

**RECARO**

the seat of innovation

# Light Weight Alloys in Seat Design

## Influence of Magnesium in Seats



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## Introduction

- The number of passengers in typical airplanes range between 117 in an A318 to 213 in a A321 and finally up to about 700 in an A380. Taking a seat weight per pax of a FAR 25.562 certified economy seat of 11kg into consideration which can easily rise up to 20kg per pax with IFE integration in a Wide Body the airplanes have to lift and accelerate “seat material” with masses between 1200kg up to 14000kg (30000 pounds). These values make clear that weight is a decisive factor for the economic efficiency in service.
- Rising oil prices in combination with a competition between airlines and its seat suppliers request continuous weight savings. Therefore the usage of light weight alloys with their individual opportunities combined with the design gets a core role in future for aircraft seats.
- Current certification requirements do not allow the usage of magnesium. The growing pressure from airlines on to the suppliers and even authorities lead to intensive discussion in working groups to take care for solutions. Besides approaches with modern aluminum alloys the lecture will cover possible Mg-alloy applications in seat design, and a brief status of a current magnesium program.

## Material Distribution in Seats

### **Seat spreaders:**

- good elongation (>13%)
- good fatigue values
- good corrosion properties
- good bending properties
- milled or forged
- 7075 alloys

### **Backrests and Armrests:**

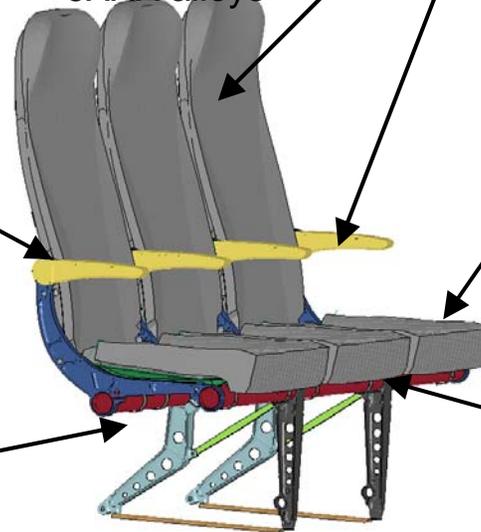
- High elongation (>15%)
- good fatigue values
- good corrosion properties
- extrusions
- 6XXX alloys

### **Beams:**

- High elongation (>15%)
- good fatigue values
- good corrosion properties
- Extrusions
- 2024 alloys

### **Rear legs:**

- good elongation (>10%)
- good fatigue values
- good corrosion properties
- milled or forged
- 7075 alloys



### **Front legs:**

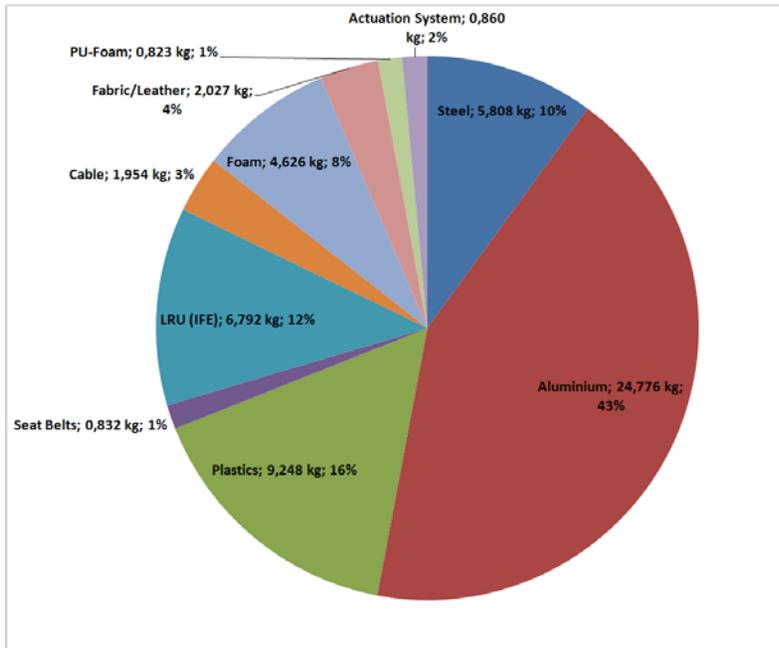
- good elongation (>7%)
- good fatigue values
- good corrosion properties
- milled, forged or casted
- 6082/ 2017/2024 alloys

- Introduction of new materials (i.e. magnesium) needs knowledge about the specific requirements for the location in the structure

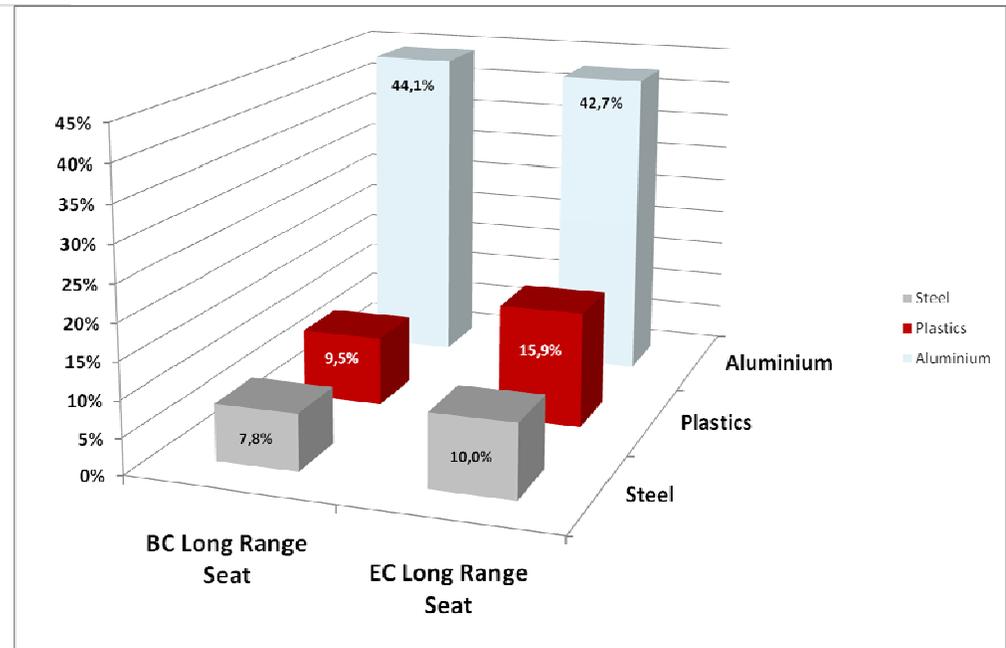
# Material and Mass Distribution in Seats



## Mass Distribution in Seats



Example for EC Long Range Seat



Range of percentage for aluminium, steel and plastics in Seats

- Introduction of new materials (i.e. magnesium) needs knowledge about the mass distribution in different seat models and its potential effect on improvement in resulting future weight.

## Examples for Relevant Safety Documents and Handbooks

### FAR 25.603 Materials

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must

- (a) Be established on the basis of experience or tests
- (b) Conform to approved specifications (such as industry or military specifications, or Technical Standard Orders) that ensure their having the strength and other properties assumed in the design data; and
- (c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.

MIL-HDBK-5J Chapter 4 with its engineering properties and characteristics of wrought and cast alloys used in aircrafts and missiles application(i.e. AZ31B; ...;AM100A;..)

Airbus Directive ABD0100.1.6 „...in general, modern, proven techniques and technology shall be selected for the design, manufacture and operational use of any item of equipment to the current status of art, since the best performance-to-cost ratio is looked for...”

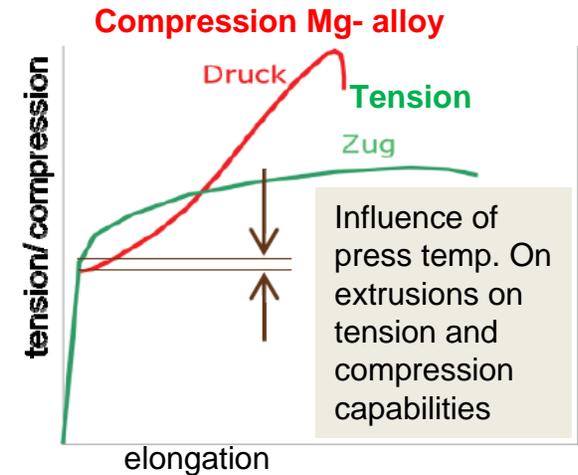
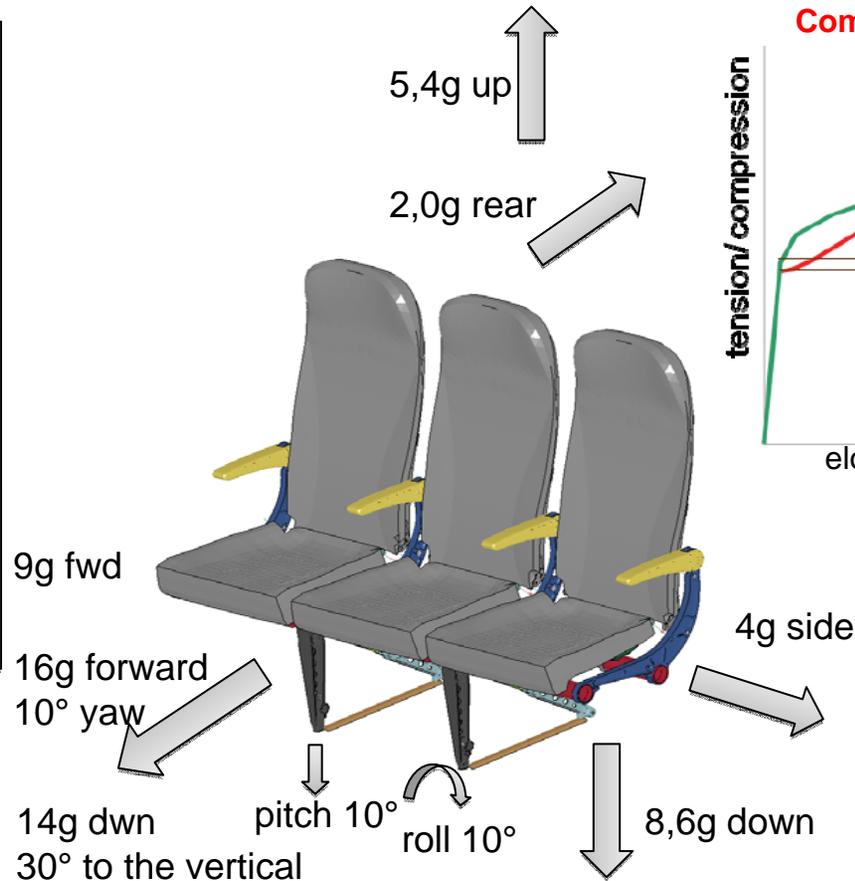
- Introduction of new materials needs background knowledge for requirements and their messages for chances in future programs

# Basic Background for Materials in Seats



## Stress Relevant Requirements

- LC for A/C seat structure:
- ☛ Static load cases
  - ☛ Dynamic load cases
  - ☛ Wind Milling (SEI)
  - ☛ Abuse
  - ☛ Env. Req(RTCADO160)
  - ☛ HALT/ HASS (A350)
  - ☛ Reliability Testing

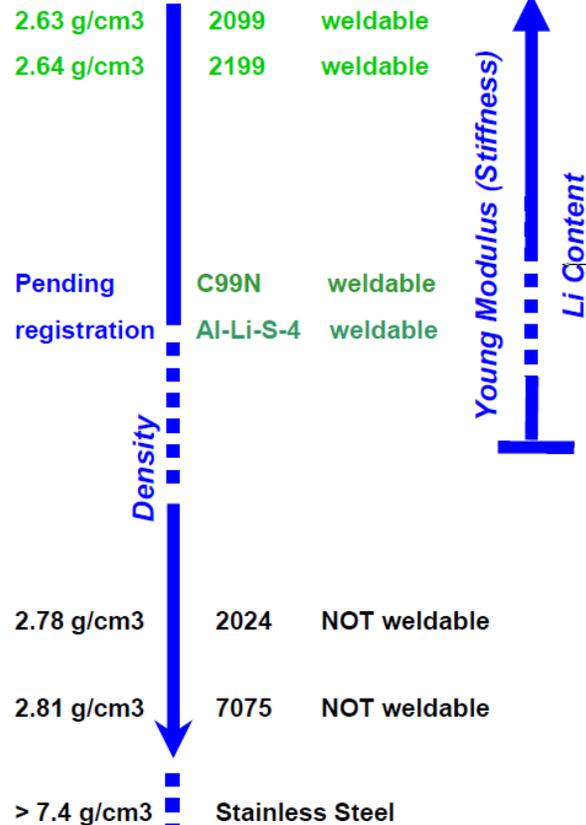


Introduction of new materials (i.e. magnesium) needs knowledge of stress relevant factors and influences deriving from specific production processes

# Current Evolution Process in Seat Materials



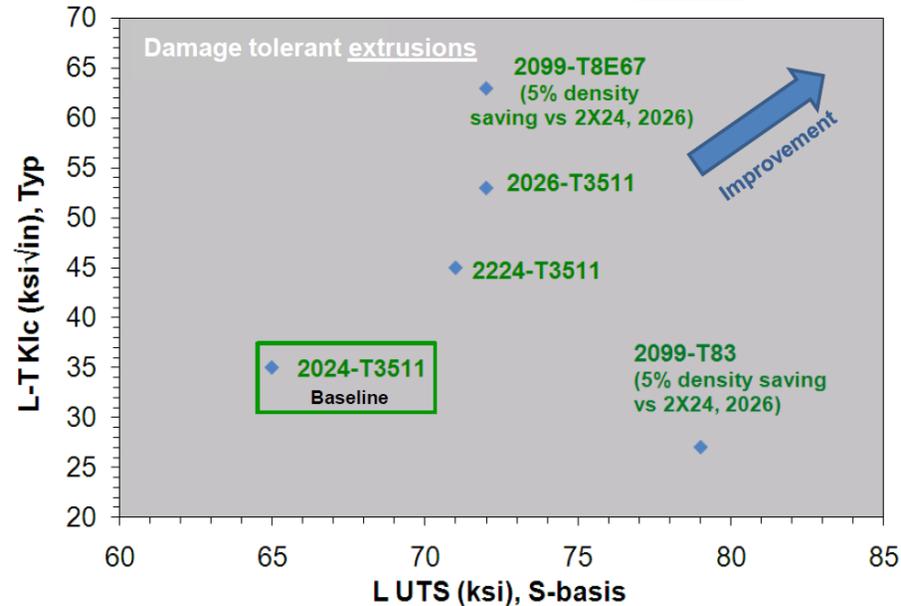
## Aluminium: Chance and Challenge for Magnesium



Information by courtesy of ALCOA

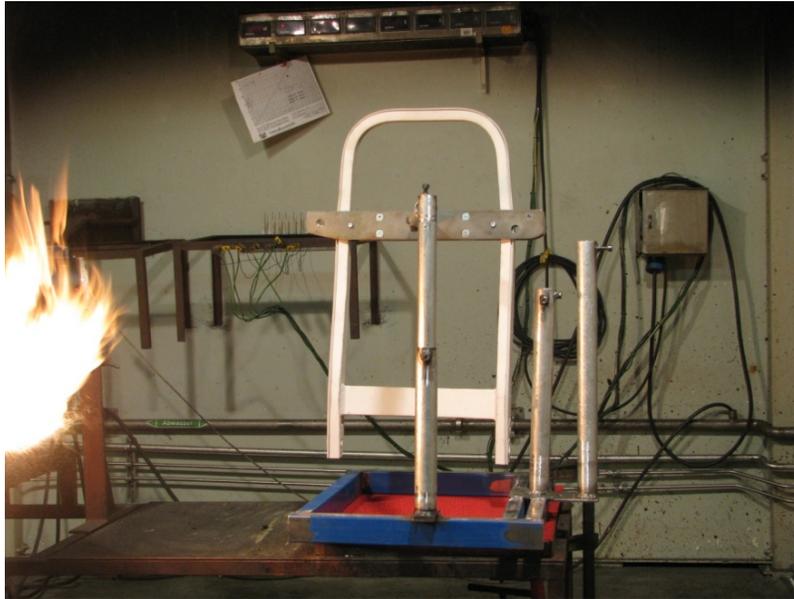


Strength and Toughness for advanced high damage tolerant extrusions alloys



- Introduction of new materials like magnesium needs knowledge of its surrounding market and developments

## Status of a Developmental Test of a Component



**Backrest Test Mount for Oil Burner Testing**

**Fire Protection mechanism:  
Material swells prior to self extinguishing**



- Attempt to use cost efficient magnesium AZ31 with careful protection by intumescent coating can withstand 300 seconds with Oil Burner Test described in Part II with a flame exhaust temperature of approximately 1000 °C.

## Summary

- Rising oil prices together with the increased demand to save fuel to protect environment leads to reaction in airline business.
- One of the biggest challenges to future design in aircraft seat business will be to find an optimum balance of weight to overall in service costs. This is a core goal for the industry of seat suppliers and its competition.
- One important parameter to achieve that is to use light weight alloys i.e. magnesium
- Selecting a material for components in seats requests a lot of investigation in their physical properties i.e. strength, ductility, corrosion resistance which is also influenced by the material production process and part production process.
- High strength aluminium alloys i.e. 7055-T77511 and Generation III Al-Li alloys i.e. 2099-T83 are continuously improved. This results in a general decrease of weight in seat structures especially in areas where extreme loads must be transported.
- As there are a lot of areas in an aircraft seat where moderate tensile strength in conjunction with moderate ductility is best practise, magnesium should have a chance for introduction into aircraft seat business.
- **The aircraft seat industry is eager to get clearance for take off and landing with magnesium alloys.**

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**thank you for your attention**

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