TÜV

EU funded project **ICEPS**:

Injury Criteria for Enhanced Passive Safety in aircraft

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Contents of the presentation

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Objectives of the project

- Investigation of two aircraft accidents:
  - Engineering aspects
  - Medical aspects
- Evaluation of existing injury criterias in the field of automotive and aviation industry
- Correlation of injuries and evaluation criterias
- Development of new injury criteria for enhanced passive safety in aircraft

Accident analysis

The following two accidents were investigated:

Accident 1: Airbus A320, Warsaw Airport, 14. Sep. 1993

(64 passengers: 1 passenger and one pilot died at scene).

Accident 2: Boeing 737-400, near Kegworth, 08.Jan. 1989

(119 passengers: 39 died at scene, 80 were rescued,
4 persons died in the following days).

Accident analysis

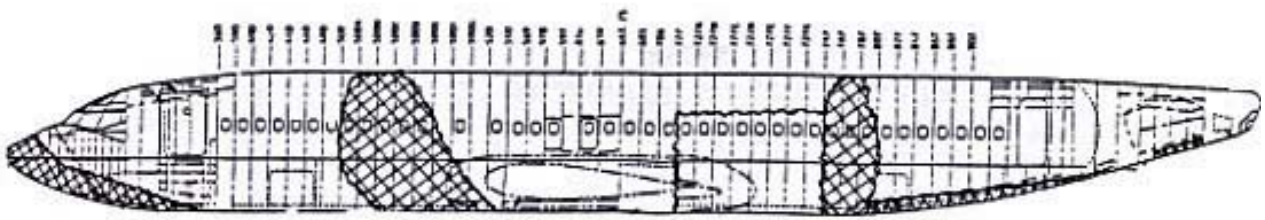
Warsaw accident

Accident analysis

Kegworth accident

Accident analysis

Kegworth accident



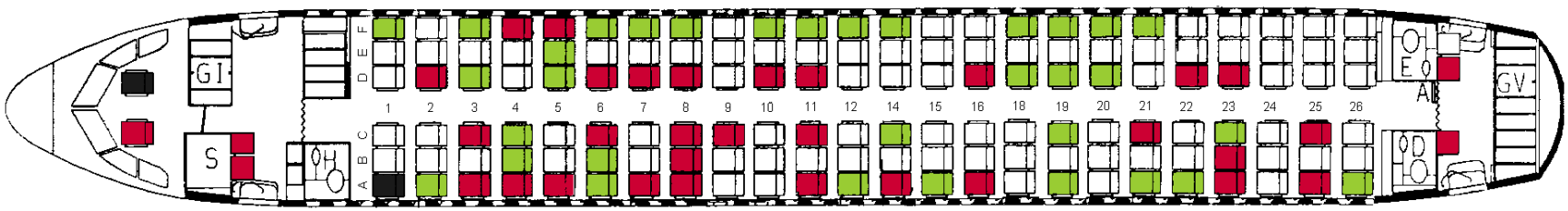
Accident analysis

Warsaw accident

14.September 1993

Airbus 320

Seat distribution



PCP 64 / 4 / 2

death

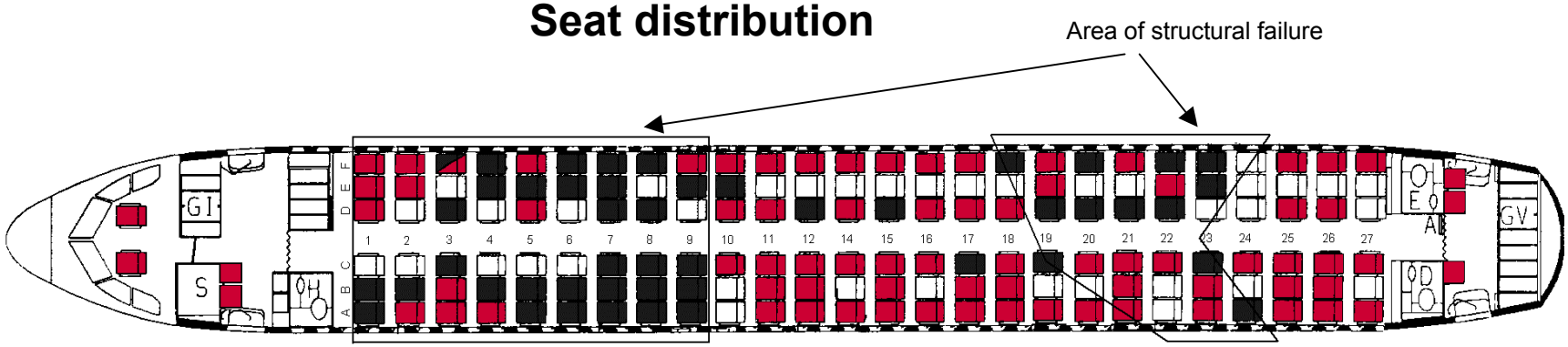
injured

not injured

Accident analysis

Kegworth accident
08.January 1989
Boeing 737 - 400

Seat distribution



PCP 119 / 5 / 2

death

injured

not injured

mother and baby
mother death / baby injured

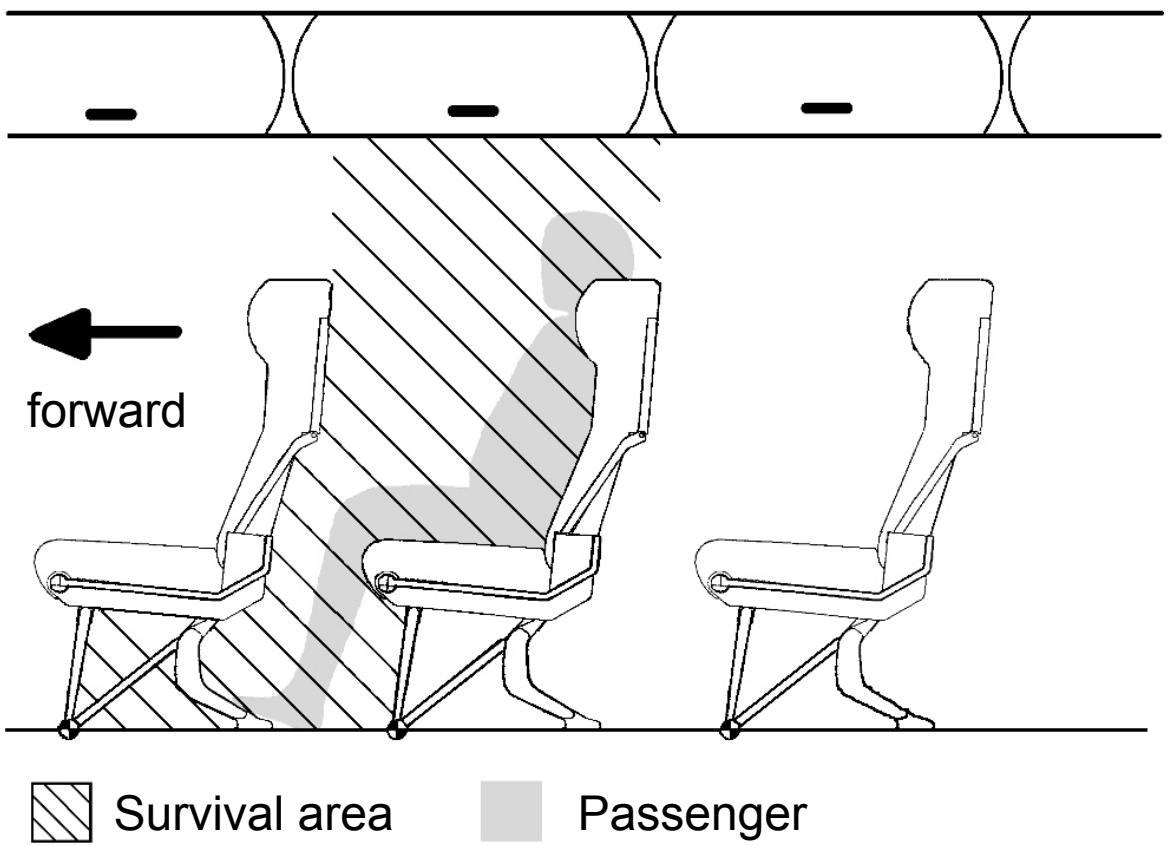
Accident analysis

With the help of the detailed personal informations from Prof. Wallace and the Medical Service of Lufthansa an allocation of the injuries to the body region and the seating position could be made.

On this basis a detail description of the injuries for each passenger per seat was made.

Evaluation of injury criterias

Survival area in aircraft cabins



Evaluation of injury criterias

All existing criterias in aircraft and automotive technology were investigated in view of their applicability in an aircraft cabin.

These criterias are coming from the “Regulations of the Economic Commission for Europe“ (ECE – Regulation) for vehicles, Federal Motor Vehicle Safety Standards (FMVSS) and JAR 25.

These criterias deal with interiors, occupant protection in interior impact and occupant crash protection.

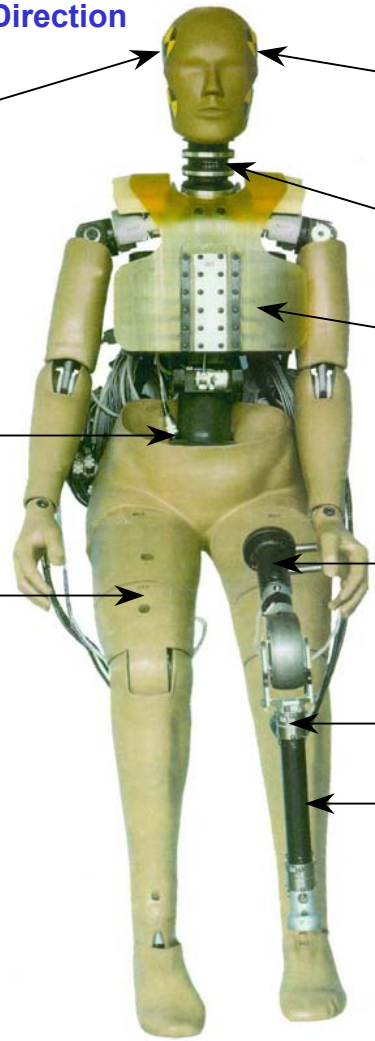
Evaluation of injury criterias

Aeronautic Sector Forward / Downward Direction

Head
Head Injury Criterion (HIC)

Pelvis
Lumbar Spine Load
Submarining

Femur
Femur Load



Automotive Sector Forward Direction

Head
Head Injury Criterion (HIC)
Head acceleration (xms)
Time range (xg)

Neck
Neck Injury Criterion (NIC)

Chest
Thoracic Compression Criterion (ThCC)
Viscous Criterion (VC)
Chest acceleration (xms)
Time range (xg)

Femur
Femur Force Criterion (FFC)

Tibia
Tibia Index (TI)

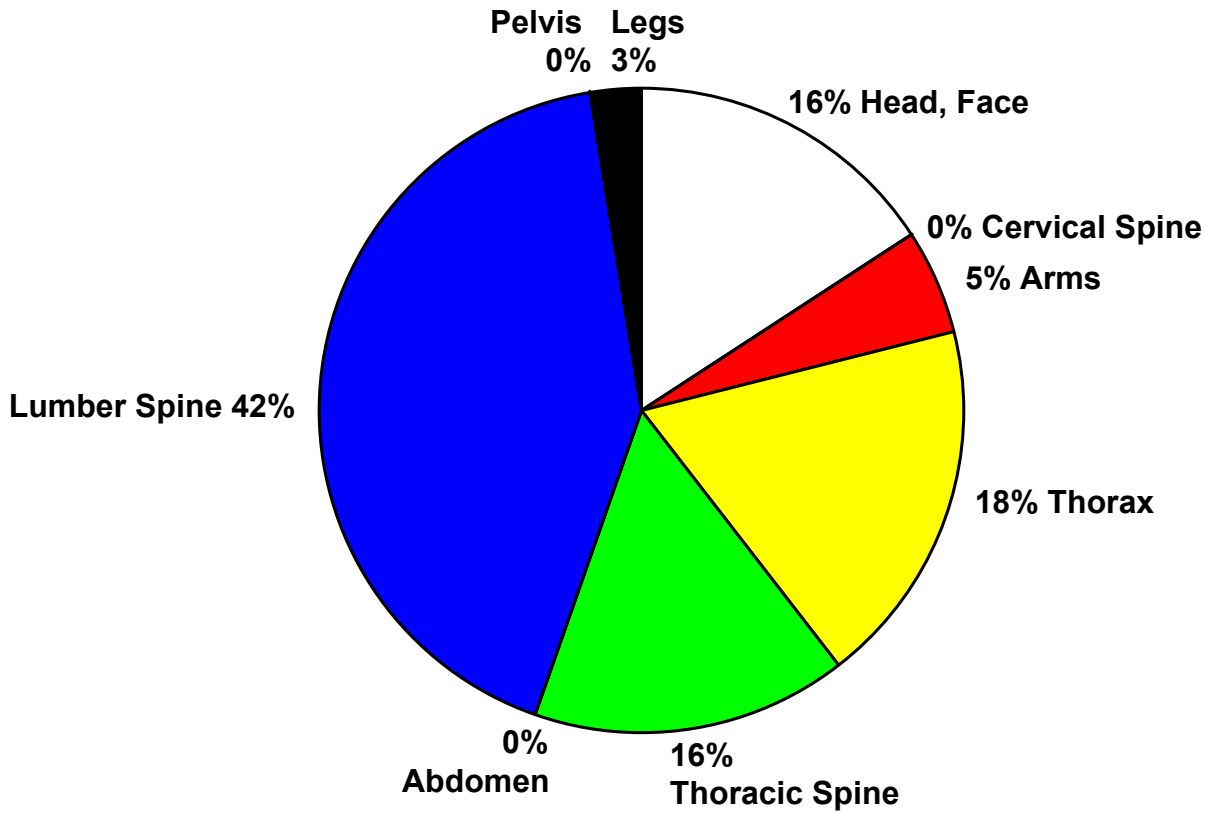
Tibia Compression Force Criterion (TCFC)

Correlation of injuries and evaluation criterias

Warsaw accident

Number of examined occupants: 27

Number of injuries per body region: 38 (100%)

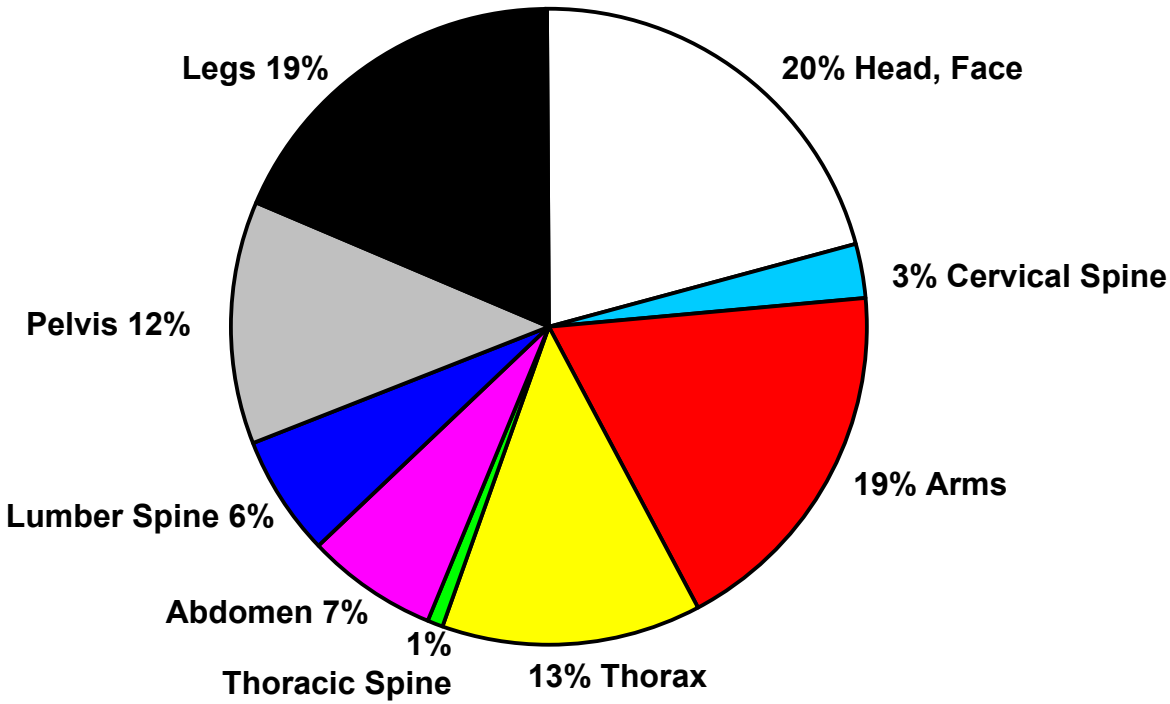


Correlation of injuries and evaluation criterias

Kegworth accident

Number of examined occupants: 75

Number of injuries per body region: 306 (100%)



Results

The existing injury criterias are insufficient to describe and evaluate the effects of accidents on passengers.

That means new/additional criterias are necessary with focus on:

- the aircraft passengers‘ state of consciousness
- the possibility of freeing themselves
- the passengers‘ ability to walk.

Results

The level of passive passenger safety can only be enhanced by a comprehensive consideration and examination of the aircraft interior, i.e. by:

- The evaluation of the survival area
  (tests with interior parts, with aircraft passenger seats)
- Determination of the energy absorption capacity of covered rigid structures in the survival area
- Application of dummies of the Hybrid III series in dynamic tests
- Application of extended dummy protection criteria

Results

Criteria required due to accident analysis and main idea	Known biomechanic tolerance limits	dummy protection criteria
head	head	head
cervical spine	cervical spine	cervical spine
upper arms	upper arms	-
forearms	-	-
hands	-	-
thorax	thorax	thorax
lumbar spine	lumbar spine	lumbar spine
abdomen	abdomen	abdomen
femurs	femurs	femurs
lower legs	lower legs	lower legs
feet	-	-

Outlook

For the continuous enhancement of passive safety in aircraft cabins the following activities are necessary:

- Development of new accident questionnaire forms
- Additional training of aircraft crash investigators
- Development of new evaluation strategies
- Exchange of information with the crashworthiness divisions of aircraft manufacturers
- Exchange of information between the doctors treating the accident victims and the technicians analysing the accident