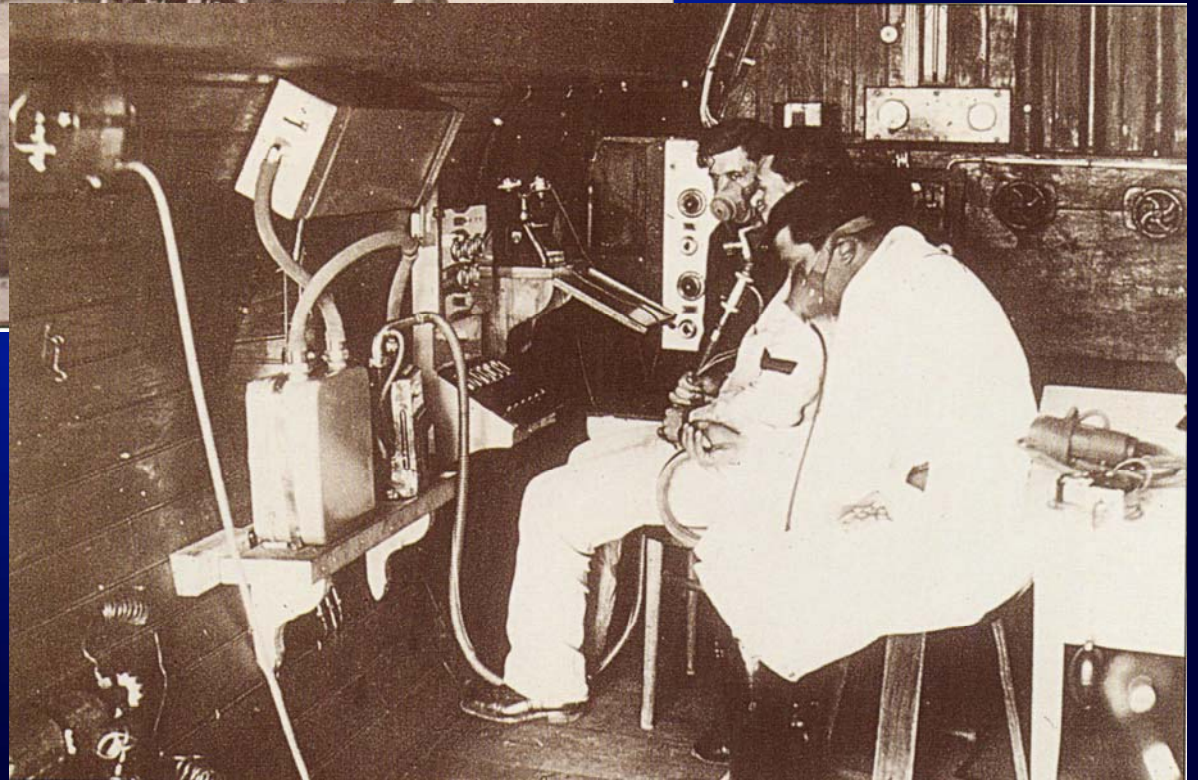
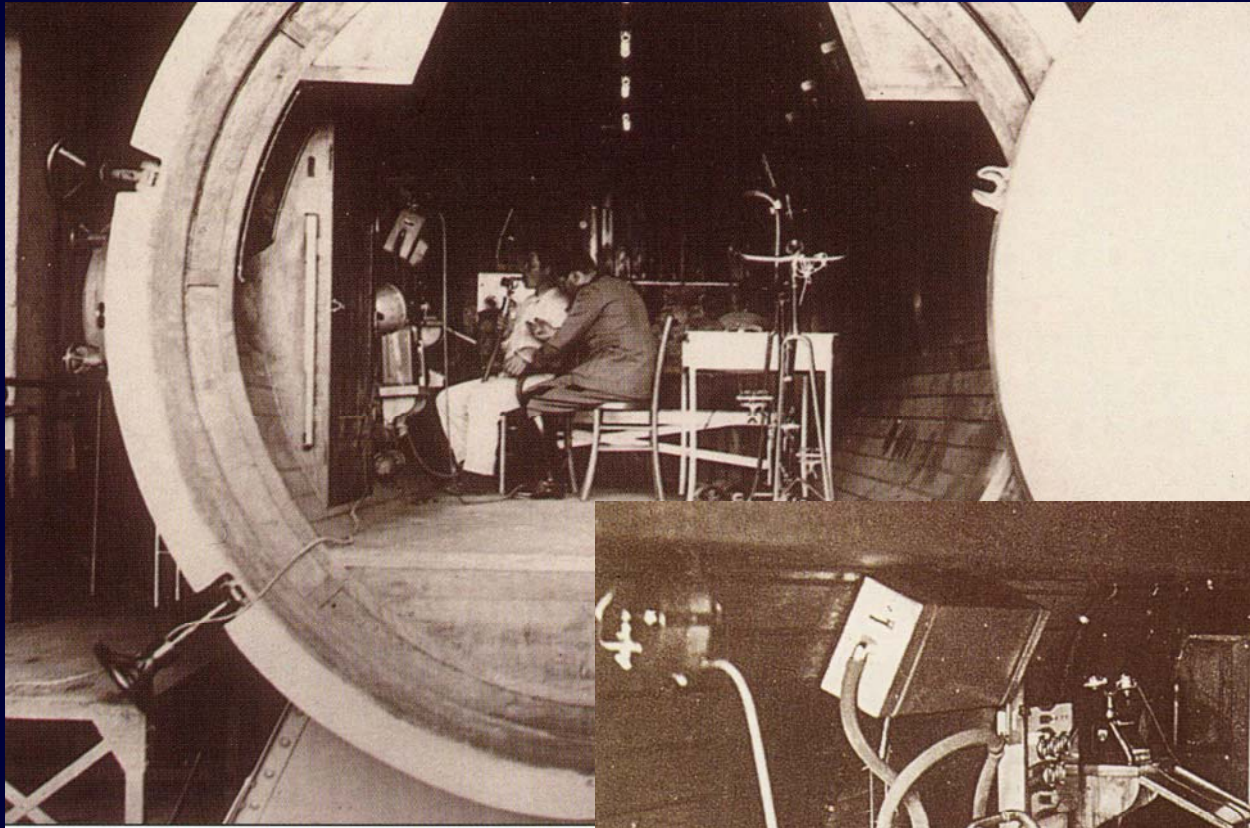


XX Congresso AI.M.A.S. – Firenze 4/7 settembre 2007

# Physiological training in Hypobaric Chamber

**Lt. Col. Francesco Torchia, M.D.**

Capo Gruppo Alta Quota ed Ambienti Estremi  
Centro Sperimentale Volo  
Reparto di Medicina Aeronautica e Spaziale



**Guidonia**  
**1938 ca.**

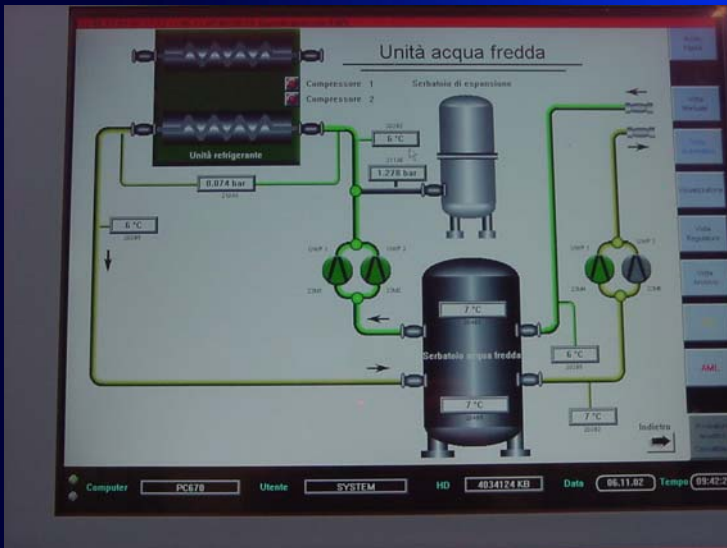
# Pratica di Mare 2007



Altitude range: 0 - 100.000 ft  
Max theoretical altitude: 200.000 ft  
Max altitude for training: 45.000 ft



Main ch. 10 seats + 2  
Secondary ch. 4+1



## Programmable logic computer

- Fresh air flow rate up to 1000 m<sup>3</sup>/h
- Temperature adj. range: 15-25 C<sup>o</sup>
- Humidity adj. range: 20-80%
- 2 Fire suppression system (water + Inergen)
- Oxygen % detector
- System failure

# Hyperbaric Chamber



DCS treatment

Single seat + 1 assistant

50 mt max capacity



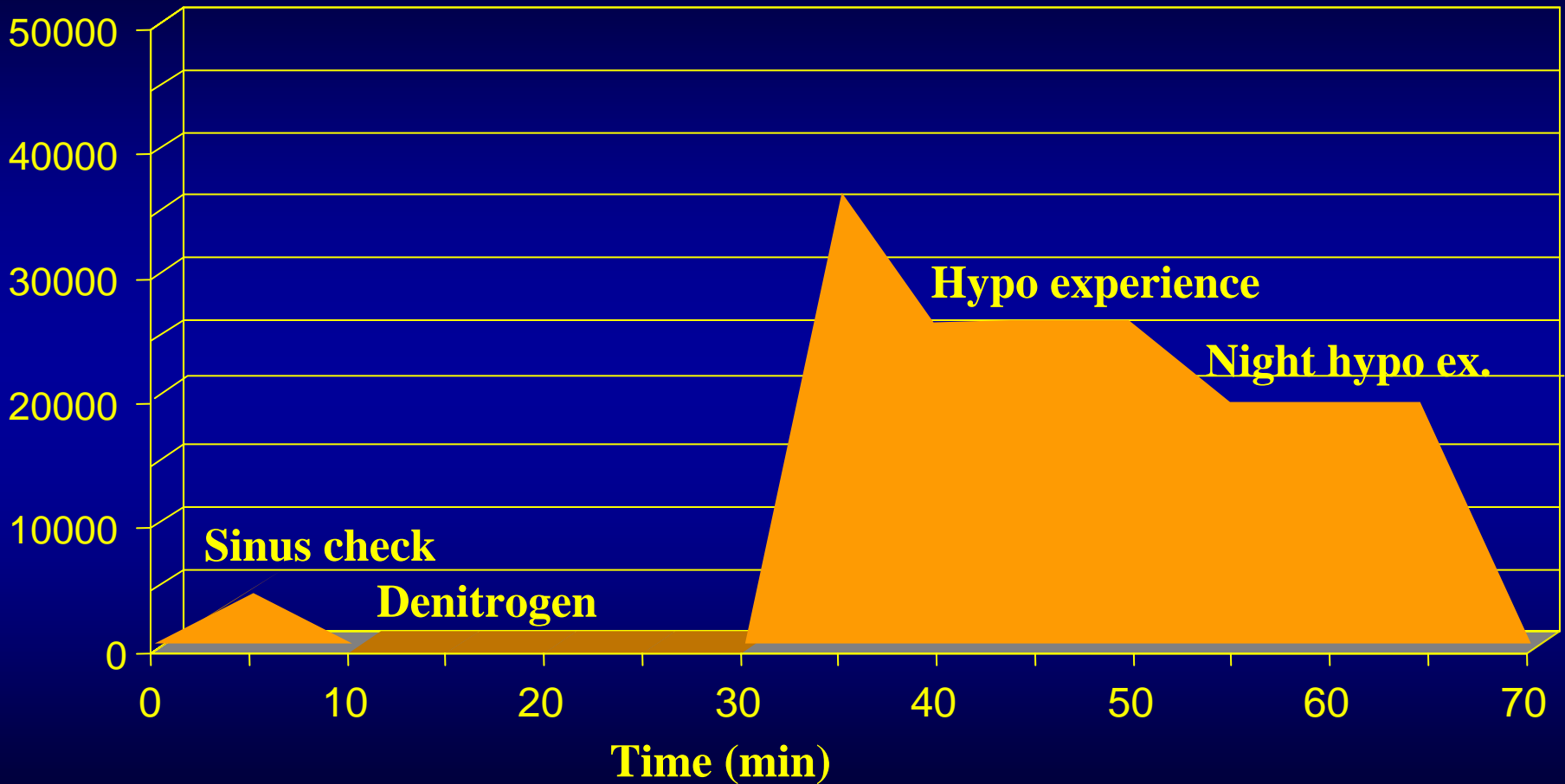
# Physiological training in hypobaric chamber

- 1) Hypoxia experience**
- 2) Hypobarism experience**
- 3) Cabin decompression**
- 4) Oxygen equipment training (oxygen mask and regulator, positive pressure breathing)**
- 5) Emergency procedure**

# Hypobaric chamber profile type 2

Basic Course : all military pilots

Altitude (ft)

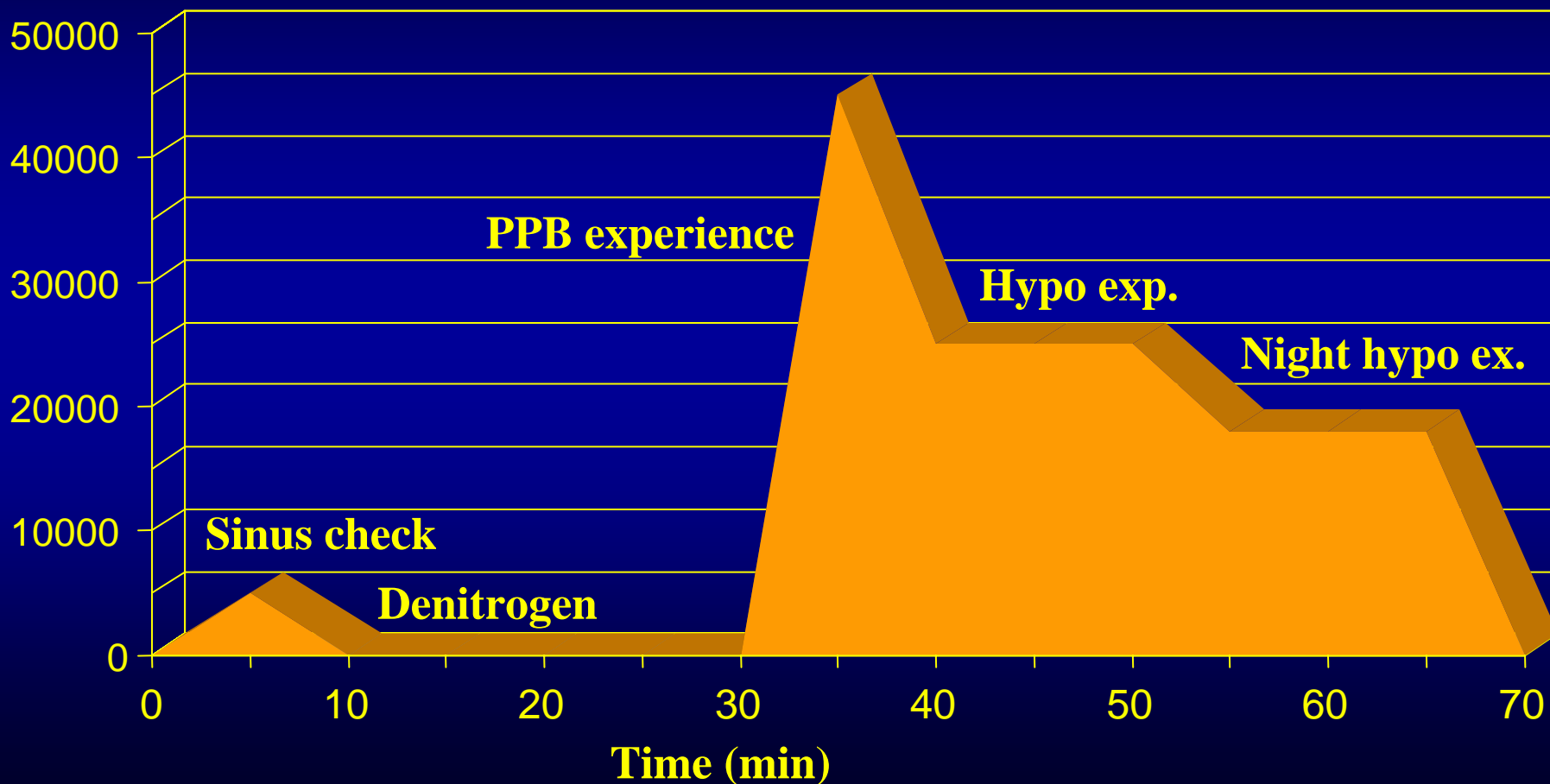




# Hypobaric chamber profile type 2A

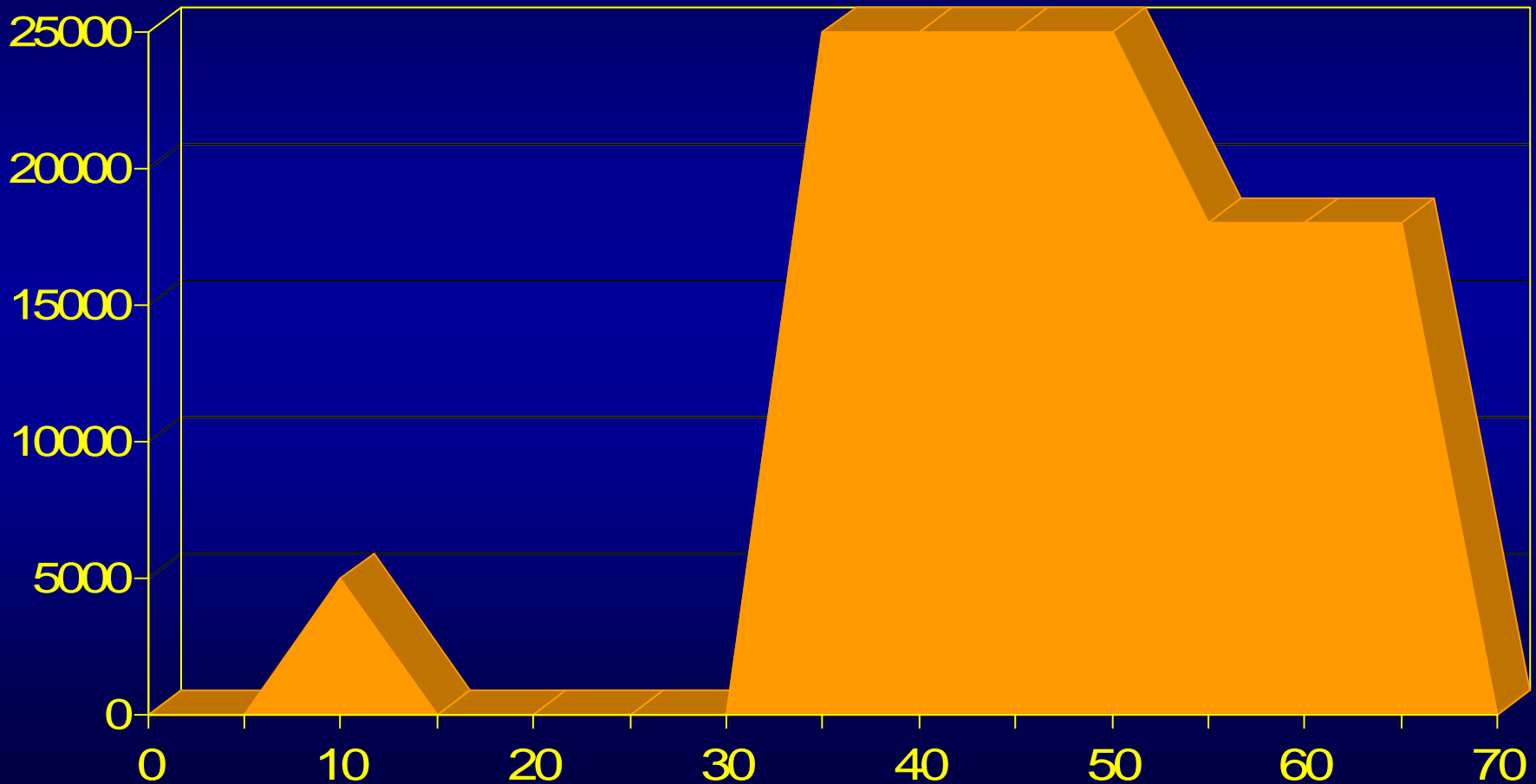
Initial Course : EFA and F16 pilots

Altitude (ft)

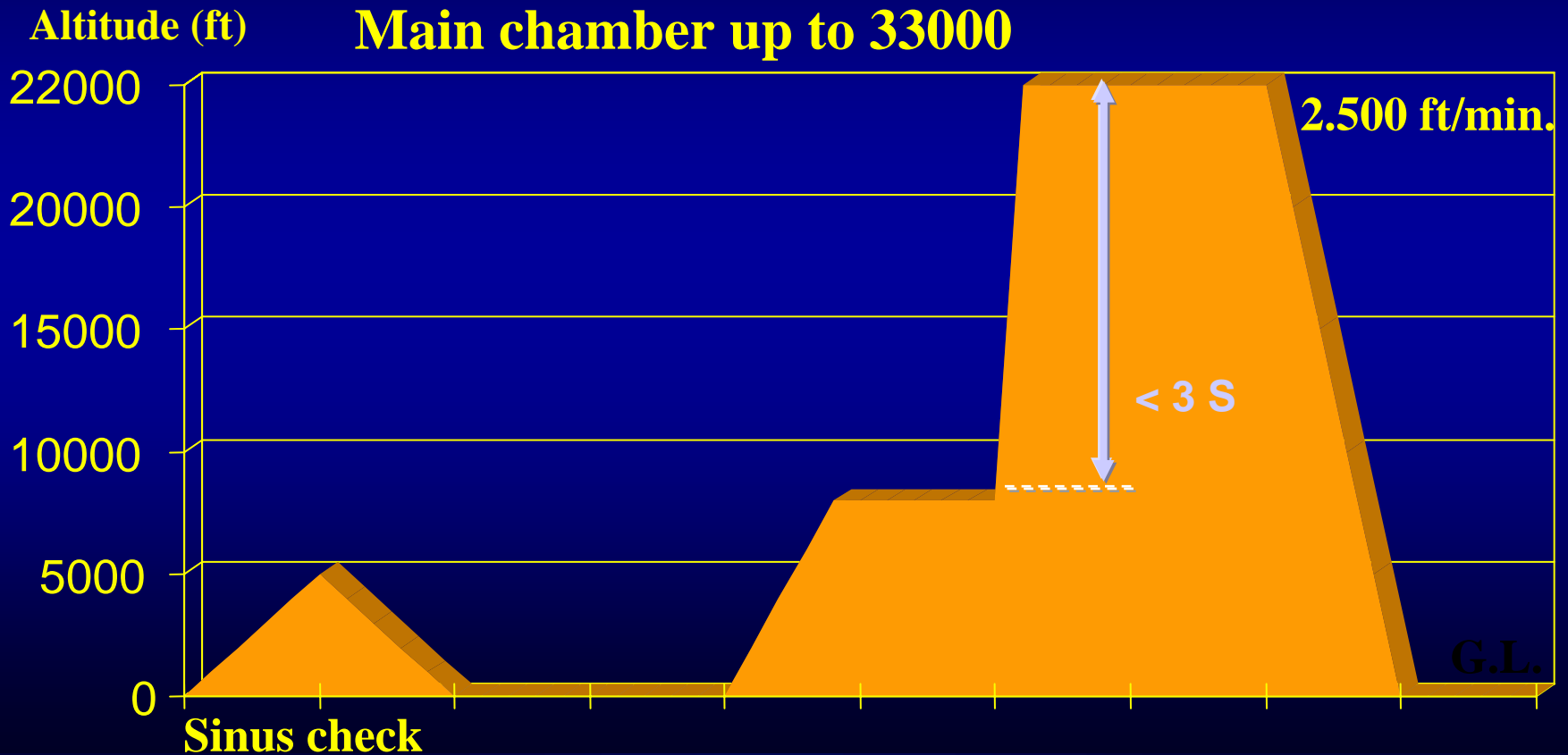


# Hypobaric chamber profile type 1

Flight personnel  
Army Paratroopers “Col Moschin”  
Refresher course (every 5 ys)



# Hypobaric chamber profile type 3 (Rapid decompression)



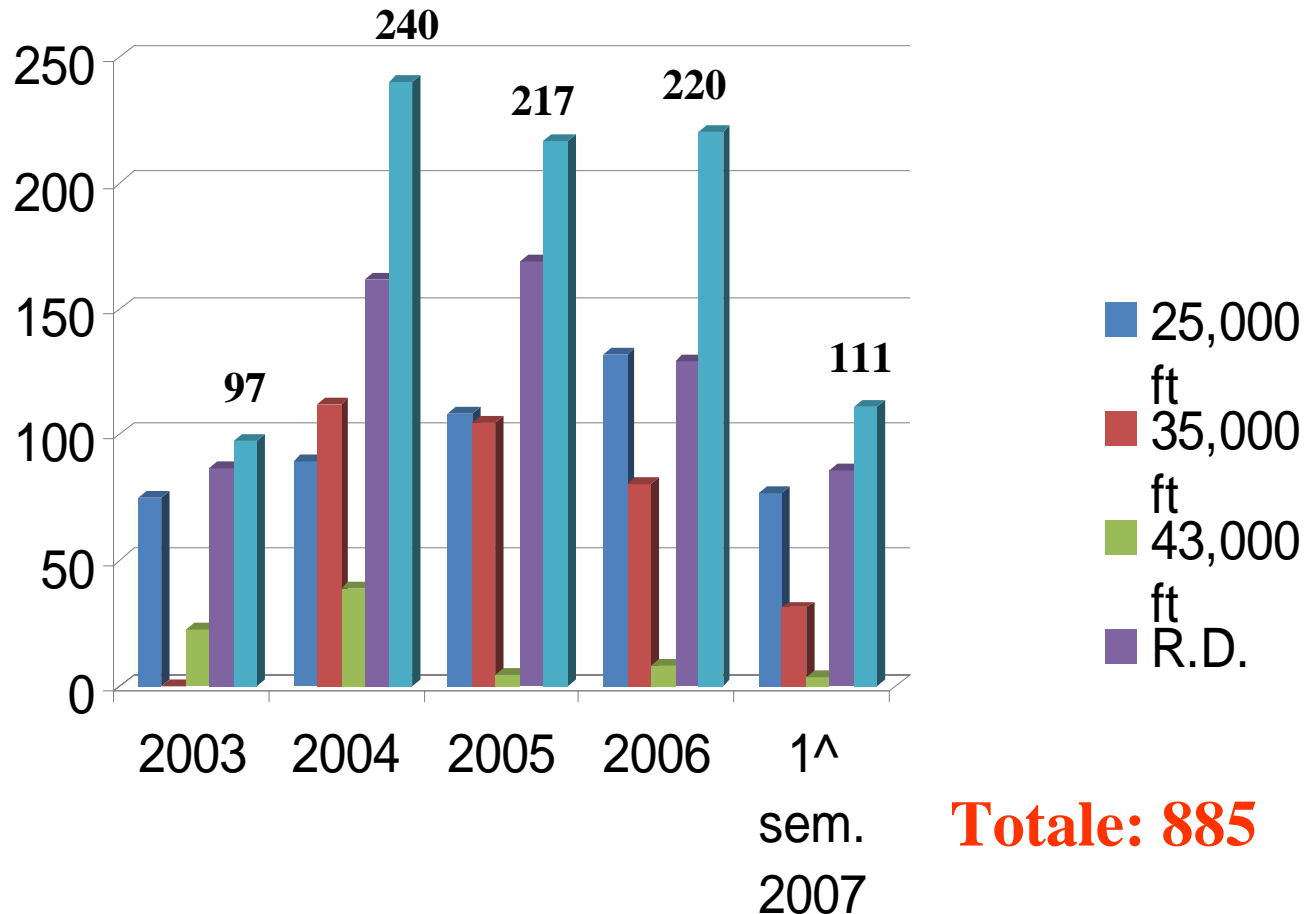
# First training exercise

20 may 2003



# Physiological Training 2003 - 2007

## Aerospace Medicine Department



# Medical problems

- No DCS
- 4 mild barotrauma
  - 1 frontal sinus (descending at 5.000ft)
  - 1 left middle ear (descending at 7.000ft)
  - 1 barodontalgia at 16.000ft
  - 1 abdominal pain at 32.000ft
- 1 hypoxia under PPB
- 1 panic reaction wearing mask + helmet ....

(a doctor !!)

# Standard Operational Procedure

- PO-RMAS-028-REV01 jan 2004
- “Hypobaric chamber” (system safety, responsibility, personnel)
- “Physiological training” (personnel, tasks)
- “Experimental exercise”
- Documents enclosed: personnel qualification, emergency procedures, check list, registrars, medical records

# Our Team

- Exercise above 18.000 ft:
  - 1 main operator
  - 1 qualified instructor every 5 students
  - 1 medical doctor
  - 1 qualified nurse
  - 2 hypobaric chamber technicians
  - 2 hyperbaric chamber technicians (Air Force personnel qualified as Navy divers)\*

(\* ) not required if the profile is below 18.000 ft



# Personnel qualification

- Aerospace Physiologist non-USAF
- Aerospace Medicine Primary for FS
- Naval Flight Surgeon
- AMST hypobaric ch. course
- PHTLS/MIMMS



# Medical check: preflight

- Blood exam (sickle cell disease screening)
- Medical questionnaire + Flight physical check
- Tympanic membrane impedance exam + ENT exam



# In-flight telemetric monitoring system

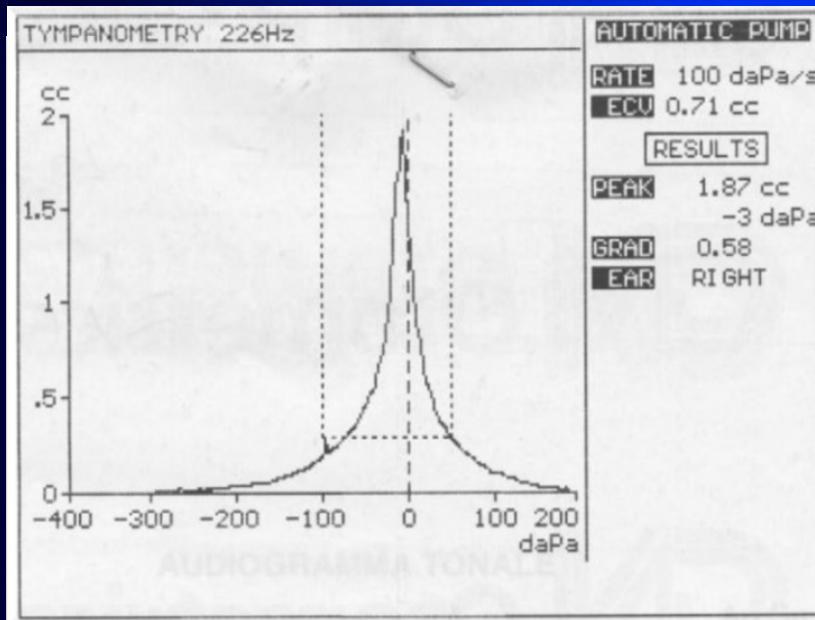


ECG  
Respiratory rate  
Heart rate  
O<sub>2</sub> arterial saturation



# Post flight

- Medical and ENT check if needed
- Otovent for delayed barotrauma prevention



# Scientific cooperation

- Angelo D'Arrigo:
  - Flying over Everest
  - Flying over Aconcagua



# Scientific cooperation

- Veronique Billat: “Alexia 8000” evaluation of COSMED K4b2 portable metabolimeter



- Milano University: evaluation of an instrument to measure pulmonary impedance (in asthmatic patients)

# Future research

- Modification of ocular pressure in hypobaric condition
- Arrhythmias and Hypoxia
- Hyperbaric preoxygenation for DCS prevention
- Hypoxic stress inducing hormones profile modification







# Dalla ricerca all'addestramento aerofisiologico....

## NATO STANAG n° 3114

**Aeromedical Training of flight personnel**

## SMA 324-01-00

**Direttiva per l'addestramento aerofisiologico  
del personale navigante e degli equipaggi fissi  
di volo**

# Operational characteristics

- Altitude range: 0 - 100.000 ft
- Max theoretical altitude: 200.000 ft
- Max altitude for training: 45.000 ft
- Climb rate range: 500 - 16.000 ft/min (max 10K' with trainees)
- Descend rate r.: 500 - 20.000 ft/min (max 11K' with trainees)

# Operational characteristics

- Main Chamber volume: 25.3 m<sup>3</sup>
- Secondary chamber volume: 12.4 m<sup>3</sup>
- Fresh air flow rate < 25.000 ft: 1000 m<sup>3</sup>/h
- Fresh air flow rate > 25.000 ft: 400 m<sup>3</sup>/h
- Temperature adj. range: bw 15 and 25 C<sup>o</sup>
- Humidity adj. range: bw 20 and 80%
- 2 Fire suppression system (water + Inergen)
- Oxygen % detector
- Data transmission via modem

# System modification

- Hypobaric chamber system separated from the hyperbaric chamber system
- O<sub>2</sub> and compressed air in a separate building
- Fukuda system
- O<sub>2</sub> sensor below the false floor
- Modem
- Audio system modification for inside instructors
- CO<sub>2</sub> sensor in hyperbaric chamber
- Autorespiratore

# Problems

- Safety valve inside the chamber
- Audio system monodirectional
- Oxygen regulator