Air Ducting Requirements and Design

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Air Ducting Requirements and Design Applicable Systems

Low Pressure Systems inside the pressure vessel

- Conditioned Air Distribution
- Recirculated Air
- Lavatory and Galley Vent
- Electrical/Electronic Equipment Cooling
- Individual Air (Gasper)
- Cargo Heat

Air Ducting Requirements and Design
Low Pressure System Requirements

Thermal

- -65 to 200°F (-54 to 93°C)

Operating Pressure

- -1.0 to +1.0 psig (-703 to 703 kg/m^2)

Thermal Isolation

- Addition of insulation to prevent condensation and improve cooling performance

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Air Ducting Requirements and Design
Low Pressure System Requirements

Weight

- Airplane performance is directly impacted by weight and is therefore kept to a minimum

- A typical 9” (22.9 cm) diameter duct 8 feet (2.4 m) long might weigh only 2.8 lbs (1.3 kg)

Air Ducting Requirements and Design
Low Pressure System Requirements

Durability

- Subject to abuse during shipping, handling, installation and airline maintenance
- Exposed to thermal and pressure cycles
- Inner walls are exposed to high velocity air
- Clamping loads at duct joints and supports
- Flight induced loads

Air Ducting Requirements and Design
Low Pressure Ducting Requirements

Flammability

- FAR 28.853, Duct materials subjected to 12 second vertical burn test (Bunsen burner)
  - Burn length not to exceed 8 inches
  - Specimen extinguish within 15 seconds
  - Drippings extinguish within an average of 5 seconds

- Current duct materials exceed this requirement

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Air Ducting Requirements and Design Material Usage

Composites

- Thermoset construction

  Epoxy, Phenolic or Polyester reinforced with Kevlar or fiberglass fabric

- Weight and durability requirements as well as part complexity have driven the use of composites

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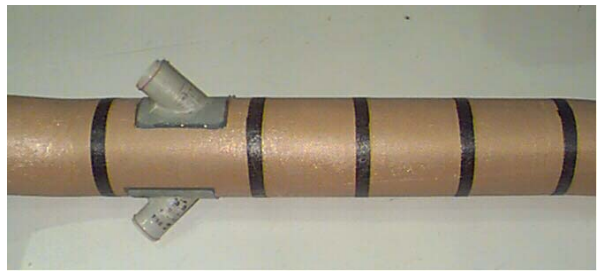
Air Ducting Requirements and Design Material Usage

Composites

- Thermoset construction with negative pressure stiffening rings



- Rigid, closed cell foam construction

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Air Ducting Requirements and Design Material Usage

Thermoplastics

- Configuration determines the material and process
  - Extrusion
  - Rotational mold
  - Injection mold

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Air Ducting Requirements and Design Material Usage

Metallic Ducting

- Aluminum Tube

Hoses / Sleeves / Elastomerics

- AS (Aerospace Standard) and Boeing designed products
- Fiberglass reinforced silicone or neoprene with nylon or Ultem helix
- Nylon reinforced polyurethane with nylon helix

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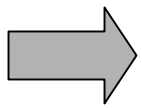
Air Ducting Requirements and Design Future Trends

Materials

- Preimpregnated sheet composites
- Aluminum tube

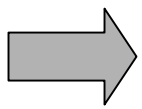


Thermoplastics

Thermoplastics

Processes

- Expendable mandrel lay-up
- Lay-up parts



Permanent mandrel

Molded parts

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Air Ducting Requirements and Design Producibility

Issues

- Many parts are only producible using one process
- Tooling investment is significant
- Process or material changes are expensive once tooling has been fabricated
- History has shown that fabrication and material changes must be proven by test and in-service to avoid significant performance issues

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Air Ducting Requirements and Design Summary

- Multiple requirements affect the design and material decision
- Fabrication process is determined by material,quantity,environment, performance selection
- Part cost varies significantly depending on material and process
- Material or process changes are expensive due to tooling investments