

# Analysis of the HighStep Climbing system



HighStep

and



Other climbing possibilities

# Analysis' purpose

- Comparison to the strain between climbing with HighStep system and ladder on a 20 meter height pylon regarding:
  - Heart rate (objective)
  - Effort: Borg (subjective)
  - Comfort (subjective)
- Strain with HighStep in a long distance
- Time-comparison

# Methodology: Subjects (participants)

- 11 subjects: principally high-voltage workers from 4 different companies.
- Subject's age: 23-55 years old, weight: 65-110 kg
- No medically risks / positive clarifications

# Methodology: Borg-scale reading:

## Borg-Skala (CR-10)

### Persönliches Anstrengungsgefühl:

- 0 überhaupt nichts
- 0.5 extrem schwach (kaum spürbar)
- 1 sehr schwach
- 2 schwach (leicht)
- 3 mässig
- 4
- 5 stark (schwer)
- 6
- 7 sehr stark
- 8 extrem stark
- 9
- 10 sehr stark, maximal

### Subjective feeling

- 0 not at all
- 0.5
- 1
- 2
- 3
- 4
- 5 intense (strong)
- 6
- 7
- 8
- 9
- 10 at most

# Methodology: Comfort-scale reading:

## ***Komfort – Skala***

Wie beurteilen Sie den Annehmlichkeit, Benutzerfreundlichkeit, Komfort des verwendeten Gerätes zur Erfüllung der vorgegebenen Arbeitsbelastung?

- extrem angenehm
- sehr angenehm
- angenehm
- neutral
- unangenehm
- sehr unangenehm
- extrem unangenehm

Die Vorstellung „angenehm“ umfasst zusätzlich Begriffe wie Benutzerfreundlichkeit, Komfortabilität und bequeme Handhabung.

How do the subject rate the usability and feel the comfort concerning conformance to work strain requirements?

Extremely agreeable  
Very agreeable  
Agreeable

Neutral

Awkward  
Very awkward  
Extremely awkward

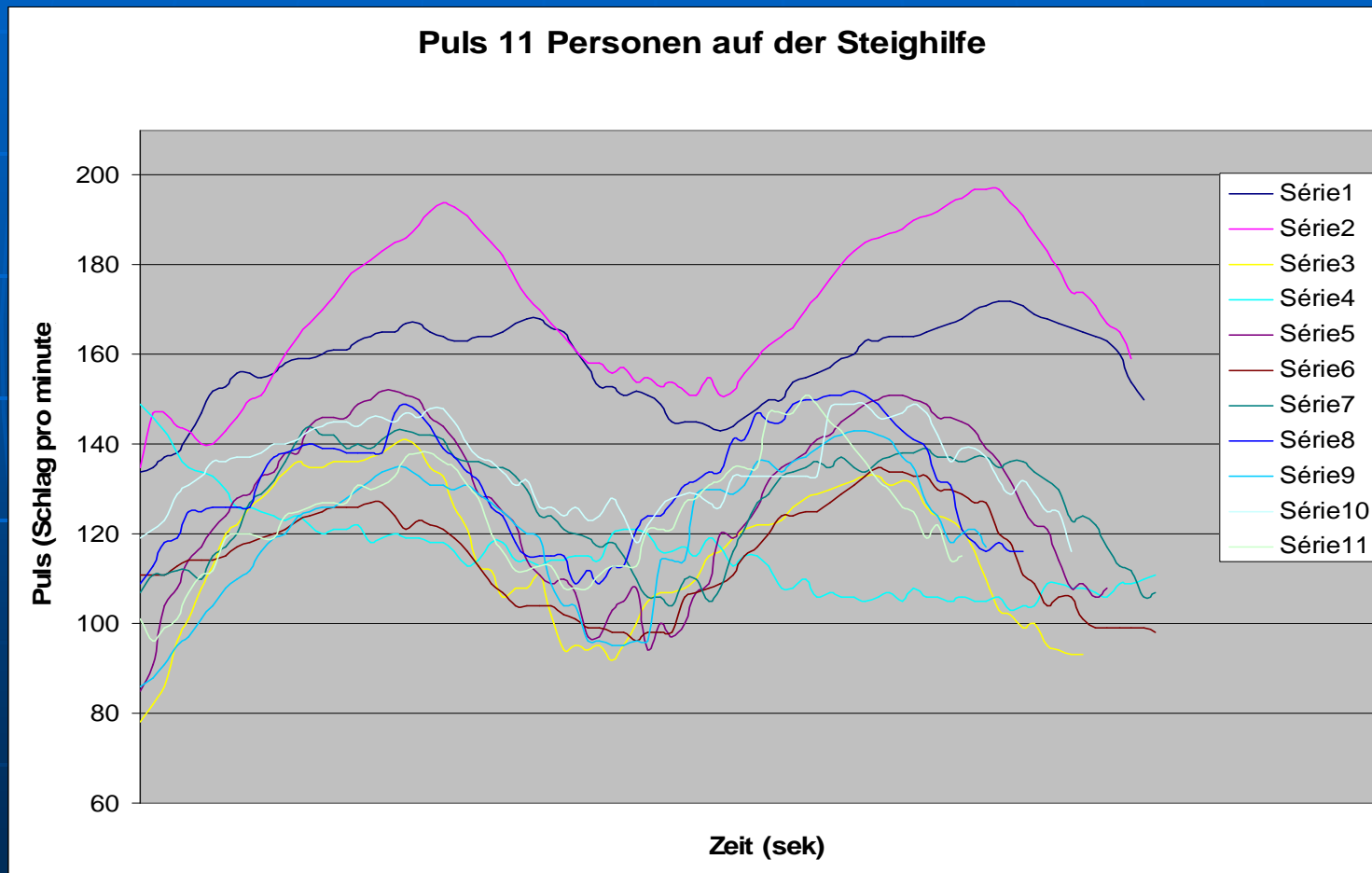
# Test conditions:

- Altitude (climb and descend) for 3 from tot. 4 tests: 2 times 20 Meter
- Climb-altitude-test (climb and descend) with crampon: 1 time 20 Meter
- 7 min. break between one and the other test-sequence
- Heart rate-record every 5 sec.
  
- Setting Borg-scale-value every min. (ca. 4 to 10 times)
- After ending of each test → value of the Comfort-scale
- Declination in all 4 test sequences: 90°

# Tests:

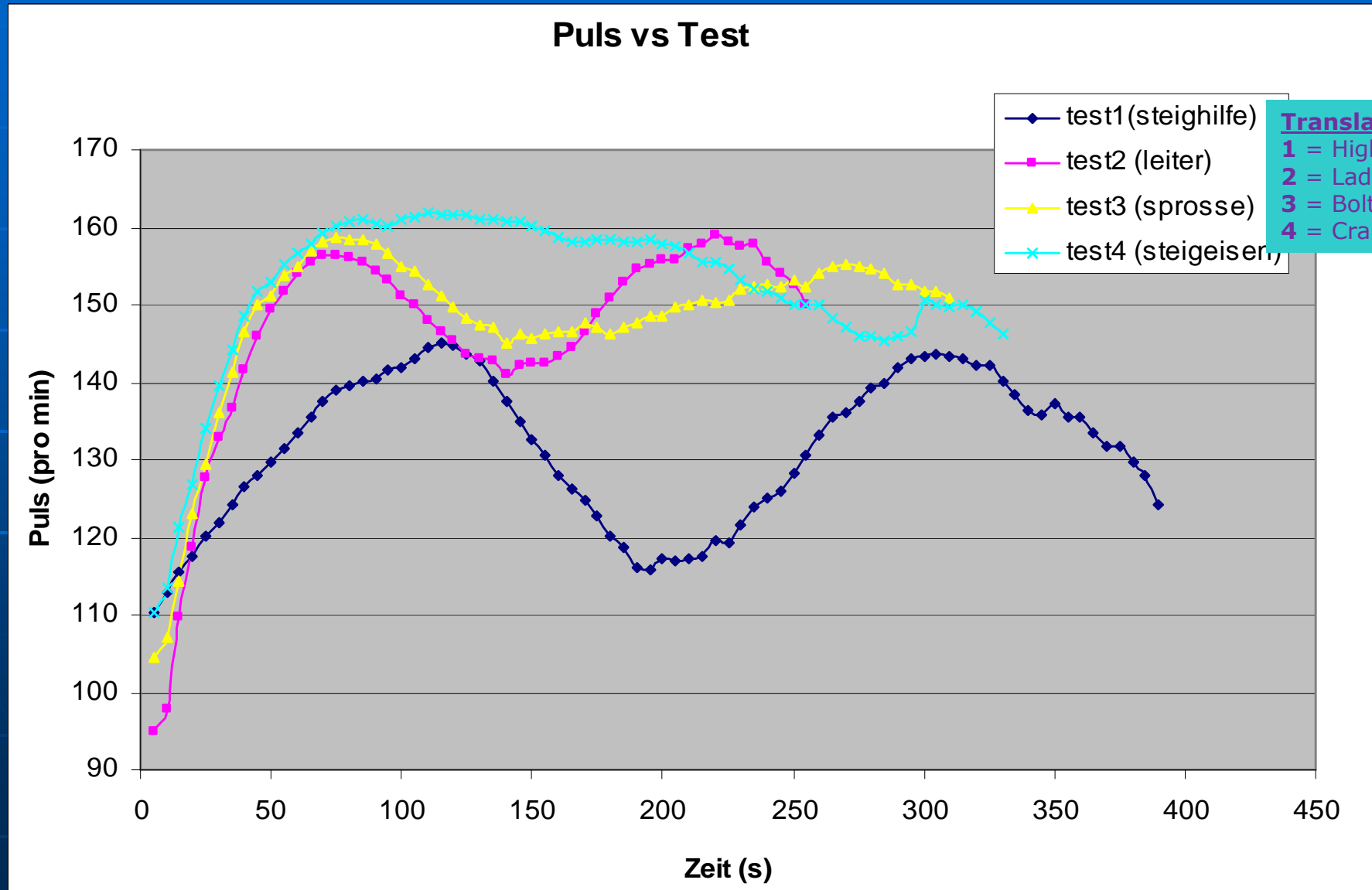
- **Test 1: HighStep system**  
climb and descend 2 times with individual speed,  
as subject would normally do
- **Test 2: Ladder**  
climb and descend 2 times with individual speed,  
as subject would normally do
- **Test 3: Climb bolts**  
climb and descend 2 times with individual speed,  
as subject would normally do
- **Test 4: Crampon**  
climb and descend 1 time with individual speed,  
as subject would normally do

# Results: Heart rate HighStep



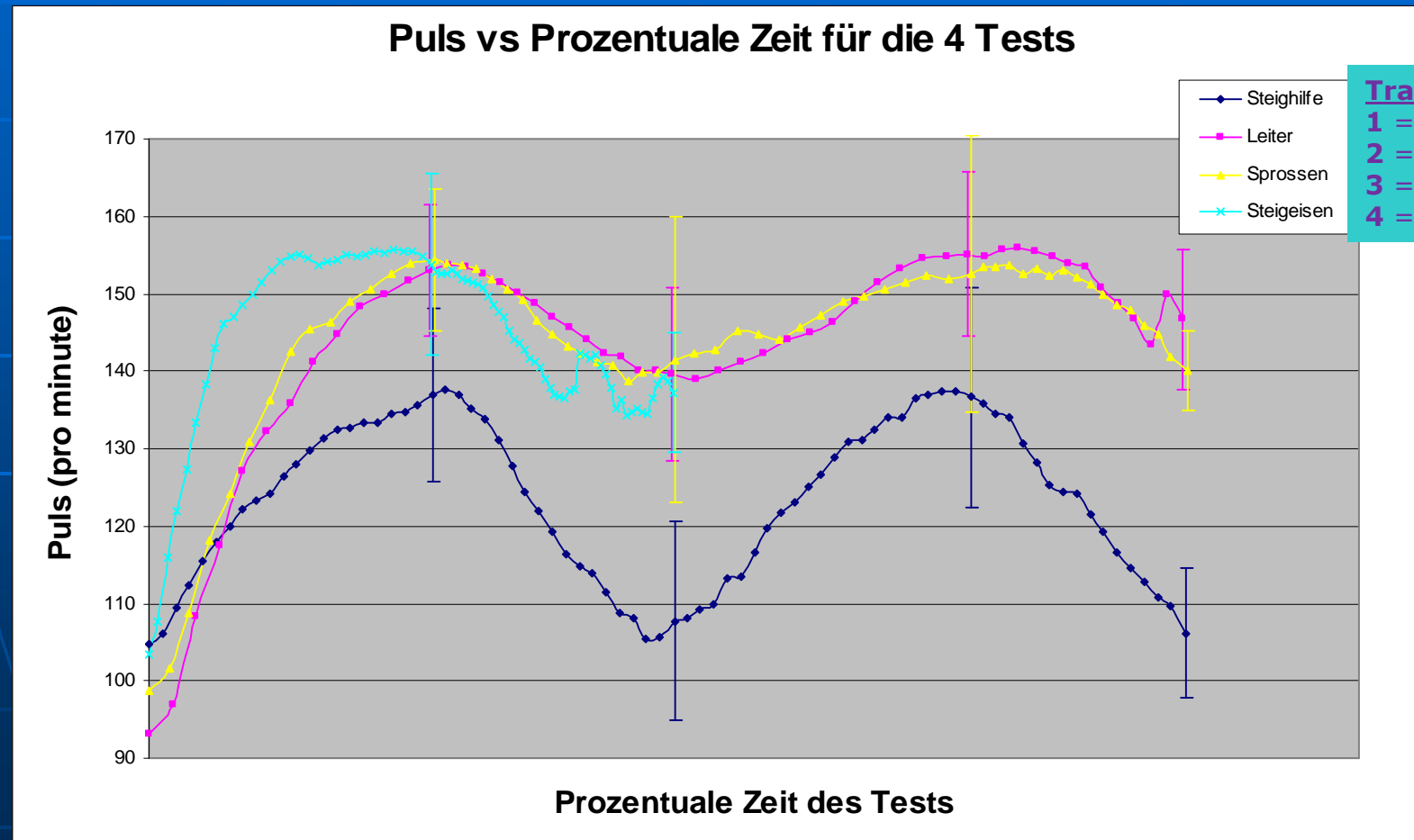


# Comparison: Heart rates



# Pulse per min. vs. test with standardized time

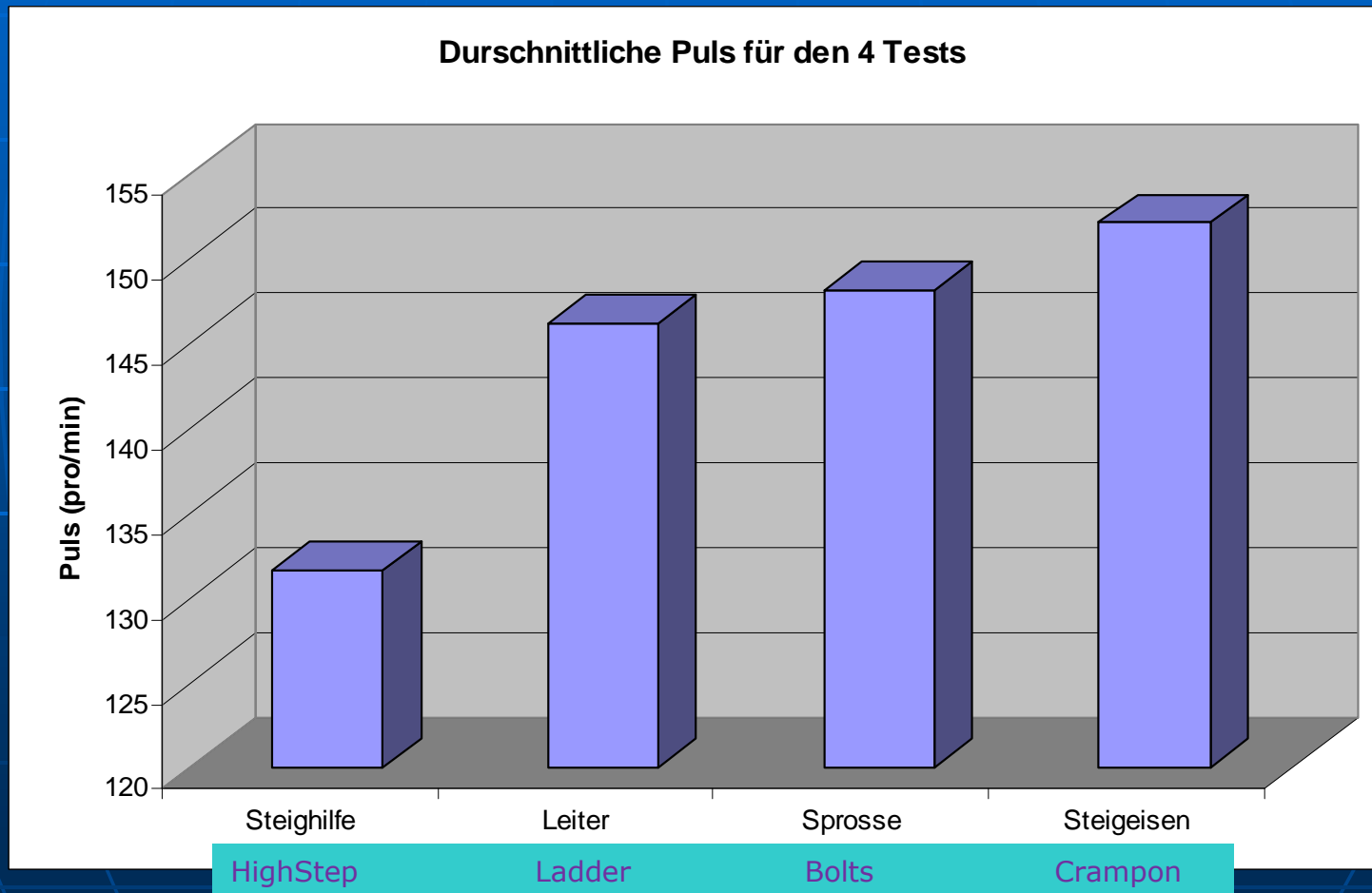
(Graph in % of total time)



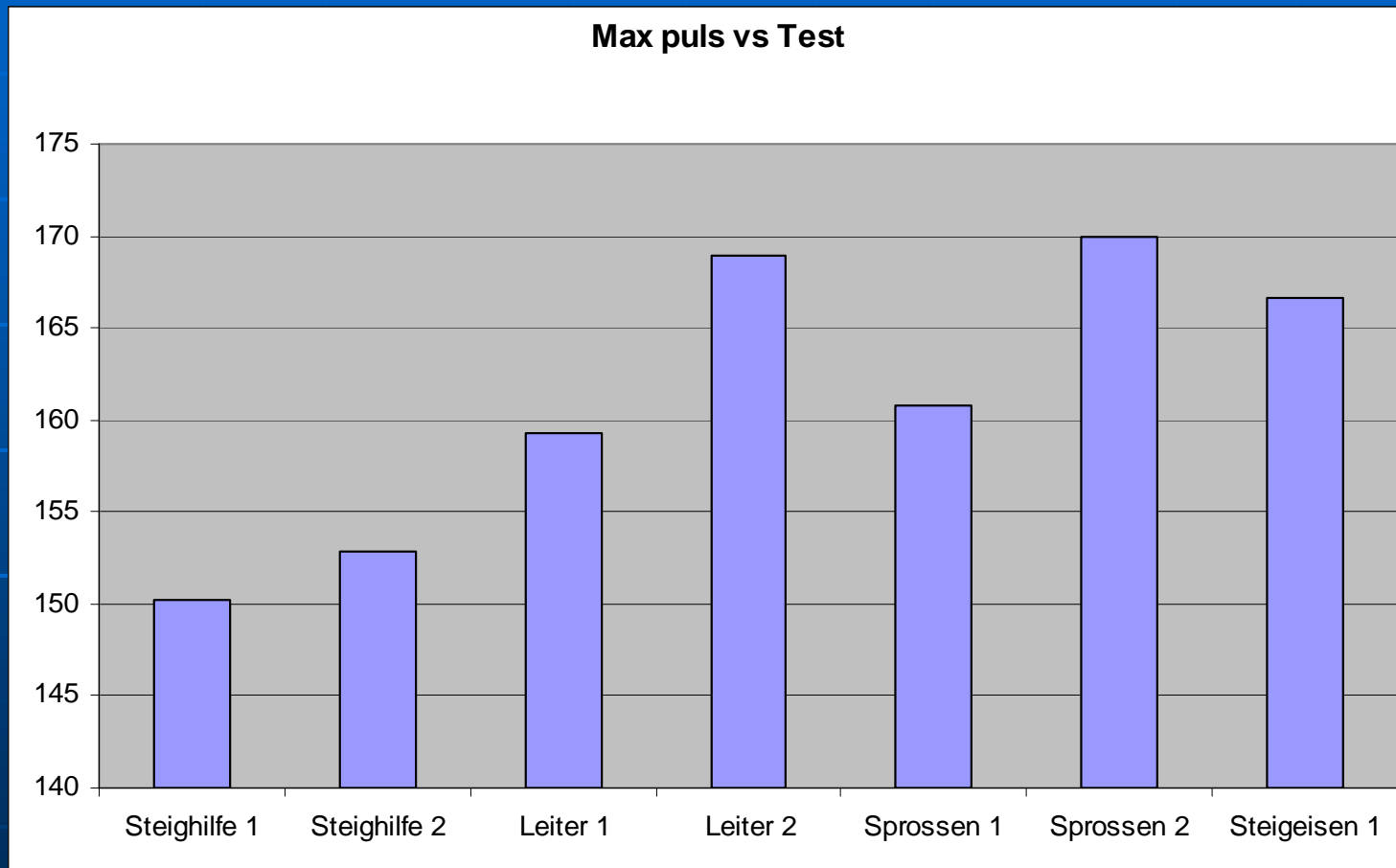
# Touched pulse using HighStep and other climbing methods. (individual climbing time)

	Climb (once)	Descend (once)	Climb ( 2 times)	Descend (2 times)
HighStep	137	105	138	105
Ladder	153	140	155	145
Bolts	154	142	152	140
Crampon	154	138		

## Medial pulse from all tests:



# Max. reached pulse-rate per test:



HighStep 1

HighStep2

Ladder 1

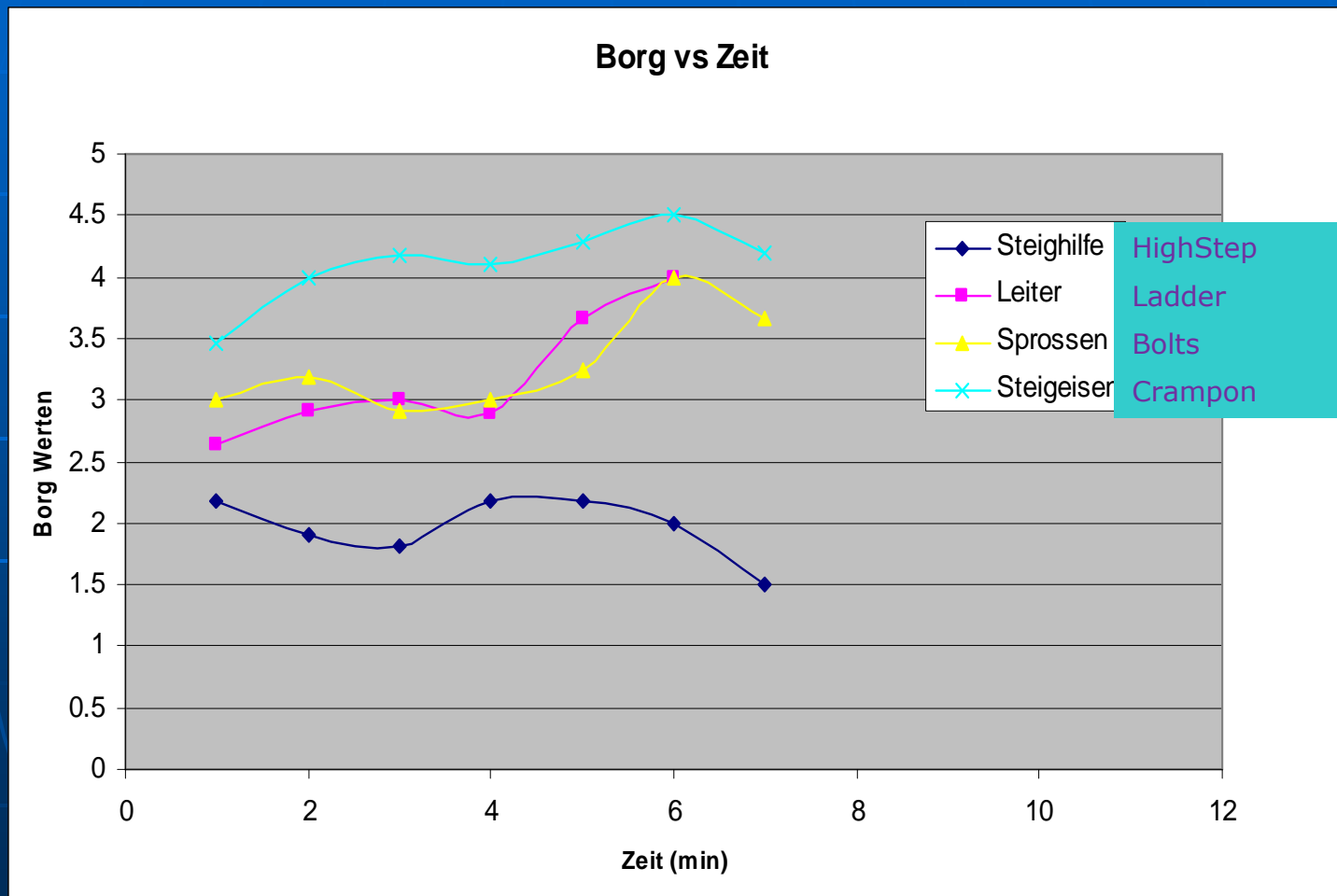
Ladder 2

Bolts 1

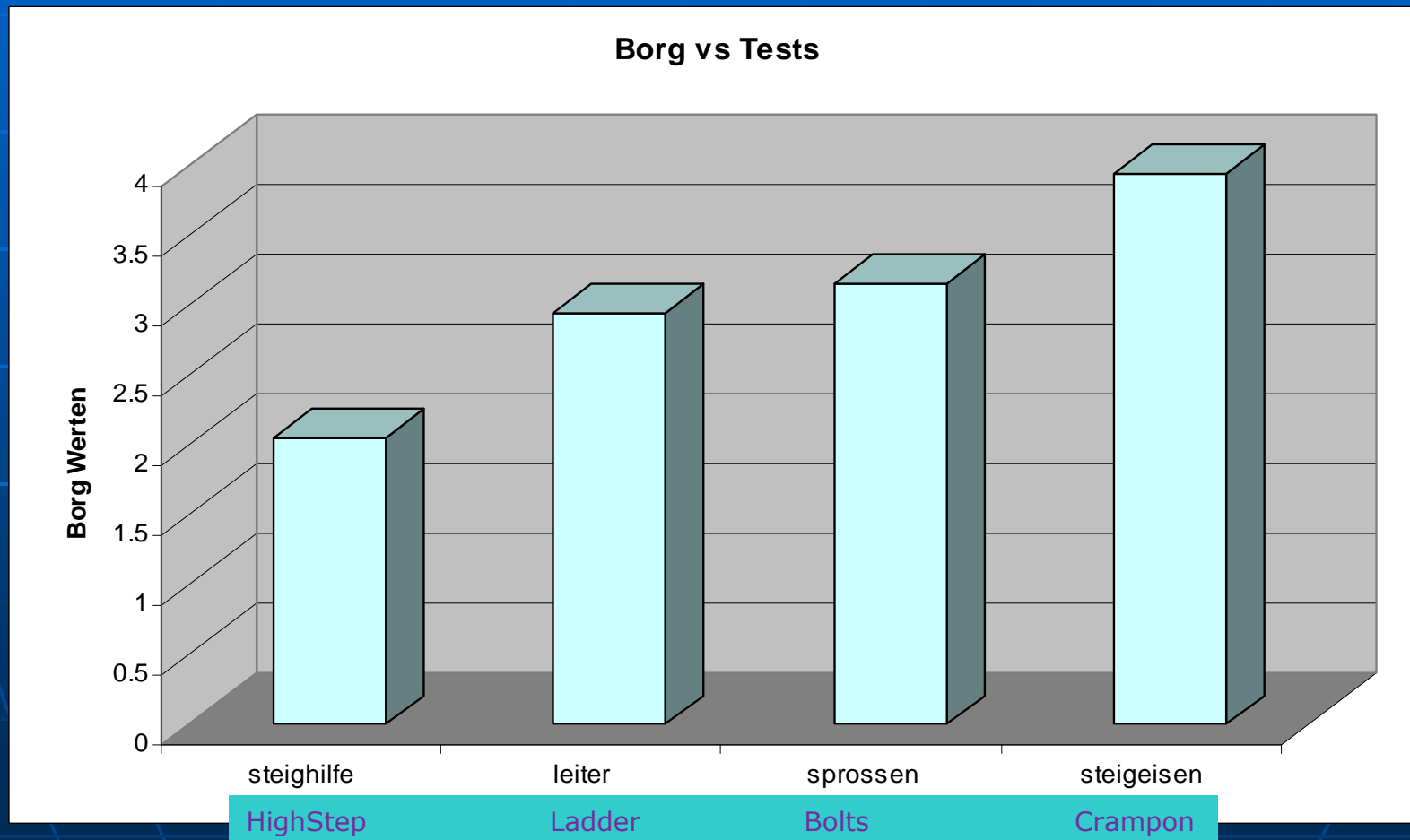
Bolts 2

Crampon

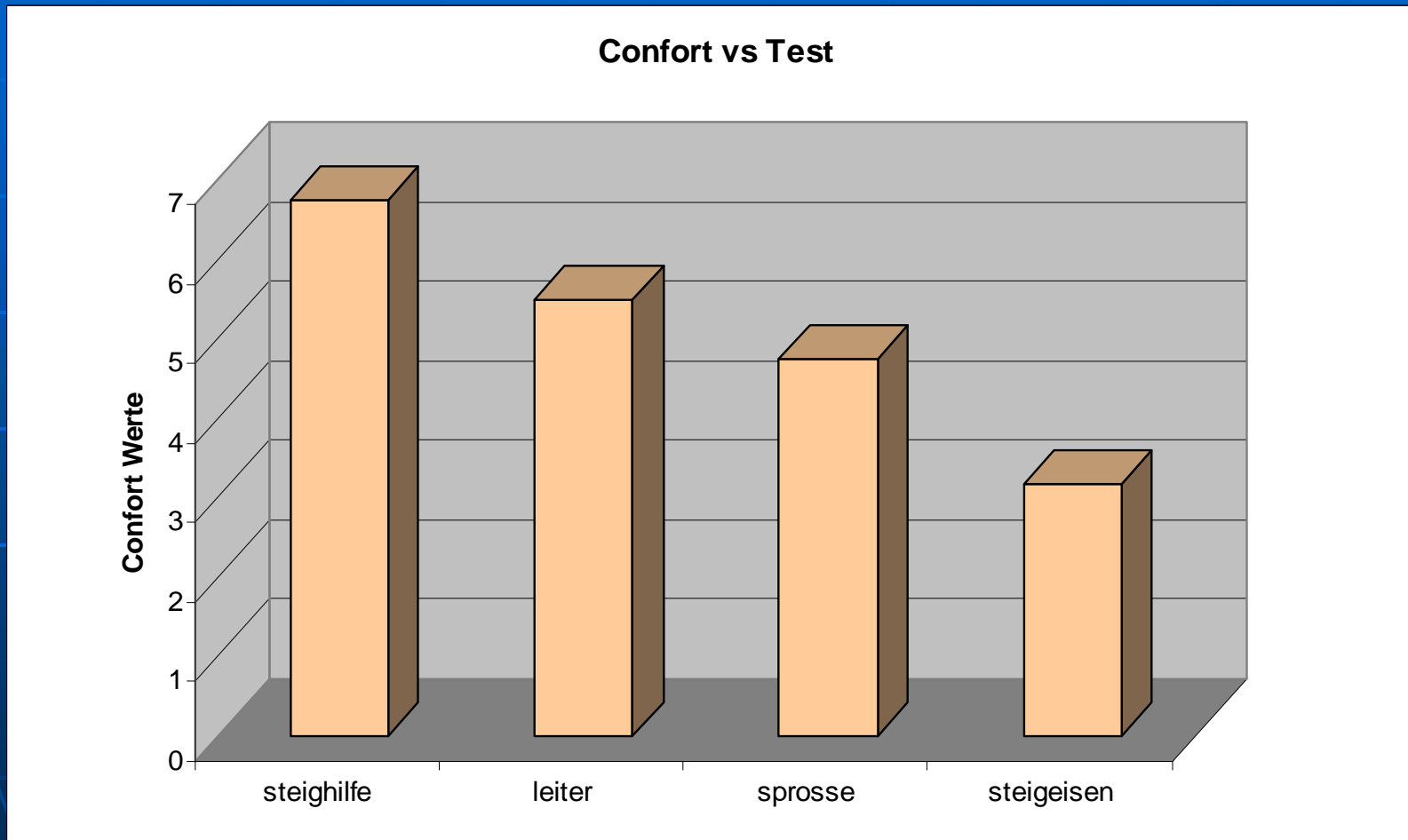
# Overview Borg-rates:



# Statistic summary and graph: Borg-rated



# Results comfort



HighStep

Ladder

Bolts

Crampon



# Executive summary:

- The physical and psychic stress with usual climbing methods are according to normal and typical work significant higher than climbing with HighStep.
- The climb-comfort with HighStep ist significant better in comparison with other climbing methods.