Set Lighting Technician's Handbook

A friendly, hands-on training manual and reference for lighting technicians in motion picture and television production, this handbook is the most comprehensive guide to set lighting available. It provides a unique combination of practical detail with a big-picture understanding of lighting, technology, safety, and professionalism, essential to anyone doing motion picture lighting.

The fifth edition delves into every aspect of lighting and features vastly expanded sections on controlling LED lights, color science, lighting control systems, wireless systems, Ethernet-based control systems, battery power, and modern set protocol for productions small and large. With a generous number of original images, the book illustrates the use of soft light, the effect of lighting angles, and how the gaffer and DP build an effective lighting plan around the blocking of the actors. This encyclopedic volume of technical knowhow is tempered with years of practical experience and a much-needed sense of humor.

This is the ideal text for professional lighting technicians across film and television including lighting directors, gaffers, DOPs, and rigging crews, as well as film and television production students studying lighting, camera techniques, film production, and cinematography.

It includes a revamped companion website with supplementary resources, forms, checklists, and images.

Harry C. Box has worked in the motion picture and television industry since 1987 with significant experience as a lighting technician and gaffer and later as a camera operator. Harry also works for the industry trade association ESTA focusing on issues relevant to the motion picture/television market.

Set Lighting Technician's Handbook

Film Lighting Equipment, Practice, and Electrical Distribution

Fifth Edition

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For my mother and father

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Preface

Lighting practices for film and television production have undergone many transformations since the summer of 1991, when I first began making notes for what eventually became the first edition of this book. At that time, the conversion from vintage DC distribution equipment to AC was still taking place. Lots of different distribution systems had popped up; there was no dominant standard for connectors and junction boxes. SCR dimmers were suddenly becoming a big part of motion picture lighting for the first time, bringing with them the attendant issues of harmonic currents. Electronic HMI ballasts were new to our industry and were pretty shaky at first. It took a few years of burning out different parts of the ballast before manufacturers arrived at the bullet proof reliability we have come to expect today.

At that time there was little or no formal training for lighting technicians. Electricians learned from each other on the job. For many old-school electricians, three-phase AC systems, power factor, current harmonics, and even grounding, were new concepts. At that same time, a much larger percentage of production in Los Angeles was non-union. Necessity being the mother of invention, these thriftier productions spawned many innovative lighting techniques that have since become common practices, but they also often resorted to methods that were actually potentially hazardous. One way and another there was a great deal of confusion and misinformation being circulated. It was in this context that I first undertook writing a book for lighting technicians in the film and television industry, with the goal of thoroughly researching the many issues I was aware of, in order to offer lighting technicians an authoritative source of information and guidance.

This book has existed in a time frame spanning a massive shift toward greater awareness and education for lighting technicians. To some extent, it has been a part of that shift. The fourth edition of the book reflected the formalization of training and rethinking of safety that occurred since the early 90s. Risks that were once casually accepted were now addressed with better technology and work practices. Things like using flammable materials or non-UL-listed parts, use of electricity around water, proper grounding, these are just a few of the areas where safety was improved in our daily work.

Revising a book is a great way to take stock of the impacts of technological change. The industry has just completed two enormous leaps forward—first the painful transition from film to digital capture in the early 2000s, and second, the LED revolution in the 2010s. What topic in this book has *not* been touched by this technology? It has given us a nimbler way to color light, which forced more sophisticated control technology. It has spawned new data/power management solutions. It has vastly increased our use of small power, like batteries, small generators, and house power. It has made rigging smaller and lighter and the production footprint not quite as deep. LED technology has changed the crew roles. Juicers now need to be IT technicians and RF engineers. It brought us systems techs, fixtures techs, and elevated the lowly dimmer board operator to full wizard status as lighting console programmer.

It has changed the way lighting technicians and gaffers work on set. It has taken light that was once static and breathed life into it, enabling it to move, morph, sputter, and travel. Built-in lighting effects, creative use of pixel mapping, the ability to fade between colors and to change the look, time of day, and atmosphere within the duration of a shot, DPs are finding exciting ways to harness the technology as tools for visual storytelling. Never before has so much been so relatively easy to do. While in some ways the changes have made things easier and increased the efficiency of production, they have also raised the expectations placed on DPs and on their lighting crews. The changes have added substantially to the knowledge base that lighting technicians need to master. So, with all that going on, we are clearly due for a new edition.

Acknowledgments

While writing the fifth edition, I was very fortunate to have the support of many top professionals in production as well as experts in the manufacturing sector. Their generosity, insights, and perspective make this book possible.

I gratefully acknowledge the many manufacturers who provided technical information, photographs, and illustrations. The manufacturers are listed in Appendix F.

I am very grateful to Mike Bauman for his generous input and terrific photographs. The man is an amazing wealth of creative talent and knowhow. Thanks to my friend and colleague Mark Doering-Powell for his ongoing advice and terrific artwork and photographs that appear in the book. I truly appreciate the continual feedback of Ted Hayash, Mark Weingartner, and Mike Ambrose, who also contributed photos. Thanks to programmer Scott Barnes for his thoughtful input, as well as the hospitality of Jared Wellman, Jason Young, Mark Hartman, and Jay Yowler who had me over for a set visit and shared their experiences.

Max DeMayo took the photo for the cover of this book. Thanks also to Al DeMayo, John Clisham, Paul Royalty, and Sean Goossen at LiteGear for supporting the project. Thanks to John Cini and the good folks at High Output, Boston for their generous hospitality. The fifth edition benefited greatly from those who read and commented on certain sections of the manuscript: Craig Brink and Adam Knapp at RatPac, Mark Wofford and Gary Murck at PC&E, Atlanta, Zack Shannon at CORE SWX, and Brian Doran and Jane Rein at ARRI. Guy Holt contributed his photos and perspective from his ongoing research into power quality issues. Frieder Hochheim and his team at Kino Flo shared research on LED color science.

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A special note of thanks to the illustrators, Shawn Murphy and Lisa Cyr, who created the hand-drawn illustrations for the first edition and who may well have been inking drawings on their wedding night to make the publication deadline. Thanks also to John Huey, who created additional artwork for the second edition. For new illustrations in the third edition, I thank Dan Haberkorn. Thanks to Laura Mancini and Keith Morgan.

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I am thankful, once again, to Joan Box, my faithful and talented (unofficial) copyeditor who has taken an interest in my writing since I was first able to form letters. It is a true testament to a mother's love that she endures all this techno mumbo-jumbo, but it is always a joy to work together on it.

Finally, my love, thanks, and appreciation go to my loving wife, Stacey, and to my family, who are officially completely sick of this book at this point, and with good reason. Thank you for your patience and support.

CHAPTER

Set basics: Your first barbecue

1

All the technical aspects of filmmaking—cameras, lighting, sound, visual effects—involve a myriad of small details that, taken as a whole, seem impossibly complex. As with any craft, to become a master requires years of experience and exposure to many different situations. It has been my experience, however, that no single piece of equipment, procedure, or technique is really complicated; there is no one thing that cannot be explained and understood in less than 10 minutes. Making movies is the artful application of millions of relatively simple details. This book helps with some of those details, describing procedures that save time and promote safety, clarifying aspects of the craft that are confusing and often misunderstood, and supplying a wealth of information about the hundreds of gadgets of which lighting technicians are so fond.

Starting with the basics, we begin with a summary of the role of the lighting crew on a film set.

JOB DESCRIPTIONS OF THE LIGHTING CREW

The electric, grip, and camera departments fall under the supervision of the *director of photography* (DP). The *gaffer* and *key grip* are the DP's lieutenants. The gaffer is the head of the electric department, in charge of the lighting crew. The gaffer's crew consists of a *best boy electric*, *lighting technicians*, and often a *lighting control programmer* or *dimmer board operator* and a rigging crew.

Director of photography

Q: How many directors does it take to screw in a lightbulb?
A: One; no, two . . . no, no one.

The DP is the director's right hand. It is the DP's responsibility to create in images what the director has envisioned for each scene; to evoke the proper time, place, and atmosphere by means of lighting; and to help choose camera angles and camera movement that will be most effective in telling the story and covering the scene. He or she designs the lighting, balancing realism against the dramatic potential of more stylized effects, as called for by the script and the director. The DP's responsibility for lighting and photographing the actors requires careful attention to how their face takes light. The DP must maintain proper screen direction (a responsibility shared with the script supervisor) and lighting continuity between setups so the film can be edited seamlessly. The DP has a say in the design and color of the sets and the wardrobe and in the selection of locations. The DP works closely with the *assistant director* (AD) to schedule scenes at the right time of day for the best light.

The DP usually shoots tests prior to the beginning of photography. He or she may experiment with lighting effects, with different color casts, levels of contrast and saturation, filters, and lenses that combine to create specific looks, which answer the special requirements of the script. The DP may also conduct his or her own research prior to production to ensure the authenticity of a period look and to inspire ideas for the cinematography.

The DP holds a position of immense responsibility, creatively and financially. The producer and director both depend on the DP to achieve photographic excellence within the constraints of the production's budget and schedule. The DP always faces conflicts in fulfilling the needs of the script, director, schedule, and budget and meeting his or her own aspirations for the photography. The lighting crew fights the DP's battles on the front lines. Their ability to light the set in a time-efficient manner directly affects the DP's ability to produce great work.

Gaffer

Q: How many gaffers does it take to screw in a lightbulb?
A: How many do we have on the truck?

The gaffer is the chief lighting technician (CLT), the head of the lighting department. He or she works directly with the DP to implement the lighting plan and help achieve the photographic look of the film. The DP, the gaffer, and the key grip attend preproduction meetings together and scout the locations where filming is to take place. They discuss the DP's approach to each scene and determine what lighting preparations and equipment are required. Gaffers are problem solvers. They often have to design a special rig, fabricate a gadget, or implement technology in some idiosyncratic way to give the DP something he or she is looking for, or to provide time efficiency during production. It falls to the gaffer and key grip to research possible solutions, source the materials, design all the specifics, and if necessary, present the plan to the DP and to the production manager for approval, and then see the plan to fruition.

On the set, the gaffer is responsible for the execution of the lighting scheme and the organization and operation of the lighting crew. The DP and the gaffer discuss the lighting. Typically, when talking about the actor's lighting, the DP may specify the placement of each fixture to accomplish a particular effect. Sometimes the DP may leave it to the gaffer to translate general ideas into specifics. The DP may express the goals in terms of the motivating sources of light for the scene, the mood, and the f-stop at which to shoot. The gaffer then instructs the crew and sees to the exact placement and focus of each light to accomplish the DP's instructions. Once the gaffer has executed the lighting, the DP may "sweeten" it to taste, with a few adjustments.

The gaffer must have a very strong eye for lighting and a solid knowledge of which lights to use to create any desired effect. As the lighting starts to come together, the gaffer functions as a second pair of eyes for the DP, always on the lookout for problems—inadequate light, overexposure, hot spots, ugly shadows, and so on. Together, the DP and gaffer look for opportunities to make the scene look more interesting. The gaffer has a critical eye for the balance of light and shade, the modeling of facial features, and the separation of foreground from middle ground and background. He or she may carry a light meter on their belt for measuring light levels. The gaffer is often next to the DP, viewing the monitors, watching for lighting issues and calling for adjustments over the walkie-talkie.

A very important part of the gaffer's job is organizing and running the lighting operations. He or she must constantly be cycling through the many tasks at hand, pushing forward the progress of each project, keeping an eye on the performance of the lighting crew, thinking ahead so that the lighting technicians will have power and lights readily at hand for subsequent shots, and forestalling delay.

The gaffer should never have to leave the immediate area in which the action is being filmed. He or she must rely on the crew to be close at hand to make lighting adjustments and fetch equipment when it is needed. Once the lighting is complete, the grips and electricians clear the set, but remain nearby, in case a tweak is called for between takes. The lighting crew is always under time pressure. A technician who stays near the action, listens, and thinks ahead can do a lot to help the gaffer and DP win their daily battle against time.

Best boy electric

The best boy electric is the assistant chief lighting technician. He or she is in charge of personnel and equipment for the electrical department—a vital role in the smooth running of the lighting crew. One of the best boy's duties is scouting locations with the gaffer, making scouting notes to help the gaffer compile the list of equipment needed. The best boy supervises the equipment inventory from the load-in at the beginning of the show, through each day of the shoot, and through the wrap and return. The best boy orders expendable supplies. He or she coordinates equipment orders, returns, subrentals, and special orders with the production department and transportation departments as necessary. The best boy supervises the loading of the truck at the rental house before the first day of production, organizes the equipment and supplies in the truck for easy access, makes sure that no equipment gets lost at each location, and keeps track of damage. The best boy supervises maintenance and repairs when possible. The best boy is in charge of hiring and laying off additional lighting technicians when needed. The best boy supervises the electrical crew's startup paperwork and time cards. When there is no rigging gaffer hired, the best boy may also plan the routing of the feeder cable and supervise the distribution of electrical power to the lights.

Most important, the best boy is the emissary of the electrical department, communicating and coordinating with other departments, with the fire marshal, and with rental houses, and other equipment suppliers. A best boy who maintains good relations with each department can get cooperation when it is needed. For example, when the best boy needs to put a light on the roof of a building, the locations team must make the necessary contacts to secure that spot. When the best boy needs some extra equipment delivered quickly, his or her relationships with the transportation department and the contact at the rental house come into play. The best boy's diplomacy is key.

Lighting technicians

Q: How many electricians does it take to screw in a lightbulb?
A: It's not a bulb, it's a globe.

Affectionately known as *juicers* or *sparks*, electricians are officially titled *set lighting technicians* or *lamp operators*. The electrician's primary responsibility is placing and focusing lights according to the wishes of the gaffer. At each location, the electricians unload and reload the lighting equipment from the trucks, run cabling, and run the distribution of electrical power for the lights. On the set, electricians are responsible for placing and focusing (aiming) the lights; manipulating the intensity, direction, color, and quality of light; wiring practical lamps (such as table lamps and wall sconces), switches, and wall outlets on constructed sets; and anticipating the needs of the gaffer so that equipment is at hand when needed. Lighting technicians secure lights and stands; however, the grip department also plays a role, such as hanging pipe or truss for the lights, securing a stand with straps, or screwing it down with grip-chain.

There is a Zen to the job of the lamp operator. An experienced lamp operator handles the equipment with deft speed and economy of movement that comes with familiarity. Through the exchange of a few words or hand signals, or by clairvoyance, the electrician grasps the gaffer's intention and manipulates the lamp to create the desired effect. His or her focused concentration is on two things: the activities of the lighting crew and the behavior of the light. The lamp operator is constantly attentive to the DP and gaffer and to fellow electricians who might need a hand. Simultaneously, the electrician is aware of the light falling, blasting, leaking, and spilling onto the faces and the surfaces around the set.

The set lighting crew may be asked also to provide power for fellow crew: camera, sound, dolly, and video village. Lighting technicians typically relinquish responsibility for powering vehicles at the base camp to the transportation department. Although powering the base camp is technically within the union jurisdiction of lighting technicians, being trained to handle electrical distribution equipment, most of the time the gaffer simply does not have the personnel to spare for anything extraneous to the set. Despite the nickname, movie electricians are very rarely licensed journeymen or master electricians. They are not qualified to wire buildings or work inside electrical panels. Their job is lighting movies.

Lighting control personnel

Lighting control refers to controlling lighting remotely via a control console, dimmer board, laptop, tablet or other device. A person who operates a computerized control console is called a *lighting control programmer*. A person who operates a dimmer board is called a *dimmer board operator*, or *board op*.

The importance and sophistication of this position on the crew has evolved drastically as lighting devices have gone from having one controllable parameter, via dimming, to having many parameters of control including color temperature, hue, saturation, and special effects. On a good-sized set, it is common for the programmer to have several thousand control channels under their command. The programmer is responsible for organizing the system including supervising assignment of DMX channels to lighting devices, selecting control modes and other device settings, running data lines, setting up wireless networks, and protecting these systems from failure and interference.

The programmer is responsible for grouping and organizing the devices on the control console so that even a large number of lights can be controlled in an intuitive and functional manner. The programmer must be able to respond quickly to instructions from the gaffer or DP to set levels and colors, write lighting cues, and execute the cues during the take. The programmer typically saves important lighting setups as cues so the levels can be recalled for future setups, so the task of organizing and archiving the data is also part of the job.

On a big production, responsibilities are delegated to one or more *systems techs* (also called *DMX techs* or *control techs*). There may be any number of people organizing and addressing DMX512 devices or assisting in other aspects of setting up and maintaining communication networks and control systems. When a lot of moving lights are used, the production may also have one or more *moving light techs*.

Rigging crew

A rigging crew is an important part of almost any project, be it a feature, episodic TV series, or even a television commercial. The rigging crew works ahead of the main unit, installing cable and distribution boxes, hanging lights, and taking care of any work that will be time-consuming for the main unit

to accomplish on the day of filming. The electric rigging crew works in tandem with the grip rigging crew. This may involve weeks of work to rig a major set or half a day laying in some cable on location.

A rigging crew consists of a rigging gaffer, rigging best boy, and rigging electricians. A rigging crew is invaluable to a production, especially to the DP and gaffer. The thought, planning, and careful, unrushed work, testing, and troubleshooting put in ahead of time translates into smooth sailing for the shooting crew. A properly rigged set means that the lighting will look better and the unit lighting technicians can work with greater efficiency. *Unit* lighting technicians are the *on-production* team, as opposed to the rigging crew who are *off-production*. *First unit* and *second unit* refer to separate film crews working on the same production. First unit typically works with the principal actors, while a second unit typically works on setups that would be too time consuming for the first unit, such as visual effects, miniatures, animals, establishing shots, beauty shots, but sometimes actual scenes with actors as well. The rigging crew usually also wraps out the set after the unit crew has finished with it.

The fixtures person (or department)

More and more, sets that require a futuristic or otherworldly high-tech look or a whole lot of razzle-dazzle are lit mostly by LED light engines that are built into the set. The set essentially lights itself. Often built-in lighting is selected to create a wide variety of colors and looks, so the look can change radically and be adaptive to whatever dramatic action is taking place.

On tentpole movies, the fixtures department can be bigger than the rigging crew, filling dozens of universes of DMX with lights throughout the set. The fixtures department is responsible for all the on-camera lighting. To avoid problems like flicker and color temperature issues, and because it needs to be controlled with the rest of the lighting, on-camera light sources need to be selected and supervised by a lighting technician who is a specialist in fixtures. Just like the first unit gaffer, the fixtures supervisor has to work closely with many other departments. For built-in lights they work with set design and construction. For *practical lights*, such as a sconce or table lamp, they work with the set decorator. Sometimes wardrobe has lighting in it like space helmets or underwater helmets, which involves issues of safety, practicality, and comfort for the actor. Like the gaffer, the fixtures person has to be smart, respectful, and collaborative in their conversations. Maintaining good relationships with the producer's team and other departments is essential to keeping things moving smoothly. The right personality is quite critical.

The skillset of top fixtures people has to be pretty diverse. They have to be familiar with fabrication techniques in a variety of materials—metals, fiberglass, plastics. They have to be comfortable specking-out and replacing electronics for practical lights when off-the-shelf electronics are unsuitable. They could be called upon to control any kind of light, which can include challenges like controlling the headlights of a moving vehicle, for example. They have to organize large data networks and work with a variety of control protocols including pixel mapping protocols in addition to standard Ethernet and DMX. Since the lights are to be photographed, there's also aesthetic and design decisions and careful craftsmanship involved.

Generator operator

The generator operator is in charge of the full-time operation and maintenance of the generator. A knowledgeable, experienced generator operator is an extremely valuable person to the set lighting department. Most genny operators today are teamsters. The production van driver typically operates the generators on the tractor. There is no special training, test, or apprenticeship program to be a

generator operator. People who lack the proper experience are of absolutely no use to you when a generator starts to hiccup. Especially when you are on a remote location where a generator cannot be quickly replaced and you encounter issues with climate, fuel, and other conditions that affect the generators, it is especially worthwhile for the gaffer and DP to insist on using a qualified generator operator.

Grip department

Q: How many grips does it take to screw in a lightbulb?
A: Grips don't change lightbulbs. That's electric.

Nonelectrical lighting equipment is handled by our brothers and sisters in the grip department. A grip is affectionately called a *hammer*. Silks, diffusion frames, flags, reflector boards, rigging, dollies and dolly track, cranes, jib arms are all in the domain of gripology. You could say that the lighting technicians do the lighting and the grips do the shading. Each time an electrician sets up a light, a grip is right next to him or her with a *grip package*, which includes a C-stand and whatever flags, nets, or diffusion frames may be needed in front of the light. Lighting technicians graduating from the nonunion world may be used to grips taking charge of placing sandbags on the light stands, providing ladders, and leveling large stands when they are placed on uneven ground. On union jobs in Los Angeles, the electricians generally handle their own ladders, sandbags, and rigging hardware, such as pipe clamps. Grips handle gel and diffusion when used on a frame or applied to windows. An electrician applies the gel and diffusion when it goes directly on a light.

Grips are responsible for the safety of the rigging, and they are often called on to rig support for lighting equipment and backdrops. Truss, I-beam rails, chain motors, speed-rail grids, wall spreaders, and similar rigs are built by the grips. When lights are to be hung from an overhead grid or rigged to the wall of the set, the grips generally rig the support. An electrician then clamps on the light, plugs it in, and focuses it. When lights are mounted on a high platform, on top of parallels, in the basket of an aerial lift, or on an elevated platform, the grips rig and secure the light and light stand. When an interior night scene needs to be shot during daylight hours at a practical location, the grips build big black tents around the windows to create darkness outside, while providing space for lights outside the building. During production the grips are in charge of removing, and reinstalling set walls as needed during filming.

The head of the grip department is the *key grip*. The key grip supervises the grips in the same way that the gaffer supervises the lighting technicians. He or she works for the DP in tandem with the gaffer, supervising the grips in the placement of grip gear in front of each light.

The key grip's chief assistant is the *best boy grip*. The best boy grip coordinates the grip crew in the same way that the best boy electric does the electric crew.

The *dolly grip* is in charge of operating moving-camera platforms, such as dollies and cranes: laying and leveling the dolly track, moving the camera smoothly up and down and to and from exact marks with precise timing. Grips also rig support for the camera when it is placed in unusual places, such as on top of a ladder or on the hood of a car.

THE COMPANY

A film crew is composed of freelance artists, technicians, and actors who are brought together by the production company when the production is ready to be mounted. The producer and director select the department heads: the DP, production designer, sound mixer, editor, and so on. Each department head usually brings his or her own staff to the production. Usually the DP recommends a gaffer, key

grip, camera operator, and camera assistants with whom he or she prefers to work. The gaffer, in turn, recommends lighting technicians he or she knows and trusts.

Each production brings new faces, new locations, and new circumstances, yet you can count on certain constants in relationships between electricians and the other departments.

Production staff

Q: How many production managers does it take to change a lightbulb?
A: None! If you'd just make it a day exterior we wouldn't have to keep screwing around with all these lightbulbs!

Officially, the crew is hired by the producer. Although the gaffer usually selects electricians for the crew, once an electrician is offered a job, it is the *unit production manager* (UPM) with whom he signs the crew deal memo. The UPM authorizes paychecks that are handled by the accounting department and issued through a payroll company.

The duties of the UPM include establishing and controlling the budget, making deals for locations and services, booking the crew, overseeing daily production decisions such as authorizing overtime and making schedule changes due to weather, and managing all the off-set logistics, including housing, meals, transportation, permits, security, and insurance. Because the UPM is responsible for executing the budget, he or she must approve all equipment orders and personnel requests.

Some productions have a *production supervisor* as well as (or in some cases instead of) a production manager. This distinction between production manager and production supervisor is that a UPM has served many years as an AD and has joined the Directors Guild of America (DGA), whereas a production supervisor has not. Typically, a supervisor has previously worked as a production coordinator working in the production office, not on set.

The *production coordinator* assists the production manager. His or her duties include booking the crew, booking and returning equipment, ordering expendables and supplies, monitoring petty cash, distributing production information to the various departments, and coordinating and distributing the shooting schedule and script revisions. The production manager, the production coordinator, and their staff work out of the production office, along with the accounting department.

The director's team

The "director's team" consists of the ADs, the production assistants (PAs), and the script supervisor.

Assistant director

During preproduction, the first assistant director (1st AD) prepares the script breakdown and production schedule and coordinates the actions of every department and the cast. He or she plans each day's schedule and gives final approval to each day's call sheet, which is usually prepared by a second AD. During production, the 1st AD runs the set. He or she is responsible for keeping the production moving and on schedule on an hour-to-hour basis. The 1st AD keeps everyone informed about the shots, constantly plans ahead and facilitates, coordinates, and motivates the actions of the crew in order to solve problems before they occur. The 1st AD must stay informed of any potential delays or problems. Every production company is required to have an appointed safety officer. On a studio lot, the safety officer is provided by the studio; for independent shows, the 1st AD is the default safety officer. Part of the 1st AD's job is calling and running safety meetings. An onset safety briefing, for which all the relevant

crew are assembled, is given to alert the crew to the specific safety issues of the shot, the location, or the day in general.

The 1st AD is backed up by a 2nd AD, who in turn are helped by 2nd 2nd ADs and a squad of PAs. The AD staff takes care of the actors: coordinating their schedules, and ushering them through makeup, hair, and wardrobe and to and from the set. The AD staff also directs the action of background artists (extras) and supervises crowd control.

ADs and PAs can be called upon to help coordinate between departments. For example, if a lighting technician needed some furniture moved to place a light and the onset dresser was nowhere in sight, the 1st AD would have him found in short order.

Prior to the first take, the AD calls "last looks," which alerts the makeup, hair, and wardrobe onset personnel to make final touches. The 1st AD initiates each take by calling "Picture is up," a warning to everyone to finish whatever they are doing and get ready for the take. This is followed by "Roll sound." These instructions are broadcast over the walkie-talkie to all the ADs and PAs, who echo "Rolling" throughout the set, so that everyone knows to settle in for the take and be quiet. Following the take, "Cut" is broadcast by the 1st AD, and again, the AD staff echo it for the crew.

Other announcements:

"We're in" or "We're back." Announced at the start of the day and after lunch respectively to call the company to work.
"Going again." A second take will be rolling immediately.
"Hold the roll." There has been a momentary delay. This cues the sound mixer to stop recording while the problem is fixed.
"MOS." Sound will not be recorded for the shot. The term comes from the early days of sound. It is an acronym for "minus optical stripe."
"Fire in the hole!" Announced before gunfire or explosions. Be prepared for a loud noise to follow.
"Check the gate." If the project is captured on film, after each shot has been successfully completed and the director is ready to move on, the camera gate must be inspected before the next shot is announced. If there is a "hair" in the gate, the shot may have to be retaken.
"Moving on" or **"New deal."** The director is ready to move to the next setup.
"Turning around." The next setup is the reverse coverage or sees the scene from the opposite direction.
"Company move." The next setup is at a new location.
"That's lunch, one half-hour." The company is at lunch. You can head to the catering truck, or do something else, just be back in 30 minutes.
"Abby Singer is up." The Abby Singer is the second to last shot of the day. It was named for (former) AD Abby Singer, who always had "just one more shot" after the last shot of the day.
"Martini is up." The martini is the last shot of the day. (Your next shot will be out of a glass.)
"That's a wrap." The last shot of the day has been successfully completed. If filming has been completed at this location, the lighting crew begins wrapping: taking down the lights, coiling the cable, and loading the truck.
"Make it safe," "Walk away." When filming will resume in the same place, and things can pretty much stay where they are, the ADs may say "make it safe."

Script supervisor

The *script supervisor* makes careful notes on the script and keeps a running log that shows scene and take numbers, lenses used, shot scale, movement, eyeline direction, good takes, flawed takes (and the reason why they were flawed), line changes including ad libs and flubs, and so forth. These notes are used to recall matters of continuity and to note for the editor what coverage was taken and which takes the director thought were the best. In a way, the script supervisor is the onset advocate for the editor, consulting with the director on questions of screen direction and coverage. Matters of continuity are often small details that have to be carefully noted—in which hand an actor holds his beer, at what point in the scene he puts out his cigarette, whether his shirt sleeves are rolled up . . . all the things that everyone sees but no one notices. For this reason, it is vital for her (or him) to be able to see the action on every take; if you stand in her way, you risk being jabbed by her sharp little pencil. The gaffer sometimes has the best boy take detailed notes on the placement of the lights, especially if the scene may be replicated at another time. The script supervisor can provide the best boy with the applicable scene numbers for these notes. The camera assistants and sound recordist also get this information from the script supervisor.

Camera department

Q: How many camera assistants does it take to screw in a lightbulb?
A: Five. One to screw it in and four to tell you how they did it on the last show.

The camera department is made up of the DP, camera operator, first camera assistant, second camera assistant, and, when shooting in a film format, a loader. When shooting in a digital format, the camera crew may include a *digital imaging technician* (DIT) and a camera/digital utility person and digital loader.

The *camera operator* sets the shot and operates the camera. The operator is charged with the responsibility of keeping the lights, grip equipment, and microphones out of the shot. If you are setting a light close to the frame line, the camera operator can tell you where it is safe. It is a very good idea that the camera operator set the shot before the lighting crew starts lighting it, as important details, such as the exact placement of the actors, and what background will be photographed, may change during this process. Although this may cause the lighting crew to hold off on the work inside the set for a couple of minutes, ultimately it saves having to set lights twice.

The *first camera assistant* (1st AC) is responsible for the camera, including building it, configuring it (physically and in terms of electronic settings) for each shot, making lens changes and performing regular maintenance as needed. During the take, the 1st AC keeps the camera in focus and may perform any of a multitude of other tasks—zooming, making an aperture change, or ramping the shutter speed or angle. The 1st AC never leaves the camera's side.

From time to time, the 1st AC calls on the lighting crew to help get rid of lens flare—light hitting the lens that may flare on the image. Usually the grips can set a flag or hang a "teaser" to keep the light off the lens.

The 2nd AC aids the 1st AC with lens changes and magazine changes, marks the actors' positions, slates each shot, and keeps the camera reports and film inventory. Almost all camera equipment runs on batteries, but a 2nd AC needs power to run a video monitor. When a director uses a video monitor, it quickly becomes habit to supply power to the monitor as soon as the camera is placed. Similarly, a hot extension cord should be supplied for the dolly at all times.

Sound department

The *sound mixer* oversees the recording of audio. The sound mixer is the one person on the set fortunate enough to perform his or her job from a sitting position. If you want to know the sports scores, he or she almost always has the newspaper at the sound cart.

The *boom operator* is the person who actually positions the microphone within range of the actors, by holding it on a pole over their heads, wiring them with radio mics, or planting hidden microphones on the set. When a power cable must cross the microphone cable, the electrician should run it under the microphone cable so that it doesn't restrict the boom's movement.

The boom operator has to contend with shadows cast onto the actors and walls by the microphone and the boom pole. Boom operators are very good at analyzing the lighting and use great ingenuity to avoid casting shadows. The lighting crew helps the boom operator by setting toppers on lights as needed to eliminate microphone shadows. Certain lighting directions are inherently problematic for the boom operator. For example, hard front light from the direction of the camera tends to throw mic shadows onto actors, set dressings, or walls that are right in line with the actor being filmed. Raising the light higher so that the light is angled downward and then topping the light can eliminate the problem. Steep, top-down lighting is another difficult angle for the boom mic, because it tends to throw microphone shadows across the actors' clothes or table surfaces. Sometimes, the lighting is such that a boom microphone simply cannot be used, and the sound department must accommodate by using other methods such as radio mics.

The sound department has a vested interest in proper placement of the generator. Even with baffles to deaden it, engine noise can be a nuisance. Ballasts and dimmers usually hum and can become a concern for sound. Place them as far from the microphones as possible—preferably in another room or outside. Obviously, cell phones must be *off* during rehearsals and filming.

Dimming, light cues, and lighting effects create electrical "noise" in the power supply. The sound cart should be powered via separate utility power. All crew members must check with an electrician before plugging in their own electrical equipment; mistakenly plugging an expensive monitor into a dimmer channel, for example, is an experiment you don't want to be a part of.

Locations

Q: How many fire safety officers does it take to screw in a lightbulb?
A: One, but it's an 8-hour minimum.

A script might call for a city street, department store, hospital, church, factory, private residence, prison, airport terminal, office building, hotel lobby, or postapocalyptic tundra. Many settings can be more easily (and cheaply) filmed at an existing real site than recreated on the studio stage or lot. Whatever the case, the locations department finds, secures, and coordinates the film's locations.

When on location, any questions or problems pertaining to the building or grounds (such as rigging lights to the structure or access to locked rooms or circuit breaker panels) are handled by the building rep or building engineer through the *location manager* or his or her assistants. The location manager must sometimes wrangle tough situations with members of the public or employees of the location. It is best to defer any questions from these people directly to the location manager or the ADs. The location manager obtains permission to place lights in unorthodox places. Any kind of rigging that might do harm to a location or otherwise alarm the owner must be preapproved through the location manager.

Care must be taken not to damage the location. The places that are most at risk of damage are floors, walls, doorway moldings, and garden plants. When a house has hardwood floors, for example, the

grips and lighting technicians can put rubber crutch tips on the legs of the stands and ask that layout board be put on the floor to protect it. Some locations impose restrictions on the use of their property. Working on a period movie, you may well find yourself shooting in a historical building with irreplaceable architectural detail. It is often the location manager's task to enforce whatever rules have been established at the location (and contractually agreed to by the producer), rules that may conflict with the needs of the lighting department. In these situations, keep in mind that it is the director's desire to film the location and it is your job to make it work. It will usually involve extra time and trouble, but it is more important to keep the location manager as an ally and to help preserve good relations with every location the company uses. In the greater scheme of things, it is better for our whole industry if the public views film production as a positive experience.

Transportation

Q: How many teamsters does it take to screw in a lightbulb?
A: Four. You got a problem with that?

The drivers are responsible for operating and maintaining all the production vehicles. In addition to the "production van" (usually a 40-foot truck that carries all the lighting equipment), transportation provides passenger vans to shuttle the cast and crew, stake beds trucks with hydraulic lift gates for delivering equipment, and any other vehicles that are needed. Stake beds are particularly useful on location when equipment needs to be shuttled to several sites in one day or must be dispersed over a large area. Drivers may also be dispatched to make runs to return or pick up equipment from suppliers. It is a good idea for the best boy to give the *transportation coordinator* as much advance warning as possible, as needs arise.

Art department

Q: How many art directors does it take to screw in a lightbulb?
A: Does it have to be a lightbulb? I've got a really nice candelabra we could use.

The construction crew builds the sets, the *set dressers* decorate the set with items not handled by an actor, and the *props department* is responsible for anything that is handled by an actor. Wall lamps, practicals, "oil" lanterns, and the like are provided and placed by the set decorators. Wiring them is taken care of by a lighting technician. During production, the *onset dresser* and his or her helpers are responsible for caring for the furniture and all elements of decoration. If a piece of furniture needs to be moved, or a picture frame removed from the wall, ask the onset dresser to do it. If you do it yourself, it will break; it's an immutable Law of Set Dressing.

Hair, makeup, wardrobe, stunts, special effects, first aid, craft service, and catering are the remaining departments on the set that electricians need to consult from time to time. They are all essential parts of the production and it pays to stay on good terms with every department.

THE GENERAL PUBLIC

One more group with whom you will come into contact, especially when working on location, is the general public. Everyone on a film crew knows how important it is to establish and maintain good relations with the

public. No one knows this more than the location manager. On location, more often than not, a film crew is a guest in someone else's house. We constantly hold up traffic and ask people to be quiet during takes. By our very presence, we often put someone out. Although typically the location is being paid well for the trouble, every flower that gets trampled in the garden, every unthinking curse word uttered within earshot of sensitive ears, and every piece of equipment left in someone's way makes the public less inclined to cooperate and to let us do our work. A disgruntled neighbor may confront the first person he or she sees, sometimes quite rudely. It is the job of the locations manager and production manager to deal with complaints. As lighting technicians, our role in all this is minimal but important. Treat any comment or question from the public with politeness and professionalism. Help the locations manager stop trouble before it starts by pointing any complaints or problems his or her way. Get approval before placing a light somewhere that it is going to annoy civilians; that way, the location manager has a fighting chance at preemptive diplomacy. When locations or production make specific rules or requests with regard to working in a location, know that they are doing so because the issue is *already* sensitive. If they tell you to wrap out quietly, they are doing so because there have *already* been complaints about the noise. Many communities have ordinances that require quiet after 10:00 p.m. and no trucks and work before 7:00 a.m. In cities like Los Angeles, New York, Toronto, and Vancouver, a large segment of the population has had a bad experience with film productions, which makes it very difficult for production to work on location. There are also those who have learned that they can extort money from a desperate production manager and make noise and get in the way until they are paid. As much as possible, these are behaviors we'd like to change.

Okay, let me just finish off the list:

Q: How many stunt men does it take to screw in a lightbulb?
A: Five. One to screw it in and four to tell him how bitchin' he looked doing it.

Q: How many studio execs does it take to screw in a lightbulb?
A: No one knows. Lightbulbs last much longer than studio execs.

Q: How many actors does it take to screw in a lightbulb?
A: 100. One to screw it in and 99 to say they could have done it better.

Q: How many screenwriters does it take to change a lightbulb?
A: The lightbulb is IN and it is staying IN!

Q: How many editors does it take to change a lightbulb?
A: If we change the lightbulb, we'll have to change everything.

Q: How many grips does it take to screw in a lightbulb?
A: Two. One to hold it and the other to hammer it in.

One final note about working with the crew. This entire book is about the nuts and bolts of being a lighting technician. That's the job. But this knowledge is only maybe 10 percent of what makes you a success. The rest is your personal relationships, your ability to listen and communicate, to get the job done smoothly and reliably without ruffling other people's feathers.

BLOCK, LIGHT, REHEARSE, TWEAK, SHOOT

Progress on the set is measured in *setups*. A feature film crew may shoot two or three pages of script a day. For a television single-camera show, the average is four to eight pages per day, typically 20–30

setups per day. The AD and DP work together to determine an efficient shooting order for the needed shots. Conventionally, wider master shots are photographed first, establishing the lighting for the scene. Closer coverage, which usually requires refinements to the master setup, follows.

Although it is convenient when the shooting order is efficient for lighting, the DP and gaffer respect the fact that sometimes the AD may have other priorities. Shot order may be arranged to give precedence, for example, to a particularly difficult performance or a stunt that destroys part of the set, or to finish the work of an underage actor who can work only limited hours by law. Removing and reassembling walls of the set is often necessary to accommodate camera movement and lighting. Because this takes some time and is labor intensive, "wall order" is the kind of thing that the DP and AD want to take into account when planning the shot order.

Ideally, each new scene follows these five steps in order:

1. Block
2. Light
3. Rehearse
4. Tweak
5. Shoot

First the director, the DP, and the actors block the entire scene (i.e., plan the staging). During blocking rehearsal, the set is usually cleared so that the actors and director can work without distraction. The director and principal actors are called the *first team*. Once the scene is ready to show, the AD calls a "marking rehearsal," and all key crew pile into the set and watch. The gaffer, key grip, and camera operators learn a great deal from the marking rehearsal, and they must pay close attention, as this is typically their only chance to observe exactly how the actors intend to play the scene before they have to start lining up shots and begin lighting. The 2nd AC marks the actors' positions with tape at their feet.

Once the scene has been blocked, the actors are sent to makeup and the DP begins setting the shots and then the lighting. Often, the lighting crew has already roughed in some of the lights during a prelight. Stand-ins, who act as models for the gaffer and DP while the lights are placed, replace the actors. The *stand-ins* are known as the *second team*. The camera crew sometimes rehearses complicated camera moves using the stand-ins to save the principal actors from technical rehearsals. When there are lighting cues during the shot, and the second team rehearsal is the lighting crew's best opportunity to rehearse them and make adjustments.

Once the lighting is in place, the AD calls the first team back to the set for final rehearsal. He or she calls, "Quiet please. Rehearsal's up." The actors run through the scene with the camera and sound crew to iron out any remaining problems. The AC gets final focus marks. After one or two rehearsals, the scene is ready to shoot.

A basic piece of set etiquette that every crew member knows: stay clear of the actors' eyelines during rehearsals and takes. Be mindful of the level of concentration that acting requires, and cause as little distraction as possible.

Block, light, rehearse, tweak, shoot is a paradigm that provides all the crew members the information they need to act independently to bring all the details of the shot together smoothly. Nonetheless, there are times when some directors and ADs would clearly prefer to bypass the first four steps. The truth is lighting without blocking first always causes delays when the actors arrive and do things differently. The crew needs to actually *see* a blocking rehearsal. This gives the crew almost all the answers they need to prepare the scene. Not doing so leads to a barrage of unanswerable questions from every

department. Trying to shoot without rehearsing and tweaking almost always results in delays while problems are addressed, followed by retakes. The DP needs an opportunity to tweak the lighting after the final rehearsal because inevitably the actors will sometimes need to do things differently than they rehearsed, or differently than the stand-ins did it. During the final rehearsal, the DP will often see a problem that needs to be addressed before shooting. When time seems like a luxury the director cannot afford, it is far better and faster to block quickly, light quickly, rehearse quickly, tweak quickly and shoot, than it is to shoot now and ask questions after.