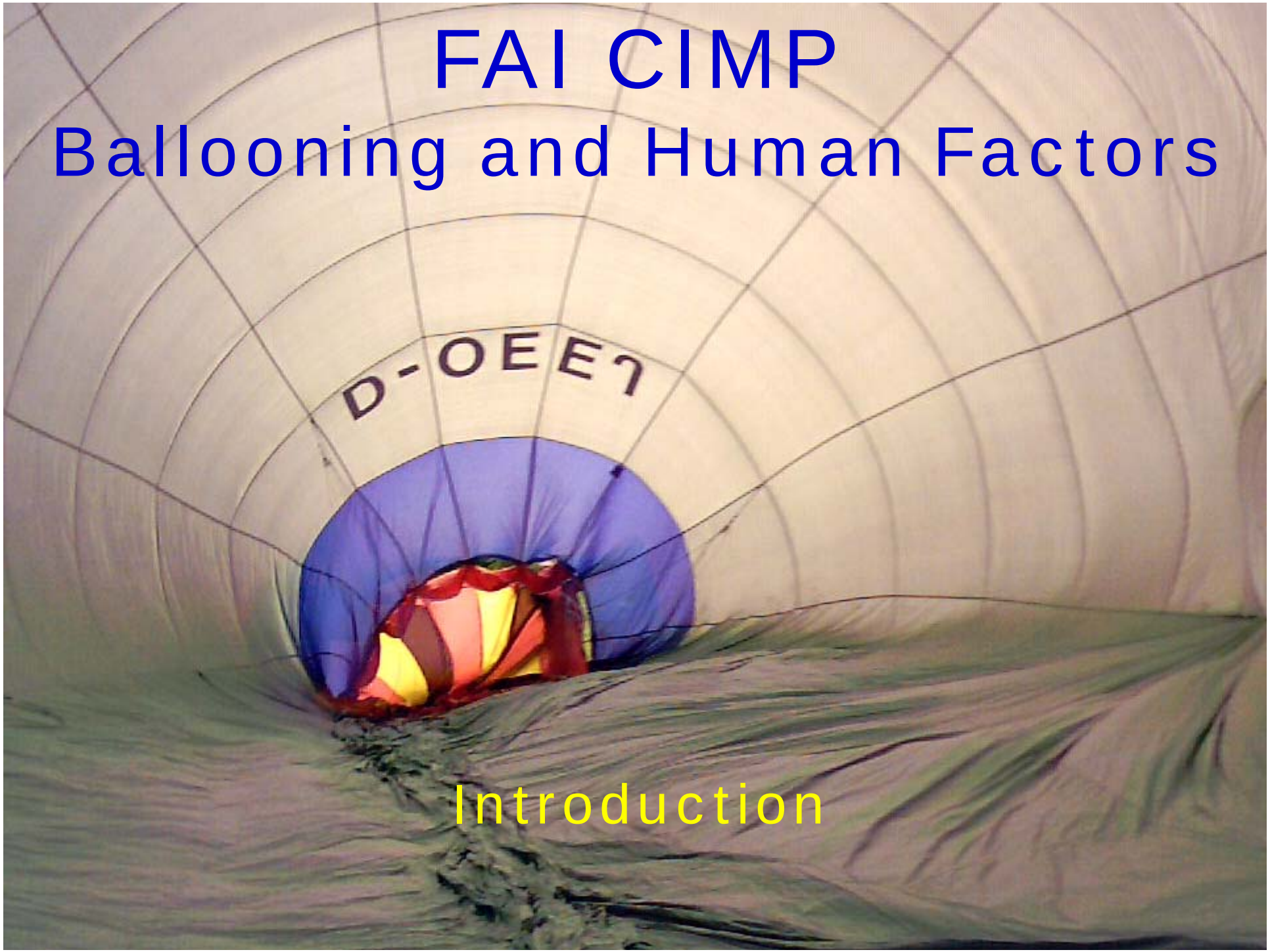
FAI CIMP
Ballooning and Human Factors



Introduction

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Balloon Pilot since 24 years,
born in Berlin, retired **Engineer.** DFSV. **Instructor,** BFU **(Accident Investigation),** HP&L Work-Group, Examiner, **Safety Administrator,** Trains the Trainers and the Instructors, …….

Human Factors, Stresses in Ballooning

1. **Technical details of balloons** and it´s operational procedured and associated problems.

2. **Physiological / psychological demands** in Ballooning.

3. **Accident causes** in Balloon Operations.

All kinds of Balloons

Special Shapes!

United States
Patriot

Hot Air Balloon:

Technical Details:

Ex.: Balloon, 4 People

+Balloon Volume: 3400m³ (Containment of ~100 Fuel-Trucks)

+About 28m (9 story building) high - **Diameter 19m**

+Envelope ~ 1300m² (> Sails of a big Sailing Ship)

+Envelope Weight: ~ 120kg (without advertisement)

+Upper Outlet about 5m Diameter

<u>Upper outlet</u>:

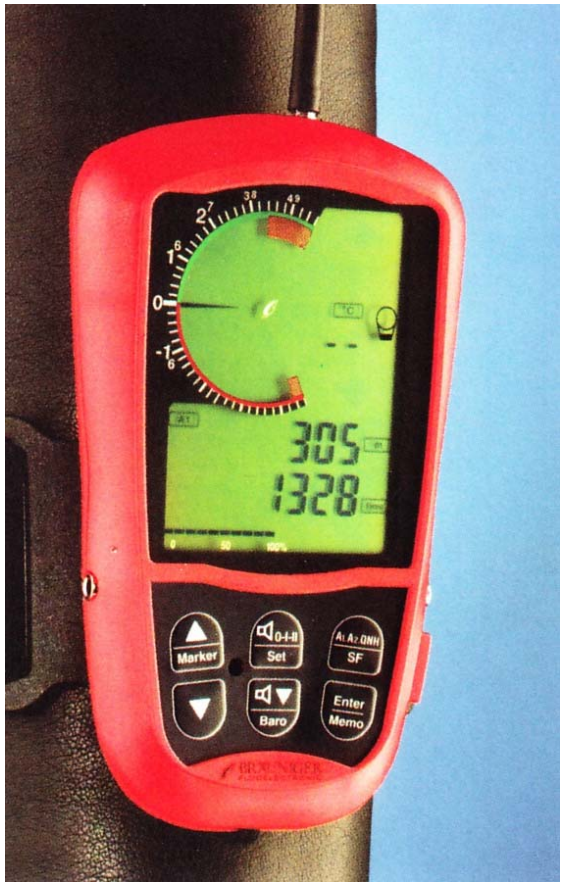
- **can be opened or closed anytime**
- **to control the lift**
- **to be able to sink or to start climbing again.**

<u>Two independent burners</u>:
(each ~ 4000 hp)

- Each burner is supported by two Gas Bottles (Propane), each 20-30 kg.

- Passenger compartment:

- a Basket, with it´s high flexibility.



<u>Combined Instruments:</u>

-Altitude

-Vertical Velocity Indicator (VVI) and a

-Temperature Gauge (balloon temperature!)

An Aviation *<u>Radio</u>* is a minimal setup.

If needed a *<u>Transponder</u>* is used.

There are Baskets up to <u>30 People</u>

Before Hot Air is used:
Filling starts with “Cold Air“ by an inflator fan

Heating up the Air with the “Burner“.


Gas-Balloons with and without a net.
PREMIUM
GERMAN BEER
D-OWBI
HB-BJS

Balloon Specialities

- ***Hold the Altitude*** **= Loss of Heat**,
  Compensation through Heating Up !
  (**Initiate** the Burner for **3 sec**, every 20 – 30sec)

- No Wind to experience in the Balloon, as it ***travels with the speed of the wind*****.**

- ***Slow Reaction***: First effect after heating up after about **~ 8 sec**

- Basically ***NO G-Forces***, no ‘Air-Holes‘

Metereology – “wise“

The Balloon is the most sensible AC

- The **ONLY *steering imputs*** possible is by **changing the altitude!**

  Because: The wind has as a rule another direction in different altitudes.

- The only Steering Option is *taken away*, if ***Updrafts and Thermals*** are present.

- Therefore Ballooning **ONLY** takes place about
  - **2 ½ hours *before SUNRISE***
  - **respectivly 2 hours *before SUNSET***

- The **Landing Place** is basically ***not known***!

Masses of a Balloon:

Basket, Burners, Envelope, 4 Gas-Bottles, Equipment, 4 People ~750Kg

3400m³ Air ~ 3400 kg

Masses on the Move > 4 t

Electrical Mast with 110kV Wires.

The Balloon is not easy to decelerate‘!

You land WITH the Wind-Speed !

Big Ballon – Big Car ……

Hot AIR-Balloon Operation :

Limitations:

- Temperatures in Balloon: 110°C – 130°C (individual makes)
- Wind Speed on Ground: < 12 kt / 20 km/h
- Masses (Minimum Weight required)

Other Ops Issues :

- **NO** Altitude Limitations and Restrictions!
- The Basket is always “below“ (**NO** Acrobatics!)
- There is **NO** “Front“ or “Rear“
- Basically **NO** SEATS, **NO** Safety Belts (only in exception)
- Practically **NO** technical Failures or Accidents.

Physiological / Psychological Demands Ballooning

Physiological Aspects:

-A typical Hot Air-Balloon Ride
-around 500m GND
-seldom longer than 2 hours

-Not enough time for big physiological changes

-Pilot in a “Standing Position“ in Open Space

-NO Cabin: Heat / Cold, Noise of Burner, Exhaust Fumes / Residuals (but no wind!**)**

Gas-Ballooning lasts much longer!

In Competitions (up to 4 days) 2 Pilots ride in a 1,2 m² Basket with seating and sleeping options.

-Typical TIME Shedule in Summer- for Ballooning!-

21:30 SS after Landing

Balloon Logistics, Drive Back, short Landing Party, Documentation, Filling of Gas bottles

0:00 - go to Sleep**!**

3:30 Get Up, **Weather Briefing and Considerations/ Decision, inform Crew and Passengers (Wake them Up!), Shower (or not), Breakfast (or not), Navigational-Preparation, Prepare TO-Field, Loading of Equipment, Trailer, get Crew and Passengers from home, Drive to the TO Place, Crew Briefing,**
Get Balloon ready for Ride

5:30 SR Take Off

-Only 3:30 h Sleep, (what about the Alcohol?)
-Max. 7h from Landing Party to next Take Off!

ALTITUDE:

It is possible to get up to very high altitudes.

-Oxygen is Required !

HEARING PROBLEMS:

-The Burner Noises are relatively loud!

-The Inflator fan for filling the Balloon with cold Air.

-HEARING PROTECTION required (No Headsets!)

VISION:

Only at low altitude ground-details can be seen.

For LANDING you have to see details (fences, wires)

Eye Glasses have to be perfect! –

The near vision has to be in the upper part,

-distant vision in lower part of the glasses!

Vision Problems. Looking Up or Down!

The view **upwards** is covered by the envelope.

Riding in a PULK: Must be achieved by looking **downwards**. “actively running“!

No typical Aviation Problems:

Pilot :

NO optical illusions on runways,

NO Flicker-Vertigo,

NO Accelerations (G-Forces),

NO Vertigo

etc.

Passengers :

Seldom occuring

Fears, Altitude Fears (Acrophobia), Hyperventilation, Vertigo

Alcohol, Drugs, Smoking

Hard Physical Work after Landing!

Psychological Factors:

Permanent Decision Making

For Example:

Searching for a Landing Site: Vegetation, Obstacles, Fences, Electrical Wires, Orographia, Wind near ground, Animals / Horses / Birds (!), Sheds, Options for Transport, sudden direction changes, …..

Psychological Pressures from the outside : Expectations from Sponsors, Companies, paying Passengers, ….

Selfinduced Pressure in Competitions / Flight, when others start preparing for Take Off (Fan On-Syndrome).

Economical Problems if a Ride gets cancelled

Peer Pressure, unexpected critical Weather Changes

Time Pressures, i.e. Updrafts begin early!

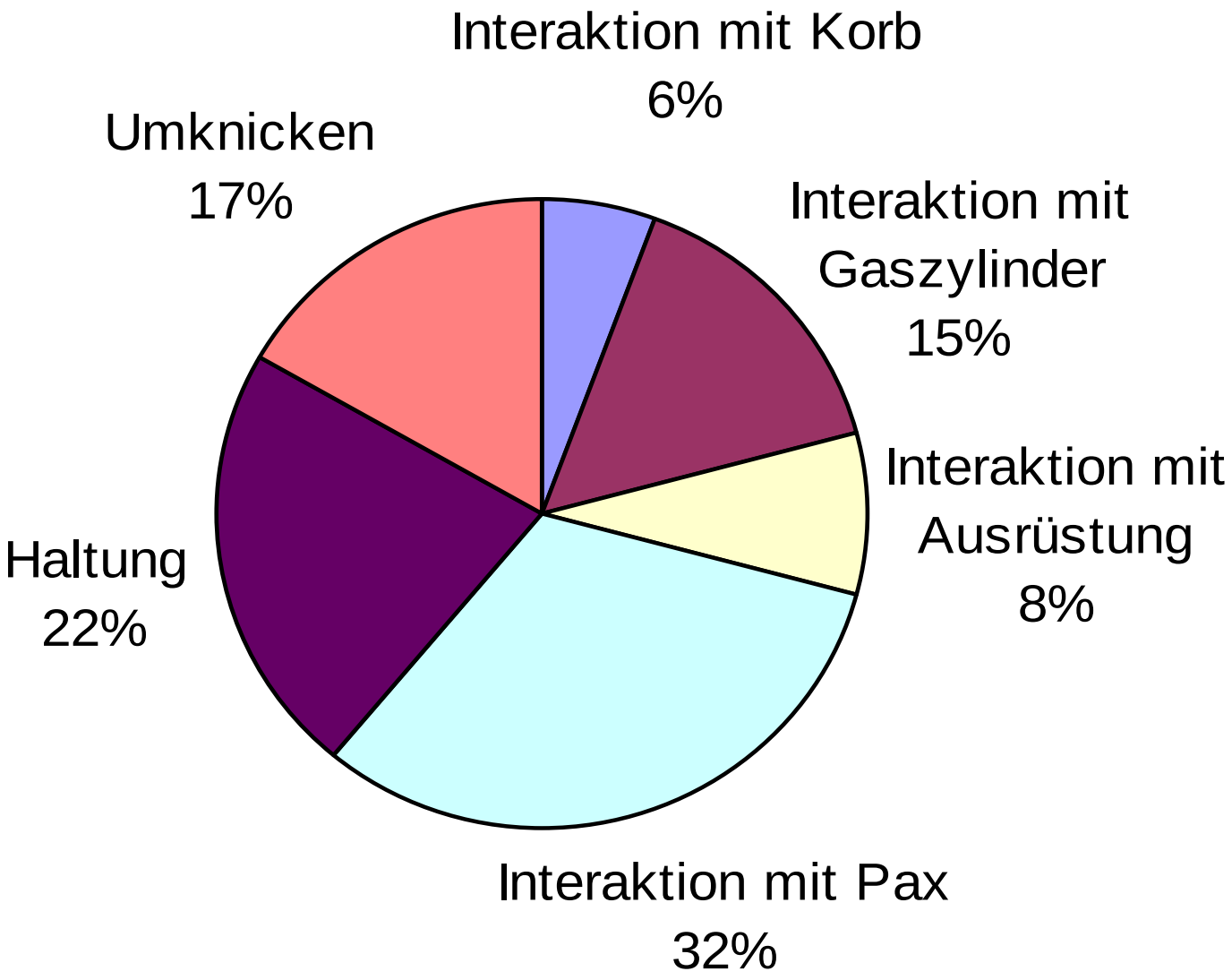
Accidents in ballooning :

- Lack of Standard Operational Procedures (SOP)
- Lack of good Training Books !
- Chain of Failures lead to Accidents

- Most accident happen on landing, approach to land!
- There is no definite position for passengers in the basket during landing.
- Collision with equipment and people.

Fast Landings: -- Main Injuries: Leg and Feet-Fractures!

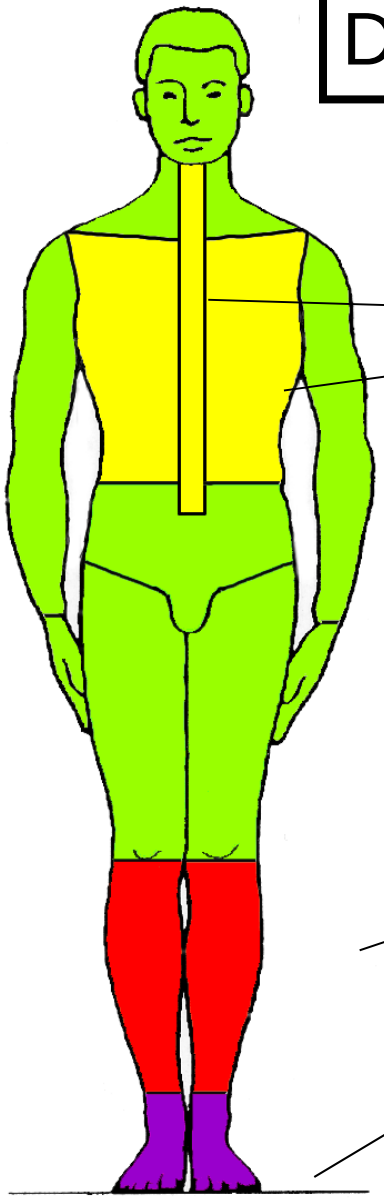
Reasons for Injuries



Reasons for Injuries

- Upright Position 22%
- Bent Joints 17%
- Interaction with Basket 6%
- Interaction with Gas Equipm. 15%
- Interaction with other Equipm. 8%
- Interaction with Passengers 33%

Distribution Heavy Injuries of Passengers



(2x) double as high
as light green area

4 x as high as light green area

6-bis 8 x as high as light green area

S: EDDINGTON/THE TIMES/AP, SENDER

Other Accidents:

Man over Board: often the pilot himself

Late identification of obstructed sites

Landing Accidents:

- bad single decision
- wrong decision chain
- deficient preparation
- any pressure
- pendulum after touch down
- fast landings are demanding /cannot be trained !

Other :

- Dealing with hot and cold parts
- Burning flame Propane 1200-1600°C
- Propane Fire
- Liquid Propane (-42°C) in free Atmosphere, or on skin
- Inadequate Emergency Procedures

(at least we cannot forget “our under-carriage“!)

Small Balloon -- Small Car.

Conclusion :

Only a few Accidents through technical defects!

>>> **Human Factors** !

No Accidents through **Medical Problems**.

Chain of failures:

- Wrong Decision-Making (WEATHER)
- Education, Training Deficits!
- Failing to respond in time,
- False Procedures !
- Deficient exercise !

etc.


Try to understand this better!

Comments?

Questions?