Brigham Young University

AUVSI Capstone Team (Team 45)

UGV Drop Mechanism Concept Test Procedures and Results

ID	Rev.	Date	Description	Author	Checked By
GV-005	0.1	10-26-2018	Initial creation proceedures listed	Jacob Willis	Andrew Torgesen
GV-005	1.0	11-6-2018	Additional detail added based on design review	John Akagi	NEEDS REVIEW

1 Introduction

This document describes the proceedures used to test each of the Unmanned Ground Vehicle (UGV) payload delivery concepts. Some of the tests were unecessary for selecting between concepts, so they will not be performed until subsystem engineering.

2 Test Proceedures and Results

2.1 Drop Mechanism Mass

The mass of all components related to landing the UGV safely were determined and summed for each concept. Results are found in Table 1.

Table 1: Estimated total mass for the delivery system for the UGV.

Concept	**Result**
Parachute	.026 kg
Parachute w/ control	.124 kg
Skycrane	.160 kg
Glider	.08 kg

2.2 Maximum Deilverable Weight

In order to determine the maximum weight the concepts could deliver, the weight constraints of the inidividual components were determined. The maximum weight is the minimum load ratings. Results are found in Table 2.

Table 2: Maximum weight the concept can safely deliver. Weight determined by load ratings of components.

Concept	**Result**
Parachute	4 kg
Parachute w/ control	4 kg
Skycrane	3 kg
Glider	1 kg

2.3 Drop Mechanism Volume

The volume of all of the UGV drop mechanisms, and the volume needed for the UGV if the mechanism requires it be inside the aircraft is measured. Results are found in Table 3.

Table 3: Volume required for each drop mechanism.

Concept	Result
Parachute	462 cm^3
Parachute w/ control	462 cm^3
Skycrane	92 cm^3
Glider	864 cm^3

2.4 Mounting distance from aircraft CG

The distance between the center of gravity of the UGV and drop mechanism is measured. Since our airframe and internal layout is still undecided, this distance was unable to be measured.Results are found in Table 4.

Table 4: Distance between the aircraft center of gravity and the drop mechanism.

Concept	Result
Parachute	Not Tested
Parachute w/ control	Not Tested
Skycrane	Not Tested
Glider	Not Tested

2.5 Stowed Drop Mechanism Drag

A preliminary estimate of this is made using the area of the mechanism that is exposed outside of the airframe and computing drag with $D = \frac{1}{2}\rho v^2 C_d A$ where air density $\rho = 1.225kg/m^3$, velocity $v = 15m/s$ is the estimated aircraft flight speed, area A is the cross sectional area of the drop mechanism, and C_d is the estimated coefficient of drag based on cross sectional area and standard drag coefficient tables. Results are found in Table 5.

Table 5: Estimated drag of the drop mechanism.

Concept	Result
Parachute	.278 N
Parachute w/ control	.278
Skycrane	.315 N
Glider	.245 N

2.6 Maximum Landing Velocity

A preliminary estimate of this is made by calculating the landing velocity based on video data taken during the drop testing. The the payload was compared to a known measure placed behind the payload and the change in position over time was used to calculate the impact velocity. Results are found in Table 6.

Table 6: Estimated landing velocity of delivery system.

Concept	Result
Parachute (48 in)	2.7 m/s
Parachute (30 in)	4.8 m/s
Parachute w/ control	4.8 m/s
Skycrane	Not Tested
Glider	1.9 m/s

2.7 Delivery Precision

A preliminary estimate of this is made by dropping a representative load with the mechanism from a height of 35 feet. The distance between where the load lands and the target is scaled to a 100 foot drop height and the standard deviation of the spread is reported. The precision of the glider was tested by dropping it from heights of 5, 6, and 7 ft and the precision was scaled to 100 ft. For more detailed explination of the test procedure, see CD-004 UGV Parachute Testing Description. Results are found in Table 7.

2.8 Rule Violations

A checklist of the relevant rules is checked for the concept. The number of violations for the concept is summed. Results are found in Table 8.

Table 7: Standard deviation of initial impact, scaled to a 100 ft drop.

Concept	Result
Parachute (48 in)	2.85 ft
Parachute (30 in)	4.14 ft
Parachute w/ control	3.23 ft
Skycrane	Not Tested
Glider	28 ft

2.8.1 UGV Rules Requirements

The following outline the rules which must be followed in order to achieve any points.

- Must carry 8 oz water bottle
- Must not fly below minimum altitude
- Must land gently and without damage (subjective measure)
- Max weight of 48 oz

Table 8: Number of rules violated by delivery system.

Concept	Result
Parachute	0
Parachute w/ control	0
Skycrane	0
Glider	1