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Disclaimer

The following report was conducted, at the request of the MO and CO, to examine the various frames that the Army has being issued with and compare it to the style that the American Military are using. Currently Australia uses the / Section 43 (1)(c)t , Section 43 (1)(c) :) pack and frame which will be replaced with a Section 43(1)(c) frame. The American Military currently use a : Section 43(1)(c)

This report compared all three frames: the , section 43 (1)(c) , the Section 43(1)(c) and that DG-6 frame by Crossfire (which is the Australian version of the s43(1)(c); frame).

The frames where looked at to see if there was any causative factors relating to the increase number of back injuries within the Battalion. This is no way a comprehensive look at the frames as there was limited time to look at the true effects of the frame. The soldiers used only carried the packs for one day during standard training drills. This report was written to have a quick look to see if there were preventative measures that could be put in place to help ease the number of back injuries.

Pictures were taken to enable Commanders to see how the load of the packs was distributed across the body.

This report has been written with the help of as many sources as possible. Due to the nature of Defence it has been difficult to talk to the designers of the section 43(1) and s43(1)(c) frames, thus there may be incomplete knowledge about how the design came about and the anatomical features behind the design.

Further research and development into this area could be conducted to see if there is a causative factor between loads carried and the design of the pack and frames and back injuries in the Army.

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Pack Frames and its effect on Perceived Weight of the Pack and Comfort: A Preliminary report

Purpose

The aim of this report is to compare the DG-6 Plastic Pack Frame with the s.43(6) frame and to the s.43(6) frame that will be issued.

Background

The DG-6 Plastic Pack Frame is a comfortable, flexible external frame that can be adapted to : s.43(6) packs. This frame is made from a heavy-duty polymer weighing only 980grams.
Crossfire Australia spent over 25 years developing the flexible frame. Originally designed for mountaineering, Crossfire saw the need to expand their market towards Defence Members.

Construction

The DG-6 Plastic Pack Frame is spring loaded and tuned to allow shoulders and hips to swing naturally with each step. The frame does not fight torsion and reflexion of the spine. The lumbar pad on the DG-6 is laminated from a series of specialist textiles (Designed by Crossfire) which reduce heat stress and moisture build up (therefore reducing blistering and increasing shock absorption). In addition the fabric is designed to provide structural integrity and tensioning. The length of the harness can also be adjusted to suit any sized torso.
The DG-6 shoulder straps are built up from 9 layers of technical fabrics. The general idea is to reduce heat stress, blistering, relieve pressure on neck and upper spine, not impinge on the gleno-humeral joint, reduce crushing load on the acromium and brachial plexus and reduce point loading everywhere. The straps are formed to sit naturally across shoulder blades and the associated muscle groups.
Sternum straps assist to bring some load over to the solid cartilage joints anchoring the front of the clavicle. The Sternum strap slides up and down for proper fit.
The top trim tabs are invaluable for adjusting the way the straps curve over the shoulder. There are two spike buckles, which attach to top frame slots to accommodate the shorter torso[1].

The current frame is s.43(6), is pop riveted together and has a weight of 1500grams. The new s.43(6) frames are sturdier than their s.43(6) counterparts however weighed almost twice as much with a weight of 2250grams[2].
These two frames are both rigid and do not flex with the motion of the body. The flimsy hip pad on the issue pack gives minimal support while the metal brackets are an ever-present impact danger. The foam shoulder straps on both these frames are not of sufficient density to provide the required load capacity rating or comfort, and have been reported to collapse within a few months of use. Hydrolysis attack will cause

[1] From Crossfire Australia, www.crossfire.com.au
[2] Pack frames were weighted within the RAP using scales by the Mercury Scale Company 6670-66-020-934

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the straps to go ropy in a few months. The full load of the pack is then concentrated in a narrow track across the shoulders[3].

Method

Four fit and healthy soldiers of 2RAR were asked to carry a pack through different situations relating to activities that are associated with 2RAR.
Each soldier packed their pack according to their personal preferences.
Each soldier carried a weight of 30 kilograms.
The frames used were the DG-6, the s.43(1)(c) frame, the s.43(1)(c) frame and the s.43(1)(c) frame.
On returning the soldiers were instructed to fill out a questionnaire on how comfortable they thought their pack was when they started the activity, how comfortable it was half way through their activity, and how comfortable it was on their return[4]. Pictures of the soldier's shoulders (posterior and anterior aspects) and back were taken at the completion of the march to determine what effect, if any, the various frames had on the way the packs sat.

Results

Soldier one: Wilderness Pack and DG-6 Frame.

BEFORE

Deletions under
section 41(1) of
the FOI Act.

AFTER:

Deleted under
section 41(1) of the
FOI Act.

[3] http://www.kitbag.com.au/category305_1.htm and Crossfire Australia
[4] See attachment 1

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Deletions under section 41(1) of the FOI Act.

Section 41(1)

Soldier Two: ~~s47(1)~~pack and 33(1)(c) frame

BEFORE:

Deletions under section 41(1) of the FOI Act

Section 41(1)

AFTER:

Deletions under section 41(1) of the FOI Act.

Section 41(1)

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Deletions under section 41(1) of the FOI Act.

Soldier Three: s47(1)(b) pack and s47(1)(b) frame

BEFORE:

Deletions under section 41(1) of the FOI Act.

Deletions under section 41(1) of the FOI Act.

AFTER:

Deletions under

Section 41(1)

of the FOI Act.

Deletions under

Section 41(1)

of the FOI Act.

Deletions under

Section 41(1)

of the FOI Act.

Soldier 4: s47(1)pack and s47(1)(c) frame

BEFORE:

Deletions
under

Section 41(1)
of the

FOI Act

Deletions
under

Section 41(1)
of the

FOI Act

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AFTER:

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It was noted, through this study, that the section 43(1)(c) frames caused the packs to sit in the lumbar curve. This causes the soldier to lean forward, to stoop through the mid spinal region and poke the chin out leading to headaches, neck/arm pain and numbness. In addition the greater the weight of the packs the increased effect on posture, causing soldiers to lean further forward to help counter balance the weight. In addition the frames sit on top of the pant line with minimal padding between the frame and the vertebrae, leaving bruising and in some cases blistering.

When a soldier takes a step the frame proceeded to come away from the back and swing into the lower back. The frame is perfect for a square surface, unfortunately the back is not square. On the action of walking the pelvic girdle drops slightly and rotates with the leg that is put forward. This allows the pack to shift its centre of balance to the side of which the step is taken on, which in turn places extra weight on the shoulder side that the step is taken. This in turn locks the hips and shoulders together so the spine and muscle groups fight each other with every step, hugely fatiguing the soldier by the end of the day. This pressure and sway of the pack is exacerbated by the stride length of the soldier (the longer the stride the more movement) and the type of terrain.

The other point that was noted was that the straps on the frames sat on the lateral side of the mid-clavicular line (illustrated by the red marks on soldier 4), impinge on gleno-humeral joint and load on acromium and brachial plexus. This is caused by the insertion point of the straps being close to the spine and not tapering off once going over the top of the shoulder. This places considerable amounts of stress on the shoulders.

The fixture of the straps is one of the main contributors, as they can not be adjusted to suit individual's body shapes. For those who are more muscular, the shoulder straps will cut more into the muscle than the shoulder joint, therefore decreasing shoulder pain. However for the majority of soldiers the straps sit across the soldier joint pressing on the nerves within this joint, therefore crushing nerves, displacing the joint, aggravate and inflame tendons and grind cartilage causing pins and needles in the arms. This combination contributes to shoulder instability leading to a loss of manpower[5].

The DG-6 frame has multiple fixture points for the straps, allowing the soldier to alter the straps to sit in the correct position. The straps are formed to sit naturally across shoulder blades and muscle groups. Sternum straps assist to bring some load over to the solid cartilage joints anchoring the front of the clavicle. The sternum strap slides up and down for proper fit. The top trim tabs are invaluable for adjusting the way the straps curve over the shoulder, there are two spike buckles which attach to top frame slots to accommodate the shorter torso. With this adjustment feature, each soldier's pack will conform to their body shape and will continue to hold its position once adjusted. The straps allow for minimal adjustment during a pack march, as they tapper off allowing them to be thinner under the arm.
In addition the frame has a feature that allows the backrest to be lengthened or shortened to suit each soldiers torso. When adjusted correctly the DG-6 frame flexes with each step. Unlike the [illegible] frames, the DG-6 flexes on the walking action. When the pelvic girdle drops, the frame flexes along the back hugging the spine to prevent any sideways rocking of the frame. Thus preventing the pack from moving around therefore decreasing lower back injuries and bruising.

Constraints:

Each person marks differently to the next. Due to the small population used in this preliminary study, a number of constraints were identified.

Due to the high activity of 2RAR at this time of year; each soldier only carried one sort of pack frame. In addition the body types of all soldiers were different therefore giving slightly different marking and pressure points. Without a change over of frames for further pack marches, it was unclear to what effect the various frames had on various body types. It is clear the effect the frames had on each soldier, but further research needs to be considered to enable a more comprehensive comparison of each frame.

[5] http://www.kitbag.com.au/category305_1.htm and Crossfire Australia

What is consistent is the remarks made by the soldiers. Each soldier noted that the s.43(1)(c) style frames push on the same area of their backs and shoulders. They noted that they were uncomfortable, appeared to get heavier and moved around a lot especially when walking around.

Discussion

Infantry soldiers are required to carry not only personal equipment but also company equipment. This can range from various weapons (such as F88, F89, Mag58), ammunition for those weapons, communication equipment, batteries, NINOX, plus any other equipment that may be required for special operations/exercises[6]. This can weigh up to 70 kilograms.
Soldiers have attempted to lighten their packs by eliminating their own personal equipment. However this still does not lighten the load to "light infantry". The s.43(1)(c) pack and frame were designed in ; the frame was designed to fit the pack, which was 19 inches x 14 inches x 10 inches. The rigidness of the frame increases the risk of fatigue, which in turn makes the tired soldier more vulnerable to all sorts of accidents because of impaired judgement and poorer situational awareness. An exhausting feature of the rigid frame is that it forces the shoulder muscle groups to swing the load sideways, then overcome the momentum and swing back, with every step.
As the sophistication of war has grown, so to has the need for more equipment. Since the Army has advanced to more powerful weapons, encrypted radios, high tech navigational devises, the burden on the soldiers has become greater.
The inception of greater weights has not transferred to the creation of more suitable carrying equipment. The s.43(1)(c) frame is not rated to the increased workloads expected of our soldiers; it was originally designed for light loads.

Conclusion

This preliminary report identified that the DG-6 frame appeared to be more suited to infantry. The s.43(1)(c) frames were issued in s.43(1)(c) when infantry was still classed as "light" this frame at the time was suitable for duties within the Battalion. However, with the increased capability of our soldiers, frames and packs need to accommodate this. The s.43(1)(c) frames are not suitable for the current equipment that infantry soldiers are required to carry. Although the s.43(1)(c) frames are sturdier, they weigh almost twice as much as the current s.43(1)(c) frames. If the idea is to make our infantry a strong fighting force, the comfort and the well being of the soldiers needs to be taken into consideration. With increased weaponry, the pack weights are going to continue to rise, the weight of the pack itself needs to be decreased as much as possible and be more conducive to the human body. It takes a very fine soldier to make an infantryman; therefore the solution is to look after them to make them perform to a more rigid regime. Further research and development could be considered to determine if there are any improvements that can be made on the existing equipment.

[6] 2 BN RAR\Orders\SOPs\SOPs v 2003\Part 1

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Frame Questionnaire

Subject: **Job:** **Height:** **Weight:**

Temp:

1. **On a scale of one to ten (ten being the most comfortable and one being uncomfortable) how comfortable was your pack at the beginning of your march?** _____

2. **On a scale of one to ten (ten being the most comfortable and one being uncomfortable) how comfortable was your pack half way through the march?** _____

3. **On a scale of one to ten (ten being the most comfortable and one being uncomfortable) how comfortable was your pack on completion of your march?** _____

4. **Did you have to adjust/shift your pack during the march?** _____

5. **If so why?** _____