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PRODUCTION SAFETY

*Industry-Standard Techniques
for Creating a Safer Set*



EMMY-WINNING DIRECTOR

Jason J. Tomaric



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Lighting Equipment Safety

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Introduction

In this chapter, we will discuss hazards you will encounter when using, or working around, lighting equipment, how to organize the lighting equipment, and properly secure lights and grip stands. We'll touch on special safety issues associated with HMI lights, cords and cables, and using lighting equipment on location. We'll end with some guidelines concerning lifting heavy items on set.

Section I: Keeping Lighting Equipment Neat and Organized

One of the best ways to avoid accidents on set is to keep the set neat and organized. Organization isn't just a matter of appearance; but creates a more efficient and far safer environment than one that is allowed to devolve. This isn't necessarily an easy task though – rushed schedules, reduced manpower and the constant pressure to work faster means the crew has to forcefully assert order to combat entropy.

When working with lighting equipment, here are some simple procedures to help keep your set organized:

- Always create and maintain an organized staging area, that is a designated space, for lighting equipment
- Always arrange the gear so there are isles through the staging area to get to every piece of equipment without having to move anything or climb over anything
- Always set up lights on stands in rows, with all the standard accessories: place the barn doors on the light, hang the scrim bag on the stand, and neatly hang the wrapped power cable on the knuckle of the stand – All lights and stands should be ready to be brought to set on a moments notice. Much like light stands, C-stands should also be complete (stand, gobo head and arm), and can be nested together.
- Once a lighting setup is finished, bring unneeded lights back to the staging area, complete with all their accessories, and put them back into neat rows



- Always store extension cords coiled and tied, and organized in crates or by some other method that assures they can be located and grabbed easily when needed
- Always remove and coil any unused extensions as soon as they are no longer in use – If they are likely to be used again right away, you can coil them and position them next to the power outlet where they will be handy. Otherwise return the stingers to the staging area. This will save you time later.

A cluttered set is an unsafe set. Always organize your lights and stands so they are out of the way, yet easily-accessible.

- Always pick up pieces of diffusion, clothes pins, black wrap and other expendables that may get dropped on the floor, so people don't accidentally slip on them

Securing Light Stands

Lights are very often raised up on stands to heights above head level. If not properly secured, stands can fall over and strike cast and crew, causing physical damage to equipment and facilities, causing head and body injuries and even burns or cuts from hot lights and broken glass. Follow these guidelines to properly secure light stands:

- **Always place a sand bag on the leg of the stand** – This ballast lowers the light's center of gravity and makes it much harder to destabilize the stand. Tall light stands can place a light 10 or 12 feet in the air and require two or more sand bags. The heavier the light on the stand, the bigger the sand bags used. A general rule of thumb – add one sandbag for every stage a stand is extended. Sand bags are available in sizes from 5 lbs. up to 35 lbs, so choose an appropriate bag for the weight of the light, the size of the stand, and the environment in which you're shooting.
- **Whenever you set-up a light, there will usually be some unused length of cord** – The proper place for this cord is coiled at the bottom of the stand so that the cord will play out easily when a lighting technician moves the light. Slack cable should not be

left at the electrical socket or where it is liable to get kicked, tangled and strewn around the set.

- **Never allow a "clothes-line cable," that stretches at a diagonal instead of dropping to the ground beneath the light** – A clothesline cable is an accident waiting to happen. Someone will not see the cable; they will walk into it, and yank the light down. If the cord is not long enough, employ an extension, even if you only need another foot of cord.

John Gresch

Vice President, ARRI Inc.'s Lighting Division

Most people's safety concerns on set involve not hurting a person or themselves should a light stand fall over with a light on it. In addition to bodily harm, we're also concerned about hurting the equipment, which can incur a major cost for replacement or repair. Many of these lights are extremely expensive—between \$5,000 and \$40,000 for one light. So any damage caused, especially if a unit would fall, could be very expensive to repair.





Always properly secure lights, overheads, and other rigs - especially when shooting outside.

- Always secure barn doors to the light with safety chain in the event it comes off its brackets
- Stands with wheels must be immobilized when in use – If the rolling stands has wheel locks, at least two of the wheels should be locked. Locking just one wheel still allows the stand to pivot. If the rolling stand has no locks then immobilize the stand with the proper number of sandbags for the height of the stand, the weight of the light and the environmental conditions.

Potential Hazards Associated with Lighting Equipment

One of the easiest ways to prevent an accident is prevention, and that begins with what you wear.

Protecting your Hands

When handling lighting equipment, it is highly advisable to wear work gloves. Gloves protect your hands from dirt and grime, cuts, pinches and (most of all) burns. They make it possible to grab a hot light with your hands to adjust it. Work gloves should be leather or another material that will not melt or burn, and will protect your hands from the extreme heat.

Now, work gloves are not intended to provide protection from electric shock. When the gloves become saturated with moisture or sweat, an electric current can still pass through the gloves into your body. To prevent a risk of shock, qualified electricians and lighting technicians who meter an electrical circuit, are required by code to wear special voltage-rated gloves. Of course, this is not something you'll be needing to do unless you are working with a large scale portable power distribution system as a qualified lighting technician. Regardless of the type of gloves you are wearing, never



touch an exposed, energized electric part, for example, never open a light to change a burnt-out lamp while it is still plugged into power.

When working with hot lights, use these simple guidelines to protect yourself from burns:

- **Always wear gloves; preferably long enough to protect wrists**
- **Always use needle nose pliers, not your fingers, to remove scrims from hot lights** – If you don't have needle nose pliers, you can take a clothespin, which is commonly used to attach colored gels and diffusion to lights, and reverse it so that the pointed ends can pinch the scrims.

Pinches

- **A heavy light (like a 5k or 10k) can pinch your hands or fingers between sections of the stand if you let it come down too quickly** – Be sure your hands are clear of the bottom of the section casting on the stand and always use two people to lower heavy lights.

Electrical Shock

- **To prevent an electrical shock, always unplug lights before opening up the light**
- **Always keep your fingers away from the blades of the plug or pins on connectors when plugging and unplugging them**

- **Always inspect equipment before you use it** – Never use equipment that shows damage, excessive wear, or where bare wires are showing.

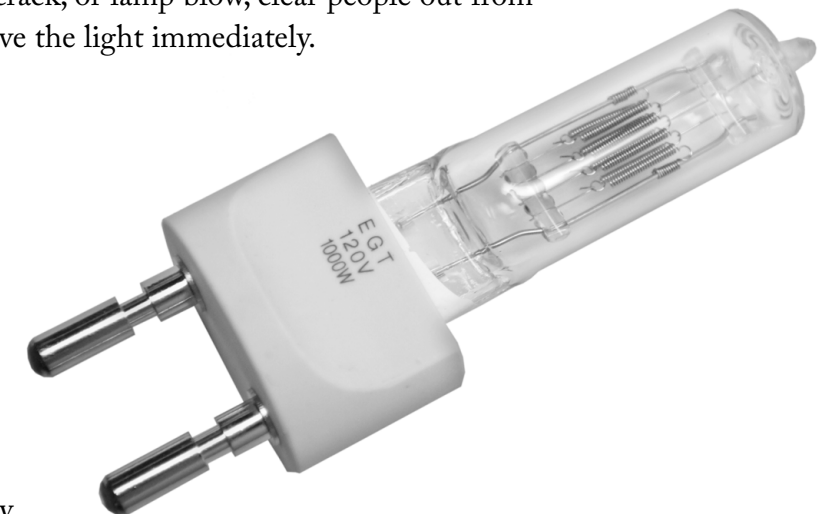
Lens or Lamp Breakage

Fresnel and ellipsoidal light fixtures have high-temperature glass lenses that provide more control over shaping the light. These lenses can break if subjected to physical abuse, or shock cooling.

- **Always protect hot lights from water spray** – Spray, carried by the wind, landing on the glass will cause high temperature differential that will crack the glass. Gels and diffusion can be used to protect the glass from spray, mist, or drizzle.
- **Both Fresnel and open face lights are required to have wire mesh safety screens to prevent lens glass from falling out of the light in the event that the lamp or lens shatters** – Be sure all lights are fitted with a safety screen. A cracked lens can break into pieces small enough to fall through the wire mesh. If you hear a lens crack, or lamp blow, clear people out from under it, and remove the light immediately.

Replacing the Lamp

Lamps will sometimes blow out on a set, requiring you to replace the lamp. Never touch the surface of a quartz glass lamp with your fingers, or with dirty



gloves. If you touch the lamp, the oily smudge from your fingers will heat the glass excessively when the light is turned on, causing the glass envelope to bubble. This greatly shortens the life of the lamp, and may cause it to fail structurally. Always hold the lamp with a soft clean lint free material. The lamp usually comes wrapped in a scrap of foam that will serve this purpose.

Lamps will sometimes fail with a sudden bang like a firecracker. This never fails to put actors' nerves on end. If the quartz lamp breaks and bits of hot glass are able to fall down out of the light this could pose a hazard. If this happens, clear people away from the light quickly and make sure that the quartz does not melt holes in the set, floor or other set dressing. Wait for it to cool and clean up the sharp glass before continuing.

Melting Stuff and Setting Things on Fire

- **Lights should not be placed so close to walls, ceilings or any combustible material that the heat could melt or burn the surrounding surfaces** – Remember 70% of the energy used by a tungsten light is radiated as heat, 30% as light. So tungsten lights are actually more efficient heaters than lights. A hot light will bubble the paint off the wall if placed too close to the surface. A flag set too close can start to smolder. A bounce card may melt, and eventually catch fire. Placing your bare hand in the beam will tell you very quickly what is “too close” to the light.
- **Certain lights have very intense beams capable of creating significant heat close to the light** – Open face lights, PAR-64 lights (such as PAR cans or Molepars), large lights “spotted in” are all capable of setting fire to materials placed too close to the light.

- **A hot scrim pulled out of a light will melt carpet or fabric, and scorch wood** – Never set the scrim down indiscriminately, rather, place hot scrims in the scrim bag between two other scrims to help protect the bag.
- **When you're finished with a light, or upon wrap at the end of the day, always shut off the lights first to allow them to cool before taking them off stands, and placing them in cases.**

HMI Safety

HMIs, or Metal Halide Arc lights, as they are more correctly known, are highly efficient daylight colored lights that are available in many forms: most commonly Fresnel, open-faced, and Par configurations. They serve a valuable function in our lighting arsenal. However, there are a couple of important safety issues unique to HMIs that you must be aware of when using them.

UV Protection

Direct light from an HMI lamp puts out a large amount of ultra violet radiation (UV), enough to give you a very bad sunburn in just a few minutes. Looking directly at a burning HMI lamp can cause retinal burns. To protect us from UV exposure, HMI fixtures feature a built-in UV filter that is carefully designed to prevent dangerous amounts of UV from escaping from the housing. To ensure HMIs only operate with this UV filter in place, a shut down mechanism prevents the light from working if the lens door is open. The lens removes a great deal of the UV from the beam, enough to make it completely safe at normal operating distances. However the

following guidelines must always be followed to prevent damaging UV exposure.

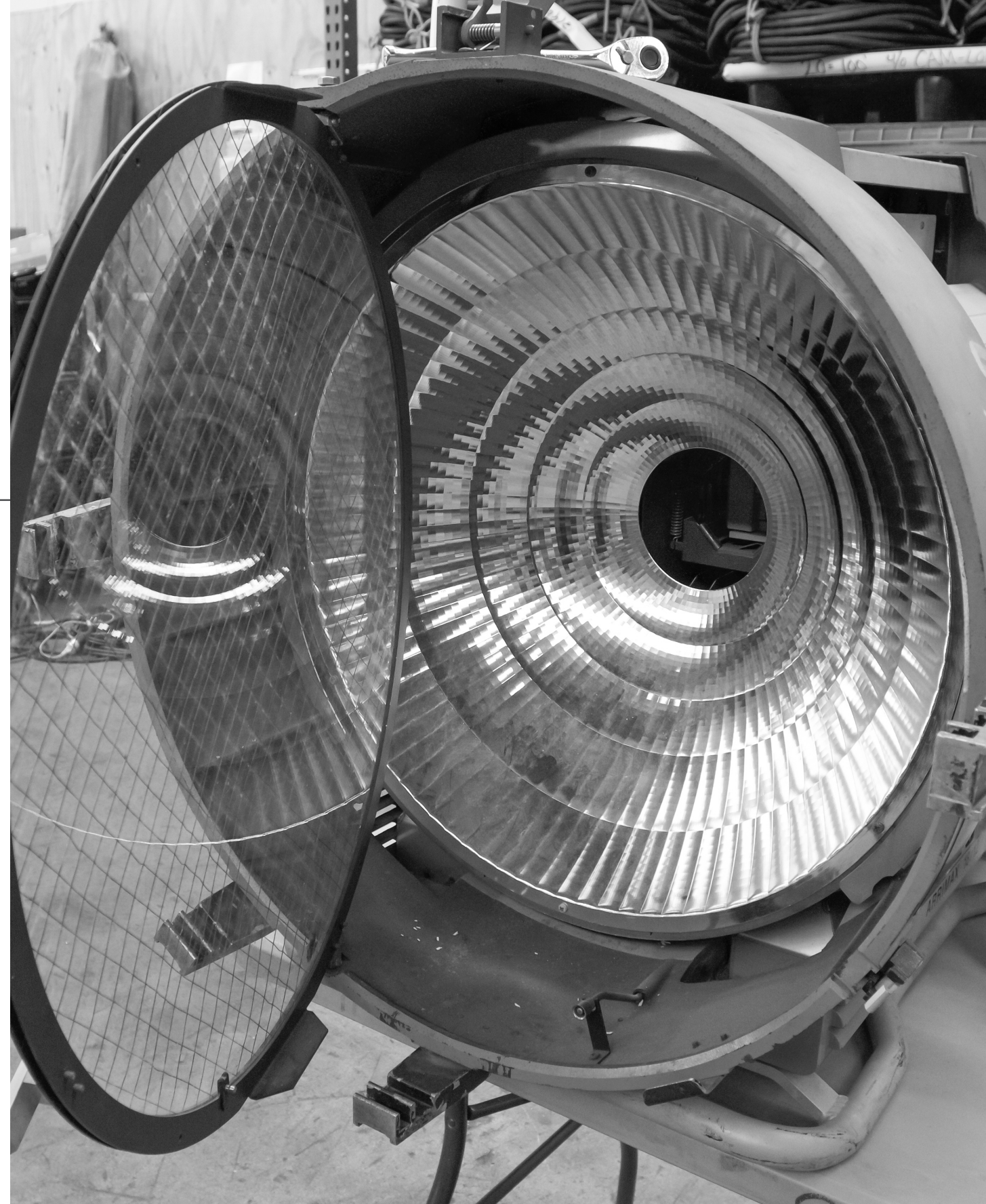
- **Never attempt to defeat the UV protection switch in the lens door**
- **Never use an HMI if the housing gets damaged or bent –** The housing is designed to prevent direct light from escaping. Direct light can cause serious skin and eye damage.

John Gresch

Vice President, ARRI Inc.'s Lighting Division



Professional equipment will say if it has any user serviceable parts. Most production equipment should be serviced by a professional technician, whether at the rental house level or the manufacturer's level. There's very little that a crew member on set could or should actually work on themselves. If you have a question, please contact the rental house or the manufacturer to determine whether the repair is something you can do on set or if it needs to be returned to the rental house or the manufacturer.



- **Always check the warnings on the side of the fixture before setting the light close to your subject** – For example, people who require very high lumen intensity when shooting high speed photography are apt to put lights too close. The subject can receive a damaging dose of UV over an extended period of time. Consult the manufacturer's literature regarding the time/distance equation for the lights you are using.

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Most HMI's will state on the light fixture itself the minimum distance between the fixture and a person, in all directions—front, back, and top, before you should have concerns of UV exposure. [This minimum distance] is rated for eight hours of exposure to the light. If you're going to be closer to the equipment than what the actual rating is on the fixture, you can apply the inverse square law to determine how long you can be in front of that fixture and not be overexposed.

Lamp Care

One component in HMI lamps is mercury, a dangerous, toxic metal. To prevent Mercury contamination, always return burnt out lamps to the studio facility or rental house for proper disposal. If a lamp breaks, always use gloves during clean up, then wash hands thoroughly. Follow the lamp manufacturers instructions that come with the lamp. You should also know that, fluorescent lamps also contain mercury, so the same handling and clean-up procedures apply.

Power Supplies

Most newer HMI power supplies use electronic ballasts to control and regulate the power sent to the fixture. These electronics include large capacitors that hold a charge for several minutes after the power supply is de-energized. Never attempt to open up a power supply or you risk an electric shock.

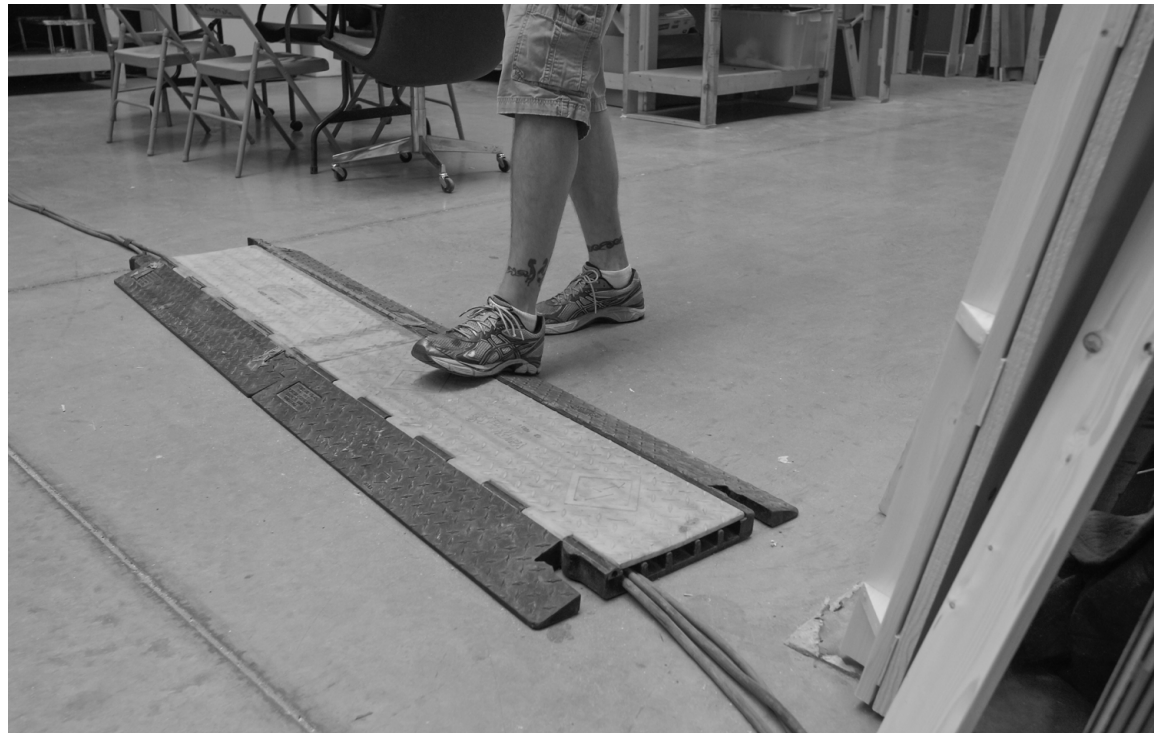
Cords and Cables

Always inspect cords and cables for damage, or signs of overheating connectors before use. If the connector shows parts that are black or brown, malformed or melted, discontinue use and return the equipment for service by a qualified person.

Electrical power cords and cables should be run in such a way that protects the cords from damage, and prevents trip hazards.

- Where a number of cords or cables cross a fire lane, or walkway, always use a ramp, rubber mat or cable crossover to protect the cable and reduce the risk of tripping
- If using a mat, always use gaffers tape to tape down the edges to prevent a trip hazard
- When running cables across a floor, always use gaffers tape to tape the cables down in high-traffic areas such as in a doorway, where they present particular risk of a person tripping or rolling their foot on the cable – This is especially true if actors need to cross over a cable during a scene, where they are focused on their performance and not the cable beneath them. When taping down cables, always use wide gaffers tape to completely cover the cord.

Always use cable crossovers to protect cables and people from trip hazards.



- When you're ready to pull up the cable, always pull the tape up first, then the cable – If you try to pull them up both together, the tape will stick to itself and cost you a lot of time trying to tear the tape off.

Lighting Equipment On Location

Working on location has its own set of hazards, making safety awareness even more important. When shooting on location, always follow these safety guidelines:

- **Protect cables from damage from foot traffic, vehicles, carts and equipment** – Use cable crossovers to span walkways.
- **If water is present, or may become present, the circuits must be protected by GFCI** – See the chapter on Electrical Safety for more information.
- **Never place hot lights directly under fire suppression sprinkler heads** – Fire suppression sprinkler heads are designed to spray water when the head reaches a preset temperature, which would normally indicate a fire. A hot burning light right under the head will trigger the head. The trigger, once released, is not resettable. So, if triggered, the water will continue to spray the room until someone can come and shut off the system, in fact, it will continue for some time after the main valve is closed. Obviously this would be a disaster.
- **Never obstruct or cover the sprinkler heads**
- **Always inspect the location during the location scout for potential exposed live electrical hazards**



Be aware of sprinkler heads and position lights a safe distance from them.

- Always provide at least a 3-ft. clearance in all directions around electrical panels – In the event of a fire, fire fighters need to get to electrical boxes to shut off power.
- Never tie in to the an electrical panel to use house power unless the work is performed by a licensed electrician with a proper permit – Tie-ins are illegal in many states, including California. An electrical panel encloses exposed live parts; one mistake can cause electrocution.



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When on location, one should be aware of how they are setting lighting equipment on the ground. It's generally not a good practice to set equipment on the ground unless it has feet or wheels, or has been designed to offset the moisture or heat of the ground. Therefore many crew members will actually place ballasts on top of an apple box, or otherwise elevate pieces of equipment to create circulation around it to help with the heat flow or the cooling. Many times the crew will set a flag or other covering to shade the ballast from direct sun. The heat fins of the ballast, that are designed to remove the heat of the inner electronics, also work in reverse. If you increase the heat outside the ballast, the fins will transmit that heat inside the fixture or ballast to the electronics.

- **If you are working with lights that require more than 15 amps, and make the decision to use the existing outlets in the building, make a thorough evaluation of the circuit layout –** First, locate all the circuit breakers. Second, patch the lights to separate circuits in order to prevent overload. Keep in mind hair dryers and other power-hungry appliances may be in use by other departments. Third, do not share circuits with computer or sound equipment (tripping the breaker could do serious harm to a computer hard drive or digital recording device).
- **Most importantly, never leave hot lights unattended –** Light fixtures are portable heaters, generating so much heat that something unexpected may bring a combustible material close to the light and start a fire. A breeze through an open window blows a curtain onto a light, and ignites a fire, or the light topples over and sets a bed on fire. Always have enough crew around so that lights are not left burning unsupervised.
- **Finally, turn off lights when not in use during meal breaks, when people are not present**



Learn more about lighting equipment and techniques with the following modules:

- Attributes of Light
- Tungsten Lighting
- HMI Lighting
- Low Budget Lighting Tools
- How to Build a Light Kit
- Reducing Light
- Softening Light
- Shaping Light
- Color Temperatures
- Lighting a Scene
- Lighting Outside
- Working with Mixed Light
- Lighting People
- Key Light Techniques
- Advanced Lighting Techniques

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Rigging Safety

Introduction

“Rigging” refers to the task of attaching grip and lighting hardware to a wide variety of structures for the purpose of lighting a set, or rigging support for a camera. Lighting equipment can be rigged to walls, ceilings, dropped ceilings, beams, set walls, suspended on rope, or hung on pipe or truss. Any time equipment is rigged overhead there is a risk that the equipment could fall by accident during the process of being put up or taken down. There is also a risk that attachments may come loose while in use, and fall. In either case, there is potential for serious injury or death, if someone is struck by a falling piece of heavy rigging or lighting equipment.

In this chapter, we are going to cover proper safety practices when rigging lighting and camera equipment.

The Fundamentals of Rigging Safely

No rigging should be undertaken unless it can be done in a way that protects people from danger. For a rig to be safe it must have the following five elements:

1. **Sufficient underlying structure** – The structure that is taking the weight of the equipment must be appropriate for the task and have sufficient residual strength to take the load.
2. **Appropriate hardware** – The rigging hardware used must be appropriate for the structure to which it is to be attached, and have sufficient strength for the load.
3. **Mechanically locking attachments** – The attachment points must rely on mechanical interlocking to prevent the parts from slipping apart or loosening. A rig that relies on friction alone is the least favorable option. Rigs relying solely on friction should be used only for lightweight loads that are not subject to forces, such as vibration or shaking in the wind, which could loosen the attachment.
4. **Resistance to forces** – Forces such as leverage, the angle or gravity working on the rig, torsion, shock loading, shear, vibrations, wind and other stresses on the materials used for the rig must be taken into account. The rig should be designed to minimize unnecessary stresses that could cause failure.
5. **Safety cable** – Any time any piece of equipment is rigged above someone's head it must be provided with "safety cable", a second form of attachment, usually chain, steel wire rope (aircraft cable), or nylon webbing, that will prevent the

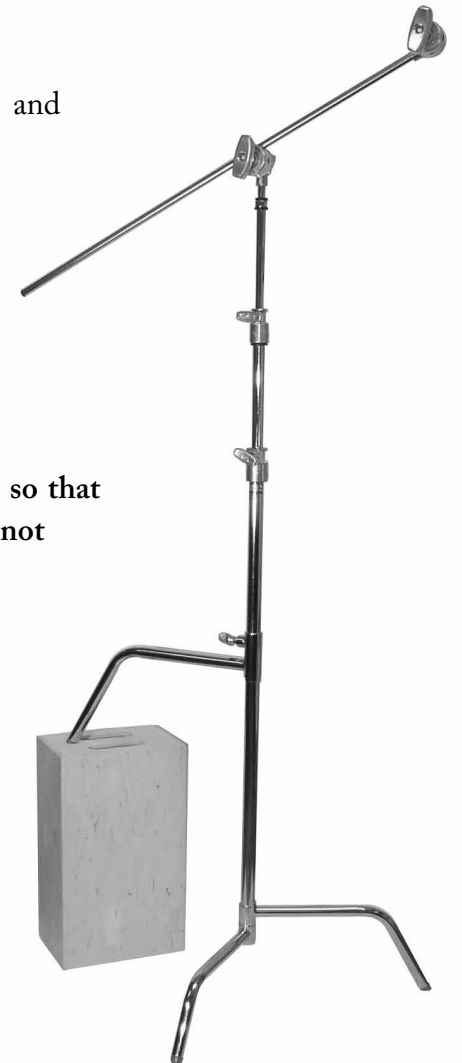
equipment from falling should it come loose from its primary rigging support.

As we discuss various way of rigging lights and cameras in this chapter we will frequently refer back to these five principal elements, and expand upon them.

C-Stand Safety

C-stands are among the most commonly used and most versatile stands used on a movie set. They are also the most commonly incorrectly used. When using a C-Stand,

- Always orient the grip arm so the weight of the extended arm is over the long leg
- Always place a sandbag on the long leg, so that the weight is holding the stand down, not resting on the floor
- Always insert flags and nets such that the weight of the flag would tend to tighten the grip head, not loosen it – Righty tighty, lefty loosey.
- When positioning the gobo arm, always make sure the end of the arm is not at eye level



For more information on using C-stands, stands and roller stands, you can watch the chapters in the Grip and Rigging section.

- When lighting and grip stands are used in a breeze it will be necessary to take additional precautions – When working outside anticipate that, even on a relatively calm day, the wind will be variable. Diffusion frames, solids and nets can catch the wind and fall over easily, so a person should be stationed next to each stand with their weight partially on the stand. With large frames, 6'x6' and larger, the frame should be secured by tying lines from the frame to secure points in front and behind either side of the frame. You can tie-off to a railing, post or other solid structure if one is handy. On soft ground and grass, metal stakes can be driven into the ground, and the frame tied to them. You can, if necessary, tie a line to a sand bag, or if conditions dictate, tie the line through several sandbags.

Always secure overheads with sufficient sandbags and ropes to prevent the wind from toppling them over.



- In strong winds, greater than 15 mph, grip frames, such as diffusion frames, silver reflectors, nets and solids, become very difficult to secure and larger heavier stands should be used – For smaller frames, multiple stands should be used where ordinarily only one is necessary. For example, you may need two stands to grip a 4x4 frame from either side. Additionally, add as many sandbags as are needed to safely secure the rig. If the winds are too high, or the equipment too susceptible to the wind, do not build the rig. This is generally the call of the Key Grip and Gaffer, both of whom are held responsible in the event of an accident on set.
- If a stand is placed on top of a platform, scaffold, high structure, or building where, if it fell, it would fall some distance, the stand must be fastened securely to the surface – You can fasten a stand using a number of techniques, including:
 - Wrapping the legs of the stand with grip chain or safety chain, and securing



When renting equipment, always make sure you have enough safety rigging equipment to secure stands and overheads - sandbags, rope, and safety chains.



An Arri light
suspended from a
cardellini clamp.

the chain to a wooden deck with suitable screws – Do not use drywall screws as they are brittle and not designed to take this kind of stress).

- Using ratchet straps made of webbing material to secure the base of the stand to the surface – If the surface provides no way to secure the hooks, eyebolt or U-bolts can be secured into the surface.
- Securing stays to three points around the stand, and securing the stays to permanent solid structures

For more information on rigging techniques, check out the FilmSkills Cinematography book, which covers detailed safety guidelines for rigging lights from pipe and grip hardware.

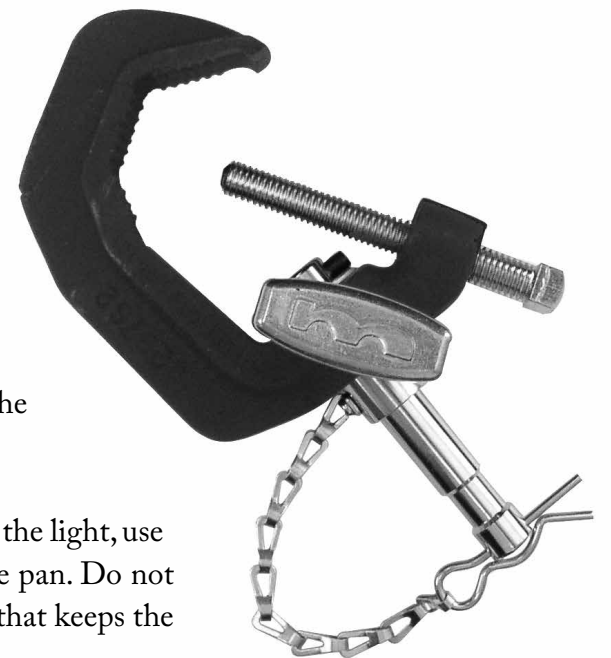
Clamps for Rigging to Pipe

There are three types of pipe clamps: baby pipe clamps, junior pipe clamps, and bolted clamps. The baby and junior types provide a pin or receptacle that fits a pin or receptacle on the light fixture. In each case the pin is indented, so that when the locking knob is tightened, the bolt advances into the indent on the pin, thus locking it mechanically. Be sure that bolt engages the indent, otherwise the receptacle can slip off the pin.

The standard pipe clamp allows a lighting technician to mount the clamp to the lighting fixture while safely on the ground, then hang the clamp onto a pipe or truss with the light attached, while he tightens the bolt onto the pipe. The downside of this clamp is that you need a wrench to tighten the bolt. Always attach the wrench securely to yourself using a lanyard so that it cannot accidentally be dropped to the ground.

When subsequently adjusting the pan on the light, use the knob on the pipe clamp to loosen the pan. Do not make the mistake of loosening the knob that keeps the receptacle on the pin.

A grid clamp.



The pin has a hole through the end. A cotter pin should be provided on a short cable and this should always be slid into the hole to prevent the receptacle from sliding off the pin if it gets loosened.

A grid clamp is a slightly different design that grasps the pipe from all sides very firmly, and is a better choice when you are hanging grip arms, because the grid clamp will not slip and turn on the pipe. It is also a very firm clamp to hang lights, but it does not provide a way to support the weight of the light while the clamp is being attached. It's safer to attach the clamp independently and then attach to light to the clamp.

Once the light is properly hug, always attach a safety cable through the yoke of the light and around the pipe.



A baby pipe clamp.

Clamps and Plates for Attaching to Sets

When attaching baby plates to constructed sets, always be sure you are screwing them into a solid block of wood, not just the 1/4-in plywood of the set wall. Secure a 1 x 3 or 2 x 4 piece of cribbing to the outside of the wall, large enough to spread the weight of the fixture over a large surface area of wall.

To attach the safety, run it to the top of the wall and fasten it there.



A baby plate.

Guidelines for Friction Clamps

Furniture clamps and bar clamps (with 1-in pipe) attach to undersling lights from beams and posts by applying pressure to both sides of the beam. This hardware is held in place only by friction.

- **Rely on this hardware to support only lightweight fixtures and grip equipment** – Do not over load the clamp.
- **Be sure the structure you are attaching to is solid** – Buildings often use ornamental beams or coffers in the ceiling. These may not be strong enough to place weight on. The material you are clamping to must also be strong enough to remain rigid under the crushing force of the clamp.
- **Cribbing should be used to protect the beam or post from being marred by the jaws of the clamp and to spread the crushing force over a larger surface area**

Electricians work on a scissor lift to rig space lights from the grid.



- Always test the strength of the attachment before attaching the light fixture or grip equipment to it
- Provide a safety to secure the light to the clamp

Wall Spreaders

If you don't have anywhere to rig overhead lights on location, you may be able to use a wall spreader. Wall spreaders are held in place by pushing outward against two opposing walls and must be secured in place with screws that penetrate into the wall studs.

- Only use wall spreaders if you have permission from the location owner to screw into walls – The production will have to pay for fixing the wall afterward.
- Use a stud finder to locate the studs in the wall – Always mount a wall spreader to studs – never to drywall.
- Always use screws long enough to drive through ½-in - 5/8-in of drywall and into the studs

To use a wall spreader, insert a 2x4 cut to an inch shorter than the distance between walls. Once in place, extend and tighten the end of the wall spreader, then screw both ends into the wall studs.



- If using 2x4 lumber, check that the lumber does not have defects, such as large knots, that will compromise the strength of the lumber
- Never use spans greater than that recommended by the manufacturer – If you want to have a wall spreader span the length of a room, but the span in that direction is too great, consider installing two wall spreaders in the shorter direction and supporting pieces of pipe between them.

Harry C. Box

Camera Operator, *Heroes*, *Brothers and Sisters*; and
Author of "The Set Lighting Technician's Handbook"

It's really a bad practice to use a wall spreader without [screwing it into] the studs in the wall. That's what it's designed to do. Just applying pressure to dry wall that's maybe a half inch thick, will easily break through. [You can't press] on that hard enough to prevent the wall spreader from coming down under the weight, it just doesn't work.



- **The strongest parts of the span are those closest to the walls**
 - Putting weight on the center 1/3rd of the span puts the greatest stress on the rig.
- **When using wall spreaders, Matth poles, or friction clamps, use light-weight lighting equipment**

Harry C. Box

Camera Operator, *Heroes, Brothers and Sisters*; and Author of “The Set Lighting Technician’s Handbook”



A producer hires the key grip, the gaffer, and the people on that crew. Part of their responsibility, and part of the reason they’re hired is to provide for safety. If they are asked to do something that is not going to be safe, it’s their responsibility to work it out, to say, ‘That way is not going to work, how about this way?’ or, ‘I can offer these other options,’ or ‘Let me research it.’ You’re not going to get fired because you raised a safety concern. That’s your responsibility. That’s what the producer expects of you.

Using Clamps On Location

Never attach any kind of clamp or rigging equipment to a water pipes or fire suppression sprinkler pipes. If a water pipe is old, it can be rusted on the inside, and will be crushed easily. Rupturing a water pipe, waste pipe, or fire suppression pipe would create a gigantic mess and likely end your shoot. It could also create a serious electrical hazard.

Always protect surfaces when using clamps. Use cribbing. Wrap the cribbing in duvatyne fabric, if the cribbing may scratch the finish. Always leave the location in the same condition that you found it.

Grid Pipe

The ideal rigging situation is to have an overhead grid made of truss or pipe, hung from the building structure at a height that is accessible to personnel by some convenient means such as an A-frame ladder, a lift, or via catwalks.

Any installed grid of pipe or truss requires a building engineer to design how it will be anchored to the building structure. Depending on the type of material used for the grid, the capacity will vary. Truss is extremely strong when supported at regular intervals. 2” Schedule 40 Steel pipe is very commonly used for making a lighting grid because it is cost effective, readily available, easy to use and sufficiently strong for almost any lighting purpose. Aluminum pipe is also commonly used, especially for temporary rigging. It is much lighter than steel pipe, and more portable, but not as strong, so it cannot bear as much weight.

On location, hanging pipe can increase your lighting options and save a lot of time during shooting, even if you just hang pipe in a couple key positions. If the location offers structural support for anchor points that are clearly strong enough for the load you are considering, then rigging pipe may also be safer and less likely to damage the location than rigging each light to some part of the building structure. However the pipe must be rigged safely and the proper materials and techniques must be used. If you have any question about how to do it properly you should seek out the assistance of a qualified, experienced grip to help evaluate the situation. In this chapter, we are only talking about small loads, no more than 100 lbs., which is just a few lights. Hanging pipe for large rigs, or very heavy equipment requires a qualified and experienced rigging grip.

- **Generally 2" Schedule 40 steel or aluminum pipe is used for lighting applications**
- **The pipe can be fastened to chain or wire rope using properly sized pipe clamps** – Alternately appropriate rope can be used to support the pipe, but only for light, temporary loads. Because rope weakens as it ages, and as it is exposed to heat or sunlight, it should not be used for standing rigs that could be in place for months or years, unless the rope is replaced with new rope on a regular schedule.
- **Suitable anchor points in the building structure must be selected and approved by the proper location representative** – Beams or trussing make strong anchor points.
- **Use appropriate knots** – People who are unfamiliar with tying knots typically tie two half hitches, which is prone to failure under a load. A well-chosen knot will be as strong or stronger than the line you are using.

A space light properly hung with cable relief and safety rigging.

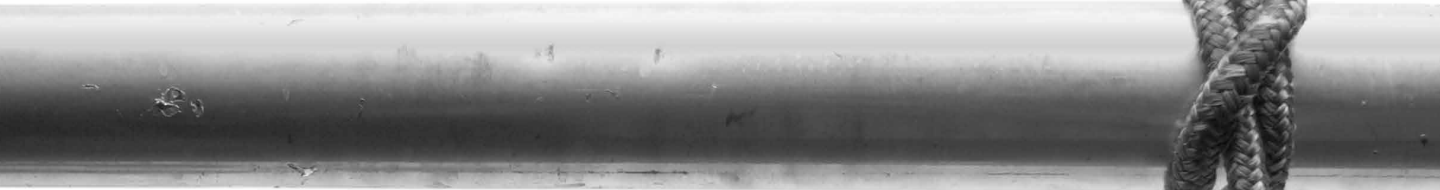


- **The size of the line you use should not be less than ½-in hemp** – The load capacity of the rig will depend on many factors: the type of line, the size of the line, if the ropes are hanging straight down or at angles, whether there is potential for shock loading (a moving load, sudden weight added, or a bouncing load), and the number of anchor points that are provided.
- **Provide support at regular intervals along the length of the pipe as appropriate for the load** – If the pipe sags, appreciably, there is too much space between lines.
- **All lines should make a straight vertical fall from the anchor point to the pipe, or as close to vertical is possible** – When lines are tensioned on an angle off vertical, the effective load increases geometrically with the angle.
- **Free hanging pipe will twist if forces are applied unevenly** – It will swing if there is airflow in the room, or if the lights have moving parts. An automated light, for example, has high torque motors that pan and tilt the light. Bracing may be required to eliminate swing.

Type of Knot	Knots to Know	Even Better Knots to Know
• Bend	• Square Knot	• Figure-8 bend • Alpine butterfly bend
• Binding Hitch	• Clove Hitch	• Rolling hitch • Constrictor hitch
• Loop Knot	• Bowline	• Alpine Butterfly
• Hitch	• Truckers Hitch	

Knots for Rigging

It is important to learn the correct knots to use, and to learn to tie them reliably and correctly. A knot that is not tied, dressed or cinched properly can easily fail. As we said earlier, the correct knot will not fail before the rope does. There are four categories of knots commonly used in rigging: loop knots, hitches, binding hitches and bends.



Loop Knots – A loop knot is used to make a loop in the end of the rope. You might use a loop knot to tie a rope through the yoke of a light, for example, to haul the light up into the catwalks from the stage floor. A bowline is very commonly used, and if properly tied and dressed, is a reliable loop knot. An alpine butterfly is another type of loop knot, considered even more reliable.

Hitches – A hitch is a type of knot used to tie a line to a post or rail. We commonly use hitches to tie the loose end of a line that is securing something in place. There are many types of hitches used for different purposes. A “high safety knot” is a type of hitch used to in motion picture/television work to secure a loaded hanging line to a rail above. A trucker’s hitch is a type of hitch for cinching down a load. There are a variety of trucker’s hitches; the best ones are those that are easy to untie. You might use a trucker’s hitch to tie down equipment when loaded onto shelving in a truck. A highwayman’s hitch is a weak but useful hitch, designed to be fast to remove.



The camera rigged to a ladder for a high shot.



Binding Hitches – A binding hitch is a type of knot that constricts around the object you tie it to. A clove hitch is an example of a binding hitch that every rigger must know. We use a binding hitch to tie line to pipe. We also use it to tie a line around an electrical cord or cable. A rolling hitch and constrictor knots are even harder binding hitches, but they are more difficult to untie, so they are not

the best choice for every situation. Experienced riggers know that rigs should be assembled in a way that is also easy and efficient to disassemble.

Bends – A bend is a type of knot used to tie one line to another line. Some bends can be used to tie lines of different widths or types; others can only be used reliably when tied to another identical piece of rope. A figure-8 bend is a very reliable and easy to learn bend knot. A square knot is a bend that everyone should know. A square knot is a moderately reliable knot. If tied improperly though it becomes a granny knot, which is an entirely unreliable knot. A figure-8 bend is one of the most reliable bends.

Rigging the Camera

If a camera is placed over a person's head, it should have a safety attached to it, so that if the camera comes off its support, it cannot fall and hurt the person. Synthetic webbing straps, having multiple loops, are typically used for this purpose. They are strong, lightweight, nonabrasive, flexible and easy to attach and adjust. Synthetic rope is also appropriate. If there is no obvious structure to which you can secure the safety line, one should be created. For example a piece of pipe or lumber could be rigged on stands, above the camera. The safety line would be looped over the pipe to allow for camera movement, without allowing the camera enough slack that it could fall far enough to hurt someone, or damage the camera.

Harry C. Box

Camera Operator, *Heroes, Brothers and Sisters*; and Author of "The Set Lighting Technician's Handbook"

Probably [the] most embarrassing situations you could have on a set is watching a camera come off its mount, and it happens. The cameras are very expensive and it's sort of a shameful experience for the 1st AC.



Ladder Safety

Ladders are commonly used on set for a number of uses including to rig lights and position set dressing. Everyone should know and follow the standard rules for using ladders.

- Always select the proper ladder for the intended use
- Always inspect all ladders prior to every use to ensure structural integrity – Damaged or defective ladders should be removed from service.
- Always use ladders on firm, level surfaces – Stabilize the base of the ladder to prevent slipping and/or moving. Ensure ground surfaces, rungs, and steps are clear of slippery substances.
- Always keep the base of the ladder clear for access and for traffic control – When necessary, use cones, tape, or a spotter to secure high traffic areas.
- Never leave tools or materials on top of any ladder
- Always ensure personal tools are secure when climbing ladders
- Straight or extension ladders should be installed on a 3:1 or 4:1 slope, e.g. one foot out at the base, for every four feet up
- When working above three meters (10 ft.) on a straight ladder or extension ladder, secure the top of the ladder to an independent anchor to prevent lateral movement



- **Independent “fall arrest” is necessary when using a ladder as a workstation above three meters (10 ft.)** – In other words, when you are not using the ladder to access another level, but as a working position. This includes rolling A-frame ladders. An independent fall arrest system typically involves an installed system of load-rated pick points, to which a personal fall arrest harness can be attached. The harness has a decelerator, which will catch the person should they fall.
- **Always face the ladder when climbing up or down** – Always maintain 3- point contact, meaning that of your two hands and two feet, three of the four should always be in contact with the ladder. Avoid reaching beyond the side-rails of the ladder.
- **Always follow the manufacturer’s recommendations to determine which rungs of the ladder are appropriate to work from** – Normally the top two rungs are not for standing.
- **Ladders made of non-conductive material should be used while working around energized wiring and equipment** – Never use aluminum ladders in association with lights and electricity, only fiberglass or wooden ladders.
- **When working in outdoor conditions extra safety measures must be taken** – conditions such as uneven ground, wet or slippery surfaces, wind, power lines, and so on – Make sure the ladder is placed in stable ground.
- **Never use ladders horizontally as scaffold planks or runways, unless they have been designed for that purpose.**

By following these basic safety guidelines, you can ensure a safe, productive work environment for the cast and the crew.



Learn more about grip and rigging techniques with the following modules:

- C-Stands
- Stands
- Roller Stands
- Dolly and Track
- Clamps
- Rigging
- Grip's Tools
- Key Grip
- Best Boy
- Grips
- Dolly Grip

PRODUCTION SAFETY

From the Hollywood
movie set into your hands



Helping Create the Standard for On Set Safety

Filmmakers often suffer from "cinematic immunity" - the false perception of immunity from injury in the controlled environment of the movie set. In reality, movie sets are incredibly dangerous. Potentially hazardous shooting locations, electrical dangers, precarious grip and rigging set-ups, weapons and pyrotechnics, and basic human error can - and have - caused serious injury and death.

Unfortunately, in this freelance industry, there is no standardized safety training protocol - until now. The producers of FilmSkills have teamed up with the architects of the California Safety Pass program - a safety course required of all union television and motion picture IATSE workers in California - to make the film industry's first production safety protocol.

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- Lifts, Trucks, and Tools
- Pyrotechnics and Special Effects
- Environmental Safety

"Safe working habits must be taught with the same dedication as the craftsmanship and artistry of filmmaking. The FilmSkills Online Safety Training Program allows us to augment our in-class lessons with in-depth and comprehensive modules."

- Professor William McDonald
Chair, UCLA Department of Film, Television & Digital Media

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