WDL 1B NEW ENVELOPE

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History of WDL

- **Founded by Inge Bachmann and Theodor Wüllenkemper in 1955 (in the same year Lufthansa and LTU got their AOC)**
- **First income with banner towing with an English biplane**

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History of

- **In a very rapid development further services could be established:**
  - **Flight school**
  - **Passenger and cargo flights**
  - **Maintenance centre with avionic department**
  - **Aerial advertising with 30 and more Piper Supercub**
  - **Aerial photography**

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History of WDL

- **In the late ‘60 first involvment in airship advertising**

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History of

- **1969 start of design and production of two WDL 1 blimps**
- **1972 first flight of D-LDFM, the second one D-LDFN short after**

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History of

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History of

- **1987 design of the derivate WDL 1 B, approval 1988**
- **1988 until 1992 production of 3 blimps and one spare envelope**
- **1992 FAA validation**

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History of

- **Operated in Europe, USA, Japan, Africa**
- **Total fleet experience approx 55.000 flying hours**

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History of

- **WDL1 D-LDFO flew more than 18000 flight hours in 25 years in Europe and Japan all the time for one client FUJI**
- **Envelope was built in 1980**
- **No significant detereoration in strength and gas tightness in 25 years**

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History of WDL Airships

Type Certificate Data Sheet

- **LBA 9002/7.9002**
  - **PL4360**
  - **WDL 1**
  - **WDL 1B**

- **EASA.AS.127**
  - **WDL 1**
  - **WDL 1B**

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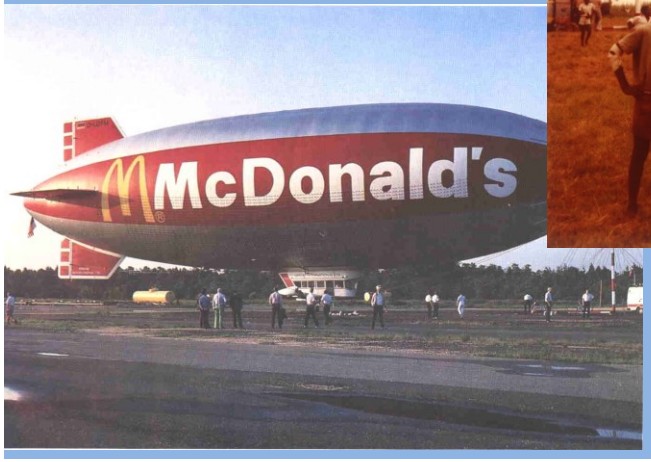
WDL 1



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WDL 1B

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Banner

with a quick release system instead of a layout of the entire envelope

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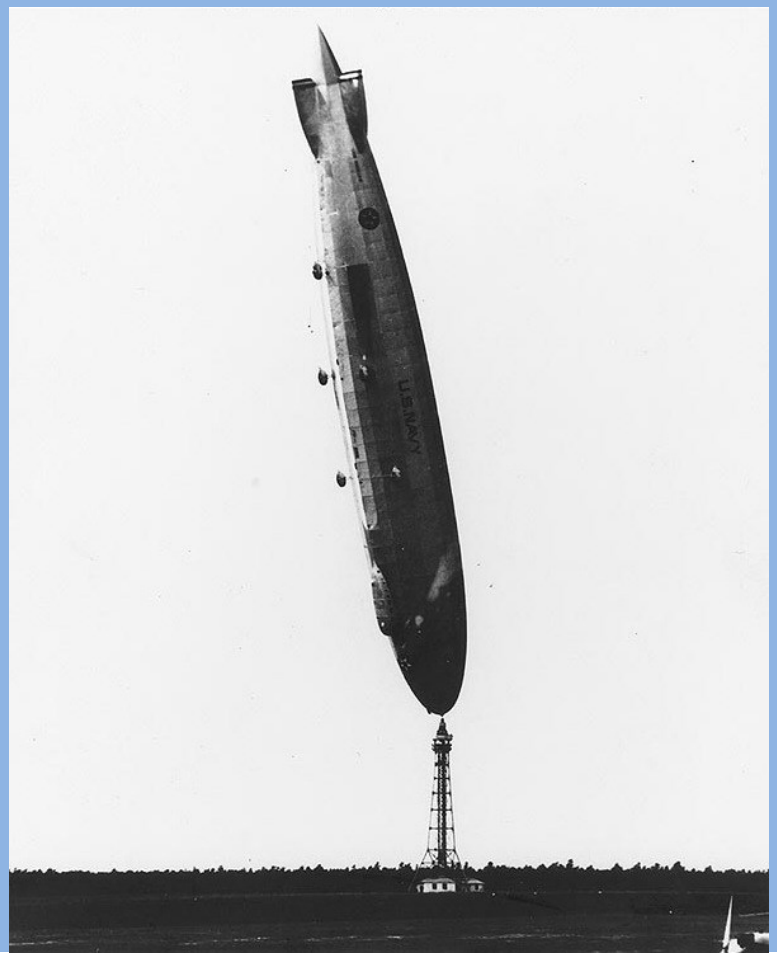
What the big one‘s could do, the smaller can, too



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Weather Risk

1972

ELA
9. Juni 2014

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Project WDL 1 B New Envelope started in August 2014

- **Major Change to TC, non significant**
- **No changes to dimensions**
- **No changes to flight characteristics and performance**
- **Changes to envelope material**
- **Changes, that came along with the material change**
  - **Seam design**
  - **Welding procedure**
  - **Design of attachment, feed-throughs etc.**
  - **Envelope assembly slightly lighter – more payload**
  - **Internal illumination to be approved and installed at a later stage**

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A cooperation between:

- **WDL Luftschiffgesellschaft mbH**
  - **TC-Holder**
  - **Operator**
  - **PART 145 Organisation**
  - **CAMO Organisation**

- **Ballonbau Wörner GmbH**
  - PART 21J Design Organisation ADOAP
  - **PART 21G Production Organisation**
  - PART M Maintenance Organisation
  - CAMO Organisation

- **Gomolzig Flugzeug- und Maschinenbau GmbH**
  - **PART 21J Design Organisation/Contracted DO**
  - PART 21G Production Organisation
  - PART 145 Organisation
  - CAMO Organisation

- **EASA PCM Manfred Reichel**

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Certification Specification

PL 4360 Initial TC

- „Lufttüchtigkeitsrichtlinien für Prallluftschiffe“
- Translation of a descriptive specification developped for Goodyear

WDL 1 Major Change to TC

- „Lufttüchtigkeitsrichtlinien für Prallluftschiffe“ for lack of a more actual specification
- Plus FAR 23 Subpart E and F, where applicable
- Some requirements specific for a hydrogen filling could be neglected

WDL 1 B Major Change to TC

- „Lufttüchtigkeitsrichtlinien für Prallluftschiffe“
- Plus FAR 23 Subpart E and F, where applicable
- Elements of FAA P-8110
- Change in envelope size and shape, max gondola weight, landing gear

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Envelope Material

Old material

- **Hypalon and Neopren coating no longer available**
- **heavy**
- **Production very labour intensive due to the gluing and stitching procedure**
- **Excellent UV protection**

New material

- **PU coating state of the art, translucent**
- **Less weight**
- **Production cost significantly reduced due to the welding procedure**

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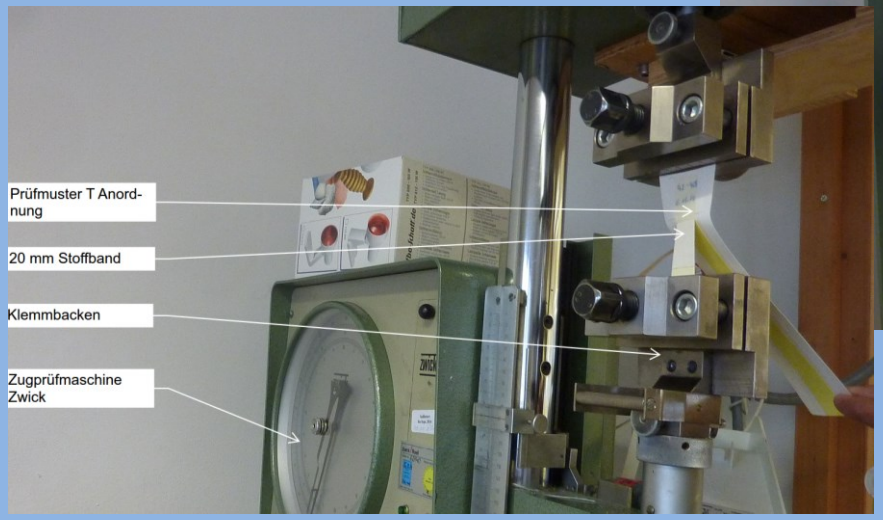
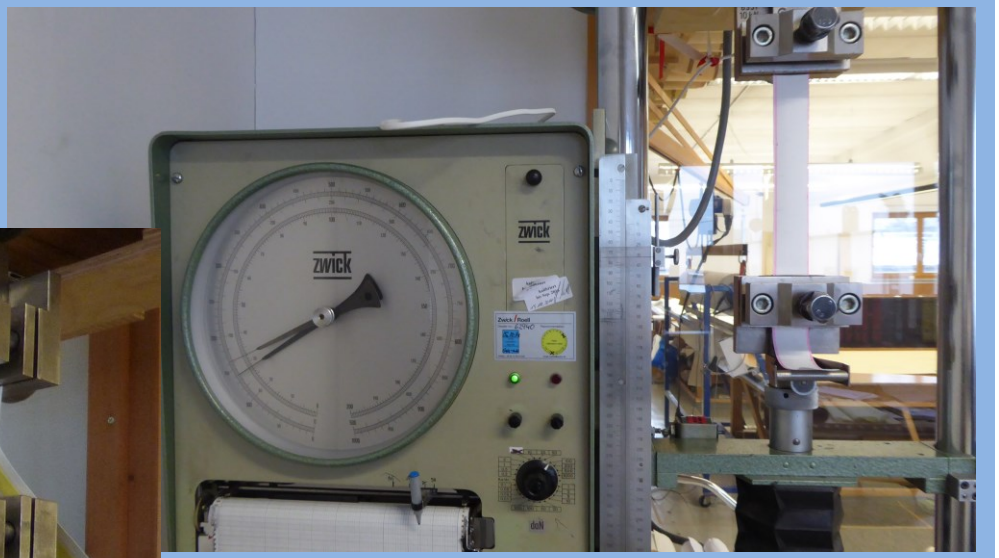
Testing

Basic approach: **new envelope material, production procedures and design elements meets at least the properties and quality of the old envelope**

Material





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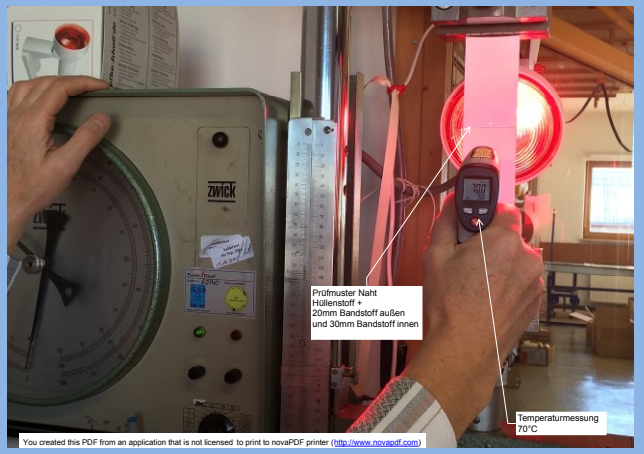
Testing of Production Procedures



Testing of Design Elements

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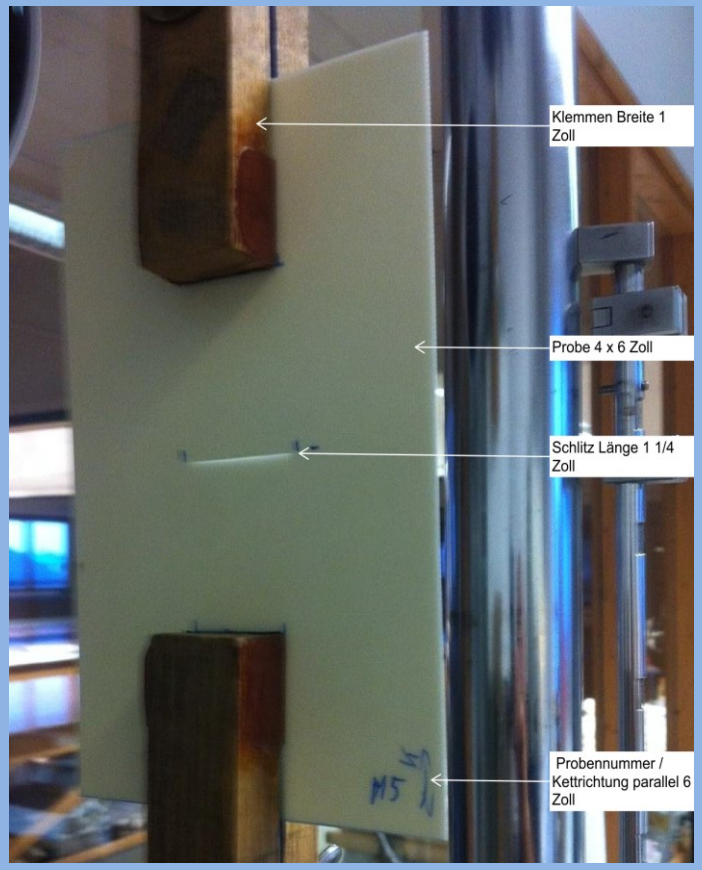
The new material does not meet the properties of the old material with respect to:

Tearing strength

but compliance with the tearing test requirements of FAA P-8110 could be shown



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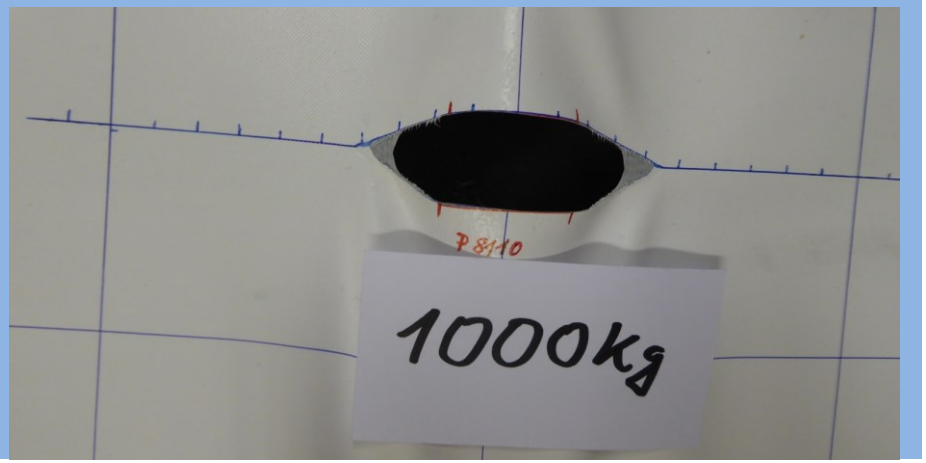
The new material does not meet the properties of the old material with respect to:

Tearing strength

In an even more realistic test it could be shown, that the tear would not propagate under limit load



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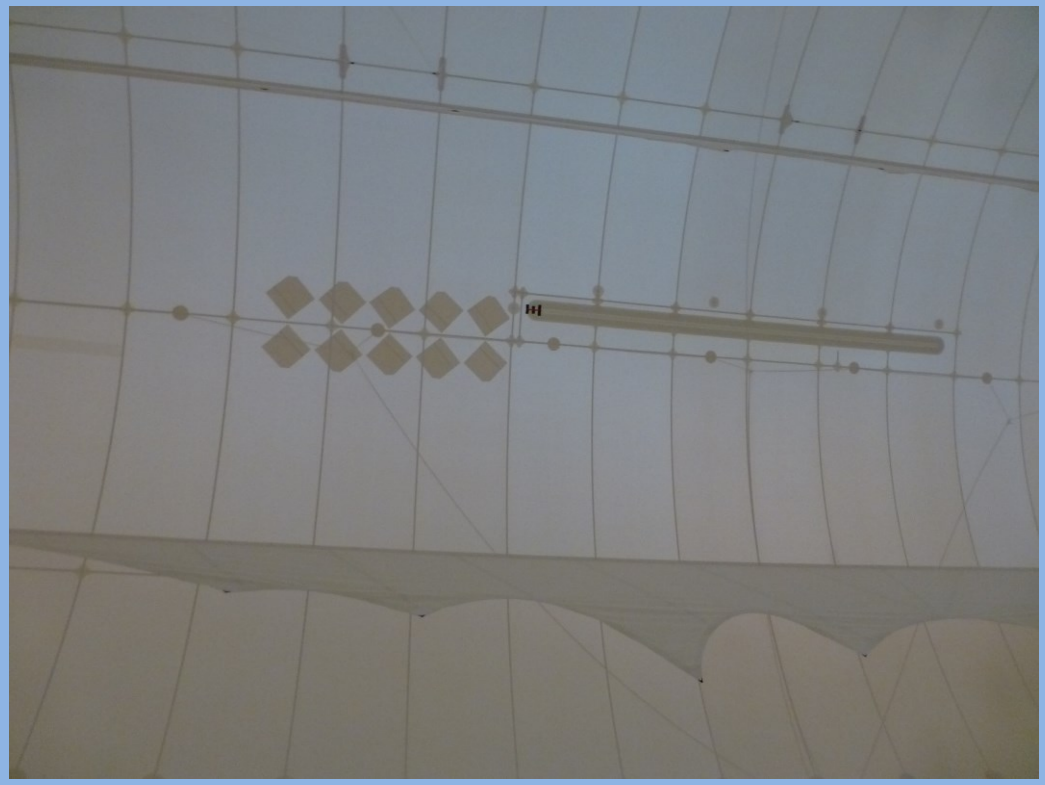
The new material does not meet the properties of the old material with respect to:



Lifetime

Due to the translucent material the fabric is less protected against UV radiation – expected lifetime is 10 years

Every year material testing is required

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Further steps:

- **Envelope pressure test in June 2015**
- **Helium filling in June 2015**
- **Test flights in August 2015**
- **Major change approved in August 2015**

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Envelope material specification:

- **Polyurethan coated Polyester fabric**
- **Weight: 512 g/m^2**
- **Breaking strength: 5500 daN/m**

Tension stress envelope ca. 550 daN/m

at max operating Pressure 55 mmWS (ca 550 Pa)

Safety factor required: 4

Achieved: 10 (inner pressure only)

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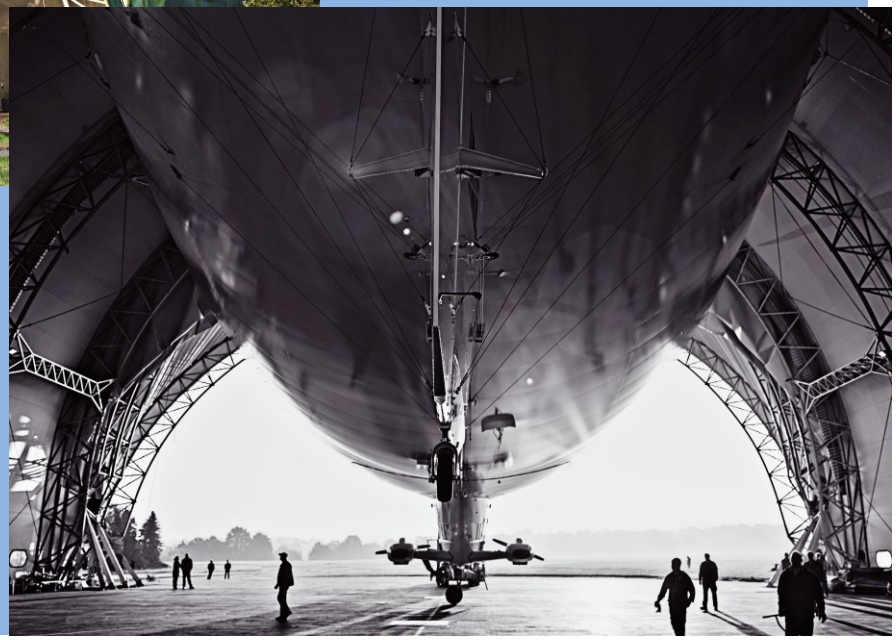

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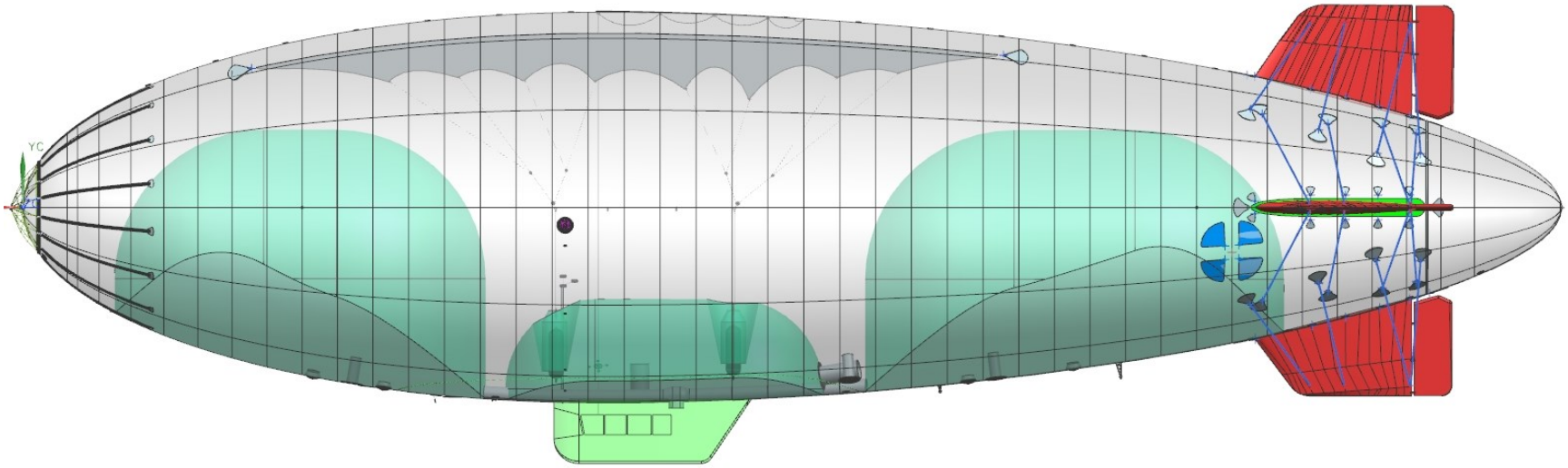
Technical Specifications and Design Philosphy WDL 1B

Length 60 m – Diameter 15,2 m - Volume 6904 m^3 – Surface 2250 m^2



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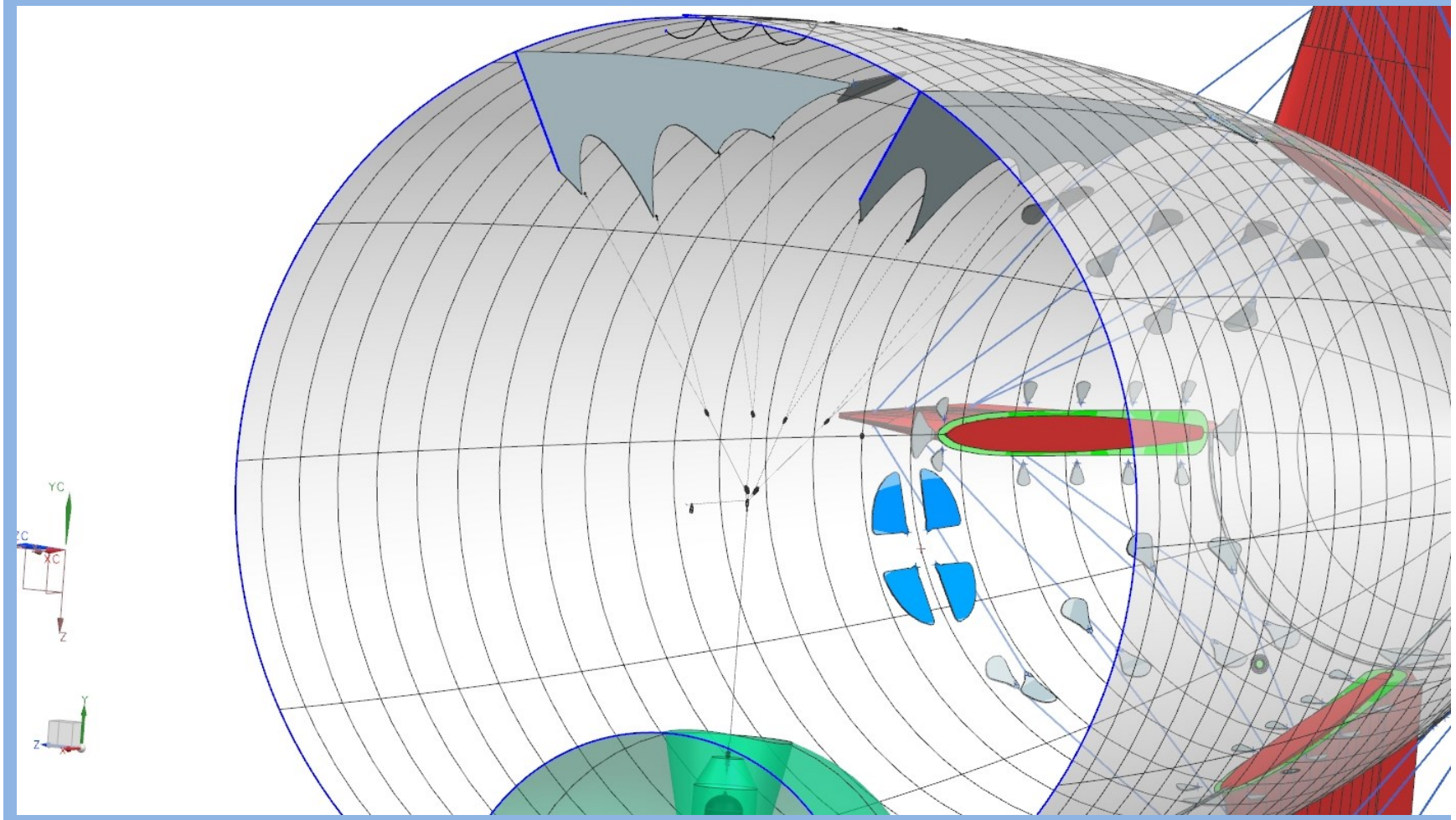
Technical Specifications and Design Philosphy WDL 1B



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Technical Specifications and Design Philosphy WDL 1B

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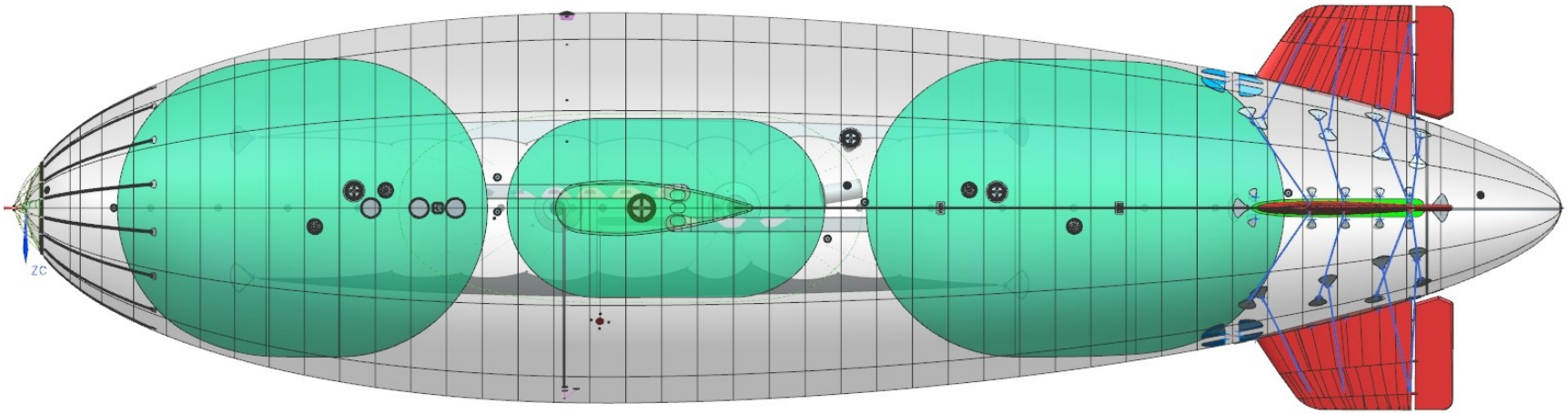
Technical Specifications and Design Philosphy WDL 1B

- **Envelope Pressure System**



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Technical Specifications and Design Philosphy WDL 1B

- **Envelope Pressure System**

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Technical Specifications and Design Philosphy WDL 1B

- **Envelope Pressure System**

Helium volume changes

- **With the height (decrease of density) by 1% per 80 m height increase**
- **With the temperature proportinal $V_2 = V_1 * T_2/T_1$**
- **Impurity (air in helium)**
- **Max climb/descent 7 m/s results in necessary volume flow of approx 6 m^3 per second in or out of the ballonets**

Lift changes

- **If gas temperature and outside temperature are different**

  1° K difference causes a lift change of approx 25 kg
- **With humidity**

  100% humidity in the air reduces the lift by 1% (20°C) or approx 60 kg

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Banner Advertising

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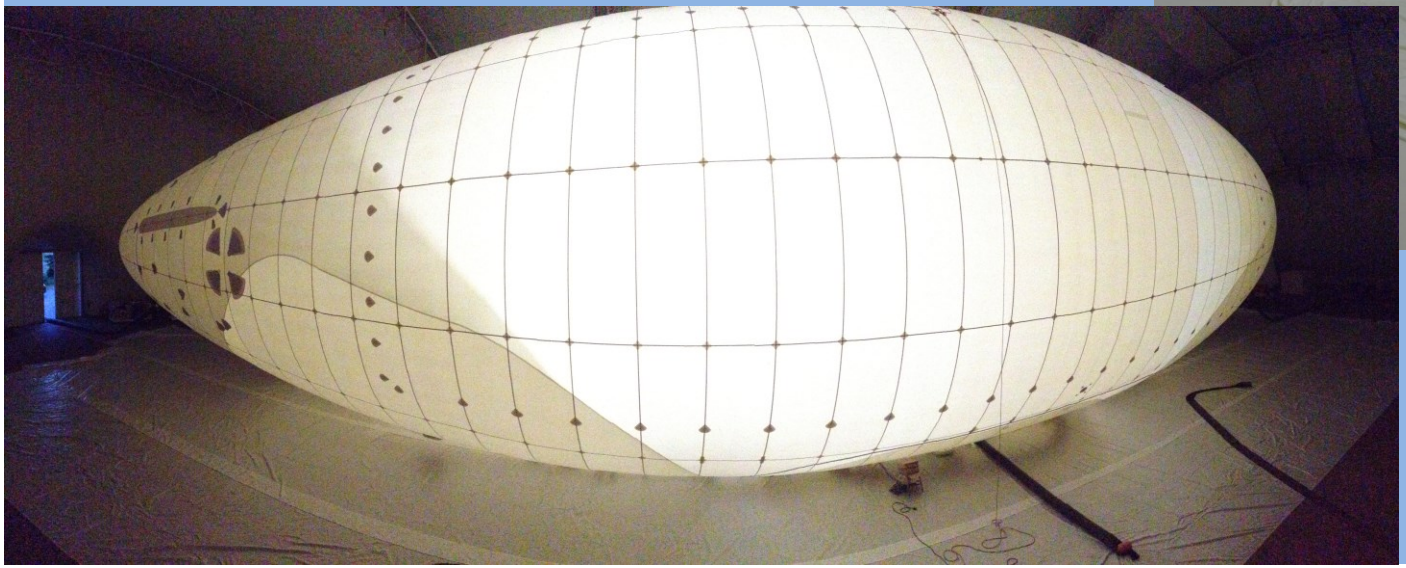
Internal Illumination



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Thank you for your attention!