

UAV Recovery Guidelines

Below is a list of products we provide to assist customers with the selection of gear for UAV recovery projects:

1 – **Main Parachute** – Unless the UAV is small we recommend the Iris Ultra chute. The Iris has a very high Cd (coefficient of drag) and allows a smaller chute to be used for a given load. This also results in a smaller packing volume. To size your chute download our Descent Rate calculator spreadsheet (link on our home page). Enter the UAV weight, and also be sure to set the Cd to 2.2. We then show the descent speeds of our different size chutes.

Choose a size that will meet your target descent speed. In general most UAV's using a parachute as primary recovery target a speed of around 15fps (4.6m/s). For emergency recovery the speed can be higher such as 20fps (6.1m/s) maximum. You need to determine what is best for your project.

In addition for your chute selection you need to consider the packing volume required. You can get the packing volume of our chute from the Fruity Chutes Webstore. The Iris Ultra chutes are listed at

http://fruitychutes.com/buyachute/index.php?main_page=index&cPath=18. We list the volume in cu" for all our chutes. The volumes given assume packing into a cylindrical shape. Many UAV's have a rectangular or other shape recovery bay depending on the shape of the craft. The packing volume is the same as long as all the ratios of the dimensions are within about a 5: 1 ratio (l / w, w / h, h / l). For more extreme ratios the packing volume will need to be increased as the chute will not pack as efficient. This mean a more rectangular space is better than a long narrow space.

For example if you have a space of 15" x 6" x 4" the largest ratio is $15 / 4 = 3.75$ which good.

2 – **Shock Cord** – This is strong and flexible nylon webbing that connects the parachute to the harness. A good rule of thumb is to make this 2 x the wingspan. You want to make sure the UAV wings can not reach the parachute under any conditions.

For sizing you can refer to the Webstore for various sizes and test strength. For smaller UAV's (up to 15Kg) use the smaller sizes of webbing (3/8", 1/2" or 5/8"). For larger (up to 80Kg) use the large shock cord (11/16, or 1"). Remember that the shock cord will need some volume to pack into.

3 – **Harness** (optional) – This connects the shock cord to the UAV. Various methods can be used. One way is to use our Kevlar Y harness to provide a two point mount. You can also use nylon shock cord.

4 – **Deployment Bag** – Most UAV projects use a deployment bag to pack the parachute and to make deployment more reliable. Then a small pilot chute is used to help pull the bag free of the craft. See our webpage http://fruitychutes.com/other_products.htm for information on how to pack the bag.

The bags we make have a 2 yard strap inside that allows the bag to be connected to the chute crown so it is not lost after deployment. After the main is deployed the bag hovers above the main chute. Below is a picture showing this as well as the pilot chute:



The deployment bag is sized to hold the chute and the volume of the bag needs to be sufficient for the chute volume. Refer to our Webstore for our standard deployment bag sizes and the volume they can accommodate. Many UAV projects have custom sizing requirements. We can quote a custom sized bag for you. There is a \$40 pattern fee charge as well to make the pattern.

5 – Pilot Chute – This is a smaller chute that connects to the deployment bag to help pull it free of the UAV for recovery. This is generally from 1/3 to 1/4 the diameter of the main chute. Our Classic Elliptical chutes are ideal for this.

6 – Pilot Chute Shock Cord – In order for the pilot chute to clear the UAV an additional length of nylon webbing used between the deployment bag and the pilot chute. Again this can be seen in the picture above. This should be at least the wingspan of the UAV.

7 – Deployment Device – We do not provide the deployment devices. But in most cases these are fairly simple. Many UAV's employ a spring loaded hatch and compartment. The hatch pops open and the pilot chute is released. It needs to be neatly folded and packed just below the hatch. If the spring is strong enough to also eject the deployment bag then that is even better but not absolutely necessary. But the pilot chute needs to be released into the air stream where it will quickly open and pull

the deployment bag and shock cord out. The deployment bag will be pulled off the main chute and it will open.

8 – Sizing Example – Below is an examples of how to choose your recover gear.

Large 70lb (32kg) UAV: In this example we assume the UAV weight to be 70 lbs (32 Kg). We want our descent speed to be under 16.4 fps (5 m / s). The recovery bay is sized at 15" x 6" x 4.5". The wing span is 4m.

First using the descent rate calculator the IFC-144 will yield 15.7fps (4.8m/s) @ 70 lbs. The packing volume for the IFC-144 is 308 cu". To accommodate the shock cord and pilot chute you should add about 20% more volume to this to hold all the gear. For our UAV example we have 405cu" available which is sufficient.

The deployment bag size needs to be determined. Given the shape of the recovery bay a good size is 15 x 6 x 3.5. This gives us 315 cu" which is sufficient for the chute. When the chute is packed into a bag cut to these dimensions it will assume a thicker and narrower profile, however it will easily conform into the space provided once the hatch is closed.

Having sized the main chute, deployment bag and determined that it will fit we can create our list of materials needed:

- 1 – IFC-144 Iris Ultra Main Chute
- 2 – CDB-CUSTOM – 15 x 6 x 3.5".
- 3 – SC-LARGE – 9 yards 1" shock cord
- 5 – KH-50Y – Kevlar Y harness, 4' length
- 4 – CFC-36 – 36" Elliptical Pilot Chute
- 7 – SC-MEDIUM – 4 yards ½" nylon webbing (pilot chute to d-bag connection)

Small 12lb (5.5Kg) UAV: Again in this example we assume the UAV weight to be 12 lbs (5.5 Kg). We want our descent speed to be under 16.4 fps (5 m/s). The recovery bay is sized at 6" x 4" x 3". The wing span is 1.5m.

First using the descent rate calculator the IFC-60 will yield 15.7fps (4.8m/s) @ 12 lbs. The packing volume for the IFC-60 is 48 cu". To accommodate the shock cord and pilot chute you should add about 20% more volume to this to hold all the gear. For our UAV example we have 72cu" available which is sufficient.

The deployment bag size needs to be determined. Given the shape of the recovery bay a good size is 6 x 4 x 2.2. This gives us 53 cu" which is sufficient for the chute. When the chute is packed into a bag cut to these dimensions it will assume a thicker and narrower profile, however it will easily conform into the space provided once the hatch is closed.

Having sized the main chute, deployment bag and determined that it will fit we can create our list of materials needed:

- 1 – IFC-60 Iris Ultra Main Chute
- 2 – CDB-CUSTOM – 6 x 4 x 2.2".

- 3 – SC-MEDIM – 3 yards 1/2" shock cord
- 5 – KH-25Y – Kevlar Y harness, 2' length
- 4 – CFC-24 – 24" Elliptical Pilot Chute
- 7 – SC-MEDIUM – 2 yards 3/8" nylon webbing (pilot chute to d-bag connection)