WARNING

SEVERE HARD OPENINGS MAY CAUSE EQUIPMENT DAMAGE, SERIOUS INJURY OR EVEN DEATH. MINIMIZE THE RISK OF HARD OPENINGS BY READING ALL EQUIPMENT OWNERS MANUALS AND THE SUPPLEMENTAL INFORMATION BELOW.

Solving Deployment Problems

There are many factors that contribute to the opening characteristics of any parachute. When selecting a canopy to jump, you determine some of the basic opening characteristics by choice of canopy design and suspension line type. For example, the actual opening shock loads transmitted to the jumper and equipment is reduced by the amount the lines stretch. Microline stretches less than Dacron line, so higher shock loads will be transmitted with Microline. All canopies have inherent opening characteristics. However, the actual openings you experience are heavily affected by other factors that only you can control. The opening characteristics of some canopies are more heavily influenced by these factors than others. When left uncontrolled, these factors can cause or contribute to extremely hard openings, canopy damage, equipment malfunction, even serious injury or death!

It Is imperative that you understand the remaining interrelated factors that only you can control. You must make them work for you. Attention to these factors will result in greater consistency in your canopy openings, minimizing the chances of injury or equipment failure. These interrelated factors are:

1. **Packing method**
    - **a. canopy folding method**
    - **b. slider position**
    - **c. bagging the canopy**
2. **Line stow method**
3. **Pilot chute**
4. **Deployment Airspeed**

1. PACKING METHODS

a. Canopy folding method

We recommend that you pack your canopy according to the manufacturers instructions supplied with the canopy. Other methods may not work as well. The "briefcase" pack job and the "roll pack" methods are definitely not recommended, since they unfold in a way that promotes asymmetrical inflation, which can cause hard openings and canopy damage.

b. Slider position

The exact location of the slider inside the pack job greatly influences the opening speed of the canopy. It is vital that the slider is all the way up the lines, with each and every slider grommet seated against the slider stops that are sewn onto the stabilizers. There should be no twists in the lines above the slider, since they would tend to push the slider down the lines prematurely. This is a common problem with "briefcase" and "roll type" pack jobs.

The orientation of the slider also affects the openings. The center of the slider should be pulled towards the mid point of the center cell. On Sabres, the front half of the slider should be pulled out in front of the center cell A-lines. This is easy to do when packing by the recommended method, and is shown in the owners manual.

c. Bagging the canopy

The correct canopy folding method and slider position must be maintained while putting the canopy in the bag. In short, if it goes into the bag disorganized, it will likely come out disorganized and open hard. If the slider moves even a couple of inches down the lines while bagging the canopy, it will really get your attention on opening. Keeping the pack job intact while putting the canopy into the bag is a skill that must be learned. Read the owners manual for instructions.

You've noticed frequent references to packing as per the owners manual. If you use another method, you should consider yourself a test jumper.

2. LINE STOW METHOD

Lines should be released one stow at a time. That sounds obvious, but it isn't as simple as it may seem. When the pilot chute first pulls the bag out of the container, it rapidly decelerates the bag. At that instant, the laws of motion say that the lines stowed on the bag will tend to continue with the jumper, rather than decelerate with the bag, unless a forge opposes that motion. That force is supplied by the stow bands. If the lines aren't stowed to the bag securely enough, they can all slip out at once. That means the stow bands attached to the bag are literally yanked right off the stowed lines. This is known as "line dump", and can lead to a very dangerous out of sequence opening. If the locking stows fall off, the canopy is released from the bag and will start to open before it has reached line stretch. It starts filling with air almost instantly while canopy and lines go everywhere! When the jumper traveling at terminal velocity finally reaches line stretch, he already has an open canopy and receives a brutal opening shock. This scenario can damage lines, canopies, risers, and
really cause serious injuries. To prevent this from happening, the stows must be held fairly tightly so that they are only released in the proper order. To check your stows on the ground, it should take between 8 and 12 pounds of force to unstow the lines when pulling the bag across a smooth surface by the bridle. Use a fish scale on the bridle to check this. Larger, heavier canopies will require more force, as does a canopy deployed at higher speeds. You can tighten your stows if they are too loose. If you use Tube Stoes, look at the instructions that were included with them. Follow the instructions labeled "For tighter Tube Stoes". Rubber bands can be tightened in the same way. Replace Tube Stoes or rubber bands that appear worn. Do not wait until they break! The line stows must have between 21/2 and 3 inches of line through each stow. Some jumpers make shorter stows because they fear bag lock malfunctions. That is not a good idea. Short stows don't prevent bag locks, but really do promote line dump. This is because they only have to slip a little before they are free. Remember, line dump is potentially more dangerous than a bag lock, since it can lead to equipment damage and bodily injury, possibly incapacitating the jumper.

3. PILOT CHUTE

The pilot chute has a big effect on canopy deployments. The size, type of fabric, length of bridle, apex length, mesh size, and aerodynamic shape all affect the deployment of the parachute. Some pilot chutes have too much drag at terminal velocity. This can cause these problems:

1. They slow the bagged canopy down so quickly that the chance of line dump is increased.
2. When reaching line stretch, the jumper instantly accelerates the canopy back to his speed, since it is attached to him by the fully deployed lines. This is the first force the jumper feels at line stretch. (Moments later, the canopy starts to fill with air and slows down again.) A pilot chute with too much drag will have slowed the bagged canopy down so much that the jumper will experience quite a strong force when the canopy reaches line stretch. The canopy feels this jolt too, and the pack job will be forcefully spread apart by this force. This can cause harder openings, since the now disorganized canopy will inflate more quickly. In extreme cases, it may even open hard enough to cause structural damage to the parachute system.

A pilot chute with more moderate drag will get the canopy to line stretch with less severe shock to the jumper and the canopy. The line dump problem is also less likely to occur, and the pack job is more likely to be released from the bag in an orderly fashion.

Although a pilot chute with more moderate drag will produce more consistent openings, a pilot chute can have too little drag. This could happen if it is too worn out, too small, malfunctioned, or designed improperly. The danger here is obvious. The pilot chute must consistently function correctly. If it does not, a bag lock, or a pilot chute in tow may result. This can happen with a ripcord system, a pull out, or a throw out, if the pilot chute problem is bad enough.

Most, but not all pilot chutes from container manufacturers are compatible with Performance Designs canopies. A pilot chute made from normal F-111 type fabric should be no more than 34" in diameter. We have found 30" to 32" to be adequate for most sport sized canopies (all measurements are finished dimensions).

Pilot chutes made of zero porosity fabric are more sensitive to specific design criteria, and two of similar size may have widely different drag. They are definitely more sensitive to variations in design, with factors such as mesh size and hole size at the pilot chute base making a big difference in the drag produced. The zero porosity pilot chutes that we have tried that work adequately are between 26" and 28" and have relatively fine mesh. These pilot chutes also seem to be more sensitive to variations in line stow length and line stow tightness than regular pilot chutes.

Collapsible pilot chutes can affect deployments too. The shock cord method of collapsing the pilot chute is tricky to design so that it works consistently. It must be properly designed and use only zero porosity fabric to maintain its calibration. Never use an F-111 shock cord collapsing pilot chute! It can be deadly, because the calibration speed changes rapidly as the fabric changes its porosity. We have seen many F-111 shock cord collapsing pilot chutes cause deployment problems due to inconsistency or outright failure to inflate.

4. DEPLOYMENT AIRSPEED

Anybody who has pulled in a steep track knows that the higher opening speed at pull time, the more potential for hard openings. In fact, any of the factors described above can occur if the jumpers free fall speed is high enough. How fast is too fast? That depends on how much effort the jumper has taken in controlling his packing, line stows, and pilot chute factors.

Smaller jumpsuits and weight vests have helped advance RW skills, but place more demands on jumpers at opening time. You should work aggressively at tracking flat. When tracking, you should grab every bit of air you can! Try to minimize your rate of decent while tracking clear of other jumpers. Then a good flare to stop the forward speed will really help smooth out your openings. Sitting up in a head high position is a common practice. It you like to sit up, try to do it smoothly with the canopy reaching line stretch simultaneously. Don't sit up too early, because you will pick up speed in the sitting up position!

Jumping at high elevation drop zones poses special problems, since the freefall true airspeeds are much higher as altitude increases. This will also aggravate the other deployment factors. At extremely high elevations, a slightly smaller pilot chute on a long bridle may make the other factors easier to control.

Conclusion:

Parachute equipment may fail to operate properly if any part of the system is incompatible or used incorrectly. It is absolutely essential to control all these factors!