



JOINING
INNOVATION
AND EXPERTISE

Testing of Clinical Hat Fastening System

TWI Project No. 35326

For: Eco Ninjas

Steve Willis

Initial Project Objectives and Deliverables

- Carry out badge 'separation' testing on three clinical hats
 - Each hat will be clamped in a mechanical test machine; however, the badge pull-off testing will be done by hand to best represent a person peeling the badge from the cap and releasing one fastener. Maximum pull-off load will be recorded each time the hat and badge fastener is separated. Each hat will be subjected to 400 separations.
- The results will be summarised in a PowerPoint presentation

Establishing Test Methodology

- Eco Ninjas supplied TWI with three clinical hats and badges. The badges were attached to the hat by metallic fasteners
- Ten TWI employees were given a clinical hat and were asked to remove the badge. The technique used to remove the badge was noted
- Nine people removed the badge by peeling the edge of the badge from one side (one fastener at a time). This is shown in Figure 1
- One person removed the badge by pulling centrally between the two fasteners (Figure 2).

Establishing Test Methodology

- The two methods used by TWI employees for removing the badge from the clinical hat are shown below.

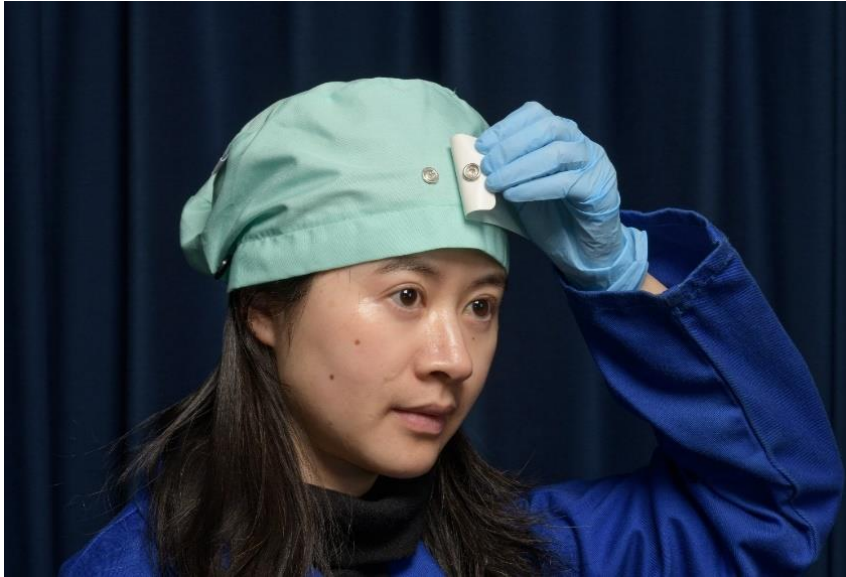


Figure 1. Nine out of ten TWI Employees removed the badge using this technique (peel one fastener at a time)

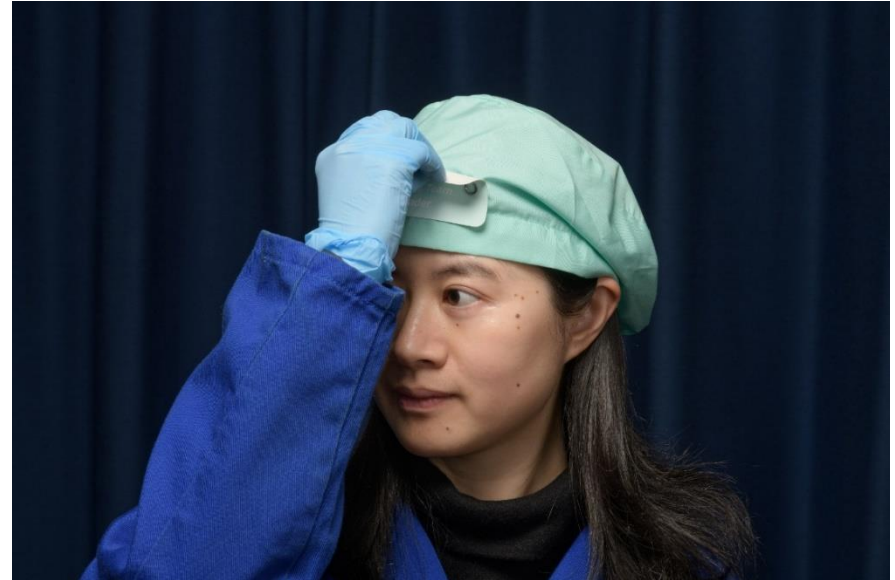


Figure 2. One TWI employee out of ten removed the badge from clinical hat by pulling centrally between the two fasteners

Peel Testing Badge/Hat Fasteners



- Following the results of the badge/hat test methodology study, it was decided that a peel test would be the most representative test and this was used for the assessment (see video)

Peel Testing Badge/Hat Fasteners Procedure

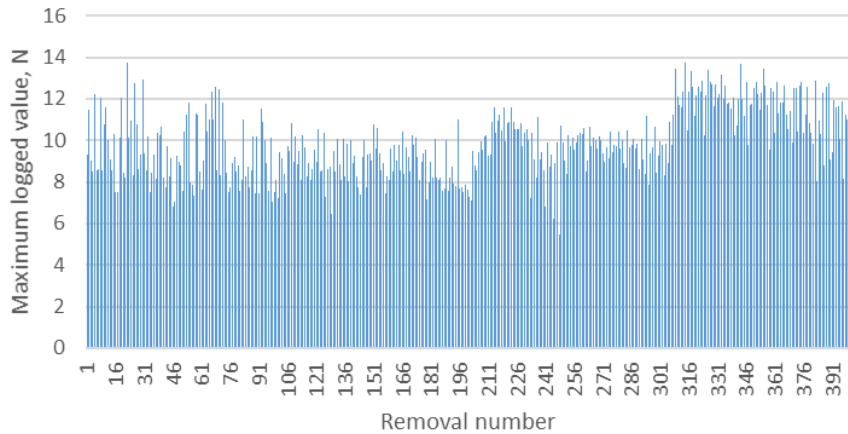
The developed procedure for peel testing the badge/hat fastener is summarised below:

- A clinical hat was clamped in the mechanical test machine jaws using modified machine jaws, ensuring the badge was free to be removed.
- Following this, the lab technician removed the badge completely from the hat (one fastener at a time) using the peel technique established in the initial TWI staff trials
- The load output required for each separation of a fastener was recorded (every 0.05 seconds) using a data logger and calibrated load cell.
- Following the separation, the badge was re-attached to the hat using a parallel but natural pressing motion.
- The separation and re-attaching cycle was completed 400 times for each fastener.
- Three hat and badge combinations were tested (two fasteners for each)

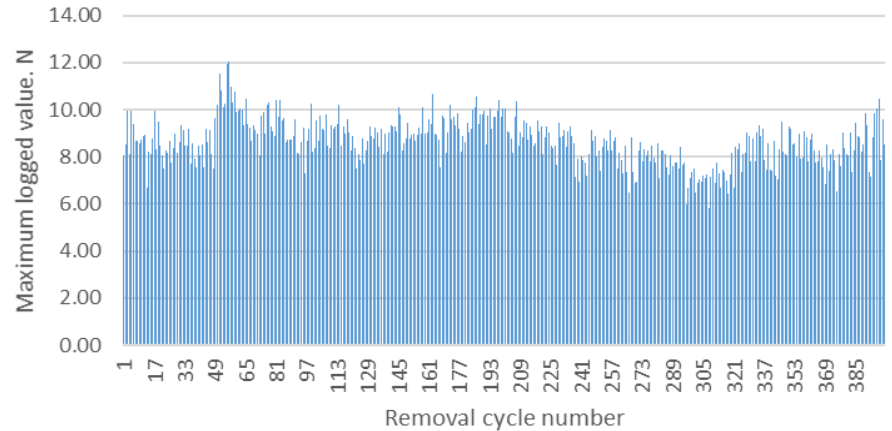
Peel Test Results - Phillip

A summary of the 400 peel tests for each fastener of the Phillip badge and clinical hat combination is shown in the graphs below

Safety hat Phillip left



Safety hat Phillip right

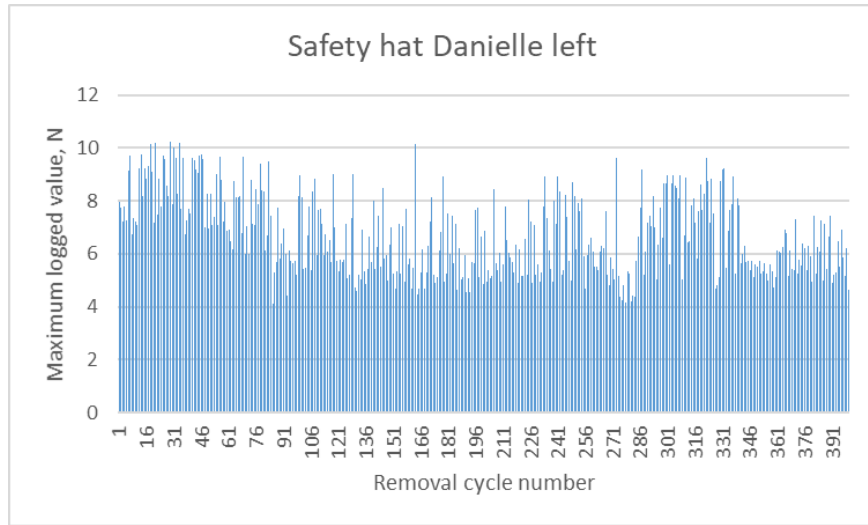


Phillips badge peel test results for the left fastener

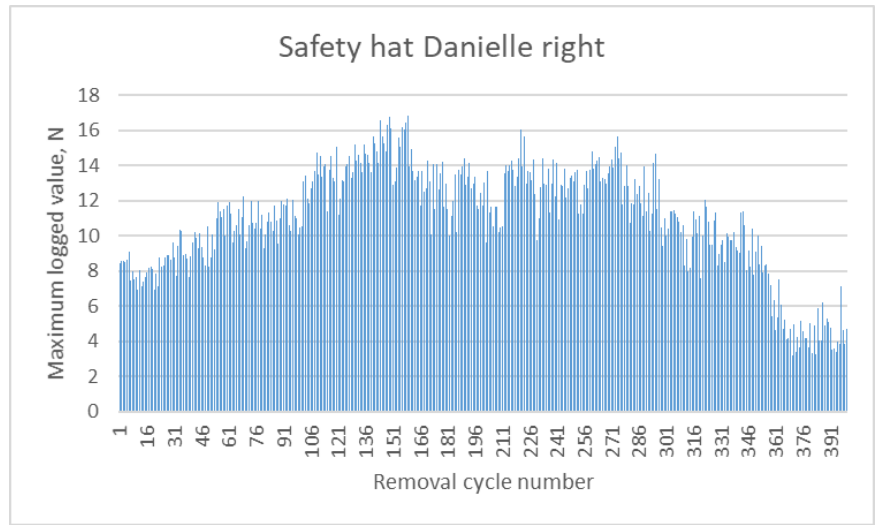
Phillips badge peel test results for the right fastener

Peel Test Results - Danielle

A summary of the 400 peel tests for each fastener of the Danielle badge and clinical hat combination is shown in the graphs below



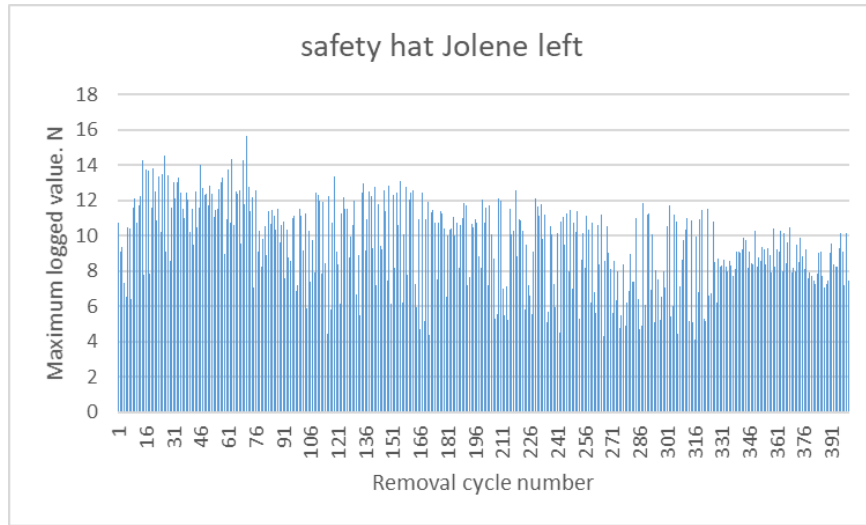
Danielle badge peel test results for the left fastener



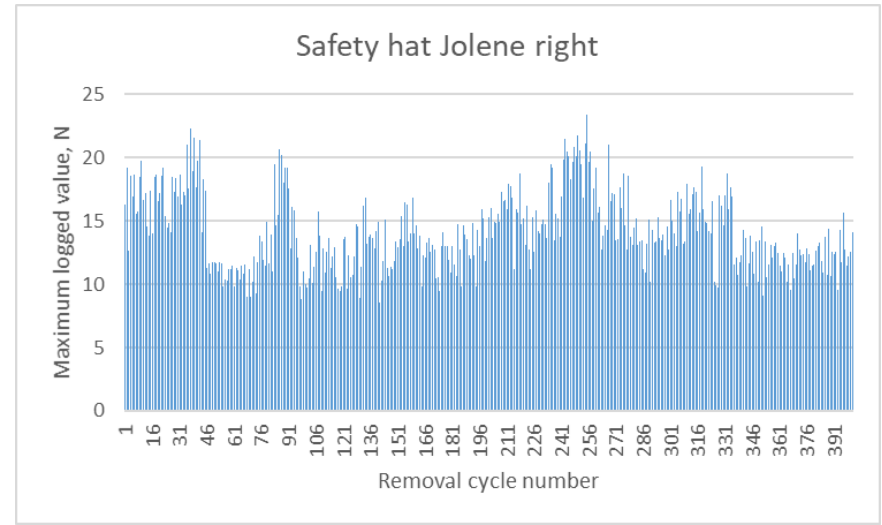
Danielle badge peel test results for the right fastener

Peel Test Results - Jolene

A summary of the 400 peel tests for each fastener of the Jolene badge and clinical hat combination is shown in the graphs below



Jolene badge peel test results for the left fastener



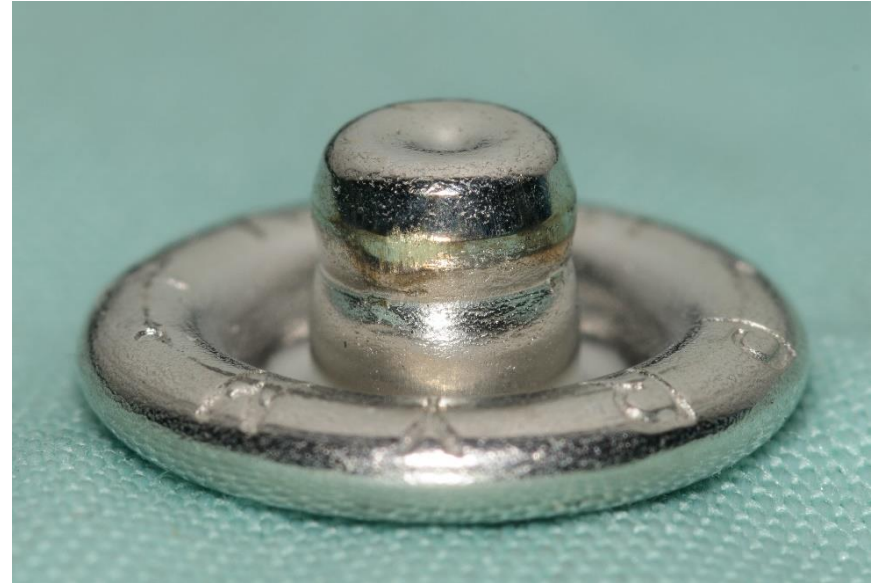
Jolene badge peel test results for the right fastener

Visual Inspection of Fasteners (male) Pre and Post Testing

Photographs of the male part of the Philip badge/hat combination before and after 400 separation tests is shown below



Male fastener part for the Philip badge/hat before testing showing no wear



Male fastener part for the Philip badge/hat after testing showing minimal wear and slight change of colour

Visual Inspection of Fasteners (female) Pre and Post Testing

Photographs of the female part of the Philip badge/hat combination before and after 400 separation tests is shown below



Female fastener part for the Philip badge/hat before testing showing no wear



Female fastener part for the Philip badge/hat after testing showing slightly polished contact area

Post Test Badge Fastener Inspection

- A post test inspection summary for the badge fasteners is provided in the table below and shows that the critical dimensions for the male part of the fastener has not changed (taking into account measuring error) post testing. In addition, the appearance of the male and female parts of the fastener had not changed.

Badge Name	Side	Male pre-test (mm)	Male post-test (mm)	Material or badge	Function at end of test
Phillip	Right	4.00	4.00	No Apparent damage	Working as expected
Phillip	Left	4.00	3.99	No Apparent damage	Working as expected
Danielle	Right	3.99	3.98	No Apparent damage	Working as expected
Danielle	Left	4.01	4.01	No Apparent damage	Working as expected
Jolene	Right	3.98	3.97	No Apparent damage	Working as expected
Jolene	Left	4.01	4.01	No Apparent damage	Working as expected

Results of the Peel Tests

A summary of the peel tests for each badge and hat combination is given below

Phillip

- It was observed that both fasteners show relatively consistent load values over the 400 tests. In fact, the left side fastener load increased as more tests were conducted. When tested by hand, after all the testing had been completed, the fasteners worked well.

Danielle

- It was observed that the load value for the right hand side fastener started to drop slightly for the last 30 cycle tests. Overall the load value for the left hand side fastener was lower than for the right side fastener but was consistent over the 400 tests. When tested by hand, after all the testing had been completed, the fasteners worked well.

Jolene

- It was observed overall that the load values for both fasteners appear to be relatively stable, although for the left side fastener, the load values seem to fall between two values. When tested by hand, after all the testing had been completed, the fasteners worked well.

Conclusions

A Review of the peel test data and visual inspection of the badge and hat fasteners suggests that:

- A peel test is a suitable and repeatable method for assessing the strength of supplied badge and hat fastening system.
- The supplied badge and hat fastening system is capable of a minimum of 400 peel separations/re-attachments and still performs as designed.
- There was no noticeable change in dimension for the male fasteners after testing
- There is variation in the maximum, minimum and mean av. loads recorded for each fastener/hat combination but this did not affect performance.
- The materials supplied (hat, badge, fasteners) does not wear or change appearance when subjected to 400 separation/re-attachment tests (conducted in a temp controlled laboratory).
- The supplied badge and hat fastening system is suitable for its designed use (as a clinical hat with removable ID badge) as the badge can be separated and reattached to a clinical hat many times without a noticeable change in performance or risk of failure.

It is worth noting that further work could be carried out to assess the performance of the badge and hat fastening system when subjected to cleaning product, in case this adversely affects fastener performance.