



**EASA**  
European Aviation Safety Agency

# Metallic Material strength properties and design values

Aiko Dühne  
aiko.duehne@easa.europa.eu  
Structures Expert

**Rotorcraft & VTOL Structures Workshop**  
19-20 February 2019





## CS 23.613: Material strength properties and design values

- Material strength properties must be based on enough tests of material **meeting specifications** to establish **design values** on a **statistical basis**.
- The design values must be chosen to **minimise** the probability of **structural failure** due to **material variability**
- The **design** of structure must **minimise** the probability of **catastrophic fatigue failure**
- **Thermal effects** must be considered where **significant**



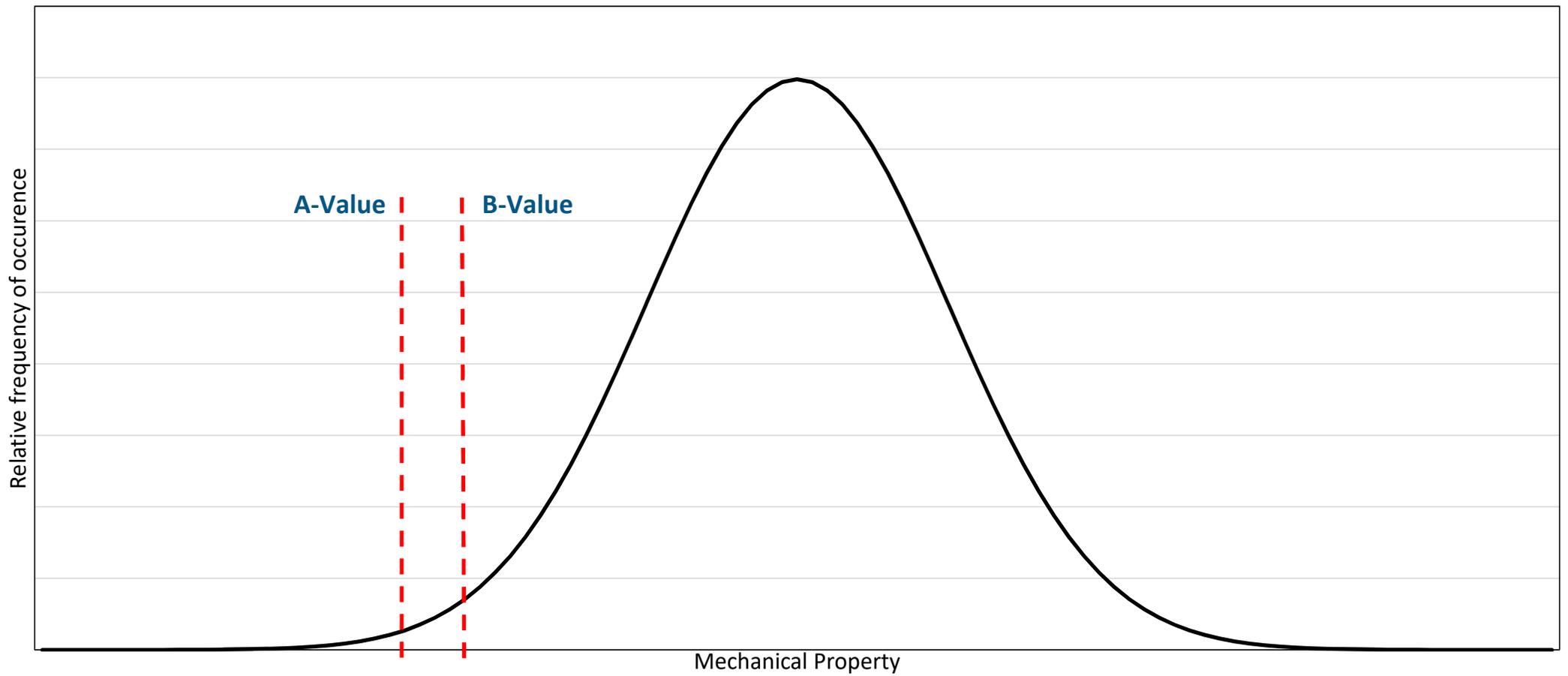
## Values to be used

- Compliance must be shown by selecting design values that assure material strength with the following probability:
- **“A-values”**: Single load path (lugs):  
At least **99 percent** of the population of values are expected to equal or exceed the A-Value, with a confidence of **95 percent**.
- **“B-values”**: Multiple load path (skin-stringer-comb.):  
At least **90 percent** of the population of values are expected to equal or exceed the B-Value mechanical property allowable with a confidence of **95 percent**.



# Values to be used

Normal Distribution





## Values to be used

### ➤ S-Values

- The S-value is based on the minimum property value
- Statistical assurance associated with S-Basis values are only established since 1975 within limitations
- Within these limitations values since 1975 can be considered as estimated A-values
- The use of S-Value should be done **carefully** and needs to be **agreed with EASA**



## Premium Selection

- Premium selection allows using design values greater than the guaranteed minimum
- A specimen of **each individual** item to be installed on the aircraft has to be tested to determine the **actual strength properties**
- Part has to have areas to obtain test specimen without destroying the part
- **Test procedures** and **acceptance** criteria must be specified on the design drawing



## Typical Sources (Examples)

### ➤ **MMPDS**

Metallic Materials Properties Development and Standardization

### ➤ **ESDU 00932**

Metallic Materials Data Handbook

### ➤ **Handbuch Strukturberechnung (HSB)**

(Fundamentals and Methods for Aeronautical Design and Analyses)

The use handbook is restricted to the members of the industry working group IASB.



## Fatigue data

- ▶ Fatigue data plotted in e.g. MMPDS may not apply directly to the design of structures
  - ▶ Fatigue curves are mean curves, **not** A- or B-basis
  - ▶ Fatigue data is based on smooth specimen
  - ▶ Fatigue data may not take into account specific stress concentrations unique to any given structural design.
  - ▶ Localized high stresses may be induced during the fabrication
  - ▶ All fatigue data require modification into allowables for design use.



**EASA**  
European Aviation Safety Agency

**Thank you for your attention!**

Any questions....?

**Your safety is our mission.**

An agency of the European Union

