



# Accommodating the 21<sup>st</sup> century pilot: The Human Factor in Ejection Seat restraint

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- ▼ Headline figures of increased population accommodated
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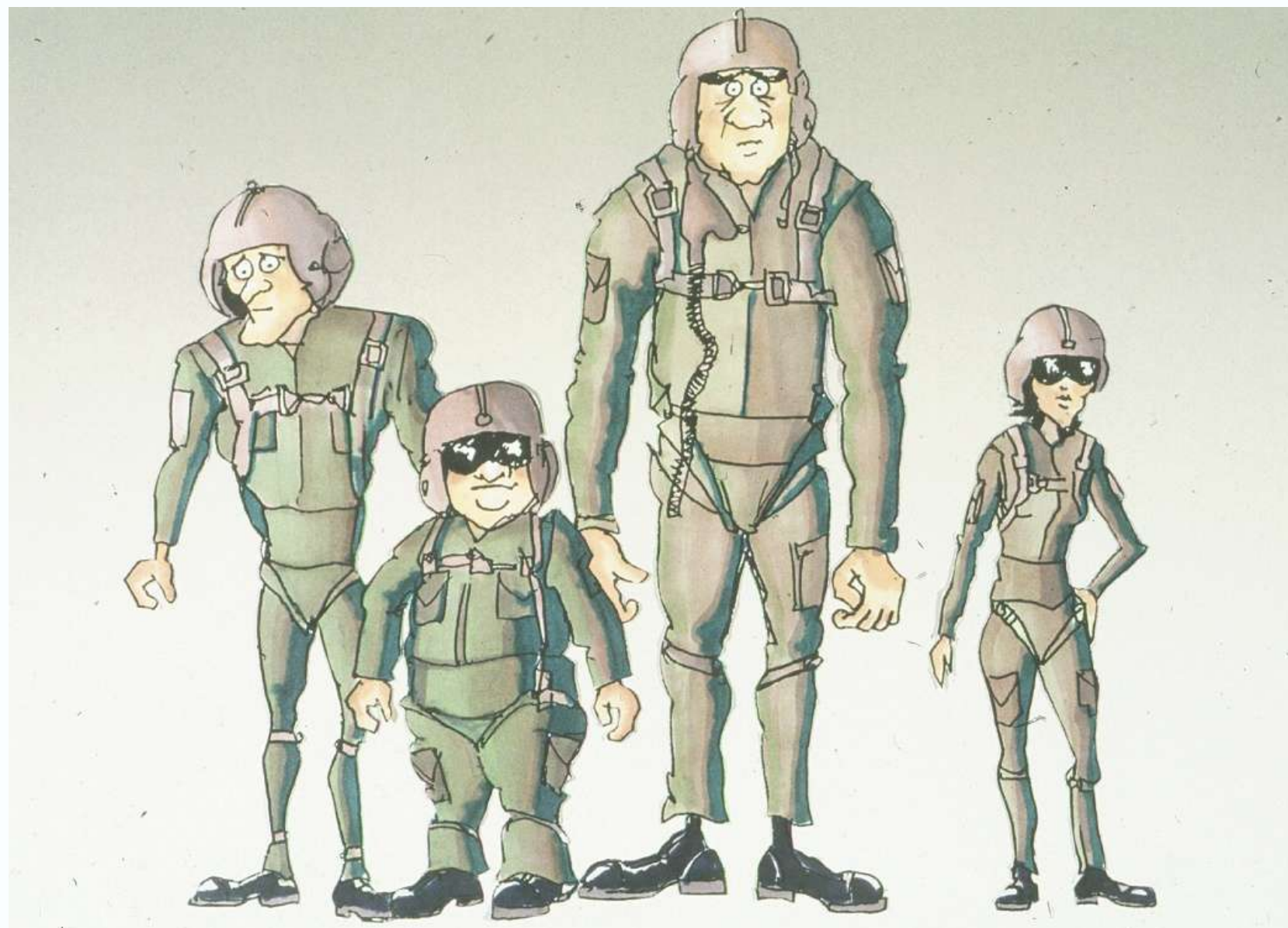
# Restraint system upgrade





# Increased flying population

- ▼ Initial aim = increased mass range
- ▼ Increased mass range = increased size range?
- ▼ Increased size range = restraint system modifications



# Increased population accommodation

	PC7 MkII		Hawk Mk120		Gripen JAS39	
	M	F	M	F	M	F
Front Cockpit						
Current	75%	62%	62%	21%	45%	16%
Post Mod	93%	92%	87%	48%	75%	40%
Rear Cockpit						
Current	68%	40%	56%	16%	40%	14%
Post Mod	93%	77%	87%	42%	70%	35%

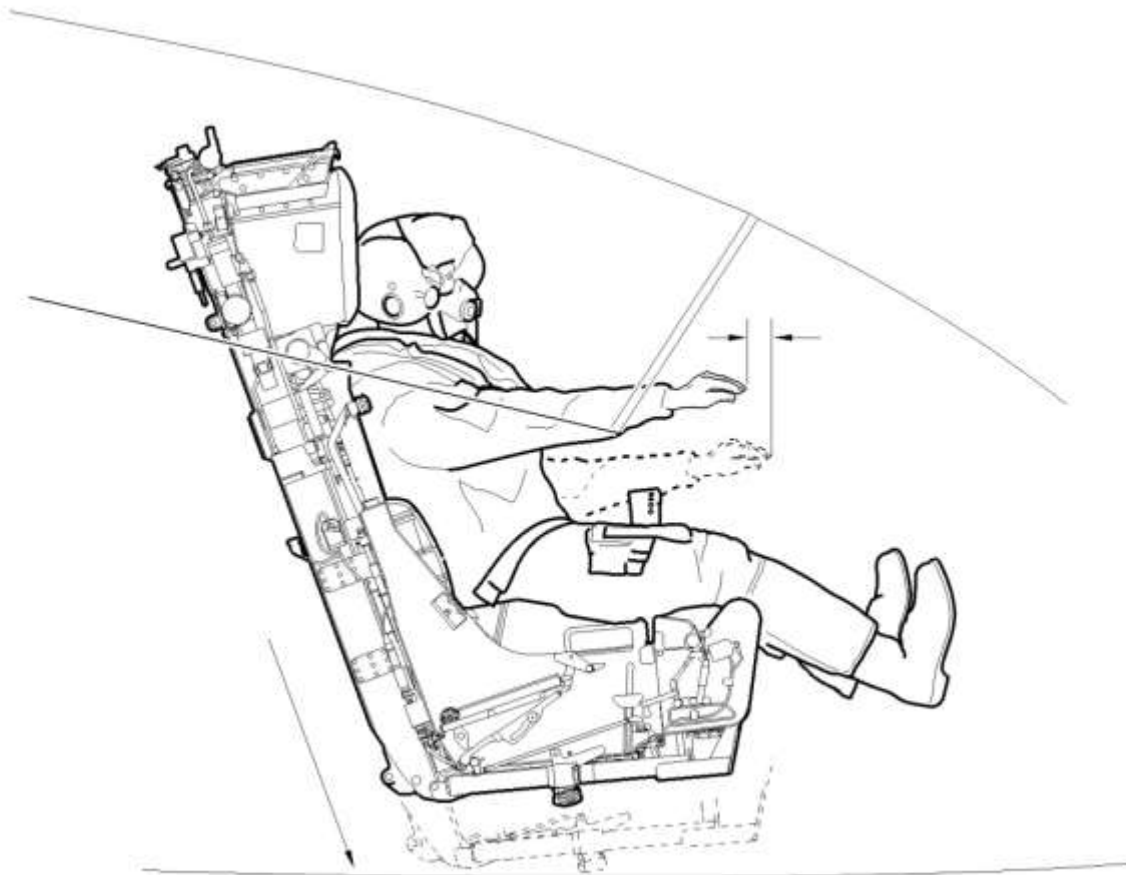
- ▼ Percentage of overall population accommodated before and after modification programme

# Cockpit accommodation assessment

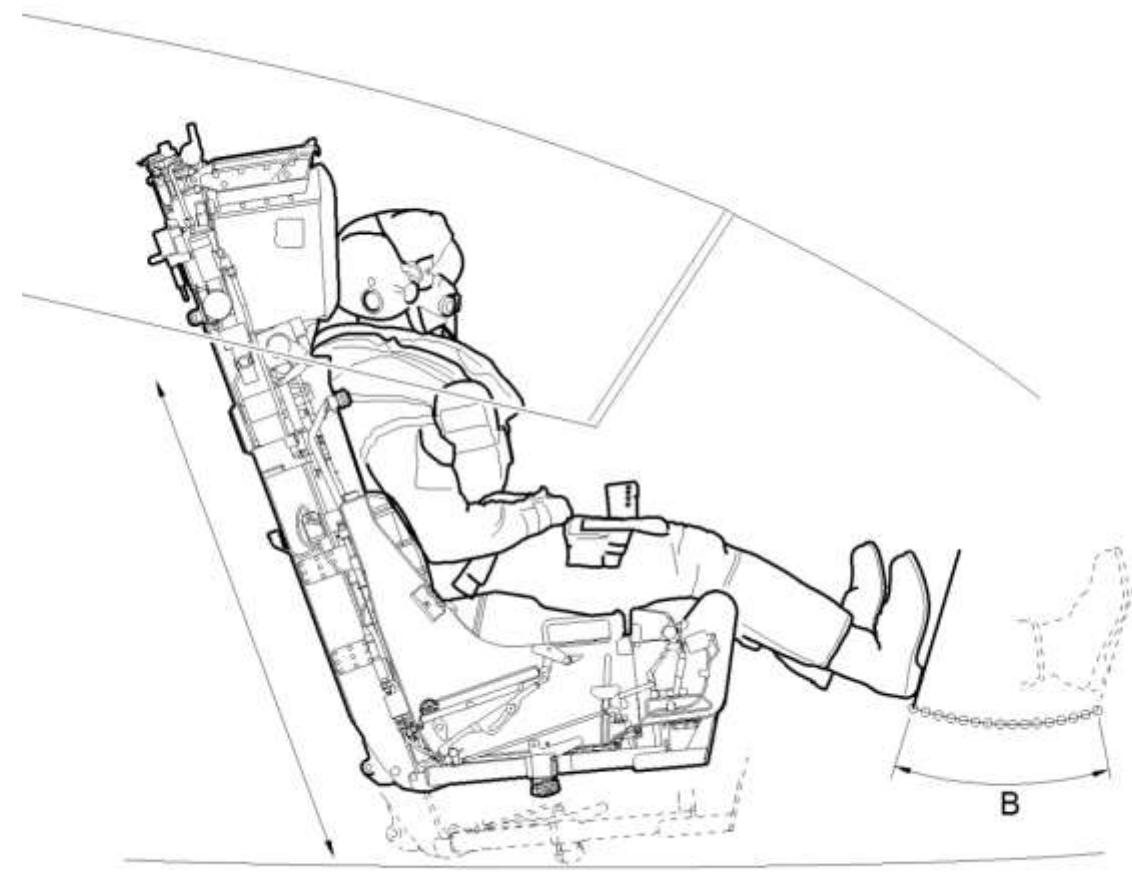


# Small subject accommodation

- ▼ Small subjects:
  - ▼ Over-nose vision
  - ▼ Arm reach
  - ▼ Leg reach



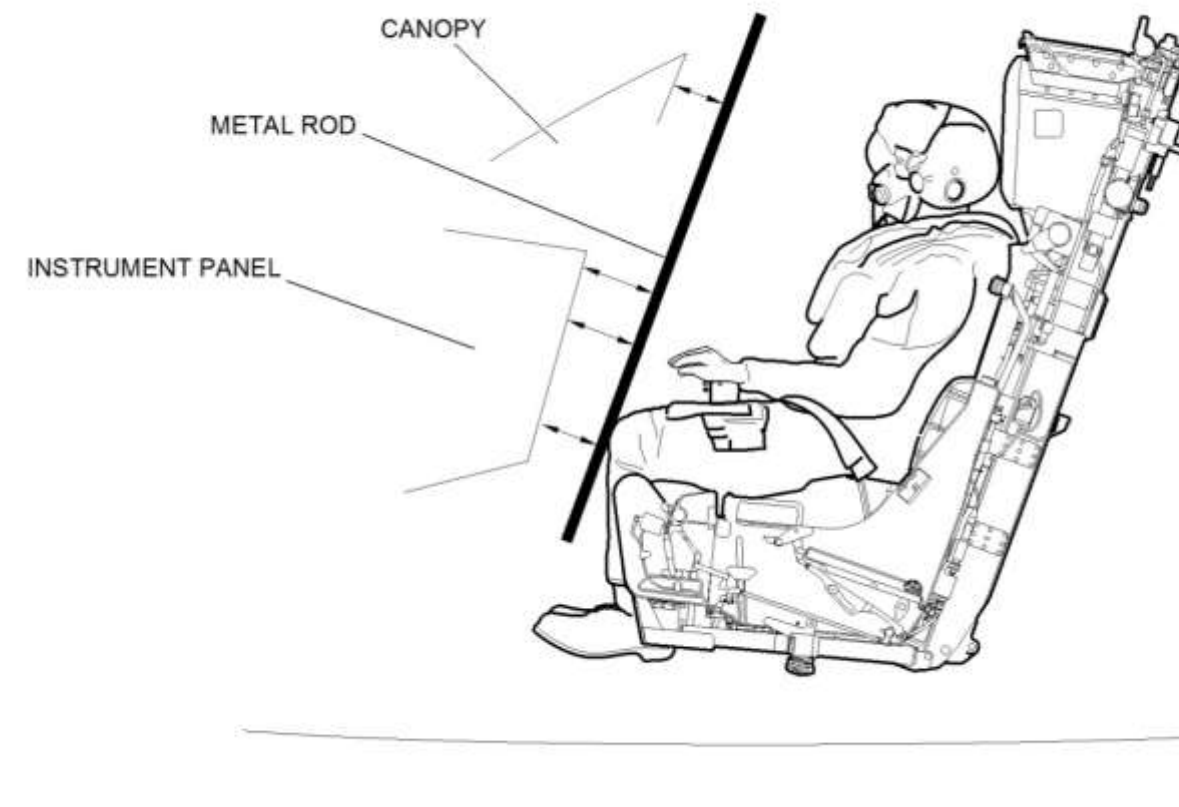
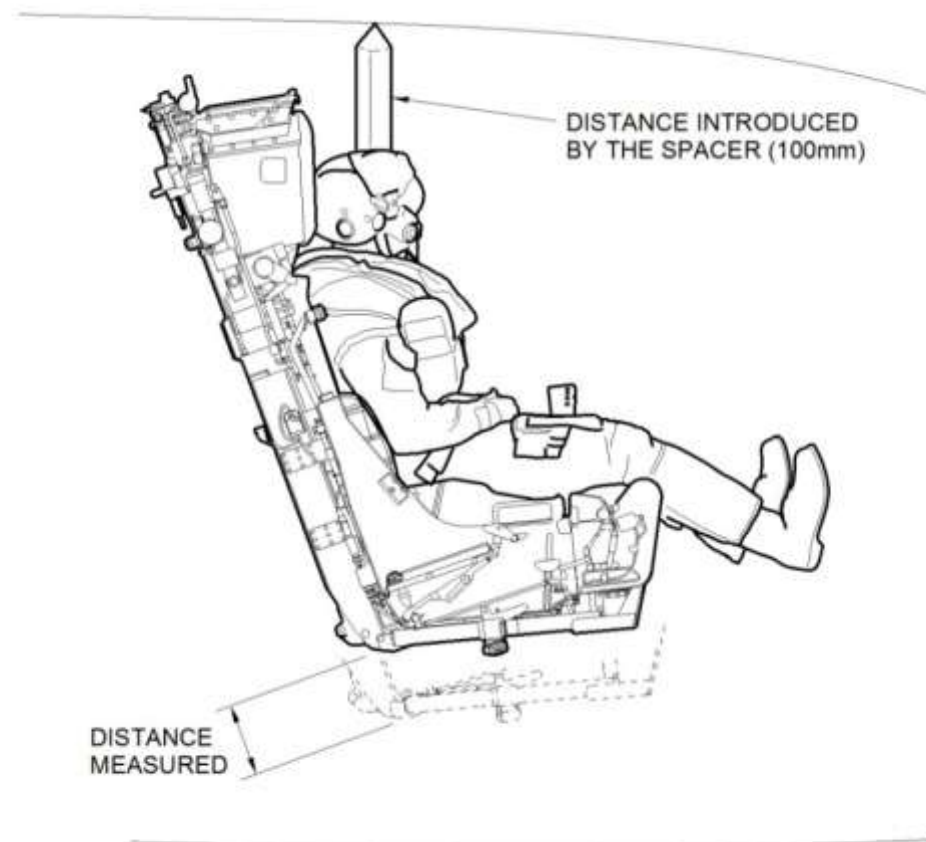
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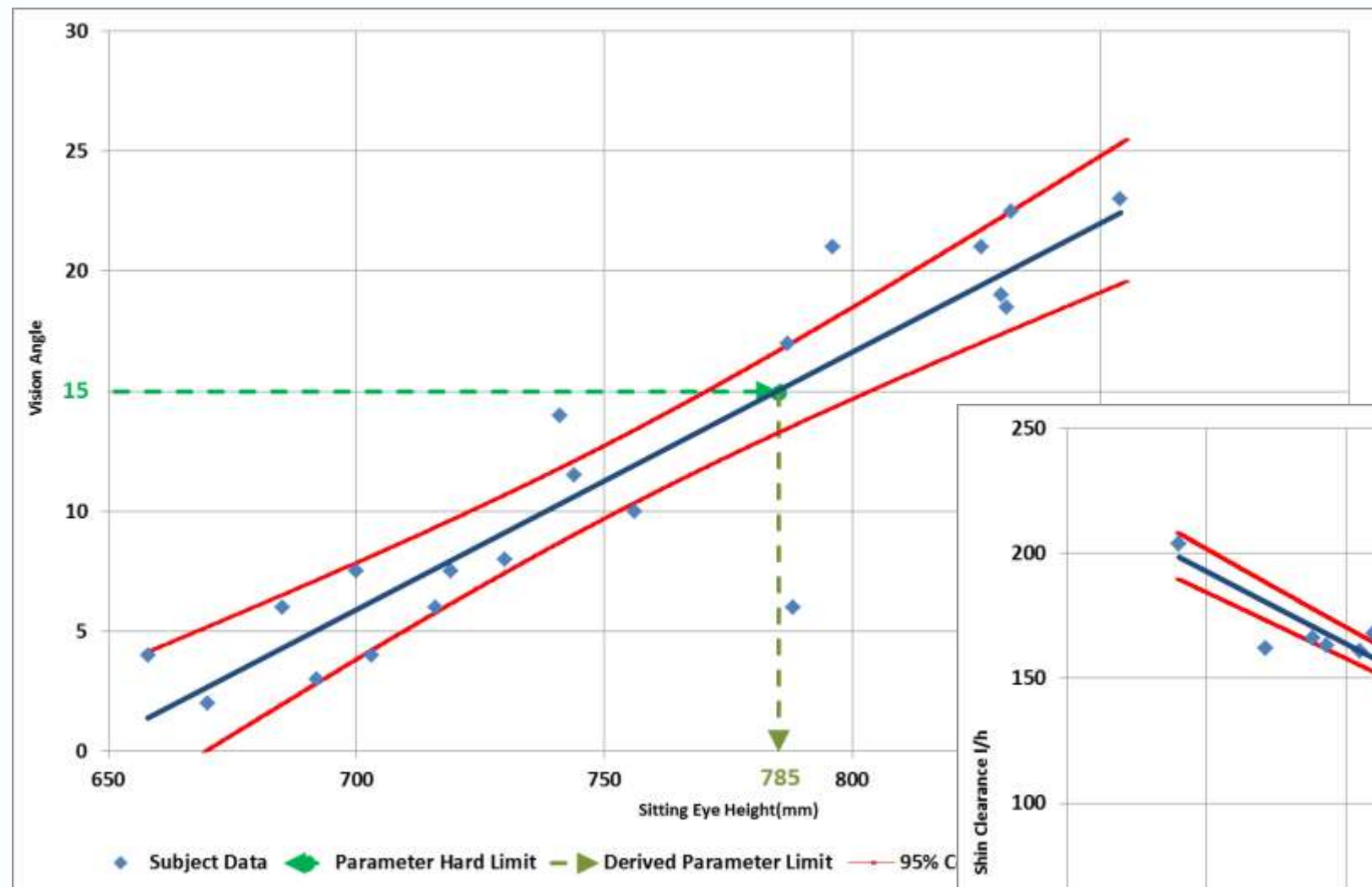
# Large subject accommodation

- ▼ Large subjects:
  - ▼ Head clearance
  - ▼ Shin clearance both operationally and during ejection

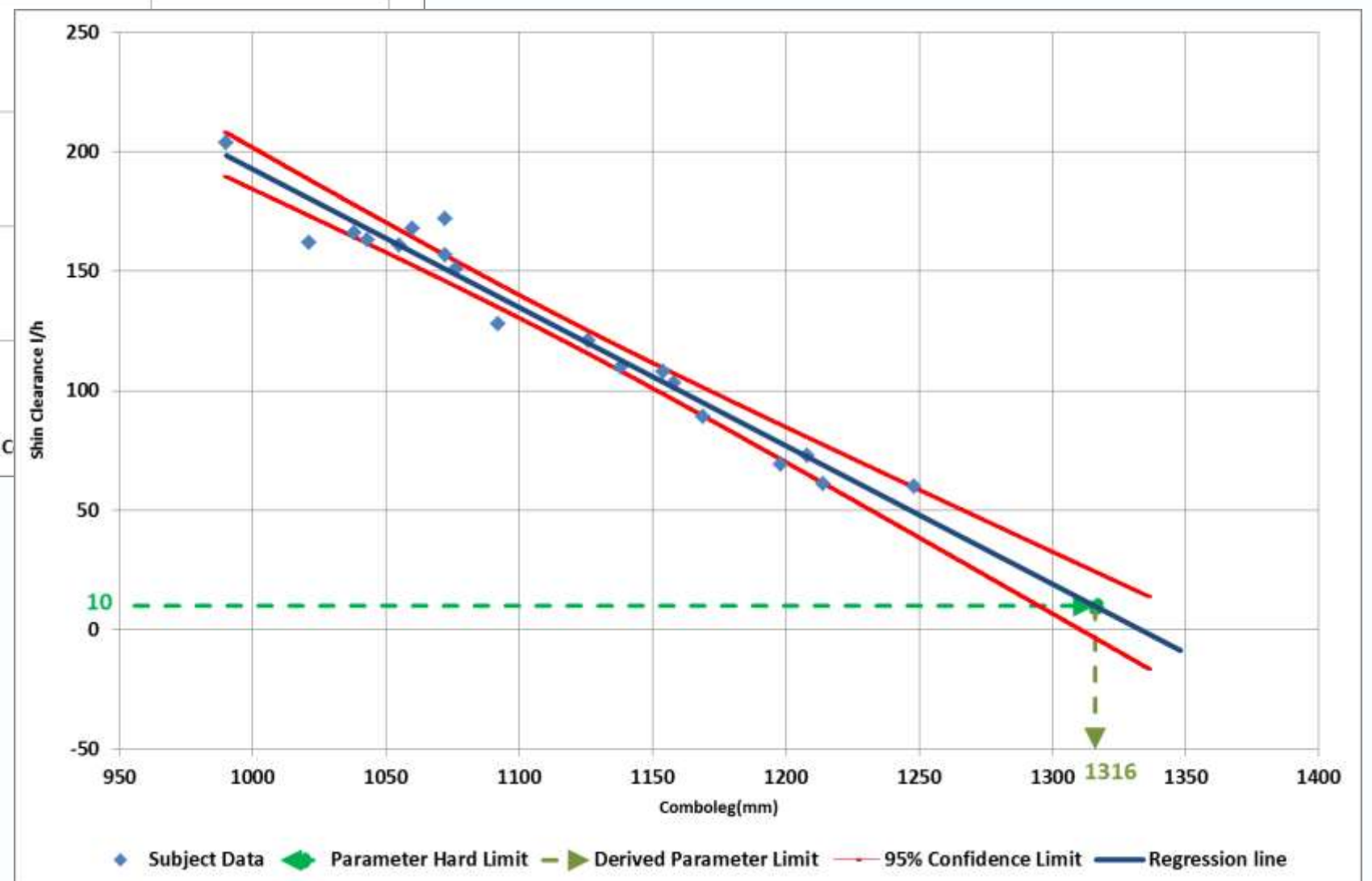




# Regression to find limits



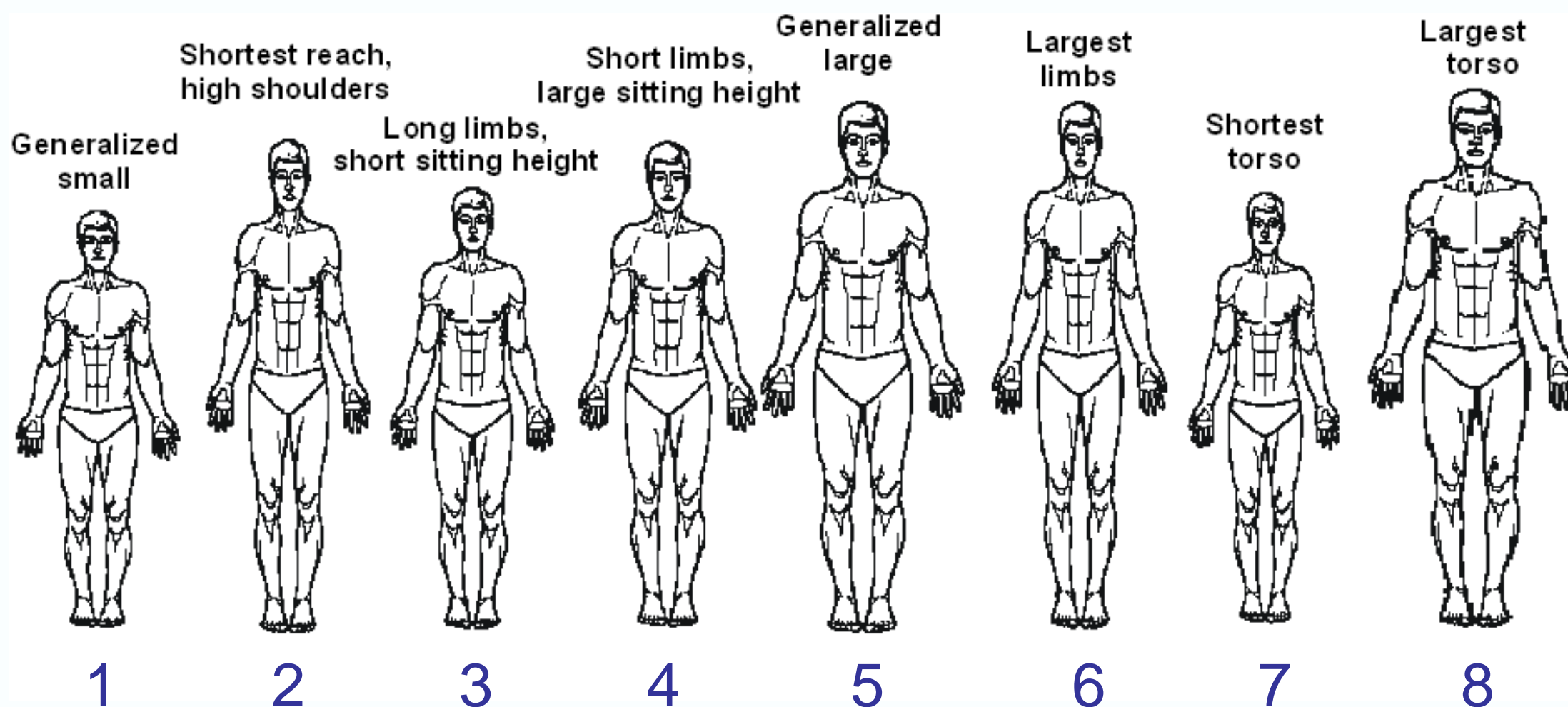
- ▼ Over-nose vision
- ▼ Minimum Sitting Eye Height



- ▼ Shin clearance
- ▼ Maximum Comboleg

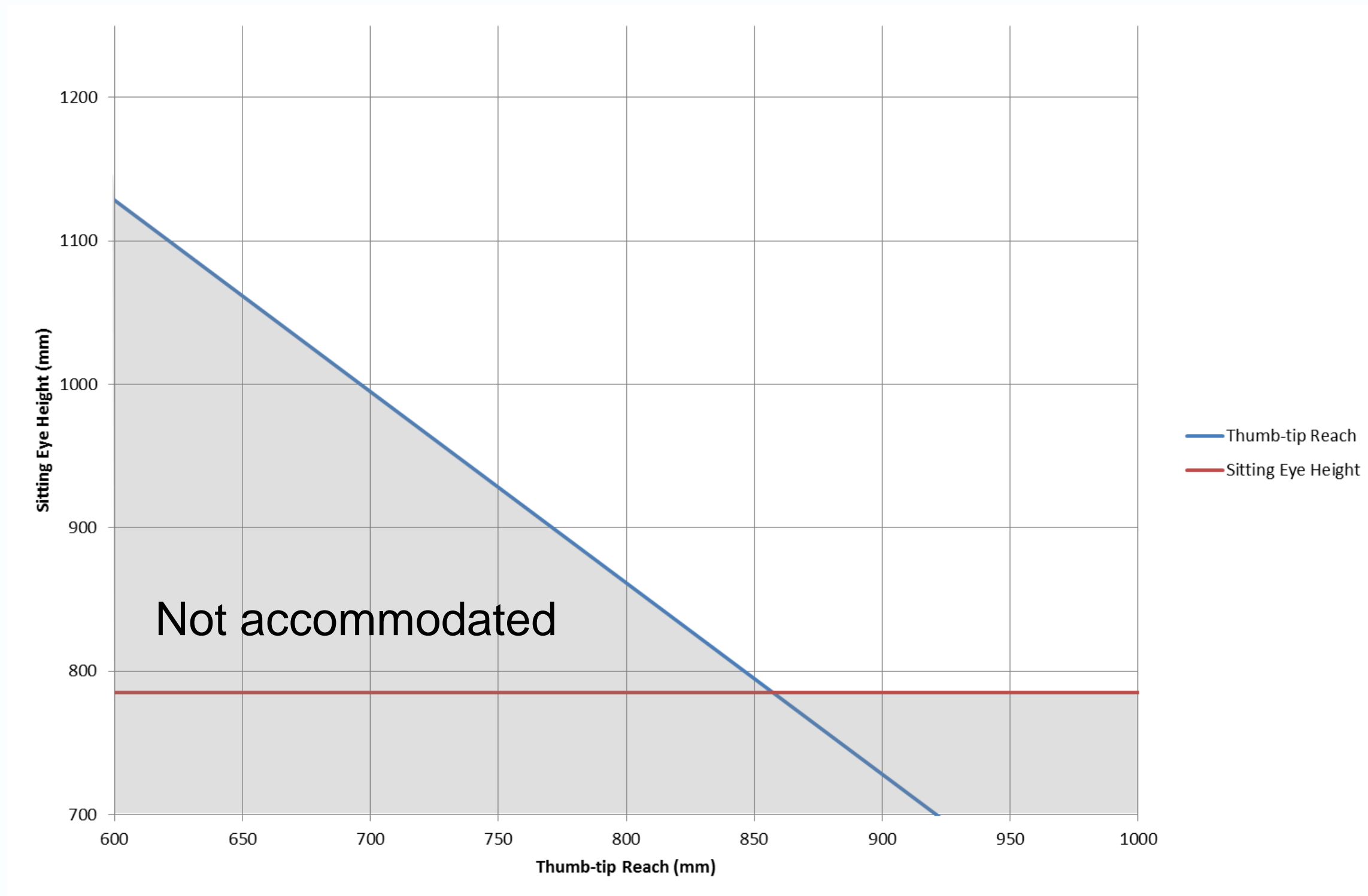
# Multivariate anthropometry

- ▼ Case sizes rather than percentiles
- ▼ Understanding that body proportions vary
- ▼ Effect of one measure on another
- ▼ Hard versus soft limits



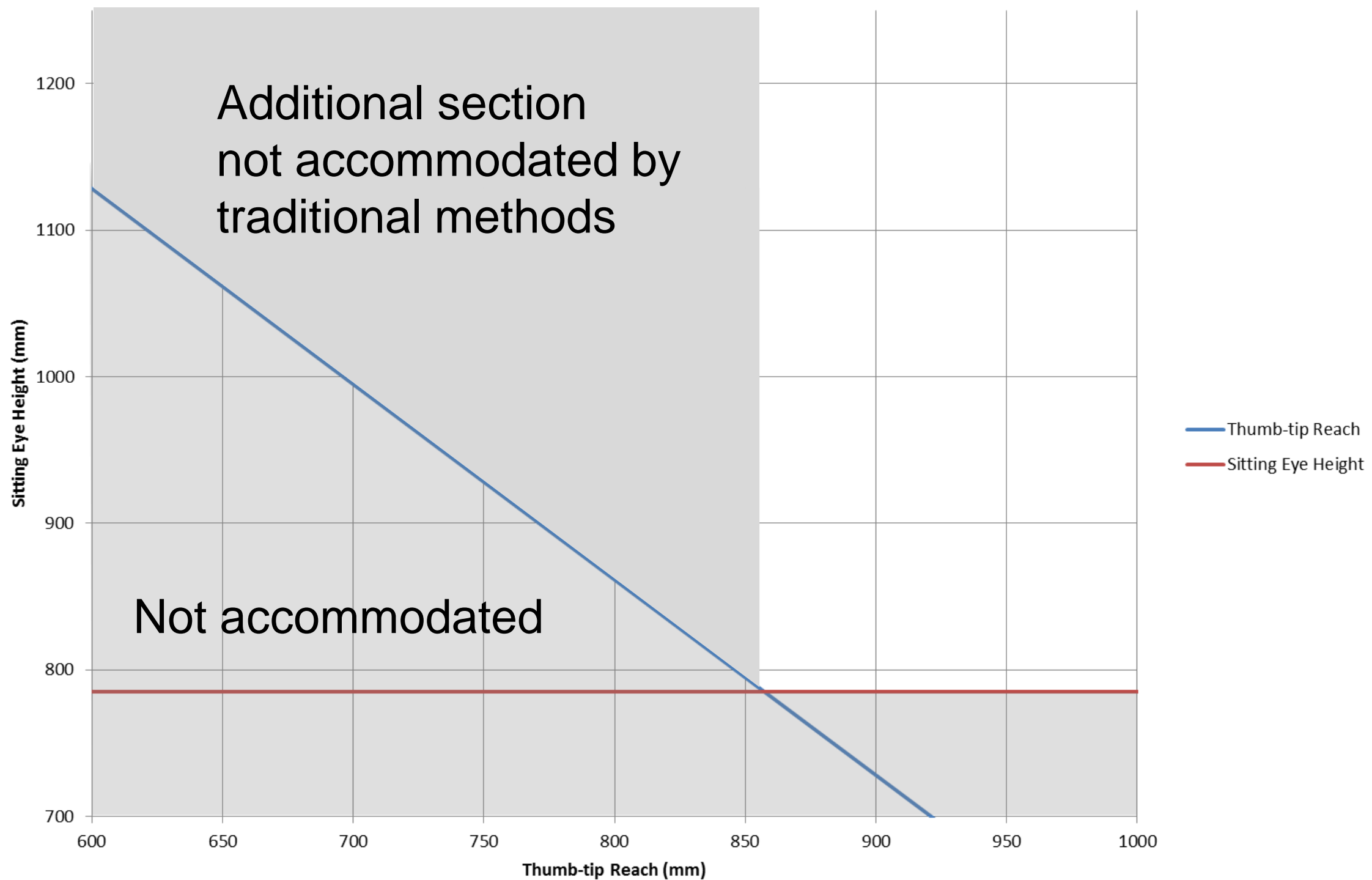


# Variation in arm reach



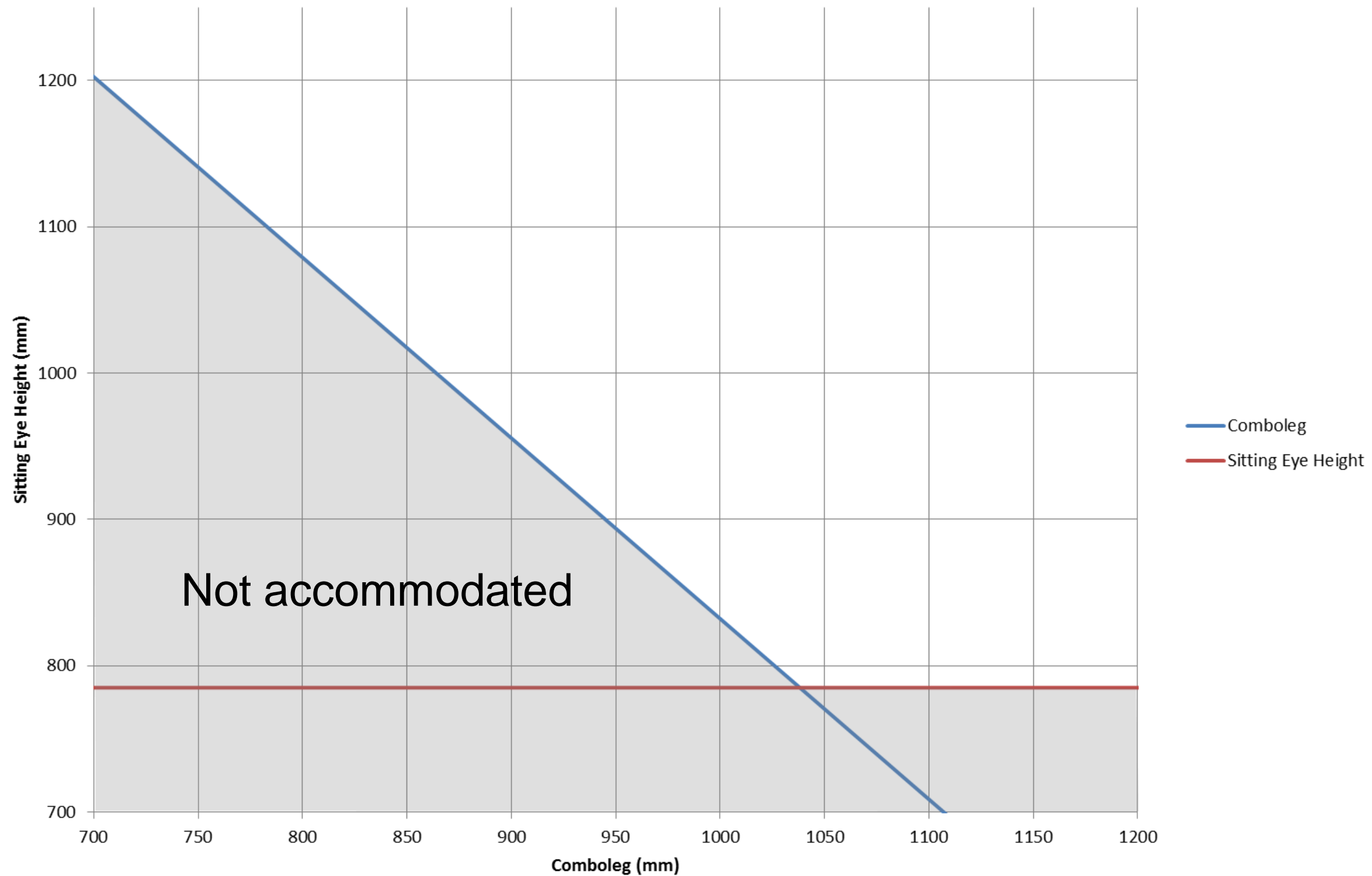


# Variation in arm reach

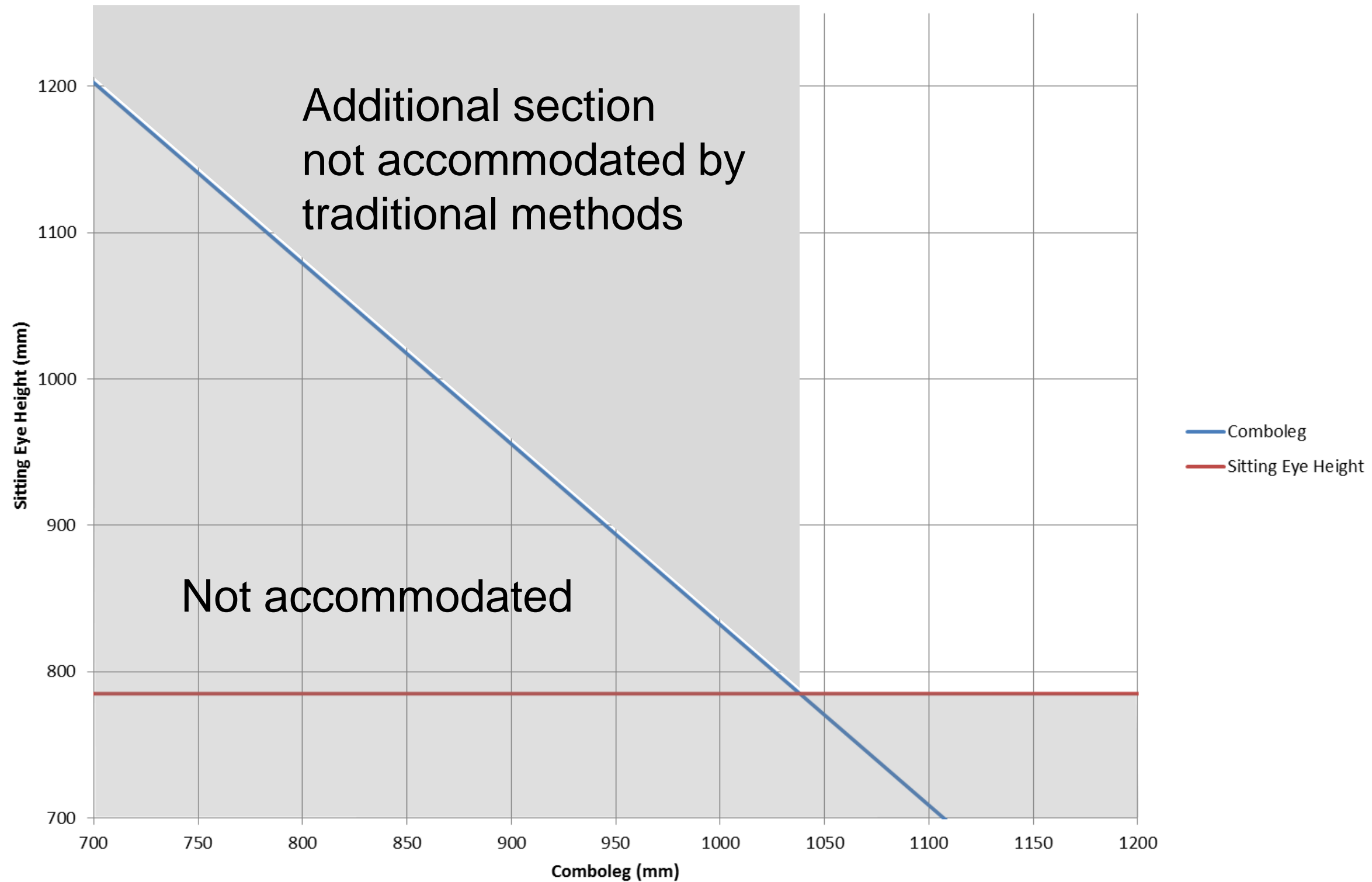




# Variation in leg reach



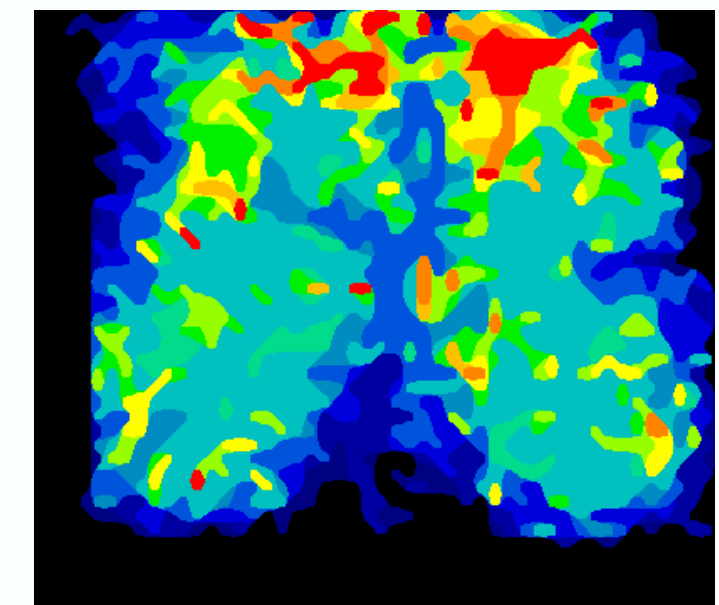
# Variation in leg reach





# Anthropometric modifications

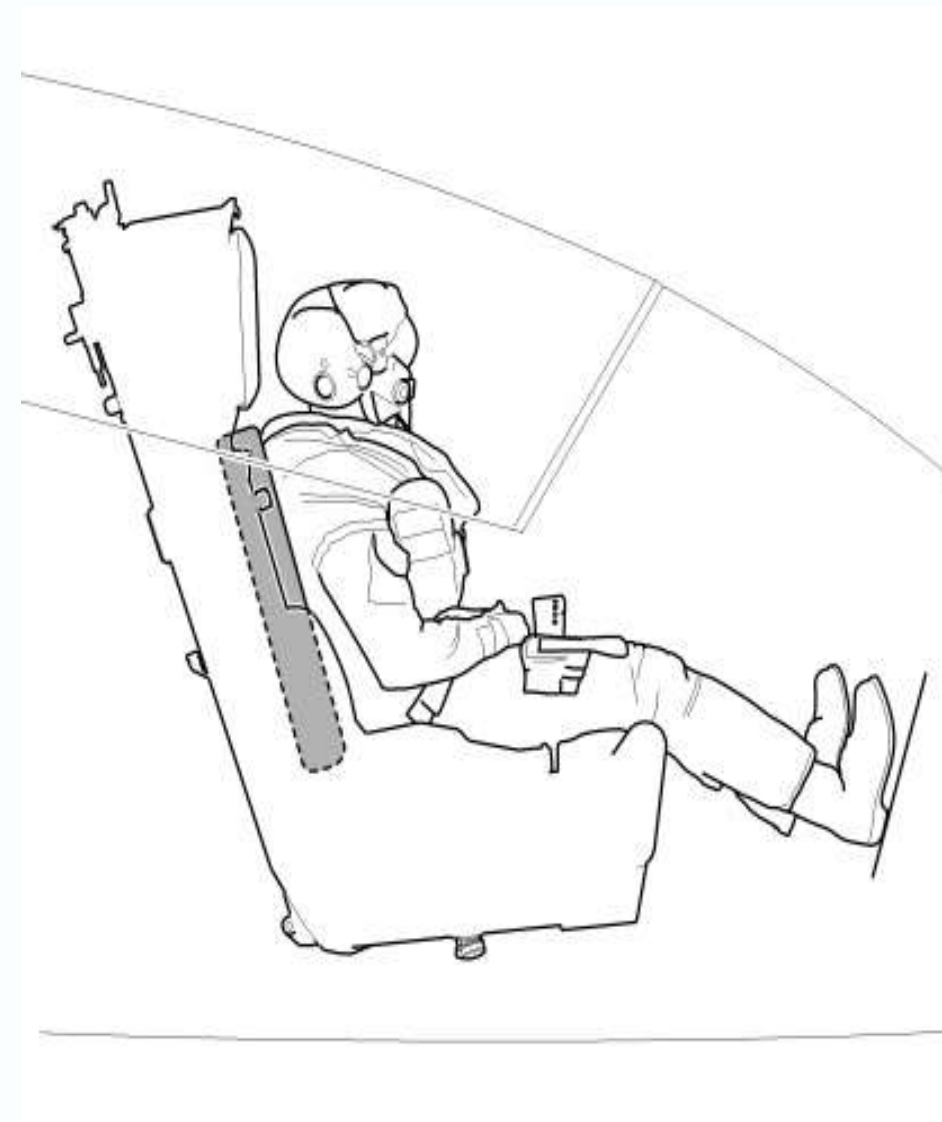
# Anthropometric modifications



- ▼ Modified Sitting Height range
- ▼ Improved comfort

# Anthropometric modifications - 2

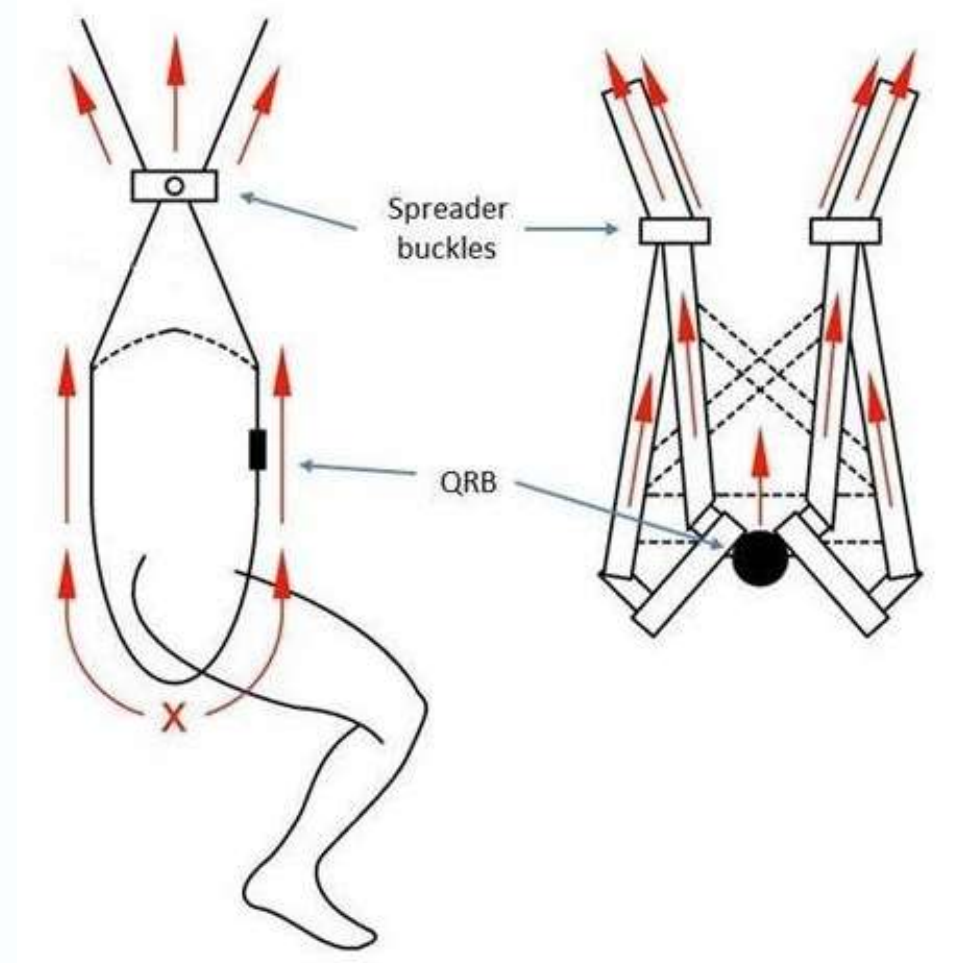
- ▼ Improved reach using:
  - ▼ Tilting seat
  - ▼ Translating back rest
  - ▼ Role fit back rest
  - ▼ Role fit spacer
  
- ▼ Safety considerations:
  - ▼ Change of CoG



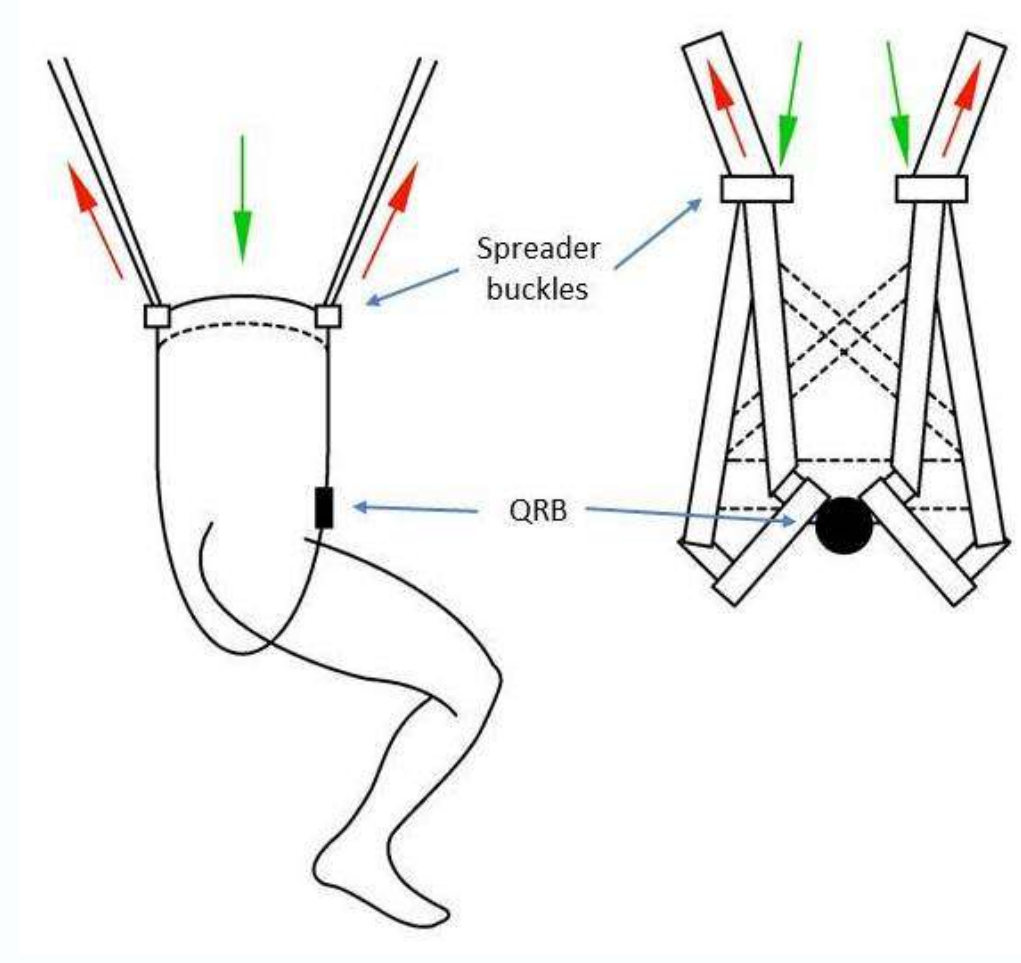


# Restraint Systems

# Restraint systems



Gen 1 & 2



Gen 5

- ▼ Improved suspension geometry
- ▼ Increase anthropometric range
- ▼ Reduced helmet / riser interaction

# Restraint systems

## Generation 5 Integrated Harness:

- ▼ Improved comfort and fit
- ▼ Designed to fit Case sizes 1 to 8
- ▼ Latest Quick Release Box (QRB)
- ▼ Improved strapping in procedures
- ▼ Maintains (vertical) suspension angle





# QRB – Safety and Training



PC-7 MkII  
Hawk



Gripen

- ▼ Consistent procedures
- ▼ Either hand operation
- ▼ No potential errors in operation



All aircraft  
post mod

# MWARS

- ▼ Martin-Baker Water Activated Release System
- ▼ Automatic harness release on sea water entry
- ▼ Qualified and in-service on F-35



# Summary

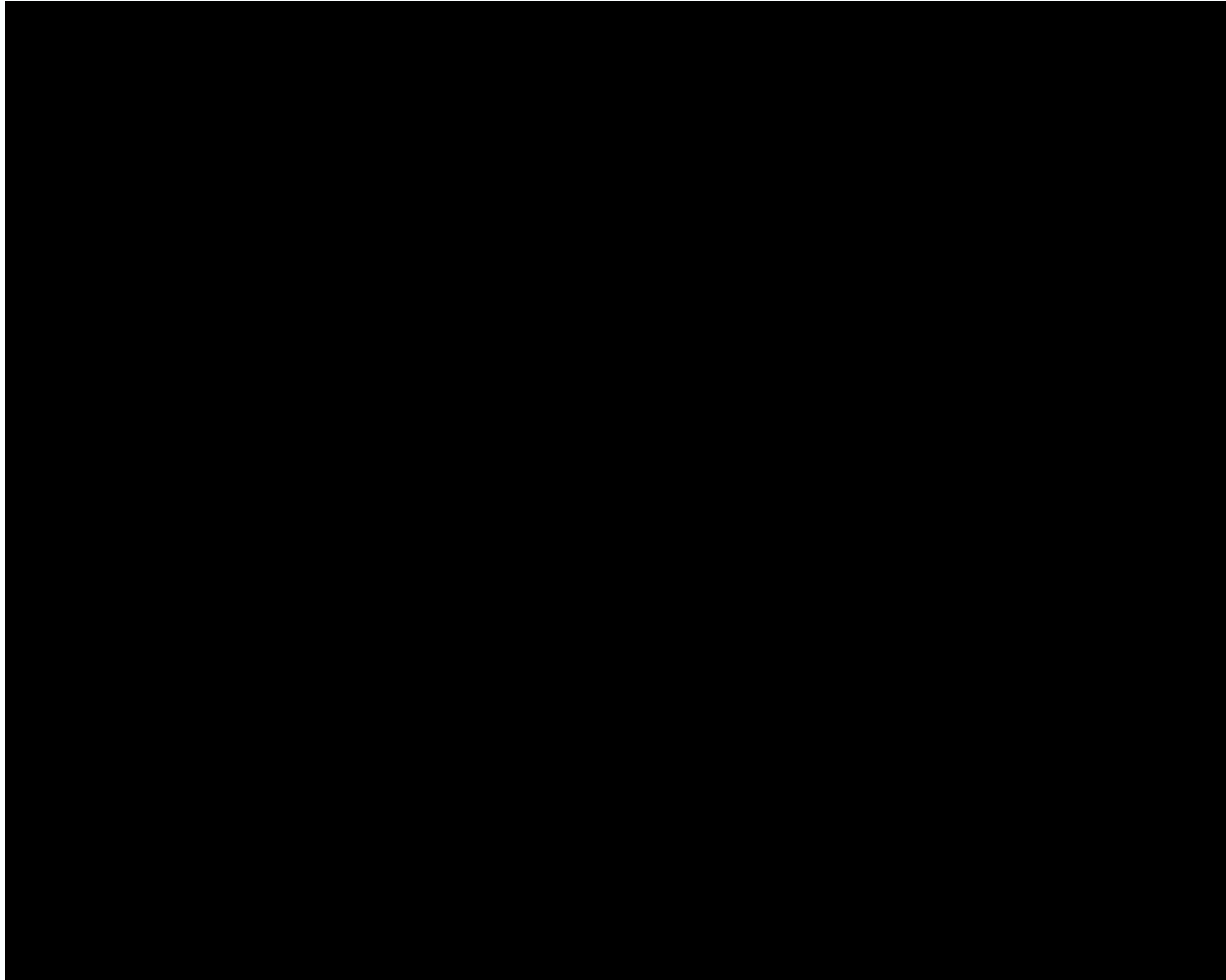
- ▼ Improved cockpit accommodation assessment using multivariate anthropometry
- ▼ Hard versus soft accommodation limits
- ▼ Ergonomic aids used to improve accommodation
- ▼ Generation 5 Integrated harness
- ▼ QRBs – safety and training considerations





**safe** europe

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**Martin-Baker**



# Questions?

## Next Event:

- ▼ Mk17 Ejection Seat demo at the Martin-Baker stand at 3pm