HARNESS/CONTAINER EQUIPMENT FOR PARACHUTES - SAFETY AND PERFORMANCE DESIGN

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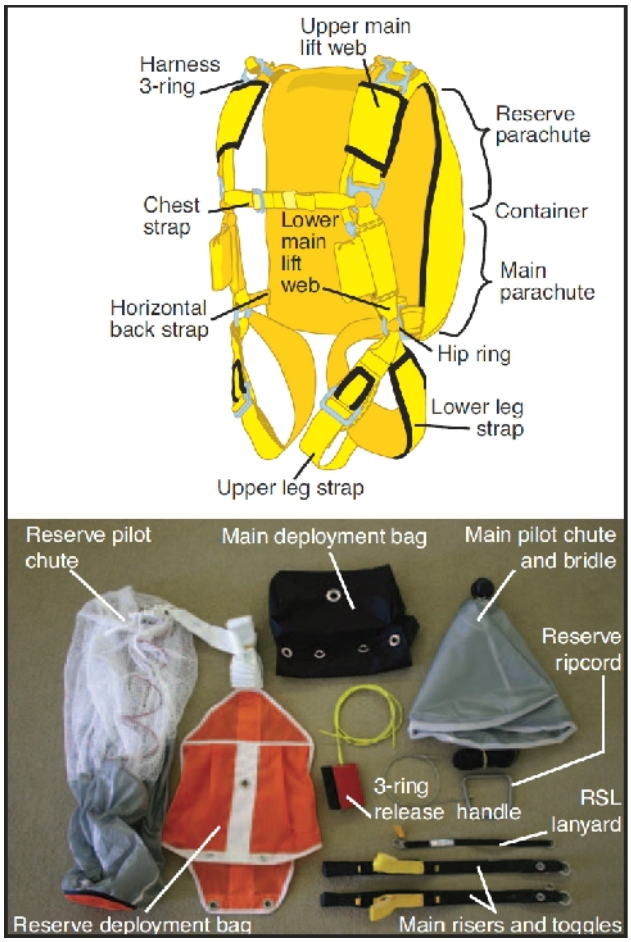
The overall objective of the research is to achieve a multifunctional harness / container assembly for parachutes, adaptable to a big range of canopy types and packing volume. The container is designed to take over and maintain main and reserve parachute canopies in a folded stage. Container / harness assembly is the safety system of the parachutist; it controls the deployment and opening of parachutes. The main components and subassemblies of container are specific with the type of parachutes connected to the container (Romanian Air Club, 2013). Containers for sport parachutes have two compartments, the bottom compartment for main parachute and its subassemblies and the upper compartment for reserve parachute and its subassemblies. Sports containers have distinct requirements for main parachute compartment and reserve parachute compartment. Currently the sizes of reserve canopy parachute and main parachute canopy compartments are manufactured in accordance with the volume of folded canopies. The project innovation is to develop a multifunctional container with adjustable variable compartments volume that allow the hosting of three different sizes of main and reserve parachutes. We propose for the variable volume compartments to be achieved by adjusting the container side panel in three positions adequate with the three packing volume of the parachutes.

Keywords: main container, reserve container, harness, main parachute, reserve parachute

INTRODUCTION

Harness / container assembly is the safety system of the parachutists; it controls the deployment and opening the parachutes. Any round or wing canopy can be connected to the container in specific compartments of the container so that they are open. The container controls the canopies opening and the harness ensures the link of the parachutist with canopy. The assembly harness / container include all parts needed to make a parachute airworthy. Basic assembly harness / container is what remains when all detachable assemblies (without being fixed by stitching) are removed.

Containers for sport parachutes have 2 compartments, one for main parachute with its subassemblies (pilot chute for main parachute, riser webbing; piloting controls; main risers and quick connectors; main deployment bag; cord connecting the main parachute with spring pilot chute; cord contact pin curved to pull main parachute; control handles; automatic opening system; RSL system.) and one for reserve parachute with its subassemblies (pilot chute; piloting controls; Reserve Static Line system; soft links on the riser webbing; reserve deployment bag; metal handle for manual opening of reserve parachute; AFF), Figure 1 (US Dept. of Transportation, 2005).



Source: Parachute Rigger Handbook; Chapter2-Design and Construction

Figure 1. Harness/container assembly and Subcomponents

Sports containers have distinct requirements for main parachute compartment and for reserve parachute compartment.

To achieve operational requirements it takes a well thought out design so, the reserve parachute compartment is generally small, tight, and especially wedge shaped when used for a wing type canopy.

Main parachute compartment design is less restrictive than the reserve parachute.

Currently the compartment sizes canopy parachute container reserve and main parachute canopies are made in accordance with the volume in folded state of the canopy. For example ICON container size (code) is designed to host only a certain range of parachute packing size for reserve and main parachute, Table 1 (Aerodyne Systems, 2005):

Table 1. Correspondence between the volume of the reserve parachute and main parachute and container size

Code container ICON	Reserve parachute volume / Max. volume accepted (m^3)	Main parachute volume / Max. volume accepted (m^3)
I2	0,0016 – 0,0018/0,0045	0,0014 – 0,0017/0,0053
I3	0,0018 – 0,0020/0,0048	0,0018 – 0,0022/0,0060
I4	0,0020 – 0,0024/0,0056	0,0021 - 0,0024/0,0064
I5	0,0024 – 0,0028/0,0063	0,0024 – 0,0028/0,0068
I6	0,0028 – 0,0036/0,0078	0,0028 – 0,0034/0,0076
S7	0,0031 – 0,0041/0,0080	0,0037 -0,0041/0,0083
S8	0,0036 – 0,0041/0,0080	0,0041- 0,0044/0,0086

Harness standard configuration is equipped so as to ensure the torso, head, arms and legs with straps, adding later survival kits or pillows.

In the past the parachute systems had detachable harness from the container, allowing the interchangeability of different models. With the development of sport parachuting the suspension system (harness) began to be integrated into the container, resulting assembly harness /container. This was accomplished by sewing the harness in the container. One of the most innovative models adopted in recent years is "articulated" harness that incorporates metal rings at the junction hip and a chest strap, Figure 2 (US Dept. of Transportation, 2005).

ICON harness is also produced in several sizes, coded according to Table 2 (Aerodyne Systems, 2005).

a) b)

Figure 2. a) Articulated harness configuration b) Icon harness

Table 2. ICON harness sizes coding

Harness code	Harness size
A	XXSpecial
B	XSmall
C	Small
D	Medium
E	Large
F	XLarge
G	XXLarge
H	XXXLSpecial

The materials used in the manufacture of container must be standardized as materials for parachutes. The well-known fabrics are Cordura Type III, 1000 denier coated one side with polyurethane film, with high durability and resistance to abrasion, tears and scuffing (MIL-C-7219, 1987).

Harness webbing must be woven with the shuttle because both sides look the same. This type of weaving creates a connection lock, which prevents it from unraveling if the edge is jagged or torn webbing, in conformity with MIL standards (MIL-STD-1480, 1988; MIL-W-27265, 1988). The tensile strength must be minimum 3000 daN.

Metallic accessories will be made of carbon steel, special steel and corrosion-resistant metals.

EXPERIMENTAL PART

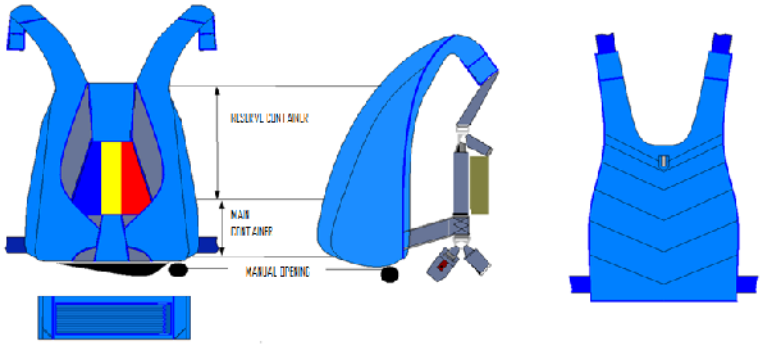
Multifunctional Container Design

The designed container model is presented in Figure 3. To achieve multifunctional use, a container that can be used with main and reserve canopies of different volumes, our innovation consists in an adjustable side panel of the container. We will obtain a container that will be able to accommodate three different volumes of main and reserve parachutes. This will be done in two ways:

Option 1: using string and rig rings, which will raise the container side panel in three positions adequate to the three volumes of parachutes, Figure 4 a). In order to preserve the shape of the container side panel edges will be strengthened, achieving volume variation on the middle panel. Also to avoid exposing the cord during flight this panel will be covered with a flap;

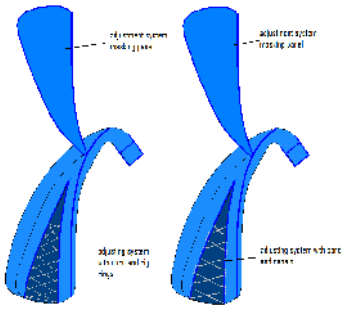
Option 2: with cord passing through the side channels. Tightening positions and dimensions are identical to the former. In this version the possibility of hanging in flight is eliminated Figure 4 b).

Sizing multifunctional container was made for a container with a larger volume, which can be reduced to a smaller volume of folded canopies. The adjustment will be done in three steps, marked on the tightening cords, and will be locked in these positions.



a) b)

Figure 3. Multifunctional container. a) Front and side view; b) Back view



a) b)

Figure 4. Adjustable side panel. a) O1: with cord and Rig Rings; b) O2: with cord and canals

Harness Design

The harness will be adjustable on the parachutist body and incorporated into the container. The parts of the harness are shown in Figure 5.

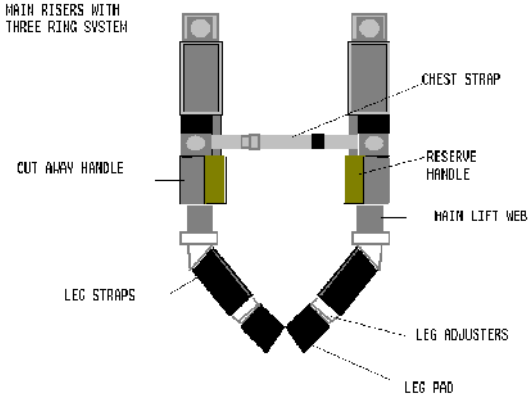


Figure 5. The parts of adjustable harness

RESULTS AND DISCUSSION

The suspension system (Harness) and container are components of parachutes.

To achieve the objective, namely designing a multifunctional container that can be used with main and reserve canopies with different volumes we have proposed an innovation that consists in adjustable side panel of the container. This will be done in two ways:

- Option 1, with cord and rig rings;
- Option 2, with cord and canals.

The adjustment of compartment volume will be done in 3 steps, marked on the tightening cords, and will be locked in these positions.

The container was custom designed for Romanian parachutists participating in international competitions.

CONCLUSION

As a general conclusion the performances of the multifunctional harness/container, experimental model, will be tested and verified on the ground.

Acknowledgements

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