Stabilised Aerial Filming from Helicopters
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Contents

Overall Questions and 'Need-to-knows'

Before confirming a shoot using a helicopter and aerial equipment, it's important that the below questions are asked to make sure that it's the best option for your production.

If you're unsure of any of the answers, it's always best to contact a professional Aerial DOP, or Helicopter company to talk through the specifics of the project in more detail.

1. Does the subject lend itself to aerials?

It's a pretty obvious question, but so often either the landscape in question or the animal behaviour does not lend itself to an aerial sequence and you have to consider this as the first question. Clearly trying to film Bonobo Chimpanzees' behaviour in deep jungle is not going to work.

2. Is the location so remote that getting a helicopter to the area is not going to be cost effective in regards of the amount of footage obtained?

If your location is so far from a helicopter base that its necessary to make staging fuel dumps and have to supply a camp from the air, then this is going to incur large costs on the scale of an expedition.

3. Is the area in question in a war zone or politically unstable?

An aerial film crew being impounded at an airport is not unknown and there are a number of countries that were ok last year but are now no go areas today. Always check government websites as a first port of call to start building a picture of where you want to film.

4. What is the likelihood of being granted permission to shoot, for instance in a nature reserve?

Certain bird sanctuaries ban any flying near nest sites in the breeding season for instance. There are also flying restrictions over most cities so this needs to be monitored any any relevant permits applied for.

5. Will there be enough daylight to capture the content?

Check sunrise and sunset times for your shoot location. Sounds strange but the poles have a winter night that lasts for a couple of months. I have been asked to shoot in Svalbard in November. The producer was quite upset when I pointed out that there was only one hour of daylight.

6. Will weather be a factor?

Always check the weather forecast. Filming during the monsoon season can be a problem but now some of the systems have a built in rain spinners for light rain. You still, however, have to be able to fly in the helicopter and land it safely. It's worth getting a regional weather forecast for the area and an historical record of the weather in in previous years. You should always factor in weather days depending on where and when. Local knowledge is also valuable, especially in mountain regions.

Flying in the dark is problematic, although not impossible. Most pilots however, will not have the skills or qualifications for this. So its worth checking right from the start. The rule for VFR (visual flight rules) is that you can fly 30 minutes before sunrise and 30 minutes after sunset, depending on the region, however in practice this can be a lot less so it's always worth checking.

7. Will we be restricted by the IMU American ban in the country we would like to shoot in?

Under an American ban on sensitive, military technology, namely the IMU'S (gyros) in the mount, there used to be a ban on systems going to certain countries. This no longer applies to the GSS and Shotover mounts, they are ITAR free.

8. Under the ITAR American ban, can we use an aerial system in Zimbabwe?

If you're using the GSS/Shotover, yes we can. If the system you are using is a Cineflex V14 (even one that has been converted), no we can't, and the system supplier can receive enormous fines for taking a system to a non ITAR country. It is possible to apply for dispensation to take the system to a banned country, but this takes months and is more than often unsuccessful. If stopped at customs this could clearly jeopardise the shoot.

9. And finally you have to ask: "Is what we want to do possible with a drone"?

If multiple locations are required, quite often the helicopter team is more cost effective and can achieve more in one shooting day than a drone can do in a week. They can go to locations that are inaccessible to a ground team and use much longer lenses. Sometimes they can work in areas/countries that drone flying has been banned and fly over populated city centres.

However, if you're planning to only shoot one or two vista shots for the project and the nearest helicopter is 400 miles away then a drone may work better for your project and your budget. It's worth talking through your project with a drone operator & pilot to make sure they can capture the shots you need before making this decision.

Aerial Filming and Further Considerations

If you still feel that the project will benefit from some amazing aerials, then we move on to further specifics of your project. You will find a glossary of aviation abbreviations in common use in the appendix (1.1).

Choice of Crew

Experience is everything when it comes to shooting aerials and a good professional Aerial Cameraperson or experienced Film Pilot will guide you through what is necessary to make your shoot work both from a budgetary and artistic and point of view.

Quite often an Aerial Camera operator will have a close working relationship with a number of pilots and companies in the area you wish to shoot and similarly an experienced film pilot will have camera personnel that they have worked with. As a producer, it's best to make these calls first, so you can start building a team of expertise to make sure that you get the kit you need to make the shoot work whilst building a realistic idea of what you can do with your budget.

Aerial Camera Operator / DOP

Make sure you discuss what you are planning to film and how with your Aerial Camera Operator / DOP right from the beginning. It is normal for them to want to know where the helicopter is being sourced from, to ask to see its pilot's record etc – they will have extensive experience which can guide the shoot production and they will be able to advise on any safety issues surrounding the shoot.
A professional Aerial Camera Operator should be able to rig the helicopter. In addition they should have a good working knowledge of the system they are using and have the ability to change lens and perform basic trouble shooting. It's also advisable that they should know how to test the polarity of the DC power source of the helicopter and how it integrates into the aircraft.

They should know how to fit the various mount brackets to the aircraft and have a working knowledge of how to use torque gauges and the effect on aviation hardware.

Knowledge of working safely around the helicopter is necessary to conform to BBC good working practice. A current underwater escape certificate (Dunker) is required on some flights over water. In addition they should know how and when to use life jackets and emergency dinghies.

Some systems are heavy and it is advisable to make sure that they have help with lifting at the rigging stage.

If the Aerial Camera Operator has no experience and is still required to shoot with a system that they don't know, then a technician will have to be present to ensure against any minor technical hitches. This can often be an insurance requirement of the suppliers insurance company and will also make sure that you save critical time on a rigging day.

Some courses on the more common mounts like GSS/Cineflex and Shotover are available for Aerial Camera Technicians, both in the UK, Germany and the USA. Normally courses take 4 days and will incur a fee.

Sometimes it is necessary to rig on location for one reason or another. It's not advisable but if its the only way then you have to bear in mind that either the pilot or a qualified helicopter engineer

may need to be on location to sign the system onto the helicopter. This is a requirement to make the flight legal. Quite often the pilot has authorisation to do this, but it is always worth asking the question. If you do decide to rig on location it is advisable to have a small 1-2 kv generator to test the system on the ground. Also bear in mind that a normal rig will take 2 hours to fit and this can be much longer in wind rain or darkness. Location rigging comes with risk, trying to rig in a thunderstorm, at night or a sand storm or in +50 or- 20 degrees C is far from ideal. In these circumstances, the rigging of the helicopter can take at least twice as long as it should and runs the risk of damage to both system, camera and lens. A simple problem with a BNC cable may take hours to rectify on location but minutes to correct in the hangar. As with all shortcuts, what seemed like a good idea at the time can cause problems for the rest of the shoot, especially if water, wind, fine sand and dust are involved.

If you rig at the helicopter base and have a long transit, try to incorporate shots relevant to the story en route. These journeys can also be used as a useful time for the Director and DOP to talk more through the shots wanted and test different angles of the camera or zoom techniques.

Choice Of Helicopter Company

The Helicopter company must be in possession of a current AOC (air operators certificate) or operate under EASA using SPO (special operations) or operate under FAA Part 91 (for aerial filming in the USA). For the transport of people other than crew, then an AOC is required.
In most, if not all case no AOC, EASA SPO, FAA Part 91 equals no insurance, so it's worth asking this question from the start.

It's always in the helicopter operators interest to adhere to the rules as they can face prosecution for non-compliance with CAA/FAA/EASA rules or equivalent. In addition insurance can be deemed invalid if such rules are broken and the flight seen as illegal. This includes all aircraft having a current C of A. (certificate of airworthiness)

Helicopter companies with an AOC will also have an operations manual designed to dictate how the company flights will take place and the steps taken to ensure the safety of passengers and crew, both in the air and on the ground. Various categories of operations come into force and these include Public Transport, Aerial Work and Special Operations.

AOC operations are the safest designed for fare paying passengers and should be a starting point if you have no knowledge of the operators in a country. It's always worth checking these details and asking the question, '*If they aren't certificated, why aren't they?*'?

It's all to do with the competency of the company. They might be very professional operation who only do aerial work and so don't need the cost of an AOC.

It's always best to speak to them and get a feel of how they operate.

Alarm bells would ring if they gave the impression of trying to avoid limitations by changing the operation eg '***I'll pay you for the day so you are an employee so it's only a private flight***'**.**
Similarly **"*You don't need to pay for the flying, we can call it stock shots "***
When it goes wrong it's still a BBC helicopter shoot and If crew and equipment are involved, you may find the flight declared illegal and insurance invalidated which should obviously be avoided in all circumstances.

The following questions should also be considered when choosing a helicopter company:

- *Where is the nearest usable helicopter to my location area?*
- *Or If I intend to do a round trip filming of an area:*
- *Where is the best start and finish point ?*

These are not always easy questions to answer and it's normally best to start with country then specific region if it's somewhere new.

Look on line for helicopter companies in the area you wish to work and then work outwards with a map to locate the nearest city that may have a helicopter company.

In general a helicopter company flying in say a mountainous high altitude region or close to the coast will have the right helicopter for the job whereas some smaller countries may only have one or two helicopter companies anyway, so choice is limited. Knowledge is key here and sometimes a helicopter company can be found just across a border in other country, but still be able to work in the area required for filming.

Try to avoid military and privately owned helicopters and refer to them only as a last resort. They may seem like a good idea at the time but have insurance implications for film work and carry different risks and legalities. It's not impossible to use such machines but it can cause major problems when either the military change the helicopter type or pilot at the last minute or you find you have to fly in a professional licensed pilot and engineer for the duration of the shoot to make it legal to fly with a privately owned helicopter. When using military helicopters it will be necessary to insure the equipment and the personal separately and this can be expensive.

Quite often an Aerial Camera Operator or Mount supplier will have the answers to these questions, and have direct knowledge and good contacts for who is the best filming helicopter company in a certain region. Once you have a helicopter company in mind you can ask the questions.

Useful questions to ask your Helicopter company

What Filming Exemptions does the company have ?
Some Helicopter companies will have low flying exemptions built in. Especially if they do lots of aerial work tasks.

When was the company last audited by an aviation authority ?
Yearly is the norm.

What Insurances are carried ?
Make sure the Insurance is up to date . Get a copy.

What Helicopters do you have?
It's really important to get the right helicopter for the job. **See types of helicopter for your reference on page 34.**

Can the helicopter company provide all of the necessary paperwork required by BBC Health and Safety?
Consult the BBC Health and Safety website for what is required.
http://www.bbc.co.uk/safety/resources/aztopics

Have you done Aerial Filming Before and if so with whom and when?

It's worth taking out references if they can make them available to you. The experience of your pilot will be crucial to the success of you're filming operations. I would start by asking whether there are any pilots on their roster who have done aerial filming before with externally mounted cameras.

Don't assume that because the helicopter supplier is providing the pilot that the pilot has done a lot of hours in the helicopter you have requested. If they have a low number of hours (Less than 1500) then I would ask if there are any more experienced pilots available.

The golden rule is they should have at least 1500 hours total time in the air and 500 on the type of helicopter you are filming with, minimum. Statistically a helicopter pilot is very safe from 200 hrs to 800 hrs total time but not experienced enough for film flying. Then from 800 -1200 hours they go through a stage of high confidence that can result in poor risk management.

After 1500 hours total time confidence is still good but risk management dramatically improves.
In the words of a pilot friend of mine "**A Safe Flight Is No Accident**." Working with an inexperienced pilot is definitely not a good idea even if it might seem like a good budget choice at the time.

Is the area we intend to film, in a restricted area and if so, what are the restrictions? Is it possible to get an exemption of restrictions and what filming exemptions does the helicopter company have?

This could be anything from a Military area, an Aviation Exclusion Zone, a National Park or a site of Specific Scientific Interest. Your helicopter company can look this up on a map and will know who to contact to get permissions. Be aware that there may be a cost involved in obtaining permissions, especially look out for a daily cost in national parks.

Local land owners and regional government will need to give permission for the helicopter to land. For overnights, in general its best to work from the local airfield, lodge or hotel (with a landing site) where both fuel and security are available.

What are the costs per hour? Does this include Pilot? Does this include fuel?

Helicopter time is charged by the hour and minute or hour and percentage of the hour i.e 1.5 equals 1 hr 30 minutes. The charge normally accounts for the fuel and is referred to a (WET hire) or without fuel and is referred to as (DRY hire). The charge may or may not include the pilot . The pilot may have a daily rate for filming and a rate for standby so it's worth making sure these charges are clear before the shoot is locked down.

Does the helicopter company have a daily minimum?

If you are asking the helicopter company to devote the helicopter to be at your beck and call throughout the filming period, they will normally charge you a daily minimum, regardless of whether you fly or not. Make sure you have this discussion up front and feed this into your budget. Normally if you are paying a daily minimum you would not pay a standby rate as well. It's sometimes also possible to do a deal based on a total number of hours over a set time period.

What does the helicopter company charge for standby rates?

Standby rates are charged for the time you are not flying but are expecting the helicopter to still be available to you exclusively. It is very important for your budgets to have this discussion with the helicopter company.

How long is the transfer time between helicopter base ?

This is going to be a major factor in whether your shoot is affordable or not – don't forget to include transfer flight times (in both directions) in your budget. It also determines how long you can spend in the air over your subject, as the helicopter will need to refuel after usually 2-3 hours flying time. If you are doing a lot of hovering on location, this uses up more fuel and will reduce your on-location time further.

The hassle of having to go back to refuel half way through your holy grail sequence is one of life's lowest moments, so planning your logistics carefully can make a big difference. Using the above, you can work out how long you can spend in the air above your subject/location before needing to refuel.

This, combined with the research on the frequency of your subject's behaviour, will give you a good indication of the feasibility of your aerial shoot.

Can the helicopter company arrange for the transport of fuel drums nearer the location?

This can be a real game changer and can save thousands in position charges. Drums of fuel can be trucked, flown or shipped into position. Invariably there is a cost involved. Fuel comes in a bowser truck with built in tank or in 200L drums. An AS350 helicopter will burn one drum per hour approximately depended on altitude and use. Fuel should be tested by the pilot for contamination before putting it into the helicopter fuel tank via a filter system and this can be done with a test kit. All drums of fuel have a seal which indicates that it has not been used. Normally the helicopter company will arrange this as it has direct consequences to the companies operations and risk management. I know of no helicopter company that would put third party fuel into its aircraft as water contamination is the single most common cause of engine failure.

What safety equipment does the helicopter come with? (GPS/Comms)

This is really important. If you are flying over water, generally you need a twin engine helicopter, or the skids need flotation devices or both. If going remote – is the helicopter fitted with a satellite phone? Also, if going remote – is the helicopter fitted with a GPS tracker? Who is tracking it? And have you fed all that information into your PRA and accident plan? Check that the helicopter company providing life jackets, survival suits, life raft, emergency rations and water.

Am I allowed to land near the location and wait on standby? If so, can I shut engines down?

It is worth asking the relevant landowner/government body/national park administration whether they are happy for you to land your helicopter if you are using it off base. Some helicopter companies will not allow you to turn your engines off when waiting on standby away from base, whilst sitting on a tidal area, an active glacier, on fast sea Ice or the side of an active volcano for fear of them not starting up again. If this is a requirement then the company will often require backup in the form of a spare battery. Check this with your helicopter supplier. The last thing you need is a rescue situation because your helicopter starts to sink through the ice or the tide starts

to come in. The pilot should never shut down in a dangerous area unless they know the helicopter and crew are not at risk.

Am I allowed to store fuel at the location?

Your helicopter operator will know the rules and regulations about where fuel can be stored and any environmental precautions that need to be taken. These can change country by country and area by area so these need to be checked on a project by project basis.

What are the overnight conditions where I am planning to store the helicopter (if I am transferring away from base)? Is there a power supply if it's cold?

Obviously this can be planned from the start and if working in extreme hot or cold this is a major factor in having a successful shoot. A warm or air-conditioned hanger may be required.
If working out in the bush then its necessary to protect the helicopter from unwanted visitors. This can come in the form of elephants to bears and everything in-between. The only way to do this is to post security, also electric fences can come in handy. It sounds extreme, but bears will try to break into helicopters if they're in the vicinity and food has been left inside, and dogs will regularly pee on the camera if it's left unattended.

How much time do I plan to spend flying over water?

It's Air Law that once past a certain distance from land that a twin engine helicopter is used and it should have certain safety equipment on board depending on the sea temperature.

Again this is very important from safety planning. BBC Health and Safety, as well as most helicopter companies, will insist you have a twin-engined helicopter for long periods of time over water, and both may insist you wear survival suits, and carry a life raft.

It is also a good idea to see if you can arrange "dunker" training for any team members that are going to be in the air over water – it has proven to increase the survival rate of those involved in incidents where helicopters ditch into water. Normally it is run in simulator pools around the UK. Don't go cheap on this – it is worth it. Some helicopters do also come equipped with floatation devices attached to the skids which are controlled by the pilot in an emergency, and are an alternative if only planning quick transfers across water.

What safety documents do I need ?

All the documents required are described in the Departmental Generic risk assessment. Also see BBC Safety Guidelines for aerial filming.

Does the helicopter have the requisite modifications? Would they be OK for you to modify it for the mount ?

It's doubtful that a helicopter company will allow you to start making holes in the belly panel of its brand new 3.5 million euro helicopter when you arrive. So its worth asking the question at an early stage in the procedure. If the company has done aerial filming before its quite likely they have already fitted a mount to their helicopter. For those A350/355 helicopters that have not been modified a belly panel can be supplied by your mount provider.

Again here, this may seem like a daunting amount of questions to be asking, but if you talk everything through thoroughly with your Aerial DOP and helicopter company, you'll be able to find a solution.

What is the power source configuration in the helicopter?

Helicopters work on a 28v DC power scheme. Most helicopters will have a spare 28V 20 Amp power output. Your Camera Operator will be trained in the correct use and polarity requirements for the system used. Sometimes it is necessary to power from the aircraft battery and this must be done with a Power Shed Box and the relevant STC.

Is the helicopter available for half a day for rigging and a possible test flight before filming?

It will take you at least half a day to rig and do a test flight with an operator/system combination that haven't worked together before. Make sure you have budgeted for this this and included it in your scheduling. It would be best if you do fit in a test flight, as this will solve any problems in advance of filming. With experienced helicopter suppliers and operators this time may come down. Bear in mind that if you haven't paid a daily minimum and you are planning to use the helicopter on consecutive days, you may be expected to de-rig the camera system at the end of every filming flight. This is best avoided as it can be incredibly time consuming and inconvenient depending on where you're landing every day.

What helicopter is best for the job?

There is no hard and fast rules on this one. In general I would always try and use ether an Airbus AS350 or AS 355 as these have been proved in the past to be the best helicopters for aerial filming.

All the two bladed helicopters can have vibration issues if they are not well maintained and have a regular track and balance on the rotor disk. It's normal to have the rotor disk tuned to be at the lowest vibration levels at maximum cruse for the comfort of passengers, however most filming is done at much lower speeds. Best practice is to track and balance for 60 Knots if the helicopter company is willing to do this.

The AS350/355 have a better power to weight ratio and are more manoeuvrable. These helicopters also have an inside open cockpit arrangement which helps both in communication between the crew and have better all round visibility for the camera operator. They may cost more but the percentage of usable shots per hour of flying dramatically increases.

Some helicopters are essential for certain scenarios, for instance at high altitude flying in the mountains only the AS350 B2 or B3 should even be considered.

As discussed about, long flights over water require by air law to be undertaken by twin engined helicopters. Similarly night flights with an equipped helicopter and qualified pilots also come with restrictions. In Europe it is also a requirement that the helicopter has stabilisation (auto pilot) for night flying and IFR tasks.

In general, the more power to weight ratio, the better the shots and the less flying hours to achieve them. Often using a cheap underpowered helicopter like the Jet Ranger or the Robinson R44 does not save money and can actually end up costing more.

However in certain locations only a Robinson R44, R66 or a Bell 206 Jet Ranger are available and it's necessary to plan accordingly and manage expectations. In these circumstances, the correct choice of pilot, mount and the availability of fuel on location are essential to a successful shoot.

On these occasions, you'll be able to choose two of the three of the below chart, as the limitations of the aircraft won't allow for all three at the same time.

Fuel/Endurance	People/Equipment including Floats and Roll Equipment	Aircraft Performance / Manoeuvrability

Even with the most powerful helicopters this still applies.

You just get more fuel or less of one of the other two. It's a formula for Aerial Filming that works every time. It's really Important when the task is to film a number of locations on a round-robin trip. Again talk to the company and ask about limitations. The company should be able to suggest solutions eg a fuel bowser to limit transition times or particular weather conditions- calm air early morning shooting. Generally we work with Pilot, Aerial Camera Operator and Director in the aircraft.

NOTAMs (Notice to Airmen)

NOTAMS are issued by the FAA/CAA/EASA organisations to inform about changes to airports, airways, and local procedures that affect safety (whether to the crew or those on the ground). Normally these are posted well in advance, so have your helicopter company check these to see that the two days you want to film does not coincide with the presidential visit. It happens!

Some animals like whales are protected by the Marine Mammals Act and it is not legally permissible to fly lower than 1000 ft over them in US waters. In Australian waters this restriction can be up to 1500 ft. If you are caught breaking these rules it's the helicopter company that is prosecuted but almost certainly the BBC that's named.

Choice of Pilot

The Pilot must be in possession of a Commercial Pilot Licence or ATPL (Air Transport Pilots Licence) for a two pilot operation a valid medical and ratings for any special flight clearances i.e. Instrument rating for IFR flights.

Pilot should have a commercial licence, ideally with 1500 hrs or more, flying experience and it is also advisable that the pilot has at least 500 hrs on the type being flown.

In general we try to use known pilots with filming experience and a proven track record in safety.
If your pilot has no film experience it is best, if given the choice, to work with a pilot who has experience in long line load lifting work or other tasks that involve using the helicopter in an aerial work category like fire fighting or rescue.

On occasions it's advisable to take an experienced pilot along for the duration of the job because the pilot has no experience or speaks no english. This is especially important when the flying can be challenging or dangerous.

There are a number of freelance pilots who can undertake this kind of work and a few that will source a helicopter in the location of choice.

Pilots who fly passenger trips from A to B rarely take to aerial filming, but there can be exceptions. Some pilots love filming as a change to charter and get involved in the whole project and become an effective member of the crew, others hate the hanging around, so pick your pilot with care.

Age is not always an indication of experience, I've known low time pilots in their 50's who only started flying as professionals after a successful career in some other line of work. The pilot should speak English, normally this is the case because English is the language used by all Air Traffic Control all over the world. Sometimes the pilot simply does not speak English. If this becomes a issue you should use a translator and possibly have them in the air with you.

Can the helicopter company assign us the same pilot for the duration of our filming period?
What are the pilot's duty hours and how will it effect the shoot?

It's quite simple really. The rules on duty hours for helicopter pilots are there to protect the passengers/crew flying in a filming helicopter from a pilot who makes a fatal mistake at a crucial moment because they are tired or fatigued.

Depending on what rules you are working with whether it's Public Transport, Aerial Work or Special Operations or FAA part 91. Duty hours for helicopter pilots differ but it is worth noting this from the start and factoring in rest time for your pilot if you are intent on filming dawn and dusk for seven straight days. Its common sense that you not want to get to a point of having an exhausted pilot and crew.

It is more efficient for filming to maintain the same operational team throughout as things like communication and operational procedure, as well as filming techniques, will become more honed the more the same team flies together. Therefore, you want to avoid changing pilots whilst working if possible.

Choice of System

Your Aerial Camera Operator /DOP will have a favourite system and may even have their own. You may have access to an in house system or there maybe a system attached to a helicopter company in the country of choice. Some systems have unique attributes.

There are now a number of excellent stabilised camera mounts in the market, capable of shooting 4K and above. The main players are Shotover, GSS/Cineflex and Pictorvision.
Some are large like the Shotover K1 and the Pictorvision Eclipse, designed for Multi-camera, 65mm and 3D.

Some are medium sized like the Shotover F1,GSS 520 the GSS516, Cineflex Elite, Ultra and Pictorvision Eclipse Mini.

The smaller systems are the GSS 512, Shotover M1, Shotover G1 and Cineflex V14 (modified).

All mounts have their pro's and cons which are outlined on pages 27-33 …

All mounts are fitted onto the helicopter using an FAA/EASA/CAA approved mounting bracket or on occasions, with certain helicopters, attached to a UniMount which is strapped to the floor of the helicopter and is classified as an internal load. The downside to this is that you fly with the doors open, which restrict the speed and range of the helicopter and you have a limited angle to shoot from.

Overview of Mounting Bracket

This is the bracket that attaches the system to the helicopter. It is the piece of equipment that is certified by the relevant FAA/EASA engineering departments and goes through a rigorous testing procedure before being certified as fit to fly.

Each time it is attached and removed from the helicopter it has to be signed for by either an engineer or a pilot with the authority to do so. This is a legal requirement and is entered into the flight log.

It's worth noting that some countries will insist on their own CAA department rubber stamping an FAA or EASA STC approval. Canada and Kenya both do this. Check these details with the helicopter company.

In general we fit the mount at the helicopter base, it makes life easy for everyone and insures that the rigging is snag free and that the engineers are happy with the work.

On occasion we fit on location. Its always worth checking that this is ok and that the pilot has authority to sign for the mount or if an engineer is required to be on location to sign for the installation. If the engineer is required to be on location then this is normally at an extra cost .

Some helicopter companies will insist that an engineer comes with the helicopter if it is to operate away from base. It can often be company policy in their operations manual and become part of the companies insurance. Don't be surprised if this happens, but its worth asking the question early on to be able to plan for this eventuality.

The mount brackets themselves carry a log book and paperwork which have to be kept up to date and inspected periodically by an approved aircraft maintenance organisation. Sometimes a form

One is required to indicate that the bracket has been inspected . Please ask the supplier if this is available to be inserted in the paperwork pack.

It is advisable to ask if the helicopter is on High Skids and does it have the modifications necessary for the installation of the mount chosen. A hole cut in the belly panel of a AS350 is a common one, and sometimes it is required to bring a belly panel for a 350/355 fit if the helicopter has not been modified. Another common modification that can cause problems if if the helicopter has been fitted with a Wire Strike Kit. This will normally have to be removed.

All of the Air Films mounts are non system specific and work on Payload Weight and Forward surface area. Some of the large systems like the Shotover K1 and the Pictorvision Eclipse only work with the Air Films double pole mount and only with the AS350/355 series and the Bell 212/412 side bracket. Talk with the helicopter mount company about the power supply. Sometimes it is necessary to connect directly to the aircraft battery, this however will require a power shed and requires its own Aircraft Mod STC.

Centre of Gravity Calculations

Once the mount is installed the pilot or engineer will do a **Centre of Gravity Calculation**. This ensures that the helicopter will never get to the point, where the helicopter cannot be controlled by the pilot because it becomes out of balance. The calculation takes the form of a graph with indicates the balance of the machine at both full and low fuel states. A worst case scenario is that this calculation is wrong and the helicopter becomes nose heavy and is impossible to land safely.

Some helicopters like the Bell 206 may require a tail weight to make the C of G work. If this is not available weight will be added to the boot of the helicopter and this may exceed the all up take off weight of the helicopter, with the crew.

You have two choices here:
a) Leave the director behind or
b) Take most of the fuel out of the helicopter which will reduce the amount of time you have in the air

C of G calculations are necessary to avoid an out of C of G situation in the helicopter which can be very dangerous. This normally will only occur with the Jet Ranger Bell 206, Robinson R44 and R66 and is another good reason to use an AS 350.

The Carnet

Most if not all systems can be taken as excess baggage. This cuts down on the number of days you will be charged for the kit hire so its quite a popular way of moving equipment .The rules are simple each box must weigh no more than 32KG. Most systems can be packed down to 8-10 peli-cases.

Either an ATA carnet or a shipping list is employed to take or ship equipment, depending on the country to be visited. Be aware that you may need more than one country on the carnet if you intend to cross boarders. There is a cost involved and you should add this to your budget.

Shipping The Kit

Sometimes you have to ship all or part of the kit. Some equipment like the UNIMOUNT weighs 45 KG and can only be shipped.

Involve BBC shipping at a very early stage about the hows and whys of getting the equipment to location.
How long will shipment and clearance take?
Again, involve BBC shipping and an agent at the other end – you don't want your team and helicopter waiting for your kit as it will costs you lots! In some countries, such as the USA, you need a special clearing agent to export the system from the USA (if registered in the USA).

Please arrange a **Van** to meet you at the airport, its just not possible to get all this equipment in a hire car. I've tried! If the equipment is shipped get the shipper to deliver to the helicopter company.

Choice of Format/ Camera Settings on the RED

Please refer to the BBC Red Dragon Setup Guide

RED DRAGON SET UP GUIDE 17-5-2016 _ FINAL.pdf
from Colin Jackson (BBC)

https://www.dropbox.com/s/hgbm7k0r3rl80to/RED%20DRAGON%20%20SET%20UP%20GUIDE%2017-5-2016%20_%20FINAL.pdf?dl=0

Types Of Aerial Filming Operations

Mountain Flying

Mountain flying requires some very special skills from a pilot and the first consideration must always be the choice of helicopter. There are only a few aircraft capable of high altitude flying namely the AS350 B3 and the Lama. Camera mounts are readily available for the AS 350 B3 but not so for the Lama. The B3 holds an unofficial altitude record of 40,000 ft and is the only helicopter that has landed on top of Mount Everest.

High winds and weather in the mountains can change rapidly and the best time to be shooting is early in the morning before the sun's effect starts to create weather patterns and high speed winds (Katabatic) that make flying particularly dangerous. Be aware that when your pilot says its time to go, they are feeling the effect of turbulence on the helicopter through the controls. Wind speed can increase dramatically in a very short space of time.

It's really important to fly with a pilot that has both altitude and mountain training as well as a local knowledge of the area that you are filming in. Cloud bases can descend very rapidly and the last thing you want is to spend several nights in a survival situation, trapped in the mountains. Make sure the helicopter is carrying enough survival equipment, food and water for this eventuality. It's also a good idea to carry a satellite phone.

Remember because of the nature of going from low level to altitudes above 12,000 ft oxygen is normally required, because there is no time for acclimatisation. Hypoxia is a real danger and can cause severe problems at altitude. Ask the pilot about the availability of oxygen on any flight above 12,000 ft. Some helicopters are limited to a maximum altitude that they can land at in ground effect, so be aware that you may have to descend to wipe the lens.

Be especially aware of "White Out" or 'Grey Out" conditions where a pilot can loose control of the helicopter at the moment of landing, when all visibility is lost due to the rotor wash on loose snow or dust.

The unwritten rule is get up there get the sequence shot and get down as soon as possible. Especially at altitudes above 12,000 ft.

Over Water Flying

This all depends on how far from the coast you will be flying, how cold the sea/water temperature is and what helicopter is available to you. In a single engined helicopter it is advisable to only fly as far out to sea, so that in the event of the engine failing, it is possible to auto-rotate back to dry land.

It's still advisable to wear life jackets. Some helicopters may have floatation equipment for extended water crossings . These are pop out floats that are initiated by the pilot in the event of a forced landing at sea (Ditching). In general these are used in conjunction with a life raft and life jackets. You will be in radio contact with an air traffic control or base and will advise on leaving the coast and arriving at the other side. In sea temperatures bellow 14 deg C an immersion suit is required to be worn, this can extend your life expectancy from a few minutes to a few hours.

For extended periods of shooting over water it is a legal requirement to use a twin engined machine with pop out floats, life jackets, dingy and Immersion suits. Be aware that not all twin engined helicopters are capable of flying away from the hover on one engine. Some are designed

to fly in the cruise on a single engine but what happens that there is just not enough power to get you back to the cruise from the hover, where Invariably you will be filming. In pilot parlance " the second engine just takes you to the scene of the crash" a few helicopters however do have single engine hover performance . Notably the AS 355 N, As355 NP, Agusta 109 Power, EC 135 and EC145/117. If you are a long way out, filming a boat in rough seas, these are the ones to go for. In addition they would all be IFR machines capable of flying in rough weather.

City Flying

Most over city filming has to be done with a twin engined helicopter. There are exceptions to this. For instance where a city has a river in the middle or it can be proven that at a certain altitude and speed a single engined helicopter can fly away from the built up area. Quite often a city is covered by an air traffic control zone and special permission has to be obtained before a flight takes place. Some city areas have sensitive areas of government and military, its not unusual to have to carry a security person on board to insure that you are not filming anything you shouldn't. This is common practice in the Middle East.

Wilderness Flying

Fuel and the ability to get to it is the main factor here along with being prepared with enough water food and shelter in the event of a forced landing. Quite often the only way to get fuel to a remote location is to fly it in, either with another helicopter or a fixed wing. For instance in most of Africa a Cessna Caravan is an ideal companion to a helicopter shoot in the wilderness. If you intend to camp for a while, then this is a major factor from both a logistic and security point of view and should be taken into budgetary considerations.

Air to Air

Air to air filming requires some special skills both from the two pilots involved and the Aerial camera operator. The first thing to do is to sit down and make a plan with both the pilots involved , the camera operator and director. So that everyone involved in the flight knows exactly what will happen. The flight direction for the light, the angles required, the proximity of the other helicopter/aircraft, along with this the radio frequencies that will be required both to talk with each other, the ground team if required and air traffic. All parties must be happy with the moves being made. Plan the sortie with meticulous precision, because it can be very hard to change things once you are locked into the flight. Your pilots will be working very hard to maintain formation and this can lead to mistakes. The golden rule is ***"Never get unsighted with each other***" Its a strange phenomenon, that two aircraft in the same airspace will inadvertently close on each other when neither can see the other aircraft. There are a few exceptions to this I will sometimes get shots when we the other aircraft to formate on the filming helicopter but this takes a great deal of trust between a team that have a long history of working together. Trust in good pilots and experience really count when doing close formation Air-Air. If you get it wrong it can be very unforgiving very fast. If things are just not working its always best to land and re-brief. This'll save you time and resource in the long run.

Hot and Cold

Sometimes it is necessary to operate in extremes of hot or cold. The worst operating environment for a helicopter is to be Hot and High as density altitude increases with temperature and this may limit the performance of the aircraft. In extremes of cold in certain conditions, the helicopter may suffer from icing. The pilot will be aware of these conditions and advise accordingly when a flight becomes risky or unwise. It is advisable to keep the helicopter and system warm at night to avoid

problems in freezing temperatures. Helicopter and camera batteries especially suffer from the effects of extreme cold and it is advisable to have an alternative battery for the first start of the morning. In extreme heat its a good idea to have reflective covers for both the system and the windows of the helicopter to stop the cabin over heating whilst standing by. In these conditions make sure the crew have the correct clothing for the conditions as well as water and food

First Rig and Test

There are a few things I would recommend doing:

- Test all the equipment on the ground including system, recorder, monitors and camera settings.
- This can be done using a ground power unit and is an essential piece of kit with your system. either run this from the mains in the hanger or use a 1-2kv Generator on location. If using an original cineflex V14 it is still advisable to do a check pictures with the helicopter running. The Sony 1500 camera model had an issue where you could get noise in the blacks in low light situations It's a good idea to put all the ND on the camera and shut down the iris, this will give you a good idea if you have noise in the blacks. If noise is present it is worth trying to earth the auxiliary box to the aircraft with an earthing strap, or run the system from 30 V batteries if available.
- Sit down with the pilot and operator with a map and discuss where and what you hope to film – this will help you develop a priority list for what you can afford in time and money. Have some video clips at hand to show the pilot and operator examples of moves and shots you are hoping to get – this will help you make sure everyone is on the same page in terms of language/ description of shots.
- Get the operator and pilot to talk about the ideal positioning of the helicopter relative to the camera and subject, as well as speeds for filming, and the light required for the scene.
- If you are using ground teams to help you find your subject/the action, test your comms with them and make sure they are included in the plans for the filming day.
- Quite often a text message is the best way to make contact with the crew on the ground. If no signal is available then Sat Phones do the trick. VHF Ground to air radios only work over a limited range and normally Line of Sight.
- Make sure you have the right lens for the job. If shooting landscapes an 18-80 wide angle is best. If shooting animal behaviour the a 50-1000 canon is a good idea. Also make sure you are running at the best camera speeds. It is useful to use a model of a helicopter to help animate a conversation around the type of move you are trying to achieve, especially when speaking to pilots whose first language isn't English!

Notes on Directing Aerial shoots

Plan Everything

A successful aerial shoot is achieved in the planning stage. It's about making the right choices of crew, equipment and helicopter at an early stage in pre-production. A good producer will also have a plan "B" "C"and "D" for when the weather turns or the animals don't show up. Having a good idea of what to expect is essential but at the same time being flexible is the key.

The Best Aerial Directors know their stuff

From a cameraman's point of view the best aerial directors come armed with a good knowledge of both the locations they wish to film. The time of day they want to film in to match a pre existing sequence and the GPS co-ordinates of the location to be filmed. This allows the pilot and aerial camera operator to make a plan of these locations and work out fuel stops . When filming animal behaviour, the director should have a good idea of what to expect. For instance how many time a whale will fluke before it dives . If searching for certain behaviour it maybe more cost effective to use a spotter plane and call the helicopter in for the shoot. We have done this very successfully when waiting for brown bears to come out of the den, for the first time with the new cubs.

Slow it all down

The rule of thumb here is to spend at least 15 minutes on each location. Don't rush it take the time to find the best angles and light and think in terms of the shot having a beginning middle and end. Shots should run for at least 30 seconds. It's best to start with a master wide and then develop the sequence with cutaways. I've done this with narwal and created a complete storytelling sequence from the air. If you are working with an inexperienced crew then get the helicopter down to 50 knots and watch for strobing, especially on longer lenses and on vertical shots.. The rule here is three seconds top to bottom or 5 seconds side to side. Get your aerial camera operator to hold the shot on animal behaviour for at least 10 seconds after you think its all over. From experience you never know.

The best aerial directors know when they have the shot

Don't over shoot a sequence. Work out before hand what you need to make it all come together in the edit. Do storyboards and have shot lists because in the air you are literally burning money by the minute. Be clear in the direction you wish to take and the style of your film on the ground. With examples of how you want it to look.

Don't scare the animals

Shots of animals galloping across the open plains, clearly being chased by a helicopter are clearly not a good idea. They should be avoided at all costs on moral grounds. It is however possible to film migratory pattens from a distance without effecting the natural behaviour of the animal. The rule here is to look for any behaviour that indicates that the animal its not happy with your presence. Elephants will flap there ears and trumpet at you if you invade their space for too long, they will also try to hide the calves in a group. Back off or try to approach from a different angle up wind and only start filming once the animals settle down into a normal behaviour. Sometimes its necessary to put time into the animal. I have achieved some spectacular footage of hunting Cheetah just by spending time gradually getting closer to them over a number of days.

Wind

It's best not to let the wind direction dictate the angle of the perfectly lit shot. I find that once you start to compromise the frame for any reason you end up with mediocre rushes. At this point of the game the shot should be designed for maximum story telling. This is why we like using the AS 350 it does not suffer from too much wind interference. However on occasions when the wind is

particularly strong or the helicopter is underpowered then it is an option to get the pilot to fly into the direction of the wind, this will improve performance and give you a smooth useable shot.

Nose mounted

Most modern systems now operate from a nose mounted bracket which gives the system a field of view of at least 200 degrees from the centre line of the helicopter. This Improves to 360 degrees at a 45 degree down angle. So getting the skids in frame is only an issue when at low level. A good pilot aerial camera team will work together to insure that the skids never inadvertently come into frame by sensing the edge of frame for a given lens angle. This comes with experience however most modern system have an overlay function on the monitor that will tell you the angle of the system relative to the nose of the helicopter for both direction and elevation.. It's worth checking the angles where the skids come into shot on the wide and make a note of the numbers.

We tend to work of the clock numbers when communicating in the helicopter ie 12 o'clock is the nose and 6 o'clock is the tail. In addition we may give a distance or angle to pinpoint a point of interest. ie 2 o'clock low 400 meters. Or reference to a land mark 2 o'clock low, just below the big tree works. Pointing and "Over There" doesn't work. A good Director looks for what is outside the frame and can give good advice on what is about to happen, as the Aerial Camera Operator is often focused on the monitor and can be somewhat blind to the wider scene. If you see a shot you like, try to come back to it in a controlled manner. Quite often the helicopter is at a high speed the altitude is too high and you end up with a snatched shot that does not have either the framing or the length require in the film.

Use your monitor

You will have a monitor, so when you are rolling use it! Try and get a hood which will allow you to shut out everything else that is going on around you and concentrate on the shot. The monitor will also allow you to assess composition/focus/exposure as well as speed.

Watch that horizon

As a director you should make sure that your horizon is level at all time as this can ruin a perfectly good shot. Most modern systems like the **GSS** and **Shotove**r will have an auto horizon function . This is accurate down to .001 degrees on both systems. Use it for the big vistas but be aware that in the mountains quite often the horizon will look out although the shot is perfectly level. Have the overlay on your monitor on and have the camera operator show you what numbers to look for. When shooting POV shots for instance its more natural to have the horizon lock to the angle of bank on the camera ship. This cuts well with an air-air closeup of the other aircraft.

Watch out for the Rotor Disk

Especially when using a wide angle lens. The Rotor Disk moves in all directions relative to the body of the aircraft, which is where your camera is attached. Therefore when pointing forward try to get the pilot to avoid large control inputs, this will bring the disk into shot. Similarly when banking hard into a side on shot, ask the pilot to perform a flat turn.

The Endless Zoom

When constructing a shot, the best looking shots use a combination of camera movement and helicopter movement. Using either on its own looks a bit awkward. An example may be if you are tracking the helicopter past a large emergent tree, panning the camera around a fixed point on the tree will give you a lovely rotate around the tree rather than a simple track past. The combination of slow zoom and helicopter pull away can be a very effective move to get to a cuttable wide. Start the zoom first.

Go back to basics

Just because you are in the air doesn't mean that your shots are going to be magic in the edit – you need to make sure you change shot size, let animals leave and enter frame, give due coverage to the other players in the scene (don't just film your lions from the air, film your wildebeest/tommies/ zebra too). Work in thirds and always lead the moving subject in the frame.

Angles

The best angles for aerial filming are either low to the ground with a shallow angle using the horizon and/or foreground, and a 90 degree looking straight down on your subject. Some mounts like the Shotover F1 and M1 have a 6th axis of stabilisation that make vertical shots much easier to perform. The GSS systems have Vector Steering for the 90 degree angle. What doesn't tend to work is a 45 degree angle in the hover as it looks like you are on a very high tripod and there won't be enough depth of field behind your subject to give a sense of movement and scale.

Parallax

Try and get the helicopter low against the horizon on a long lens to include some foreground/ background in the shot as this will give you "parallax", which makes an aerial shot come alive. Be especially careful of the shutter angle and speed of movement as going too fast around the subject will create strobing in the background. Like filming on the ground it is also useful to have something wiping frame in the foreground as an editing point and /or to reveal your subject.

Forward tracking reveals and zoom in/pull outs

It can be nice to tilt up from looking directly down to reveal a landscape/subject whilst the helicopter is moving in a forward direction and also pulling out from/zoom into a subject to reveal the landscape around it. In fact, they are often the shots that people remember most, which is why aerial directors often ask for them – but they often form a disproportionate amount of the rushes. Remember, they are killer beginning/ending shots for a sequence, but it is often hard to edit them into a middle of sequence so there is no use doing lots of them! When you do make sure the shot is special enough to warrant the time to do them. Think about the light, the movement of both helicopter and camera and try to have the shot have a beginning middle and end.

Get a sense of scale

Gyro stabilised aerials are one of the best forms of cinematography for knocking people's socks of with a sense of scale. Be constantly thinking of how you might convey this. Getting the helicopter to crane up above a subject to reveal the horizon, or a slow zoom in/out from a subject are favoured methods, but don't forget a simple tracking wide shot if you can still see your subject. It is also one of the few places in wildlife film making where sticking people/another helicopter/plane/car in a landscape is acceptable as it gives the viewer a frame of reference. Avoid power lines and roads unless this is part of the story.

Lighting From The Air (God Is My Gaffer}

Some systems now shoot clean having no glass in front of the lens making back lit shots a real possibility. Flare can also work with the shoot clean systems. If you are shooting with a system that has glass in front of the lens, be aware of having annoying flares in the shot that wobble to the uni-stabilised frequency of the system housing. This can be expensive to remove in post. Some systems have a rotating polar screen that can be controlled by the operator . This can be invaluable when shooting marine animals or for controlling sparkle in a back-lit master wide.

Keep an eye out for helicopter shadow and rotor wash

Try to avoid the helicopter's shadow. Unless its for a 'making of shot', which can be quite effective to portray speed or time in the sequence. The shadow will be harder to avoid at midday but in

general if you work in the 3/4 back light it is avoidable. Try to rehearse a shot that has a choreographed move, so the pilot and camera operator can adjust for the shadow getting in the shot. It takes up a little time but is well worth it.

Downloading and viewing

If you can I think it is very important to view the rushes every evening after filming and include the pilot and the operator in this so you can learn lessons for the following day. An Atomos Ninja Inferno recorder is very useful tool for looking at instant rushes. It records not only the scene but also all the camera settings, enabling you to make an instant decision on a shot.

Set aside time to download and backup, this may take a couple of hours every night. On multi-camera shoots its advisable to have a highly trained DIT to do this for all cameras.

You must make sure that the power source that you are running your drive and laptop from is a constant one – if it cuts out halfway through download you will have to start again, and files maybe corrupted. Make sure you have more cards than you need and more backup drives.

Budgeting Overview

This will undoubtedly be the single biggest cost on your production, so make sure you look at it early on to decide what you can afford. Remember, you want to maximise your time in the air, but don't use that as an excuse to cut corners in the set up or safety. A smaller, cheaper helicopter is not going to make your shoot more successful – just more dangerous and less successful.

	Per Hour	Per Day	Per Job	
Aerial Camera Operator DOP Daily				
Helicopter Filming				
Helicopter Transit				
Helicopter Standby				Normally a standby rate or daily minimum apply but not both
Helicopter Daily Minimum				
Fuel Costs/ Bowser or Drums				If Required
Pilot Daily				If required some Helicopter companies include this in the hourly rate. A named pilot often charges a daily rate
Engineer Daily				If Required
System Technician				If Required
Permissions CAA FAA Local				Ask
Permits in Park areas				Ask
Landing Fees				Ask
System Hire Cineflex/GSS/ Shotover				
Camera /Lens Hire				If required some Systems com with camera an lens supplied.
Carnet				Shipping Costs
Media				Have more than enough cards for your shoot.

	Per Hour	Per Day	Per Job	
Rain Spinner/ Extras Hire				
Pole Mount Hire/ Helicopter bracket Hire				
Radio/Coms hire				Helicopter companies often supply
T&D's				
Backup Drives				Have more than you need
Safety equipment				Helicopter companies often supply but not always
Insurance				Make sure you have Hired in Camera equipment insurance or expect this as an additional cost

Helicopter and Mount Compatibility

Helicopter types and uses						
	Crew	Range	Max Speed knts	No of Engines	Mount Compatibility Single Pole	Mount Compatibility Twin pole
Robinson R44	2	300NM	106	1 Piston	GSS 512, 516 Cineflex Ultra Shotover M1	None
Robinson R66	3	350NM	110	1 Jet	GSS 512, 516 Cineflex Ultra Shotover M1	None
Bell 206 Jet Ranger	3	374 NM	110	1 Jet	Cineflex Ultra Shotover M1	None
Bell 206 LongRanger	3	340 NM	130	1 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	None
Bell 407	3	297NM	140	1 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	None
AS 350 BA	3	350NM	140	1 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	GSS 512, 516,520, Shotover F1,M1 K1 Eclipse +Mini
AS 350 B2	4	350NM	140	1 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	GSS 512, 516,520, Shotover F1,M1 K1 Eclipse +Mini
AS350 B3	4	350NM	140	1 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	GSS 512, 516,520, Shotover F1,M1,K1 Eclipse +Mini
AS 355 F2	3	340 NM	130	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	GSS 512, 516,520, Shotover F1,M1,K1 Eclipse +Mini
AS355 N	4	350NM	140	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	GSS 512, 516,520, Shotover F1,M1,K1 Eclipse +Mini
Hughes 500	3					
EC 135 H135	6	342NM	137	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	None
EC145 /BK117	6	274NM	133	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	None
MBB BO105	3	300NM	110	2 Jet	GSS 516	None
Agusta 109 Power	4	385NM	150	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini	None
Mi8	6	596NM	140	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini With Unimount	None
Mi17	6	494NM	135	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini With Unimount	None
Mi2	4	300NM	106	2 Jet	GSS 512, 516,520, Shotover F1,M1, Eclipse mini With Unimount	None

Systems in Common Use

Find below an overview of the best aerial systems currently in use with a short overview of their positive and negative aspects.

GSS 512 Cinema Mini

The Cinema Mini is a small and light professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

Small and Light
5 Axis of stabilisation. Plus Vector Steering for vertical shots
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Gimbal weight 16 Kg + Payload
Sealed system for Air/ground/marine work
Operational temp -20-50+ Deg C
Typical setup Sony 1500 P1,P43 and 42 x Fuginon
Will take Red and 30-300 canon
Will work on fixed wing
No ITAR

Minus Points

Shoots through glass, so watch for flares.
No rain Spinner
No Rotating Pola

GSS 516 Cinema Pro

The Cinema Pro is a medium weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

Good Look Down with no gimbal lock
5 Axis of stabilisation. . Plus Vector Steering for vertical shots
Breaks down into 32kg cases for excess baggage.
Gimbal weight 28 Kg + Payload
Shoots Clean or sealed
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 25-250 Angenieux
DP 30-300 Canon
Or 50-1000 Canon
Will work on fixed wing
No ITAR

Minus Points

No rain Spinner
No Rotating Pola

GSS Cinema Pro + (GSS 520)

The Cinema Pro + is a Medium weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

5 Axis of stabilisation.. Plus Vector Steering for vertical shots
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Gimbal weight 39 Kg + Payload
Sealed system for Air/ground/marine work
Can shoot Clean
Open Platform will take Angenieux 12-1
Will take 65mm Arri
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 25-250 Angenieux DP
Or 50-1000 Canon
No ITAR

Minus Points

No rain Spinner
No Rotating Pola

Shotover M1
New releases at NAB 2018

The Shotover M1 is a small and light professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

Small and Light
Many Lens camera combinations
6 Axis of stabilisation.
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Gimbal weight 18.9 Kg + Payload
Sealed system for Air/ground/marine work.
Can shoot clean.
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 30-300 Canon
Or SonyP43 and 45x canon for 2/3 4K
Will work on fixed wing
No ITAR

Minus Points

To small for a 50-1000

Shotover F1

The Shotover F1 is a Medium weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

Very adaptable.
Rock Solid stabilisation
6 Axis of stabilisation.
Best Look down and control in pan
Breaks down into 32kg cases for excess baggage.
Gimbal weight 35 Kg + Payload
Sealed system for Air/ground/marine work
Can Shoot Clean
Rain Spinner
Rotating Pola
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 25-250 Angenieux DP
Or 50-1000 Canon
Will work on fixed wing
No ITAR

F1 Rush version is for high speed operations 350 knots 5 G on a jet

Minus Points

Takes time to change lenses

Shotover G1

The Shotover G1 is a small and light professional grade Gyro-stabilised system capable of stabilising wide to medium length lenses

Plus Points

Small and Light
4 Axis of stabilisation.
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Gimbal weight 5.7 Kg + Payload
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 18-80 Alura
Microlights etc For a slow stabilised nose mount feel. Limited to 60 KNTs
No ITAR

Minus Points

Open to the elements

Shotover K1

The Shotover K1 Heavy weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

Any Lens or Camera inc 65mm
Hydra 6 Camera setup for VFX
6 Axis of stabilisation.
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Gimbal weight 80 Kg with Payload
Sealed system for Air/ground/marine work
Can shoot Clean
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 25-250 Angenieux DP
Or 50-1000 Canon or 12-1 Angenieux
No ITAR
Rain Spinner
Rotating Pola
Brilliant for special projects. Including Hydra 3D and IMAX

Minus Points

Heavy
Takes time to build
Technician required

Cineflex Elite

The Cineflex Elite is a medium weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses . The first Cineflex to incorporate a Red

Plus Points

Small and Light
5 Axis of stabilisation.
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage. Just
Gimbal weight 20 Kg + Payload
Sealed system for Air/ground/marine work
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 30-300 Canon
Will work on fixed wing
No ITAR

Minus Points

Shoots through glass
No rain Spinner
No Rotating Pola
Can be slow to operate

Cineflex Ultra

The Cineflex Ultra is a medium weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

5 Axis of stabilisation.
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Gimbal weight 20Kg + Payload
Sealed system for Air/ground/marine work
Can shoot Clean
Operational temp -20-50+ Deg C
Typical setup Red Weapon and 25-250 Angenieux DP
Or 50-1000 Canon
Will work on fixed wing
No ITAR

Minus Points

No rain Spinner
No Rotating Pola

Cineflex V14 HD

Some 4K Broadcast 2/3 Chip conversions available.

The Cineflex V14 is a small and light professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

Small and Light
5 Axis of stabilisation.
Fast setup time Quick payload / Lens swap.
Breaks down into 32kg cases for excess baggage.
Gimbal weight 16 Kg + Payload
Sealed system for Air/ground/marine work
Operational temp -20-50+ Deg C
Typical Setup Sony 2500 camera 9.7x42 Fuginon lens
Some move towards after-market installation of the Sony P43 and 45x Canon
Will go HDC P43 for 4k 2/3 broadcast
Will work on fixed wing

Minus Points

Shoots through glass
No rain Spinner
No Rotating Pola
Still noise in the blacks
ITAR restricted
Mostly HD
All units are getting old

Pictorvision Eclipse

The Pictorvision Eclipse V14 is a Heavy Weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

6 Axis of stabilisation.
Gimbal weight 90 Kg + Payload
Operational temp -20-50+ Deg C
Typical Setup Any Camera and Lens inc Hydra 6 Camera for VFX
No ITAR
Rain Spinner
Rotating Pola
Brilliant for special projects. Including Hydra 3D and IMAX

Minus Points

Heavy
Technician Required
Operator Required
Only 3 in the world
Backup

Pictorvision Eclipse Mini

The Pictorvision Eclipse Mini is a Medium weight professional grade Gyro-stabilised system capable of stabilising long focal length lenses .

Plus Points

6 Axis of stabilisation.
Fast setup time , Quick payload swap. Breaks down into 32kg cases for excess baggage.
Can Shoot Clean
Gimbal weight 34Kg + Payload
Operational temp -40-71+ Deg C
Typical Setup Red Weapon and 12-1 Angenieux
No ITAR

Minus Points

No rain Spinner
No Rotating Pola
Very Specialist
Technician Required
Operator Required
Backup

Dyna X5

The Dyna X5 is a light weight professional grade Gyro-stabilised system capable of stabilising medium focal length lenses .

Plus Points

Small and Light
5 Axis of stabilisation.
Fast setup time Quick payload / Lens swap.
Breaks down into 32kg cases for excess baggage.
Gimbal weight 16 Kg + Payload
Sealed system for Air/ground/marine work
Operational temp -20-50+ Deg C
Typical Setup Sony 2500 camera 9.7x42 Fuginon lens
Red and wide zoom
Some move towards after-market installation of the Sony P43 and 45x Canon
Will go HDC P43 for 4k 2/3 broadcast
Will work on fixed wing

Minus Points

No long lens capability
Controls are a bit clunky
Shoots through glass
Roll is the worst of all systems
Some drift issues

Helicopters & a short overview of their capabilities

Please find below a summary of different helicopters which might be available to you. As with the systems, it's always best to make sure the aerial DOP and Helicopter company have a full brief in regards to your individual project so that they can help you make an informed decision as to which helicopter will be best for your unique shoot.

HELICOPTERS	
Airbus AS 350 BA (Astar USA) Equirrel (Squirrel) Single engined helicopter found in most countries. This is the most common helicopter for filming. It can accommodate all the modern mounts and has an open cockpit layout which makes communication simple in most languages. Seats Pilot plus Cameraman plus Director very comfortably and has a 3 Hour endurance.	
Airbus AS350 B2/B3, B3 + Same cockpit layout as the BA but with a more powerful engine. When filming in mountains or at high altitude this is the only helicopter worth considering. Remember above 12000 ft crew should be flying with oxygen to avoid Hypoxia. We've used this type of helicopter successfully in the Alps, Andes, Rockies, Himalayas, Rewenzories, Mount Kenya, Mount Kilimanjaro, Rift Valley and the Ethiopian Highlands.	
Airbus AS 355F2 Twin engined variant of the 350 this version is required for over city and over water operations. Some F2's have IFR capability and can fly at night. Limited single engine performance.	

Airbus AS 355 N/NP

A more powerful version of the 355 f2 The N has more powerful engines and unlike the F2 can hover on one engine. Normally fitted with the equipment to fly IFR this machine can fly in most weathers and at night. Its the ultimate over water machine.

Airbus AS H130

Essentially this is an AS 350 B3 with extra cabin space and a fenestron tail rotor.

The Airfilms mount is new to this helicopter for recent use but it has been working successfully with a bespoke mount for a number of years in Australia.

Airbus EC 120

This is the baby brother of the Airbus series it is a little underpowered but will seat Cameraman Director and Pilot with a good payload of fuel. Best used at low altitudes because of the limited power.

MD500

Small with ample power this little rocket ship is a very usable camera platform. A five bladed rotor dis makes this a stable platform. Its fast and very manoeuvrable.

Pilot plus Operator in the front and Director in the back. Be aware there is very little room in the back and it will be uncomfortable after a few hours flying.

Turns normal steady helicopter pilots into cowboys.Each helicopter should come with a set of spurs.
Mounts for this type are quite rare.

Bell (Agusta) 206 L Variant 3 and 4

Larger Brother of the 206 Jet Ranger. Two Blades Bigger engine a usable film platform if well maintained and rotor disk tracked and balanced. The long Ranger has a system to stop vibration called Nodal Dampening. This can be problematic in extreme cold weather.
AFG1 mount

Bell (Agusta) 206

Small three usable seat helicopter. Two blades. The Jet Ranger has limited appeal for film work as its often running out of power down wind .
AFG1 mount

Bell 407

Same as the Long Ranger but with four blades. Quite a powerful helicopter up to 10000 ft
AFG1 Mount

EC 135

Commonly used as a police or Utility helicopter The EC 135 is a medium sized helicopter that is quite expensive and so not normally used for film work.

EC145 BK117

Commonly used as a police or Utility helicopter
The BK 117 is a medium sized helicopter that is quite expensive and so not normally used for film work.

Bell 212.412 205 (Hughey)

Large Bell utility helicopter all have two blades except the 412 which has four blades.

Known for the noise . You can hear these coming from about five miles away.

It has a limited ground clearance for many systems. Please check this .

Works with the UNIMOUNT as well as nose mount.

Robinson R44
Robinson light training helicopter.
Normally used as an alternative to a Jet ranger 206 the R44 is a piston powered 3 seater helicopter with a limited range and altitude performance.

Robinson R66
Turbine powered version of the R44. Not readily available in the UK. Limited mounts available .

Agusta 109 C
Twin engined and fast. The 109 c can be a good camera-ship. Some what limited in the UK to only one company. Some restrictions on the type of System at the moment only good for the Cineflex V14 series. Ultra and Elite

Agusta 109 Power
Twin Engined and fast the 109 power Somewhat limited in the UK to only one company. Some restrictions on the type of System at the moment only good for the Cineflex V14 series. Ultra and Elite also Shotover F1 possible

MBB BO 105
Due to its rotor design ie fixe rotor head the BO105 has inherent vibration issues and is the shakiest of all the helicopters. Use with caution and be prepared to test. Some mount options available for the V14 and GSS

Mi2
Russian/Polish designed helicopter with limited mount options. Normally used with the UNMOUNT

Mi 8 Very large Russian utility helicopter with limited mount options. Normally used with the UNMOUNT	
Mi17 Very large Russian utility helicopter with limited mount options. Very powerful with good altitude performance Normally used with the UNMOUNT	
Aircraft	
Piper Super Cub **2 seater** Probably the best spotter aircraft in the Buisness. Cheap and can land and takeoff in a very short distance .	

Cessna 208 (Caravan)

Mount works from the wing so only good for Air-Air or traveling shots. Great for moving a crew with lots of baggage space . Short take off and landing for bush airfields.

Cessna 172
Good aircraft for spoting.

Cesna 206
Mount works from the wing so only good for Air-Air or traveling shots good spotter aircraft

Helicopter Safety

The following list is a brief overview of general safety guidelines for working around the aircraft. If you are uncertain about any safety requirements, ask the pilot or flight crew for an additional safety briefing.

- Always approach the helicopter from the front within the pilot's vision.
- Only approach after the pilot has acknowledged your presence and waves you forward.
- Walk - don't run, towards the aircraft.
- Always move towards the aircraft in a crouched position even if the blades are turning slowly.
- Never walk behind the aircraft or near the tail rotor or tail boom.
- Do not throw any object towards or away from the aircraft.
- Do not wear caps or hats that can blow off while walking near the aircraft. Do not lay loose clothing on the ground.
- Unless authorised specifically by the pilot in command, remain 100 feet away from any parked aircraft.
- No smoking in or around the aircraft or near fuel storage areas.
- Carry equipment parallel to the ground to avoid a rotor strike.
- Watch any take-off or landing from a safe distance of 300 feet or more. The down wash of the rotor blades can turn loose gravel into projectiles.
- If anything looks out of place or unusual, or you see unauthorised persons near the aircraft, immediately notify the pilot or flight crew.
- If you are in the aircraft, do not open the door or depart the aircraft unless you have verbal consent from the pilot. Helicopters typically have a three minute engine cool down period after landing. Be patient. Remember to always walk forward so the pilot can see you.
- Work as a team. Do not rush. Think through every move.

Use the following guide as instructions of how to act when approaching or leaving a helicopter, and always follow the pilots guidance if in any doubt.

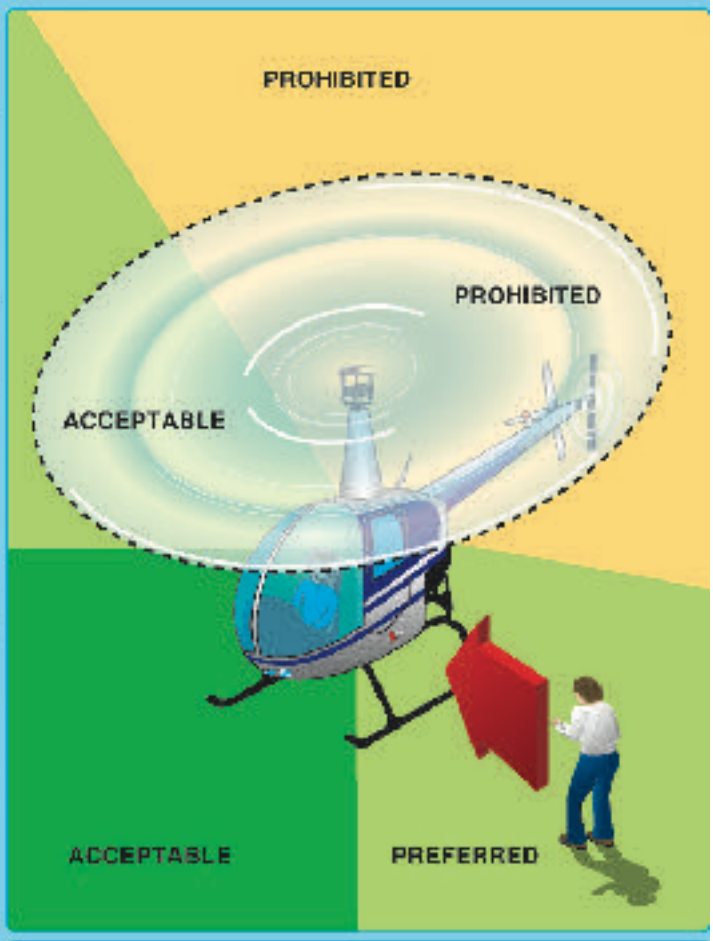
SAFETY AROUND HELICOPTERS

Approaching or Leaving a Helicopter

Do not approach or leave without the pilot's visual acknowledgment. Keep in pilot's field of vision **at all times. Observe helicopter safety zones** (see diagram at right).

On sloping ground, always approach or leave on the downslope side for maximum rotor clearance.

If blinded by swirling dust or grit, **STOP**. Crouch lower, or sit down and await assistance.



If disembarking while helicopter is at the hover, get out and off in a smooth unhurried manner.

Proceed in a crouching manner for extra rotor clearance. Hold onto hat unless chin straps are used. **NEVER reach up or chase after a hat or other articles that blow away.**

Do not approach or leave a helicopter when the engine and rotors are running down or starting up.

Carry tools, etc., horizontally below waist level—never upright or on the shoulder.

What can go wrong in a helicopter

We rarely experience error within a helicopter, but it's best to be aware of possible problems. If you are in any doubt, discuss these further with your helicopter pilot.

Pilot Error
Pilot error refers to any action or decision – or lack of proper action – made by a pilot that plays a role in an accident. This may include a simple mistake, a lapse in judgment or failure to exercise due diligence. There are two types of pilot error, according to Aviation Safety Magazine: tactical errors, which are related to a pilot's poor actions or decisions, often caused by fatigue, inebriation or lack of experience; and operational errors, related to problems with flight instruction and training. In fact, pilot error is the leading cause of commercial accidents, with close to 80% percent of accidents caused by pilot error. The other 20% are mainly due to faulty equipment and unsafe, weather-related flying conditions. This is why pilots have duty hours.

Engine Failure
Engine failure is thankfully a rare event, but pilots will train for this eventuality. The procedure is known as auto rotation. The helicopter will descend, (sometimes quite rapidly) towards the ground before the pilot will perform a flare to use up the kinetic energy in the rotor disk for a controlled landing.There is a caveat to this in that if you are too slow or two low or a combination of both you can end up in a situation where is difficult to carry out a successful auto rotation. This is referred to as the Avoid Curve and experienced pilots will want to minimise the time spent in this area. An engine failure over water in a single engined helicopter will result in the helicopter ditching. Make sure you are well briefed on the emergency door release, seat belt release and the correct use of the life jacket. This is where a "Dunker" course is invaluable.

Loss Of Tail Rotor
In the event of the loss of the tail rotor a pilot will normally perform either a full auto rotation or carry out a run on landing, depending on the flight configuration at the time. Tail rotors are normally lost due to bird strikes or in some cases mechanical failure. A pilot friend lost the tail rotor because the back baggage compartment wasn't secure and his puffer jacket fell out and wrapped around it just above Ben Nevis. So it can happen. Pilots train for this eventuality.

L.T.E
(Loss of Tail Rotor Effectiveness) is an aerodynamic situation where the aircraft experiences an un-commanded yaw and the tail rotor thrust at that particular time isn't sufficient to stop it. The way a tail rotor works is that it draws air from one side, accelerates it and pushes it out the other side generating thrust. When you push on the power pedal (the pedal you use to counteract torque. Left in US machines, right in clockwise rotating aircraft), more pitch will be put on the blades and a greater amount of thrust will be generated. The tail rotor generates thrust in much the same way the main rotor does. LTE is not a mythical beast that comes out of nowhere and grabs the unsuspecting pilot. The simple fact is that LTE is completely pilot induced. It happens when flying at low speeds, downwind, Certain helicopters seem to be more susceptible than others but at the end of the day, the burden of responsibility lays not with tail rotor design or wind but with the soft squishy thing located in the command seat.
A lighter load and still air reduce the risk of this happening. If needed a particular shot may want to wait for correct conditions.
So what can I do if I'm only directing the shoot and not flying the helicopter? First off, get an Aerial Camera Operator and Pilot who are experienced in aerial filming – it is a different discipline to passenger A-B flying. Also check that they are aware of LTE, especially in countries where their aviation authority may be less well informed and regulated than in the West.– discuss your required shots with the Pilot and Camera Operator marking up proposed flight paths / sequences on maps or diagrams and note on it the wind direction and speed – most of all, avoid any

situation which will have you flying downwind, especially in a Jet Ranger that is overloaded, at low altitudes.

Vortex Ring State

Conditions conducive to settling with power are a vertical or nearly vertical descent of at least 300 feet per minute and low forward airspeed. The rotor system must also be using some of the available engine power (from 20 to 100 percent) with insufficient power available to retard the sink rate. These conditions occur during approaches with a tailwind or during formation approaches when some aircraft are flying in turbulence from other aircraft.

Under the conditions described above, the helicopter may descend at a high rate which exceeds the normal downward induced flow rate of the inner blade sections. As a result, the airflow of the inner blade sections is upward relative to the disk. This produces a secondary vortex ring in addition to the normal tip vortex system. The secondary vortex ring is generated about the point on the blade where airflow changes from up to down. The result is an unsteady turbulent flow over a large area of the disk which causes loss of rotor efficiency even though power is still supplied from the engine.

Power settling is an unstable condition. If allowed to continue, the sink rate will reach sufficient proportions for the flow to be entirely up through the rotor system. If continued, the rate of descent will reach extremely high rates. Recovery may be initiated during the early stages of power settling by putting on a large amount of excess power. During the early stages of power settling, the large amount of excess power may be sufficient to overcome the up-flow near the centre of the rotor. If the sink rate reaches a higher rate, power will not be available to break this up-flow, and thus alter the vortex ring state of flow.
Normal tendency is for pilots to recover from a descent by application of collective pitch and power. If insufficient power is available for recovery, this action may aggravate power settling resulting in more turbulence and a higher rate of descent. Recovery can be accomplished by lowering collective pitch and increasing forward speed. Both of these methods of recovery require altitude to be successful. It's also possible to slip sideways a new method being taught. The Vuichard Recovery Technique

In general speed and height are safest in a helicopter. Aerial filming is often low and slow and needs to be carefully considered. Experienced professional pilots with well-maintained appropriate helicopters are the best safety solution.

When pilots and operators say no to a proposal– this isn't to be considered a challenge, they have said no for a good reason. If you have picked a good helicopter operator, trust them and ask for a solution to achieve what you want.

To see what happens in Vortex Ring State:

https://www.youtube.com/watch?v=HjeRSDsy-nE

Appendix 1.1 Glossary of aviation abbreviations in common use

FAA	Federal Aviation Authority USA
EASA	European Aviation Safety Authority
CAA	Civil Aviation Authority UK
FAA part 91	FAA Aerial Filming Category
SPO	Special Operations Category
AOC	Air Operators Certificate
C of A	Certificate of Airworthiness
STC	Supplementary Type Certificate
ITAR	International Traffic In Arms Regulations
EAR	Export Administrations regulations USA
NOTAM	Notice to Airmen. Used as a temporary restriction