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TECH SHEET 2

The Beauty of Black & White Infrared Photography

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INTRODUCTION

Infrared film is sensitive not only to visible light, but also to longer wavelengths which are invisible to our eyes. The film reproduces subjects in tonal qualities that we are accustomed to seeing, plus records light that is beyond our perception. It collects light differently than panchromatic films and therefore causes dramatic changes in tones resulting in ethereal images.

I enjoy using this film because of the unusual and beautiful qualities it captures. It shows me a world with which I am not familiar. Landscapes with green grass or foliage have a soft, snowy look. Blue skies tend to go black, and white puffy clouds seem to jump out of the darkness. Buildings and objects that hold heat are presented with a glow that resembles an aura. Portraits have a luminous glow, often with a halo that encompasses the subject. The film has an ability to create dreamlike and surreal images. And while infrared film has several idiosyncrasies which can be controlled by the photographer, I like discovering information in my pictures that I could not see at the moment of exposure.

The roots of infrared photography are in the scientific community. The uses and applications of this unique film include: medical use (infrared film can penetrate into the skin to show vein patterns); aerial photography; ecology; hydrology (for showing water lines in tidal country); geology; plant pathology (the film can depict plants under stress from disease); military and law enforcement; animal studies and pictorial photography.

Edisto Beach in South Carolina. Infrared film with 25A filter, 1/125 @f/11.

The film is available in black and white and color. Color infrared film (Kodak Ektachrome Infrared EIR) has three emulsion layers which respond to green, red and infrared parts of the visible spectrum. This new EIR film can be processed in E-6, as well as in the EA-5 process. The film produces a variety of unusual and interesting false colors depending on the filtration. Not using a filter between the lens and the scene will produce a severe magenta cast. The yellow (#8) filter is most commonly used with this color film. Orange (#15) and red (#25) filters also remove the magenta cast and each filter offers a different, subtle arrangement of colors.

Both Kodak and Konica manufacture infrared films. Kodak produces 35mm and 4x5 inch sheet film, while Konica produces 35mm and 120 roll film. Kodak film has a longer spectral response to infrared radiation, while the Konica's film has a tighter grain structure.

This Tech Sheet will provide you with all the necessary information to make black and white infrared photographs. The technical information provided in this paper has been successfully used by my students in photography classes at Odessa College. If you follow the simple procedures described in this Tech Sheet, I can promise dynamic infrared images.

I'll cover such issues as the special handling precautions necessary to use this film. I'll show how to determine exposure and use filters to enhance the infrared look. You will learn easy film processing steps with standard chemistry that can be found in any black and white darkroom. And finally, we will look at basic testing methods and the use of flash. A brief reading list follows at the end of the Tech Sheet. Good luck, and enjoy making photographs.

HANDLING

Infrared films require special attention in several areas to prevent fogging. The film is very sensitive to high temperatures. After purchase, store the film in a refrigerator prior to use. Prolonged exposure to high temperatures can cause the film to fog. Avoid leaving the film in your camera, your camera bag, and the camera in the car during hot weather. When traveling with infrared film, I keep the film in a cooler with ice. 35mm film in the black canisters is waterproof. In order to keep loaded 4x5 film holders protected from water, I keep them in sealed Tupperware™. Always let the film warm to room temperature by removing it from the cool environment about one hour prior to loading. After the film has been exposed, return it to a cool place until it

can be processed. As with most films,it is recommended to process as soon as possible after exposure.

Infrared film must be loaded and unloaded into your camera in total darkness. Do not open the black canister except in a darkroom or in a changing bag. I have had students lose film from unsafe changing bags. Not all bags may block the infrared radiation. Loading film into your camera in total darkness may be tricky the first time, so practice loading standard film, with your eyes closed, before using infrared materials.

In addition, if your camera back has a window which lets you view the film cartridge already loaded in the camera, then you will need to tape over the window. This will prevent light from fogging your film. Use two layers of black plastic electrical tape.

The pressure plate on a camera "pushes" the loaded film up against the film plane so the image is sharp. Some cameras have a pattern of small dimples on the pressure plate. If you have such a camera, these dimples may appear in your image while using infrared film. This may be attributed to overexposure. One student corrected this problem by using electrical tape on the pressure plate, although I do not recommend this procedure. I suggest exposing a few frames to test for problems or light leaks before shooting an entire roll of film. In addition, slowly rewind the film after exposure. Rapid movement of the film through the camera will create annoying static electricity streaks on the film.

Sheet film is a little more difficult to work with because the film holders must be free of dust and lint. Some film holders may allow infrared radiation to expose the film. When making large format exposures, prior to removing the dark slide, I normally drape my focusing cloth over the film holder. This will help insure that infrared radiation will not bleed through the dark slide opening. Keep good records the first time you use 4x5 infrared. Label each side of the holder and note subject matter. If there are light leaks, you will know which holder is causing the problem. Because of the size of film, it is very susceptible to finger prints. The FBI may love this, but it may not appeal to your aesthetics. I suggest using latex gloves when you load film into the holders and during processing.

FOCUSING

Focusing requires special consideration when using infrared film. Lenses are not manufactured to see both visual light (which we see with our eyes) and infrared radiation (invisible to our eyes). Infrared has longer wavelengths than the visual spectrum and those wavelengths focus beyond what normal lenses can accommodate.

Most contemporary lenses have a special focusing point for infrared film indicated by a red dot or the letter "R." This point may be on either side of the focusing index marker on the center of your lens. Focus your lens as you would in any normal situation. Note the distance. Then rotate the focusing barrel so that distance is now aligned with the red dot or the letter "R." If you are photographing extreme close-ups, the image may look fuzzy or out of focus as you look through the camera. This is normal because the infrared film focuses on a different plane than visible light. This is an important consideration when photographing objects close-up,flat objects, photographing with long telephoto lenses, or with a very shallow depth-of-field. My favorite lens is the slightly wide angle 35mm, as I generally photograph landscapes in bright sunlight (f/11 to f/16) with infrared. The small aperture size and the wide angle lens results in a greater depth of field; therefore, accurate focusing is less of a problem for me.

'Refocusing' is not a problem when the main subject is at infinity. This image is an example of hyperfocal focusing, as everything from the woman to the Eiffel Tower is in sharp focus, as described in the text.

I suggest using hyperfocal focusing for your outdoor work. In bright sunlight your exposure might be f/16 at 1/125. Let's say you are using a 50mm lens on your camera. Roll the focusing ring so the infinity mark is lined up across the f/16 mark on the depth of field scale. Look at the other f/16 mark and you will notice the focus distance is roughly eight feet. This means everything is in focus from eight feet to infinity.

Grace. A 4x5 infrared image. Note the silky smooth skin quality. While a view camera was used the image was shot at f/45 to insure sharpness across the face.

View cameras do not have a focusing index marker. Focus the camera on the most important part of the image and then increase or extend the bellows by 1/4 of 1% of the focal length of the lens. Again, if you are photographing with a small aperture size or a wide angle lens, this is less of a consideration. For copy work or extreme close-ups, I recommend testing to ensure crisp focus of the image.

EXPOSURE

Calculating exact film speed and exposures with infrared materials is difficult and does require some testing and patience. Infrared materials see beyond the visual spectrum and most light meters (including the one in your camera) cannot respond to infrared radiation. Often, the amount of infrared reflected in a scene and captured on film varies dramatically. The time of day, temperature, and position of the sun to the camera are just a few of the variables that determine film exposure.

Kodak suggests a starting point Exposure Index (EI) of 50 for their film. I have found, from experience, that a better starting point for usable exposures is EI 200. Many of my students find that an EI 400 also makes a workable beginning.

Trial exposures should be made in typical lighting conditions. I generally use the red (# 25a) filter when photographing outdoors with infrared and bracket the film's exposures from f/8 to f/16 at 1/125. For example, a typical exposure for a landscape on a bright sunny day in West Texas is 1/125 at f/11. Keep detailed notes with all your bracketing and tests when using infrared materials; it will make your printing easier.

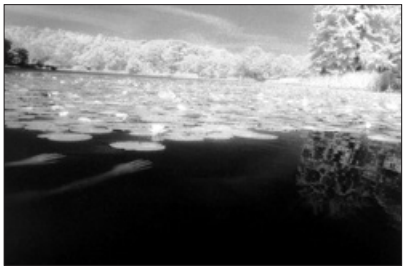
Camera to subject distance can also affect exposure. Distant scenes often require less exposure than close-up work. The above given exposure of 1/125 at f/11works well for scenics; however, a close subject in the same light might require two stops more light. Distant scenes have more infrared radiation reflected and scattered in the atmosphere than close-ups, thus requiring less exposure.

Most photographers use the red (#25a) filter while using infrared film. This filter makes blue skies go black in most situations. If you meter with the filter on the camera, adjust the EI to 200, and use the suggested exposure and then bracket your exposures. As you review your exposure notes, you will notice a pattern. You will be able to calculate exposures based on this information with less bracketing for future work. Infrared is difficult to work with because of the variations of radiation in a given scene. My recommendation is that when you know you are making an important photograph with infrared material, you should liberally bracket to ensure a good exposure.

Beckwith. Photographed with a 25a red filter. Note black sky indicative of a correct exposure 1/125 @ f/11.

On a beach. The red filter cut through the haze in this picture creating the pure black sky. Dark skies often result when shooting with the sun to our back.

Sand Dunes, Death Valley. Again, the red filter cuts through extreme overcast. As I was shooting more into the sun, the sky does not go black.



Lake Alma. With the use of the 25a filter, the blue sky reflecting off the surface of the water makes the water darker.

FILTERS

Infrared film is sensitive to the visual spectrum of light, as well as to the infrared wavelengths. If you were to look at the electromagnetic spectrum of light, you would see a narrow band of wavelengths called the visible spectrum of light. This visible spectrum is bordered by ultraviolet wavelengths and infrared wavelengths. To make the most dramatic results on film it is necessary to photograph more to the infrared side of the visible wavelengths. Filters assist the photographer in working at the lower end of this spectrum.

The red (#25a) filter is the most commonly used filter. It absorbs excess ultraviolet light (blues and greens) and allows red and infrared wavelengths to reach the film for exposure. Even though the filter is dark red, it allows enough light to pass through so that you can see to focus your camera. The red filter can produce dramatic effects on the film. Clear skies will often go completely black . The filter helps to cut through haze. A darker red filter (#29) absorbs more light and creates a varied effect. Try side-by-side tests of these two related filters to see which you like best.

Any warm filter, such as yellow or orange, will block the cooler light and allow the red and infrared light to reach the film. Each filter will produce a different effect. The polarizer, especially when used with other filters, creates a dramatic look. It is known for penetrating haze and is commonly used in aerial photography. Again, try test exposures and keep detailed notes of all your work.

The most unusual of all the filters is the opaque #87, available in a 3 and 4 inch Wratten, a hard, plastic material. This filter is completely opaque to visual light. It absorbs all visible light and allows only infrared radiation to reach the film. This creates interesting problems due to focusing through our camera with an opaque filter. The filter must be removed from the camera and returned to the lens after focusing is completed. It is not user friendly, but it does create great results.

Imagine, no visible light is reaching the film. What you see as you look at the subject will not be recorded on the film. Only the invisible infrared wavelengths expose the film. Try placing this filter over a flash. When you trip the exposure button, no visible light is emitted from the flash – only infrared. Think of the possibilities of photographing in low light with a flash that doesn't emit light.

Panchromatic film without a filter.

Infrared film without a filter. Least Infrared effect.

Infrared film with a yellow (#12) filter, moderate infrared results. Filter would be a good choice for experimentation.

Infrared film with a red (#25a) filter, normal filter for use with Infrared films. Great infrared results.

Infrared film with an opaque number #87 filter. Slightly more Infrared effect than #25a.

Table 1 >>>>>>> Suggested Filter use with High Speed Infrared Film

Filter	Effect
No filter	Allows more light from the visible spectrum to expose the film. The film grain structure is most evident. Creates slight infrared look in foliage.
Yellow (#12)	Results are less dramatic than with the red filters.
Red (#25a)	Heavily darkens blue skies when photographing with the sun to your back, and penetrates haze. Creates very dramatic effects. The filter most commonly used.
Opaque (#87)	This filter does not permit visible light to reach the film. Creates dramatic and exaggerated effects because only infrared radiation reaches the film.
Polarizer	Helps infrared film to penetrate haze. Effective when used in conjunction with any of the above filters.

FLASH

Electronic flash can be used in numerous ways with infrared film. The studio portraits illustrated in this Tech Sheet were shot with the #25a filter and a strobe through a soft box. I have had great results using a flash meter with an EI of 200 for these portraits. Many elect to use a tungsten/quartz light source in the studio, which contains high amounts of infrared radiation and produces a beautiful glow on the subjects. When using the hot lights, experiment with and without filters. Document all of your tests.

Portable electronic flash offers a variety of possibilities. Place a filter over the lens and use the flash under the usual circumstances. Remember to compensate for the filter factors for the various filters. Use the Wratten #87 gel and cut it to cover the flash head of your strobe. The flash is nearly undetectable to the eye and permits the photographer to work unnoticed in dark locations.

PROCESSING

Developing infrared film is easy; however, there are a few precautions, and you will need a little patience.

The 35mm film can be developed in small tanks or rotary processed. I use stainless steel tanks and reels. Stainless tanks with plastic lids are okay, since I have never seen a problem with fogging from plastic lids. Plastic tanks can be covered with aluminum foil to block the infrared radiation. Prior to turning off the lights and rolling film on the reels, realize that the film is very susceptible to finger prints. As you open the film cartridge in the dark, handle the film only by the edges. You will notice that the film "feels" a little different. Infrared film is thinner than standard films. Also, you cannot tear the leader from the film to begin rolling. The film must be cut with scissors.

Table 2 >>>>>>>

Film Processing

(temperature at 68°)

Step	Time
Pre-wet	2 minutes
Developer	12 minutes
Stop bath	1 minute
Fixer	4 minutes
Rinse	5 minutes
Orbit bath	3 minutes
Final wash	15 minutes
Photo flo	1 minute

I have tried several developers with infrared, and the one I like best is one of the most common film developers, D-76. I have seen good results with Kodak's HC-110 and D-19. Yet D-76, with a modest dilution, yields long tonal ranges between black skies and glowing foliage. I am pleased with the results of the following ratio of D-76: from the stock solution, use 650 mls. of D-76 to 350 mls. of water to make one liter of working developer. This amount will process four rolls of film in a 32 ounce tank. Simply cut the solution quantity in half if you are using a two reel tank to process your film.

Years ago, we experienced some problems with tiny, clear "pinholes" through our negatives and these appeared on the prints as small black spots throughout the prints. The problem went away when we diluted the stop bath by more than twice the recommendation on the package.

Table 3 >>>>>>>

Suggested Development Times (temperature at 68°)

Developer/Dilution	Time
D-76 - 325ml :175ml	12 minutes
HC-110 - B	6.5 minutes
D - 19	6 minutes

PRINTING

I print most infrared images on a grade two or three paper. I like the deep black skies and hot glowing highlights, but I also print for long tonal ranges between these two extremes.

Depending on the amount of infrared radiated from the scene, I may purposely omit full texture and detail in portions of the highlights when printing. At times, it just feels right to allow those areas to "blow out." When using papers, I prefer cold tones for my infrared images. Many of my students, on the other hand, print with warm toned papers, and I have seen beautiful results, some toned with sepia and other warm toners.

Dodging and burning-in scares a lot of people, but I have found it a necessity when working with infrared materials. I have no fear of my skies going black without any detail, and there are times that I push it to that position by burning-in those areas of the image. Dodging important shadow information has become routine.

Global or localized bleaching of the print is a possibility to lighten the highlights. If your print is too dark overall, experiment with bleaching the entire print. Try one half teaspoon of potassium ferricynide in 48 ounces of water. Place the print in the bleach solution and agitate gently for a couple of minutes. Use fixer as an agent to stop the action of the bleach. Small areas of the print can be lightened by applying the bleach with a Q-tip or cotton ball. Again, fixer halts the action of the bleach.

Lake Shafter salt lake. 25A red filter in conjunction with hyperfocal focusing. I normally print on a half grade higher paper with an I/R negative.

As a finishing touch to your print, consider adding oils or pencil coloring to

your work. These materials work best on prints with a matte surface. The addition of selective coloring to the highlights of an infrared image can emphasize the ethereal, dreamlike quality of the image.

Shelia. This portrait utilized studio strobe and the #25a filter. Shelia was wearing rose colored sunglasses and the film penetrated the lenses allowing us to see the eyes.

Dale. I was attracted to his reflection in the plate glass. Note the infrared effect in the reflection.

SUMMARY: Working with Infrared Film

Equipment

- Format of choice: either 35mm SLR or 4x5 view/field camera.
- Your favorite lens.
- Infrared film: Kodak or Konica.
- Filter of choice 15, 23, 25a or 87.
- Changing bag.
- Cooler to keep film cool.

The Process

- Keep film refrigerated until use.
- Load film in total darkness.
- Process as quickly as possible.

The Subject

- In bright sun and distant subjects try exposing at 1/125 @ f/11.
- With subjects closer than 5 feet, try an exposure of 1/125 @ f/5.6.

FOR FURTHER READING

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Steve Goff is Chair of the Mass Communication Department and Head of the Photography Program at Odessa College. He received his B.F.A. and M.F.A. from Ohio University and taught at the Maine Photographic Workshops, Lakeland and Cuyahoga County Community Colleges, and Cleveland State University before coming to Texas in 1984. He has been awarded the Ohio Arts Council Aid to Individual Artist Grant. In 1987 he received the Mid-American Arts Alliance/National Endowment for the Arts Fellowship and represented the Fellowship winners at (Mois de la Photo à Paris) in Paris, France. He has an extensive exhibition record and teaches workshops around the state and region. Steve is Vice-President for State Affairs of the Texas Photographic Society and originated our Annual Workshop Series.

Steve Goff. Self portrait with studio strobes.

ABOUT TPS

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The Texas Photographic Society, founded in 1985, is a nonprofit organization of amateur and professional photographers whose purpose is to "support contemporary photography as a means for creative expression and cultural insight. TPS focuses on the education and artistic development of its members and the community by providing exhibitions, publications, education, and outreach programs." It sustains over 650 active members from 26 states.

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