

ERGONOMIC AND HUMAN FACTORS ANALYSIS OF RAM PARACHUTE RIPCORDER/HANDLE SYSTEMS

PART I: TORSO POSITION

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INTRODUCTION

Parachute ripcorderhandle positioning on the parachute harness in both military and civilian ram parachute assemblies have not formerly been subject to a comprehensive ergonomic and human factor analysis. Some studies have analyzed strength requirements and release capabilities of ripcorders/handles for certain populations, however to date little work is available defining torso position based on an ergonomic and human factor analysis¹⁻². A study of this nature is important. Parachute ripcorders/handles are used to deploy main parachutes, 'cut-away' a malfunctioning parachute, and deploy the reserve parachute. These procedures require precise hand-arm-eye coordinated movements which are executed in a freefall and stressful environments. In the military setting this situation is magnified due to the added problems of equipment weight and bulk, clothing bulk, gloves, and in certain circumstances life support systems.

This study conducted an ergonomic and human factors analysis of ripcorderhandle system positioning on the harness of conventional present day military ram air parachute assemblies. Specifically, vertical and horizontal positioning on the harness was studied to define arm movements required to activate the system and to identify the optimal positioning to ensure ease of grasp, accessibility, visibility and biomechanical advantage. In Part I of the study, the main deployment handle was analyzed. This is located on the right riser of the harness.

METHODS

The primary method of analysis was based on a biomechanical computer model that was designed to simulate the upper arm movements around the ripcorderhandle along the front right of the torso. The model used a geometric solution solving for elbow angle, and posterior shoulder rotations necessary to reach and grasp the ripcorder/handle without flexing the wrist. Fixed variables in the model were based on a three dimensional input which included shoulder declination, position of the ripcorder on the torso, and the protrusion of the ripcorder beyond the side of the torso. The model is based on the 95th centile arm length with component segments calculated from regression models from US Army male anthropometric data³. Three dimensional graphic surfaces were generated to describe the output and to define the associations between the output variables. The model was run in iterative sequences mapping out contours of elbow angle required to reach and activate the ripcorderhandle. The model assumed a properly fitted and adjusted harness.

RESULTS

Military ram air parachute assemblies show poor ergonomic and human factor design of the ripcorderhandle system positioning. Ripcorderhandles are placed in positions that require extreme elbow flexion and posterior shoulder rotation with wrist flexion to acquire and activate the system. Military parachutists are therefore forced to use awkward arm movements and positions to activate the parachute. The biomechanical model also defined and quantified the required arm movements. This showed that ripcorders and handles are commonly too high (headward) up on the front of the chest. The model demonstrated by lowering the ripcorderhandle downward (towards the waist) on the front of the chest, the angles at the elbow, posterior shoulder rotation, and wrist flexion could be optimized thus ensuring a less awkward ripcorder/handle operation.

It was found that the ideal position for a ripcorderhandle is dependent on the individual's arm length, torso length, clothing bulk, and chest depth. The ideal location for the ripcorder can be identified using an anthropometric land mark, the olecranon. This is used by placing a 90 degree flexed elbow against the side of the body in the vertical plane and using the olecranon to mark the mid-point of the ripcorderhandle position on the side of the torso. Here the ripcorder/handle should be placed on the riser of the harness.

CONCLUSION

The governing principles underlying the placement of ripcorderhandle systems on the parachute harnesses is visibility, accessibility, ease of grasp, and force to activate. All of these criteria are improved by keeping

the positioning **low** rather than **high** on the t.o.m. This analysis **has** begun to formalise and define parameters of upper arm movement that **will** provide parachute designers With guidelines to make **ripcord/handle** system with **better** ergonomic and human factor design.

REFERENCES

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