The Zone System - Part One

What is the zone system?

By Lars Kjellberg The zone system was invented by Ansel Adams, one of the most famous photographers ever. He was a master of technique, and had an eye for light that few are blessed with. His photographs were the result of a happy combination of comprehensive technique and the knack of taking a picture when the light was at its best. A distinguishing feature of his black and white photographs is how light and dark areas play off each other in an instantly appealing manner.
Yet Adams did not approve of what he saw as the 'abuse' of his zone system. As an old man, he thought far too many people had misunderstood the method and burdened it with too much mystery. Why had it turned out like that? Most likely it was poor communication that was to blame: Ansel Adams was a much better photographer than he was a teacher. His first books on the zone system are very hard to follow. The final editions of 'The Negative' and 'The Print' are much better.

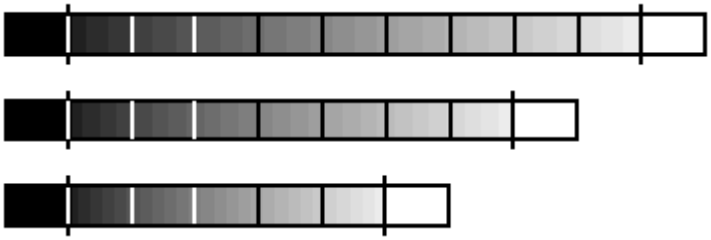
The zone system is simple
The zone system is very simple and its principles are logical and easy to understand. Its scientific basis had been known long before Ansel Adams and Fred Archer hit upon the method in the 1940s. The pioneers were Ferdinand Hurter and Vero Driffield who, at the end of the nineteenth century, studied the way in which light sensitive photographic materials reacted during exposure and development. They succeeded in describing the properties of light sensitive materials in a graph that showed what was termed the H&D curve, a curve still in use today in sensitometry.

Art or science?
Some of the difficulties in understanding the zone system probably had to do with the conflict between art and science. Is photography an art or a science? Is it in fact both? If you decide photography is an art, it becomes difficult for some to treat it as a science, and thus it inevitably becomes much harder to grasp what is going on. If, on the other hand, you accept that photography is both art and science, and understand its principles on a scientific and logical basis, it becomes much easier. To my mind this approach does not necessarily intrude upon the artistic side of photography. On the contrary, a better understanding of techniques can greatly improve personal creativity. When you really understand what is happening, you can exploit to the full all the means photography provides to express your artistic vision.

Visualisation, exposure and development
In brief, the zone system is made up of three basic components, all of which were very important to Ansel Adams: visualisation, exposure control, and contrast control.
Visualisation is not really a question of technique. It is a method used to picture the finished photograph before it is taken, and is useful for everybody, regardless of whether they are using the zone system or not.
Exposure control is key, partly because it is important to learn how your own photographic equipment works, and partly because you want to choose a shutter speed and aperture that will provide a negative with as much detail as possible. It is with exposure that we control the reproduction of shadows.
Contrast is controlled by development and the contrast grade of the paper used for printing. It is the contrast control that determines how white the picture's light areas will become in the finished photograph. You should learn to use a suitable development time that will give you the contrast you are looking for.

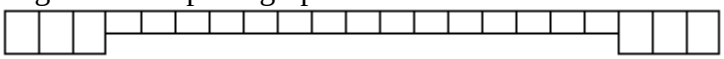
Difficult terms
Visualisation, exposure, and contrast control are terms that are simple to understand. What can be confusing are the words Ansel Adams used to describe exposure and contrast control: Zone V or Zone III exposure, N-2 or N+1 development. However, we will save these for later and concentrate first on a few basic requirements.

Brightness levels
It is a common mistake to think that you only take one exposure each time you press the shutter button. You take an exposure with a specific aperture and at a specific speed. However, another thing that affects the exposure is the reflected light from the object you are photographing, and this can vary greatly for the same object. The darkest details reflect less light than illuminated white details. Normally we have a number of different exposures every time we take a photograph. The object has many different levels of brightness, sometimes ranging from black in the shade to white in the sun. The range of exposure values is a result of variations in both the incident light (sun and shade) and the ways the object's various surfaces reflect light.
Measuring the range of the contrast in a picture is easy. It is best to measure the contrast according to the number of exposure stops from the darkest part of the picture to the lightest. One exposure stop is the equivalent of a halving or doubling of brightness. From 1/125 to 1/250 seconds is one exposure stop. From f5.6 to f8 is also one exposure stop. By first pointing the light meter at the darkest part of the picture and then the lightest, we can calculate the number of exposure stops between them. Normally there are seven stops between shaded black and illuminated white, but it varies depending on how harsh the incident light is. Direct sunlight on a clear day will give a very wide range of contrast, while a grey, hazy day will give a low contrast with few exposure stops between black and white. Normally, the contrast range varies between five and nine stops.



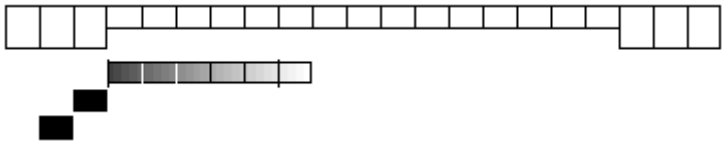
Nine stop contrast range, plus all black and all white
Seven stop contrast range, plus all black and all white
Five stop contrast range, plus all black and all white

Film's exposure latitude
Photographic film reacts to exposure. When film is developed, the blackness increases to a large extent in proportion to the exposure. A strong exposure (a white surface in sunlight) means that development heavily darkens the negative. A weak exposure (a black surface in shade) results in little darkening of the developed negative.
However, film has its limitations. Very weak exposures will not give any darkening at all, while very strong exposures do not give any more darkening than slightly weaker exposures would. The exposure must not be too weak or too strong. We are interested in the range of exposures that lie between the two extremes of underexposure and overexposure. We call this range the film's exposure latitude. A negative black and white film has a wide exposure latitude of up to fifteen stops. This is much more than the brightness range of almost all objects we might want to photograph.



A negative black and white film with an exposure latitude of fifteen stops.

Ideal exposure
When a film is going to be exposed in a camera, we have to make sure that all the object's individual exposure values fall within the film's exposure latitude. If we use too short an exposure (too small an aperture or too fast a shutter speed) the darkest areas of the object will end up outside the film's exposure latitude, and the photograph will be underexposed. If we expose for too long (too large an aperture or too long a shutter speed) we risk overexposing the lightest parts of the object, giving flat, bright areas devoid of contrast.



At a level of two stops underexposure, we will lose the two darkest stops of the object.

The best results are achieved if we use as short an exposure as possible without losing any of the shaded details. The way to do this is to measure the darkest element in the object and then pick a shutter speed and aperture as close to the threshold value for underexposure as possible.

The ideal exposure is to place all the tones of the object except all black, just within the films threshold to the left.

The reasons for choosing short exposures are the numerous advantages we gain. We have the smallest possible aperture, something that is generally desirable. We also have a fast shutter speed, which again works to our advantage. We end up with negatives that are not overly dark, thus shortening the exposure times when printing the photographs. Last but not least, the negatives will have a fine grain (the lighter parts of the negatives being more fine grained than the darker), which is almost always preferable.

Photographic paper's dynamic range
The point of taking a photograph is to produce a finished picture on photographic paper. It is the blackening of the paper that forms the image. In principle, a wide dynamic range produces the best results. The paper is said to have a wide dynamic range if it turns fully black in the darkest areas of the image and is wholly white in the lightest areas, which means that there is the widest scope for reproducing the image's details. One of Adams' strengths was that he knew which material to use, and he always used the best photographic papers.

A very good paper will have a dynamic range corresponding to more than six exposure stops.

A paper's dynamic range can be measured with a densitometer, and it can be described in terms of stops of exposure. A very good paper will have a dynamic range of about six exposure stops. If you compare this with the object to be photographed, which normally will have a range of seven stops, you will see that the paper can therefore reproduce the object's detail with little or no compromise. If you choose a paper with a range of four stops, the range of detail will have to be compressed to make it fit the paper's capabilities. For some photographs this is not much of a problem, indeed they can even benefit, but if we are looking for a picture with a full grey scale running from black to white, paper with a narrow dynamic range will not give particularly good-looking results.

I want to stress that the point of using the zone system is not always to produce this kind of photograph. Your aim should be to learn how to take the kind of picture you want, regardless of whether you want every last tonal detail, or whether you want your picture to be soft and grey.

Exposure controls shadows
This is an old adage that most people have heard more than once. What does it mean? Simply put, because it is normal to use the shortest exposure possible that will still preserve those details that are in shadow, you should get as close to the threshold value for underexposure as you can. If you were to go too far, the detail in the darkest shadows will be lost, and you will end up with an underexposure. In deciding the exposure, we also decide how much of the detail in the shadows will be kept. Exposure controls shadows!

Development controls highlights
This is another adage that still holds good. The longer the development time the higher the contrast, and the greater the difference between black and white. If you print the photograph so that the shadows come out right, the highlights will vary with different development times. A longer time produces lighter highlights and shorter time produces darker highlights. Development controls the highlights!

Two controls
What we have here are two controls, one for the darkest areas and one for the lightest. Once we have accepted this way of thinking, things become much easier. An object is made up of different tones ranging from black to white. To produce pictures with a full tonal scale you need to know how to control all the tones. To do that, all you need to do is to adjust the darkest and the lightest parts of the image. All other tones land between these two extremes, and will automatically fall into the right places. You control the darkest tones by learning how your camera and film react to exposure (by calibrating your equipment) and by then choosing an exposure that will ensure that the darkest tones will appear on the negative (by exposing in the correct zone). After this, you control contrast by picking a development time that ensures that the lightest areas of the picture will be reproduced on the photographic paper. The two controls are exposure and development. It is that simple.
Top left: With correct exposure and correct development, the image will get a full tonal range from dark tones to bright highlights.
Top right: With two stops underexposure the result is an image with lost shadow detail. With a longer exposure and/or larger apertur opening, the shadows would have been correctly exposed.
Bottom left: Less development gives lower over-all contrast and in this case to gray high-lights. With 20% more development this image would have been better.

Bottom right: To much development gives to high contrast. The high-lights are too white without any detail. 30% less development would have been better.

The Zone System - Part Two

Exposure

By Lars Kjellberg In Part 1 we looked at some of the basic principles of the zone system that you should be familiar with if you are going to understand its ideas fully. In Part 2 we are going to look at a few more of the basic principles before we go on to apply them in practice.

The exposure meter always assumes it is pointed at a "normal" gray surface, even if the surface in reality is black or white.

An exposure meter cannot tell what it is being aimed at. Is it aimed at a light or a dark surface? An illuminated dark surface will give you the same reading as a light surface in a dark room. Whether the surface that the light meter is measuring is dark or light (in other words, is reflecting a little or a lot of light), is something that the meter cannot determine. It is only able to measure how much light is reflected from the surface; it can give us an exposure reading for the surface

By exposing the back camera-bag two stops less than the measured value, it came out properly black. The white surface in the middle comes out properly white when exposed 2 1/2 stops more than the measured value.

Always grey
This brings us to something very important; the light meter always assumes that the measured surface is supposed to be grey. The exposure reading the meter produces is geared towards rendering the object's tone as medium grey.

Exercise: Load your camera with black and white film, and go out and take photographs of objects that have entire surfaces that are monotone. Vary between white, black and grey surfaces. Coloured surfaces can also be used. Measure the exposure with the camera's meter or a hand held meter. Expose all the surfaces exactly as the meter suggests. The camera's automatic exposure can be used with great advantage. Develop as usual, and print the photographs using the same exposure time and a normal paper. Every finished picture will have the same tone.

Deliberately controlling tone
Once we have grasped that using the settings suggested by the exposure meter means that our photographs will have a medium grey tone, we can start to think about how to change the overall tone of the picture. This is done by choosing a setting different from the one suggested

by the meter for the shutter speed and/or the aperture. If the meter tells us to use f8 and 1/125 seconds, we can, by choosing f8 and 1/500 seconds, achieve a tone that is two stops darker. 1/500 seconds is two exposure stops shorter than 1/125 seconds, the film will be two stops less exposed, and therefore the picture two stops darker. You can also make the picture lighter by choosing a longer shutter speed or a wider aperture.

The chapel of the Atlantic island Madeira, didn't have any windows. The contrast was extremely high. The left picture was exposed using an average measuring method. The result is a negative with no details at all behind the door.

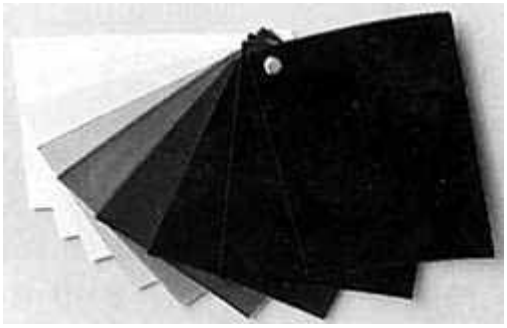
In the right picture exposure was calculated after measuring the darkest parts with a spot-meter, ensuring negative details in the shadows. The over-all contrast was reduced with less development of the film. Once we know how to control the picture's tone, we can photograph any object of any tone and get it right at the first attempt. We simply choose a setting for the exposure that will give us the correct tone.

Exercise: Load the camera with black and white film, and go out and take more pictures of surfaces, only this time practice altering the exposure. For example, when you shoot a dark surface the exposure can be reduced two stops. Light areas demand an increase in exposure, so try increasing two or three stops. Grey areas should be exposed according to the meter's suggestions. Develop as normal, and print all negatives on a normal paper with the same exposure for all the negatives. Choose an exposure where the grey surfaces come out grey, and the other surfaces will then automatically come out right.

Making a comprehensive exposure scale

The next problem is that we do not know how much lighter or darker the image will be when we change the exposure by a certain number of stops. We are therefore going to create a test series of exposures to establish the picture tone.

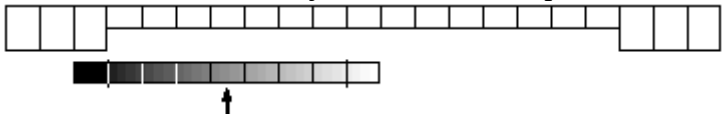
Exercise: Place a grey card outdoors so that it is evenly lit. Point the camera, loaded with black and white film, at the grey card without shadowing it. Focus on infinity. Measure the grey card's exposure with the camera's meter or a hand held meter. Start by decreasing the exposure by four stops: thus, if the meter reads f8 and 1/125 seconds, set the camera to f11 and 1/1000 seconds. Take the first picture. Increase the exposure one stop (to f8 and 1/1000 seconds) and take the second picture. Continue until you have taken nine pictures, which will mean that you have a picture for every setting from minus four stops to plus four stops. Develop the film as usual, and print all nine negatives using the same exposure and a normal paper. If they have been correctly printed, you will have a scale ranging from totally black to totally white with seven stops of grey in between.



Using this grey scale to help, it becomes much easier to choose an exposure regardless of what you are photographing. It is makes no difference if you are photographing a black, white or grey surface; with an exposure meter and the help of your grey scale you can give the photographed surface any grey tone you wish. All you have to do is adjust the exposure in the appropriate direction. Increased exposure (wider apertures or longer shutter speeds) provides tones that are lighter than medium grey. Decreased exposure (smaller apertures or faster shutter speeds) provides tones that are darker than medium grey.

Underexposure

By decreasing the exposure by 3.5 stops, you reach the limits of underexposure. By decreasing the exposure by more than 3.5 stops from the measured value, the negative will be blank and the picture will print as totally black. This limit has to be watched out for. It is best to make sure than none of the object's detail ends up beneath this limit.



The threshold for under-exposure is situated 3 1/2 stops left of (under) the measuring point for the exposure meter (the arrow).

Knowing this will make it easier to expose black and white film correctly. Confronted with an object to photograph, you start by identifying the darkest and measuring the exposure there, and you then adjust the exposure to ensure that this area ends up slightly above the underexposure limit. The exposure the meter will suggest will give this a medium grey tone, but we do not want the darkest part of the object medium grey; we want it to be black. Thus we have to decrease the exposure. The grey scale will help us decide by how much we need to decrease the exposure. Two stops may be sufficient. If the exposure meter gives a reading of f4 and 1/30 seconds, we should set the camera to f5.6 and 1/60 seconds. This will make sure that the darkest part of the object will appear on the negative. Set your exposure according to the shadows.

Ansel Adam's exposure zones

Ansel Adams chose Roman numerals for the exposure stops, which he called zones (exposure zones). He probably did this to give the different exposures separate names rather than talk about minus one stop or plus two stops. In Adam's terminology, the 'normal' exposure is called Zone V. A Zone V exposure is the exposure you get if you use the reading the meter provides, without changing it. If you decrease exposure one stop you get a Zone IV exposure. If exposure is increased three stops, you get a Zone VIII exposure. In other words, the numbering system starts from the normal Zone V exposure and then adds or deducts one for each of the stops by which the exposure is increased or decreased.

Zone 0, which is so underexposed that the negative will come out blank, is five stops beneath the normal exposure. Zone I is also under the underexposure limit: it may give you some detail in the negative, but it is still essentially useless to print from. To be able to distinguish detail from the wholly black in the finished photograph, it has to be exposed at least in Zone I 1/2 and preferably in Zone II. Detail exposed in Zone III will be very distinct in the finished print. Brighter details need to be exposed using the higher zones. Zone IX will be totally white when printed. Zone VIII will be almost white. Details that are supposed to appear white should be exposed somewhere within Zones VIII to VIII 1/2.

The zone scale
The grey scale described earlier can also be called a zone scale, which is arrived at by numbering the greys with Roman numerals from I to IX. The scale is used to help us see what the different zones (and their exposures) will look like in the finished photographs.

The advantage of the zone system
Getting the exposure right is probably the most important part of the zone system. When you have learnt how to determine the correct exposure using to the zone system, you no longer risk ending up with underexposed negatives. You can photograph the most difficult objects without losing fine detail, and a correctly exposed negative is the most important prerequisite for photographs that are rich in tone. It is not a disaster if the contrast is not spot on - that can always be adjusted in the printing - but an underexposed negative will never give you a good picture. If you choose too fast a shutter speed or too small an aperture, inevitably important detail will be lost that cannot be retrieved in the dark room.

An "impossible" object in the eyes of many average photographers. The only light source is the small window. It is very dark in the corner. I measured the reflected ligth at the darkest places in the corner with my Pentax digital spot-meter. I then calculated an exposure that garanteed me to have details in the darkest parts. The negative was developed less than normal in order not to get the high-lights to black on the negative. Film: Kodak T-Max 400 9 x 12 cm. Exposure: f 22 and 13 seconds.

The Zone System - Part Three

Contrast

By Lars Kjellberg The obvious difference between colour prints and black and white prints is that the black and white prints have no colours. Colour as a medium of information is very important in colour prints, so to compensate for this in black and white photography we have to be much more aware of the problems of working with a grey scale. The grey scale is the black and white print's 'colour', the most important provider of information, and in order to master the grey scale we must control the contrast.
Fortunately it is much easier to control the contrast in black and white film than it is in colour. All negative colour films are developed to the same contrast, and generally there is only one contrast grade of colour paper. Slides are also developed to the same contrast. The most important way of limiting contrast in colour pictures is to pre-expose (or post-expose) the film slightly, which will decrease contrast in the darkest areas.
Even though we hardly ever do anything about the contrast in colour prints, most of the time we still accept them as good pictures.

Black and white contrast

When you work with black and white there are many ways of controlling the contrast. The most common is to use a different grade of paper or to filter a variable contrast (VC) paper. Most people working with black and white follow one set of instructions, and hardly ever change the development time. Development time is in fact an excellent tool for controlling the contrast in black and white film. Shorter development times give you a low contrast negative and longer times give you a high contrast negative.

As with colour film, you can also decrease the contrast by slightly pre-exposing the film before use. This can also be done to the paper while printing. Pre-exposing the paper decreases the contrast.

These different methods of controlling the contrast affect the final photograph in various ways. An alteration in the development time changes the contrast evenly. A strongly reduced development time may make even the darkest shadows disappear, something that has to be compensated for by increasing the exposure.

Different paper grades also affect the whole tonal scale more or less evenly. If you are forced to use a really high contrast paper (Grade 4 or more) the detail in the darkest shadows and brightest highlights may be lost. VC papers will not give you as even a change in contrast as graded papers, although it should be noted that some VC papers will have a more even effect than others.

Pre-exposing the film reduces the contrast only in the darkest shadows, while pre-exposing the paper reduces the contrast in the brightest highlights.

Aim to use a normal paper

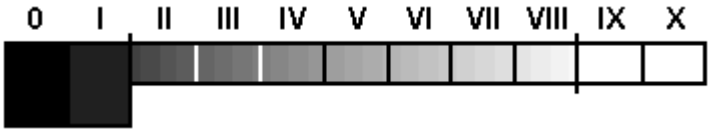
In his final version of 'The Negative', Adams recommended using the film development time to control contrast, but he also warned against becoming obsessive about it. Despite all claims to the contrary by many zone system experts, the idea is to be able to print every negative on a normal paper. According to Adams, you should try to find a development time that works with Grade 2 paper, but that said, having to use a Grade 1 or Grade 3 paper is not a disaster. The reason for aiming to use Grade 2 paper is that you can then use Grade 1 or Grade 3 if you have to. If you set out to use a Grade 3 paper you may end up having to use Grade 4, loosing shadow and highlight contrast in the process.

Which contrast?

There are many reasons why you should vary the contrast when making black and white prints. The contrast inherent in the object varies. Soft light that casts no shadows requires a negative or paper with a high contrast. Harsh light creates pictures with too much contrast if not compensated for by a low contrast negative or paper.

Some objects do best with less contrast, others need more if they are to come out well in the final print. Tastes differ. Some people prefer soft pictures, others prefer them with a higher contrast.

Before we go further into the zone system's method of contrast control, and the terms used to describe this, we will take a closer look at the zone scale and the different zones.



A schematic picture of a zone scale from 0 to X. The border between black and almost black is marked between zone I and II (zone I 1/2). The border between white and almost white is between zone VIII and IX (zone VIII 1/2).

Blackpoint and whitepoint
There are two very important points indicated on the zone scale shown in the figure the blackpoint and the whitepoint. The blackpoint comes between Zones I and II, and the whitepoint between Zones VIII and IX.
The blackpoint is the point where totally black becomes nearly black. Details that are exposed so they fall into a zone beneath Zone I 1/2 will be more or less absent from the negative, and the print will be wholly black and devoid of all detail. Details exposed in Zone I 1/2 and up will appear on the negative.
At the other end of the scale, details exposed beyond the whitepoint at Zone VIII 1/2 will come out totally white in the print if we do not do something lower the contrast. Unlike those at or beyond the blackpoint, these details are present on the negative, and by choosing a low contrast paper or by using post-exposure we can make these details appear in the print.

The different zones
Zones 0 and I will always appear totally black when printed. Occasionally you may be able to obtain some tone in Zone I, principally if you have used a short-toed film and paper with a short shoulder.

Zone II will be distinguishable from totally black on the negative and the paper. Very dark details in shadow should be exposed in this zone.

Zone III shows distinct texture.

Zone IV will be slightly darker than medium grey. Skin tones in shadow and dark foliage are suited to this zone.

Zone V is the one to which exposure meters are adjusted. The intent is to make Zone V appear medium grey in the finished picture. Since the choice of film and paper affects the tone, do not try to follow the grey card too closely when printing Zone V.

Zone VI is light grey. Well-lit pale skin tones come out best in this zone, as do snow and white sand in shadow.

Zone VII approaches white, but can reproduce detail with distinct texture.

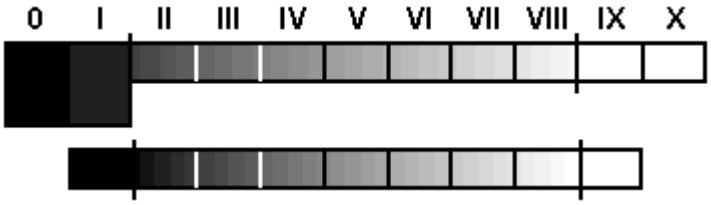
Zone VIII is almost completely white.

Zones IX and X are usually completely white. Using a softer paper, shorter development time or post-exposure when printing, we may be able to make even these zones appear in the final print.

Zone placement
When using the zone system to decide upon the exposure and development, you normally use a type of exposure meter called a spot meter. This measures the light for only a very limited area of the object. Many modern cameras have a built in spot meter that can be used for this purpose. You take a selective measurement of a small part of the object.
However, before you measure the exposure, you have to consider how you want the different details of the object to appear in the finished picture. The best way is to look for details that will be reproduced as relatively dark in the picture.
Say we start by finding a detail we will want reproduced in Zone III. We want it to appear as

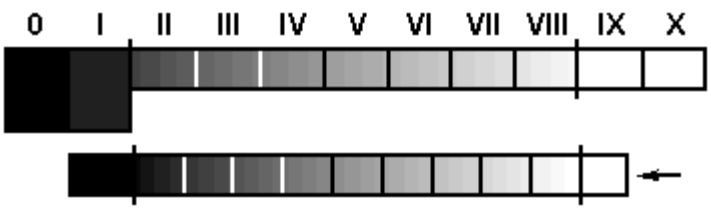
very dark in the picture, but we also want to maintain its texture. Point the spot meter at this area and take a measurement. Since the meter will always want the exposure to be in Zone V (making everything medium grey), the exposure has to be adjusted to Zone III. Since Zone III is two stops darker than Zone V, we will have to reduce the exposure by using a smaller aperture or a faster shutter speed. If the meter suggests f8 and 1/30 seconds (8/30), we can choose to use 8/125 to get an exposure in Zone III. We will set the camera to 8/125 when we photograph the object. To use zone system terminology, we say that we placed the detail in Zone III.
When the placement - and thus the decision on the whole exposure - has been made, the next job is to check where the remainder of the object details fall. All this really means is that we check the contrast. Point the spot meter at the brightest area on the object and read off the value. Calculate how many stops brighter than Zone III it is. Take the difference and add three (since the placement was made in Zone III) and you will know which zone the brighter detail falls into. For example, if the reading for the bright area is 8/1000, it is five stops brighter than the dark area we measured first (the difference between 8/30 and 8/1000). 5 + 3 = 8, thus the bright are falls into Zone VIII, which will be almost completely white in the finished picture.

Normal development
The zone system uses the terms plus, normal, and minus development. Normal development is used when you are satisfied with the zones the different areas of the object fall into. If, in our example, we were happy for the bright area to fall into Zone VIII, we can develop as normal. Normal development produces a good average contrast suitable for pictures taken in light that is neither unnaturally soft nor harsh.
What constitutes a normal development time is decided by calibration or experience. We will take a closer look at calibration in Part Four.



Normal development. The contrast of the object corresponds with the zone scale. We are content with the result and do not have to adjust the development.

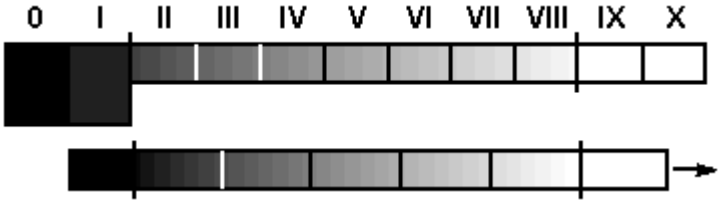
Minus development
If, on the other hand, we are not satisfied with the way the other details fall, we will have to adjust the contrast. Assume that we do not want the bright area to fall into Zone VIII as being too white, and that we would prefer to have it in Zone VII. If this is the case, we want to reduce the picture's contrast. To do this we use minus development, and since we want to adjust the detail down one stop, we do a minus 1 development. We could also achieve the same reduction by printing onto a softer paper.



Minus development. The contrast of the object do not corresponds with the zone scale. The contrast is too high and needs to be reduced. Zone VIII in the object has to be moved down to zone VII on the scale. We will have to reduce the development. A minus 1 development is a

proper development in this case.

Plus development
Equally well, we can find ourselves in a situation where we need to increase the contrast. Perhaps the light when we took the picture gave too low a contrast, leaving us with soft negatives and pictures as a result. Alternatively, the contrast in the picture is low simply because the object was low-contrast.
You will notice this when you measure the object with a spot meter. The exposure is chosen by measuring the darkest parts of the object, and placing the dark detail in the corresponding zone. When we measure the other details we may discover that they fall in too low a zone, resulting in a low-contrast picture. If, for example, we want to move a detail from Zone VI to Zone VIII, it means a two-stop move, and thus a plus 2 development. Later, we will take a closer look at how you calibrate exposure and development more precisely.



Plus development. In this case we are going to move zone VI in the object, up to zone VIII, in order to get the result we have visualized. Two stops up calls for a plus 2 development.

A ready reckoner for contrast control

Object light contrast	Diffusion enlarger	Condensor enlarger
Low	Plus 15% development Or use grad 3 paper	Recommended development
Medium	Recommended development	15% less development Or use grad 1 paper
High	15% less developmen Or use grad 1 paper	30% less development Or use grad 0 paper

The Zone system - Part Four

Calibrating exposure and developing times, a way of achieving perfect tone control.

By Lars Kjellberg Film speed and developing times are not sacred cows. On the contrary, they often need to be adjusted for your pictures to be full in shadow detail and to control contrast. The speeds and times provided by the manufacturer should be regarded as starting points for you to make your own adjustments by. In this part of the Zone System course you will learn several different ways of calibrating for your personal needs. If you use one of these methods while going through your routines, your black and white negatives will be easier to print and the technical quality of your pictures will be better.

Why calibrate?
Exposure index (ISO, or film sensitivity setting) is calibrated because a camera's shutter and aperture aren't always correct, the exposure setting may not be correctly adjusted, and the film

developed in your developing time may not hold the speed the manufacturer claims it does. If your equipment fails in a negative way (your shutter speed are too short, your aperture is too small and your meter shows values that are too high), your negatives will come out underexposed, which always results in a lack of detail in the dark parts of the picture. A simple calibration will reveal such defects and will provide a proper exposure index for your equipment, resulting in pictures with full shadow detail.
The contrast of the negative depends on several differents factors. The most important ones are, of course, what film and developer you choose to work with. Every combination of film and developer demands it's own developing time. But contrast is also affected by developing time, agitation, concentration and temperature. Usually the contrast of the negative is regulated by varying the time of developing, while other variables are kept constant. The ideal contrast is not clear. It depends on the source of light in your enlarger, your choice of photographic paper and your personal taste. Besides that, it can be to your advantage to vary the time of developing with the contrast of the photography light in order to always keep the contrast of the negative unchanged. An enlarger with a diffuse light (cold light or a color head with light mixing box) demands more contrasty negatives than enlargers with condensor light. If you choose to print on a high contrast photographic paper your developing time has to be shortened so as to not make the picture's contrast too high. All this might seem difficult, with all the different variables to keep track of, but it really isn't that complicated.

The principle of calibration
The scale of tones start with black and end in white. Between black and white are a large number of grays. These gray shades relate to black and white in a predictable manner, they are always between black and white. If we calibrate black and white, we will also control all the gray shades. Black and white are at the far ends of the spectrum. Normally, the scale consists of seven stops of exposure and the point of metering is at the middle of the scale, 3 1/2 stops away from black and 3 1/2 stops away from white. When calibrating, we first check where the black and white points are located at standard exposure and standard developing. If we have to, we adjust these two points in order to control them perfectly. We will find out how to expose to hit the black point exactly, and how to develop to hit the the white point exactly. When we know how to hit these two points, we can also figure out how the grays in between will fall.

Correct Exposure Index
Let's begin with a few methods of calibrating the exposure index (EI). Normally, you set the exposure meter on the camera (or a detached exposure meter) at the value recommended by the manufacturer. If you use a 35 mm camera you may even let the camera read the DX-code on the cassette. In most cases this is all that is needed, but we still recommend that you check if the shadow detail is good enough when using the standard setting.

1) The first method is the simplest and maybe the best. Place your negatives on a light table and look at them through a magnifying glass to see if there is a slight shade of gray in the lightest part of the negative (the part of the negative that turns almost black when printed). If large parts of the negative is almost completely or completely transparent, the EI should be adjusted somewhat lower. If, for example, you have used Tri-X set at 400, and the shadow part of the negative is too light, the EI should be adjusted to 250. This simple method of calibration is most accurate if you shoot an entire roll of film of a motive that has been placed in Zone 1 1/2, that is: a motive that has been exposed 3 1/2 stops below the meter reading. Expose the dark parts of the motive in Zone 1 1/2. Develope as usual and take a close look at the negatives on a light table. If the EI is correct, the dark parts of the negative should show a slight, but distinct, shade of gray.

2) Calibrating with a densitometer. Very few photographers have access to a densitometer. A

densitometer is an instrument that measures blackness. All graphic art companies and photographic labs have one. Call them up and ask if you may use their densitometer to measure some negatives. Densitometers measures blackness in a logarithmic number that describes the proportions between the light that has been absorbed and the light that has been let through. If all light was let through the negative (which is an impossibility in reality) the densitometer would show the value of 0. If half the light was let through, the densitometer's value would be 0.30. A forth would be 0.60, and an eighth would be 0.90. All negatives consist of a film base with fog that absorbs some of the light. We call this base+fog (b+f). B+f absorbs light evenly across the entire negative and therefore does not affect the finished picture. To be able to reproduce on paper the darkest part of a negative, it has to be exposed so that the developed negative shows a densitometer value of 0.10 above b+f. This is what we have to measure with the densitometer.
Set the exposure meter to the films suggested speed. Photograph an evenly lit surface (a gray card for example) and expose it 3 1/2 stops below the meter reading. If the meter suggest you set the camera to 1/60 at aperture 8, you may choose to set it at 1/500 (3 stops below) and adjust the aperture to between 8 and 11 (another 1/2 stop below). Develop as you'd normally do and measure the negative with a densitometer. Let's start by measuring the b+f which is usually at about 0.30 for 35 mm, and 0.15 for 120 and sheet film. The value of the exposed negative should be at about 0.10 above the b+f. If the negative is too thin, less than 0.08 (not exposed enough) the EI should be lowered. Try 1/3 below for 0.07 and 2/3 below for 0.04. If the suggested speed of the film is 400, 1/3 below will result in an EI of 320 and 2/3 will result in an EI of 250. In a similar way the EI should be increased if the negative is too dense. At 0.14 above b+f the EI should be adjusted by approximately 1/3 and at 0.18 above the b+f by 2/3. Increased by 1/3, an ISO of 400 becomes 500, and increased by 2/3 it becomes 640.

3) Calibration using a 0.10 ND-filter (a gray filter with a blackness measured to 0.10). Kodak sells ND-filters of different blackness values. This filter can be used as a reference when we evaluate the correct EI.
The ideal blackness for a negative that has been exposed 3 1/2 stops below normal, is 0.10 above the b+f. Therefore you need to use an unexposed and developed negative (filmbase+fog) with an ND-filter placed on top of it as a reference when the correct EI is evaluated. Start by photographing a detail of a motive that has an even tone and is evenly lit, for example a gray card. Expose it at 3 1/2 stops below the meter reading. Develop as you normally would. Compare this on a light table to the gray shade of the b+f+ND 0.10. If the developed gray is lighter than the reference, the EI should be decreased. Your equipment is underexposing, which can be compensated by a decrease of EI. Do another shoot with a decreased EI and compare it again to the reference. If you find it difficult to compare them just by looking at the negatives, they can be printed on a high contrast photographic paper. A high contrast paper provides the most visible result and is easier to evaluate. Print the b+f+ND 0.10 to a middle gray shade on the hard paper. Then print the exposed and developed negative at the same exposure time and compare the developed prints. If the b+f+ND 0.10 turns a lighter shade of gray on the print, your EI is too high and your negative is too thin (underexposed).

Calibrating the normal developing time
To balance the contrast of the negative, the developing time needs to be calibrated. Here are some different methods for calibration.

1) The visual method. It's rather hard to judge whether the developing time is correct or not just by looking at the negatives. It's essential to first make prints and then evaluate if the contrast in the prints is correct. Print on a paper of average grade. Print more than one negative and compare the dry prints in a normal light (not too bright). Do you experience the contrast as beeing correct? Or are the prints too low or high in contrast? If the prints are too contrasty, the

developing time should be shortened. If the prints are too soft and gray, the developing time needs to be longer. You may use a more sophisticated way of deciding your developing time, but this visual method should be the definitive check. If you think that the prints are generally too harsh, the developing time should be shortened no matter what the densitometer says!

2) Contrast can easily be measured with a densitometer. Expose two negatives, one black-point negative and one white point-negative. One should be exposed 3 1/2 stops below the meter reading and the other 3 1/2 stops above the meter reading. The white-point negative is, after developing, the dark negative, and the black-point negative is the light one. Measure the blackness in both of them and calculate the difference. If, for example, the white point negative has a blackness of 1.42 and the black point negative has a blackness of 0.32, the difference in blackness is 1.10. The contrast is 1.10. As mentioned earlier, enlargers have different sources of lights and they demand negatives of different contrast. The approximate negative contrast desired when printing in an enlarger with diffuse lights is 1.20. A print made in an enlarger with a condensor light should measure between 1.00 and 1.05 in contrast. These values are approximates and should be regarded as starting points for your own printing. Personal taste may require negatives of deviating contrast.

3) Print the white point and the black point negatives simultaneously in the enlarger. Place them in the negative carrier in a way that ensures that half of each negative is printed. Between the negatives is a small slice consisting of the b+f alone. In the finished print, this slice should come out completely black, the black point should come out almost black and the whitepoint almost white. If the white point is too dark, then the contrast is too low. You need to increase your developing time. If the white point is too bright, the contrast is too high, and this can be adjusted by shortening the developing time.

4) Use a fact sheet. The contrast of a negative can be described by another number: contrast index (CI). The contrast index describes the inclination of the film curve. An ideal CI for a negative that is to be printed in a condensor enlarger is 0.50. The corresponding number for a print that is to be printed in a diffusor enlarger is 0.57. Some manufacturers provide fact sheets with charts showing the developing time appropriate for a certain CI. Along the y-axis of the chart are different developing times and along the x-axis are the different CI values. The chart has a number of lines and every line represents a developer. Suppose you are going to shoot T-MAX 100 and develope it using D-76. You want the negative contrast most suitable for a diffusor enlarger, this means a CI of 0.57. Draw a line parallell to the x-axis at 0.57 until that line crosses the D-76 line. Draw another line down to the x-axis and read the developing time, which according to the Kodak fact sheet is 8 minutes. This method is very simple and doesn't demand any darkroom work. The drawback is that not all manufacturers provide fact sheets like Kodak do.

Calibrating plus- and minus times

For calibrating plus- and minus, we can use a similar method as when calibrating the developing time. Normal developing assumes that the contrast of the motive spans seven stops. That is why you expose at 3 1/2 stops below and 3 1/2 stops above. You get a difference of seven stops. At minus 2 developing the contrast is nine stops. The two frames exposed are minus 3 1/2 and plus 5 1/2. At minus one, developing it is minus 3 1/2 and plus 4 1/2. The corresponding frames for plus 1 developing is minus 3 1/2 and plus 2 1/2. The contrast should be the same in all examples, and this is done by varying the developing time. Start from the following approximate times: For minus 2 developing time should be shortened by 30 %. For minus 1 by 15 %. For plus 1 time should be increased by 20 % and for plus 2 by 40 %

The Zone System - Part Five

No Magic!

By Lars Kjellberg It is not that often that we get the chance to use the zone system to its full extent. In principle it would require working with a large format camera so that you can process every negative individually. However, it is not necessary to stick grimly to the zone system's principles. You will get far just by learning how it works and by using the parts that can be usefully applied each time you take photographs.
The two main principles important to remember are 1) that exposure controls the dark tones and 2) that development (or paper grade) controls the lighter tones. When you have taken these principles on board and use them when taking photographs, you will find your negatives will be much easier to print.

Avoid underexposure
When you stand looking at an object you want to photograph, trying to decide what you want in the way of exposure and development, you should ask yourself two questions.
1) How high is the contrast of the object? If you have direct sunlight from a clear sky to cope with, you should plan on reducing the development time in order to reduce the contrast. If you reduce the development time you may also have a problem with a slight reduction in film speed. This has to be compensated for when taking the photograph.
2) Which of the darkest parts do I want to be able to see? Choose an exposure setting accordingly. It is better to expose a little too much than not enough. A slight overexposure can be compensated for by using longer exposure times when printing. An underexposure can never be completely compensated for, either in development or printing. Avoid underexposure!
It is of little importance whether the picture's contrast is adjusted when developing the film or by using different grades of paper when printing. It is difficult to detect any difference between a picture printed from a soft negative on a high-contrast paper and a picture printed from a hard negative on a low-contrast paper. It is also difficult to see any difference between a print from a normally exposed negative and one from a slightly overexposed negative. On the other hand, it is all too easy to tell apart a picture printed from an underexposed negative and a picture printed from a normally exposed negative, since the underexposed negative will have no detail in the shadows.

Roll film
It is easy to see that you cannot develop every picture on a roll of film separately. When using a roll of film it is therefore best to decide the kind of development you want before you take your photographs. Consider the light and the contrast, and decide whether you can use a normal development, or whether it will have to be plus or minus. Then shoot the whole roll as carefully as possible. It is a good idea even to make notes of the grade of paper the negatives should be printed on. If it turns out that you need a plus development for a film that you had already decided to develop normally, you simply print on a higher-contrast paper. Printing will be easier if you have made a note of this while you were taking the photographs.
Since graininess in the negative increases when using a plus development, it is best to avoid plus development when using high speed 35 mm films. It is preferable to print on higher-contrast paper. Adams supposedly minus 1 developed his 35 mm Tri-X film to avoid graininess. When working with sheet film the grain is far less obvious, which means that plus-development can be used without problem.

Evaluation
A knowledge of the zone system is also handy in evaluating negatives and prints. It becomes easy to see if a negative is underexposed, normal, or overexposed. Place the negative on a light

table and look at the areas that are in shadow. Is there enough detail? Are there empty black holes without any texture? Empty holes are not what we are after: next time, increase the exposure.
The quality of the development is judged by looking at the finished print. Is the contrast balanced? Would we have preferred a higher or lower contrast? If the prints are too soft you will need to increase the development time. There is no Film X that is 'uncommonly high contrast', or indeed a Film Y that 'is suitable for sunlight because of its low contrast'. All films can be developed to be high or low in contrast. It is only a matter of changing the development time.

Visualisation
Ansel Adams came up with a concept that he called 'visualisation'. This means that when looking at the object you are about to photograph, you should try to envision the finished print. Try to disregard the object's colour, movement, smell, feel, and three-dimensional character. What remains is a black and white, two-dimensional, static picture, without smell, feel, or taste.
There are certain tricks that can be used to simplify visualisation. You can close one eye and squint with the other. Try looking at the object through a Kodak Wratten 90 filter: it is dark yellowish-green in colour, and cancels out the object's colours. Try to picture what the object will look like, with all its shadows, middle tones, and highlights. Then choose the zones you want the different parts of the object to be placed in.

The spot meter
A spot meter is the best tool to help you choose the exposure. It measures light reflected from a very small area of the object. Most spot meters have a measuring angle of only one degree, which makes it possible to measure small details all over the entire object.
You can stick a zone scale onto your spot meter's setting ring. Zone V should be placed in front of the spot that indicates a standard exposure.

Point the meter at one of the object's dark surfaces and read off the value. Turn the setting ring so that that value is next to the Zone in which you wish the detail to be placed; Zone III, for example. The value next to Zone V is the exposure setting you should use. It is now time to see which zones the highlights fall into. Point the meter at a bright part of the object and read off the zone it falls into. Are you satisfied with this, or do you want to adjust it with different development times or paper grades? If you want the bright area moved up one zone, it can be achieved either by using plus 1 development or by printing the picture on a paper that is one grade higher in contrast.

Measuring with the camera
You can also draw an exposure scale in your notebook. Point the camera at the dark part of the object and take a reading. If, for example, we have a reading of f11 and 1/8 seconds, you write 11/8 next to the zone that you want the dark part placed; for example, Zone III. Fill in the rest of the scale, reckoning on an increase of one exposure stop for every zone. In the box by Zone V, for example, you will have 11/30. Now measure a brighter part of the object, and see where it falls. If the meter reads 11/250, it will be placed in Zone VIII. Are you satisfied, or do you

want to adjust it?

II	III	IV	V	VI	VII	VIII
11 4	11 8	11 15	11 30	11 60	11 125	11 250

The all-important printing
The whole point of the zone system is to provide you with good negatives that are easy to print. When it comes to the actual printing, you can forget the zone system completely. Ansel Adams compared printing to playing music. The negative is the score and the print is the music as it is performed. Put the score in the hands of five different conductors and the music will sound different every time. You will recognise it, but it has been interpreted in five different ways. The same holds good for photographic negatives. Give five printers the same negative and they will give you five different prints. You can see that the prints have been made from the same negative, but you will have five different interpretations.
It is in printing that the small but all-important details are decided upon; choice of photographic paper, dodging, burning, toning, and so on. This is something we will return to in another series of articles.

No magic
The zone system was invented some fifty years ago as a means of controlling exposure and contrast. Over the years it has become shrouded in myth, and has been raised to the level of metaphysics by people who do not really understand it. The zone system is easy and logical. It has been abused by people who claim that their otherwise mediocre pictures are great art because they used the 'difficult zone system' to take them.
Many are led to believe that the method is time-consuming, requires weeks of preparation, and inhibits creativity. But if you use the zone system in a suitably personal way, you will have a wonderful tool that will enhance rather than inhibit your photography.

Practice makes perfect
Almost every adult can ride a bike, a skill no-one is born with. Everyone had to learn how to do it. Despite all the mistakes - who hasn't lost their balance, or fallen off and grazed knees and elbows? - we kept practising. When we finally mastered the technique, we were elated. To stay vertical riding a bike was success enough. That cycling could also be a form of transport didn't enter our heads.
The zone system is exactly the same. It is not something you are born with, so you decide to learn it. You make many mistakes, but keep going. At a certain point - invariably after a great deal of practice - you feel that you have mastered it. You can control the tonal qualities of your pictures. The zone system all too easily becomes an end in itself.
But if you continue beyond this point, you will find that zone technique becomes less important. You will use the zone system to a greater or lesser extent, but only to serve your purposes. The technique is always there in the background, just as cannot forget how to ride a bike, and you will no longer get the exposure wrong in your negatives. You acquire a confidence that improves your pictures, regardless of the kind of photographs you take.
When we can ride a bike, we sometimes use it because it is the best way of getting from A to B. In the same way, we can sometimes choose to use the zone system because it is the best tool for tonal control.