



# **Confidential Report**

**Our Ref: 30/08041/13**



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Date: 2 November 2016

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Client: JiuH Wan Enterprise Co., Ltd  
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Pu Li Chen  
Nan Tou Hsien  
Taiwan  
R.O.C.

Job Title: RALPH manikin testing of a firefighters suit

Client's Order No: Email message dated 27 July 2016

Date of Receipt: 27 July 2016

Date of Test Start: --

Description of Sample(s): Firefighters suit comprising jacket and a trouser, referenced:  
JW-P07

Work Requested: We were asked to make the following test:  
ISO 13506: 2008 on BTTG male manikin (RALPH)  
8 second flame exposure time  
After 1 wash/dry pretreatment at 60°C



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## RALPH MANIKIN TESTING OF A FIREFIGHTERS SUIT

### REFERENCE: JW-P07

#### 1. Samples

One firefighters suit comprising a jacket and trouser Reference JW-P07 was submitted for test. The jacket and trouser construction comprised:

Outer fabric: 30% Meta-aramid (Nomex) / 30% Para-aramid (Kevlar) / 40% Oxidised Fiber, 260g/m<sup>2</sup>  
Moisture barrier: PTFE membrane laminated with 20% Para-aramid / 80% Meta-aramid fibre, 120g/m<sup>2</sup>  
Thermal lining: 100% Oxidised Fiber, 150g/m<sup>2</sup> quilted to 15% Para-aramid / 35% Oxidised Fiber / 50% Artificial fibre Viscose, 120g/m<sup>2</sup>

The jackets and trousers were unsized but 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/m<sup>2</sup> ± 2.5% (i.e. 81.9kW/m<sup>2</sup> – 86.1kW/m<sup>2</sup>)  
Flame exposure time: 8 seconds  
Data acquisition time: 120 seconds

The test was performed with the manikin dressed only in the jacket and trouser submitted – no other garments were worn.



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### 3. Cleansing Pretreatment

Prior to test the jacket and trouser were washed once at 60°C according to EN ISO 6330: 2012 Procedure 6N followed by tumble drying (Procedure F) (max. 80°C outlet temperature).

### 4. Summary of Results

See pages 5- 8.

#### 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 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 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 Testing & Certification Ltd.



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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 2-3 seconds of surface afterflame immediately following the burners being switched off. There was a further 70 seconds of afterflame from the touch and close fasteners on the right chest pocket and strap. 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 and stiff but intact. Inside the jacket appeared undamaged apart from at the bottom where flames from the burners had gone between the jacket and trouser causing localised charring of the anti-wicking strip and the inner lining fabric.

Trouser: The exposed areas of the outer fabric were generally charred and stiff but intact. Inside the trouser appeared to be 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.

Percentage of burn injury	Pain	1st° Burn	2nd° Burn	3rd° Burn	2nd° + 3rd° Burn
At 30s	11.4	0.9	0.9	0.0	0.9
At 60s	21.1	0.9	5.3	0.0	5.3
At 90s	30.7	1.8	5.3	1.8	7.1
At 120s	31.6	1.8	4.4	4.4	8.8

See page 5 for the burn injury prediction diagram.

See page 6 for the burn injury development with time

Reported by:..... *K Du-Rose* ..... K Du-Rose, Laboratory Technician

Countersigned by:..... *M T Healey* ..... M T Healey, Principal Technician

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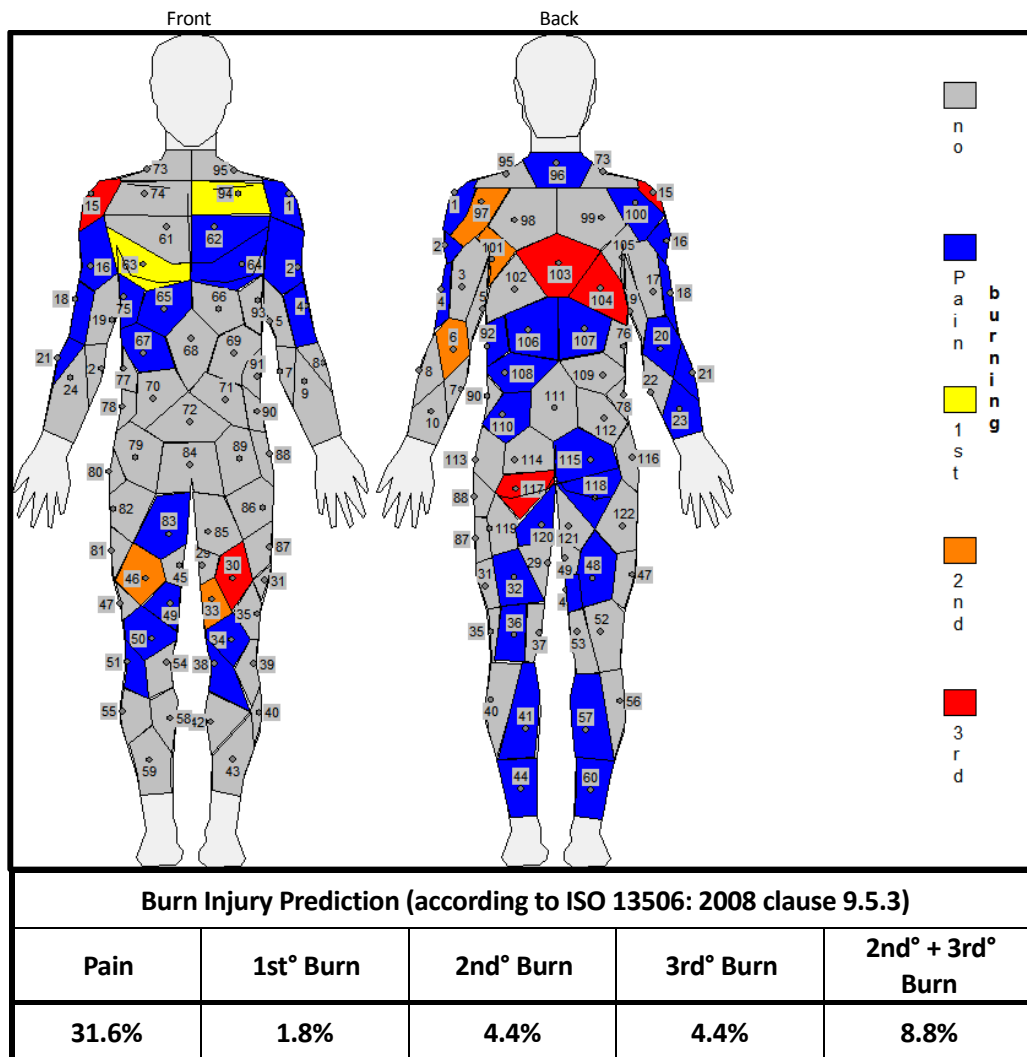
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**RALPH MANIKIN TEST – BURN INJURY PREDICTION AT 120s**

**Sample:** Firefighters suit comprising jacket and trouser, referenced: JW-P07

**Flame Exposure Time:** 8 seconds (data acquisition time 120 seconds)



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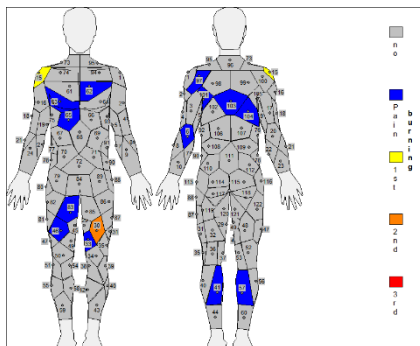
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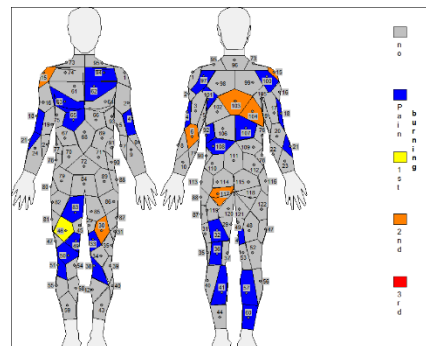
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**RALPH MANIKIN TEST – BURN INJURY PREDICTION AT 120s**

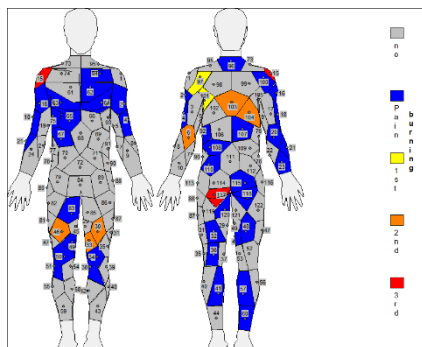
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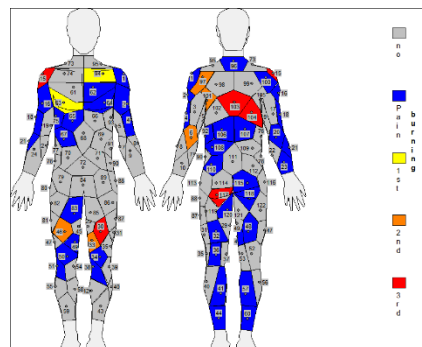
At 30 seconds



At 60 seconds



At 90 seconds



At 120 seconds

