As the operator tilts the sled, the precious lens height gained with an extended telescoping post quickly disappears. The more one tilts, the more rapidly the lens height is lost.

The left diagram represents a long mode rig without the tilt head. Here, a 20 degree tilt would lose 1.8 inches of lens height, and a 40 degree tilt would lose 6.5 inches, and a 60 degree tilt would lose 14 inches.

With the tilt head (the right diagram), we can maintain full lens height with 20 degrees of tilt in the lens, lose 1.8 inches with 40 degrees of tilt, and lose only 6.5 inches with 60 degrees of tilt.

In low mode, the same pre-tilting not only preserves the minimum height of the lens, but it also keeps the monitor in front of you where you can see it.

Without the tilt head in low mode, the monitor quickly shifts back behind your shoulder, and as you struggle to see the image, you lose form, dignity, confidence, framing, etc.

This pre-tilting is useful looking up or down in both high and low modes.
The Tilt Head – Other Applications

One of the more unusual applications of the tilt head is to angle the sled and its components relative to the desired position of the lens. Moving the sled relative to the lens might avoid casting shadows into the shot, seeing one’s own feet, or prevent the sled from hitting something on the set.

Several examples:

Imagine shooting in the narrow aisle of a bus in ultra low mode with lens parallel to the ground. Without the tilt head, the operator has to keep the whole sled very far in front of him. With the tilt head, the sled can be angled back towards the operator.

A man sits at a desk, and the lens needs to be over part of the desk to get his close-up. Without the tilt head, the monitor hits the desk and restricts the travel of the lens.

Angle the sled to the rear (tilt the camera up), and push the lens over the desk. Use the tilt head in this manner, and combine it with the telescoping post and/or a long post in the arm, and a whole new range of lens positions is possible.

The same angling in super long low mode could place the lens underneath the center in a football game, inches from his hands, looking down and forward across the ball.

Another unusual application for the tilt head:

Making switches is a common maneuver in Steadicam operation. It requires that the post be more or less vertical when the switch is made. The tilt head allows a switch to be made at a different and perhaps more convenient time during a shot. Unusual, but possible and easy to configure.
Lens height

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. If you are tall or using a light camera, a lens height of 8.5 to 9.5 feet is not impossible.

To be more precise takes a bit of work - see below.

In low mode, your camera can always reach the floor. Always. See page 40 for the trick.

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.

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.

Adding a six pound diving weight to the bottom of the sled via the integral dovetail. Then raise and rebalance the camera.

But how high can one get the lens??

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

To get the maximum possible lens height with any camera, extend the bottom two sections (posts #3 and #4) and fully lower the monitor all the way down on its section (post #3).

Position the gimbal at the top of its section (post #2). See photo above.

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.
To get an accurate idea of the possible lens heights obtainable with the Ultra, you must first measure the maximum and minimum height at which you can position your gimbal with your arm.

This “primary gimbal height range” is the same regardless of how short or long your rig is, or the specific camera you might be using. As an example, one operator we know is 71” tall and his primary gimbal height range is 38 to 65.5 inches.

To generate your own primary range of gimbal heights, measure the top and bottom gimbal position from the floor when in high mode.

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.

Several additional gimbal height ranges also should be calculated:

• Using the 12 inch arm post (this adds 8.5 inches to the primary range),
• The additional height that can be made by raising the height of the socket block on the vest (adds 3 more inches).

• Low high mode using an inverted F-bracket with a six inch arm post (minus 4.5 inches to the primary range)
• Low mode using the old style F-bracket and the minimum length arm post (minus 10 inches to the primary range)
• Low mode using the new, slanted F-bracket (minus 7 inches to the primary range)
Another range to make note of is the comfortable reach of your operating hand.

Not all possible gimbal positions – high or low – can be reached with the operating hand.

Measure the operating hand's range while in the vest and carrying a rig. The comfort level is up to you.

In our example, the operating hand range is about 33 to 75 inches.

To get to the 75 inch height, the operator added a 12 inch arm post (see photo at right).

The operator can actually reach a bit higher and lower, but his comfort level decreases – along with his form and control.

Raising the socket block three inches in low mode has no effect on how low you can get the lens, and it adds three inches to the top of the lens height range.

Low mode using the 12 inch arm post adds 8.5 inches to the lens height range - and the camera gets just as low as before. See page 37.
**Lens Height – High Mode Chart**

The sled was configured with a Panavision Lightweight II camera, 30mm C series anamorphic lens, 2 lens motors, two BFD receivers, and a PC-3 VCR.

At 30 pounds, this is not a very light camera and the ultimate lens height is not that high. Measurements are in inches.

<table>
<thead>
<tr>
<th>gimbal range</th>
<th>High mode w/ telescoping post fully compressed</th>
<th>lens height range</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 - 65.5</td>
<td>with shortest arm post (+ 9.5 inches to lens)</td>
<td>47.5 - 75</td>
</tr>
<tr>
<td>46.5 - 74</td>
<td>with 12 inch arm post (+8.5 inches)</td>
<td>56 - 83.5</td>
</tr>
<tr>
<td>49.5 - 77*</td>
<td>with 12 inch arm post* and raising socket block (+11.5 inches)</td>
<td>59 - 86.5</td>
</tr>
</tbody>
</table>

**Low high mode**

w/ F-bracket (-4.5) and 6 inch arm post**

| 33.5** - 61 | 43 - 70.5 |

**High mode**

with telescoping post fully expanded

| 38 - 65.5    | with shortest arm post (+ 20.5 inches to lens) | 58.5 - 86         |
| 46.5 - 74    | with 12 inch arm post (+8.5 inches)            | 67 - 94.5         |
| 49.5 - 77    | with 12 inch arm post and raising socket block (+11.5 inches) | 70 - 97.5         |

**High mode**

with telescoping post expanded and 5 lbs***

| 38 - 65.5    | shortest arm post (+ 28.5 inches to lens)      | 66.5 - 95         |
| 46.5 - 74    | with 12 inch arm post (+8.5 more inches)       | 75 - 102.5        |
| 49.5 - 77    | with 12 inch arm post and raising socket block (+11.5 more inches) | 78 - 105.5        |

---

* Tip:

It is also good to note the height of the socket block on your body.

Then when you hardmount on a vehicle, you can calculate the proper socket block height for the range of lens heights you desire.

For example, the socket block height of the operator used in the lens charts on this page is 44 inches.

From first high mode chart, one can predict that when hardmounting in compressed high mode, the lens heights would be 3.5 to 31 inches above the socket block height when using the shortest post. (47.5 – 44 = 3.5 inches; and 75 – 44 = 31 inches).
### Lens Height – Low Mode Chart

The sled was configured with a Panavision LW II, 30mm C series anamorphic lens, 2 lens motors, two BFD receivers, and a PC-3 VCR, (30 lbs!). The old style F-bracket was used to generate these ranges. The new F-bracket adds three inches to all the ranges.

<table>
<thead>
<tr>
<th>gimbal range</th>
<th>Low Modes</th>
<th>lens height range</th>
</tr>
</thead>
<tbody>
<tr>
<td>24* - 51.5</td>
<td>Normal low mode, with telescoping post compressed (-10 inches to lens)</td>
<td>25 - 41.5</td>
</tr>
</tbody>
</table>

| 30** - 57.5 | High low mode, telescoping post compressed (-10) + high socket block (+3) + 6.5 inch arm post & collar (+3) | 25 - 47.5 |

| 35 - 62.5*** | High low mode, telescoping post fully expanded (-22) + high socket block (+3), + 11.5 inch arm post & collar (+8) | 13 - 40.5 |

| 35 - 62.5 | High low mode, all the above + 5 lbs (-30) | 5**** - 32.5 |

*The operating hand can’t reach down to twenty four inches. In normal low mode, about eleven inches at the bottom of the arm’s boom range is wasted.

**Only five inches of the arm’s boom range are still wasted. We can’t use a longer arm post and make switches; the arm hits the camera’s magazine.

***The full range of the arm is restored. Also, the expanded post permits the eleven and a half inch long arm post to be used without the arm hitting the camera mag.

****In this configuration, the camera body eats lots of dirt.
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 BL IV or similar very heavy camera will be frustrating. If you want to get a really high lens height, you must use a lighter camera.

One example of a slightly lighter camera:

With the sled full compressed, the high mode lens height range for an Arri 435ES is only about 0.8 inch higher than the range with the LWII in our example on the previous page.

The 435ES weighs 27 pounds or 3 pounds lighter than the LWII.

When the telescoping post is fully extended, the lens height range for the 435ES is only 1.5 inches higher than with the LWII.

Using a twenty pound camera would put the lens about 4.5 inches higher than the LWII in the most compressed mode (51 to 79.5 inches) and nearly ten inches higher in the fully extended mode (from 80 to 107.5 inches).

The maximum theoretical lens height that one can achieve with the Ultra is about 48 inches up from the gimbal. Set the gimbal set at the bottom of section # 2 with the rig fully expanded.

This generates a lens height of about 125 inches (ten feet 5 inches), but it requires a very, very light camera, and/or a very heavy counterweight, and/or a clever use of Antlers™ as the additional counterweight.
Low Mode Operating

For low mode, the sled is flipped upside down, the monitor is re-righted, and the camera is mounted from its top.

A special low mode bracket is required for every camera.

Many cameras, such as the Panavision Lightweight II and Millennium XL, most Moviecam Compacts, and the Arri 435ES, come with user friendly low mode brackets.

Most Arri III’s and SR’s can be accommodated via Jerry Hill’s brackets, and many video cameras can be made to work fairly well with a couple of bolts and U-bolt holders.

But most doesn’t always work, so you may have to improvise, make, or buy a specialized bracket for your camera.

A low mode bracket should be placed so that the upper clamp plate will mount directly above the correctly located clamp plate on the bottom of the camera.

Also, the bracket should be as close to the camera body as possible. It should be small, strong, and not interfere with other camera functions, such as tape loading for video cameras, video assist cameras, or mag loading for film cameras.

Other than a film magazine, the top of the camera and its accessories should not extend above the upper clamp plate, as this may cause interference with the camera mounting stage.

Lightweight “universal” cages generally flex too much to be useful.

Many video handles are not stiff or strong enough for low mode.

The 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, working with the camera in high mode, etc.

Flip the monitor over by releasing the clamp shown in the photo. The monitor flips on it’s c.g., preserving dynamic balance if the sled's length isn't changed.

An F-bracket is required for the gimbal, and this new arrangement of components must be balanced, both statically and dynamically.

Be sure to readjust the electronic level when going to low mode and back. Flip the right/left switch and place a spirit level on the camera.

Tilt the camera until it is level and adjust the electronic level to match.

Cautionary Tip:

When in low mode and 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.
The other necessary accessory for low mode operating is the F-bracket.

Its function is to bring 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 and the operator will find it difficult to operate and impossible to make changes.

The Ultra’s unique slanted F-bracket has several advantages over "traditional" F-brackets.

The gimbal-to-centerpost angle is changed to increase 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 wastes about three fewer inches of the arm's boom range than the old style F-bracket.

Insert the safety pin to hold the F-bracket into the gimbal.

Older gimbals use a shoulder bolt and require a tool. A special no-tools shoulder bolt is now available.

A useful trick:

The lens height in any low mode range easily can be lowered by making the rig more bottom heavy.

With this trick – and the unique design of the Ultra’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 four feet below the gimbal – which might be great for a trench or grave shot or working off scaffolding.

All the information about lens heights with the sled configured in various ways can be placed into the included Palm Pilot computer. If you change cameras, you can generate a new set of lens heights quickly.
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 new 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.

See the lens height chart on page 37 for details.

Rebalance dynamically.

Rebalancing is often ignored because it's next to impossible to spin balance in low mode. But dynamic balance is critical for precise work.

Fortunately, the Ultra is easier to get in dynamic balance in low mode than any other Steadicam.

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

If the operator changes the sled length and/or the monitor position, the Ultra's computer can calculate the battery position for dynamic balance.

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 principal allure of long mode operating.

The Ultra'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, inertia, clearances, static balance, dynamic balance, and flexing are key issues.

Increasing the lens height by extending the telescoping post may be the only way to get the height you need (see the lens height charts, pages 36 and 37), or it may service an additional need, such as better viewing of the monitor or adding increased inertia in tilt and roll.

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

Instead of using a drop test, tilt the Steadicam with your operating hand and note how much force is required to tilt the sled.

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.

If the range of lens heights desired is less than the maximum possible, the operator has choices in configuring the Ultra's components.

An example: In the high mode, maximum extended post example on page 36, raising the monitor from the bottom to the top its post - for better viewing - would lower the overall lens height range by only 2.5 inches.

Extending the telescoping post and rebalancing should take well under a minute with a trained crew, and a minute and a half at most.

Adjusting the tilt head, a few more seconds. If you need to attach the stiffening system, another minute (see page 44 for details).
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 Ultra, spin balancing for each one would be time consuming and unproductive. Use the dynamic balance computer to instantly get your sled properly balanced. See page 26.

**Very long sleds have a lot of inertia in tilt and roll.**

If you extend the monitor fully (and the battery for dynamic balance), it will add a lot of inertia in the pan axis, and the sled will feel more normal.

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.

It takes time and effort to tilt or roll a long mode sled - 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.

**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.

**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.

In the most expanded high mode, the bottom of the sled can be as much as 46 inches below the gimbal.

You can use your gimbal and lens height charts to find when your minimum gimbal height is lower than 46 inches and it is possible that the rig will drag on the floor.

And one 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.**
The Stiffening System

Any long post Steadicam 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 a spreader that attaches to the monitor arcs, attachment points on 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.

To use the system, screw in the two halves of the spreader through a hole in the monitor arcs.

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 via the spreader, 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. See the pictures!

Lacing the line around the spreaders on the green screen monitor.

Keep some tension the line to prevent it from jumping off the guides.

Lacing the line around the spreaders on the LCD monitor.

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

Two tips:

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.

It also is possible to attach the Vectran line to some solid part of the camera to further stiffen the rig.

However, once you have balanced your sled and tensioned the Vectran, be careful that you don't move the camera very far on the stage.
Maintenance

General:

Keep the sled clean.

Protect the steel parts in the arm from water, salt water, and other corrosives.

Keep sand away from the rig.

Avoid baking the rig in the hot sun.

Battery:

Keep your batteries charged. NiCads will self discharge over time.

Read the manual that comes with the charger for additional information.

Avoid excessive heat loading. Do not store or attempt to charge batteries in the hot sun, or above 104 degrees F (40 degrees C). In cold conditions, keep batteries above 40 degrees F if possible.

The Ultra’s 28.8 volt battery is rated at 55 watt hours. It is equipped with a self-resetting thermal circuit breaker that will trip if the cell pack is shorted or becomes excessively warm during charging.

Care should be taken to not charge an already fully charged battery as this also will trip the circuit breaker.

If the breaker has been tripped, the fuel gauge display will continue to function, but the battery will not supply any power.

Reset the breaker by allowing the cell pack to cool down for approximately 10 to 15 minutes.

Using a 4A charger, the charge time for a fully depleted battery is approximately 45 minutes.

All standard NiCad battery handling and operating precautions should be followed.

The fuel gauge system on the battery pack displays battery capacity in approximately 20 percent increments.

The last LED on the fuel gauge is triggered by battery voltage and not battery capacity. During battery discharge, the red LED indicator will start to blink when the battery voltage has reached 24V ± .5V.

Big tip:

Care should be taken to prevent the Ultra battery from becoming overly discharged.

Discharge levels well below the last LED power meter indication may cause the battery fuel gauge system to loose its programming and capacity information.

In most cases, the fuel gauge system in the battery can be reprogrammed in the field by following the procedure below:

Insure that the battery is at a discharged state by verifying that the last LED on the fuel gauge meter remains off, or is in the blinking state when the TEST button is pressed.

Connect the battery to a 4A-battery charger (PAG 301 or equivalent) and charge the battery continuously until the charger terminates the charge cycle.

Do not disconnect the battery from the charger during this step.

After the battery has been fully charged, it must be discharged continuously until the LED indication on the fuel gauge display either is in the red blinking mode or has just extinguished.

Care must be taken not to let the cell pack become overly discharged or to interrupt the discharge cycle.

Within approximately 5 minutes of completing the discharge cycle, the battery must be put back on the charger for at least 5 minutes. This completes the programming cycle.

If for any reason the charge or discharge cycles are interrupted, the entire reprogramming sequence needs to be repeated.

Docking the sled. Time to go home.

Vest:

Keep clean.

The pads are washable. Hand wash or use the gentle cycle; air dry or use very low heat.

General:

Keep the sled clean.

Protect the steel parts in the arm from water, salt water, and other corrosives.

Keep sand away from the rig.

Avoid baking the rig in the hot sun.

Battery:

Keep your batteries charged. NiCads will self discharge over time.

Read the manual that comes with the charger for additional information.

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