ERGONOMIC AND PERFORMANCE DIFFERENCES BETWEEN FIREFIGHTER PROTECTIVE CLOTHING SYSTEMS

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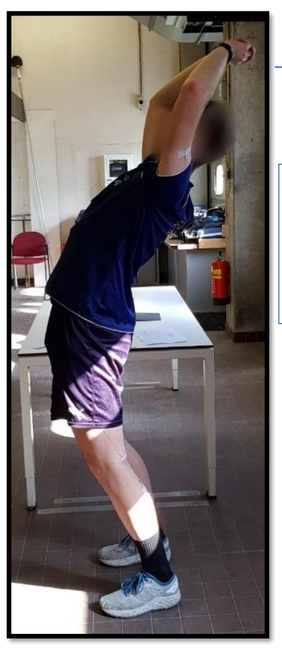
Introduction

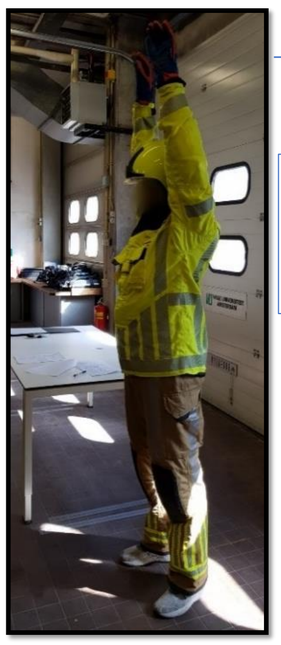
Protective clothing systems (PCS) protect firefighters from hazards. PCS testing procedures need standardization. Therefore 3 PCS were tested to quantify differences and to provide recommendations for ergonomic test battery optimization.

Methods

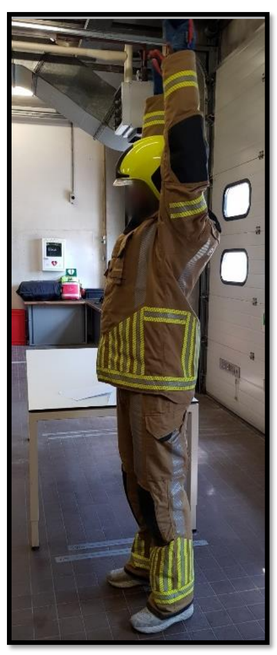
6 males (26.8±11.4 y) performed 12 consecutive physical firefighter task related- and 9 stretching exercises in three PCS in balanced order in 21.1±0.2 °C and 37±5 % RH.



PCS 1



PCS 2



PCS 3

Methods (measures)

Skin temperatures (T_{skin})
Rectal temperature (T_{rectal})
Heart rate (HR)
Mean body temperature (T_{body})

Performance time/distance
Rating of perceived exertion (RPE)
Thermal sensation
Comfort
Skin Humidity
Fit and reach score scale A & B (1-5)

Increases over time (Δ-values) were calculated.

Results

Table 1. Temperature and heart rate increases over time for 3 protective clothing systems (mean ± SD).

	PCS1	PCS2	PCS3
ΔT_{skin} (°C)*	-0.26±0.63 [23]	0.60±0.31 [13]	0.81±0.46 [12]
ΔT_{rectal} (°C)*	-0.03±0.06 [2]	0.00±0.07 [1]	-0.01±0.06
ΔT_{body} (°C)*	-0.07±0.11 [23]	0.12±0.08 [13]	0.15±0.12 [12]
ΔHR (BPM)*	6.2±15.4 [3]	6.6±20.9 [3]	14.5±19.2 [12]

* = p<0.001.
In superscript = PCS with which a significant difference was found.

Donning & doffing time: PCS2<PCS3
Ladder climbing time: PCS1<PCS3

Elbow mobility movement restriction (scale B): PCS1>PCS3

Remaining measures: no significant differences between PCS

Conclusions

The two firefighter PCS differ in heat strain; ΔTskin, ΔTbody and ΔHR.
The use of ΔTbody for fire fighter clothing evaluation is recommended since it gives the best representation of body heat storage.

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