Set Up

p/n LIT-257010-E

STEADICAM®

General Set Up & Balancing

NOTE: The steps shown on these pages are illustrated with an Ultra[2®] Steadicam®. Your system may look slightly different, and all features may not be applicable.

Attaching the Camera

The basic idea: We want to position the camera's center of gravity about .75in (2cm) behind the centerline of the post fore-aft (as seen from the side) and directly over the centerline of the post side to side (as seen from the front or rear). We do this to facilitate both static and dynamic balancing. We fine-tune the placement of the camera as we balance the rig.

First, center the side to side and fore-aft adjustments of the camera mounting platform, using the knobs, the remote control, or better yet, flip the centering switch to "C" and the motorized stage centers itself!

Attach all the accessories to the camera, including lenses, loaded film magazines, focus motors, obie lights, transmitters, etc. Don't worry too much if you must add your motors or other accessories after you have attached the dovetail plate.

Using a rod or pencil, find the c.g. of the camera, both fore-aft and side to side. Temporarily mark this with pieces of tape.

Finding the camera's fore-aft center of gravity.

Finding the camera's side to side center of gravity.

Attach the long dovetail plate to the bottom of the camera, centered as closely as possible under the camera's c.g. Use two screws to keep the plate from rotating.

If possible, attach a second dovetail plate to the top of the camera, directly above the other dovetail. This may require additional hardware, such as a special low mode bracket for your camera.

Place the camera above the camera mounting platform. Be sure the locking lever is fully open. Angle the left edge of the dovetail into the holder. Be sure to keep everything parallel. Lower the right side into the holder.

Dovetail locking lever fully open.

If the camera won't drop fully into place, be sure the left side of the dovetail is fully inserted, all is parallel, and the locking lever is fully open. It's a close fit.

After the dovetail drops into place, close the locking lever half way and slide the camera until the fore-aft c.g. mark is about .75in (2cm) behind the centerline of the telescoping posts. Post #2 is approximately 1.580in (4cm)in diameter, so you can use the back of the post as a guide for placing the camera c.g.

Push the locking lever forward to fully lock the camera into place. You are now ready to static balance the sled.

Closing the locking lever.

Push firmly.

The dovetail locking lever has three positions: 60º back is fully open and the dovetail plate can be inserted or released. At the half way or 90 degree position, the dovetail can slide back and forth for gross positioning of the camera, but it cannot be released. All the way forward is the locked position.

Sliding the camera with the locking lever at 90 degrees. With the locking lever in this position, the dovetail can slide but cannot be removed.

Tip: If you add your focus motors at this point, remark the camera c.g. If the side-to-side position drastically changes, you may have to reposition the dovetail plate on the camera.

Big, important tip: Wrap up, tie up, tie down, Velcro®, or gaffer tape all cables so they don't flop around and mess up your precise balancing. If you have cables that run to the outside world, leave them off at this point.

For more information on general set up, balancing, and Steadicam® terminology, see Section One of ***The Steadicam® Operator's Handbook.***

Camera c.g. .75in (19mm) behind the center post – fore-aft.

Camera c.g. centered over post – side to side.

Static Balancing

Static Balancing

First, extend the posts and position the monitor where you want it, then find the proper position for the battery and camera for static and dynamic balance.

Static Balancing

The sled should be carefully balanced to help the operator get the shot. Before balancing, the sled should have the camera and battery attached, all cables secured, and all accessories on board. The gimbal should be near the top of its post.

First we must position the monitor to the best possible advantage. We want to be able to see the image and we want it to create the proper balance and inertia for the shot. Experience will help, but here are some general rules:

Extend the monitor horizontally to increase pan inertia.

Bring the monitor closer to the post for a quicker, "hand-held" feel.

Lower the monitor and/or extend the posts to balance a heavy camera, gain lens height, and/or to increase tilt and roll inertia (or all three!!).

The posts and the monitor bracket should all be properly aligned. Check the index marks on the posts. Release the proper clamp and rotate any section that is out of alignment.

For normal operating

Mount the gimbal on the balancing stud. Even if your C-stand has plenty of sand bags, it's a good idea to have an assistant hold the C-stand. You need to balance the sled in all three axes: fore-aft, side to side, and top to bottom. Pick the most out of balance axis and get that close to being in balance, then work on another axis. You may have to go back to tweak the balance in any given axis several times.

With the camera and monitor set, release the two battery rod clamps and pull out the battery until the sled balances upright. Balance as best you can with the battery – do not move the camera or monitor – then tighten the battery rod clamps.

To adjust top-to-bottom balance, tilt the sled until it is horizontal. Hold the sled firmly and release the gimbal clamp. Slide the gimbal until the sled balances horizontally - but never allow the sled to move from horizontal with the gimbal clamp open. Slide the gimbal up towards the camera about .5in (13mm) and lock the gimbal.

Now let the sled rotate (drop) through vertical and note the time. A two second drop time is a good starting point. 2 to 4 seconds is typical. Raise or lower the gimbal slightly to get a faster or slower drop time. (Again, only release the gimbal clamp when the rig is horizontal!!) A different drop time is required for long mode shooting.

To fine tune fore-aft and side to side balance, use the knobs on the camera mounting stage, or use the remote control.

When the sled is very bottom heavy, it has a quick drop time and it will require bigger movements of a weight (camera or battery) to properly balance the sled. When the sled is nearly neutrally balanced top to bottom, very slight movements of any component will have a large effect on balance.

Tip: When adjusting the balance fore-aft or side to side, moving any weight "up hill" makes the sled hang more vertically.

Working with an Ultra$^{2®}$ and a Very Light Camera

With a fully compressed sled and a very light camera, the gimbal can get very low, causing the arm to hit the electronics module.

Tip one: You can raise the gimbal by raising the monitor while leaving the sled length the same. Release the clamps at the top of posts three and four and slide post three up to the gimbal. Lock post three in place, and then lock post four to maintain the minimal sled length. Move the upper monitor mount to the top of post 3, and attach the monitor.

Re-balance top-to bottom.

An alternative solution (tip two): Raise the c.g. of the sled – and therefore the gimbal – by raising post number one. This makes the whole sled a little longer and raises the lens height slightly. Either way, the gimbal moves away from the electronics module.

Tip three: Add weight to the top of the camera.

Tip: To speed up the balancing process, hold the sled vertical with your operating hand on the gimbal. Hold the gimbal the same way you would do while operating. Hold the sled absolutely vertical as you adjust the side to side or fore-aft balance. Turn the adjustment knobs with your other hand (or use the remote) until you feel no pressure on your operating hand, and the sled will be in static balance.

Dynamic Balancing

A sled is in dynamic balance when the center post remains vertical as the sled is panned (and this is critical) at any and all panning speeds..

Dynamic balance is extremely important for precise operating and also for whip pans.

For each arrangement of camera, monitor position, post length, accessories, etc., there are many possibilities for statically balancing the rig.

However, for each arrangement of camera, monitor position, post length, accessories, etc., there is only one combination that also balances the sled dynamically.

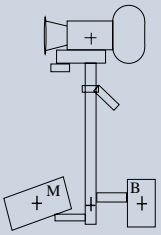
There is some leeway as to the required precision of dynamic balance. What is acceptable depends upon the operator and the situation.

Dynamic balance can easily and quickly be achieved by the trial and error method. You can also use the Dynamic Balance Spreadsheet which is available at www.steadicam.com.

In all cases, when a sled is in dynamic balance, both the camera's c.g. and the battery' c.g. will be to the rear of the center line of the center post. This rule gives you some point to begin balancing the sled.

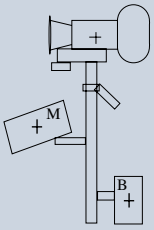
First, set up your sled at the proper length for the shot and place the monitor where you want it for proper viewing and inertial control. Position the camera so that its c.g. is about .75in (19mm) behind the center post. The center post is approximately 1.580in (4cm) in diameter, so you can use the back of the post as a guide.

Three figures to study for understanding dynamic balance



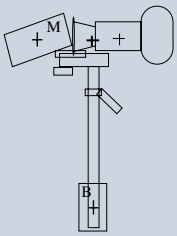
The top figure looks like the Model One or the SK. The camera c.g. is centered over the post; the monitor and battery are on the same horizontal plane, and their common c.g. is in the post. This unit is in dynamic balance and pans flat.

The second figure has the monitor raised a bit. This looks like most Steadicam® models, high or low mode. Note that the battery c.g. is closer to the post, and the camera c.g. has moved to the rear. Why?? See the third figure.



In the third figure, the monitor has been raised all the way up in front of the camera. It's absurd, of course, but it makes a point. Now the common monitor and camera c.g. is over the post, and the battery's c.g. is directly under the post.

So you can see that as the monitor is raised, the camera c.g. must move to the rear and the battery c.g. must move towards the post. With the Ultra2®, the monitor is always raised above the battery. Therefore camera is always to the rear of the centerpost.



It typically works out that the camera c.g. is pretty close to .75in (19mm) to the rear — a bit more if the camera is light or the monitor is higher, and somewhat less if the camera is very heavy or the monitor is lower.

Next, static balance with the battery so the sled hangs perfectly vertical fore-aft. Use a slow drop time (3-4 seconds).

Trim side to side with the camera, using the knobs on the stage. If your rig is equipped with the stage motor remote control, you can use it as shown. Fine tune fore-aft balance with the motors as well. Double check that the post is perfectly vertical. Give the sled several careful test spins. Very important: do not spin the rig very fast – certainly not any faster than your usual panning speed.

Note the results. Good or bad, flat pan or wobbly? Is it your technique or is the sled out of dynamic balance?

To get the sled into dynamic balance, do not move the monitor! You put it where it is for a reason, so leave it there. Move the battery a little bit first, then rebalance with the camera.

There are only two directions to move the battery, in or out. You have a 50% chance of choosing the right direction, so stop worrying about it and give one direction a test. Just be sure to make a note of which direction you move the battery.

After you lock the battery in place, you must rebalance the sled statically with the camera. Do not move the monitor!

Once you are in static balance, spin the sled again. Is it better or worse? Again, you have two choices for moving the battery. Re-rack, rebalance, and spin again (and again!) until the sled pans flat. This should not take a lot of time.

When the battery is within about .25in (6mm) of ideal, the sled will behave nicely and feel "sweet."

We suggest you do not attempt to do this for the first time on set!

Adding any accessory to the sled will affect both static and dynamic balance.

Changing the length of the sled, moving the monitor in or out, up or down will change both static and dynamic balance.

How much will dynamic balance change? It depends on the mass and position of the new object, and the masses and positions of everything else on the sled.

You will discover that as the monitor is placed higher towards the camera, the closer the battery c.g. gets to the center post, and the more the camera c.g. moves away from the post to the rear.

In practice, it's a lot easier than it sounds on the page, and luckily, there's one great gift in all this: it doesn't matter for dynamic balance what weight camera you are using or if you change lenses, filters, tilt the head, etc. Really!

So if you make any changes with the camera, there are no worries about getting back in dynamic balance! You only need to rebalance statically and you will be in dynamic balance again. Honest.

Put the other way around: you can set up your rig in various ways (long short, monitor high or low, extended, etc.) with a practice camera at home, make note of the positions of the monitor and batteries, and be able to get into dynamic balance quickly on set, regardless of the camera or accessories you might carry. Really. Honest. No fooling.

For the complete story, see the Dynamic Balance Primer and play with the Dynamic Balance Spreadsheet, available online at www.steadicam.com.

Three tips:

- The monitor pivots close to its center of gravity, so changing the angle of the monitor will not affect dynamic balance.
- The tilting head nearly preserves the camera's center of gravity, so tilting the camera also has very little effect on dynamic balance.
- Changing lenses or adding accessories to the camera (or even changing cameras) will not mess up your dynamic balance. Just re-balance statically (rack the camera) and you will be back in dynamic balance.

Make sure to give it an even spin. Use your thumb and first finger up at the gimbal.

Spinning a bit wobbly.

Looking good!

Inertial Control

Inertial control

Always remember to make the sled's balance and inertia work for you, not against you.

All Steadicam® stabilizers work, in part, because various masses are added to and mounted away from the camera, which slows down the camera's angular response to external forces.

Our primary tool for inertial control is extending or compressing the centerpost and/or the battery, monitor, and other components. The "moment of inertia" generated by each component is a function of its mass (weight) times the square of its distance to the center of rotation (the gimbal). Doubling the distance creates four times the inertia.

Positioning masses away from the gimbal will increase inertia, while bringing them closer to the gimbal (the point of rotation) will reduce inertia.

In general, the "bigger" the sled is, the slower its rotation and the more stable it will feel.

Extending the center post will slow down the rig's angular response in tilt and roll, while extending the battery and/or monitor will slow down the rig's response in tilt and pan.

Reducing the length of the post or bringing in the battery and monitor will make the rig rotate more quickly on those same axes.

To get one effect or benefit you may have to sacrifice performance in some other area. For instance, changing the post length also will have some effect on the lens height (although a lot less than the post extension), and the position of the

Shadow™ sled at maximum horizontal extension.

Ultra²® sled at maximum horizontal extension.

gimbal relative to the camera mounting stage or the electronics module.

Experiment to become familiar with all that happens as you move components around. Although the sled is stabilized in all three axes, the sled is most stable or inert in the tilt axis. This is the consequence of an important, early design consideration, which was to get the sled close to the body and make panning and switches as easy as possible.

Some actual numbers

The monitor and yoke weighs approximately 4.8 lbs. The two batteries, the mount and the converter weigh 4.6 lbs.

In the maximum configuration, the monitor's c.g. is extended 17in (43cm), the battery pack's c.g. is extended 16in (41cm), creating a total of about 2,564 pound inch^2 in the pan axis.

In the minimum configuration, as shown, the monitor is extended 5in (13cm) and and battery 5.5in (14cm), creating only 259 pound inch^2 — almost 10 times less angular resistance in the pan axis. We love the square law!!

If you remove one battery for a 12 volt rig, flip the battery down, and push the battery pack all the way in, you can reduce the pan inertia even further - to 139 pound inch^2!

If you want a quick, fast panning and tilting rig, bring the masses in as close as possible to the gimbal. If you want a slow rig, or need the shot to be as stable as possible, spread the masses far apart. Every time you move one component, other things happen with static and dynamic balance and with viewing and clearances and stability.

Minimal pan inertia with the Shadow™ sled.

Ultra$^{2®}$ sled at minimum horizontal extension.

Minimum pan inertia with one battery.

Lens height and the telescoping post

Just how high or low a lens height can you get?

As a rough estimate, in high mode you should be able to get a lens height of about 7.5 feet (2.3m) with an Ultra[2®] stabilizer. If you are tall or using a light camera, a lens height of 8.5 to 9.5ft (2.6-2.9m) is not impossible. For 2 post systems like the Shadow™ stabilizer, normal lens height will be in the 6 to 6.5ft (1.9-2m) range, and about 7.5ft (2.3m) with very light cameras.

Maximum lens height

To get the maximum possible lens height with any camera:

- Extend the bottom two sections (posts #3 and #4)
- Fully lower the monitor all the way down on its section (post #4).
- Position the gimbal at the top of its section (post #2).
- Raise the camera from the gimbal by extending the upper section (post #1) until the rig is in static balance. The lighter the camera, the more you can extend it from the gimbal and raise the lens. An assistant is useful for this operation, or grab the battery with your legs as shown.
- If you have a two or three post system, extend all posts fully and then balance top to bottom by moving the gimbal.

To gain additional gimbal and lens height, use one of the provided long arm posts in the arm and also position the socket block as high as you can on your vest.

If you can carry additional weight, add it to the bottom of the sled via the integral dovetail. Then raise and rebalance the camera.

This arrangement of components creates the maximum distance between the counterweights (battery, electronics, and monitor) and the gimbal (the pivot or balance point), which enables you to push the camera c.g. as far as possible from the gimbal.

But how high can one get the lens?

Alas, the answer isn't easy. The exact lens height you can achieve with any sled depends on your height, the camera weight, and how much additional weight you are willing to carry at the bottom of the sled.

A useful accessory: specially made stainless steel rods that fit perfectly inside the battery rods. The two rods weigh .75lbs (.34kg) and screw tightly into place. The low position help keep the sled shorter (or the gimbal lower) and the battery in slightly as well.

Lens Height – Camera Weight and the Facts of Life

Using a heavy camera makes it hard to gain a lot of additional lens height via the telescoping posts. Using a Genesis®, BL IV or similar very heavy camera will be frustrating. And it's heavy!

If you want to get a really high or low lens height, you must use a lighter camera.

The maximum theoretical lens height that one can achieve with the Ultra2® is about 48in (1.2m) up from the gimbal. You first set the gimbal at the bottom of post 2 with the rig fully expanded. Place the monitor as low as it can go and flip the battery downwards. This gimbal placement generates a lens height of about ten feet 5in (3.2m), but it requires a very, very light camera, and/or a very heavy counterweight, and/or a clever use of Antlers™ as an additional counterweight as shown in the photo (with an original Ultra).

Establishing the primary gimbal height range with the shortest post in the arm.

Note that the operator can reach higher with his operating hand, but the arm can't reach any higher. Do this with the arm attached to the socket block at its lowest practical point on the vest, and with the shortest possible arm post. This will generate your primary range of gimbal heights. You may find it useful to have someone measure this range of lens heights.

Lens Height — High Mode

Normal range for high mode with short arm post. Range is different if operator is taller or shorter.

The range of the G-70x™ arm is 29in (74cm). If, while wearing the rig, you stretch up a bit while booming up and scrunch a little while booming down, the boom range is about 34in (86cm).

You can change your lens heights in many ways

The basic tools are: raising the socket block, using longer arm posts, using an F-bracket, making the sled shorter or longer, flipping to low mode, and any combination of these techniques. Each technique has its advantages and disadvantages; it's up to you to decide which technique works best for the shot.

One easy way to shift the arm's boom range is to raise the socket block on the vest. It's not a big change (3.5in/9cm), but it might be just enough and there's no real operating penalty or compromise.

Another easy way to raise lens heights is to use a different length post in the arm. The longest post you should use is 12in (30cm). A longer post will put huge stresses on the arm, and you can't reach higher and operate at the gimbal anyway.

You can also extend the telescoping post and balance the rig with the camera further from the gimbal. How much of an increase in lens height you get depends on how heavy the camera is, and how much weight you are willing to add to the bottom of the sled. This mode is often called “super-high mode” or “long high mode.” It depends on the level of hype you want to use.

Heavy cameras in long mode (high or low) will be disappointing. There is very little additional lens height for a huge increase in sled length. Light cameras are operator friendly in many, many ways.

Sleds longer than 6 feet (1.8m) are impractical to carry, don’t fit through doorways, limit boom ranges, and are hard to control.

Low high mode

We can use the F-bracket in high mode to lower the range of lens heights. It’s sometimes called “low high mode.” How low we go is often a function of how low we can reach.

Lens Height — Low Mode

Low mode and long low mode radically change the range of lens heights we achieve.

We typically use the F-bracket to bring the arm back into a proper relationship with the sled so we can pan, tilt, and make switches without hitting the camera. A longer post from the F-bracket to the gimbal is impractical. Even with the shortest possible post, one cannot reach the gimbal at the bottom of the G-70™ arm’s range. A longer post only lowers the maximum height you can reach.

In low mode, we typically raise the socket block and add longer posts to raise the range of heights and restore the full boom range of the arm. If we don’t use these techniques while in low mode, we cannot reach the gimbal at the bottom end of the arm’s range, and therefore we are wasting precious boom range.

A long post in “normal length” low mode may make the arm interfere with the sled again, so you must test how long a post you can use.

Very long low mode configurations don’t require an F-bracket for clearance. Not using an F-bracket is just another easy way of raising the range of lens heights.

Low Mode

Configuring the sled for low mode

In order to configure the sled for low mode operating, you must:

- Flip the monitor and the camera upside-down.
- Attach the optional slanted F-bracket (P/N 252-7906) to the gimbal.
- Rebalance the sled, both statically and dynamically.
- Re-set the electronic level.
- You also might change the post in the arm and/or raise the socket block on the vest to restore some of the arm's lost boom range.

The camera will need some means of attaching a second dovetail (P/N 252-7410) to the top of the camera.

A low mode handle clamp (P/N 078-7393-02) works for some cameras, but be sure the camera's handle is strong enough. Many plastic handles on video cameras are inadequate, and a custom cage or bracket is required.

Many film cameras come with dedicated low mode brackets and 100% video viewfinders. Some camera-specific low mode bracketry might also provide a means of mounting motor rods (or a dovetail with motor rods), and this system should not interfere with camera functions or working with the camera in high mode.

Most operators work with the low mode bracketry and second dovetail in place — ready to go at all times.

Attach the second dovetail directly above the first dovetail. Check that it does not interfere with changing mags or any other camera functions.

Remove the monitor mount and flip to low mode

Always support the monitor. Loosen the Kipp handle, depress the safety button, and slide the monitor bracket straight up or down. To replace, engage the monitor bracket with the dovetail squarely and slide it down until the safety clicks in. Tighten the Kipp handle. The monitor will be square to the post.

By design, the monitor flips on its c.g., preserving dynamic balance — if the sled's length isn't changed.












Balance the sled

The sled can be balanced the same as in high mode. Hang the rig by its gimbal on the balancing spud. The camera will still be on top, but it is upside down. Balance statically and dynamically. Once balanced, adjust your drop time so the camera now falls to the bottom of the rig: simply move the gimbal toward the ***electronics*** to achieve a proper drop time.

Cautionary Tip: When in low mode and grossly adjusting the camera position by sliding the dovetail, be sure to: 1) support the camera; and 2) lock the dovetail by pushing the lever forward. Balance as you would for high mode.

Adjust the electronic level

Place a spirit level on the camera. Hold the sled level and push the level button quickly. Pushing the "level" button on the sled for less than 1 second will set the level; pushing and holding the level button for 1-3 seconds will alter the direction for low mode.

The slanted F-bracket (aka CRB)

There are two positions for the F-bracket (P/N 252-7906), one for regular side operating and one for goofy-foot. Be sure to angle the F-bracket away from you (about 45 degrees forward) when standing in the Missionary position.

Regular operating

Goofy foot operating

With the F-bracket

The F-bracket brings the arm back into a proper relationship with the inverted sled. Without an F-bracket, the end of the arm will be next to the camera. Switches are impossible and operating is severely limited.

Without the F-bracket

Tip: In very long and low mode operating, the F-bracket can be omitted, as there is plenty of room for the arm.

The slanted F-bracket has several advantages over the original straight F-brackets. With the new bracket, the gimbal-to-centerpost angle is changed, increasing the gimbal yoke's clearance to the centerpost. The operating hand-to-arm hand differential is reduced, which makes it easier to operate and is less fatiguing. The new bracket also wastes about three fewer inches of the arm's boom range than the old style F-bracket.

A useful trick

The range of low mode lens heights can be lowered by making the rig more bottom heavy. With this trick – and the unique design of the Ultra$^{2®}$'s telescoping post – even a very heavy camera can kiss the ground. In fact, if one didn't care at all about bottom heaviness, the top of the camera could be almost 4 feet (1.2m) below the gimbal – which might be great for a trench or grave shot or working off scaffolding.

Low mode operating

Traditionally, it's considered harder to operate in low mode than in high mode. Why?

Several factors may work together to make low mode operating harder. The operator usually holds the sled further from his body than in high mode. The operator's hands are not at the same height. Many times, the post is tilted from vertical. The boom range is sometimes reduced. The rig may not be in dynamic balance. The operator often cranes his neck to see the image. In addition, every director wants the lens height lower or higher than one can properly reach. And it's just plain weird to have the monitor so far above the lens.

To make low mode operating easier and more precise:

Use the tilt head to keep the post more vertical and to make viewing the image easier. Use the F- bracket to reduce the hand height differential and to have fewer clearance issues with the post. Use the telescoping post system and different arm posts to set the proper lens height range and to restore the full boom range of the arm.

Be sure to rebalance dynamically as well as statically. Dynamic balancing is often ignored because it's next to impossible to spin balance in low mode, but dynamic balance is critical for precise work.

If the operator does not change the length of the sled or the monitor position, the sled remains in dynamic balance. (Remember, the monitor tilts and flips on its center of gravity.)

But one still has to hold the camera further from one's body, and the monitor is still above the lens. So practice until low mode is as easy as.... it can be.

Long Mode Operating

Long mode operating presents some wonderful opportunities and hazards. Unusual lens heights, both high and low, is the principal allure of long mode operating.

Tiffen's tool-free clamps make it easy to extend or compress the integral post system, and also to configure the monitor and battery to best advantage for the shot. The tilt head makes long mode operating practical.

Most operators are used to working with relatively short sleds. As the telescoping posts are extended, new factors must be taken into consideration. Viewing, clearances, increased inertia, inertial imbalances, static and dynamic balance, and flexing are key issues.

Increasing the lens height by extending the telescoping post may be the only way to get the lens height you need. It may also get you better viewing of the monitor or a needed increase in tilt and roll inertia – or all three!

The standard "drop time test" that is typically used to determine bottom heaviness should be ignored.

Instead of using a drop test, tilt the sled with your operating hand and note how much force is required. Compare this force to your normal length sled's feel. Accelerate the rig and note the pendular action. Again, adjust the bottom heaviness accordingly, depending on the requirements of the shot.

The operator dynamically balances a long sled using the same procedures as with a shorter sled. The trial and error method is fairly quick. However, because there are so many possible configurations with the Ultra2®, or similar Steadicam® rigs, spin balancing for each one can be time consuming and unproductive. Use the Ultra2® Dynamic Balance Spreadsheet to virtually discover how to get your rig into dynamic balance under various conditions.

Very long sleds have a lot of inertia in tilt and roll. It takes time and effort to tilt or roll — and time and effort to stop a movement you've started. Although the sled may be harder to get off-level, it's also harder to get it back to level once you've strayed.

With the monitor fully in — which might be desirable for quick panning — the pan axis will feel very light compared to the tilt or roll axis. To make the sled feel more "normal" (or inertially balanced in all three axes), extend the monitor fully and extend the battery for dynamic balance. Extending the monitor and battery adds a lot of inertia in the pan axis.

A long post configuration adds lots of inches to the bottom of the sled. Operators tend to pay attention to the lens, and they may be surprised when that other part of the sled strikes something on the set. Panning the camera when a long sled is angled up or down requires that both ends of the sled move in great arcs. This spatial translation of masses is very hard to control.

The uselfulness of any long mode sled is greatly enhanced by the addition of an integral tilt head and a motorized stage, if so equipped. Use the tilt head to keep the rig more vertical, reducing the spatial translations, and, at the same time, reducing clearance problems between the sled and objects on the set.

Use the tilt head to keep the sled in dynamic balance — always a plus.

With an Ultra2® sled in the most expanded high mode, the bottom of the sled can be as much as 46in (117cm) below the gimbal.

The operator also needs to get used to the increased distance from the monitor to the lens.

Tip: Avoid violent moves with long sleds. The stresses can be very large.

Attempting a long low mode pan with the lens looking up:

With a tilt head

Without a tilt head

Without a tilt head and the lens angled up or down, precise panning becomes nearly impossible, due to the huge and odd spatial translations of the sled. The faster the pan, the worse it gets.The camera is tilted 20 degrees up in both cases.

The Stiffening System

Any long post sled, whether single or multi-section, suffers from increased flexing. The longer a post, the more it flexes — unfortunately by the cube law. Doubling the post length makes the rig eight times more flexible!

The carbon fiber telescoping post is very stiff, but it will need extra rigidity under certain situations. The heavier the camera or the more violent the moves, the more help is required.

The stiffening system consists of attachment points on the monitor, the battery mount, the bottom of the sled, and just underneath the tilt head; and a length of lightweight Vectran® line.

Vectran® is a polymer cable that is as strong as steel, but it has one-fifth the weight and is much more flexible.

The Vectran® line is laced from one side of the battery mount down around a pin at the base of the sled, up around the spreader on the monitor, further up to a hook just under the tilting head, and down the other side, around the pin at the bottom of the sled, and back up to the battery where the line is tensioned and secured under a special washer.

The Vectran® line is given its final tension by extending the telescoping posts slightly, pulling out the monitor rods as shown, and/or by tilting the sled horizontal with the monitor down and retightening the line.

The stiffening system is very useful with normal length sleds when the shot has violent moves or high stresses, such as during a vehicle shot on rough roads.

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