Observed Altimetry System Error (ASE) B744-10 Aircraft

John Warburton
FAA ANG-E61
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Issue for Discussion

• Previously presented Altimetry System Error (ASE) results for B744-10 aircraft identified a potential issue with the number of non-compliant points and overall Measuring Group bias.

• Data from the previous presentation was re-processed, and a new data set was generated.
  • New data was created using the past methodology.

• An apparent increase in the monitoring group bias is being observed.
Similar data continues to be observed by and reported to ANG-E61 by other RMAs

- Data available from Automatic Dependent Surveillance-Broadcast (ADS-B) ASE processing was used to confirm Aircraft Geometric Height Measurement Element (AGHME) ASE

Boeing issued a Special Attention Service Bulletin, 747-34-3010, in 2013 giving instructions to test the altimetry system, including pitot-static probes, air data computers, and pressure transducers
Previously Presented Result

B744-10 Aircraft Performance

January 2010 to February 2014

Presented to: NAT Ops Air 13 Meeting
             Paris, France

By: Dale Livingston,
    Separation Standards Branch Manager

Date: 4 March 2014
Airframe Observations
Group Mean & Standard Deviation

Results for Airworthiness-Approved Airframes

Note: ASE variance estimate reduced by assumed measurement variance of (46.8 ft²)
Recent Results

Results for Airworthiness-Approved Airframes

B744-10

Aircraft Operator
- ALA
- HIA
- AIM
- BAN
- CAL
- GOL
- CSA
- CLX
- CMA
- DAL
- DIA
- EVA
- GTI
- ICL
- IZA
- EAL
- EVA
- TAM
- MIA
- NOR
- FCA
- QPA
- S2O
- SCL
- SVA
- TAV
- TSD
- USI
- UAL
- UBB
- YUL
- YVR

Date of Chart: Wednesday, September 30, 2015
Results for Airworthiness-Approved Airframes

Note: ASE variance estimate reduced by assumed measurement variance of 42.6 ft²
Date of Chart: Wednesday, January 06, 2016
ASE Group Chart
ADS-B Data

Results for Airworthiness-Approved Airframes

Note: ASE variance estimate reduced by assumed measurement variance of (12.6 ft^2)
Date of Chart: Tuesday, October 06, 2015

Aircraft Groups Monitors

- A300: 82
- A320: 41
- A330: 39
- B744-15: 15
- B767: 64
- BD700: 19
- B70-190: 75
- B785: 41
- F900: 26
- E77X: 46
- GLB4: 52
- GLF4: 56
- CLF6: 16
- LF48: 38
- MD11: 56
Measurement Comparisons

- The following charts show the ensemble of ASE measurements observed in the UPS ADS-B equipped fleet.
- Single Aircraft Monitoring Group measurements are plotted on top of the ensemble to provide a comparison of that group with the population.
- AGHME and ADS-B ASE measurements are plotted for each Monitoring Group.
Population of ADS-B ASE Measurements

Overall bias of approximately -75ft.
MD-11 ASE

MD-11 bias of approximately 0ft.
B744 bias of approximately -100ft.
Results for AAMA Airworthiness-Approved Airframes B747
Mean: -80.82
S.D.: 47.23
EUROCONTROL ASE Measurements

B744 bias of approximately -100ft.
• ANG-E61 provided a set of ASE-Rs to FAA Flight Standards, AFS-470 for coordination with manufacturers in January 2016
• Track ASE changes during corrective actions
• Share corrective actions in the effort to develop a resource for aiding future large ASE remedies
• One of the subject B744 was removed from service
  + No repair data available, however the aircraft has been identified with the reported error
Aircraft 1

Date of Measurement

ADS-B ASE
AGHME

B744 AGHME and ADS-B ASE
Repeated AGHME Measurements
February 5, 2015 to July 1, 2016
Aircraft 1 Actions Taken

• 5/19/2016 – 5/20/2016: Accomplished ADC accuracy test per AMM 34-12-00-735-020, para. S (Fig. 502 altitude points) on both L and R systems, with R ADC out-of-tolerance (reading high at all test points). It is worthy to note that R ADC originally installed on 5/09/2008 with approximately 36,500 flt hrs. R ADC, S/N 32578786 was replaced and both systems re-tested and found to be within tolerances. Tested both.

• ATC transponders per 34-53-00-735-465 with all altitudes tested (30,000 to 42,000 at 1,000 ft increments) satisfactory. Accomplished pitot static probe inspections per 34-11-01-601, task 206-001 with no noted defects. Accomplished satisfactory altitude alert operational check
Aircraft 2 Corrective Action

- Operator reported they R&R'd all three ADCs, checked everything else but have indications they may still be trending low. – Need to review HM data.
- Resolution insufficient to date although the improvement was noted
Repeated AGHME Measurements for Aircraft 3
January 4, 2015 to August 6, 2016
Aircraft 3 Corrective Action

• Boeing Service Bulletin 747-34-3020 - Navigation - Air Data System - Altimetry System Test. The Test revealed that the altimetry system was out of tolerance, with all Air Data Computers (ADC) exceeding a static error of 0.6mb. All 3 ADCs were replaced and the altimetry system tested satisfactorily after this.

• All other company 747-400 aircraft will have the Boeing Service Bulletin 747-34-3020 performed on them within the next 6 months. Aircraft Maintenance Schedule Amendment to repeat the check at every 747-400 aircraft C check (every 24 months).

• Resolution Insufficient
Aircraft 4 Corrective Action

- 747-FTD-34-12004 Altimetry System Error due to Latent Transducer / Pitot-Static Probe Degradation
- Operator actioned Boeing Service Bulletin 747-34-3020 - Navigation - Air Data System - Altimetry System Test. The Test revealed that the altimetry system was out of tolerance, with all Air Data Computers (ADC) exceeding a static error of 0.6mb, and that the Pitot struts were damaged beyond limits.
- All 3 ADCs and 2 Pitot probes were replaced and the altimetry system tested satisfactorily after this.

• Resolution Insufficient
Summary

• ASE results presented for B744-10, including AGHME data from 2011-2015 and ADS-B data from 2014-2015, show a large and increasing bias in this monitoring group
  ✷ Group Bias 2011-14: 76ft; Group Bias 2014-15: 84ft

• Large ASE was observed in measurements from multiple operators of aircraft in this group
  ✷ Altimetry System Error-Reports (ASE-R) were issued and resolutions are being tracked

• Only one of the cases has been resolved