SEATS

ADDITIVE MANUFACTURING

EXAMPLES OF LOW CRITICALITY PARTS

Nov 2021

SAFRAN

CERTIFICATION OF AM PARTS BY SAFRAN SEATS DOA

Scope of Design Organisation Approval (Cabin Interiors & Seats)

- **2019 added scope of Qualification of Low Criticality AM Parts for Cabin Interior Application**
- **DOA processes & capability was assessed by EASA**
- **Obtained EASA's approval for DOA capability to qualify AM parts with Low Criticality**

REQUIREMENTS CONSIDERED FOR AM PARTs MANUFACTURING & RELEASE

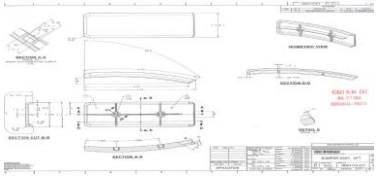
Robust Quality Control Process (Internal Manufacturing and/or Supplier Manufacturing)

- DO-PO arrangements between the Design Organisation (DOA) & Production Organisation (POA) releasing the parts

Robust Quality Control Process (Internal Manufacturing and/or Supplier Manufacturing)

- **Responsibility of QA of POA to approve the parts manufacturing site**
- Qualify the machines
  - Include machines calibration cycles
- Qualify manufacturing processes
- Qualify material handling process
- Qualify personnel working to produce parts
- Process for quality control of the products, i.e, inspection, x-ray, CT Scan, etc to verify no defects or voids
- Batch/Lot control process for serial production
- Ensure that parts are consistently manufactured without any deviation from the parts design and specification
- Parts released with complete conformity certificate
- Robust internal audit process to ensure adherence to aforementioned processes

Examples of Low Criticality Seat Parts qualified under minor change



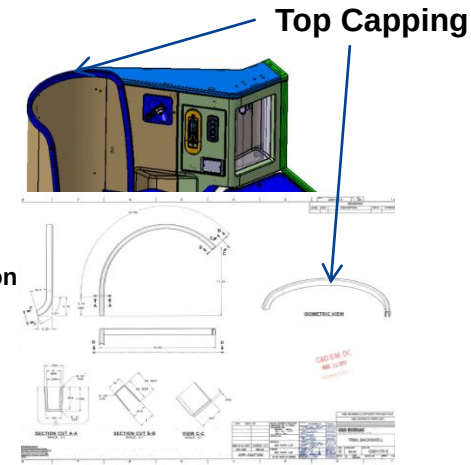
Post damage evaluation
for sharp edges of bumper

Bumper Pad attached with 2 attachments protect seat backshell from trollys' impact

- Current part is injection mounted with compliance requirements :
- New part is ALM part made with Ultem 9085 FDM Technology
- Certification Requirements
  - Mechanical requirements of 25.561, 25.601, 25.603, 25.789,
  - Retention under its own inertia at 9g emergency landing condition
  - Sharp Edges ARP5526D – when break under impact
  - Flammability Compliance to 25,853
  - Environmental DO160
  - Abuse, Endurance/Cyclic testing based on application

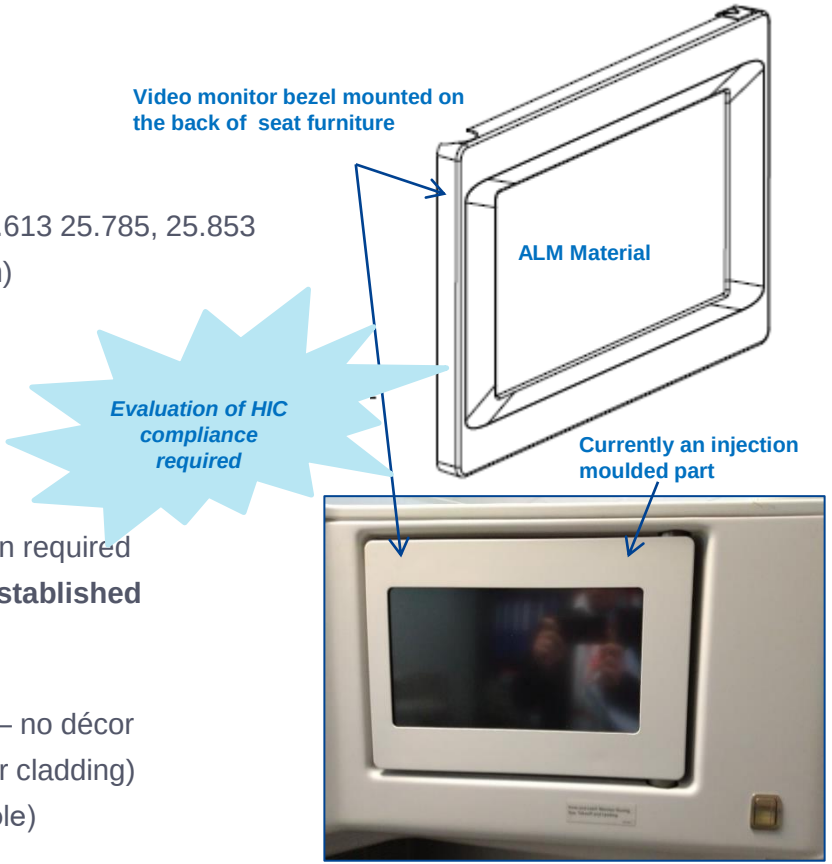
Top capping – Decorative Panel

- Current part is injection moulded with compliance requirements :
- New ALM part is made with Ultem 9085 FDM Technology
- Certification Requirements:
  - No affecting dynamic & occupact safety requirements of 25.562
  - Mechanical requirements of 25.561, 25.601, 25.603, 25.789,
  - Retention under its own inertia at 9g emergency landing condition
  - Hand hold abuse load
  - Sharp Edges ARP5526D
  - Endurance/Cyclic testing
  - Flammability 25,853
  - Environmental DO160



Another example….

- **Part with 4 attachment to the back of Seat Furniture**
  - Establish the affected CS 25 specifications
  - 25.561, 25.562 (Structural & Occupant safety), 25.601, 25.605, 25.613 25.785, 25.853
  - Classified as Minor (based on part usage – non structural trim item)
  - Static Substantiation
    - Strength & Stiffness
    - Retention under 9g Static,
    - Behaviour when break by an impact (produce sharp edges)
    - Cyclic/endurance testing to establish the fatigue/cracking
  - Occupant Safety Substantiation (Head/Neck Injury) – full evaluation required
    - This could classify as ‘Major Change’ if **Head Contact is established**
      - *In this application part is outside of head strike zone*
  - Flammability Properties
    - Establish the worst case - testing in different layers' orientation – no décor
    - Certification testing in combination with décor (paint, laminate or cladding)
    - Meet EASA’s Heat Release Special Conditions (where applicable)
  - Environmental Consideration
    - Establishing the worst case for temperature & humidity



Note: Installation of part as well as interaction with aircraft cabin occupants are considered when deciding about the criticality of parts

Tests Conducted

- **Various material tests to establish the mechanical allowables for internal applications**
  - Tests with various thicknesses material x 24+
- **Inserts shear & tension Tests**
  - Tests to ensure inserts tension & shear strength meet the design requirements
  - Total 34 tests conducted
- **Retention tests for parts**
  - Certification test to ensure parts meet the design intent. 4 Test conducted to verify consistent performance
- **Abuse/Impact test for different thicknesses**
  - 4 Tests each are conducted for strength and sharp edges
- **Cyclic tests to establish the part endurance**
  - Different part & configurations are tested
- **Flammability Tests in different direction to establish the worst case scenario**
  - 36 bare material tests & 36 finish article tests are conducted