Cog FTE (Reece Ollenburg) also requested Flight Sciences/Control Laws group to analyze event w.r.t. planned alpha-limiter system performance to determine if function/system would have had an impact on the test
  - Primary question was whether KCAS-dot and AOA-dot terms being added to a future version would have had an impact given the dynamics of the maneuver

6002FLT132 Post-Event Actions

- **Flight Sciences performed the requested analysis**

Flt Sci FLT132 AOAL Analysis

- **Results were emailed to Reece on 3/29/2011, and updated on 3/30/2011 to include shaker information**
- **Determination was that AOA-limiting would not have activated because the AOA and rate terms never got high enough to trigger the onset with weight off wheels**
- **Reece distributed the presentation to other FTEs and Pilots via an email (4/1/2011)**

6002FLT132 Post-Event Actions

- NAOA stayed below shaker setting of 0.90NAOA throughout maneuver – highest peak ~0.86NAOA
  - 0.90NAOA selected for shaker based on Vmu CL data
    - Reece calculated -1.6deg CL vs. Alpha shift in Vmu data
  - Because normalized alpha stayed at or below 0.86NAOA, this was not determined to be a stall event
- Takeaway was that the rolloff was caused by a lateral-directional disturbance (Cl-beta, roll due to sideslip) aggravated by the unavailability of the Yaw Damper
- Following the FLT132 review, Reece then requested the same review of the FLT088 Vmu test rolloff event (3/30/2011)
  - In the email distributing the results of the FLT132 review, Reece stated of the FLT088 review that “Hopefully, it will show the limiter catching us before we got to the 13 deg pitch attitude. If not it should.”
  - Analysis never completed because original request cited wrong flight number