Material testing and fire-testing of family tent

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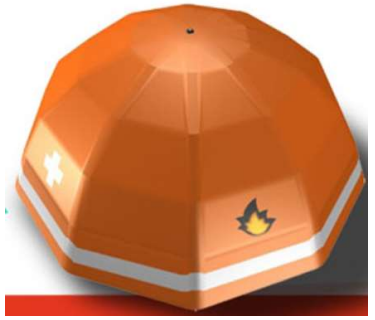
Fire safe shelter



“FR scale”

CEN
TEX
BEL

Outline

- **Background**
- FR Tent test results
- FR Treatment of fabric
- Summary

Centexbel

- Collective research and technical centre
- Membership organisation:
  - Belgian textile producing companies
  - Associated member companies and organisations
- Staff:
  - 150 skilled and highly educated men and women

Testing of emergency relief items

- CENTEXBEL is recognised test body by UNHCR, IFRC, MSF,…

Experimental setup to simulate rain conditions

Relief tent specs

SPECIFICATIONS

-> outer roof canvas
-> outer wall canvas
-> inner tent canvas
-> mud flaps
-> ground sheet
-> mosquito nets
-> guying lines
-> hammer

Tests on fabric samples of the different tent parts

-> tensile strength (ISO 13934-1)
-> tear strength (ISO 9073-4)
-> breathability (ISO 17229)
-> water penetration resistance (ISO 811)
-> weight & composition

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Artificial ageing:
Weatherometer & UV ageing

Measurement of: Strength loss after artificial ageing

QUV
ASTM G53/94 (UVB 313 nm peak)

Weatherometer
WOM (ISO 4892-2)

Artificial ageing: Soil Burial

Measurement of: Strength loss after soil burial

BS 6085

Rain test

Measurement of: Rain penetration resistance

ISO 5912 - 5.6

What about FR ?

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FR project Relief Tent
Goal and scope

- Aim of the study:
  - Assess flammability behaviour of UNHCR family tent
  - Proposal for improvement of FR properties

- Parts of study:
  - Review & discussion of available FR methods
  - Burn test on complete tent
  - FR testing of polycotton materials of existing tent
  - FR treatment of textile samples + testing

Burn test complete tent
Experimental set-up

- Ignition source: sand bed burner with a power output of 6 kW

Burn test complete tent

Time lapse pictures during 18 (!) seconds

5:04

5:06

5:08

5:10

5:12

5:14

5:16

5:18

5:20

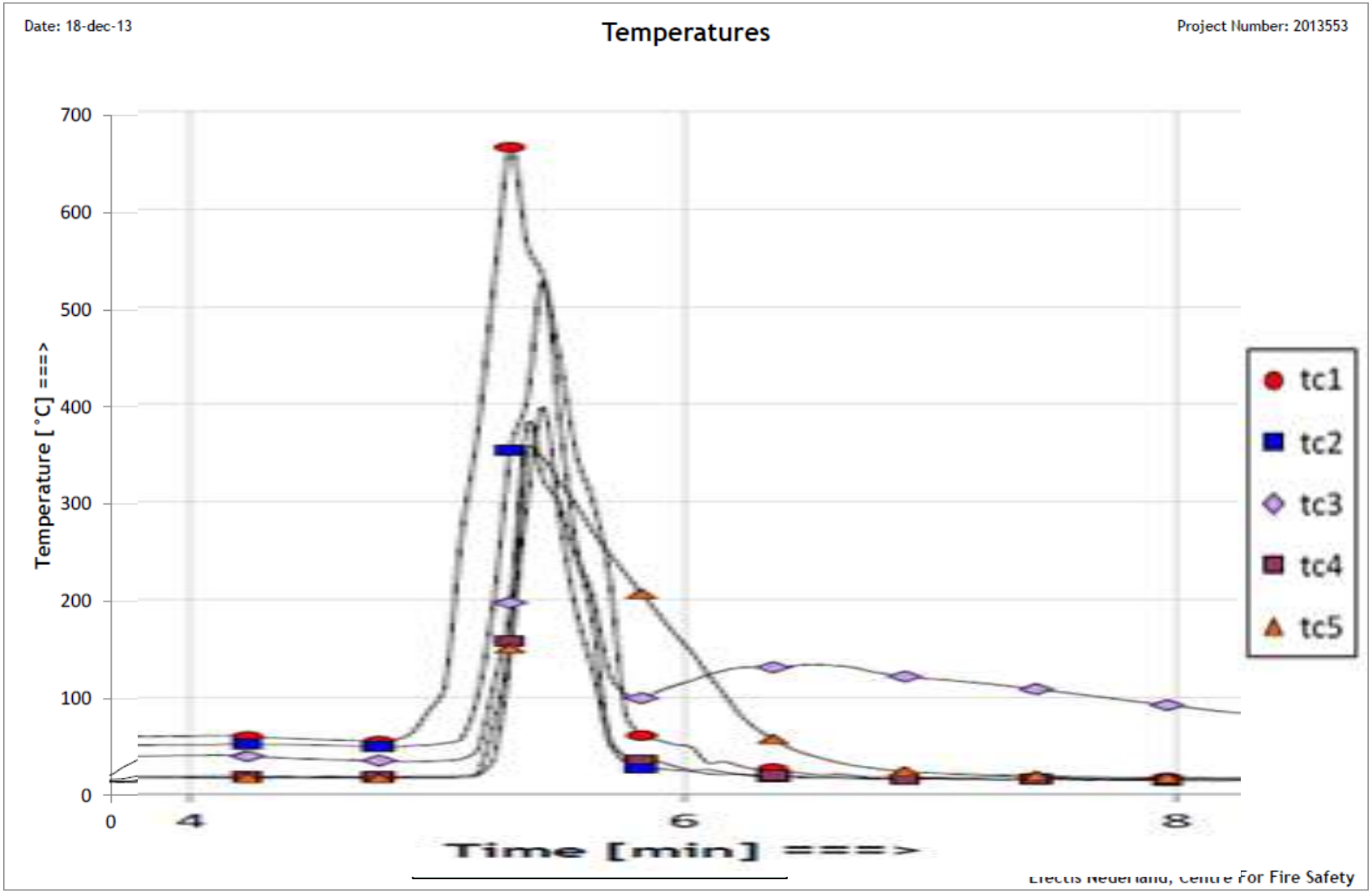
5:22

Burn test complete tent

Afterwards…

Burn test complete tent

Maximum temperature …



Tent fabric testing

sample	EN ISO 6940		EN ISO 6941	
	Mean ignition time (s)		Mean flame spread velocity (mm/s)	
	Length direction	Width direction	Length direction	Width direction
Outer roof canvas	4	4	4,67	4,99
Outer wall canvas	3	3	10,19	12,17
Inner tent canvas	2	2	32,54	28,25

→ Quite problematic … solutions ?

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Behaviour of other fabrics?

- Method: flame spreading (EN ISO 15025)
- Various components of tent tested:
  - Outer wall and roof
  - Inner wall
  - Shade nets: synthetic / natural
- Result: …

Illustration of edge ignition (ISO 15025)

	Afterflame time (s)	Afterglow Time (s)	Flaming debris	Molten debris	Flame on edge	Holes?
Polycotton 200	80	60	No	No	Yes	no
Polycotton 350	120	50	No	No	Yes	no
Polycotton 440	120	4	No	No	yes	no
PE-sheet	70	0	yes	Yes	yes	yes
PVC/PES B8103	0	0	No	No	No	yes
PVC/PES B8125	0	0	No	No	No	yes
PVC/PES C2260	80	0	Yes	No	yes	yes
PVC/PES C2357*	75	0	Yes	No	yes	yes
PVC/PES C7458	140	0	Yes	No	yes	yes
PU/PES	35	0	Yes	Yes	yes	yes
Silicone/PA	55	0	yes	yes	yes	yes

Behaviour of other fabrics?

- Method: flame spreading (EN ISO 15025)

- Various components of tent tested:
  - Outer wall and roof
  - Inner wall
  - Shade nets: synthetic / natural

- Result: none of the common fabrics has intrinsic FR properties
  → FR treatment required

Illustration of edge ignition (ISO 15025)

What and how to treat?

- What?
  - Outer fabric (wall, roof): ✗
    - Water repellency -> no option for a water-based treatment
  - Inner fabric (inner tent): ✔
    - More feasible to treat
    - Most vulnerable for ignition
- How ?
  - Focus on non-halogenated solutions: organic and inorganic phosphorous compound
  - Water based

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Results

- Ignition test:

Sample	EN ISO 6940		EN ISO 6941	
	Mean ignition time (s)		Mean flame spread velocity (mm/s)	
	Length direction	Width direction	Length direction	Width direction
Treatment 1	No ignition within 20 s		-	-
Treatment 2	No ignition within 20 s		-	-

- Ignition time:
  - Treated inner fabric: ***no ignition after 20 sec*** (maximum waiting time required by test)
  - Comparison:
    - Untreated outer roof: 4 sec
    - Untreated inner fabric: 2 sec

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Impact of FR treatment

- Benefit:
  - Increase of ignition time:
    - Less risk to burn whole tent
    - Create time slot to leave
    - Possibility to extinguish
  - Inner tent is shielded → no leaching
  - No influence on breathability
- "Add-on":
  - Weight: *measured* 20% on fabric weight
    → ca 1 kg for whole inner tent
  - Price: ***estimate*** ca 5% of cost of whole tent

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Summary

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- **Potential solution:**
  FR treatment of polycotton inner tent
  - No ignition (after 20 sec)
  - Remains breathable
  - Reasonable add-on of cost and weight

Contact

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