Air Data Pressure sensor
Thales In-service experience

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Thales Product Range

- A range of products for pressure measurements
  - Pressure sensor
  - Air data processors (ADM, ADC)
  - Standby Instrument fitted with standalone pressure sensor

- 2 generations of pressure sensor
  - High accuracy and maturity
  - Excellent in-service reliability and stability
  - More than 100,000 sensors in-service for Commercial Aircraft use
Pressure sensor product range

2 generations of pressure sensors

Piezo Electric Sensor

1992

Silicon Chip Sensor

1997

Currently in production

20,000 sensors produced

85,000 sensor produced

2011

2 generations of pressure sensors

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2011
Product performance

- Down to +/-0.25 hPa for the operational pressure range (from 100 hPa up to 1400 hPa)

Corresponds to:
- +/- 7 ft at sea level
- +/- 27 ft at FL400

High accuracy pressure manometer used for acceptance test in production and repair shop
Focus on measurement errors

- Measurements performed using a « Primary pressure standard »

- Schwien pressure generators considered as « Primary pressure standards » (COFRAC : French Accreditation Organisation)

- Used for: Initial performance, stabilisation process, final calibration

- Accuracy of Schwien pressure generator is pressure dependant
  
  From 0,03 hPa @ low pressure, up to 0,07 hPa for high pressure

Product performance (+/- 0,25 hPa) close to the performance of the highest manometer standard
Sensors long term stability

As pressure sensors long term stability is a key player in ASE, it is a main driver in Thales pressure sensor design and production process

Design

➢ From piezo-electric to various silicon chip sensors, design targets long term stability with root cause analysis in design as well as in process
➢ Accelerated ageing testing on sensors sets are used to validate the design
➢ In service results are compared to accelerated ageing tests results

Production process

➢ Stability monitored during production process for each sensor
➢ Final acceptance test in production highlights the stability
In service experience: Piezzo Electric Sensor

THALES collects in-service data from its worldwide repair network.

These data give an overview of the behavior of suspected ADM, removed from the A/C following a maintenance action.
In service experience: Piezzo Electric Sensor

For ADM fitted with Piezzo Electric sensor

- Very good in-service reliability observed
- Some units affected by drift phenomenon
- One of the known root cause responsible for a negative drift of the sensor:
  - loss of vacuum inside the reference cavity
  - reference pressure increases
  - causes a negative misreading (pressure underestimated)
  - can explain A/C flying below the assigned altitude

Most of these drifts occur during the first years of operation: typical value 5 years

- Phenomenon stabilizes with time
- Mean drift value: -0.9 hPa (-90 ft at FL400)
In service experience: Silicon Chip Sensor

For ADM fitted with Silicon chip sensors

- Reliability greatly enhanced compared to former generations
- Regular design and manufacturing process improvement leading to excellent stability and accuracy
- These sensors are not affected by drift effect
  - Fail safe concept: decrease of vacuum quality inside the cavity leads to sensor failure (loss of ADM output)
- Common failure modes observed:
  - Very seldom case of slight decalibration can be observed, not correlated to unit age
  - Decalibration equally distributed between positive and negative values
  - Average decalibration value:
    - Negative: -0.5 hPa (50ft at FL 400)
    - Positive: +0.7 hPa (70ft at FL 400)
Conclusion

- For A/C fitted with last ADM generation, limited number of altimetry system error
- For older A/C, some ADM may need to be removed from the A/C for recalibration in Thales shop
- Once recalibrated, ADM recover its nominal performance and a high level of stability, no other drift is expected