



**FIRE
TECHNOLOGY
SERVICES**

Confidential Report

Our Ref: 30/07863/3

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27 May 2015

Page 1 of 6

Our Ref: 30/07863/3

Client: SYSTEM 5S Private Limited
No.B4. Sidco Industrial Estate
Villivakkam
Chennai 600049
India

Job Title: RALPH manikin testing of a firefighters suit

Clients Order Ref: Letter referenced SE/OC/24560/14-15

Date of Receipt: 9 April 2015

Description of Sample: Firefighters suit comprising jacket and overtrouser, referenced:
Model: PROTECSAFE
Jacket: SYS FF NJ-01
Overtrouser: SYS FF NT-01

Work Requested: Testing to ISO 13506: 2008 on BTTG male manikin (RALPH)
8 second flame exposure time
After 1 wash at 40°C



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27 May 2015

Page 2 of 6

Our Ref: 30/07863/3
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RALPH MANIKIN TESTING OF A FIREFIGHTERS SUIT

REFERENCE: PROTECSAFE

1. Samples

One firefighters suit comprising a jacket and overtrouser was submitted for test. The jacket and overtrouser was referenced:

Model: PROTECSAFE
Jacket: SYS FF NJ-01
Overtrouser: SYS FF NT-01

The jacket and overtrouser construction comprised:

Outer fabric: FTC Nomex IIIA, 205g/m²
Moisture barrier: FR Fabric 81/85,
Thermal lining: FR Felt, 55g/m² quilted to Modacrylic/Cotton, 240g/m²

The jacket was sized: XL, Chest: 104-112, Height: 176-182
The trouser was sized: XL, Waist: 100-108, Height: 176-182

All garments were considered to be a "good" fit on the manikin.

2. Method of Test

Testing was undertaken on the 2006 version of the "male" heat sensing manikin known as RALPH (Research Aim Longer Protection against Heat) developed at BTTG Fire Technology Services. This version of RALPH together with the associated test facility has been built to comply with ISO 13506: 2008.

RALPH has a total of 135 sensors distributed over the head, torso, legs, arms and hands which monitor the temperature on the surface of the manikin during a test. (The feet of the manikin are not sensed.) For this test the sensors in the hands and interface areas were not used leaving 123 sensors being monitored.

From the temperatures recorded predictive percentage burn injury at Pain, 1st, 2nd and 3rd degree levels are calculated using the Takata and Stoll skin model as specified in Annex C of ISO 13506: 2008.

During a test the manikin is challenged by a flame engulfment apparatus consisting of 12 burners (in two tiers of six) surrounding the manikin in a hexagonal pattern. The manikin is placed at the centre of the hexagonal pattern. The lower set of six burners are pointed at the legs and lower body of the manikin whilst the upper set of six burners are pointed at the upper body and head.

The tests were performed under the following conditions:

Mean heat flux: 84kW/m² ± 2.5% (i.e. 81.9kW/m² – 86.1kW/m²)
Flame exposure time: 8 seconds
Data acquisition time: 120 seconds



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27 May 2015

Page 3 of 6

Our Ref: 30/07863/3
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3. Cleansing Pretreatment

Prior to test the garments were washed once at 40°C according to EN ISO 6330: 2012 Procedure 4N. The garments were dried by a combination of drip drying, low temperature tumble drying and final line drying.

4. Summary of Results

See pages 4 – 6.

Notes Relating to Interpretation of Results

The RALPH manikin test has been developed to provide information on the flammability and heat transfer performance of clothing systems when subjected to flame envelopment such as might only reasonably be expected to occur under "emergency" conditions. It is essentially intended to compare one clothing system with another, it does not purport to provide information in terms of the "survivability" of a given event. The following points should also be borne in mind when assessing the results obtained.

- (a) These results were obtained using the specified test conditions and do not necessarily represent the behaviour of the clothing system under other conditions of test or use.
- (b) The fit of the garments has an important bearing on the heat transfer results obtained during the test. For this test the jacket and overtrouser were considered to be a "good" fit.
- (c) It must be stressed that whilst the test conditions used can be considered very severe there may be occasions where the clothing system is subjected to even greater challenge which could result in serious injury to the wearer.
- (d) The RALPH manikin together with the associated test facility has been built to comply with ISO 13506: 2008. Not all manikin test systems fully comply with ISO 13506: 2008 and, therefore, currently results from the various manikins will not necessarily be the same. **It is very important when comparing manikin test results to take into account which "skin model" has been used to calculate the percentage burn injury results. The results in this report have been calculated using the Takata and Stoll skin model as specified in Annex C of ISO 13506: 2008.**
- (e) The burn injury results are expressed according to clause 9.5.3 of ISO 13506: 2008 which calculates the percentage burn injury based on the total area of manikin covered by the garments under test being 100%. For this test, therefore, the head is not included in the calculations.
- (f) These particular test results must be considered as indicative only in that no replicate testing was carried out.
- (g) These results must not be used in advertising or promotional literature without the written permission of BTTG Fire Technology Services.



27 May 2015

Page 4 of 6

Our Ref: 30/07863/3
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4. Summary of Results

Observations during the test

The reflective strips on both garments charred and the exposed touch and close fasteners on the jacket collar and sleeve ends melted. There was no obvious ignition of the suit apart from 3-4 seconds of surface afterflame immediately following the burners being switched off apart from minor flaming from the touch and close fasteners on the left sleeve for 30 seconds. There was no "break-open" of the outer fabric of either garment during the test.

After test examination

Jacket: The exposed areas of the outer fabric were generally charred, stiff and brittle. Inside the jacket appeared undamaged apart from at the bottom where flames from the burners had gone between the jacket and overtrouser causing localised charring of the anti-wicking strip and the inner lining fabric.

Overtrouser: The exposed areas of the outer fabric were generally charred, stiff and brittle. Inside the overtrouser appeared undamaged.

Burn Injury Prediction

The results below are expressed according to clause 9.5.3 of ISO 13506: 2008 which calculates the percentage burn injury based on the total area of manikin covered by the garments under test being 100%. For this test, therefore, the head is not included in the calculations.

Burn Injury Prediction (according to ISO 13506: 2008 clause 9.5.3)				
Pain	1st° Burn	2nd° Burn	3rd° Burn	2nd° + 3rd° Burn
20.2%	2.6%	18.4%	11.4%	29.8%

See page 5 for the burn injury prediction diagram.

See page 6 for the burn injury development with time

Reported by:..... ..... M T Healey, Principal Technician

Countersigned by:..... ..... C Dean, Operational Head

27 May 2015

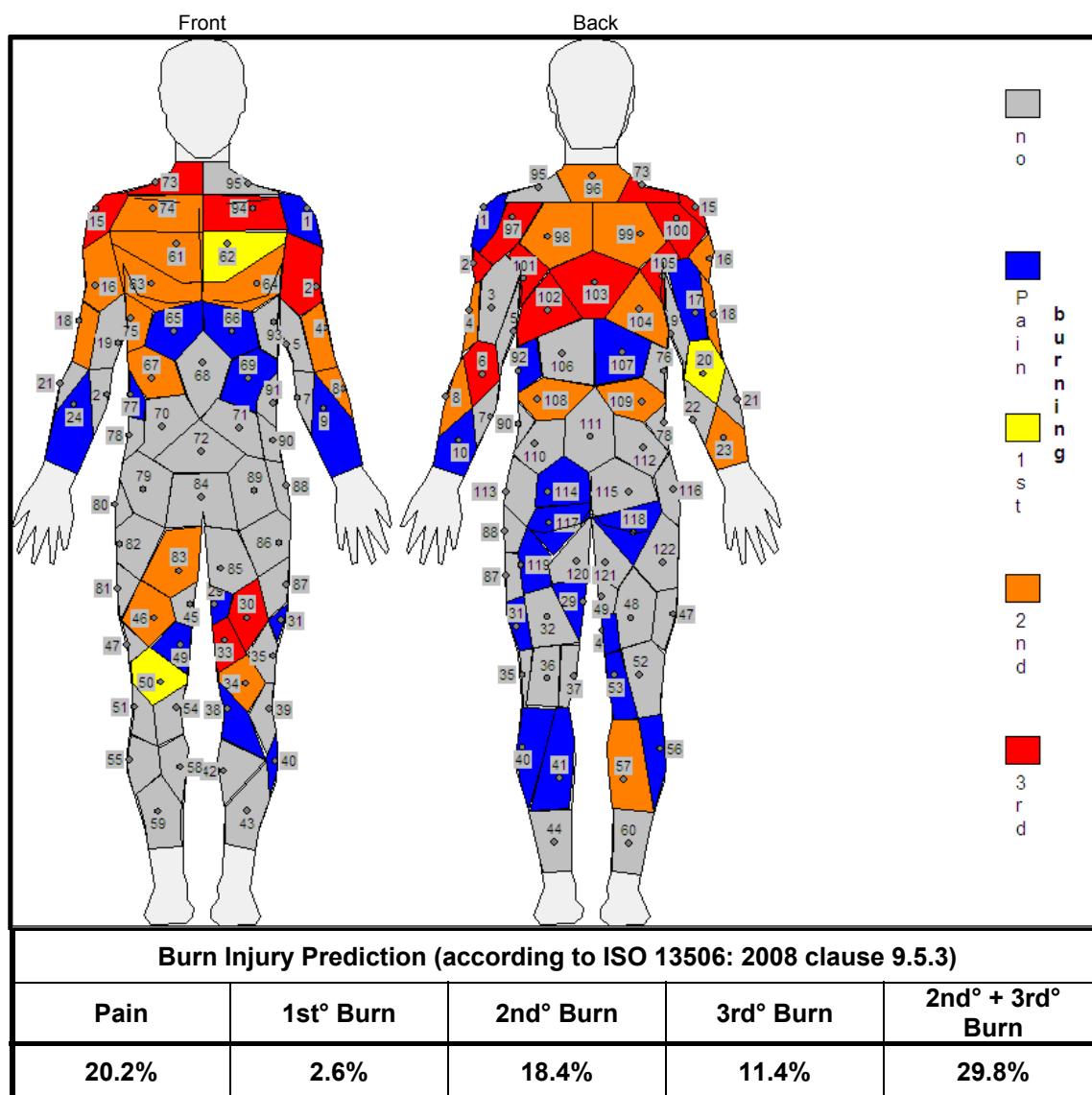
Page 5 of 6

Our Ref: 30/07863/3
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RALPH MANIKIN TEST – BURN INJURY PREDICTION AT 120s

CLOTHING SYSTEM: Firefighters suit comprising jacket and overtrouser, referenced:
Model: PROTECSAFE
Jacket: SYS FF NJ-01
Overtrouser: SYS FF NT-01

FLAME EXPOSURE TIME: 8 seconds (data acquisition time 120 seconds)



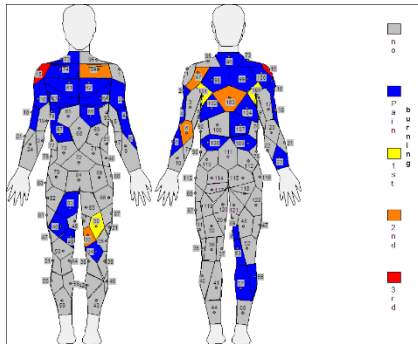
27 May 2015

Page 6 of 6

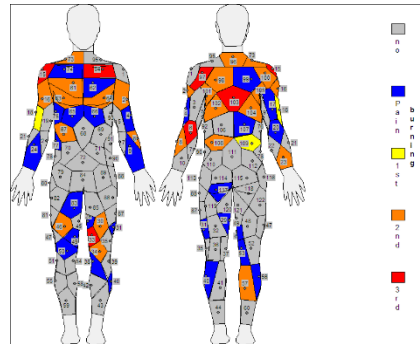
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RALPH MANIKIN TEST – BURN INJURY DEVELOPMENT WITH TIME

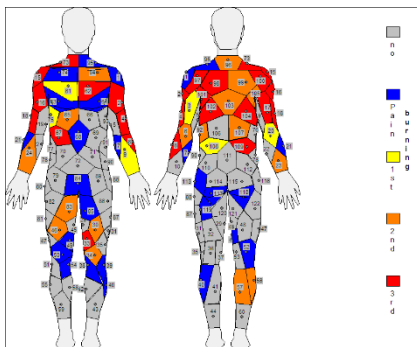
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Model: PROTECSAFE
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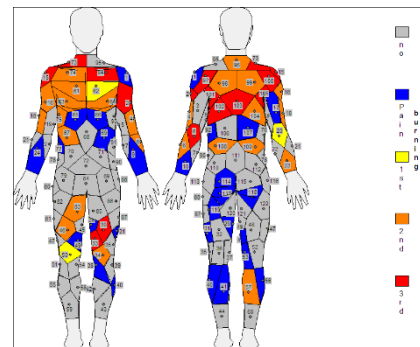
At 30 seconds



At 60 seconds



At 90 seconds



At 120 seconds

