Topics for Discussion

- FAA Concern with Airbus A320 Aircraft
  - FAA Data
- Cooperation with United Airlines
- Cooperation With Jet Blue Airways
- Cooperation with Airbus
  - Airbus analysis
Interest in Large ASE A320 Aircraft

• The lack of uniformity for US Airways and United Airlines fleets was notable.
  + US Airways acquired many aircraft from the merger with America West.
  + It was decided that working with United (UAL) seemed to be a more tractable problem definition.

• The FAA contacted Airbus in order to get geometric data for each Airbus aircraft type.
  + Geometric height reference: at the GPS antenna or corrected to the altimetry system station on the aircraft?
    • No correction needed.
Mean ASE Performance 2015

Results for Airworthiness-Approved Airframes

Aircraft Group: A320
Group Mean: 81.6
Airframe Mean S.D.: 55.0

Aircraft Operator
- AAL
- AMR
- ASA
- B6
- ANA
- SAS
- CES
- CPT
- CES
- CVG
- CMI
- EWR
- DCA
- DTW
- EWR
- FLL
- IAH
- IAD
- ZRH
- FLL
- IAA
- ORT
- LAX
- JAX
- RDU
- ORT
- TAR
- VCT
- VHL
- YUL
- VCV
- VGB
- VCT
- VGB

Date of Chart: Thursday, February 19, 2015
Airframe
Mean ASE Performance 2016

Results for Airworthiness-Approved Airframes
A320

Reference Statistics:
Aircraft Group: 3680
Group Mean: 26.5
Airframe Mean S.D.: 64.2

Aircraft Operator
- ALN
- AMR
- APA
- ARN
- ASA
- ABD
- AAI
- AAA
- AAE
- ANA
- DKL
- DLR
- DTC
- FFT
- GDE
- GSP
- HDO
- HLD
- JLM
- MEG
- MDA
- MDI
- NMD
- NRS
- NMD
- NBS
- NDS
- NDR
- NPE
- MCO
- MEO
- MIA
- MCI
- MGF
- MSG
- MOL
- VZS
- VQI
- HUF
- NCE
Group Mean ASE and SD 2016

Results for Airworthiness-Approved Airframes

Note: ASE variance estimate reduced by assumed measurement variance of (48.2 ft²)
Date of Chart: Monday, August 22, 2016
A320 ASERs

Repeated Azimuth Measurements for A504D0 (N422UA)
January 10, 2011 to March 1, 2016

Repeated Azimuth Measurements for A50887 (N423UA)
January 1, 2011 to March 8, 2016

Repeated Azimuth Measurements for A51763 (N427UA)
December 19, 2009 to February 20, 2016
A320 ASERs
• 09/29/11
The CMO received copies of six large Altimetry System Error (ASE) Reports (ASE-Rs) sent to the operator by the North American Approvals Registry and Monitoring Organization (NAARMO). (A total of 12 ASE-Rs were delivered on this operator’s aircraft in 2011-2012) The CMO discussed the ASE-Rs with the carrier. They were to review the data and develop a plan to address the reported ASE.

• 11/15/11
The CMO and the operator conducted a teleconference with NAARMO and AFS-360. The measurements methods and potential sources for the altitude deviations were discussed. The operator will contact Airbus to discuss the ASE-Rs and determine if they can help.

• 02/13/12
The CMO received an ASE-R Resolution Form from the operator for a specific aircraft. As this aircraft shows the highest error of the six ASE-Rs, the CMO and the operator agreed to concentrate on correcting this aircraft to determine how best to correct the other aircraft. The aircraft in question had Air Data testing performed on it and it showed an error of 10 feet between the Captains and First Officers altimeters. The CMO, AFS-360, and the operator agreed the best approach to determine the cause of the anomalous altitude measurements was to selectively replace air data components on the subject aircraft and see what effect that made to the measurements. The operator replaced two (2) Air Data Modules which provide input to the #1 (Captain’s) Air Data Inertial Reference Unit. Further measurements were requested and the Resolution Form was forwarded to NAARMO.
Repetitive AGHME Measurements for A4F752 (N419UA)
January 9, 2010 to November 10, 2015

Estimated ASE = 0.0003x + 139
Slope = 0.11 ft per year
Standard Error = 57
Average = 152
Number of Measurements = 764
Continued Investigation

- Aircraft N419UA
  - After swapping ADMs, the resulting ASE was still unsatisfactory.
  - A visual inspection of the static ports revealed that the painted red stripes surrounding the left and right primary static ports had a thickness (0.012 in) that exceeded SRM limits.
    - The red stripes were sanded down and repainted within limits.
  - The Captain’s and F.O.’s left and right Air Data Modules (4 total modules) were replaced as a precaution.
    - The removed ADMs were returned to the vendor for further evaluation with a request from UAL that the units be tested under cold soak conditions.
  - The #2 ADIRU was also replaced.
Repeated AGHME Measurements for A4F752 (N419UA)

- ADMs Replaced
- Static ports fixed
- ADMs replaced
- #2 ADIRU replaced

Altitude System Error (ft)

Measurement Date

1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
4/15/2014
7/15/2014
10/15/2014
1/15/2015
4/15/2015
7/15/2015
10/15/2015
1/15/2016
4/15/2016
7/15/2016

A4F752
Other Operator Maintenance (2)

- 10/21/13 ADM Swap Test
- Operator swapped 4 ADMs (a poor performing aircraft and a good performing aircraft.)
Resulting Observations for N429UA

Repeated AGHME Measurements for A51ED1 (N429UA)
January 1, 2012 to March 31, 2016

Poor performing ADM switched with ADM from N494UA ???
Resulting Observations for N494UA

Repeated AGHME Measurements for A620B7 (N494UA)
January 1, 2012 to March 31, 2016

ADM switched with ADM from N429UA ???
Other Operator Maintenance (3)

- ADIRU 4 MCU v 10 MCU:
  - There was some discussion about the group of this operator’s aircraft that only one of the 8 aircraft have an ADIRU – 4 MCU while the other 7 have a ADIRU – 10 MCU. There seems to be some indication that aircraft with the 4 MCU have better ASE performance.
  - Aircraft SN452 was planned to have a change to the 4-MCU.
  - FAA was notified of change, which occurred January 13, 2016
Cooperation With Operator 2
Maintenance Results

The following work was performed by the operator:

- Replaced ATC2 Transponder – 4/10/14
- Purged all static ports - no water contamination found – 10/7/14
- Performed Altitude and Airspeed Functional check - found normal – 10/7/14
- Accomplished Altitude reporting test – Normal findings – 10/8/14
- Performed skin waviness check – found within limits – 10/8/14
- Performed ATC Transponder Function test - found normal – 10/8/14
- Removed Flight Control Unit - replaced S2 switch – 10/8/14
- Removed ATC1 Transponder – confirmed external failure - 10/17/14
- Removed TCAS computer (erroneous display indications) - found normal – 10/17/14
- Performed all ADIRUs bite check - found normal – 10/21/14
- Performed ADM Accuracy test - found within limits – 10/28/14
- Removed 2 Captain side ADMs – confirmed failure
  - Software fault on 1 ADM
  - The other ADM – NFF - 11/7/14
- Removed 2 FO side ADMs
  - 1 ADM confirmed failure
  - The other was returned to stock on SOS program – 11/30/14
- Extracted several FDR datas 10/8 flights and 11/30 flights- some flights exhibited high altitude readings as compared to ISIS altitude readings. Sent to Airbus for their analysis 12/30/14.
- Provided 4 FAA ASE Charts to Airbus for analysis-12/30/14.
Maintenance Results (continued)

- Provided ADM test results to Airbus - 12/30/14
- Provided Skin waviness test results to Airbus – 12/30/14
- Informed Airbus that mods 31038/31039 Altitude Trim correction not embodied during production
  - noticed that aircraft exhibited Trim = -150ft = Law 3= PM P6129 – 12/30/14
- Provide Airbus with actual flight profile data on flight 577 FLL-SFO with altitude readings on Captain, FO, and Standby
  with AP1 on command and AP2 in command – 1/13/15.
- Provided a clear close-up digital pics on all static ports done during the RON to Airbus – 1/20/15
- Provided Airbus with requested all ADIRS BITE discrete digital inputs – 2/19/15.
- Provided Airbus with an in- depth measurements on Captain side and FO side static ports – 2/19/15
- Provided Airbus with requested alpha call-up parameters – 2/19/15
- Provided Airbus with the second skin waviness test results - 3/2/15

- On 4/3/15, the operator changed all of the static ports on the aircraft.
- One port (FIN 8DA1) which was installed at delivery was found with a plastic plug installed in it.
- After the static ports were changed, ops and leak checks were performed per AMM 34-11-16, which yielded normal results.
ASE History on N629JB

Repeated AGHME Measurements for A83876 (N629JB)

January 5, 2015 to August 13, 2016

Altimetry System Error (ft)

Measurement Date

- AGHME
- ADS-B
Airbus Analysis of FAA ASE Data
(December 2015)

• Airbus was notified by the operator of the large number of ASE-Rs. They contacted ANG-E61 directly for data exchange
  ✦ Timeframe: from April 2013 to April 2015
  ✦ ASE measurements: 318,263
  ✦ Aircraft (MSN): 1772 (1244 SA & 528 LR)
    • Discard MSN without ASE excursions
      ✦ |ASE| < 245 ft
    • Discard MSN with unconfirmed ASE excursions
      ✦ |20 days moving average| < 200 ft
    • Discard MSN with beneficial trend
      ✦ |6 Months Forecast| < 245 ft
  ✦ Found 2 aircraft of concern
    • Aircraft 1
    • Aircraft 2
Current Aircraft 1 ASE Results

Repeated AGHME Measurements for A99077 (N715UW)
January 4, 2015 to August 12, 2016

Altimetry System Error (ft)

Measurement Date

A99077
Repeated AGHME Measurements for AA15CC (N749US)
January 2, 2015 to August 16, 2016
Summary

- Continuing to work with United and Airbus on large ASE causal factors