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FLASH PICTURES

FLASH PICTURES

SIXTH EDITION
FIRST PRINTING, 1965

Things change fast in the world of flash photography. There are new bulbs, new films, and new kinds of flash equipment. This new edition of *Flash Pictures* has up-to-date information on these new products. It contains an expanded section on fill-in flash, new information on flash with color films, and information on the use of remote or "slave" flash units.

This is one of a whole series of Data Books published by Kodak on black-and-white and color photography. They include information on photographic techniques, processes, and materials in the amateur, professional, industrial, scientific, and graphic arts fields. Each Data Book is a self-contained unit, punched for insertion in the *KODAK Photographic Notebook*, a metal-ring binder.

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Page

Introduction 3

Finding the Right Exposure 4

There are different ways of finding the right exposure—using flash guide numbers, tables, and other aids. This section tells how to use them and describes some factors that affect exposure.

Techniques for Better Pictures 6

Some tips on how to improve your flash pictures by telling a story, controlling the flash position, and learning good flash habits.

Flash Away from The Camera 14

Sometimes flash away from the camera produces better modeling. It has other advantages, too. This section describes when and how to use flash away from the camera.

Multiple Flash 20

Two heads—and two flashbulbs—are often better than one. Here's how to use two or more flashbulbs with extension or remote slave units.

Fill-in Flash 26

Flash is useful for filling in shadow areas in outdoor pictures, or in pictures made inside near a window. Here's how to use flash for fill.

Open Flash 29

The old-time method of making flash pictures without a synchronized shutter still has some valuable uses.

Flash With Color Film 30

Using flash with color film is a little different from using it with black-and-white films. Some ways to improve your flash color shots.

Electronic Flash 31

Electronic flash is different from conventional flash in several ways. Here are the things you need to know to use electronic flash intelligently.

How Flash Equipment Works 38

All about power supplies, synchronization, and differences between flashbulbs.

Tables of Flash Exposure Guide Numbers 48

Flash Safety First 53

Whumpf!

FLASH PICTURES

• "Whumpf!" went the flash powder, accompanied by an eerie glow and followed by dense clouds of acrid smoke. That's the way flash pictures were made a scant thirty years ago, and a hardy undertaking it was. If you used too much magnesium powder, you might end up photographing a burning building instead of your family. Each shot filled the room with so much smoke that you could play a quick rubber of bridge while the haze cleared between exposures. Synchronization between the flash and the shutter was unknown. You just put the camera on a tripod, opened the shutter, and let her rip, hoping you could get the shutter closed again before your subjects moved too much.

If all this sounds like a pretty nerve-shattering experience for the subject, pity the poor photographer. The following warning appeared in a KODAK Flash Manual of 1920 vintage: "As some subjects may become nervous during your preparations for the exposure, do not neglect to reassure them, avoiding all appearance of nervousness yourself, proceeding calmly and slowly with each operation."

Fortunately for all concerned, you no longer need the combined talents of a psychiatrist and a fireman to take flash pictures. Flash today is simple, safe, and effective. Even inexpensive cameras have built-in synchronization to assure that the wink of the shutter will coincide with the flash of your bulb. Hundreds of millions of flash bulbs are used every year to make some of the most enjoyable pictures ever taken – new babies in the hospital, Christmas morning under the tree, weddings, parties, and all the other indoor activities that brighten our lives. Flash pictures freeze these happy moments on film for us so that we can enjoy them over and over again. We hope this booklet will help make your flash pictures more fun to take and to see.

Finding The Right Exposure

With any type of flashbulb and flasholder, the most important thing affecting exposure is the distance from the flasholder to the subject.

If you are using a simple, non-adjustable camera, just make sure that the distance from the flasholder to your subject is within the range recommended for the type of film and flashbulb you are using. Most equipment manufacturers put these distance ranges for various films on the flasholder or camera, or in their instruction books. If so, it is best to follow that information, because it applies to that particular flasholder and camera. Subjects that are closer than the recommended range are likely to be overexposed and to come out too light in the picture. Subjects that are beyond the recommended range are likely to be underexposed and to come out too dark.

If your camera has provision for adjusting the lens opening, you can close down the lens to avoid overexposing very close subjects, or you can open the lens diaphragm to avoid underexposing more distant subjects. How do you know what lens opening (f-number) to use? The easiest way is to use the Flash Exposure Sticker for the film, bulb, and reflector you are using. Measure or estimate the distance (in feet) from the flasholder to your subject; locate this distance on the footage scale of the Flash Sticker; in the block below it, read the f-number at which to set your lens. You can get a set of Flash Exposure Stickers for the more popular KODAK films, flashbulbs, and reflector types from your Kodak dealer. Just peel off the appropriate sticker and stick it to your flasholder, camera, or camera case, so you will always have it handy.

For special situations, or if you don't have the Flash Exposure Sticker, you can use the guide number for your film-bulb-reflector combination. Just divide the flash distance into the guide number—the answer is your f-number.

There are various aids available to help with this arithmetic. The tables on page 52 have done the calculations for four popular color films. The KODAK *Snapshot Dial* automatically divides any guide number by any distance and shows the correct f-number.

Some cameras, such as the KODAK Automatic 35R4 and MOTOR-MATIC 35R4 Cameras, have a guide-number scale engraved on the lens mount. You simply set the arrow at the proper flash-exposure guide number, and a coupling between the focusing adjustment and the diaphragm automatically sets the proper lens opening for any distance from about 5 feet to 25 feet. With KODAK INSTAMATIC 704 and 804 Cameras, the film-speed notch in the KODAPAK Cartridge causes the correct flash guide number to be set inside the camera. The guide number takes into account the speed of the film you are using, the amount of light from the flashbulb, the effectiveness of the flash reflector in concentrating the light on the subject, and the effect of the shutter speed.

On pages 49 and 50 there are tables of guide numbers. One table is for blue flashbulbs, the other is for clear flashbulbs. Here's how to find the guide number you should use. First, in the lefthand column find the film that you are using; for that film, guide numbers are given for all of the popular flashbulbs. Find the column for the flashbulb you are using. Then select a shutter speed. (In most cases, especially if you are in doubt, it is best to use a 1/25 or 1/30 second shutter speed.) Note that the guide numbers in the tables are for polished, bowl-shaped reflectors of suitable sizes for the various bulbs. For other types of reflectors, you'll need to modify the numbers as indicated.

Remember, guide numbers are just that—guides. They work under average conditions. But what do you do when you see a guide number on the film instruction sheet that is different from the guide number on the flashbulb package, which is different from the guide number on the flasholder or in the camera manual? Which number should you use? Well, in most cases it is best to start with the guide number that comes with the camera or flasholder, because it is based on tests made with that type of equipment. In any event, you will be wise to do a little testing on your own to make sure of the best guide number to use. A suitable test procedure is described on page 33.

Techniques For Better Pictures

Early in the game, we should dispose of a few fairly obvious faults found in many flash pictures. First of all, watch out for mirrors, windows, shiny walls, or any other glossy background that might bounce the light back into your lens. Just stand at an angle to such surfaces, so that the light will not reflect directly back at you.

The second thought concerns the location of the flash unit – keep it *above* your subject. On some cameras, the flash unit attaches to one side. It's easy to position the flash at the bottom of the camera for vertical pictures; but don't do it! Light coming up from below the subject is strictly for horror movies. Don't kneel and shoot up at a standing subject, either, because it produces the same unflattering results.

And finally, try to keep your subject at least several feet from the wall or background. If you don't, you'll cast a beautifully dark and terribly distracting shadow against the nearby wall. On the other hand, if you get too far away from the background, you might end up with a well-exposed subject that stands out like a "cutout" from the dark, distant (and therefore underexposed) background. Before you chuck out your equipment in discouragement, remember that putting your subject about 5 feet from the background will eliminate both problems.

Shadow frames vanish when a subject moves away from the wall.

Holding a flash holder high and to one side of your camera often helps the quality of flash snapshots, but not when it's aimed at a mirror! Watch out for shiny walls, windows, and other glossy surfaces. Moving the flash unit to one side will avoid a bounce-back from the light.

Bundles of flax are broken on a hand-operated machine as the first step in making linen. A single flash at the camera was used for all these pictures.

Next, the fibers are combed out so they lie straight. Fill-in flash was used for this and the preceding picture. The shadow tells you this scene is back-lit.

The familiar spinning wheel was used to spin the fibers into a continuous thread.

It's easy to make your flash pictures more interesting by telling a story. This series was shot at Colonial Williamsburg, Virginia. It shows how linen was made in Colonial times.

TELL A STORY

The best pictures, flash or otherwise, are taken of people doing natural, logical things: mother knitting, dad reading the paper, children playing with a favorite toy. The best pictures – whether they're still or movies, black-and-white or color – tell an interesting story. A good flash project on a miserable day would be recording a day in the life of some member of the family, showing his activities much as the picture magazines do in their photo-essays. Or, just take a small slice of action, such as baby's bath or mother baking a cake, and make a series of pictures that show the steps in story-telling sequence. Although much of this booklet deals with mechanics – the nuts and bolts – of flash pictures, *what* you photograph is almost as important as how well you carry it off technically.

LIGHT POSITION AND DIRECTION

It's a fact of life that objects that are close to the flash will receive more light than more-distant objects. This often leads to pictures in which hands, arms or other areas close to the light look too bright,

The thread was collected on this four-armed spindle device, sometimes called a "weasel."

The thread was woven into linen cloth with a large wooden loom like this one.

Here's a close-up view of the operation. Use lots of close-ups to show details.

The logical way to end a picture story of this sort is with a shot of the finished product.

Flash on the camera is quick and convenient but tends to produce flat lighting.

An off camera flash moved to the left rear, puts the emphasis on the knitting and produces a pleasing highlight on the model's hair. A reflector was used to fill in the shadows.

while the face looks dark. The answer is to find a position that puts the most light on the most important areas of a scene. You can usually do this by putting the flash above the subject. Always try to aim the main part of the light at the center of the most important point of interest. The thing you want to emphasize in the picture will receive the most light; subordinate, foreground objects will be illuminated by light "spilled" from the edges of the reflector. This technique of using weak light from the edge of the flash to light the foreground is sometimes called "feathering" the flash.

Light-toned walls and surroundings reflect a good bit of your bulb's light, helping to fill in shadows and equalize the brightness over the whole scene. Try to take advantage of such surroundings.

The off camera flash placed high on the right produces pleasing modeling, but notice the harsh shadow on the left side of the face.

The off camera flash placed high on the right with a reflector to fill in the shadow area balanced the lighting.

A single flash unit at the camera produces strong, flat front lighting. It's not very "arty," but it's perfectly adequate for recording most family activities.

Flash At The Camera

To most photographers, using a single flash at the camera is the simplest and most straightforward method of making flash pictures. Flash at the camera is unquestionably simpler and more convenient; and used with care, it yields such consistently good results for most subjects that we urge its use for most flash pictures.

Exposure is especially easy with flash at the camera, because the flash-to-subject distance and the camera-to-subject distance are always the same. When your camera has a rangefinder, a glance at the focusing scale will give you the flash-to-subject distance in feet — the number you divide into the guide number to find the right lens opening.

Flash at the camera has been made even easier with the advent of the "flashcube"—a precision assembly of four tiny AG-1 flashbulbs. Each bulb is accurately positioned in a mirror-bright parabolic reflector. The bulbs and reflectors are enclosed in a transparent shell and

You can snap four flash pictures within seconds and record all the tears and smiles of a boy's first haircut with a KODAK INSTAMATIC Camera and a flashcube.

are mounted on a base that fits a rotating socket on top of certain KODAK cameras, such as the KODAK INSTAMATIC 104 Camera. The flashcube rotates automatically after each flash shot.

Having the flash close to the camera's lens occasionally results in a disconcerting effect called "red-eye." In color pictures, the subject's eyes look red or amber in color; in black-and-white pictures, the pupil may look whitish. This effect is caused when the light from the flash is reflected by the chorioid layer of the eye, which is behind the retina. Red-eye is more common in pictures of children than of adults, and usually occurs when pictures are made in a dimly-lit room; in such lighting, eyes are necessarily dilated. You can reduce red-eye by having your subject look at a bright area just before you take the picture.

If you are using a flashcube, mentioned above, an extender is available to increase the separation between the cube and the lens, which helps to prevent red-eye.

GROUP PICTURES

Figuring the exposure for pictures of one person is no chore, but what do you do when a group is involved – people sitting around a table, for example? Some are considerably closer than others, so what flash-to-subject distance do you use for figuring the lens opening? With flash on the camera, about the only thing you can do is calculate the distance to the middle of the group and make a compromise exposure. With black-and-white film, the exposure latitude will usually give satisfactory results. In color pictures, you'll have to live with the fact

that the nearest people will be somewhat overexposed, while those more distant will be a little on the dark side. It does help to get as far away as possible, because that reduces the relative distance between the flash and the nearest and farthest people in the group.

LIGHTS IN THE ROOM

In that 1920 KODAK Flash Manual we quoted from earlier, the photographer was advised to turn on all the lights in the room. The reasons were that the films were slow and that the flash powder gave various amounts of light, depending on how much you used. You needed all the light you could get.

Today's flashbulbs provide all the light you need for most scenes, but there's still an advantage to using the normal room lights. Here's why. The flash itself is pretty strong and harsh. The lighting it provides looks nothing like the normal inside lighting you're accustomed to. But if you'll use a slow shutter speed, enough of the room lights will register to soften the shadows and give a more natural appearance.

You can use this technique in various ways. If you've ever taken a flash picture of a lighted Christmas tree, you may have been disappointed to find that the tree lights didn't look at all bright. The answer to this problem is to use a slow shutter speed – 1/30 second is good – and a small flashbulb – because it requires a bigger lens opening than a large bulb. This combination of a slowish shutter speed and a big lens opening gives the lights time to register on the film while the bulb is lighting up the rest of the tree.

In a large room, such as a gymnasium, you can use the same technique to record distant walls that are far beyond the carrying power of the flash. The flash lights up the foreground action and "stops" it, to some extent, while the existing room lights illuminate the background.

Flash Away From The Camera

While flash at the camera takes top honors for convenience in capturing spontaneous expressions, a single flash away from the camera has a definite place in creating special moods and lighting effects. Two inexpensive tools that will let you make off-camera flash pictures are a flash extension cord and a KODAK Flexiclamp. Such cords are sold by some photo dealers, or can be improvised to provide a connection between your camera and the flash unit. The KODAK Flexiclamp is a talented piece of hardware – made much like a carpenter's "C" clamp – that holds your flash unit firmly on any chair, table, car window, or other flat surface you might have handy.

Be sure your batteries are fresh and strong, to provide the extra kick needed to trip the flashbulb at the end of a long extension cord– the longer the cord, the higher the electrical resistance.

IMPROVED MODELING WITH LIGHT

When do you use off-camera flash? Well, certainly when you want to provide "character" modeling on your subjects. Position your flash higher and to one side of the camera, and you eliminate the flat, washed-out front lighting produced by on-camera flash. Moving the flash farther and farther from the camera produces deeper and deeper shadows on the subject.

One use of off-camera flash is to simulate other lights. Here, an extension was placed outside the window to give the impression of moonlight streaming in.

The "fire" in this fireplace is a flash placed on an extension. The cord is hidden behind the wood basket.

SIMULATING OTHER LIGHTS

An off-camera flash provides a convenient way to simulate other kinds of light. Placing your bulb in a fireplace, for example, produces a good facsimile of firelight shining onto the people gathered before it. An off-camera flash unit can also be the "candle" in a jack-o-lantern, or it can be placed to simulate light coming through a window. You can also place a remote flash outside of the picture area to simulate light coming from a lighting fixture that's visible in the picture.

An off camera flash is the "candle" in this jack-o'-lantern.

You can use a flash placed low and near the fire to provide a firelight effect. Pictures of bonfires or beach fires don't look real when they're made with a flash unit on the camera. A fairly long shutter speed (1/30 second) helps to record the fire on the film.

An extension flash placed inside the car provides more realistic lighting than flash at the camera would have. It avoids the problem of flash bouncing back from the window or shiny surface of the car, too.

Many types of flash equipment are designed so that their reflectors can be removed for making reflectorless flash pictures.

Reflectorless flash produces this soft, glare-free, almost shadowless kind of light.

BARE-BULB FLASH

Here's a technique that yields pictures with excellent tonal quality and a soft, natural appearance. If you can conveniently remove the reflector from your flash unit, give it a try, for some pleasantly surprising lighting.

Have your reflectorless flash unit on a cord at some distance from the camera. Place it high and to one side, holding it in place with a KODAK Flexiclamp if it's convenient; or have a partner hold it for you. Put a clear plastic bag over the bulb to prevent flying glass, just in case that one-in-a-million bulb should shatter when you fire it.

Now when you make the picture, your flash will provide both direct light and light reflecting from the surroundings. If the picture is made in an average-size room that has light walls, the resulting lighting seems as effective as multiple flash. The highlights have a soft, luminous quality, and the shadows are transparent, showing fine detail. The photograph looks very much as the original scene did by natural light. Fan-fold reflectors can be used in their folded-up position for bare-bulb results.

Since there's no reflector to concentrate the light in one direction, you need a wider lens opening. The amount of the increase depends mostly on the reflecting power of the surroundings and on the flash-to-subject distance. In fact, the size and color of the room are very important when a reflector is not used. It's hard to make a rule to cover all picture situations, but for trial, allow two-lens-openings more exposure for a picture made with reflectorless flash than you

When you aim your flash unit at the ceiling, the diffused light that reflects from the surroundings is soft and pleasing, similar to lighting outdoors on an overcast day.

would use for the same picture made with a reflector. The bigger the room, the greater the exposure increase needed.

Reflectorless flash is useful outside, too, to fill in shadows on side- or back-lighted subjects. See page 26 for more on fill-in flash outside.

BOUNCE FLASH

The light hits the ceiling in this technique, which lets you duplicate the soft, hazy sunlight that makes possible such pleasant pictures of people outdoors. Aiming your flash unit at the ceiling or a corner of a room lets the light bounce down on the subject to produce soft, pleasing illumination. Obviously, light-colored surroundings reflect more light than dark ones, and require less exposure. With color film, stick to white or almost-colorless ceilings, because the colors reflected from the surroundings can turn your subject an unappetizing pastel color.

Exposure depends on the size and color of the room and the total distance the light has to travel from flash to ceiling and back down to the subject. As a rule of thumb, use at least two-stops more exposure for bounce flash than for direct flash at the same distance.

Here are two more examples of bounce flash. Notice the extremely soft, even quality of the light. For a given film, exposure depends partly on the size and color of the room, partly on the total flash-to-subject distance.

Using two or more flash units helps you to create a sense of depth and drama with cross lighting.

Multiple Flash

There's no question but that excellent flash pictures can be made with a single flashbulb. There's also no question but that you can almost always make better pictures with more than one bulb. Multiple flash gives you more versatility and lighting control, improves modeling, and helps reduce lighting contrast.

EXTENSIONS AND SLAVE UNITS

Multiple-flash pictures are almost always made with one flash at the camera and another high and to one side of the subject. The mechanical problem is how to get both bulbs to flash at the same time. Flash extension cords supply one answer to the problem. Some flash units are made so that extra units can be plugged into them by means of

A remote "slave" unit placed high and to the right provided the main light for this picture, while a flash unit at the camera filled in the shadows.

Notice the pleasing roundness and modeling produced by using multiple flash.

A KODAK Electric-Eye Remote Flash Unit is useful for making multiple-flash pictures like this without having to string electrical wires.

electrical extension cords. If you have such equipment, it will do a satisfactory job.

Another, somewhat more convenient, way to set off remote flashbulbs is with a so-called slave unit. Slave units are self-contained flash units, not connected to the camera by wires. They are triggered by the light from a bulb which *is* attached to the camera. You can flash any number of slave units from a single flash at the camera. Slave units have the obvious advantage of needing no cords, which have to be strung out, stored, and kept in repair.

TYPICAL SETUPS

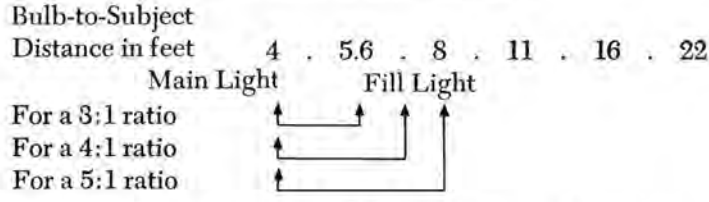
When you're picturing a person (as opposed to a large group, an interior, or some other subject), you get pleasing lighting by having one flash unit on the camera and a second flash higher, to one side,

You can often identify pictures made with more than one light by looking at the eyes of the subject. The two highlights in the dog's eyes tell you that two lights were used to make the picture.

With multiple flash you can illuminate the background separately from the main subject to eliminate shadows, reduce contrast, and produce more realistic lighting.

and closer to the subject. The extension, or slave, unit should be the "main" light, creating the shadows and depth in the scene. The flash at the camera acts as the fill-in light, reducing contrast in the shadows made by the off-camera flash. You can control the intensity of each light by bulb size or distance. The off-camera flash must be hidden from the camera lens, but the slave photocell should "see" the lamp fired by the camera shutter—a good trick!

If you want to get technical about it, you can control the lighting ratio exactly by placing the lights as shown below. This table applies to flashbulbs used in flash units of similar design.



Consider that the bracket for each ratio can move along the footage scale. For example, a 4:1 ratio with the main light at 8 feet puts the fill light between 11 and 16 feet — or at 13 feet. Notice, too, that the footage scale is the same as the aperture numbers on your lens — which makes a handy way to remember the whole thing.

The following table gives actual distances for different lighting ratios, but it's designed specifically for use with the KODAK Electric-Eye Remote Flash Unit — triggered by a flash at the camera which has a polished, bowl-shaped reflector. The "slave" unit in this case has a very shallow reflector; it produces a wider but weaker beam of light than a polished, bowl-shaped reflector. The following table takes this difference in reflector efficiency into account. It's based on use of the same type of bulb in each unit.

DISTANCES FOR CONTROLLING LIGHTING RATIOS WITH THE *KODAK* ELECTRIC-EYE REMOTE FLASH UNIT (SAME TYPE OF BULB IN SLAVE AND AT CAMERA)

	Distance from Flash Unit* on Camera to Subject (in feet)						
	5	7	10	14	20	28	40
Lighting Ratio	Slave-Unit Distance (similar bulb)						
1:1	3	4	6	8	12	16	24
2:1	2	3	4	6	8½	12	17
3:1	1¾	2½	3½	5	7	9½	14
4:1	1½	2	3	4	6	8	12

*polished, bowl-shaped reflector

Any number of these KODAK Electric-Eye Remote Flash Units can be triggered by a flash at the camera, at distances up to 30 or 40 feet.

SYNCHRONIZATION FOR MULTIPLE FLASH

When you're using slave units, both the flash unit at the camera and the remote units should reach their peak brilliance while the shutter is open. After the shutter release is pressed, medium-peak, or Class M, bulbs (No. 5, 25, M5) take about 20 milliseconds to build up maximum brilliance. (You can read all about different types of bulbs and synchronization starting on page 38.) If you also use Class M bulbs in the slave unit, they take 20 milliseconds after the slave unit is triggered to reach their peak brilliance.

Under favorable conditions, the slave unit will trigger somewhat before the camera light reaches peak; but even so, there will be a delay—around 10 to 15 milliseconds with Class M bulbs, or around 5 to 12 milliseconds with AG-1 bulbs. Thus, it is unwise to use shutter speeds higher than 1/60 second when working with slave units, and it is safer to stick to 1/30 second.

If the camera shutter has adjustable synchronization, it should be set for the type of flash used at the camera—"X" for electronic flash, "M" for medium peak bulbs, etc.

EXPOSURE

Although you may be using two bulbs to light a single subject, each bulb is (or should be) illuminating a different part of the subject. So use the same exposure you would use for a single bulb. If you are aiming two or more bulbs on the same part of the subject just to get more light, the following rules apply.

For 2 bulbs, multiply the single-flash guide number by 1.4
For 3 bulbs, multiply by 1.7
For 4 bulbs, multiply by 2

Fill-In Flash

Using your flash unit to make outdoor pictures in bright sunlight might seem as silly as entering your beagle in a cat show. As a matter of fact, though, flash is an almost indispensable tool for making crisp, high-quality outdoor close-ups.

The reason is fairly obvious when you think about it. Bright sun is hard to look into without squinting. Even if you can manage not to squint, the sun creates harsh, dark shadows that are most unflattering.

The alternative to looking *at* the sun is looking *away* from it. But then there's a new problem, since the shadow side of backlit subjects is quite dark. The answer is fill-in flash—the technique of lighting up shadows with the light from a flashbulb or electronic flash unit. Nothing quite beats the fill-in-flash technique for making sharp, beautifully-lit pictures of nearby subjects, especially when you're using color film.

Blue flashbulbs or electronic flash are needed to produce light with a color balance close to daylight. All of the subject must be illuminated by light of the same color quality for proper color balance in the finished color picture.

To preserve the natural sunlit effect, light from the flash must lighten the shadows—not eliminate them. The relative amount of fill-in light can be controlled, as explained below.

LIGHTING RATIO

Fundamentally, fill-in lighting is a matter of lighting ratio. The exposure required for the filled-in areas bears a ratio to exposure for the sunlit parts. For subtle effects, the ratio is about 1:4; for a more pronounced result, 1:2. The amount of fill-in is never related to film speed, but only to the intensity of sunlight already on the subject.

Since flash exposure is not continuous, you cannot see and adjust the fill-in beforehand. The data you do have for flashbulbs is in terms of guide numbers or is derived from them. So, our approach will be based on guide numbers.

Just as in flash photography indoors, the amount of fill-in light on the subject from the flash depends on flash-to-subject distance. The amount of sunlight does not depend on the distance between the camera and the subject. This is why fill-in flash technique differs from that for indoor flash photography. When you follow the usual

The shadow side of back-lit subjects is quite dark unless it's illuminated by light from a flashbulb or electronic flash.

The Fill-in Flash Computer in the *KODAK Master Photoguide* simplifies exposures for fill-in flash.

flash-exposure table (for indoors) you generally use the same shutter speed for all flash shots, and set the lens opening according to flash distance. Outdoors, you also set the lens opening according to flash distance, but in addition you must adjust the shutter speed for proper sunlight exposure. (This assumes either electronic flash or an M-synch shutter with flashbulbs.) Set the shutter so that it will give you the proper daylight exposure with the lens opening required for flash.

The usual flash table or guide number, when used outdoors, results in about half or even a quarter of the exposure that it does indoors, because there are no walls and ceiling to reflect the light. Since we want a quarter to half of full flash exposure for fill-in light, we can therefore use the usual guide numbers, even for fill-in flash.

BETWEEN-THE-LENS SHUTTERS

If you have an electronic flash unit and a camera with "X" flash synchronization, you can get the same amount of fill-in flash over a wide range of distances. This is because electronic-flash guide numbers are the same *at any shutter speed* for a given film. (Guide numbers for regular flashbulbs get smaller at faster shutter speeds.) Here's

an example of how the technique works. Let's suppose you're using a 64-speed film, such as KODACHROME-X. All the following combinations of lens openings and shutter speeds produce the correct exposure for bright sunlight:

1/30 at f22; 1/60 at f16; 1/125 at f11; 1/250 at f8; 1/500 at f5.6.

Now let's assume you have an electronic flash unit with a guide number of 110 for a 64-speed film. At f22, your flash distance would be five feet (f22 goes into 110 five times). At f16, your flash distance would be seven feet (16 goes into 110 seven times). At f11, the flash distance would be nine feet. At f8, you would be 13 feet from the subject. At f5.6, you would be 18 feet away. In other words, you can keep the amount of fill-in flash constant over a wide range of distances by using different combinations of lens openings and shutter speeds. Such figuring is done for you by the Fill-In Flash Dial in the *KODAK Master Photoguide.*

You can exercise similar control, but to a lesser degree, with Class M flashbulbs (such as M5B's) and the shutter set for "M" synchronization. Use the same approach as with electronic flash: small lens openings with slow shutter speeds for close subjects, or large lens openings with higher shutter speeds for more distant subjects. Depending on the timing of your "M sync," this control may extend to 1/250. A few trials will tell you.

Flash was used here to balance the daylight outdoors and to keep the people from becoming silhouettes against the bright windows.

FILL-IN WITH FLASHBULBS AT 1/30 SECOND

The distance range possible is quite limited, but fortunately is in the close-up region where it is needed most. Using 1/30 sec to synchronize the flashbulb demands an f-number of f22 for 64-speed films for proper exposure of sunlit parts. This f-number in turn limits the range of the flashbulb. There are so many variations of reflectors, bulbs, etc., that we suggest you try a few tests in the 3½- to 8-foot range to find what applies to your equipment. You may be able to use 1/60 sec with the AG-1B bulb, even with shutters designed to sync only at 1/30. Exposure times of either 1/30 or 1/60 demand a firm grip to avoid camera movement.

Fully Automatic Cameras are limited as to their fill-in range, but fortunately, the range is where it is needed most: in close-ups. KODAK INSTAMATIC 704 and 804 Cameras give quite acceptable fill-in in the 4- to 8-foot range when a flashbulb is used in the ordinary way.

It would be difficult to overstress the importance of fill-in flash as a technique for improving the pictures you take of people in bright sunlight. Try it!

Open Flash

Before shutters were synchronized for flash, *all* flash pictures were made by the "open-flash-close" technique. That is, the shutter was opened, the bulb was flashed by hand, then the shutter was closed.

This technique is still useful in some situations. Indoors, where the light is dim, you can open the shutter and "paint" a whole room with light from repeated flashes of bulbs or an electronic flash unit. Open flash is also useful for "burning in" dim lights, such as candle flames, while you flash the lamp by hand.

Obviously, you can only use open flash where there is very little existing light. Otherwise, the picture might be overexposed by the long exposures needed. A tripod or other firm support is a must for holding the camera immobile while the flashing is going on.

When a team approach is used, open flash is good for getting the light where you want it when you have no extension cord. The camera operator opens the shutter, the flash man shorts out the flash unit with a paper clip, and the camera man closes the shutter again.

Flash With Color Film

Almost everything that's said in this book about flash applies to color films as well as to black-and-white films. There are some differences you should know about, though.

Color films are "fussy" about the color of light they require. All KODAK color slide films meant for daylight require blue flashbulbs. Recently, KODACOLOR-X Film was changed in recommendation to blue bulbs. Using blue bulbs also for black-and-white films prevents mistakes. So, go blue all the way!

Most photographers who use Daylight Type color films with electronic flash get pictures of good color balance. If your electronic flash pictures are a little too blue, try a "warm" filter, such as the KODAK Light Balancing Filter No. 81B to improve the color balance.

Exposure is somewhat more critical with color reversal films (the kind that make color slides) than with color negative films. KODACOLOR-X Film can tolerate quite a bit of overexposure (at least two stops), but the quality of prints and transparencies made from underexposed KODACOLOR negatives is poor, and gets poorer as underexposure increases.

The contrast of color films is greater than that of black-and-white films. This means that lower lighting ratios usually produce better color pictures. Dark materials, such as blue and green fabrics, need about 50 percent more light than skin tones to photograph correctly in color. Light-colored materials need less light to reproduce as the eye saw them in the original scene. To reduce lighting contrast, extra light should be thrown into shadows and dark areas of the scene — which makes multiple flash especially valuable for color pictures. With more than one flash unit, you can light a dark background separately from the main subject or minimize shadows with fill lighting.

A good way to reduce lighting contrast with a single light is to use the bounce-flash or reflectorless-flash techniques described on pages 17 and 18. You do have to be careful to avoid strongly colored surroundings with these techniques, though, because the bounced light reflects some of the color onto the subjects and can turn them an unappetizing pastel color.

You'll find many helpful hints on flash photography with color film in the KODAK Data Book, **Adventures in Indoor Color Slides,** which is sold by Kodak dealers.

Electronic Flash

More than a hundred years ago, William Henry Fox Talbot took a picture of a newspaper, and that really started something. The newspaper was a rapidly whirling page from the *London Times*. The light source was an electric spark whose duration was so brief it stopped the action dead. It was the first "electronic flash."

Today electronic flash units are becoming increasingly popular with serious photographers. Light, compact power supplies have replaced the cumbersome generators and Leyden jars used by Talbot, and modern electronic flash units have much to recommend them:

- Each flash tube is good for 10,000 or more flashes.
- The color quality of the light is very close to that of daylight. This means you can standardize on daylight-type film for both indoor and outdoor use.
- Electronic flash is ideal as fill-in for outdoor shots.
- The cost-per-flash is quite low.
- The flash duration of most portable units is 1/500 to 1/2,000 second – fast enough to freeze fast action and eliminate camera movement, yet slow enough to avoid reciprocity effects (lowered contrast and speed changes at extremely short exposure times).

- Because the flash is so brief, it is easily synchronized with the shutter. All the light is used. It's easy to check synchronization.
- Electronic flash guide numbers are the same at any shutter speed. Most good things have their disadvantages, and electronic flash is no exception. Among its drawbacks are these considerations:
- The required recycling time prevents rapid sequence shooting.
- The same battery will fire fewer electronic flashes than it will flashbulbs.
- With focal-plane shutters, it can be synchronized only at such slow speeds as 1/25 or 1/50 second. With between-the-lens shutters, however, the "X," or no-delay, setting of the synchronizer allows the electronic flash to be used at any shutter speed. (Check your camera instruction manual to make sure your camera has proper synchronization for electronic flash.)

EQUIPMENT

There is a wide variety of electronic flash units on the market, ranging from the large, high-output studio units to small portable units.

Basically, an electronic flash unit consists of one or more condensers which are charged by a high-voltage supply. These condensers are discharged, by means of suitable triggering circuits or relays, through a tube usually filled with xenon gas. In the large high-output units, the power supply consists of a transformer which steps up the 115-volt alternating current to 2000 to 4000 volts. This high-voltage alternating current is changed to direct current by a suitable rectifier and applied to the condensers. In the lighter, more portable units, wet or dry batteries are used, in conjunction with a vibrator, transformer, and rectifier, to supply the necessary power. With the introduction of low-voltage flash tubes, the circuits have been simplified so that the units might well be compared to a B-C flash system. A high-voltage dry battery of 240 or 450 volts is connected directly to one or more condensers with a relatively high capacitance. By a suitable triggering circuit, the tube is made to fire either with an external synchronizer or by using the flash contacts built into the shutter.

LIGHT OUTPUT

The light output of an electronic flash unit depends on several things – such as the energy applied to the flash tube (measured in watt-seconds), the efficiency of the tube, the efficiency of the reflector, the distribution of the light from the reflector, and the number of flash heads being fired from a single power source.

DETERMINING YOUR OWN GUIDE NUMBERS

People continue to flub flash pictures simply because they're working from inaccurate guide numbers. Whether you use electronic flash or flashbulbs, the best way to determine a guide number that matches your equipment and shooting conditions is by actual photographic test. Here's how to determine your own personal flash guide numbers.

Put a subject in typical surroundings exactly 10 feet from the flash. Measure, don't guess. Load your camera with a reversal film, such as KODACHROME II or KODAK EKTACHROME-X Film. Using the recommended shutter speed for your camera and flash unit, make a series of exposures at half-stop intervals.

For each exposure, use a felt marking pen to print on a sheet of typing paper the aperture you're using; then have your subject display it in the picture. If you're using electronic flash, be sure to allow time for the condensers to recharge fully.

Use normal projection conditions to pick the processed slide with the best exposure. Multiply by 10 the lens opening used to make that picture. The answer is *your* guide number for that film-flash combination.

This simple test is the cheapest flash insurance we know of. Why not try it?

Tests shot on KODACHROME II Film for Daylight with electronic flash. Shooting distance: 10 feet. The best slide was made at f11. So the guide number for this film-flash combination is 110.

Use fill-in flash to light up the harsh shadows created by backlighting or sidelighting. The Fill-in Flash Dial in the *KODAK Master Photoguide* makes it easy to determine your camera settings.

CHECKING SYNCHRONIZATION

If you have any doubts about whether your camera is synchronizing properly with any kind of flash, you can make a quick check if your shutter will operate when there is no film in the camera. Open the camera's back, put the flash in front of the lens, and fire it as you look through the lens from the back. The lens should be wide open. If you see a round spot of light through the lens, synchronization is probably all right. If you see the outline of your shutter blades (or no flash at all), the flash is not properly synchronized. Your camera dealer will check the trouble for you.

SHUTTER TIME

Since the duration of electronic flash is so extremely short, varying the shutter speed has no effect on the exposure. But where other strong light is present, especially sunlight, use a fast enough shutter speed to stop the action. This will avoid double or ghost images. But, if stopping action is not a problem, and if remote background detail is wanted, use a relatively long shutter time, say 1/25 second.

DEVELOPMENT TIMES WITH BLACK-AND-WHITE FILMS

A few KODAK sheet films require some increase in development time when exposed with electronic flash equipment. The sheet films requiring adjustments in development times are these:

	Increase in Development Time
KODAK Portrait Panchromatic Film	30%
KODAK Super Speed Ortho Portrait Film	30%
KODAK Super Panchro-Press Film, Type B	30%
KODAK PANATOMIC-X Film	15%

KODAK black-and-white roll films require no change in development time. Because films and recommendations change from time to time, always check a film's instruction sheet for latest information.

EXTENSIONS AND LIGHT OUTPUT

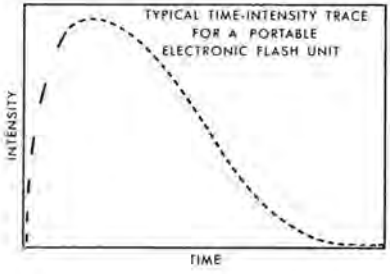
Using extension lights will not increase the total output unless additional power packs are also used. Two lights from one power pack will produce no more light than a single light from one power pack. In fact, unless the light from both lamps is superimposed on the subject, the aperture must be increased. The advantage of using more than one light is the greater flexibility of lighting control—just as in any method of lighting. Two power packs can be used to double the light from one tube, provided the total wattsecond rating of the tube is not exceeded.

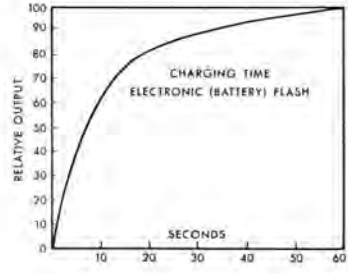
HUMAN REFLEX LAG

This varies from about 1/7 second to about 1/4 second. So, for very fast action, you will have to allow for your own lag and press the shutter just before the action reaches its climax or the subject reaches the proper location in the picture frame. Many of the ultra-high-speed shots you see published were made with units operating at extremely short exposures and with concealed electric contacts, microphones, photocells, or other tripping devices rigged so that the subject itself sets off the flash.

CHARGING TIME

The accompanying curve shows that it usually takes a minute to recharge a battery unit to its fullest capacity. But after 10 seconds, a typical electronic unit will produce about 65 percent of its maximum light output. The charging rate varies in practice and depends on the type of power pack, condition of the batteries, and other factors. An a-c powered unit usually recharges more quickly than a battery unit.





CAUSES OF LIGHT LOSS

As batteries lose power with use and age, the recharging time increases. When the battery is used to the extent that its voltage drops below the required value, light output decreases. Another factor which can weaken batteries and cause loss of light output is the tendency of electrolytic condensers to "de-form" after a month or so of inactivity. It takes an extra long time to "re-form" (that is, build up electrically the insulating layer which separates the metal foil and the electrolyte) and to bring the condensers back up to a full charge. This "re-forming" can be quite a drain on the batteries. If a unit can be used on regular house current, it's a good idea to recharge it from the power line after a month or so of non-use.

The speed of electronic flash lets you use high shutter speeds to "stop" action or catch a fleeting expression.

CAUTIONS

Take care of your unit. Follow the instructions in your manual.

. . . Respect the high voltages involved in electronic-flash circuits. Follow directions carefully when performing minor repairs. Better yet, let an experienced electronics repairman do the work.

. . . Shut off modeling lights before making the actual exposure. Unless the shutter speeds are very high, double or ghost images can be formed on the negative, and the color balance of color film can be upset. Built-in modeling lights should not be left on unnecessarily.

POWER SUPPLIES FOR ELECTRONIC FLASH

Power supplies for electronic flash units all contain certain basic elements. Since electronic flash tubes require a very high-voltage discharge, the unit must have a way of stepping up the power supply voltage to the level required by the tube. In some units, direct current is converted to pulsating direct current so that it can be transformed to high voltage. Then, the high-voltage alternating current must be rectified to reconvert it to direct current because only direct current can be stored in the condensers.

Condensers store the electrical energy until it is needed and then release it almost instantaneously. There may be either one condenser or a number of them. Circuits using direct current, either from batteries or lines, may use a group of condensers in parallel to store the current and provide for them to be fired in series. This is a means of multiplying the voltage without a transformer.

Because the intensity of the flash of an electronic flash lamp depends upon how much current is discharged through the tube, proper performance of the power supply is important. Variations in the supply voltage may cause large differences in output since the light output varies with the square of the tube input voltage. Condenser breakdown may be partial so that less power is stored. Partial failure may not be obvious since the lamp may flash even though its output may be much lower. Complete failure of one condenser in a bank of several may not be noticed, if it is not shorted.

The extremely brief duration of electronic flash makes it valuable for stopping action.

How Flash Equipment Works

FLASH LAMPS

The light of flash lamps is produced by the rapid burning of metal wire, foil, or primer powder. The lamp is charged with oxygen to promote rapid and complete burning. The lamp flashes once only.

The metal of a foil- or wire-filled lamp, such as the No. 5 or No. 25, is ignited in two steps. When the electric current flows through the lamp, a tiny wire filament is heated white hot and burns out. If the current through the lamp is strong enough, this burning-out takes about one millisecond* (1/1000 second). When the filament burns, it ignites the primer, a powder that is coated on the tips of the filament support wires. The furious burning of the primer then ignites the foil or wire, the burning of which produces most of the light.

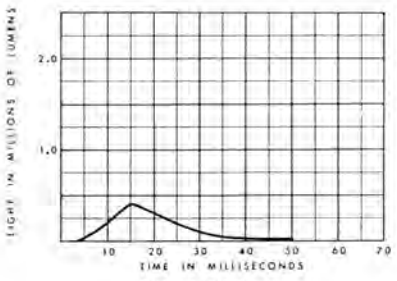
The light output of flash lamps is usually given in lumen-seconds. This is the product of the number of lumens produced times the number of milliseconds the flash is sustained. Lamp manufacturers usually publish the total lumen-second output (open flash).

The principal classes of expendable flash lamps are M-2 and AG-1 (intermediate-peak), M (medium-peak), S (slow-peak), and FP (focal-plane).

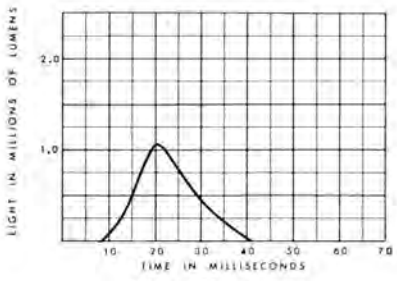
M-2 and AG-1 Lamps (intermediate-peak). These midget lamps peak sooner than Class M lamps. They reach greatest brilliance about 15 ms after current is applied. The small size of these lamps makes possible the use of very small reflectors. They can be used on all KODAK amateur cameras currently being manufactured. The shutter speed should be set at 1/25 or 1/30; the lamp itself will provide an effective speed in the neighborhood of 1/50 second.

Class M Lamps (medium-peak), such as the M-3, M-5, 5, 25, 11, 40, 2, or 22, peak in about 18 to 20 ms after current is applied. Class M lamps, if a strong electric current is used, may reach peak only 16 ms after current is applied. If a very weak current – just strong enough to flash the lamp – is applied, it may take 25 ms or more for Class M lamps to reach peak. On cameras with Class M synchronization, these bulbs can be used at all shutter speeds, even up to 1/400 or 1/500 second. M-2 bulbs cannot generally be used at high shutter speeds.

*To save space, the abbreviation "ms" is used for the term "millisecond."



Intermediate Peak AG-1



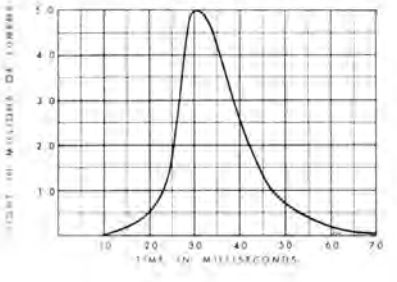
Class M Lamp No. 5 or 25

Small M lamps, such as the No. 5 or 25, have a lumen-second output of about 18,000 lumen-seconds; M lamps, such as the No. 11 or 40, are about twice as powerful; and lamps such as the No. 2 or 22, about four times as powerful. Unfortunately, the more powerful lamps do not necessarily provide proportionately more light on the subject because the reflectors in which they are generally used are less efficient.

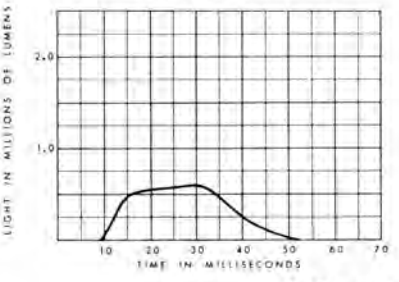
Class S Lamps (slow-peak), such as the No. 50 or 3, are used primarily for open-flash work in the photographic studio. Their time to peak brilliance is about 30 ms after current is applied. They have a sharp peak and a very large output—roughly 100,000 lumen-seconds.

Class FP Lamps (focal plane), such as the No. 6 or 26, were designed for use with cameras having focal-plane shutters. Because the focal-plane curtain moves across the film during the exposure, taking about 1/50 second (20 ms) to do so in the case of a small camera, the light of a focal-plane lamp must be given off at a fairly even rate throughout the whole of the time the shutter is moving. If the rate is not even, the exposure on one part of the film will not be the same as on others. Consequently, focal-plane lamps rise to a plateau about 20 ms after the current is applied. They continue to give off light at this same level for either 20 (small lamps) or 40 ms (large lamps).

Class S Lamp No. 50 or 3



Class FP Lamp No. 6 or 26



FLASH POWER SUPPLIES

The electric power used for firing flash lamps for synchronized flash must be of sufficient amperage and voltage to fire the lamp on time. For proper operation, the current delivered should not be less than 3 amperes *at the lamp.* How much voltage is needed to deliver this current depends on the resistance of the flash circuit. To overcome this resistance, a margin of excess power is needed at the power supply, and the higher the resistance, the more power is needed.

It is, therefore, important to reduce the resistance of the flash circuit. The bottom contact of a flash lamp is sometimes corroded by the action of oxygen or moisture on the metal. The practice of cleaning this contact with an emery board or some other clean, rough surface immediately before use often prevents flash failures.

A weak power supply may fire a lamp too late, or not at all. With enough current and voltage, the filament will burn out (as it is designed to do) in approximately 1 ms. But, if the current falls much below 3 amperes, it may take 8 or 9 ms to burn through and ignite the primer. With fast shutter speeds, such a delay would put the flash after the shutter is closed.

Batteries. To give sure synchronization, therefore, batteries for flash use should deliver a current of more than 3 amperes. The larger cells in good condition do deliver 5 amperes or more, and penlite cells deliver 3½ amperes or more. Two of these small cells are usually used to get more voltage.

Several new types of batteries have appeared on the market recently. These include manganese-alkaline, mercury, and nickel-cadmium cells. These have several advantages over the traditional zinc-carbon dry cells – such as longer life and greater useful current capacity – which make them desirable for use in flash units. There is an important qualification however. Most older flash units, made before these new batteries were on the market, have battery contacts made of unplated brass. A reaction can occur between the tops of these batteries and the brass contacts, producing a high-resistance surface film. Then the flashbulbs will not fire. If you have equipment with unplated brass contacts, continue to use the old style zinc-carbon batteries.

B-C Power Supply. These variations in battery performance need no longer plague the flash photographer. They have been overcome by the use of the battery-capacitor (B-C) power system. Here, one or two 15 or 22½-volt batteries provide higher voltage to charge a capacitor

Flash is useful for making pictures in the shade or on dark days when there isn't enough daylight for proper exposure.

(also called a condenser). The capacitor acts as a reservoir, collecting the current in a small trickle and saving it until required. When the circuit is completed, the capacitor empties itself with a flood of current which overcomes almost any resistance likely to be found in the circuit. Even older, relatively weak batteries can successfully "fill" the capacitor, although they will take a few seconds longer. The batteries usually last a year or more. They will not fire flash lamps by themselves. Another advantage of B-C power is the added assurance that the lamps will fire on time. The extra strong punch of power delivered by the capacitor burns out the lamp filament in less than 1 ms.

Multiple Flash. Adequate voltage and current are so essential in the case of the firing of one lamp that it is not surprising that in a multiple-flash hookup the same is also true. Series wiring of flash units is important because, for good synchronization, the same current and voltage must reach all the lamps simultaneously. Long extensions powered with ordinary flashlight batteries may require extra power in the form of a booster battery. When B-C power is used, however, additional power is not usually needed.

To find whether your flash units are series- or parallel-wired, connect one to the camera, and the second to the first flash unit. Then, put a lamp in only the second unit. If this lamp fires when the camera shutter is tripped, then the first unit is parallel-wired. In a multiple-flash circuit, one parallel-wired unit can be used as the last unit in a string of series-wired units.

Electronic-Flash Power Supplies are discussed in the section on Electronic Flash, page 37.

SYNCHRONIZATION

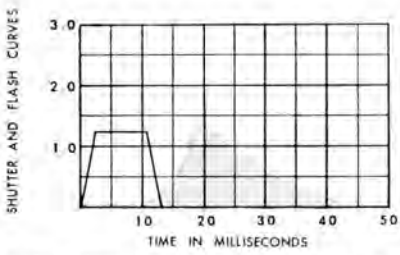
In flash synchronization, the object is to make the shutter open and the flash lamp reach the peak of its flash at the same time. The purpose is to have the camera "catch" as much of the light of the lamp as practical at that particular shutter speed. This means, of course, that the shutter must be wide open at the exact time that the lamp reaches its peak.

Shutter Operation. To understand flash synchronization, it is necessary to understand camera shutters. There are two principal types of camera shutters: between-the-lens, and focal-plane. Within these two major classifications there are minor variations. A shutter whose moving parts weighed nothing whatever could spring instantaneously to full aperture at the moment the shutter release was pressed, and close instantaneously the moment the desired shutter time had expired. Practically, this is not possible with either between-the-lens or focal-plane shutters.

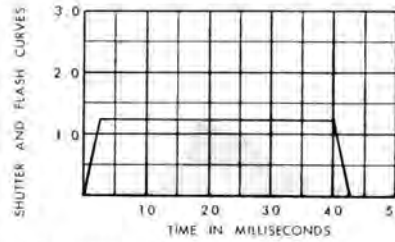
The average between-the-lens shutter takes from 2½ to 4 ms to open fully, and about the same time to close. As a result, for a shutter of good efficiency, at a shutter speed of 1/100 second, the blades take 2½ ms to open, are fully open about 8 ms, and take 2½ ms to close. Thus, they are at least partially open for about 13 ms. However, the effective shutter time at full aperture is still only 10 ms, or 1/100 second.

Type M Synchronization. When an M-type lamp is being used, the shutter and the lamp could not be started at the same time. If they were, and the shutter were set for one of the faster shutter speeds, such as 1/100 second, the camera shutter would open and close before the lamp could reach the peak of its brilliance. It should be pointed out, however, that if the shutter is set for a relatively slow speed, such as 1/25 second, the shutter will open in about 3 ms and then remain wide open for about 37 ms. Since the M-type lamp will flash at about 20 ms and fade out at about 30 ms, the whole of the lamp's flash will be caught at this shutter speed.

But, what about synchronization at the faster shutter speeds? To have the lamp flash occur while the shutter is open, with Type M lamps the electrical contact must be made first, and the opening of the shutter must be delayed until the lamp actually begins to flash. This delay of the shutter can be accomplished with either a mechanical or an electrical device.



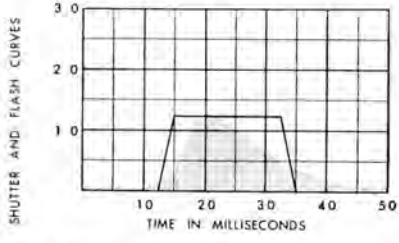
1/100-second shutter action, started at same time as Type M lamp, misses nearly all light.

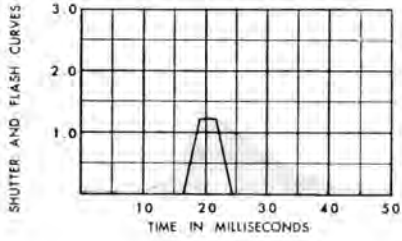


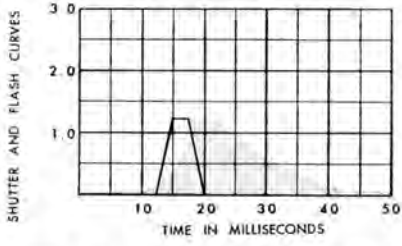
1/25-second shutter action, started at same time as Type M lamp, catches nearly all light.

Whether this delay mechanism is mechanical (gear-train, springs, etc) or electrical (solenoid, etc), it is possible and advantageous to have the delay adjustable. This is because the same delay time will not give ideal synchronization for all shutter settings.

Suppose that the electrical contact is made at the moment the shutter release is pressed, but the shutter does not begin to open until 12½ ms have passed. The curve shows the synchronization for shutter settings of 1/50 second (20 ms) and 1/200 second (5 ms). It is obvious that the 12½ ms delay gives reasonably good synchronization for 1/50 second, but does not for 1/200 second. With the latter, the shutter closes before the lamp reaches its peak. Much better synchronization for the 1/200-second setting can be obtained with a delay of about 16 ms (see graph).







Upper left, 1/50-second shutter action, started 12½ ms after Type M lamp, catches nearly all light.

Above, 1/200-second shutter action, if started 12½ ms after Type M lamp, would miss most of light.

Left, 1/200-second shutter action, started 17 ms after Type M lamp, catches all light possible at that speed.

Type X Synchronization. If the lamp used is electronic, having a time-to-peak of much less than 1 ms, it is usual to delay the starting of the flash instead of the opening of the camera shutter. In fact, in cameras set for electronic or X synchronization, it is customary to have the electrical contact made only when the shutter blades reach the fully open position. In this way, there is no possibility of losing any of the flash.

Some electronic flash units contain circuits that delay the firing of the lamp. This delay may be for a specific number of milliseconds, or it may be adjustable from zero to about 20 ms. When such a unit is used with a shutter having built-in flash contacts, the combination of the delay in the shutter and the delay in the unit must result in the electrical contact being made while the shutter blades are fully open. For instance, if the unit delay is adjustable, it can be set at zero, and the camera shutter at X. It would also be correct to set the unit at 20 ms and the camera shutter at M (16 ms delay plus 3 ms to open).

Users of electronic flash may want to combine expendable flash with electronic flash. They can do this if a delay circuit is used with the electronic flash so that the two will flash simultaneously, avoiding a double image.

FP Synchronization. A focal-plane shutter has a slit that travels across the film. The slit may be set to expose each point on the film for 1/200 second, but the slit may take 1/50 second (or longer in a larger camera) to travel across the whole film area. The synchronization problem involved is therefore somewhat different because the FP lamp needed must have an illumination plateau that lasts longer than the time the curtains take to cross the film. If this plateau is shorter, one or both edges of the negative will receive less exposure than the central portion. FP (focal plane) lamps, therefore, are designed to peak for longer times than other flash lamps.

As with Class M lamps, class FP lamps must be started first, and the opening of the shutter delayed till the lamp has reached (or nearly reached) its plateau. Since the curtain travel time with most cameras is the same for all shutter settings, the time the shutter is delayed can be the same for all shutter settings. Just as it is important to have the lamps fire on time for synchronization with between-the-lens shutters, it is important in synchronization with focal-plane shutters. Too little power causes the lamp to flash late, and that means that one side of the picture will be underexposed. With the curtain wide open (open flash, shutter set for 1/25 second and zero delay), cameras with focal-plane shutters can use any flash lamp, including electronic.

KODAK Flash Shutters and Electronic Flash. Shutter contacts may be damaged by using equipment which imposes on them a load of more than 25 volts at 15 amperes or any excessive load which is inductive. The manufacturer of the flash equipment should be consulted for information on the extent of the load imposed by the equipment.

Properly designed, small, portable electronic flash outfits equipped with "O" or "X" delay-triggering mechanisms will not harm the flash contacts of KODAK shutters.

SYNCHRONIZATION FAILURES

Because flash-lamp synchronization involves making such quick events happen together, it is not surprising that synchronization failure sometimes occurs. The reasons for failure are usually simple. The commonest cause is weak batteries. In this situation, the lamp flashes so late that the camera shutter is already closed, or closing.

Among the users of cameras with between-the-lens shutters having built-in flash contacts, another common cause of synchronization failure is the use of the incorrect lamp. Most of the simpler flash cameras are designed for making flash snapshots with any kind of lamp.

External synchronization, depending upon the action of a solenoid, also requires a strong, dependable source of power. The B-C system can supply this power, but a solenoid designed for regular battery operation loses its timing characteristics when used with the almost instantaneous surge of power from a capacitor, and acts merely as a shutter tripper.

If you have reason to suspect the accuracy of your synchronization, there are devices on the market for checking it yourself, or your dealer can check it for you. Do not attempt to make internal shutter adjustments yourself.

REFLECTORS

The effectiveness of a flash lamp or flash unit is dependent, to a very large extent, upon the efficiency of the reflector. In turn, the efficiency of a reflector depends mostly on four factors: the relative size, the shape, the surface finish, and the lamp position. Generally speaking, a large reflector is more efficient than a small one. A parabolic reflector is more efficient than a flatter one. A reflector with a highly polished surface is more efficient than one with a satin or matte surface. A parabolic reflector with the lamp located at its focus is more efficient than one with the lamp at any other position.

The most efficient reflector, however, is not necessarily the best one for photographic purposes. A small reflector having a highly polished surface, if parabolic in shape, tends to direct a narrow beam of light with a spotlight effect. A picture made with such a reflector might be properly exposed in the center of the picture area and considerably underexposed at the edges of the picture. While this type of illumination might be suitable for certain special situations, it is definitely not desirable for general picture taking, especially for color. For color, it is usually best to have the light that reaches the film as uniform as possible over the whole film area.

The KODABLITZ Flasholder (left) and the KODAK Flashcube Holder, Model 1 (right), are small enough to carry in your pocket, and they have flash-exposure information printed right on them.

MAINTENANCE SUGGESTIONS

1. Keep good fresh batteries in your unit. Probably more failures in synchronization are due to weak batteries than any other reason. Use *photo* flash batteries. When you want long useful life, short recuperation time, and good resistance to leakage and swelling, use alkaline batteries.
2. Keep the resistance in your unit to the minimum by keeping all contacts clean and bright, replacing cords with cracked or frayed insulation and keeping screws tight. To prevent corrosion do not use alkaline batteries if the camera contacts are of unplated brass or copper. Use conventional zinc carbon batteries.
3. Handle your unit with care. Fittings should not be forced or cords tugged. Most units have a lamp ejector; use it, rather than pull the bulbs out by hand.
4. Flashbulbs are fragile; handle them carefully to avoid cracking the glass. Slight cracks often cause lamps to shatter when fired.
5. Check batteries and circuits by repeatedly flashing these test lamps: EAC or equivalent substituted for No. 5 bulb, EEK for M-2 bulb and BJY for AG-1 bulb.

An emergency check can be made with a regular flash lamp. Disconnect the cord from the shutter and short the cord contacts; the lamp will flash if the circuit is complete and the battery up to strength.

FACTORS IN COMPUTING FLASH EXPOSURE GUIDE NUMBERS

Most guide numbers published in the United States by the manufacturers of films, lamps, and other flash equipment are calculated by a formula developed through the joint efforts of the photographic industry and the American Standards Association, Inc., in American Standard PH 2.4-1953. The formula is $GN = \sqrt{.004LtMs}$

The formula applies where GN is the guide number (f-number times lamp-to-subject distance in feet); L is the lumen output of the lamp, and t equals the time of exposure in seconds. The product Lt is the lumen-second output, the figure given for open flash by lamp makers as a measure of the useful light of a flash lamp. M is the reflector factor, and S is the speed of the film or plate.

For shutter times that cut off part of the flash, the Lt product must be obtained from the output curve for the lamp by graphical integration. The integration limits for a particular shutter setting depend upon the shutter performance. In other words, the Lt product for a particular lamp at a particular shutter speed will be a certain percentage of the total Lt product. The percentage depends upon the shutter setting, the synchronization, and the shutter efficiency.

The reflector factor (M) depends upon the reflector shape, the surface, and the size of the lamp. Reflector factors may be as high as 12 for a small bulb in a polished parabolic reflector, or as low as 2 for a shallow cylindrical reflector. The former reflector concentrates the light in a narrow beam, the latter spreads it more widely.

Electronic Flash. Wattsecond ratings are not related to light output closely enough for use in computing exposure. "Beam candlepower-seconds" (BCPS), a better index of light output, can be measured by the manufacturer, following American Standard 3.40-1962. BCPS is similar to, but more valid than, the earlier ECPS, "effective candlepower-seconds." You can find the BCPS rating for your unit in its instruction manual; or, request it from the manufacturer. The relation of such a rating to a guide number is tabled on page 51 and is:

$$\text{Guide Number} = \sqrt{.063 \times (\text{BCPS or ECPS}) \times \text{Film Speed}}$$

The Flash Exposure Dial in the *KODAK Master Photoguide* solves this formula. In fact, it lets you start with a BCPS rating, or a guide number, and arrive at guide numbers, subject distances, and lens apertures for any film of known film speed.

See page 33 for determining your own guide numbers.

Tables of Flash-Exposure Guide Numbers

These guide numbers are only what the name indicates: guides. Because of variations in reflector efficiency, synchronization, etc., they may need to be modified to give correct exposure with your particular equipment.

To use guide numbers, divide the appropriate number by the distance in feet from the lamp to the subject. The answer is the f-number (lens opening) at which to set your camera lens.

These numbers are for average subjects. With black-and-white film or KODACOLOR-X Film: for light subjects, use one lens opening smaller than the guide number indicates; for dark subjects, use one lens opening larger. In small rooms with white or light-colored walls, use one lens opening smaller. With color transparencies make a total allowance of only ½ lens opening for these subject variations.

To find the best guide number for your equipment, make a series of test exposures and follow the procedures described in the section "Determining Your Own Guide Numbers," on page 33. Or, you can use the "Direct Reading Table" on page 52. In this table, we've done the arithmetic, but more important, we have given you the information for the three basic types of reflectors – the shallow cylindrical, the shallow fan-shaped (or intermediate-shaped), and the polished bowl-shaped. Use the column of figures most appropriate to the type of reflector and flashbulb you are using. If you find that a different column works better for you, by all means use it. Note that this table applies only for shutter speeds of 1/25 or 1/30 second.

FLASHBULB TYPES AND SYNCHRONIZATION

FLASHBULB BASE	BULBS FOR SIMPLE CAMERAS	Flashbulbs for Most Cameras with Adjustable Shutters		
		At 1/25 or 1/30 sec	At Higher Shutter Speeds	
			M sync	X sync
Screw	11, 40	11, 40, 2, 22	11, 40, 2, 22	None
Bayonet	5, 25	5, 25	5, 25	5, 25
Miniature	M2, M3	M2, M5, M3	M5, M3	
Baseless	AG-1	AG-1		

Note: If a flash-holder socket accepts both miniature and bayonet-base bulbs, the miniature bulb is preferable.

FLASH GUIDE NUMBERS FOR BLUE FLASHBULBS

All guide numbers are for polished, bowl-shaped reflectors; they do not apply to other shapes of reflectors. For shallow cylindrical reflectors, divide these guide numbers by 2. For intermediate-shaped reflectors (such as the shallow fan-shaped reflector), divide these guide numbers by 1.4.

KODAK Films	Between-The-Lens Shutters	SYNCHRONIZATION				Use 1/25 second or slower 3B, 50B¶	Focal-Plane Shutters	6B† 26B†
		X or F	M					
		M2B* AG-1B§	M3B* M5B* 5B† 25B†	11B‡	2B‡ 22B‡			
EKTACOLOR Professional, Type S	1/25-1/30	120	160	190	220	350	1/50	130
	1/50-1/60	—	140	160	200		1/100	75
	1/100-1/125	—	120	140	170		1/250	50
KODACHROME II	1/25-1/30	60	80	100	120	200	1/50	60
	1/50-1/60	—	70	85	110		1/100	40
	1/100-1/125	—	65	75	90		1/250	25
KODACHROME-X EKTACHROME-X KODACOLOR-X	1/25-1/30	100	140	160	180	300	1/50	100
	1/50-1/60	—	110	140	160		1/100	65
	1/100-1/125	—	100	120	140		1/250	40
EKTACHROME Daylight (Process E-3)	1/25-1/30	85	110	140	160	275	1/50	90
	1/50-1/60	—	100	120	140		1/100	55
	1/100-1/125	—	90	110	120		1/250	35
High Speed EKTACHROME Daylight	1/25-1/30	150	200	250	300	500	1/50	160
	1/50-1/60	—	180	200	250		1/100	100
	1/100-1/125	—	150	180	220		1/250	60
PANATOMIC-X (Rolls)	1/25-1/30	80	100	140	160	250	1/50	80
	1/50-1/60	—	90	125	140		1/100	50
	1/100-1/125	—	80	110	125		1/250	32
	1/200-1/250	—	60	80	100		1/500	—
PANATOMIC-X (135)	1/25-1/30	70	90	125	140	225	1/50	70
	1/50-1/60	—	80	110	125		1/100	45
	1/100-1/125	—	70	100	100		1/250	28
	1/200-1/250	—	55	70	80		1/500	—
VERICHROME Pan, and PLUS-X Pan	1/25-1/30	140	180	250	280	440	1/50	140
	1/50-1/60	—	160	220	250		1/100	90
	1/100-1/125	—	140	200	200		1/250	55
	1/200-1/250	—	110	140	160		1/500	40
TRI-X Pan (Roll and 135)	1/25-1/30	250	320	400	500	775	1/50	250
	1/50-1/60	—	280	350	450		1/100	160
	1/100-1/125	—	250	320	350		1/250	100
	1/200-1/250	—	200	220	280		1/500	70

Bowl-Shaped Reflector Sizes: §2-inch. *3-inch. †4- to 5-inch. ‡6- to 7-inch. ¶12-inch.

Note: At 1/25 or 1/30 second, cameras having X or F synchronization can use any of the bulbs listed under M synchronization.

FLASH GUIDE NUMBERS FOR BLACK-AND-WHITE SHEET FILMS AND CLEAR FLASHBULBS

All guide numbers are for polished, bowl-shaped reflectors; they do not apply to other shapes of reflectors. For shallow cylindrical reflectors, divide these guide numbers by 2. For intermediate-shaped reflectors (such as the shallow fan-shaped reflector), divide these guide numbers by 1.4.

Kodak Films	Between-The-Lens Shutters	SYNCHRONIZATION				3, 50¶ Use 1/25 second or slower	Focal-Plane Shutters	6† 26†	2A‡ 31‡
		X or F	M						
		M2* AG-1§	M3* 5† M5* 25†	11‡	2‡ 22‡				
Plus-X Pan (Estar Thick Base), and Portrait Panchromatic	1/25-1/30	180	260	340	400	600	1/50	220	220
	1/50-1/60	—	240	300	350		1/100	130	160
	1/100-1/125	—	210	260	300		1/250	90	100
	1/200-1/250	—	160	190	240		1/500	65	75
Super Panchro-Press, Type B	1/25-1/30	250	380	450	550	800	1/50	320	320
	1/50-1/60	—	340	400	500		1/100	190	220
	1/100-1/125	—	300	360	450		1/250	120	140
	1/200-1/250	—	220	280	340		1/500	95	100
Super-XX Panchromatic, and Tri-X Ortho (Estar Thick Base)	1/25-1/30	220	350	400	500	900	1/50	280	280
	1/50-1/60	—	320	350	450		1/100	170	200
	1/100-1/125	—	280	320	400		1/250	110	125
	1/200-1/250	—	200	250	320		1/500	80	90
Tri-X Pan (Estar Thick Base)	1/25-1/30	280	450	500	600	1000	1/50	360	360
	1/50-1/60	—	380	450	550		1/100	210	250
	1/100-1/125	—	340	400	500		1/250	140	160
	1/200-1/250	—	250	320	380		1/500	100	110
Royal Pan (Estar Thick Base)	1/25-1/30	320	500	600	700	1100	1/50	400	400
	1/50-1/60	—	450	500	650		1/100	240	280
	1/100-1/125	—	380	450	550		1/250	160	180
	1/200-1/250	—	280	360	450		1/500	120	120
RS Pan (Estar Thick Base)	1/25-1/30	400	600	750	900	1400	1/50	500	500
	1/50-1/60	—	550	650	800		1/100	300	360
	1/100-1/125	—	500	550	700		1/250	200	220
	1/200-1/250	—	360	450	550		1/500	150	160
Royal-X Pan (Estar Thick Base)	1/25-1/30	550	850	1000	1200	2000	—	—	—
	1/50-1/60	—	750	900	1100		1/50	700	700
	1/100-1/125	—	650	800	1000		1/100	420	500
	1/200-1/250	—	500	650	750		1/250	300	320
	1/400-1/500	—	380	500	550		1/500	210	220

Bowl-Shaped Reflector Sizes: §2-inch. *3-inch. †4- to 5-inch. ‡6- to 7-inch. ¶12-inch.

Note: At 1/25 or 1/30 second, cameras having X or F synchronization can use any of the bulbs listed under M synchronization.

CAUTION: Since bulbs may shatter when flashed, use a flashguard over the reflector. Do not flash bulbs in an explosive atmosphere.

TYPE AND SHAPE OF FLASH REFLECTORS

Shallow Cylindrical

Shallow Bowl

Polished Bowl

Flashcube

FLASHCUBE GUIDE NUMBERS FOR BLACK-AND-WHITE AND COLOR FILMS

KODAK Color Films	Shutter Speed of 1/40
KODACOLOR-X KODACHROME-X EKTACHROME-X	70
KODACHROME II	50
High Speed EKTACHROME	120
KODAK Black-and-White Films	
PANATOMIC-X	50
PLUS-X Pan	100
TRI-X Pan	200

GUIDE NUMBERS FOR PORTABLE ELECTRONIC FLASH UNITS

KODAK Films	*Output of Unit*—(Beam Candlepower-Seconds—BCPS—or Effective Candlepower-Seconds—ECPS)									
	350	500	700	1000	1400	2000	2800	4000	5600	8000
BLACK-AND-WHITE										
PANATOMIC-X (135)	24	28	32	40	50	55	65	80	95	110
PANATOMIC-X (Roll)	26	32	35	45	55	65	75	90	110	130
VERICHROME Pan, PLUS-X Pan, and Portrait Panchromatic	45	55	65	80	95	110	130	160	190	220
Super Panchro-Press, Type B	65	80	95	110	130	160	190	220	260	320
TRI-X Pan (ESTAR Thick Base)	75	90	110	130	150	180	210	250	300	360
TRI-X Pan (Roll & 135) and ROYAL Pan	85	100	120	140	170	200	240	280	340	400
RS Pan (ESTAR Thick Base)	110	130	150	180	210	260	300	360	430	510
ROYAL-X Pan	150	180	210	250	300	350	420	500	600	700
COLOR										
KODACOLOR-X	32	40	45	55	65	80	95	110	130	160
High Speed EKTACHROME, Daylight Type	55	65	75	90	110	130	150	180	210	250
EKTACHROME-X	32	40	45	55	65	80	95	110	130	160
KODACHROME II	20	24	30	35	40	50	60	70	85	100
KODACHROME-X	32	40	45	55	65	80	95	110	130	160
High Speed EKTACHROME, Type B*	35	45	55	65	75	90	110	130	150	180

*With a KODAK WRATTEN Filter No. 85B.

DIRECT-READING TABLE OF EXPOSURE SETTINGS FOR FLASH PICTURES

Lens apertures at various distances. Shutter at 1/25 or 1/30.

Flash to Subject Distance in Feet	Shallow Cylindrical Reflector	Intermediate-Shaped Reflector	Polished Bowl-Shaped Reflector	Intermediate-Shaped Reflector	Polished Bowl-Shaped Reflector
					
	Flashbulbs		Flashbulbs		
	AG-1B	M2B	M5B	5B	25B
KODACHROME-X, KODACOLOR-X and EKTACHROME-X—Daylight Type Films					
4½	f/11	f/16	f/22	f/22	—
6½	8	11	16	16	f/22
9	5.6	8	11	11	16
13	4	5.6	8	8	11
18	2.8	4	5.6	5.6	8
26	2	2.8	4	4	5.6
35	—	2	2.8	2.8	4
KODACHROME II Film					
3½	f/8	f/11	f/16	f/16	f/22
5	5.6	8	11	11	16
7	4	5.6	8	8	11
10	2.8	4	5.6	5.6	8
14	2	2.8	4	4	5.6
20	—	2	2.8	2.8	4
28	—	—	2	2	2.8

EXPOSURE FOR EXTREME CLOSE-UPS

Flashbulbs—At short distances, these give higher illumination than sunlight. Thus, they permit small apertures and greater depth of field. The usual flash reflector, because of its position relative to the camera lens, does not light an extreme close-up uniformly. Therefore, we suggest placing one thickness of white handkerchief over the reflector to act as a diffuser. When so covered, differences in reflector shape, size, and surface are reduced in effect. The table assumes the covering handkerchief. Regard it only as a basis for trial. Set the shutter at 1/25 or 1/30 second.

Flashbulb	KODACHROME II			KODACHROME-X EKTACHROME-X KODACOLOR-X		
M2B and AG-1B	8-10 in.	12-14 in.	18-22 in.	8-10 in.	12-14 in.	18-22 in.
	f/11-16	f/11	f/8-11	f/16-22	f/16	f/11-16

For M3B, M5B, 5B, or 25B flashbulbs, add another thickness of handkerchief.

FLASH SAFETY FIRST

Flash is perfectly safe if a few common-sense safety habits are acquired. The light from flash at usual distances does not appear to be harmful to eyes that are healthy and normal. No evidence has come to our attention of any harm from such light, even to infants.

SAFETY HABITS

• If by some chance the electrical circuit of your camera-flash unit is closed, the socket will be live and the lamp will flash when you put it into the socket. You may burn your hand or temporarily blind yourself. So, when you take the first of a batch of flash pictures, insert the first bulb with the cord disconnected. Have the flash holder aimed away from you when you connect the cord. This is especially important if the equipment is unfamiliar, is very cold, or has had rough handling.

• Examine lamps for cracks. A cracked bulb will let in air. Such a lamp will explode.

• Since lamps may shatter when flashed, use a suitable shield, such as a KODAK flashguard, over the reflector. It is unwise to take flash pictures of people closer than five feet. *Do not flash the lamps in an explosive atmosphere.*

• Remove used lamps by operating the lamp ejector (if your flash holder is so equipped). Flash lamps are too hot to handle immediately after firing; also, pulling lamps out by force can damage the flash-holder socket.

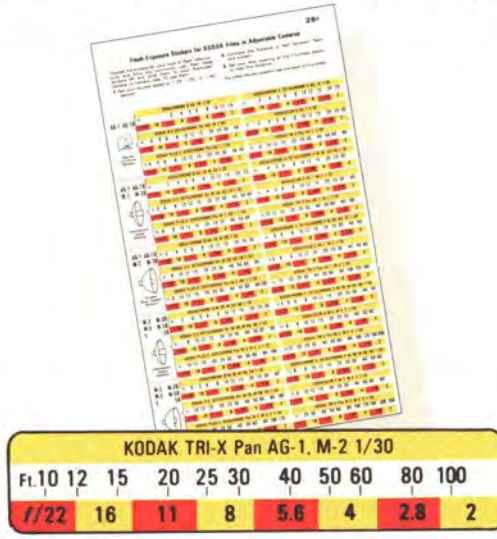
• Operate the ejector while holding the flash holder over a suitable container, such as a waste basket, but never so that the flashed lamp will fall into contact with new lamps. *Never* drop a freshly fired lamp into a pocket or bag containing new lamps—it may ignite them.

• Do not fire flash lamps by house current unless the lamp carton says they are designed for 3 to 125-volt operation.

• Do not throw used flash lamps into an open fireplace.

• Do not carry bulbs loose in your pocket or gadget bag – friction may ignite them.

Flash exposure made easy!



FLASH EXPOSURE STICKERS

for Kodak films in adjustable cameras
Kodak Publication No. C-6

KODAK MASTER PHOTOGUIDE

Contains Flash Exposure Dial
for use with flash bulbs and electronic flash
Kodak Publication No. R-21

Both publications are available from Kodak dealers.

Consumer Markets Division

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