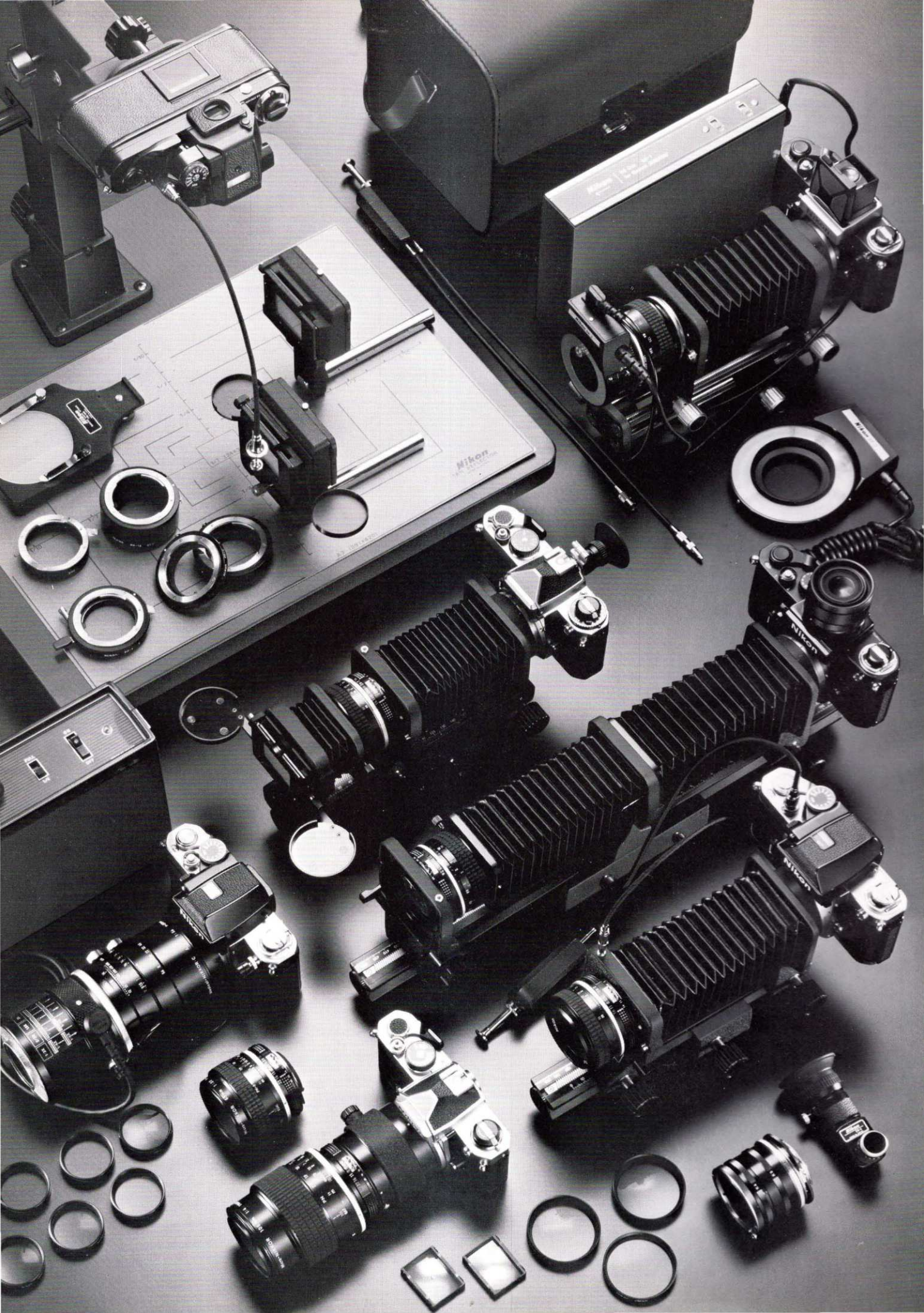


Close-Up Equipment

SALES MANUAL



INTRODUCTION

Close-up photography is *one* field in which the 35mm single-lens reflex really excels. No other camera type can match it for convenience. The 35mm SLR provides through-the-lens viewing and metering no matter which close-up accessory is attached, so it's easy to previsualize and get good results; yet the camera equipment is small and light enough to carry anywhere for shooting the most inaccessible of subjects in the field. And when it comes to close-up equipment, nothing can beat the Nikon System for versatility.

For years, Nikon has had the 200mm Medical-Nikkor—a lens so easy to use that even photographically unskilled personnel in science and industry can get perfect results right away. Now,

with the recent introduction of the PB-6, Nikon has one of the most advanced bellows systems on the market today. It is really a system within a system and consists of the main bellows unit, plus an extension bellows, slide copier, and macro copystand.

So when your customer expresses an interest in close-up photography, you can recommend the Nikon System knowing that there is always just the right lens or accessory to meet his needs, regardless of his involvement. Another fact worth considering is that very few customers switch brands once they have purchased Nikon. This means satisfied customers and repeat sales.

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FUNDAMENTALS

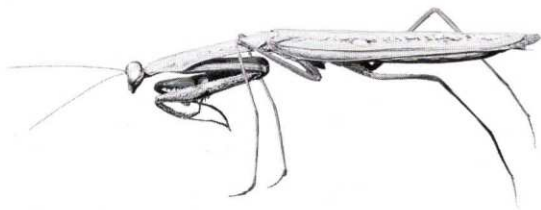
Probably the most important single concept in close-up photography is reproduction ratio or magnification. When you compare the size of the image recorded on film with the actual size of the subject, you can determine the reproduction ratio or magnification. This relationship is expressed in the formula:

$$\begin{array}{c} \text{Reproduction ratio} \\ \text{or} \\ \text{Magnification} \end{array} = \frac{\text{Image Size}}{\text{Subject Size}}$$

For example, suppose you want to take a picture of a praying mantis, which is 3" (72mm), and you want to fill up the long dimension of the frame with its image. Since the 35mm frame is 1½" (36mm) long, we have:

$$\frac{\text{Image Size}}{\text{Subject Size}} = \frac{1\frac{1}{2}'' (36\text{mm})}{3'' (72\text{mm})} = \frac{1}{2}$$

The reproduction ratio is written as 1:2, 1 to 2, or as 1/2X magnification. Another way of saying it is 1/2 life-size. A photograph is said to be "life-size" when the image size is equal to the subject size. Most lenses, at their closest focusing distance, provide a reproduction ratio of approximately 1:8, hardly sufficient for filling up the frame with small subjects. To increase the magnification, there are basically **four** things you can do: 1) attach a screw-in close-up lens to the front of the lens; 2) use a special-purpose close-focusing lens instead; 3) add extension rings or a bellows unit between the lens and camera body; or 4) mount the lens in the reverse position on the camera. These methods can be used singly or in combination to achieve the desired magnification.



Actual size of subject



1/2 life-size

1) Close-up attachment lenses

An easy and economical way to enter the exciting field of close-up photography is by using close-up attachment lenses. For the beginning photographer, one of the biggest attractions of these lenses is that they are the same size as regular screw-in filters, so they are light and easy-to-carry and attach to the lens in seconds. Another nice feature is their operational simplicity. Since the close-up lens simply magnifies the image without reducing the amount of light passing through the lens, absolutely no exposure compensation is required. But, as is true in photography, for every advantage there is a disadvantage. With close-up attachment lenses, the main drawbacks are limited magnification (less than 1X) and the lack of sharp resolution at the edges of the frame unless the lens is stopped down at least two or three f/stops from its maximum aperture. Although close-up lenses may be attached to a variety of focal lengths, they are usually used with ones in the normal to telephoto range. The reason is that the longer the focal length, the greater the magnification produced.



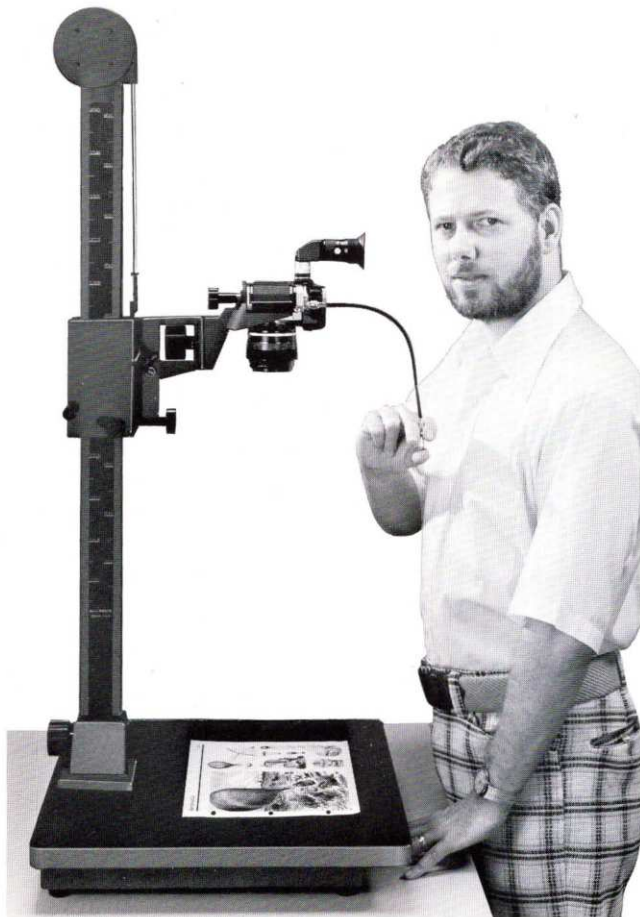
2) Special-purpose close-focusing lenses

For the customer who demands the ultimate in image quality and ease of operation, there are specially designed lenses which allow close focusing without accessories. In photography, as in everything else, you get what you pay for, so consequently these lenses are more expensive than any other type of close-up equipment. However, the quality they provide is well worth the additional cost.

One group of close-focusing lenses is called "micro." These lenses are designed to render the best definition at a 1:10 reproduction ratio rather than at the infinity setting which is the case with other lenses. With extra-long helicoids, they focus continuously from infinity down to one-half life-size and, with the addition of their own optional extension ring, from one-half to full life-size. Moreover, they have exceptional flatness of field making them perfectly suited for two-dimensional copywork where center-to-edge sharpness is mandatory. Many camera manufacturers now offer micro lenses in two different focal lengths—normal (50–55mm) and medium telephoto (90–105mm)—the reason being the amount of free-working distance and type of perspective they provide. The normal micro lens is designed for

document and slide copying as well as flower and small specimen photography; whereas the medium telephoto micro provides greater working distance and more natural-looking perspective for shooting "shy" subjects in the field or for taking product shots under studio lighting.

Another lens in the close-focusing category is the 200mm Medical-Nikkor. Nikon designed this lens expressly for scientific, industrial, and medical applications where photographically unskilled personnel are often required to take the shots. It offers eleven fixed reproduction ratios ranging from 1/15X to 3X, has its own built-in ringlight flash for stop-action, shadowless illumination, and uses either AC or DC power packs. In addition, its 200mm focal length provides that extra free-working distance so necessary when shooting high-speed machinery or delicate medical or dental operations. All the user has to do is set the ASA and desired reproduction ratio on the lens, attach the proper color-coded attachment lens(es), and the exposure will be automatically adjusted when using the ringlight. Nothing could be easier.



FUNDAMENTALS—cont'd

3) Extension rings or bellows

Another way to shoot close-ups is by attaching extension rings or a bellows unit between camera and lens. Extension rings are metal tubes of fixed length. They are inexpensive and lightweight, yet provide a relatively small amount of extension. On the other hand, a bellows unit is bulkier and costs more, but offers continuously variable extension over a wide range. Despite their differences, extension rings and bellows both serve the same function: they extend the distance between camera and lens.

It's an optical fact that as the lens is moved further away from the camera body, you are able to focus closer. To determine the amount of extension needed to produce a certain reproduction ratio, this equation can be used:

$$EXT = RR \times FL$$

where EXT is the amount of extension needed,
RR is the reproduction ratio, and
FL is the focal length of the lens in mm.

Suppose you are using a normal 50mm lens and want to shoot at 1X magnification, how much extension will be needed? By substituting into the equation, we have:

$$\begin{aligned} EXT &= RR \times FL \\ &= 1 \times 50 = 50\text{mm of extension} \end{aligned}$$

From the equation, it becomes apparent that the shorter the focal length, the less the extension needed to produce the same magnification. Carrying it one step further, with a set amount of extension, the shorter the focal length, the greater the magnification produced. Therefore, to obtain the greatest possible reproduction ratios when using extension rings or a bellows unit, use wideangle lenses.

Another fact which must be taken into consideration is this: As the lens is extended away from the camera, the actual amount of light striking the film is reduced, thereby requiring an increase in exposure. A handy formula for finding the exposure factor is as follows:*

$$EF = (1 + RR)^2$$

where EF is the exposure factor,
and RR is the reproduction ratio.

If we are shooting at 1X magnification, let's see what the exposure factor would be:

$$\begin{aligned} EF &= (1 + RR)^2 \\ &= (1 + 1)^2 \\ &= (2)^2 \\ &= 4 \end{aligned}$$

* This formula is applicable only to lenses of symmetrical design. For determining the exposure factor with lenses of asymmetrical design, please refer to the Technical Information in the PB-6 Section, page 33.

6



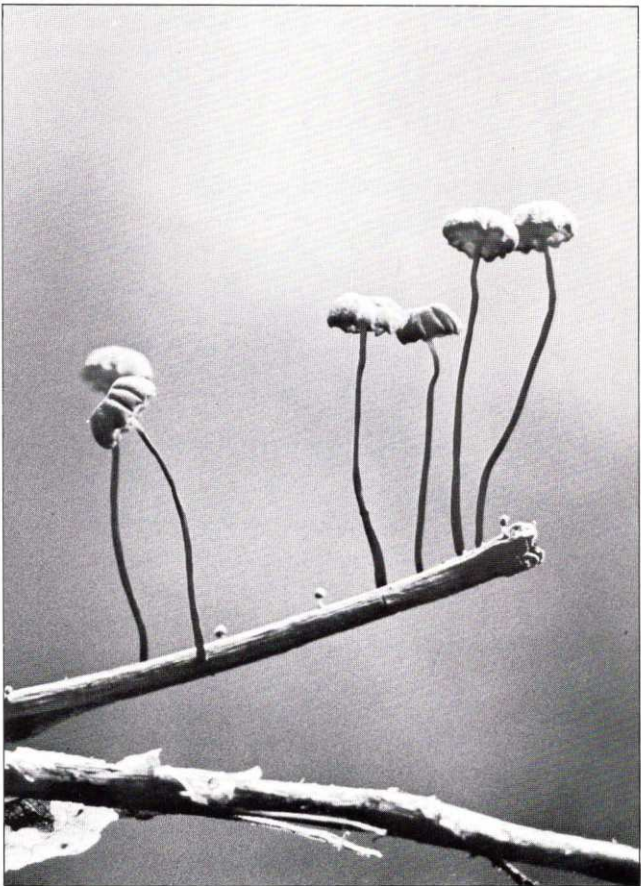
Thus, the exposure factor is 4. To find the amount of exposure increase, you multiply the original shutter speed by the exposure factor to get the corrected shutter speed. For example, suppose the original shutter speed was 1/8 second. Multiplying it by 4, we have:

$$1/8 \times 4 = 4/8 \text{ or } 1/2$$

So, 1/2 second is the correct shutter speed to use. An alternate method is to use the following chart to determine the number of f/stops of exposure increase needed.

Exposure factor	2	3	4	6	8	12	16	24	32
Increase in f/stops	1	1½	2	2½	3	3½	4	4½	5

With an exposure factor of 4, it's necessary to open up the lens by two f/stops, for instance from f/8 to f/4. Please understand that when using the camera's through-the-lens exposure meter, the exposure factor is *automatically* taken into consideration, so no compensation is required. However, when working with a separate hand-held meter or when using electronic flash to illuminate the close-up subject, it's mandatory to make the compensation.



4) Reverse mounting

Undoubtedly, the most inexpensive way to shoot extreme close-ups is by mounting a lens in the reverse position directly to the camera body. Having threads on one side and a bayonet on the other, a special reversing ring is screwed into the lens like a filter allowing the front of the lens to be mounted to the camera. An unbelievably simple solution to the problem of shooting life-size close-ups is to mount a normal 50mm lens in reverse. And when even greater reproduction ratios are required, you can use wideangle lenses. For instance, a reverse-mounted 24mm lens produces 2½X magnification. Optically, when a lens is reversed to get greater than life-size magnification, there is an improvement in image quality, especially on the edges of the frame. In addition, the free-working distance is increased. But as always there are drawbacks. One is the inevitable exposure compensation* required when using a hand-held meter or electronic flash, and the other is the inability to vary the reproduction ratio. With the exception of the 43-86 Zoom, once a lens is reversed on the camera, both the reproduction ratio and the focused distance are fixed. Turning the focusing ring has absolutely no effect. To overcome this limitation and to get a variety of even greater magnifications with reasonable working distance, a reverse-mounted lens can be used in conjunction with a bellows unit.

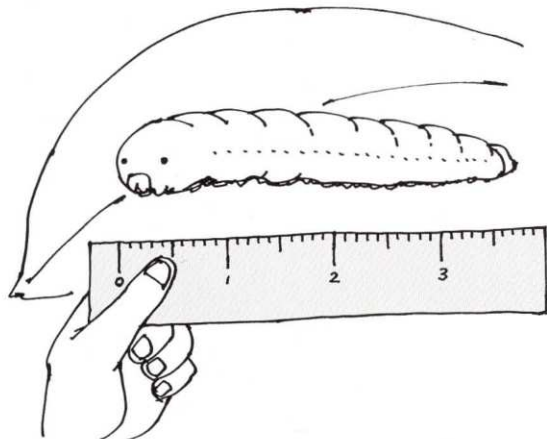


* For detailed information on determining the extension and the exposure factor for a reverse-mounted lens, please refer to the PB-6 Section, page 32–33.

HOW TO TAKE CLOSE-UP PHOTOGRAPHS

Because close-up photography is such an exacting field, this brief step-by-step guide is presented to help you explain to your customers the recommended procedure for taking close-ups.

1) Determine the reproduction ratio.



First, measure the subject or simply estimate its size. Then, assuming that you want to fill the long dimension of the 35mm frame with the subject (which is usually the case), just divide the subject's length by $1\frac{1}{2}$ if you're using inches or by 36 if millimeters are more convenient. For example, suppose you want to photograph a caterpillar measuring $1\frac{1}{2}$ " (36mm). By dividing $1\frac{1}{2}$ into $1\frac{1}{2}$, it's obvious that the reproduction ratio is 1:1.

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2) Select the close-up equipment.



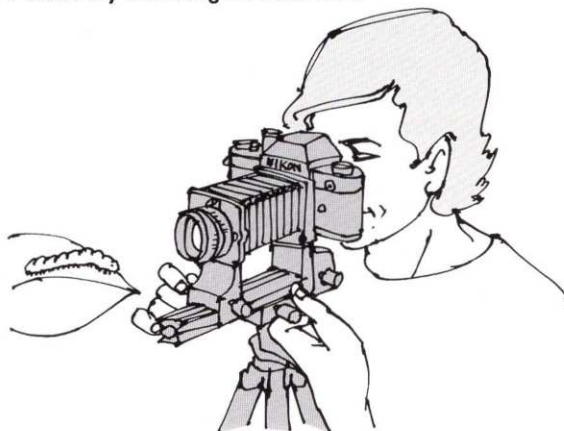
The choice of which close-up equipment to use is usually determined by the magnification required. For reproduction ratios up to life-size, close-up attachment lenses, extension rings, or a micro lens all give good results. When magnifications from life-size to approximately 3–4X are desired, you can either use a bellows unit or reverse-mount a normal or wideangle lens directly onto the camera. For extreme magnifications of 4X and larger, you must reverse-mount a wideangle lens on a bellows—the wider the wideangle, the greater the magnification.

3) Set up the equipment.



Attach the appropriate equipment together and set it to the desired reproduction ratio. Whenever possible, use a tripod or other support, because in close-up work, the slightest vibration is magnified many times. In addition, a cable release is strongly recommended to reduce camera shake.

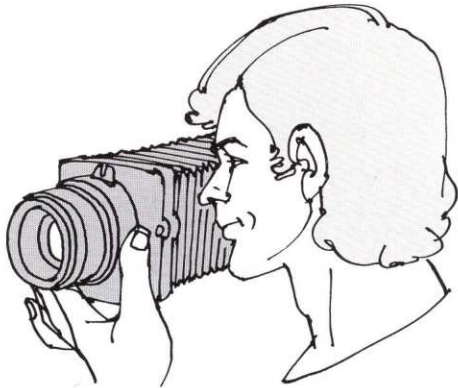
4) Focus by moving in and out.



"Seeking Focus" is a technique where you move the entire camera set-up in and out until the subject appears sharp in the viewfinder. In close-up work, it is inconvenient to focus by turning the focusing ring or trying to adjust the bellows extension, because in so doing you also change the magnification. Therefore, for accurate focusing in the shortest amount of time, it's best to set the reproduction ratio first and then "seek focus" by moving the camera rapidly in and out. In the viewfinder of most cameras, the central focusing aids darken or black out completely when close-up equipment is used. For cameras with interchangeable focusing screens, it's advisable to replace the standard screen with one designed especially for close-up photography.*

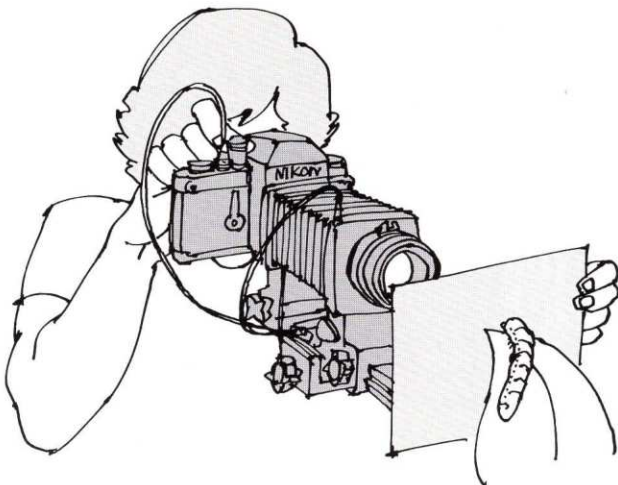
* For information on recommended focusing screens, see the Focusing and Viewing Accessories Section, page 45.

5) Stop down the lens aperture.



In close-up photography, as the magnification increases, depth of field decreases drastically. In fact, it becomes so shallow that it's often impossible to get all portions of a three-dimensional subject in sharp focus at one time. Although stopping down the lens doesn't really increase the depth of field that much, it is still recommended, because it improves image quality tremendously at the edges. And, even for those photographers who are unconcerned with image quality, stopping down the lens still increases the depth of field just enough to cover slight errors in focusing. However, you must realize that there is a point of diminishing returns, usually reached at $f/11$, where stopping down the lens further actually results in a degradation of image quality through diffraction.

6) Take a meter reading.



Because close-up subjects vary tremendously in their reflectance, the best way to determine the proper exposure is to take a substitute reading. Hold a standard 18% gray card at the subject position and take a through-the-lens meter reading directly off the card. Make sure the card is held in the same light as that striking the subject. If a gray card is not available, the palm of your hand, held in front of the lens and in exactly the same light as the subject, works fine provided you open up by one stop over the indicated exposure. Of course, this procedure is time-consuming and is not always possible or even desirable when shooting action subjects. But it's amazing the exposure accuracy it delivers, when there is time to use it.

7) Use supplementary lighting when the available light is dim.



After taking a meter reading, you may find that the shutter speed is too long to produce sharp results. In this case, try using supplementary illumination. When working in the studio, it's an easy matter to employ additional lighting, but in the field, what do you do? Many photographers have found that electronic flash is the ideal light source. Not only is it portable and cool to operate, but its burst of light is short enough to freeze just about any subject movement. In addition, the color quality of its light matches that of daylight. When using electronic flash, you can create the feeling of roundness in the close-up subject by removing the flash from the camera and holding it either above or to one side of the subject. If the flash is always held three feet (one meter) from the subject, it provides nice, even lighting and also makes exposure calculations simpler. Even with automatic flash units, you're better off by shooting in the manual mode. Now, to find the correct f /stop, divide 3 into the "feet" guide number (or 1 into the "meters" guide number). Consult the flash unit's instruction manual for the guide number relative to the film you are using. If exposure compensation is required, then use the exposure factor to determine the "corrected" f /stop. To be on the safe side, it's recommended that your customer make a series of test exposures at half-stop intervals from two stops under to two stops over the calculated exposure. In this way, he can "fine-tune" his results.

8) Take the shot and bracket your exposures.



As insurance against not getting the perfect exposure, it's always a good idea to bracket your shots by taking the first picture at the calculated reading, then the second at one-stop under, and the third at one-stop over. In this way, you have a series of three shots of the same subject, one of which is just the right exposure.

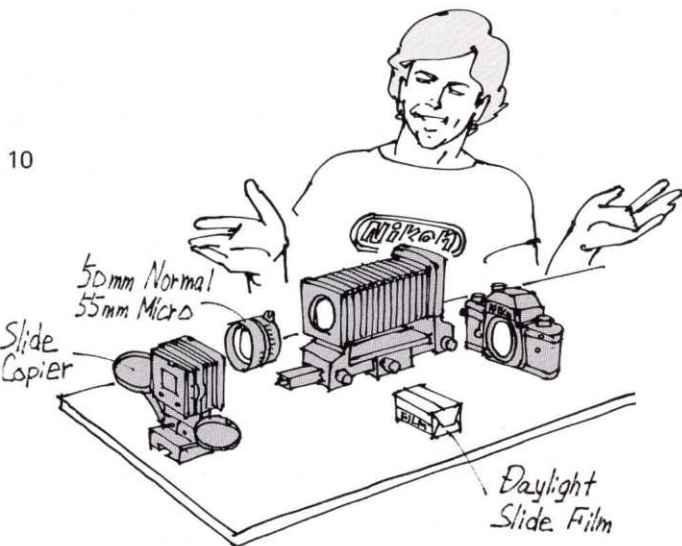
HOW TO MAKE SLIDE DUPLICATES

When you take an original slide and copy it using normal film, there is always a build-up in contrast. This is usually not a problem when converting color slides into either color or black-and-white negatives, because the negative is able to handle the additional contrast. But when making duplicate slides, the goal is to produce a copy which is as faithful to the original as possible. Therefore, an increase in contrast is generally unacceptable.

To control contrast, there are basically two things you can do: one, use a special duplicating film which has been designed by the film manufacturer to be much lower in contrast than their normal films; or two, use regular film, but give it a very small exposure to white light before or after the basic exposure to lower the maximum density in the shadow areas. Because duplicating film is sometimes difficult to obtain and requires a 3200° K. light source or compensating filters, we at Nikon recommend the second method. In addition to the standard slide copying equipment, all that's needed is regular daylight slide film, an electronic flash unit, and a No. 96 Kodak Wratten® neutral density gelatine filter.

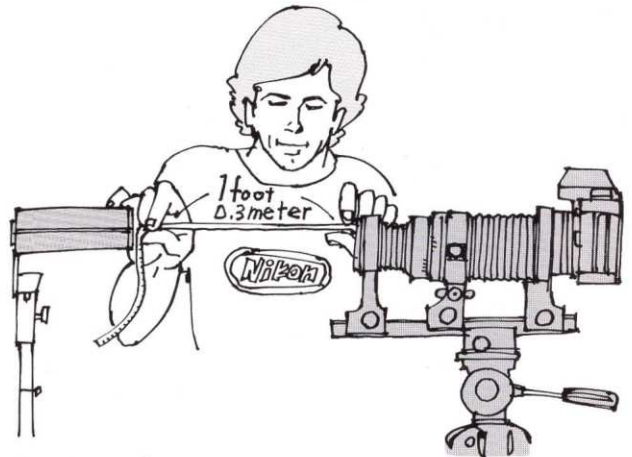
® Registered trademark of Eastman Kodak Company.

1) Set up the equipment.



Equipment for making slide duplicates includes the camera body, a normal or 55mm micro lens, a bellows unit, and the appropriate slide copying adapter. In selecting a film, pick the slowest one available, because slow films are generally low in contrast and very fine-grained. Now, load the camera with film and set the duplicating equipment for 1:1 copies.

2) Use electronic flash as the light source.



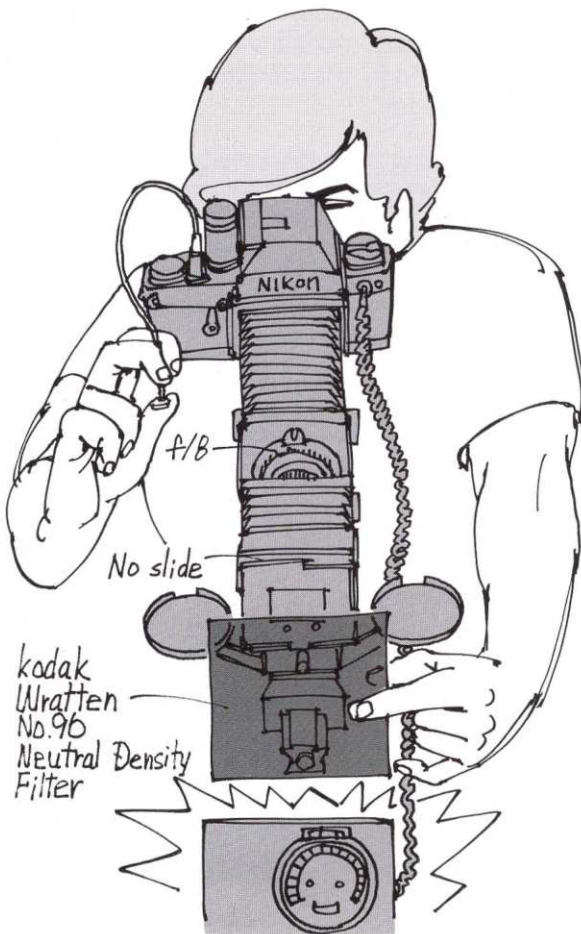
Electronic flash is the perfect light source for slide copying, because it doesn't heat up the original slide even when placed close to the diffuser of the slide copying adapter. Set the flash unit for manual operation, and place it at the same height as the diffuser and exactly one foot (0.3m) away.

3) Make a series of test exposures.



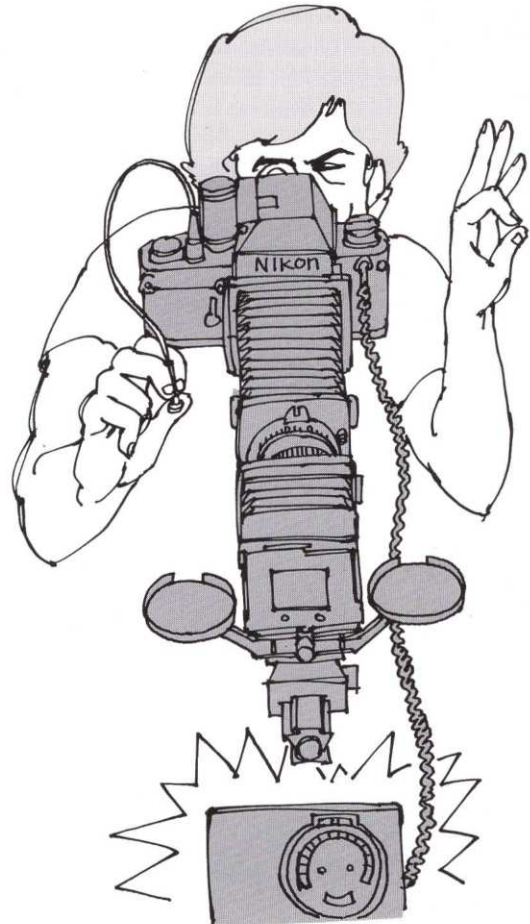
First, choose a slide of average density and contrast for the test. Try to select one that has both highlight and shadow areas and is well-exposed. Then make a series of exposures at one-half stop increments using electronic flash. Start with the lens wide open and go through the entire aperture range. Don't forget to write down the frame number with the particular f/stop used for future reference. Send the film out for processing. When it comes back, pick out the duplicate which corresponds to the density of the original. Judge the highlights rather than the shadows. If they appear washed out, then choose a frame in which they have adequate detail as the correct exposure. Now, set the lens to the f/stop which produced the selected frame and use that as your standard setting.

4) Pre- or postflash the film.



To preflash the film, hold the No. 96 Kodak Wratten neutral density filter in front of the diffuser and take a shot without a slide in the copying adapter. Then use the multiple exposure capability of the camera to cock the shutter without advancing the film. This is no problem with current Nikon cameras, since they all have built-in provisions for making multiple exposures. For older Nikon or Nikkormat cameras, please have your customer consult his instruction manual for the recommended procedure. The neutral density filter is extremely dense and reduces the amount of light striking the film by $6\frac{2}{3}$ f/stops. This small exposure actually fogs the film slightly thereby lowering the maximum density and contrast in the shadow areas without affecting the highlights. To postflash the film, simply perform the above operation after the following step instead of before.

5) Take the shot.



Put a slide you wish to copy into the slide copying adapter making certain that it is seated properly and in sharp focus. Now, make the second exposure in the normal way and advance the film to the next frame. Note that the neutral density filter is only used for the pre- or postflashing step and not for this one. Some compensation for under- or overexposure in the original slide can be made by changing the aperture setting. For slightly overexposed slides, close the lens down by one f/stop; for underexposed ones, open up one-stop. Thus it's possible through slide duplication to improve upon the original, especially a transparency which is too dark.

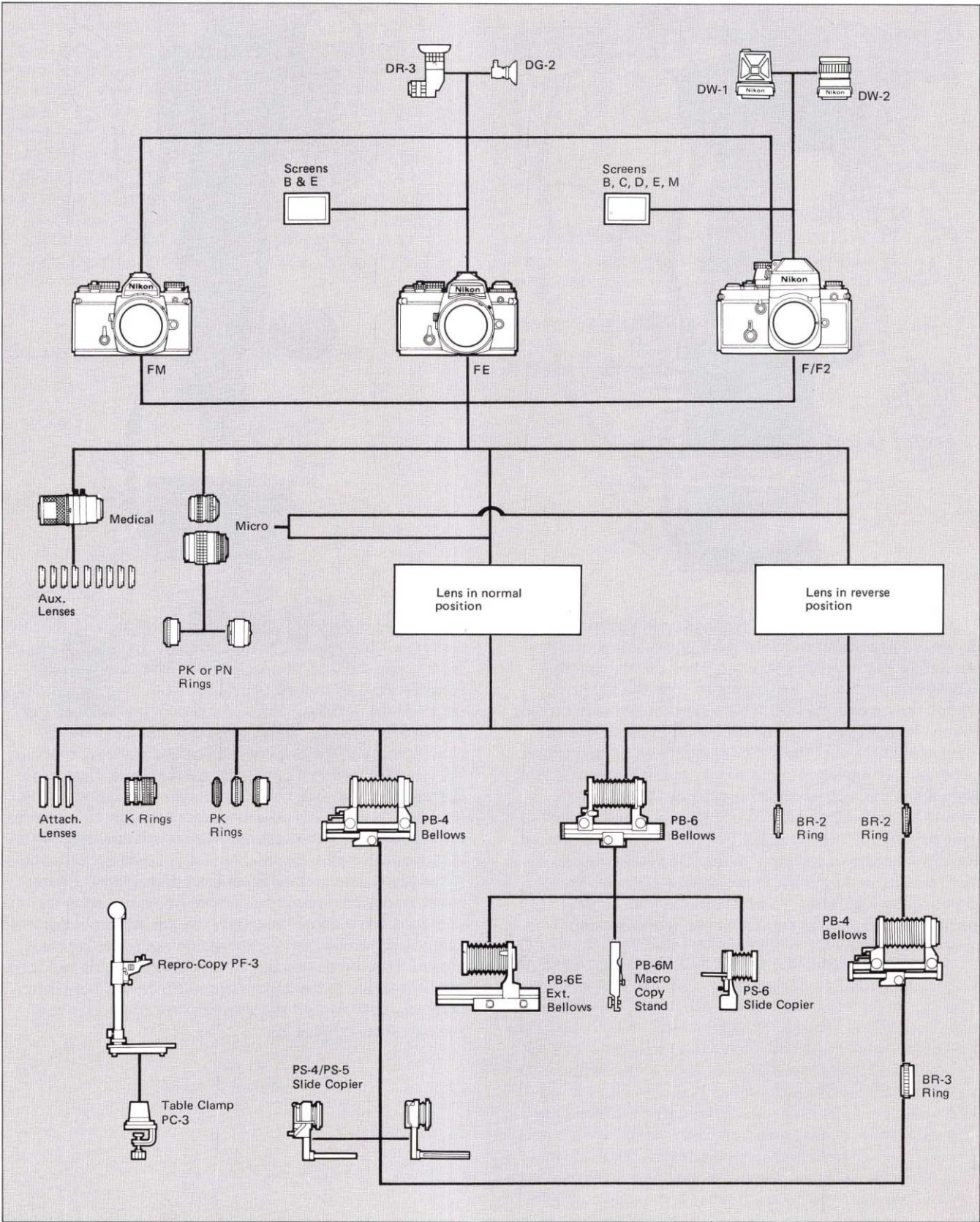
After your customer has experience in making 1:1 duplicates, he can start cropping his originals to improve the composition whenever necessary. By taking into consideration the additional bellows extension needed to produce greater than life-size copies, he can determine the exposure factor to apply to his basic f/stop setting. For more information, please consult the technical information in the Bellows Section, page 32.

EQUIPMENT SELECTION

Although the selection of photographic equipment is a highly personal matter, we at Nikon believe that an informed salesman can do more to influence his customers than any other single factor. Your customer looks to you for sound advice, and if he gets it, it's quite likely that he'll be back again

asking specifically for you. In general, the type of equipment which you should recommend is based on two things: 1) the extent of your customer's involvement in close-up photography; and 2) the amount of money he is prepared to spend.

12



1) Involvement

In photography, the type of pictures a person takes is determined in large measure by the equipment he owns. Therefore, it's easy to find out how deeply your customer is involved in close-up photography. Just ask him what close-up equipment he presently owns. If he doesn't own any equipment whatsoever, then you can safely recommend either close-up attachment lenses, extension rings, or a reversing ring as a first choice. These accessories are inexpensive and easy to use with a normal lens. However, if your customer already has one or more of these accessories, then you can suggest a bellows unit or a special close-focusing lens because of the quality and versatility they offer. And for the customer who has a full complement of close-up equipment, in addition to numerous lenses, try suggesting these exciting possibilities:

- Mount a 43-86mm Zoom in reverse directly to the camera. By zooming the lens, he can vary the reproduction ratio from approximately 1/4X to nearly 1½ times life-size.
- Add one or more extension rings between an 80-200mm Zoom and the camera.

Although the resolution on the edges of the frame is a little soft, this combination allows you to vary the reproduction ratio simply by zooming the lens. The free-working distance is also considerable because of the telephoto focal lengths involved.

- Mount a 20mm f/3.5 wideangle in reverse on a bellows unit.

This is the ultimate in ultra-high magnification close-up work. Reproduction ratios ranging from 5–12X are possible. At 12X, you can fill up the frame with a subject only 1/16" (3mm) long!

- Use the TC-200 Teleconverter with any lens of 200mm or less.

It doubles the focal length without reducing the closest focusing distance. Therefore, you can fill up the frame with an image twice as large.

2) Budget

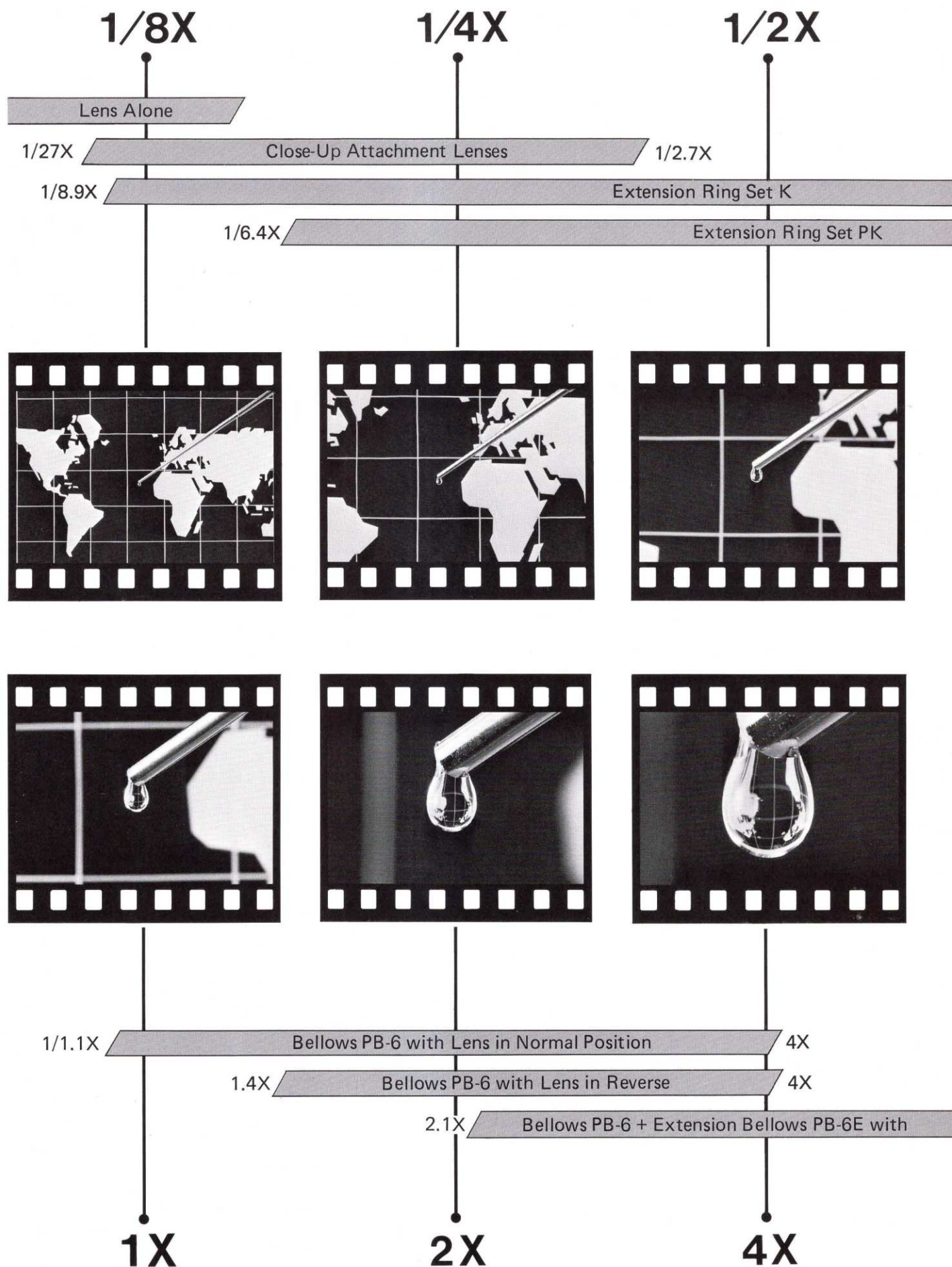
A second consideration, and in many ways the most important one which must be taken into account, is the amount of money your customer has to spend on close-up equipment. Only you, the salesman, can be the judge in this matter. But you might remind your customers that even though Nikon equipment may cost more than other brands, it will last a lifetime. So, Nikon is really the better investment in the long run.

SUMMARY OF NIKON CLOSE-UP EQUIPMENT

TYPE OF EQUIPMENT	PRODUCT NAME	LENS DIAPHRAGM CONTROL	FEATURES
Close-Up Lenses	Nikon Close-Up Attachment Lenses No. 0, 1, and 2	Automatic	Simple to use. No exposure compensation required.
Special-Purpose Close-Focusing Lenses	Micro-Nikkor 55mm f/3.5	Automatic	Focuses continuously from infinity to one-half life-size; with the PK-3 or PK-13 ring, from one-half to full life-size. Ideal for document or slide copying.
	Micro-Nikkor 105mm f/4	Automatic	Focuses continuously from infinity to one-half life-size; with the PN-1 or PN-11 ring, from one-half to full life-size. Ideal for shooting elusive subjects and/or ones requiring supplementary illumination.
	Medical-Nikkor 200mm f/5.6	Automatic	Eleven fixed reproduction ratios from 1/15X to 3X. Built-in ringlight flash. Ample free-working distance.
Extension Rings	Nikon Extension Ring Set K	Manual	Various reproduction ratios depending on the combination of the 5 rings.
	Nikon Auto Extension Rings PK-11, 12, and 13	Automatic	Simple to use. Larger magnifications than with close-up lenses.
Bellows Units	Nikon Bellows Focusing Attachment PB-4	Manual	Continuously variable reproduction ratios. Accepts slide copying adapter.
	Nikon Bellows Focusing Attachment PB-6	Semiautomatic*	Comprehensive bellows system for continuously variable magnifications Accepts an extension bellows, macro copy-stand, and slide copying adapter.
Reversing Ring	Macro Adapter Ring BR-2	Manual	Permits reverse-mounting of lens directly to the camera or PB-4 bellows.

* Built-in cable release socket in the lens panel allows direct connection of the Nikon Double Cable Release AR-4.

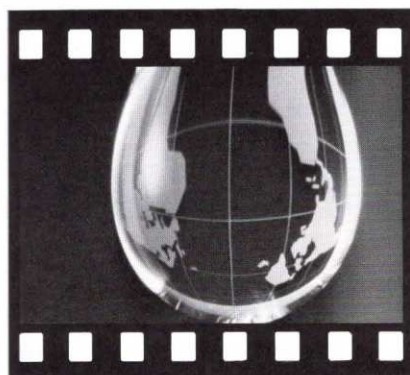
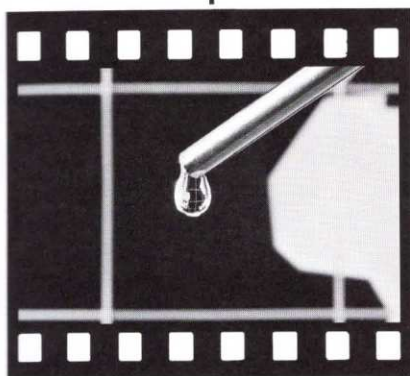
MAGNIFICATION RANGES WITH 50mm f/2 LENS



1X

1.1X

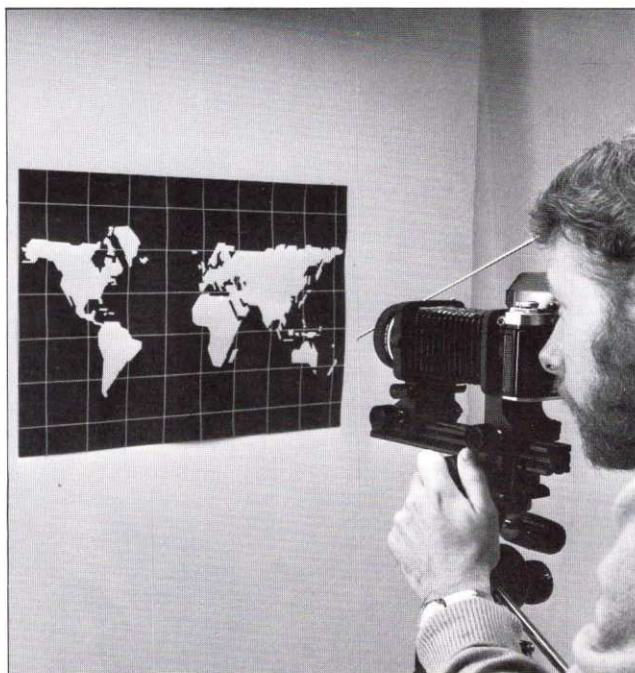
1.1X



Lens in Reverse

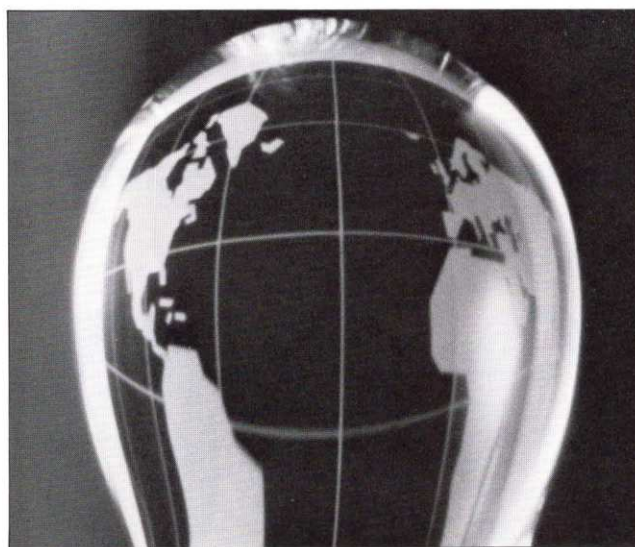
8.4X

8X



A drop of water suspended in front of a map of the world—an unlikely subject in real life, but a good demonstration of what Nikon close-up equipment can do. A reproduction ratio of 1:8 is what most lenses produce at their closest focusing distance and is therefore the starting point for this series. Doubling the magnification each time doubles the size of the image until finally at eight times life-size, we see that the droplet has transformed the map into a globe. The photograph below is the 8X magnification photo turned upside-down to show the globe as it normally appears.

Note: The actual size of the world map is 8" x 12" (20 x 30cm).



CLOSE-UP ATTACHMENT LENSES

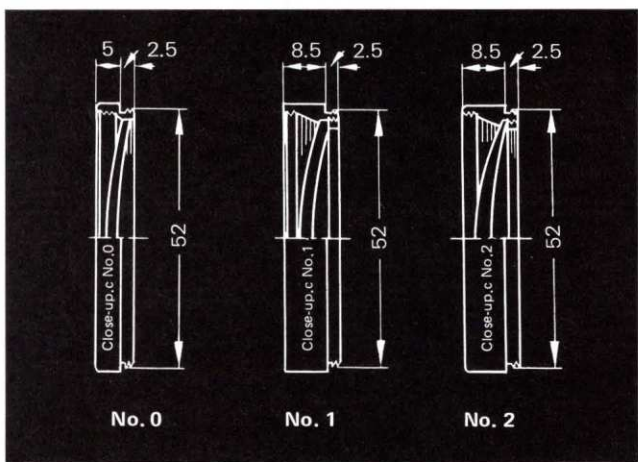
A Perfect Introduction to Close-Up Photography

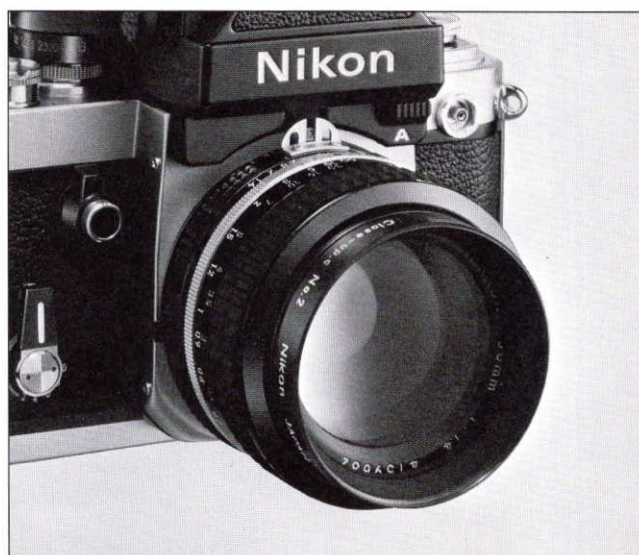
Nikon close-up attachment lenses are especially recommended for the customer just getting interested in shooting close-ups. They provide magnifications of less than life-size and therefore

are well suited for photographing a variety of subjects, including flowers, large insects, book and magazine illustrations, stamps, and coins.



Nikon Close-Up Attachment Lenses Nos.0,1, and 2





Sales Points

- Three models (0.7, 1.5, and 3 diopters) provide various magnifications.
- Standard 52mm attachment size allows use with 23 Nikkor lenses from 20–200mm. (Screw-in lens hoods and standard filters can be used, too.)
- Inexpensive, lightweight, and easy to use.
- Optical axis of attachment lenses matches perfectly that of the prime lens.
- Nikon Integrated Coating (NIC) for virtually flare-free images.
- Automatic diaphragm and full aperture metering still operable.
- No exposure compensation required.

Photographic Tips

- No. 1 (1.5 diopters) and No. 2 (3 diopters) are designed primarily for normal lenses; No. 0 (0.7 diopter) is for longer focal length lenses.
- Optical performance is best when the prime lens is stopped down to at least f/5.6. Whenever possible, f/11 should be used.
- Two attachment lenses can be stacked together for increased magnification. When doing so, always put the lens with the stronger diopter next to the prime lens.
- More than two lenses should not be stacked together, because it may cause vignetting and a loss of image quality.
- When critical center-to-edge sharpness is mandatory, close-up attachment lenses are not recommended.

Technical Information

When a close-up lens is attached to a prime lens, it changes its focusing distance. Regardless of the focal length of the prime lens, the focusing distance is primarily a function of the diopter power of the attachment lens. A simple way to find the approximate focusing distance (when the lens is set to "infinity") is to divide the diopter power into 39.3 inches. To get the focusing distance in centimeters, just divide the diopter power into 100cm. For example, when using a No. 2 close-up lens having a diopter of 3, divide 3 into 39.3 inches to get 13 inches as the approximate focusing distance. Or divide 3 into 100cm to get approximately 33cm.

The close-up lens also alters the focal length of the prime lens. To find the combined focal length, use this formula:

$$CFL = \frac{1000}{\left(\frac{1000}{FL}\right) + D}$$

where CFL is the combined focal length of the prime lens and the close-up attachment lens in mm, FL is the focal length of the prime lens, and D is the diopter power of the attachment lens.

Therefore, assuming that we attach the No. 2 close-up lens to a normal 50mm, we have:

$$CFL = \frac{1000}{\left(\frac{1000}{50}\right) + 3} = \frac{1000}{20 + 3} = 43.5\text{mm}$$

SPECIAL-PURPOSE CLOSE-FOCUSING LENSES

The Ultimate in Quality and Ease of Operation

Nikon makes three special-purpose close-focusing lenses for the customer who demands quality, yet doesn't want to fuss with extra accessories or mathematical calculations. Offering magnifications

spanning the gap from infinity to three times life-size, these lenses are designed for the serious close-up enthusiast.



Micro-Nikkors



Medical-Nikkor



Micro-Nikkor 55mm f/3.5



Sales Points

- Perfect for normal shooting as well as close-ups.
- Focuses continuously from infinity to one half life-size; with the optional PK-13 Ring,* from one half to full life-size.
- Exceptional flatness of field for document and slide copying.
- Automatic diaphragm and full aperture metering.
- Two reproduction ratio scales engraved on the lens barrel for convenient reference.
- Minimum aperture of f/32 for additional depth of field.
- Deeply recessed front lens element eliminates the need for a separate lens hood.
- 52mm front thread accepts BR-2 Ring for reverse mounting on the camera.
- Weighs only 245 grams.

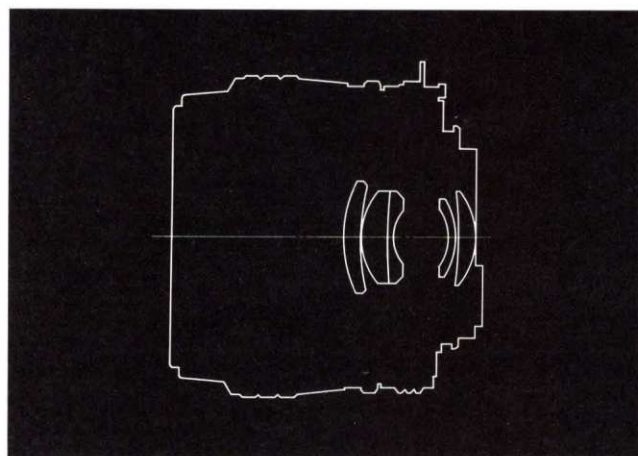
* PK-3 Extension Ring, with its pin-and-prong coupling mechanism, is still available for non-AI-type Nikon cameras. It offers the same amount of extension and automatic diaphragm operation as the PK-13.

Specifications

Focal length/maximum aperture:	55mm f/3.5
Mount:	Nikon bayonet type
Lens construction:	5 elements in 4 groups
Picture angle:	43°
Distance scale:	Graduated both in meters and feet from 0.241m, 9.5 in. to fininity (∞)
Aperture scale:	From f/3.5 to f/32; ADR scale also provided
Diaphragm:	Fully automatic
Reproduction ratios:	Scales provided on lens barrel; 1:10 to 1:2 for lens only; 1:2 to 1:1 for lens plus optional PK-3 or PK-13 Ring
Exposure measurement:	Via full-aperture method; meter-coupling ridge provided for AI cameras and meter-coupling shoe for non-AI cameras
Attachment size:	52mm (P = 0.75)
Dimensions:	66mm dia. x 64.5mm long
Length from lens mount:	53.5mm
Weight:	245g



Optional PK-13 Ring



SPECIAL-PURPOSE LENSES—cont'd

Micro-Nikkor 105mm f/4



Specifications

Focal length/maximum aperture:	105mm f/4
Mount:	Nikon bayonet type
Lens construction:	5 elements in 3 groups
Picture angle:	23°20'
Distance scale:	Graduated both in meters and feet from 0.47m, 1.55 in. to infinity (∞)
Aperture scale:	From f/4 to f/32; ADR scale also provided
Diaphragm:	Fully automatic
Reproduction ratios:	Scales provided on lens barrel; 1:10 to 1:2 for lens only; 1:2 to 1:1 for lens plus optional PN-1 or PN-11 ring
Exposure measurement:	Via full-aperture method; meter coupling ridge provided for AI cameras and meter coupling shoe for non-AI cameras
Lens hood:	Built-in
Attachment size:	52mm (P = 0.75)
Dimensions:	74.5mm dia. x 104mm long
Length from lens mount:	96mm
Weight:	500g

NOTE: PN ring incorporates rotatable tripod mounting collar to permit vertical and horizontal format picture-taking; click-stops provided at each 90° of rotation.

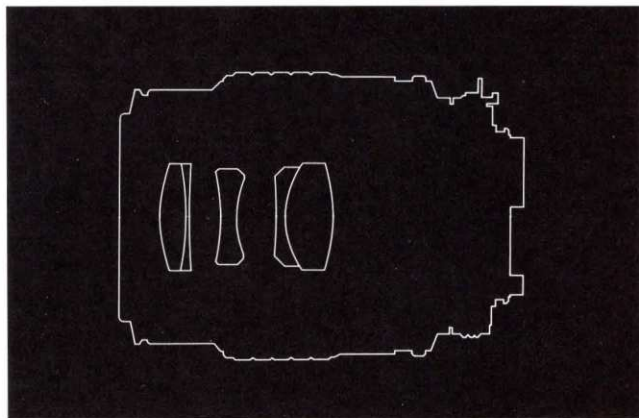
Sales Points

- Ideal for portraits as well as close-ups.
- 105mm focal length provides extra free-working distance for shooting elusive close-up subjects and/or ones requiring supplementary illumination.
- Focuses continuously from infinity to one-half life-size; with the PN-11 Extension Ring*, from one half to full life-size.
- Exceptional sharpness and flatness of field.
- Automatic diaphragm and full aperture metering.
- Two reproduction ratio scales engraved on the lens barrel for convenient reference.
- Minimum aperture of f/32 for additional depth of field.
- Takes standard 52mm filters.

* PN-1 extension ring, with its pin-and-prong coupling mechanism, is still available for non-AI-type Nikon cameras. It offers the same amount of extension and automatic diaphragm operation as the PN-11.



Optional
PN-11 Ring



Medical-Nikkor 200mm f/5.6



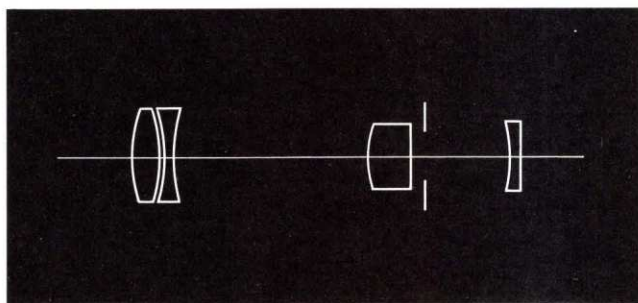
Sales Points

- Integrated close-up system for industrial, scientific, dental, and medical applications.
- 200mm focal length provides considerable free-working distance for shooting high-speed machinery or delicate medical or dental operations.
- Offers 11 fixed reproduction ratios ranging from 1/15X down to 3X life-size. (Magnifications or frame numbers can be imprinted on the film for future reference.)
- Built-in ringlight flash for stop-action, shadowless illumination of even inaccessible subjects.
- Built-in focusing lamps for convenient shooting in dim light.
- Usable indoors or out—takes either AC or DC power packs.
- Extremely easy to use—the exposure is set automatically when using ringlight flash.

Specifications

Focal length/maximum aperture:	200mm f/5.6
Mount:	Nikon bayonet type
Lens construction:	4 elements in 4 groups in prime lens; 6 auxiliary lenses provide a total of 11 different reproduction ratios
Diaphragm:	Automatically set by determining film speed and reproduction ratio; stops down to f/45
Reproduction ratios:	1/15X with prime lens; 1/8X, 1/6X, 1/4X, 1/3X, 1/2X, 2/3X, 1X, 1.5X, 2X, 3X when auxiliary lenses mounted singularly or in combination
Focusing distance:	Fixed when reproduction ratio is determined; 4 pilot lamps incorporated for focusing accuracy
Illumination:	Built-in xenon ring flash tube; output approx. 60W; flash duration approx. 1/1000 sec. (full output)
Identification number and reproduction ratio selector:	Provided
Power source:	AC or DC unit
Dimensions of prime lens:	79mm dia. x 177mm long
Weight of prime lens:	700g

Note: Supplied with 6 auxiliary lenses, a 1.5m power source cord, a sync cord, front and rear lens caps, accessory shoe safety cover and four 2.5V spare bulbs.



SPECIAL-PURPOSE LENSES—cont'd

NOMENCLATURE FOR 200mm f/5.6 MEDICAL-NIKKOR

Lens combination diagram

Illustrates which combination to use to get desired reproduction.

Power socket

Accepts the connecting cord from the AC or DC power unit.

Sync socket

Accepts a sync cord from the camera's flash-sync socket.

Ready light

Glowes when the flash capacitor is charged and ready to fire.

Indicator window

Shows which number or magnification will be printed on the film.

Film-speed index dot

Aperture-index dot

Aperture scale

Selector ring

Turn to select an identification number or magnification to be printed on the film.

Focusing-lamp switch

Press to switch on the focusing lamps.

Film-speed locking screw

Locks the ring to prevent accidental shifting of the settings.

Film-speed scale

Aperture-ring locking screw

Locks the aperture ring to prevent accidental shifting of the setting.

Magnification scale

Magnification-index dot



Medical-Nikkor Lens Data

Reproduction ratio	Lens combination	Lens-to-subject distance		Subject field	
		mm	(inch)	mm	(inch)
1/15X	Prime lens	3,350	(10'11.89")	360 x 540	(14.17 x 21.26)
1/8X	1/8X + Prime lens	1,780	(5'10.08")	192 x 288	(7.56 x 11.34)
1/6X	1/6X + Prime lens	1,336	(4'4.64")	144 x 216	(5.67 x 8.50)
1/4X	1/4X + Prime lens	890	(2'11.04")	96 x 144	(3.78 x 5.67)
1/3X	1/4X + 1/6X + Prime lens	635	(2'1.0")	69 x 103	(2.72 x 4.06)
1/2X	1/2X + Prime lens	446	(1'5.56")	48 x 72	(1.89 x 2.83)
2/3X	1/2X + 1/4X + Prime lens	326	(1'0.83")	35 x 53	(1.38 x 2.09)
1X	1X + Prime lens	221	(8.70")	24 x 36	(0.94 x 1.42)
1.5X	1X + 1/2X + Prime lens	154	(6.06")	17 x 25	(0.67 x 0.98)
2X	2X + Prime lens	108	(4.25")	12 x 18	(0.47 x 0.71)
3X	2X + 1X + Prime lens	72	(2.83")	8.4 x 12.6	(0.33 x 0.50)

Accessories for Medical-Nikkor 200mm f/5.6



DC Unit

Battery power pack for use when the Medical-Nikkor is used in the field. Holds eight 1.5 volt D-type batteries. With alkaline batteries, the recycling time at "Full" is approximately 9 seconds and at "1/4" approximately 4 seconds.



Compartment Case

Leather compartment case designed to house the Medical-Nikkor lens with camera body attached, six auxiliary close-up lenses, and the AC or DC Unit, plus sync and power cords.

		Number of flashes		Recycling time	
		Full	1/4	Full	1/4
D Cells	General	50 approx.	120 approx.	14 sec. approx.	6 sec. approx.
	High-rate	110 approx.	260 approx.	12 sec. approx.	5 sec. approx.
	Alkaline	600 approx.	1400 approx.	9 sec. approx.	4 sec. approx.
AC		Unlimited		8 sec. approx.	5 sec. approx.



AC Unit

Convenient power source for the Medical-Nikkor's ringlight and focusing lamps when the lens is used indoors. At "Full" power, recycling time is 8 seconds; at "1/4," it is 5 seconds. User adjustable voltage selector allows the unit to be used with any standard house current—either 100, 117, 220, or 240 volts.

EXTENSION RINGS

An Inexpensive Way to Get Quality Close-Ups

Extension rings are a favorite with beginning and experienced close-up photographers alike. They are compact, lightweight, and can be used with virtually any lens to increase its closest focusing distance. In addition, they produce images of very high quality, especially when the lens is stopped down to f/5.6 or smaller. Extension rings are strongly recommended for the customer who already owns close-up attachment lenses, yet wants better image quality, or for the person who is just starting in close-up photography and has a little bit more money to spend. Depending on the lens used, extension rings can produce reproduction ratios up to approximately 2:1 and are ideal for most low magnification close-up situations.



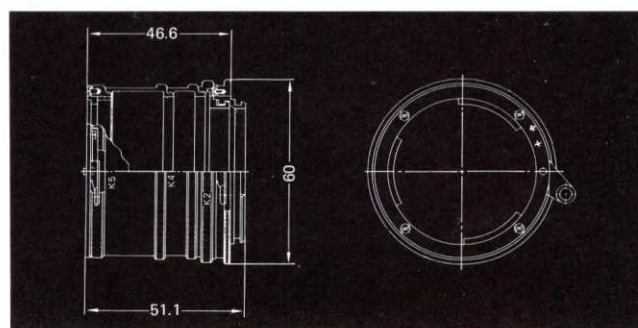
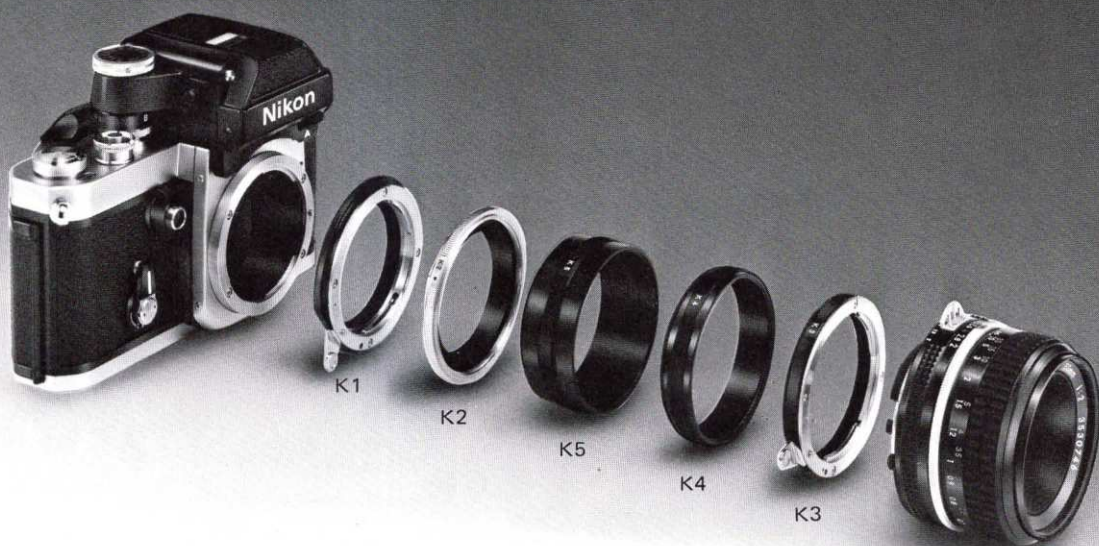
Nikon Extension Ring Set K

Sales Points

- Integrated set of five rings of various thicknesses provide various magnifications.
- Total extension of 46.6mm: K1 is 5.8mm; K2—5.0mm; K3—5.8mm; K4—10.0mm; and K5 is 20.0mm.
- Very inexpensive.
- Easy to use—simply open up the lens diaphragm for viewing and focusing and then stop it down for metering and shooting.*
- Supplied with leather carrying case.

* This operation can be made even easier by using the Auto Ring BR-4 between the extension rings and the lens. For more information, see page 40.



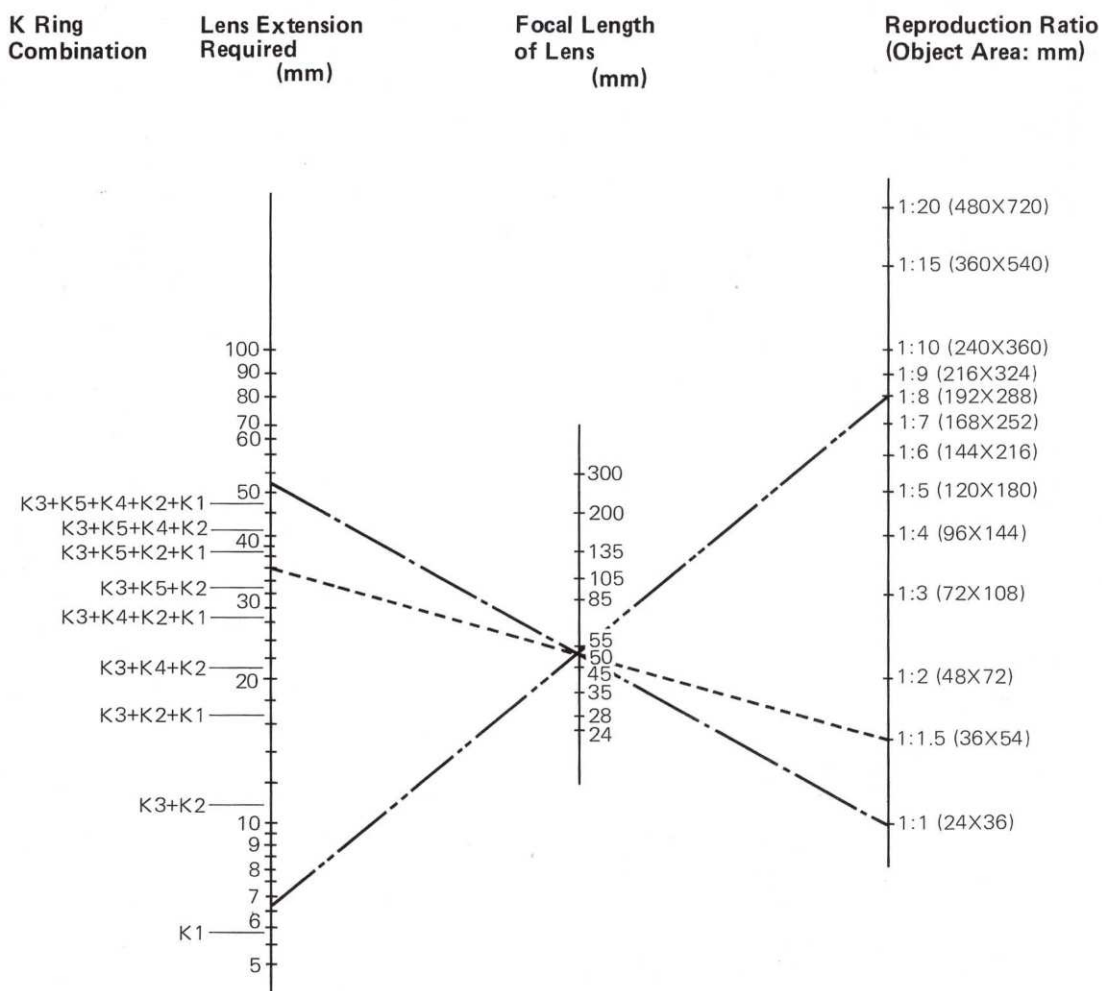


Combinations of K Rings

Type	Extension Length	Fitting	Attachable to Lens	Attachable to Camera	Combination
K1	5.8mm	Bayonet mount on both sides Black and chrome finish.	Yes	Yes	K1 = 5.8mm
					K3+K2+K1 = 16.6mm
					K3+K4+K2+K1 = 26.6mm
					K3+K5+K2+K1 = 36.6mm
					K3+K5+K4+K2+K1 = 46.6mm
K2	5.0mm	Screw-threaded (female) on one side, bayonet mount (male) on the other. Chrome finish.	No	Yes	K3+K2 = 10.8mm
					K3+K2+K1 = 16.6mm
					K3+K4+K2 = 20.8mm
					K3+K4+K2+K1 = 26.6mm
					K3+K5+K2 = 30.8mm
					K3+K5+K2+K1 = 36.6mm
K3	5.8mm	Bayonet mount (female) on one side, screw-threaded (male) on the other. Black and chrome finish.	Yes	No	K3+K5+K4+K2 = 40.8mm
					K3+K5+K4+K2+K1 = 46.6mm
					K3+K2 = 10.8mm
					K3+K2+K1 = 16.6mm
					K3+K4+K2 = 20.8mm
					K3+K4+K2+K1 = 26.6mm
K4	10mm	Screw-threaded on both sides. Black finish.	No	No	K3+K5+K2 = 30.8mm
					K3+K5+K2+K1 = 36.6mm
					K3+K5+K4+K2 = 40.8mm
K5	20mm	Screw-threaded on both sides. Black finish.	No	No	K3+K5+K4+K2+K1 = 46.6mm
					K3+K5+K2 = 30.8mm
					K3+K5+K2+K1 = 36.6mm

EXTENSION RINGS—cont'd

Nomograph for a proper K ring combination when the reproduction ratio and the lens used are known.



Maximum Extension by Lens Focusing Helicoid

20/3.5	1.9mm	Micro	55/3.5	27.5mm
24/2	2.3mm		55/1.2	7.6mm
24/2.8	2.1mm	Noct	58/1.2	8.6mm
28/2	4.0mm		85/2	10.5mm
28/2.8	3.8mm		105/2.5	12.6mm
28/3.5	3.8mm	Micro	105/4	52.5mm
35/1.4	4.6mm		135/2	18.1mm
35/2	6.5mm		135/2.8	18.0mm
35/2.8	6.3mm		135/3.5	18.1mm
50/1.2	6.6mm		180/2.8	21.9mm
50/1.4	7.6mm		200/4	27mm
50/1.8	7.7mm		300/4.5	28.7mm
50/2	7.7mm	ED	300/4.5	29mm

Connect the point indicating the known reproduction ratio with the point indicating the focal length of the lens in use. Then, extend this line so it intersects with the line of lens extension required. The extension value is read off at this intersection and the K ring combination immediately below this intersection is the proper combination to use. For example, when photographing an object with a size of 36 x 54mm (reproduction ratio 1:1.5) with a 50mm normal lens, the lens requires an extension of about 34mm. This is shown by the dotted line in the nomograph. The K Ring combination of K3 + K5 + K2 is the proper combination to use as it provides an extension of 30.8mm. A deficit of 3.2mm will be covered amply by the extension of the lens focusing helicoid.

Nikon Automatic Extension Rings PK-11,12,13, and PN-11



Sales Points

- Automatic extension rings for AI-type cameras.*
- PK-11 ring provides 8mm of extension; PK-12—14mm; PK-13—27.5mm; and PN-11—52.5mm.
- Extremely easy to use—automatic diaphragm and full aperture metering still operable.

* PK-1, 2, 3, and PN-1 Auto Extension Rings, with their pin-and-prong coupling mechanisms, are still available for non-AI-type Nikon cameras. They offer the same amount of extension and automatic diaphragm operation as the PK-11, 12, 13, and PN-11.

27

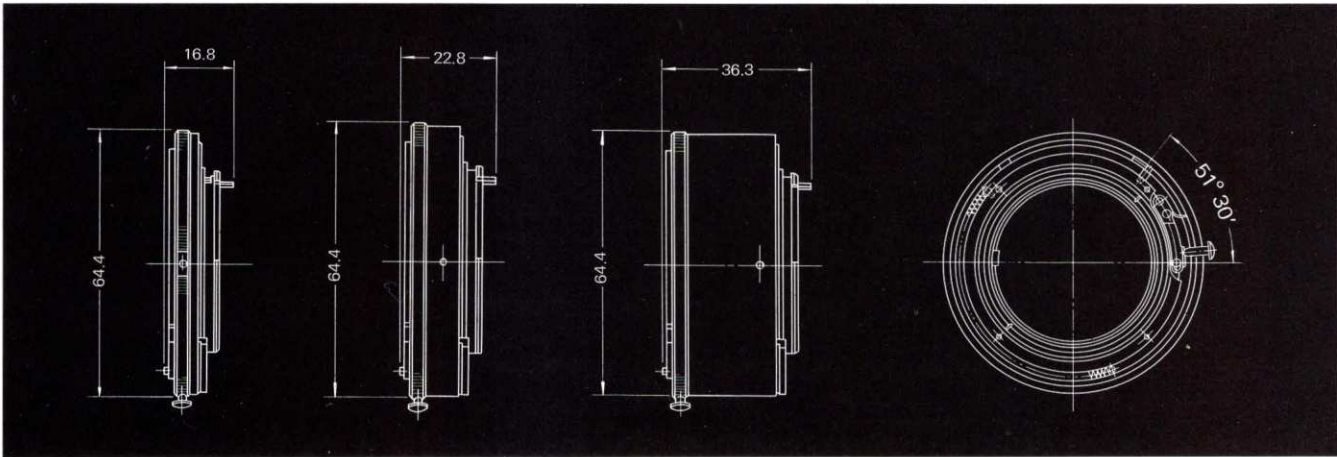
Extension with PK and PN rings

Ring Combination		Extension
PK-11	PK-1	8mm
PK-12	PK-2	14mm
PK-11 + PK-12	PK-1 + PK-2	22mm
PK-13	PK-3	27.5mm
PK-11 + PK-13	PK-1 + PK-3	35.5mm
PK-12 + PK-13	PK-2 + PK-3	41.5mm
PK-11 + PK-12 + PK-13	PK-1 + PK-2 + PK-3	49.5mm
PN-11	PN-1	52.5mm

Camera-Lens-Ring Combinations

Ring	Camera	Lens	Metering
PK-11	AI	AI	Full-aperture*
PK-12	AI	non-AI	Cannot be used
PK-13	non-AI	AI	Stop-down
PN-11	non-AI	non-AI	Cannot be used
	non-AI	non-AI	Full-aperture
PK-1	non-AI	AI	Full-aperture
PK-2	AI	non-AI	Stop-down
PK-3	AI	AI	Stop-down
PN-1	AI	AI	Stop-down

* Only this combination permits automatic indexing.



BELLOWS

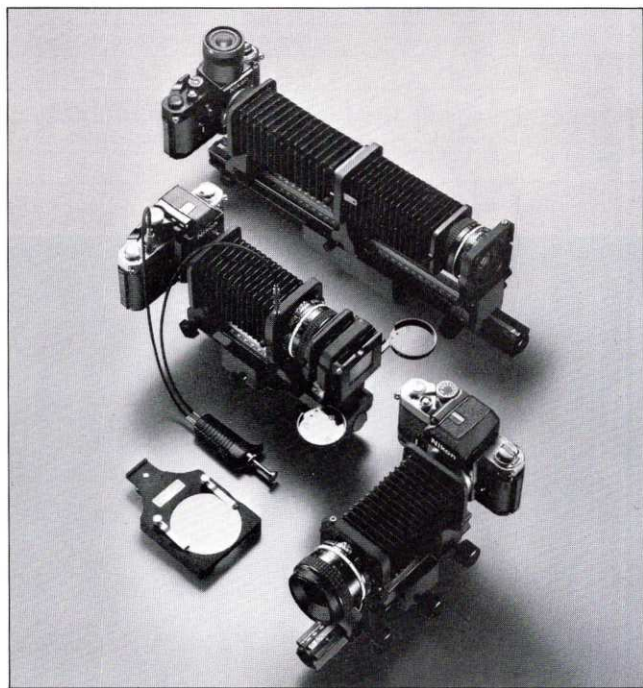
The Ultimate in Flexibility for All Types of Close-Up Work

A bellows unit is the most flexible of all close-up accessories, because it provides continuously variable extension over an extremely wide range. It can be used with just about any lens to produce magnifications running the gamut from less than 1X all the way up to 12 times life-size. If your customer is interested in shooting tiny details of flowers, stamps, or shells, or wants to photograph

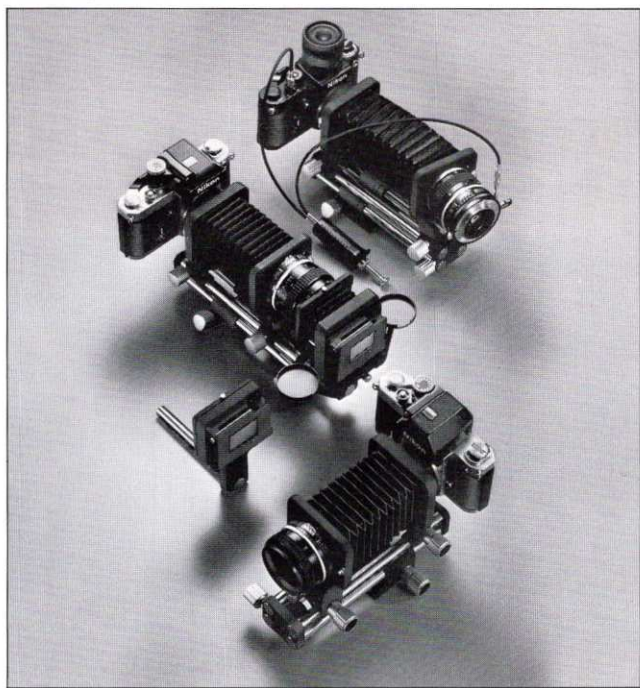
small insects, then this is the equipment to recommend. Also, if he wants to make slide duplicates, then he will need a bellows, plus the appropriate slide copying adapter. Nikon currently offers two different bellows systems—the PB-6 and the PB-4. Please familiarize yourself with their individual features, so that you can recommend the one best suited to your customer's needs.

28

PB-6 System



PB-4 System



Nikon Bellows Focusing Attachment PB-6



29

Sales Points

- Cornerstone of a comprehensive new bellows system including an extension bellows, macro copystand, and slide copying adapter.
- Provides continuously variable extension from 48mm to 208mm for a wide range of magnifications.
- Double-dovetail rail allows independent, non-jitter adjustment of the magnification and focus.
- Easy to focus—lens is automatically held open at full aperture for bright viewfinder image.
- Semiautomatic diaphragm control—lens panel has a built-in socket accepting the front cable of Nikon Double Cable Release AR-4.
- Reversible lens panel can be taken off the rail and turned around for reverse mounting of the lens without the BR-2 ring.
- Convenient depth-of-field preview and continuous stopped-down metering via levers on either side of the lens panel.
- Two built-in scales for accurate determination of the bellows extension regardless of the position of the camera or lens panels.
- Horizontal or vertical picture formats possible.
- Modular construction allows the unit to be disassembled for compact storage in a gadget bag.

BELLOWS—cont'd

Features of the PB-6

The PB-6 is the cornerstone of a new comprehensive Nikon bellows system. Featuring modular construction, it uses a single rail of double-dovetail design with removable camera and lens panels. The back of the bellows is permanently attached to the camera panel, but the front is of the clip-on type. In particular, the PB-6 has the following features:

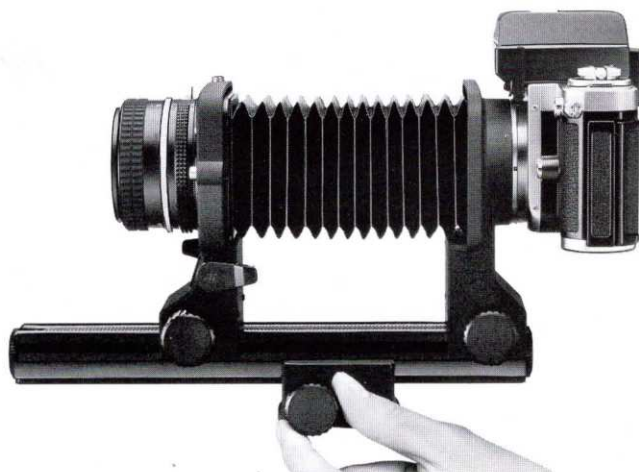
1) Reversible lens panel

The lens panel is reversible on the rail, so that a lens can be mounted in reverse without using the BR-2 reversing ring. Simply mount the lens onto the lens panel in the regular manner. Then turn the lens panel around on the rail and clamp the front of the bellows to the front edge of the lens. Absolutely no accessories are needed. Mounting a normal or wideangle lens in reverse improves flatness of field, and increases both the magnification and free-working distance.



2) Double-dovetail rail

A single rail houses the camera and lens panels on the top dovetail section with the tripod head on the bottom section. This design permits the bellows extension to be set first on the top section, then locked in, while the entire bellows assembly, plus rail, can be moved back and forth for focusing without altering the magnification. Single rail construction not only ensures that the lens and camera panels will be held perfectly parallel to each other for superior optical performance, but also contributes to the bellows compact size.



3) Horizontal or vertical shooting

When the camera body is mounted on the bellows, it can be rotated easily from the horizontal to the vertical format, or back again, regardless of the position of the camera panel on the rail.



4) Semiautomatic diaphragm control

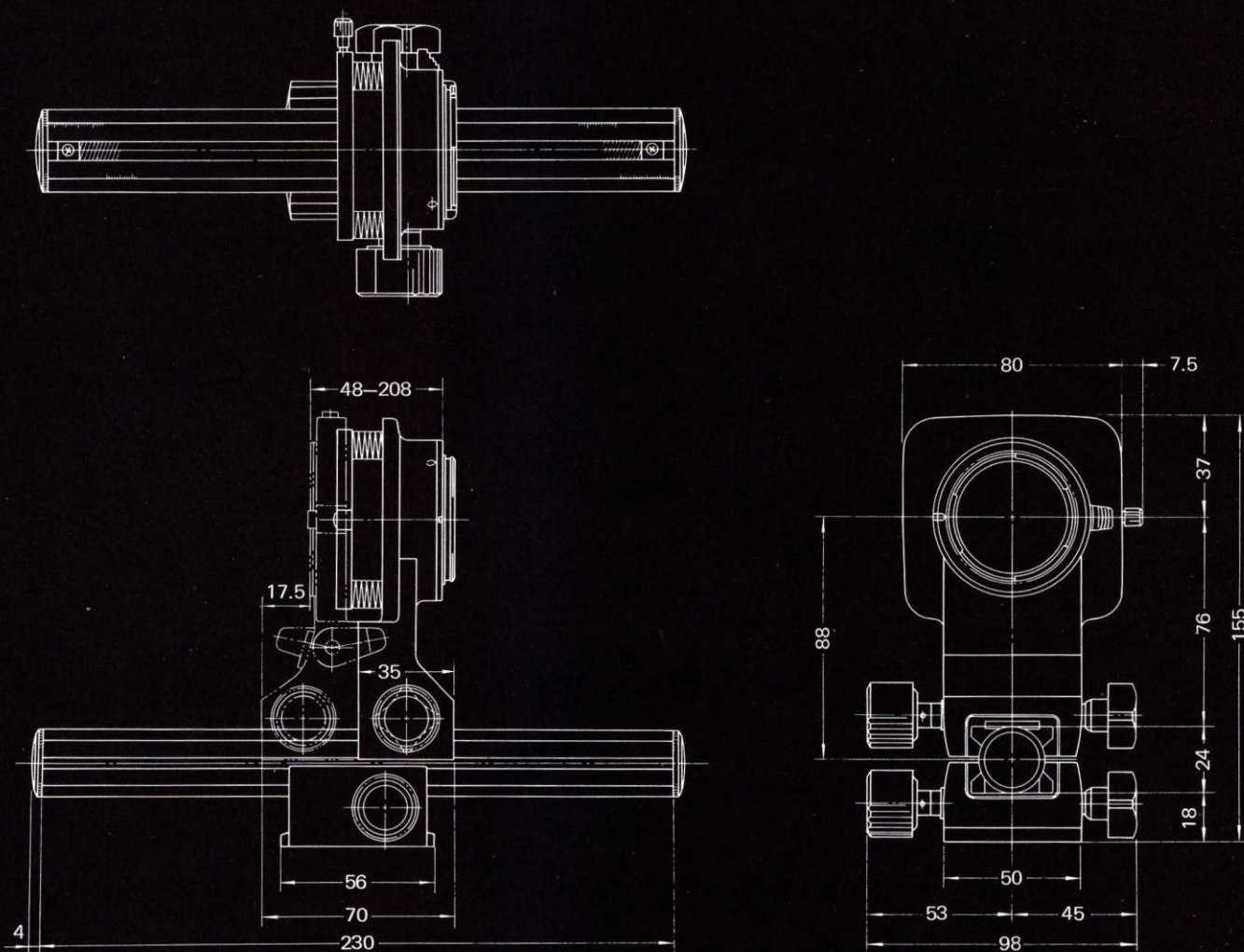
The lens panel has a built-in socket which accepts the front cable of the Nikon AR-4 Double Cable Release. Regardless of whether the lens panel is mounted on the rail in the normal or reverse positions, the lens diaphragm is held open for bright viewing and easy focusing. When the AR-4's plunger is pushed in, the lens is stopped down to the selected aperture and then the shutter is released. By depressing the plunger halfway, the lens can be stopped down to its shooting aperture without releasing the shutter. In this way, the photographer can take a stopped-down meter reading and/or preview depth of field. In addition, special manual stop-down levers on either side of the lens panel allow the photographer to make a more leisurely stopped-down meter reading/depth-of-field preview. Thus, semiautomatic operation is provided without the accessory Auto Ring BR-4.



Specifications

Construction:	Double-dovetail rail, bellows, tripod mount, camera and lens panels, accessory mount
Compatible cameras:	All Nikon cameras having Nikon F bayonet mount
Suitable lenses:	20mm to 200mm
Bellows extension:	48mm to 208mm
Reproduction ratios:	With 50mm f/2 lens: 1/1.1X to 4X (in normal position) 1.4X to 4X (in reverse position) See table on page 51 for details.
Lower track adjustment:	180mm
Dimensions:	98mm(W) x 155mm(H) x 238mm(L)
Weight:	1kg

Dimensional Drawing of PB-6



BELLOWS—cont'd

Technical Information



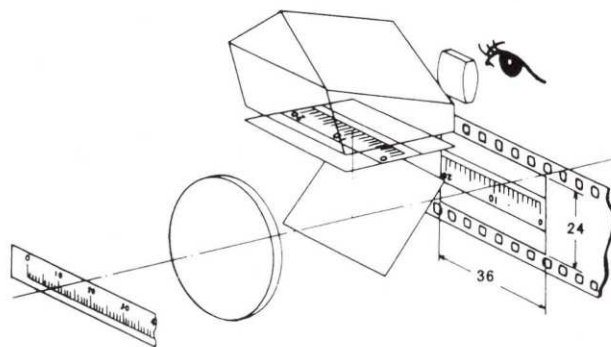
1) Setting the extension

Using the formula, $EXT = RR \times FL$, it's easy to determine the amount of extension necessary to produce the reproduction ratio you wish to shoot at. Suppose your customer wants to get 3X magnification with his 50mm lens* mounted in the normal position on the PB-6. Just multiply 3 by 50 to get 150, which is the number of millimeters of extension needed. For accurate setting, the PB-6 has two built-in extension scales: white and yellow. With the camera panel stationed at the back end of the rail, move the lens panel until its front edge lines up with the 150 mark on the white scale. Alternatively, when the lens panel is positioned at the front end of the rail, move the camera panel until its back edge is over the 150 mark on the yellow scale. With the camera and lens panels set at intermediate positions, use either the white or yellow scales. Read off the values using the outside edges of the panels, calculate the difference and subtract 22. This will give the exact bellows extension.

Once the extension is set, focusing is accomplished by using the lower rail adjustment knob to move the entire bellows assembly back and forth until the subject appears sharp in the viewfinder. Please note that when the lens panel is reversed on the PB-6's rail, the above extension formula is no longer valid. In this case, use the bellows tables at the back of this manual to determine the amount of bellows extension required to produce a particular magnification.

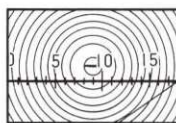
2) Visually determining the magnification

A visual method of determining the reproduction ratio, with the lens mounted in either the normal or reverse position, makes use of a simple millimeter scale. Place the scale at the subject position, look through the camera viewfinder and read off the scale length of the area which is in sharp focus. Divide this number into 36, and the result will be the reproduction ratio. For example, if the horizontal scale image which is in focus is 18mm in length, the reproduction ratio will be $36/18 = 2X$. For convenience, use the nomograph on the opposite page to find the reproduction ratio. When using Nikon cameras other than the F or F2, the reproduction ratio obtained by this method must be multiplied by 0.9 due to their smaller viewfinder coverage.



Schematic of viewfinder technique with Nikon cameras for determining the reproduction ratio.

* The actual focal length of Nikkor 50mm normal lenses is exactly 51.6mm, but for the purposes of this discussion let's assume it's 50mm.



Scale



Longitudinal reading (mm)	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Reproduction ratio	12X	9	7.2	6	5.1	4.5	4	3.6	3.3	3	2.8	2.6	2.4	2.3	2.1	2	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2					

Longitudinal reading (mm)	32	33	34	35	36	37	38	39~42	43~48	49~55	56~65	66~80	81~103	104~144	145~240	241~380
Reproduction ratio	1.1	X						0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1

3) Determining the exposure factor for asymmetrical lenses

If you remember from the Fundamentals Section, the exposure factor was expressed by the formula:

$$EF = (1 + RR)^2 \quad \text{where EF is the exposure factor, and RR is the reproduction ratio.}$$

This formula is true only for symmetrical lenses, such as the Micro-Nikkor 55mm f/3.5. For all other lenses, the difference in pupillary magnification must be taken into consideration to establish the correct exposure. The pupillary magnification is the ratio of the exit pupil diameter to that of the entrance pupil. If "P" represents the pupillary magnification, use the following modified formula for asymmetrical lenses mounted in the normal position.

$$EF = (1 + 1/P \cdot RR)^2$$

Or for lenses mounted in reverse, use:

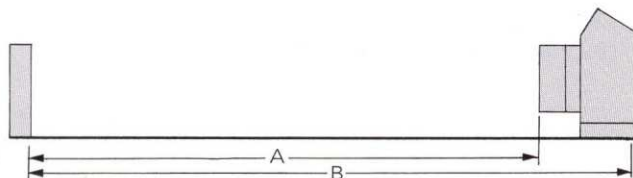
$$EF = (1/P + RR)^2$$

The values of 1/P vary depending on the lens in use, as shown below.

1/P	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.6	2.2
Lenses	35/1.4 58/1.2 Noct	20/4 24/2 24/2.8 28/2 28/4 PC	28/2.8 28/3.5 35/2 35/2.8 PC 50/1.4 55/1.2	35/2.8	50/1.8 50/2 105/4 Micro	45/2.8 GN 55/3.5 Micro 105/2.5	85/2	135/2 135/2.8 135/3.5 180/2.8	200/4

4) Free-working distance

The free-working distance between the close-up subject and the front edge of the lens should be kept as long as possible for unobstructed picture-taking. In general, when the magnification remains the same, a longer focal length will produce greater free-working distance. Therefore, for low magnification work (up to 3–4X), it's best to use a telephoto lens with a proportionally greater amount of bellows extension. However, for higher magnifications, it becomes impractical to use a telephoto because of the extreme amount of extension which would be required. In this case, you have to use a normal or wideangle lens in reverse, even though in doing so, you drastically reduce the free-working distance. In fact, for ultra-high magnifications (8X and above), the free-working distance is so short that a ringlight is strongly recommended for illuminating the subject.



The two-key distances used in close-up optical computations. A: free-working distance; B: object-to-film distance.

BELLOWS—cont'd

Extension Bellows PB-6E



Sales Points

- Exclusive extension bellows for the PB-6.
- More than doubles the magnifications available with the PB-6—up to 23X when the 20mm f/3.5 is mounted in reverse.
- Provides continuously variable extension from 83mm to 438mm when attached to the PB-6.
- PB-6's full aperture viewing and semiautomatic diaphragm control with the AR-4 are still retained.
- Extension scale of the PB-6E joins perfectly with that of the PB-6 for accurate determination of extension.
- Large tripod/rail connector* provides excellent stability.

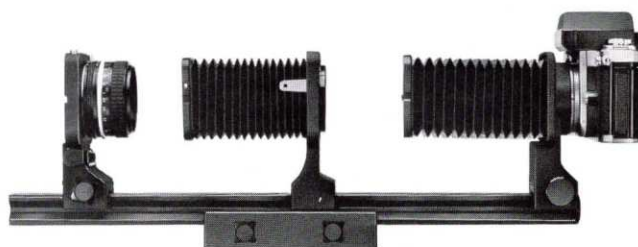
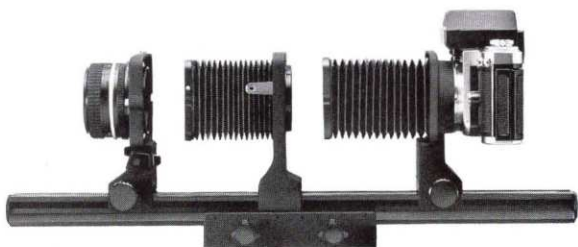
* When the PB-6E is attached to the PB-6, focusing can no longer be accomplished by shifting the entire bellows assembly using the lower track adjustment knob.

Specifications

Construction:	Double-dovetail rail, extension bellows, tripod head/rail connector
Compatible bellows:	PB-6 Bellows Focusing Attachment
Dimensions:	82mm(W) x 155mm(H) x 230mm(L)
Weight:	800g

	PB-6 only	PB-6 & PB-6E
Suitable lenses	20mm to 200mm	
Bellows extension	48mm to 208mm	83mm to 438mm
Reproduction ratios with 50mm f/2 lens*	Normal	1/1.1X to 4X
	Reverse	1.4X to 4X
Lower track adjustment	180mm	Impossible
Viewing	Full aperture	
Diaphragm control	Semiautomatic w/optional AR-4	

* Please refer to the table on page 51 for reproduction ratios with other lenses.



Macro Copy Stand PB-6M



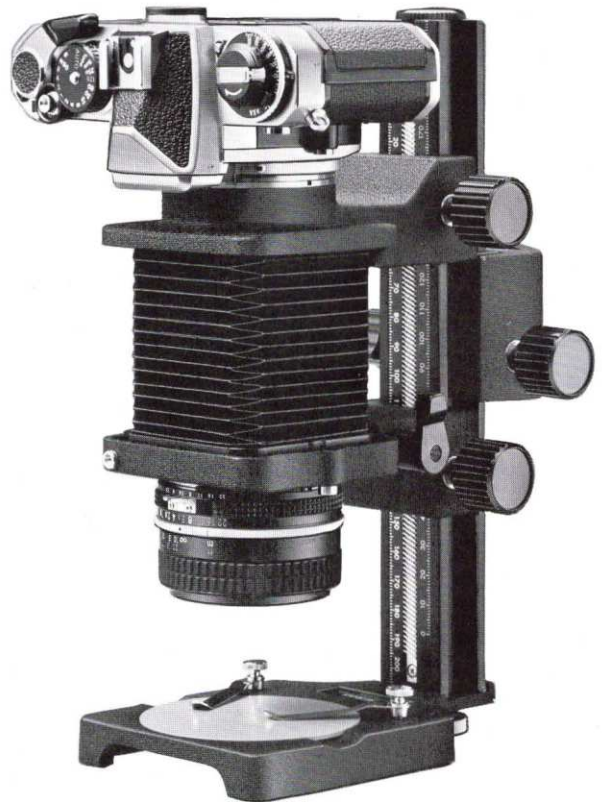
Sales Points

- Exclusive macro copystand and specimen stage for the PB-6.
- Permits both horizontal and vertical shooting.
- Easy attachment via a single locking screw.
- Two types of baseplates—white opaque acrylic and gray-painted aluminum discs—supplied as standard equipment. The white acrylic disc allows direct or transillumination of subjects or slide copying; the 18% gray disc can be used for through-the-lens metering.
- Built-in clips to hold the specimen in place.



Specifications

Construction:	Frame/base, white acrylic and gray-painted aluminum alloy discs (74mm) and clips
Compatible bellows:	PB-6 Bellows Focusing Attachment
Suitable lenses:	20mm to 55mm
Reproduction ratios:	With PB-6 and 50mm f/2 lens: 1/1.1X to 3X (in normal position) 1.4X to 3X (in reverse position)
Dimensions:	See table on page 52 for details. 90mm(W) x 144mm(H) x 27mm(D)
Weight:	150g with acrylic plate 170g with aluminum alloy plate



BELLOWS—cont'd

Slide Copying Adapter PS-6



Sales Points

- Exclusive slide copying adapter for the PB-6.
- Attaches easily to the upper dovetail section of the PB-6's rail in front of the lens panel.
- Permits full life-size or cropped duplicates to be made from any 35mm original.
- Slide holder can be shifted sideways up to 9mm in either direction or moved up and down up to 6mm for cropping of small portions of the original.
- Slide holder accepts mounted transparencies up to 4mm thick.
- Removable film trays on either side of the slide holder for use in duplicating uncut rolls of film.
- Small light shielding bellows clamps directly onto the front of a lens mounted normally or onto the rear of the lens panel when a lens is mounted in reverse.

Specifications

Construction:	Bellows, shiftable slide holder with opal diffuser, rail attachment arm, and roll film trays.
Type of original:	35mm transparency (mount thickness not to exceed 4mm); 35mm film strip or uncut roll film
Compatible bellows:	PB-6 Bellows Focusing Attachment
Suitable lenses:	20mm to 55mm
Reproduction ratios:	With PB-6 and 50mm f/2 lens: 1/1.1X to 2.9X (in normal position) 1.4X to 2.9X (in reverse position) See table on page 52 for details.
Frame shifting range: (for cropping)	6mm up or down; 9mm to either side
Light shielding bellows extension:	Up to 60mm
Dimensions (excl. trays):	88mm(W) x 118mm(H) x 42mm(D)
Weight (incl. trays):	300g



Nikon Bellows Focusing Attachment PB-4



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Sales Points

- Provides continuously variable extension from 43mm to 185mm for a wide range of magnifications.
- Dual twin-rail construction allows independent adjustment of magnification and focus.
- Lens panel can be swung horizontally through an arc of 25° and shifted up to 10mm sideways in either direction for complete control of depth of field.
- Lens can be mounted in reverse using the Macro Adapter Ring BR-2.
- Easy to use—full aperture viewing and semi-automatic diaphragm control are possible when used in conjunction with AR-4 Double Cable Release and BR-4 Auto Ring.*
- Built-in scale for accurate determination of the bellows extension.
- Horizontal or vertical formats possible.
- Accepts the Slide Copying Adapters PS-4 or PS-5.

* See page 40 for more information.

Specifications

Construction:	Dual twin-rails, bellows, tripod mount, camera panel, tilt and shift lens panel, slide copier socket.
Compatible cameras:	Any Nikon camera having Nikon F bayonet mount
Suitable lenses:	20mm to 300mm
Bellows extension:	43mm to 185mm
Reproduction ratios:	With 50mm f/2 lens: 1/1.2X to 3.6X (in normal position) 1.6X to 4.4X (in reverse position*)
Lower rail adjustment:	152mm
Lens panel shift:	10mm to either side
Lens panel tilt:	Horizontally through an arc of 25°
Dimensions:	109mm(W) x 160mm(H) x 211mm(L)
Weight:	1.25kg

* BR-2 ring required for reverse mounting

Features of the PB-4

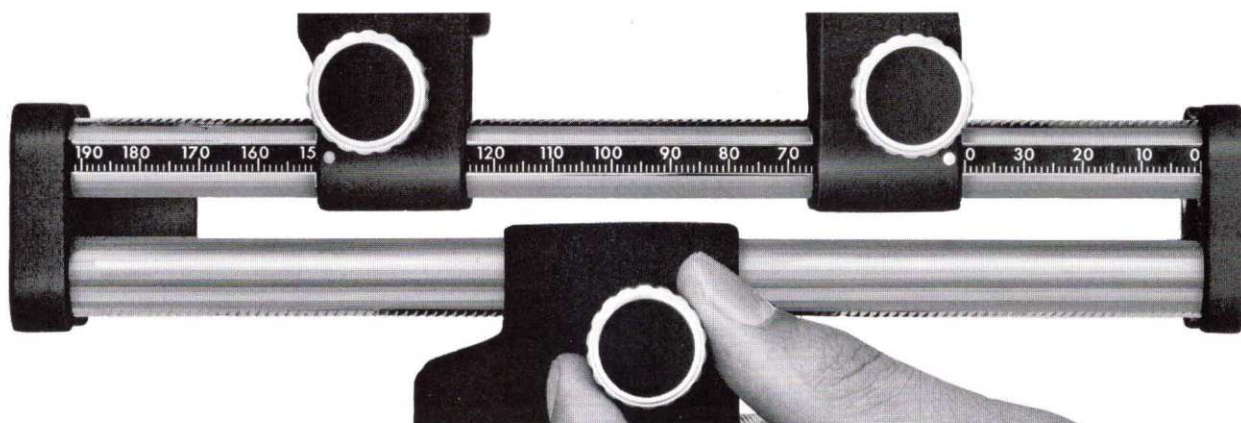
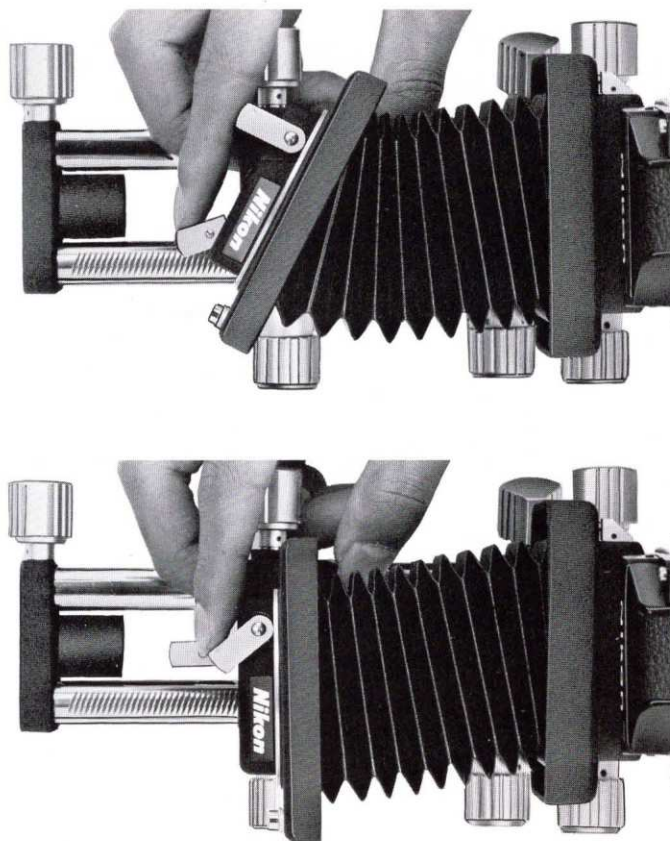
The PB-4 is a solidly built and extremely versatile bellows focusing attachment. In particular, the PB-4 has the following features:

1) Swing and shift lens panel

Featuring a lens panel similar to a view camera, the PB-4 bellows offers both swing and shift movements. The lens panel can be swung horizontally through an arc of 25° and shifted up to 10mm sideways in either direction for control of depth of field. Suppose your customer is shooting an oblique close-up subject and cannot get all of the subject from front to back in sharp focus, even when working at the lens' minimum aperture. By swinging the PB-4's lens panel, so that its axis is more nearly parallel to that of the subject, he can obtain overall sharpness. The shift movement is usually used in conjunction with the swing movement to keep the subject in place on the focusing screen. Another use of the shift movement is for slide cropping with the Slide Copying Adapter PS-5 which has no shift adjustment of its own.

2) Dual twin-rail construction

38 By using two sets of rails—upper and lower—the PB-4 provides for independent adjustment of the magnification and the focus. Once the bellows extension is set on the upper rails for the desired reproduction ratio, the entire bellows assembly can be moved back and forth on the lower rails for focusing.



3) Built-in extension scale

A convenient extension scale is engraved on the upper rail for precise setting of the magnification regardless of the positions of the camera and lens panels. Once you determine the necessary amount of bellows extension, either by calculation or table reference, it is set by aligning the outer edges of both lens and camera panels with the scale. Then, the actual extension is determined by subtracting the camera panel's position on the scale from that of the lens panel's. In the example, the lens panel is set at the 150mm position, while the camera panel

is at 40mm. Therefore, $150 - 40 = 110$, the exact amount of extension in millimeters. With a lens mounted in reverse using the BR-2 ring, it is not practical to calculate the necessary amount of bellows extension, because each lens has different nodal points. As mentioned in the Technical Information for the PB-6, it is more convenient to determine the bellows extension required for a specific magnification by referring to the tables at the back of this manual.

Slide Copying Adapter PS-4/PS-5



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Sales Points

- Exclusive slide copying adapter attaches directly to the front of the PB-4 bellows.
- Permits duplicates to be made from any 35mm transparency.
- PS-4's slide holder can be shifted sideways up to 9mm in either direction or moved up and down up to 6mm for cropping of small portions of the original.
- PS-5's slide holder does not move, but horizontal cropping can be accomplished by shifting the PB-4's lens panel.
- Slide holder accepts mounted transparencies up to 4mm thick.
- PS-4 has built-in film trays on either side of the slide holder for ease in duplicating uncut rolls of film.
- PS-5 has no film trays.
- Small light shielding bellows clamps directly to the front of a lens mounted in the normal position.*

* When slide copying is done with a lens mounted in reverse on the PB-4, the BR-3 Adapter Ring must be used.

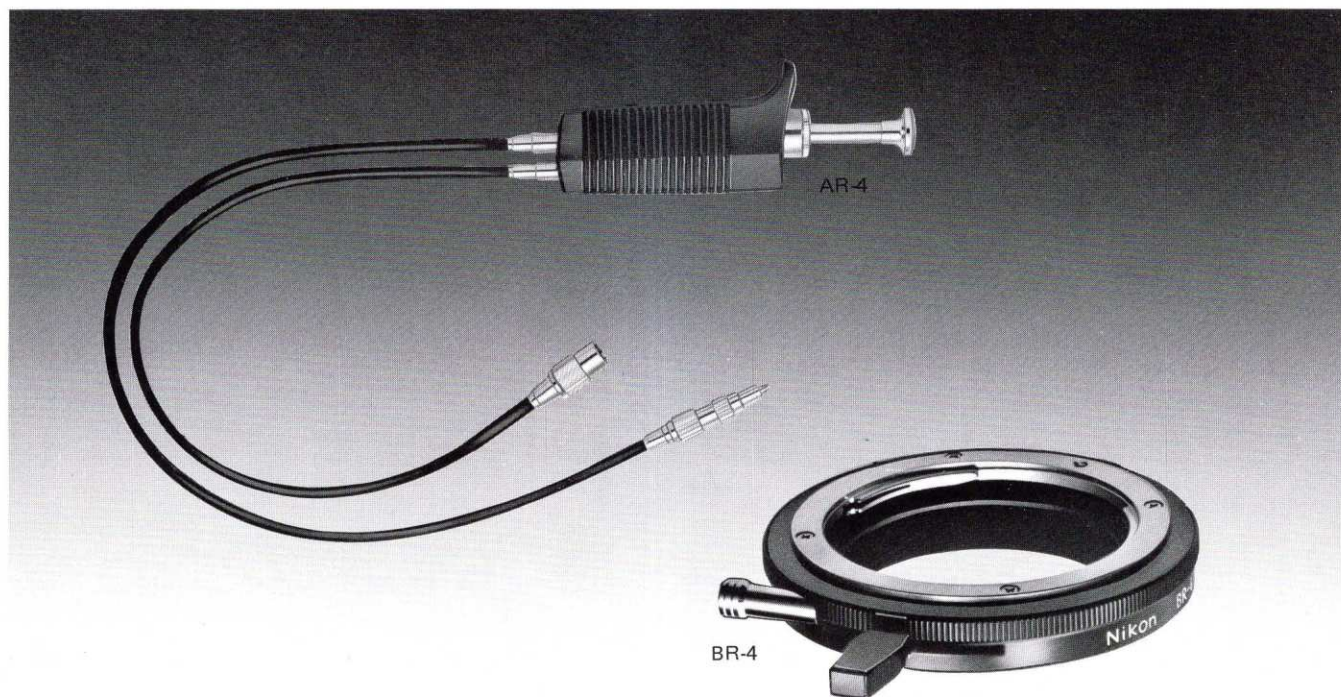
Specifications

	PS-4	PS-5
Compatible bellows	Any Nikon bellows unit except PB-6 model	
Suitable lenses	From 24mm to 85mm Nikkor	
Magnification with 50mm f/2 lens*	Normal	1/1.2X to 2.4X
	Reverse	1.6X to 4.4X
Copying frame area	25mm x 37mm	
Bellows extension	From 10mm to 70mm	
Extent of frame shift	6mm, up or down; 9mm, to either side	Impossible
Trays for roll film	Available	None
Dimensions	188(W) x 132(H) x 162.2mm(D)	82.5(W) x 132(H) x 147.2mm(D)
Weight	500g	360g

* Please refer to the table on page 55 for reproduction ratios with other lenses.

BELLOWS—cont'd

Nikon Double Cable Release AR-4 & Auto Ring BR-4



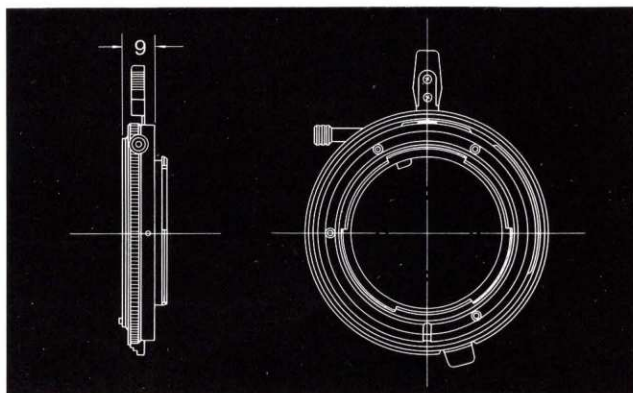
Sales Points of AR-4

- Provides semiautomatic diaphragm control when used with the PB-6 bellows. (PB-4 owners can enjoy the same semiautomatic operation if they use the AR-4 in conjunction with the BR-4 ring.)
- Double cable system first stops down the lens to the selected aperture, then releases the shutter in a single step.
- Plunger can be locked in for time exposures.

Sales Points of BR-4

- Provides semiautomatic diaphragm control when used in conjunction with the AR-4 Double Cable Release and the PB-4 bellows.
- Spring-loaded pin holds the lens diaphragm at maximum aperture for bright viewing and easy focusing.
- Lockable stop-down lever on the bottom of the ring allows manual depth of field preview or stopped-down metering.*
- Provides an additional extension of 9mm (with lens in normal position).

* When used with K extension rings or a lens mounted in reverse using the BR-2 ring, full aperture viewing and focusing is assured. The BR-4's stop-down level then allows the photographer to stop down the diaphragm for metering and shooting without manually operating the aperture ring.



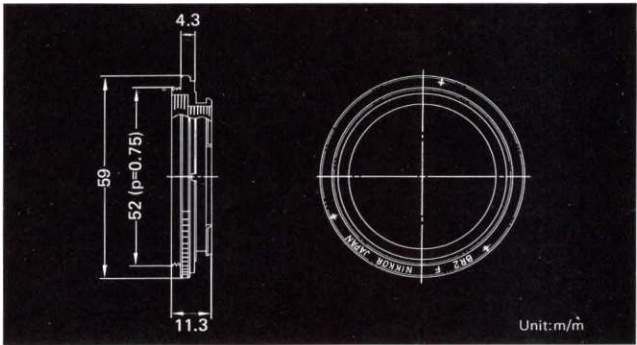
REVERSING RING

Ideal for Low-Cost High Magnification Work

A reversing ring is by far the least expensive way to shoot close-ups at life-size reproduction ratios or larger. With it your customer can mount his lens in reverse directly onto the camera body for shooting at a set magnification. (Please see the table below for details.) Or, if he already owns the PB-4, he can use it to reverse-mount the lens onto the bellows focusing attachment.



BR-2 Ring



Macro Adapter Ring BR-2

Sales Points

- Permits a lens to be mounted in reverse directly onto the camera body.
- Standard 52mm attachment size allows use of all but one* Nikkor lens between 20mm and 55mm, including the 43-86mm Zoom.
- Very lightweight and inexpensive.
- Easy to use—simply open up the lens diaphragm for viewing and focusing and then stop it down for metering and shooting. (Focusing is accomplished by moving the camera in and out.)
- Required when mounting the lens in reverse on the PB-4 bellows.

* The only exception is the PC-Nikkor 28mm f/4 which has a 72mm front thread.



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Nikon Adapter Ring BR-3

Sales Points

- Bayonets onto the front of a reverse-mounted lens to provide a 52mm attachment size for filters, lens hoods, or the PS-4 or PS-5 Slide Copying Adapters.
- Serves as a manual extension ring of 20.3mm when combined with the BR-2 ring.

Note: When the lens is attached directly to the camera body in reverse more via the BR-2 ring, the use of BR-3 ring is strongly recommended for protecting the exposed rear element of the lens.

Magnifications with various lenses mounted in reverse.

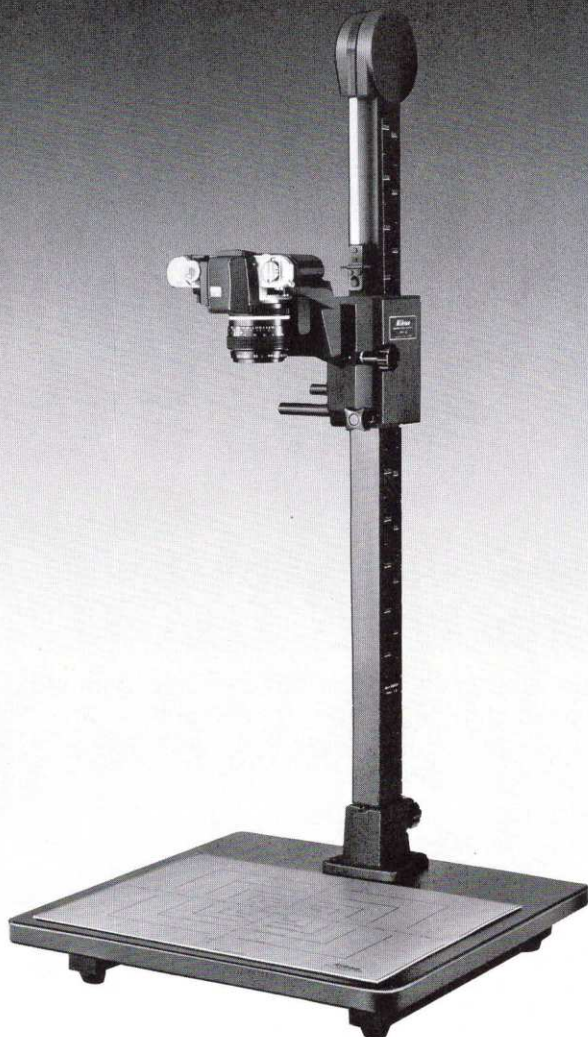
Lens	Magnification	Lens	Magnification
20/4	2.9X	35/2.8	1.4X
24/2	2.6X	35/2.8PC	1.5X
24/2.8	2.5X	50/1.4	1/1.1X
28/2	2.2X	50/2	1/1.2X
28/2.8	2.1X	55/1.2	1.0X
28/3.5	2.1X	55/3.5 Micro	1/1.1X
35/1.4	1.8X	58/1.2 Noct	1/1.2X
35/2	1.6X	43-86/3.5	1.2–1/3.9X

Note: Lenses of 85mm or longer cannot be used.

COPYSTAND

Ideal Way to Make Photographic Copies of Flat Subjects

A copystand consists of a camera cradle, an upright post or column, and a flat baseboard. The camera is suspended over the baseboard and points straight down, so that the film plane remains parallel to the subject being copied. This accessory is highly recommended for teachers, audio-visual specialists, or anyone else who wants to make high-quality photographic copies of drawings, diagrams, or printed materials.

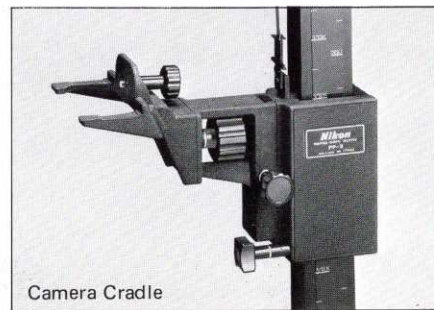
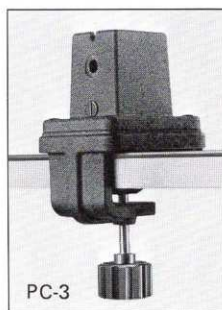


Nikon Repro-Copy Outfit PF-3 Sales Points

- Copystand designed especially for Nikon cameras and lenses.
- Solid construction assures vibration-free operation.
- Rectangular column with counterbalanced camera cradle provides easy, nonrotational movement of the camera up and down.
- Column can be turned around on the baseboard for photographing larger subjects on the floor.
- Coarse and fine focusing adjustments provided.
- Interchangeable camera cradles for cameras with or without a motor drive.
- Built-in scales on the column give reproduction ratios and diagonal dimensions of the subject when the Micro-Nikkor 55mm f/3.5 is used.
- Standard 18% gray card/focusing sheet supplied as standard equipment.
- Accessory table clamp can be substituted for the baseboard.

Specifications

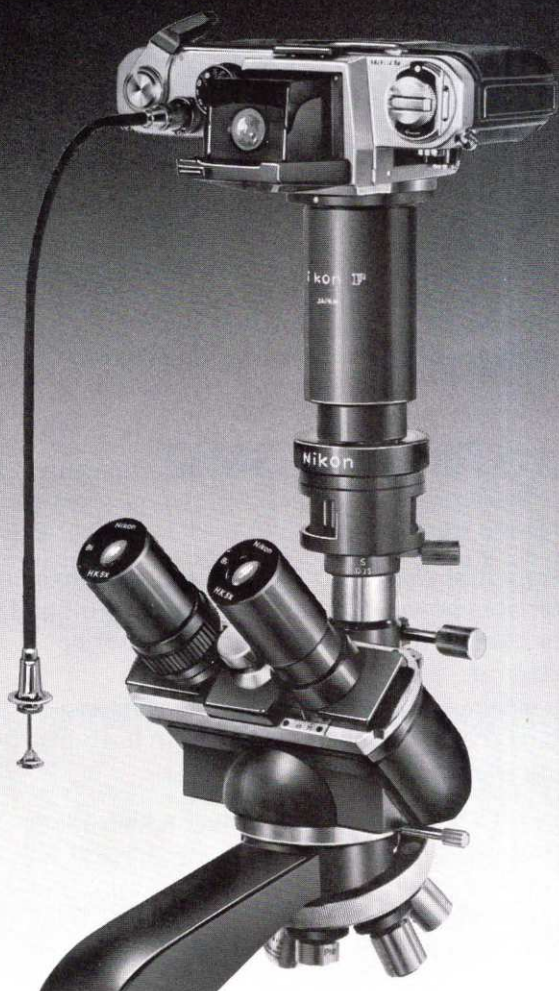
Compatible cameras:	Any F/F2 Nikon camera with or without motor drive Any Nikkormat camera, including the Nikkormat ELW fitted with auto-winder Nikon R10/R8 Super Zoom
Reproduction ratio:	1/14—1/2X with the Micro-Nikkor 55mm f/3.5 (1:1 with accessory PK-3 or PK-13 ring)
Subject distance:	888mm maximum (from the film plane to the baseboard)
Column clearance:	218.5mm (clearance between the axis of the column and the optical axis of the lens; F/F2 Nikon camera)
Camera cradle:	Interchangeable, counterbalanced
Camera cradle travel:	Coarse: 604mm; Fine: 70mm
Baseboard:	475mm x 335mm (usable area)
Dimensions:	475mm x 445mm x 1,053mm
Weight:	9.1kg
Accessories:	PH-3 MD Holder, PC-3 Table Clamp



MICROSCOPE ADAPTER

For Photographing the Infinitesimal

A microscope adapter tube simply connects the camera body directly to the microscope's eyepiece for extremely high magnification work. This accessory is recommended for scientists, medical personnel, or the hobbyist interested in photomicrography.



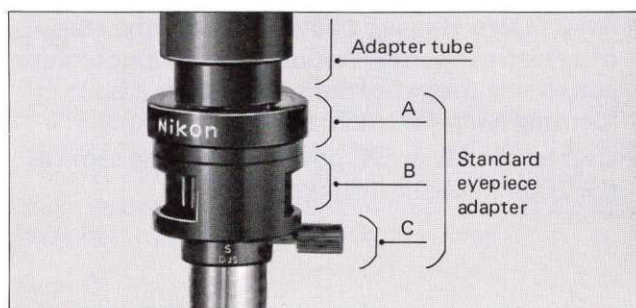
Nikon Microscope Adapter Tube Model 2

Sales Points

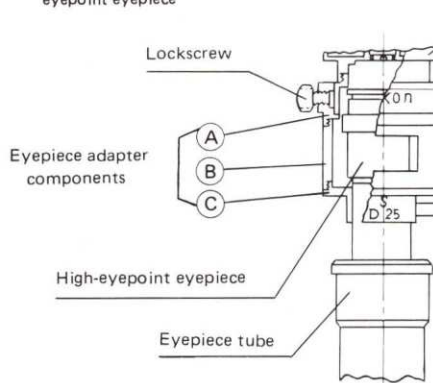
- Exclusive Nikon accessory which connects any Nikon F bayonet mount camera to virtually any microscope.
- Provides one half the magnification of the microscope.
- Supplied with a 33mm green filter and the standard eyepiece adapter.

Note: Nikon manufactures a complete line of high-quality microscopes and related accessories. For more information on precision photomicrography, please contact your Nikon microscope distributor.

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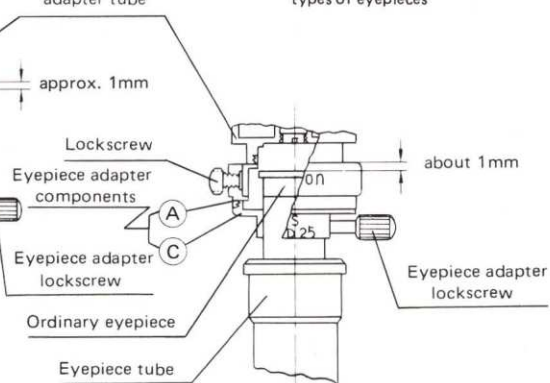


Three components of eyepiece adapters assembled for high-eyepoint eyepiece



Microscope adapter tube

Two components of eyepiece adapters assembled for other types of eyepieces



RINGLIGHTS

Professional Lighting for Close-Ups

Wrapping around the front of the lens, a ringlight creates a circle of light which bathes the subject in virtually shadowless illumination no matter how

short the free-working distance is. Therefore, a ringlight is ideal for shooting in inaccessible areas or for extremely high-magnification work.



Nikon Ringlight Unit SR-2 and Macro Ringlight SM-2

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Sales Points

- SR-2 Ringlight Unit screws into the 52mm front thread of Nikkor lenses from 35mm to 200mm for shooting subjects between approximately 6 to 18 inches (0.2–0.6m) from the film plane.
- SM-2 Macro Ringlight bayonets onto the rear of a reverse-mounted Nikkor lens* for photography at extreme magnifications. It also has a built-in focusing lamp for use in dim light.
- Uses either AC or DC power packs—the same as the 200mm Medical-Nikkor.
- Short flash duration “freezes” subject movement.
- Variable power output in two steps (Full or 1/4) for control of depth of field and shooting distance.
- Accurate manual exposure determination by using the handy charts supplied in both instruction sheets.

* The BR-2 ring is required even with the PB-6 bellows unit.

Specifications

Description		SR-2	SM-2
Light output control	Automatic	Impossible	
	Manual	FULL and 1/4	
Guide number	(ASA 100 and meters)	16 (FULL), 8(1/4) (Usable at distances of more than 0.6m)	
	(ASA 25 and feet)	26 (FULL), 13 (1/4)	
Angle of coverage		65°	—
Recycling time	Manual	Approx. 12 sec.	
Approx. No. of flashes	Manual	Alkaline manganese batteries: 600 (FULL), 1,400 (1/4)	
Power source		DC power unit: LD-1 (Both units also usable with Medical-) AC power unit: LA-1 (Nikkor 200 f/5.6)	
Ready-light & test-firing button		Built-in	
Mounting		Screws into 52mm front thread	Bayonets onto rear of the lens
Dimensions		140 x 106 x 25mm	70 x 100 x 35mm
Weight (without batteries)		200g	185g

FOCUSING AND VIEWING ACCESSORIES

The Finishing Touches to a Complete Close-Up System

No close-up system would be complete without special accessories to make viewing and focusing as convenient as possible. Nikon produces various viewfinder-related accessories designed especially for close-up work.



DW-1



DW-2



DG-2



DR-3

Nikon Viewfinders and Attachments

Waist-Level Finder DW-1

Designed for Nikon F and F2 cameras, the DW-1 permits viewing from directly above the camera. A self-erecting hood blocks out extraneous light, and a pop-up 5X magnifier is provided for critical focusing on the center part of the image.

6X Focusing Finder DW-2

Usually used with the Type C and M focusing screens for parallax focusing of the aerial image, this finder provides 6X magnification of the entire focusing screen for direct, above-the-camera viewing. Ideal for critical high magnification work. For Nikon F and F2 cameras.

Eyepiece Magnifier DG-2

The DG-2 screws into the finder eyepiece of any Nikon/Nikkormat model to produce 2X magnification of the center part of the image and flips up out of way when not in use. It also has built-in diopter adjustment and a rubber eyecup.

Right-Angle Viewing Attachment DR-3

The DR-3 provides upright and unreversed right-angle viewing of the entire focusing screen with any Nikon/Nikkormat model. With diopter adjustment and a rubber eyecup, it is very useful for copywork, because the camera's TTL metering can still be used.

Nikon Interchangeable Focusing Screens

Type B

Suitable for normal shooting as well as close-ups, the Type B can be used in all Nikon F and F2 cameras. In addition, a special Type B screen is available for the Nikon FE automatic compact. This screen has an overall matte/Fresnel field with a 12mm fine matte focusing spot which corresponds to the centerweighted metering area of Nikon cameras.

Type E

The Type E screen is exactly the same as Type B with the addition of an etched grid pattern for reference in document copying. A special Type E screen is also available for the Nikon FE.

Type M

For high magnification work with Nikon F or F2 cameras fitted with the 6X Focusing Finder, the Type M's clear

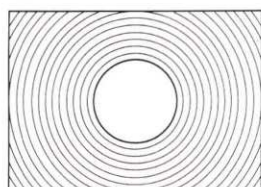
Fresnel field is etched with a double cross-hair reticle for parallax focusing of the aerial image. In addition, the Type M has reference scales graduated in millimeters for easy determination of the reproduction ratio. Through-the-lens metering is not possible when using this screen.

Type C

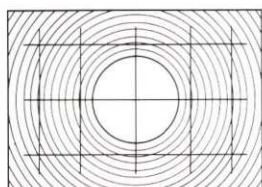
Featuring a fine matte field with a central 4mm clear spot with a single cross-hair reticle, the Type C is also used with Nikon F and F2 cameras and the 6X Focusing Finder for aerial-image parallax focusing.

Type D

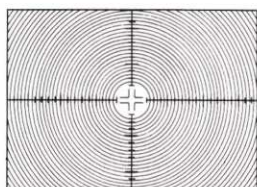
Type D is a plain matte screen without a Fresnel field. It provides completely unobstructed viewing and focusing and is recommended when doing copywork. For Nikon F and F2 cameras.



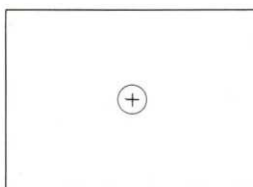
Type B



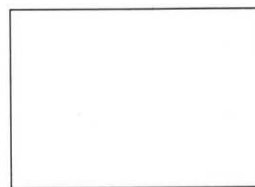
Type E



Type M



Type C



Type D

TABLES

Subject Area

Magnification	Subject Area	
	mm	in.
3X	12 x 8	0.47 x 0.31
2X	18 x 12	0.71 x 0.47
1.5X	24 x 16	0.94 x 0.63
1X	36 x 24	1.4 x 0.94
1/1.5X	54 x 36	2.1 x 1.4
1/2X	72 x 48	2.8 x 1.9
1/3X	108 x 72	4.3 x 2.8
1/4X	144 x 96	5.7 x 3.8
1/5X	180 x 120	7.1 x 4.7
1/6X	216 x 144	8.5 x 5.7
1/7X	252 x 168	9.9 x 6.6
1/8X	288 x 192	11.3 x 7.6
1/9X	324 x 216	12.8 x 8.5
1/10X	360 x 240	14.2 x 9.5

Magnification Ranges Obtainable by Lens Alone

Lens	Magnification	Subject Distance	
		cm	in.
20/3.5	1/∞–1/10.8X	∞–30.0	∞–11.8
24/2	1/∞–1/8.7X	∞–30.2	∞–11.9
24/2.8	1/∞–1/8.8X	∞–30.0	∞–11.8
28/2	1/∞–1/7.2X	∞–30.0	∞–11.8
35/1.4	1/∞–1/5.4X	∞–29.6	∞–11.7
50/1.2	1/∞–1/7.9X	∞–50.1	∞–19.7
50/1.4	1/∞–1/6.8X	∞–45.0	∞–17.7
50/2	1/∞–1/6.7X	∞–45.0	∞–17.7
55/3.5 Micro	1/∞–1/2X	∞–24.1	∞–9.5
85/2	1/∞–1/8.1X	∞–85.0	∞–33.5
105/2	1/∞–1/8.3X	∞–107	∞–42
105/4 Micro	1/∞–1/2X	∞–47.1	∞–18.6
135/2.8	1/∞–1/7.5X	∞–130	∞–51.3
135/3.5	1/∞–1/7.5X	∞–130	∞–51.2
180/2.8	1/∞–1/8.2X	∞–183	∞–72.1
200/4	1/∞–1/7.4X	∞–200	∞–78.6
300/4.5 ED	1/∞–1/10.3X	∞–396	∞–156

Note: AI-Nikkor is used; with non-AI models, the values may be slightly different.

Close-Up Attachment Lens Data

Lens	Close-Up Attachment Lens	Magnification	Focused Distance		
			cm	in.	
50mm f/1.4 50mm f/1.2	No. 0	1/27.0–1/5.5	150–38.1	59.2–15.0	
	No. 1	1/13.0–1/5.0	77.1–33.4	30.4–13.1	
	No. 2	1/6.6–1/3.4	43.5–27.5	17.1–10.8	
50mm f/2 50mm f/1.8	No. 0	1/27.0–1/5.4	151–38.2	59.4–15.0	
	No. 1	1/13.0–1/4.4	77.3–33.5	30.4–13.2	
	No. 2	1/6.6–1/3.3	43.6–27.6	17.2–10.9	
	No. 1 + No. 2	1/4.4–1/2.7	39.9–24.9	12.9–9.7	
85mm f/2	No. 0	1/16.6–1/5.3	152–60.0	59.8–23.6	
	No. 1	1/7.9–1/3.9	78.4–47.2	30.9–18.6	
	No. 2	1/4.0–1/2.6	44.8–35.1	17.6–13.8	
105mm f/2.5	No. 0	1/13.0–1/5.0	153–69.5	60.3–27.4	
	No. 1	1/6.4–1/3.5	80.0–53.0	31.5–20.9	
	No. 2	1/3.2–1/2.2	46.4–38.6	18.3–15.2	
135mm f/2.8 135mm f/3.5	No. 0	1/11.0–1/4.6	156–84.9	61.5–33.5	
	No. 1	1/5.0–1/3.0	82.7–61.6	32.6–24.3	
	No. 2	1/2.5–1/1.8	49.1–43.7	19.4–17.3	
200mm f/4	No. 0	1/7.1–1/3.3	158–98.9	62.3–38.9	
	No. 1	1/3.4–1/2.0	84.9–69.3	33.4–27.2	
	No. 2	1/1.7–1/1.2	51.3–48.6	20.1–19.1	
43-86mm f/3.5 Zoom	43mm	No. 0	1/32–1/13	150–75.0	59.0–29.5
		No. 1	1/15–1/8.7	80.0–57.5	31.5–22.5
		No. 2	1/7.8–1/5.5	48.0–41.0	31.5–22.5
	86mm	No. 0	1/16–1/6.5	150–75.0	59.0–29.5
		No. 1	1/7.7–1/4.4	80.0–57.0	31.5–22.5
		No. 2	1/4.0–1/2.7	48.0–41.0	18.9–16.2

Notes: 1) AI-Nikkor is used; with non-AI-Nikkor, the values may be slightly different.
2) If more than one lens is included in each lens column, magnifications apply only to the first lens.

K Rings Data

Nikkor 20mm f/3.5, 20mm f/4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/3.5–1/2.7	15.6–14.0	6.1–5.5	1.2–1.3
K3 + K2	1/1.9–1/1.6	12.7–12.4	5.0–4.9	1.4–1.5
K3 + K2 + K1	1/1.2–1/1.1	12.0–11.9	4.7–4.7	1.7–1.8
K3 + K4 + K2	1.0–1.1	11.9–11.9	4.7–4.7	1.9–2.0
K3 + K4 + K2 + K1	1.3–1.4	12.0–12.1	4.7–4.8	2.2–2.3
K3 + K5 + K2	1.5–1.6	12.2–12.4	4.8–4.9	2.4–2.6
K3 + K5 + K2 + K1	1.8–1.9	12.6–12.7	5.0–5.0	2.8–2.9
K3 + K5 + K4 + K2	2.0–2.1	12.9–13.1	5.1–5.1	3.0–3.2

Nikkor 24mm f/2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/4.2–1/2.9	19.5–16.4	7.7–6.5	1.2–1.3
K3 + K2	1/2.3–1/1.8	15.2–14.4	6.0–5.7	1.3–1.4
K3 + K2 + K1	1/1.5–1/1.3	13.8–13.6	5.4–5.4	1.5–1.6
K3 + K4 + K2	1/1.2–1.0	13.5–13.5	5.3–5.3	1.7–1.8
K3 + K4 + K2 + K1	1.1–1.2	13.5–13.5	5.3–5.3	1.9–2.0
K3 + K5 + K2	1.3–1.4	13.6–13.7	5.3–5.4	2.1–2.2
K3 + K5 + K2 + K1	1.5–1.6	13.9–14.0	5.5–5.5	2.3–2.5
K3 + K5 + K4 + K2	1.7–1.8	14.1–14.3	5.6–5.6	2.5–2.7
K3 + K5 + K4 + K2 + K1	1.9–2.0	14.5–14.7	5.7–5.8	2.8–3.0

Nikkor 24mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/4.2–1/2.9	19.0–16.0	7.5–6.3	1.2–1.3
K3 + K2	1/2.3–1/1.8	14.8–13.9	5.8–5.5	1.4–1.5
K3 + K2 + K1	1/1.5–1/1.3	13.4–13.2	5.3–5.2	1.7–1.8
K3 + K4 + K2	1/1.2–1.0	13.1–13.1	5.2–5.1	1.8–2.0
K3 + K4 + K2 + K1	1.1–1.2	13.1–13.1	5.1–5.2	2.1–2.3
K3 + K5 + K2	1.3–1.4	13.2–13.3	5.2–5.2	2.3–2.5
K3 + K5 + K2 + K1	1.5–1.6	13.5–13.6	5.3–5.4	2.7–2.8
K3 + K5 + K4 + K2	1.7–1.8	13.7–13.9	5.4–5.5	2.9–3.1
K3 + K5 + K4 + K2 + K1	1.9–2.0	14.1–14.3	5.6–5.6	3.2–3.4

Nikkor 28mm f/2, 28mm f/2.8, 28mm f/3.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/4.9–1/2.9	23.9–18.5	9.4–7.3	1.2–1.3
K3 + K2	1/2.6–1/1.9	17.8–16.2	7.0–6.4	1.4–1.5
K3 + K2 + K1	1/1.7–1/1.4	15.8–15.2	6.2–6.0	1.6–1.8
K3 + K4 + K2	1/1.4–1/1.2	15.2–15.0	6.0–5.9	1.8–1.9
K3 + K4 + K2 + K1	1/1.1–1.1	14.9–14.9	5.9–5.9	2.0–2.2
K3 + K5 + K2	1.1–1.2	14.9–15.0	5.9–5.9	2.2–2.4
K3 + K5 + K2 + K1	1.3–1.4	15.1–15.3	5.9–6.0	2.5–2.7
K3 + K5 + K4 + K2	1.4–1.6	15.3–15.5	6.0–6.1	2.7–2.9
K3 + K5 + K4 + K2 + K1	1.6–1.8	15.6–15.9	6.1–6.2	3.0–3.2

Nikkor 35mm f/1.4, 35mm f/2, 35mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/6.2–1/2.9	32.5–21.2	12.8–8.4	1.1–1.2
K3 + K2	1/3.3–1/2.1	22.7–18.8	8.9–7.4	1.2–1.3
K3 + K2 + K1	1/2.2–1/1.5	19.1–17.5	7.5–6.9	1.3–1.4
K3 + K4 + K2	1/1.7–1/1.3	17.9–17.1	7.1–6.7	1.4–1.5
K3 + K4 + K2 + K1	1/1.4–1/1.1	17.1–16.8	6.7–6.6	1.5–1.6
K3 + K5 + K2	1/1.2–1.0	16.9–16.8	6.7–6.6	1.6–1.7
K3 + K5 + K2 + K1	1.0–1.2	16.8–16.9	6.6–6.7	1.7–1.9
K3 + K5 + K4 + K2	1.1–1.3	16.9–17.1	6.6–6.7	1.8–1.9
K3 + K5 + K4 + K2 + K1	1.3–1.5	17.1–17.4	6.7–6.8	1.9–2.1

Nikkor 50mm f/1.2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/8.9–1/4.2	55.3–31.6	21.8–12.4	1.1–1.3
K3 + K2	1/4.8–1/3.0	34.5–25.8	13.6–10.2	1.2–1.4
K3 + K2 + K1	1/3.1–1/2.2	26.5–22.6	10.4–8.9	1.4–1.5
K3 + K4 + K2	1/2.5–1/1.9	23.6–21.2	9.3–8.4	1.5–1.6
K3 + K4 + K2 + K1	1/1.9–1/1.6	21.4–20.1	8.4–7.9	1.6–1.8
K3 + K5 + K2	1/1.7–1/1.4	20.5–19.6	8.1–7.7	1.7–1.9
K3 + K5 + K2 + K1	1/1.4–1/1.2	19.7–19.2	7.8–7.6	1.9–2.1
K3 + K5 + K4 + K2	1/1.3–1/1.1	19.4–19.1	7.6–7.5	2.0–2.2
K3 + K5 + K4 + K2 + K1	1/1.1–1.0	19.1–19.1	7.5–7.5	2.2–2.4

Nikkor 50mm f/1.4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/8.9–1/3.9	55.6–30.4	21.9–12.0	1.2–1.4
K3 + K2	1/4.8–1/2.8	34.9–25.5	13.7–10.0	1.3–1.6
K3 + K2 + K1	1/3.1–1/2.1	26.8–22.6	10.6–8.9	1.5–1.8
K3 + K4 + K2	1/2.5–1/1.8	24.0–21.3	9.5–8.4	1.6–1.9
K3 + K4 + K2 + K1	1/1.9–1/1.5	21.8–20.3	8.6–8.0	1.9–2.2
K3 + K5 + K2	1/1.7–1/1.3	20.9–19.9	8.2–7.8	2.0–2.3
K3 + K5 + K2 + K1	1/1.4–1/1.2	20.1–19.6	7.9–7.7	2.3–2.6
K3 + K5 + K4 + K2	1/1.3–1/1.1	19.7–19.5	7.8–7.7	2.4–2.8
K3 + K5 + K4 + K2 + K1	1/1.1–1.0	19.5–19.5	7.7–7.7	2.7–3.0

Nikkor 50mm f/2, 50mm f/1.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/8.9–1/3.8	56.1–30.7	22.1–12.1	1.2–1.5
K3 + K2	1/4.8–1/2.8	35.4–25.9	13.9–10.2	1.4–1.7
K3 + K2 + K1	1/3.1–1/2.1	27.3–23.0	10.8–9.1	1.7–2.0
K3 + K4 + K2	1/2.5–1/1.8	24.5–21.8	9.7–8.6	1.8–2.2
K3 + K4 + K2 + K1	1/1.9–1/1.5	22.3–20.8	8.8–8.2	2.1–2.5
K3 + K5 + K2	1/1.7–1/1.3	21.4–20.4	8.4–8.0	2.3–2.8
K3 + K5 + K2 + K1	1/1.4–1/1.2	20.6–20.1	8.1–7.9	2.7–3.1
K3 + K5 + K4 + K2	1/1.3–1/1.1	20.2–20.0	8.0–7.9	2.9–3.4
K3 + K5 + K4 + K2 + K1	1/1.1–1.1	20.0–20.0	7.9–7.9	3.2–3.7

Micro-Nikkor 55mm f/3.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/9.5–1/1.7	63.1–22.8	24.8–9.0	1.2–2.6
K3 + K2	1/5.1–1/1.4	39.4–22.1	15.5–8.7	1.4–2.9
K3 + K2 + K1	1/3.3–1/1.2	30.2–21.6	11.9–8.5	1.7–3.2
K3 + K4 + K2	1/2.6–1/1.1	27.0–21.5	10.6–8.4	1.9–3.5
K3 + K4 + K2 + K1	1/2.1–1.0	24.4–21.4	9.6–8.4	2.2–3.9
K3 + K5 + K2	1/1.8–1.1	23.3–21.4	9.2–8.4	2.4–4.2
K3 + K5 + K2 + K1	1/1.5–1.2	22.3–21.5	8.8–8.5	2.8–4.7
K3 + K5 + K4 + K2	1/1.3–1.2	21.9–21.6	8.6–8.5	3.0–5.0
K3 + K5 + K4 + K2 + K1	1/1.2–1.3	21.5–21.9	8.5–8.6	3.4–5.5

Noct-Nikkor 58mm f/1.2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/10.0–1/4.0	68.7–34.9	27.1–13.8	1.1–1.1
K3 + K2	1/5.4–1/3.0	42.4–29.4	16.7–11.6	1.1–1.2
K3 + K2 + K1	1/3.5–1/2.3	32.1–26.0	12.6–10.2	1.2–1.3
K3 + K4 + K2	1/2.8–1/2.0	28.4–24.5	11.2–9.7	1.2–1.3
K3 + K4 + K2 + K1	1/2.2–1/1.6	25.5–23.2	10.0–9.2	1.3–1.4
K3 + K5 + K2	1/1.9–1/1.5	24.2–22.6	9.5–8.9	1.3–1.4
K3 + K5 + K2 + K1	1/1.6–1/1.3	23.0–22.1	9.1–8.7	1.4–1.5
K3 + K5 + K4 + K2	1/1.4–1/1.2	22.5–21.9	8.9–8.6	1.4–1.6
K3 + K5 + K4 + K2 + K1	1/1.2–1/1.1	22.0–21.8	8.7–8.6	1.5–1.6

TABLES—cont'd

K Rings Data

Nikkor 85mm f/2

Extension Ring	Reproduction Ratio	Subject Distance		Exposure Factor
		cm	in.	
K1	1/14.7–1/5.2	141–61.2	55.3–24.1	1.2–1.5
K3 + K2	1/7.9–1/4.0	83.4–51.4	32.8–20.2	1.3–1.7
K3+K2+K1	1/5.1–1/3.1	60.6–44.7	23.8–17.6	1.5–1.9
K3+K4+K2	1/4.1–1/2.7	52.2–41.6	20.5–16.4	1.6–2.0
K3+K4+K2+K1	1/3.2–1/2.3	45.2–38.5	17.8–15.2	1.9–2.3
K3+K5+K2	1/2.8–1/2.1	41.9–37.0	16.5–14.6	2.0–2.4
K3+K5+K2+K1	1/2.3–1/1.8	38.8–35.4	15.3–13.9	2.2–2.7
K3+K5+K4+K2	1/2.1–1/1.7	37.2–34.6	14.6–13.6	2.4–2.9
K3+K5+K4+K2+K1	1/1.8–1/1.5	35.5–33.7	14.0–13.3	2.7–3.2

Micro-Nikkor 105mm f/4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/18.1–1/1.8	212–45.6	83.3–18.0	1.1–2.4
K3 + K2	1/9.7–1/1.7	124–44.6	48.8–17.6	1.2–2.6
K3 + K2 + K1	1/6.3–1/1.5	89.0–43.7	35.0–17.2	1.3–2.7
K3 + K4 + K2	1/5.0–1/1.4	76.0–43.3	29.9–17.0	1.4–2.9
K3 + K4 + K2 + K1	1/3.9–1/1.3	65.0–42.7	25.6–16.8	1.6–3.1
K3 + K5 + K2	1/3.4–1/1.3	59.8–42.4	23.5–16.7	1.7–3.2
K3 + K5 + K2 + K1	1/2.9–1/1.2	54.7–42.2	21.5–16.6	1.8–3.4
K3 + K5 + K4 + K2	1/2.6–1/1.1	52.0–42.0	20.5–16.5	1.9–3.6
K3 + K5 + K4 + K2 + K1	1/2.3–1/1.1	49.2–41.9	19.4–16.5	2.1–3.8

Nikkor 135mm f/2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/23.3–1/5.6	342–106	135–41.8	1.2–1.7
K3 + K2	1/12.5–1/4.7	197–93.4	77.7–36.8	1.3–1.9
K3 + K2 + K1	1/8.1–1/3.9	139–83.5	54.7–32.9	1.5–2.1
K3 + K4 + K2	1/6.5–1/3.5	117–78.2	46.1–30.8	1.6–2.3
K3 + K4 + K2 + K1	1/5.1–1/3.0	98.7–72.7	38.8–28.6	1.8–2.5
K3 + K5 + K2	1/4.4–1/2.8	89.7–69.6	35.3–27.4	2.0–2.7
K3 + K5 + K2 + K1	1/3.7–1/2.5	80.9–66.3	31.9–26.1	2.2–2.9
K3 + K5 + K4 + K2	1/3.3–1/2.3	76.2–64.3	30.0–25.3	2.3–3.1
K3 + K5 + K4 + K2 + K1	1/2.9–1/2.1	71.3–62.1	28.1–24.5	2.6–3.4

Nikkor 135mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/23.3–1/5.7	342–106	135–41.8	1.1–1.6
K3 + K2	1/12.5–1/4.7	197–93.3	77.5–36.7	1.3–1.8
K3 + K2 + K1	1/8.1–1/3.9	139–83.3	54.6–32.8	1.4–2.0
K3 + K4 + K2	1/6.5–1/3.5	117–78.0	46.0–30.7	1.6–2.1
K3 + K4 + K2 + K1	1/5.1–1/3.0	98.3–72.5	38.7–28.5	1.7–2.3
K3 + K5 + K2	1/4.4–1/2.8	89.4–69.4	35.2–27.3	1.9–2.5
K3 + K5 + K2 + K1	1/3.7–1/2.5	80.6–66.0	31.7–26.0	2.1–2.7
K3 + K5 + K4 + K2	1/3.3–1/2.3	75.9–64.0	29.9–25.2	2.2–2.9
K3 + K5 + K4 + K2 + K1	1/2.9–1/2.1	70.9–61.8	27.9–24.3	2.4–3.1

Nikkor 135mm f/3.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/23.3–1/5.7	342–106	135–41.8	1.1–1.6
K3 + K2	1/12.5–1/4.7	197–93.3	77.6–36.7	1.2–1.7
K3 + K2 + K1	1/8.1–1/3.9	139–83.3	54.6–32.8	1.4–1.9
K3 + K4 + K2	1/6.5–1/3.5	117–78.1	46.1–30.7	1.5–2.0
K3 + K4 + K2 + K1	1/5.1–1/3.0	98.5–72.6	38.8–28.6	1.6–2.2
K3 + K5 + K2	1/4.4–1/2.8	89.5–69.5	35.3–27.4	1.8–2.3
K3 + K5 + K2 + K1	1/3.7–1/2.5	80.7–66.1	31.8–26.0	1.9–2.5
K3 + K5 + K4 + K2	1/3.3–1/2.3	76.0–64.1	29.9–25.3	2.1–2.6
K3 + K5 + K4 + K2 + K1	1/2.9–1/2.1	71.1–61.9	28.0–24.4	2.2–2.9

Nikkor 180mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/31–1/6.5	592–151	233–59.5	1.1–1.6
K3 + K2	1/17–1/5.5	334–133	132–52.4	1.2–1.7
K3 + K2 + K1	1/11–1/4.7	230–119	90.6–46.9	1.3–1.8
K3 + K4 + K2	1/8.7–1/4.2	191–111	75.2–43.7	1.4–1.9
K3 + K4 + K2 + K1	1/6.8–1/3.7	158–103	62.2–40.6	1.5–2.1
K3 + K5 + K2	1/5.8–1/3.4	141–97.6	55.5–38.4	1.6–2.2
K3 + K5 + K2 + K1	1/4.9–1/3.1	125–92.1	49.2–36.3	1.8–2.3
K3 + K5 + K4 + K2	1/4.4–1/2.9	117–88.8	46.1–35.0	1.9–2.4
K3 + K5 + K4 + K2 + K1	1/3.9–1/2.6	107–85.0	42.1–33.5	2–2.6

Nikkor 200mm f/4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/34.5–1/6.1	739–174	291–68.5	1.1–1.8
K3 + K2	1/18.5–1/5.3	420–158	165–62.4	1.2–2.0
K3 + K2 + K1	1/12.0–1/4.6	291–145	115–57.1	1.4–2.2
K3 + K4 + K2	1/9.6–1/4.2	243–137	95.7–54.0	1.5–2.3
K3 + K4 + K2 + K1	1/7.5–1/3.7	202–129	79.5–50.7	1.7–2.5
K3 + K5 + K2	1/6.5–1/3.5	182–124	71.6–48.7	1.8–2.6
K3 + K5 + K2 + K1	1/5.5–1/3.1	162–118	63.7–46.5	1.9–2.8
K3 + K5 + K4 + K2	1/4.9–1/2.9	151–115	59.4–45.1	2.1–3.0
K3 + K5 + K4 + K2 + K1	1/4.3–1/2.7	139–111	54.8–43.5	2.3–3.2

Nikkor 300mm f/2.8 IF-ED, 300mm f/4.5 ED, 300mm f/4.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
K1	1/51.7–1/8.5	1611–307	634–121	1.1–1.8
K3 + K2	1/27.8–1/7.4	893–276	352–109	1.2–1.9
K3 + K2 + K1	1/18.1–1/6.4	603–249	237–98.1	1.4–2.1
K3 + K4 + K2	1/14.4–1/5.9	493–234	194–92.0	1.5–2.2
K3 + K4 + K2 + K1	1/11.3–1/5.2	400–217	157–85.3	1.6–2.4
K3 + K4 + K2	1/9.7–1/4.9	354–206	139–81.3	1.7–2.5
K3 + K5 + K2 + K1	1/8.2–1/4.4	308–195	121–76.6	1.9–2.7
K3+K5+K4+K2	1/7.4–1/4.1	283–187	112–73.7	2.0–2.8
K3 + K5 + K4 + K2 + K1	1/6.4–1/3.8	257–179	101–70.4	2.1–3.0

Notes:

- 1) AI-Nikkor lens is used; with non-AI-Nikkor, the values may be slightly different.
- 2) Left figures: Lens set at infinity
Right figures: Lens set at the closest focusing distance
- 3) If more than one lens is included in each column, magnifications apply only to the first lens.
- 4) Subject distance indicates the distance between the subject and film plane.

PK Rings Data

Nikkor 20mm f/3.5, 20mm f/4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/10.8	∞–30.0	∞–11.8	1–1.1
PK-11	1/2.5–1/2.1	13.8–13.0	5.4–5.1	1.3–1.4
PK-12	1/1.5–1/1.3	12.2–12.0	4.8–4.7	1.6–1.7
PK-11 + PK-12	1.1–1.2	11.9–11.9	4.7–4.7	2.0–2.1
PK-13	1.3–1.4	12.1–12.2	4.8–4.8	2.3–2.4
PK-11 + PK-13	1.7–1.8	12.5–12.7	4.9–5.0	2.7–2.8
PK-12 + PK-13	2.0–2.1	13.0–13.1	5.1–5.2	3.1–3.2

Nikkor 24mm f/2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/8.7	∞–30.2	∞–11.9	1.0–1.1
PK-11	1/3.1–1/2.3	16.9–15.2	6.7–6.0	1.2–1.3
PK-12	1/1.7–1/1.5	14.2–13.8	5.6–5.4	1.4–1.6
PK-11 + PK-12	1/1.1–1.0	13.5–13.5	5.3–5.3	1.7–1.9
PK-13	1.1–1.2	13.5–13.6	5.3–5.3	1.9–2.1
PK-11 + PK-13	1.4–1.6	13.8–14.0	5.4–5.5	2.3–2.4
PK-12 + PK-13	1.7–1.8	14.2–14.3	5.6–5.6	2.5–2.7

Nikkor 24mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/8.8	∞–30.0	∞–11.8	1.0–1.1
PK-11	1/3.0–1/2.3	16.4–14.8	6.5–5.8	1.3–1.4
PK-12	1/1.7–1/1.5	13.8–13.4	5.4–5.3	1.5–1.7
PK-11 + PK-12	1/1.1–1.0	13.1–13.1	5.2–5.1	1.9–2.0
PK-13	1.1–1.2	13.1–13.2	5.2–5.2	2.2–2.3
PK-11 + PK-13	1.5–1.6	13.4–13.6	5.3–5.3	2.6–2.8
PK-12 + PK-13	1.7–1.8	13.8–14.0	5.4–5.5	2.9–3.1
PK-11 + PK-12 + PK-13	2.0–2.1	14.3–14.5	5.6–5.7	3.4–3.6

Nikkor 28mm f/2, 28mm f/2.8, 28mm f/3.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/7.2X	∞–30.0	∞–11.8	1–1.1
PK-11	1/3.6–1/2.4	20.2–17.2	8.0–6.8	1.3–1.4
PK-12	1/2.0–1/1.6	16.4–15.5	6.5–6.1	1.5–1.6
PK-11 + PK-12	1/1.3–1/1.1	15.1–14.9	5.9–5.9	1.8–2.0
PK-13	1.0–1.1	14.9–14.9	5.9–5.9	2.1–2.2
PK-11 + PK-13	1.2–1.4	15.0–15.2	5.9–6.0	2.4–2.6
PK-12 + PK-13	1.5–1.6	15.3–15.5	6.0–6.1	2.7–2.9
PK-11 + PK-12 + PK-13	1.7–1.9	15.8–16.1	6.2–6.3	3.2–3.4

Nikkor 35mm f/1.4, 35mm f/2, 35mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/5.4X	∞–29.6	∞–11.7	1–1.1
PK-11	1/4.5–1/2.4	26.6–19.9	10.5–7.8	1.1–1.3
PK-12	1/2.6–1/1.7	20.3–17.9	8.0–7.1	1.2–1.4
PK-11 + PK-12	1/1.6–1/1.3	17.7–17.0	7.0–6.7	1.4–1.5
PK-13	1/1.3–1/1.1	17.1–16.8	6.7–6.6	1.5–1.6
PK-11 + PK-13	1.0–1.2	16.8–16.9	6.6–6.7	1.7–1.8
PK-12 + PK-13	1.2–1.3	16.9–17.1	6.6–6.7	1.8–1.9
PK-11 + PK-12 + PK-13	1.4–1.6	17.2–17.5	6.8–6.9	2.0–2.2

Nikkor 50mm f/1.2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/7.9	∞–50.1	∞–19.7	1.0–1.1
PK-11	1/6.5–1/3.5	42.9–28.5	16.9–11.2	1.2–1.3
PK-12	1/3.7–1/2.5	29.2–23.8	11.5–9.4	1.3–1.5
PK-11 + PK-12	1/2.3–1/1.8	23.1–20.9	9.1–8.2	1.5–1.7
PK-13	1/1.9–1/1.5	21.2–20.0	8.3–7.9	1.6–1.8
PK-11 + PK-13	1/1.5–1/1.2	19.8–19.3	7.8–7.6	1.9–2.1
PK-12 + PK-13	1/1.2–1/1.1	19.3–19.1	7.6–7.5	2.0–2.2
PK-11 + PK-12 + PK-13	1.0–1.1	19.1–19.1	7.5–7.5	2.3–2.5

Nikkor 50mm f/1.4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/6.8X	∞–45.0	∞–17.7	1–1.2
PK-11	1/6.4–1/3.3	43.2–27.8	17.0–10.9	1.2–1.5
PK-12	1/3.7–1/2.4	29.5–23.6	11.6–9.3	1.4–1.7
PK-11 + PK-12	1/2.3–1/1.7	23.4–21.1	9.2–8.3	1.7–2.0
PK-13	1/1.9–1/1.5	21.6–20.2	8.5–8.0	1.9–2.2
PK-11 + PK-13	1/1.5–1/1.2	20.2–19.6	7.9–7.7	2.2–2.5
PK-12 + PK-13	1/1.2–1.1	19.7–19.5	7.8–7.7	2.5–2.8
PK-11 + PK-12 + PK-13	1.0–1.1	19.5–19.5	7.7–7.7	2.8–3.2

Nikkor 50mm f/1.8, 50mm f/2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/6.7	∞–45.0	∞–17.7	1.0–1.3
PK-11	1/6.4–1/3.3	43.7–28.2	17.2–11.1	1.3–1.6
PK-12	1/3.7–1/2.4	30.1–24.1	11.8–9.5	1.5–1.9
PK-11 + PK-12	1/2.3–1/1.7	23.9–21.6	9.4–8.5	1.9–2.3
PK-13	1/1.9–1/1.5	22.1–20.7	8.7–8.2	2.2–2.6
PK-11 + PK-13	1/1.5–1/1.2	20.7–20.1	8.1–7.9	2.6–3.0
PK-12 + PK-13	1/1.2–1.0	20.2–20.0	8.0–7.9	2.9–3.4
PK-11 + PK-12 + PK-13	1.0–1.1	20.0–20.0	7.9–7.9	3.4–3.9

Nikkor 55mm f/1.2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/7.2X	∞–49.8	∞–19.6	1–1.2
PK-11	1/6.9–1/3.5	47.8–30.2	18.8–11.9	1.2–1.4
PK-12	1/3.9–1/2.5	32.2–25.4	12.7–10.0	1.3–1.5
PK-11 + PK-12	1/2.5–1/1.9	25.2–22.4	9.9–8.8	1.5–1.8
PK-13	1/2.0–1/1.6	23.0–21.3	9.0–8.4	1.7–1.9
PK-11 + PK-13	1/1.5–1/1.3	21.3–20.5	8.4–8.1	1.9–2.2
PK-12 + PK-13	1/1.3–1/1.1	20.6–20.3	8.1–8.0	2.1–2.4
PK-11 + PK-12 + PK-13	1/1.1–1.0	20.3–20.2	8.0–8.0	2.4–2.6

Micro-Nikkor 55mm f/3.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞–1/2X	∞–24.1	∞–9.5	1–2.2
PK-11	1/6.9–1/1.5	49.0–22.4	19.3–8.8	1.3–2.7
PK-12	1/3.9–1/1.3	33.4–21.8	13.1–8.6	1.6–3.1
PK-11 + PK-12	1/2.5–1/1.1	26.3–21.4	10.4–8.4	2.0–3.6
PK-13	1/2–1.0	24.1–21.4	9.5–8.4	2.2–4.0
PK-11 + PK-13	1/1.5–1.1	22.4–21.5	8.8–8.4	2.7–4.6
PK-12 + PK-13	1/1.3–1.3	21.8–21.6	8.6–8.5	3.1–5.1
PK-11 + PK-12 + PK-13	1/1.1–1.4	21.4–22.0	8.4–8.7	3.6–5.8

TABLES—cont'd

PK Rings Data

Noct-Nikkor 58mm f/1.2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/6.7	∞—50.0	∞—19.7	1.0—1.1
PK-11	1/7.2—1/3.5	53.0—32.1	20.9—12.6	1.1—1.2
PK-12	1/4.1—1/2.6	35.6—27.3	14.0—10.7	1.1—1.2
PK-11 + PK-12	1/2.6—1/1.9	27.7—24.2	10.9—9.5	1.2—1.3
PK-13	1/2.1—1/1.6	25.2—23.1	9.9—9.1	1.3—1.4
PK-11 + PK-13	1/1.6—1/1.3	23.2—22.2	9.1—8.7	1.4—1.5
PK-12 + PK-13	1/1.4—1/1.2	22.4—21.9	8.8—8.6	1.5—1.6
PK-11 + PK-12 + PK-13	1/1.2—1.0	21.9—21.8	8.6—8.6	1.6—1.7

Nikkor 85mm f/2

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/8.1	∞—85.0	∞—33.5	1.0—1.3
PK-11	1/10.6—1/4.6	106—56.2	41.9—22.1	1.2—1.6
PK-12	1/6.1—1/3.5	68.4—47.3	26.9—18.6	1.4—1.8
PK-11 + PK-12	1/3.9—1/2.6	50.4—40.8	19.9—16.1	1.7—2.1
PK-13	1/3.1—1/2.2	44.4—38.2	17.5—15.0	1.9—2.3
PK-11 + PK-13	1/2.4—1/1.8	39.3—35.7	15.5—14.0	2.2—2.7
PK-12 + PK-13	1/2.0—1/1.6	36.9—34.5	14.5—13.6	2.5—2.9
PK-11 + PK-12 + PK-13	1/1.7—1/1.4	34.9—33.4	13.8—13.2	2.8—3.3

Nikkor 105mm f/2.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/8.3X	∞—107	∞—42	1—1.3
PK-11	1/13.1—1/5.1	157—73.5	61.6—28.9	1.2—1.5
PK-12	1/7.5—1/3.9	98.1—62.0	38.6—24.2	1.3—1.6
PK-11 + PK-12	1/4.8—1/3.0	70.2—53.2	27.7—21.0	1.5—1.8
PK-13	1/3.8—1/2.6	60.8—49.4	23.9—19.5	1.6—2.0
PK-11 + PK-13	1/3.0—1/2.2	52.5—45.6	20.1—18.0	1.8—2.2
PK-12 + PK-13	1/2.5—1/1.9	48.6—43.7	19.1—17.2	2.0—2.4
PK-11 + PK-12 + PK-13	1/2.1—1/1.7	45.1—41.9	17.8—16.5	2.2—2.6

Micro-Nikkor 105mm f/4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/2.0	∞—47.1	∞—18.6	1.0—2.2
PK-11	1/13.1—1/1.7	159—45.2	62.8—17.8	1.2—2.5
PK-12	1/7.5—1/1.6	101—44.1	39.8—17.4	1.3—2.7
PK-11 + PK-12	1/4.8—1/1.4	73.2—43.1	28.8—17.0	1.5—2.9
PK-13	1/3.8—1/1.3	63.7—42.7	25.1—16.8	1.6—3.1
PK-11 + PK-13	1/3.0—1/1.2	55.5—42.2	21.8—16.6	1.8—3.4
PK-12 + PK-13	1/2.5—1/1.1	51.6—42.0	20.3—16.5	1.9—3.6
PK-11 + PK-12 + PK-13	1/2.1—1.0	48.1—41.9	18.9—16.5	2.2—3.9

Nikkor 135mm f/2, 135mm f/2.8, 135mm f/3.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/7.5	∞—130	∞—51.2	1.0—1.5
PK-11	1/16.9—1/5.2	256—99.9	101—39.3	1.2—1.8
PK-12	1/9.6—1/4.2	159—87.5	62.6—34.4	1.4—2.0
PK-11 + PK-12	1/6.1—1/3.4	113—76.9	44.3—30.3	1.7—2.3
PK-13	1/4.9—1/3.0	96.5—72.0	38.0—28.4	1.8—2.5
PK-11 + PK-13	1/3.8—1/2.5	82.4—66.9	32.4—26.3	2.1—2.9
PK-12 + PK-13	1/3.3—1/2.3	75.6—64.0	29.7—25.2	2.4—3.2
PK-11 + PK-12 + PK-13	1/2.7—1/2.0	69.3—61.2	27.3—24.1	2.7—3.5

Nikkor 180mm f/2.8

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/8.2X	∞—183	∞—72.1	1—1.4
PK-11	1/22.5—1/6.0	439—144	173—56.9	1.1—1.6
PK-12	1/12.9—1/5.0	266—127	105—50.0	1.3—1.7
PK-11 + PK-12	1/8.2—1/4.1	183—111	71.9—43.8	1.4—1.9
PK-13	1/6.5—1/3.6	154—104	60.5—40.8	1.6—2.1
PK-11 + PK-13	1/5.1—1/3.1	128—95.2	50.3—37.5	1.7—2.3
PK-12 + PK-13	1/4.3—1/2.8	115—90.5	45.4—35.6	1.9—2.5
PK-11 + PK-12 + PK-13	1/3.6—1/2.5	103—85.6	40.7—33.7	2.1—2.7

Nikkor 200mm f/4

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/7.4X	∞—200	∞—78.6	1.0—1.7
PK-11	1/25.0—1/5.7	550—167	216—65.6	1.2—1.9
PK-12	1/14.3—1/4.9	336—150	132—59.2	1.3—2.1
PK-11 + PK-12	1/9.1—1/4.1	233—135	91.7—53.3	1.5—2.3
PK-13	1/7.3—1/3.7	197—128	77.6—50.3	1.7—2.5
PK-11 + PK-13	1/5.6—1/3.2	165—119	65.0—46.9	1.9—2.8
PK-12 + PK-13	1/4.8—1/2.9	149—114	58.8—44.9	2.1—3.0
PK-11 + PK-12 + PK-13	1/4.0—1/2.6	135—109	53.0—42.8	2.3—3.3

Nikkor 300mm f/4.5 ED, 300mm f/4.5

Extension Ring	Magnification	Subject Distance		Exposure Factor
		cm	in.	
—	1/∞—1/10.3X	∞—396	∞—156	1—1.5
PK-11	1/37.5—1/8.1	1210—330	476—130	1.1—1.7
PK-12	1/21.4—1/7.0	727—297	286—117	1.2—1.8
PK-11 + PK-12	1/13.6—1/5.9	494—265	195—104	1.4—2.0
PK-13	1/10.9—1/5.3	413—248	163—97.7	1.5—2.1
PK-11 + PK-13	1/8.5—1/4.7	340—229	134—90.2	1.7—2.3
PK-12 + PK-13	1/7.2—1/4.3	304—218	120—85.8	1.8—2.5
PK-11 + PK-12 + PK-13	1/6.1—1/3.8	270—206	106—80.9	2.0—2.7

Notes:

- 1) AI-Nikkor lens is used; with non-AI Nikkor, the values may be slightly different.
- 2) Left figures: Lens set at infinity
Right figures: Lens set at the closest focusing distance
- 3) If more than one lens is included in each column, magnifications apply only to the first lens.
- 4) Subject distance indicates the distance between the subject and film plane.

PB-6/PB-6E Data

Lens	Mounting position	Reproduction ratio	Subject field (mm)																							
			$\infty \times \infty$	360×240	180×120	144×96	108×72	72×48	36×24	18×12	9×6	7.2×4.8	6×4	5.1×3.4	4.5×3	3.6×2.4	3.3×2.2	3×2	2.6×1.7	2.3×1.5	2×1.3	1.8×1.2	1.6×1.1	1.5×1		
			$1/\infty \times 1/\infty$	$1/360 \times 1/240$	$1/180 \times 1/120$	$1/144 \times 1/96$	$1/108 \times 1/72$	$1/72 \times 1/48$	$1/36 \times 1/24$	$1/18 \times 1/12$	$1/9 \times 1/6$	$1/7.2 \times 1/4.8$	$1/6 \times 1/4$	$1/5.1 \times 1/3.4$	$1/4.5 \times 1/3$	$1/3.6 \times 1/2.4$	$1/3.3 \times 1/2.2$	$1/3 \times 1/2$	$1/2.6 \times 1/1.7$	$1/2.3 \times 1/1.5$	$1/2 \times 1/1.3$	$1/1.8 \times 1/1.2$	$1/1.6 \times 1/1.1$	$1/1.5 \times 1/1$		
20mm f/4 f/3.5	Reverse	Extension																								
		Working distance																								
24mm f/2.8 f/2	Reverse	Extension																								
		Working distance																								
28mm f/3.5 f/2.8 f/2 f/4 PC	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
35mm f/2 f/1.4	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
35mm f/2.8 f/2.8 PC	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
45mm f/2.8 GN	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
50mm f/2 f/1.8 f/1.4 f/1.2	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
55mm f/3.5 Micro f/1.2	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
58mm f/1.2 Noct	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
85mm f/2	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
105mm f/4 Micro f/2.5	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
135mm f/3.5 f/2.8 f/2	Normal	Extension																								
		Working distance																								
	Reverse	Extension																								
		Working distance																								
180mm f/2.8	Normal	Extension																								
		Working distance																								
200mm f/4	Normal	Extension																								
		Working distance																								

- Notes:**
- 1) AI-Nikkor lens is used; with non-AI-Nikkor, the values may be slightly different.
 - 2) Magnifications are those obtained at the infinity setting.
 - 3) If more than one lens is included in each lens column, magnifications apply only to the first lens.
 - 4) The 135mm f/2 and 28mm f/4 PC lenses cannot be used in the reverse position because of the larger size of their attachments.
 - 5)  = with PB-6 alone.  = with PB-6 and PB-6E together.

TABLES—cont'd

PB-6M Data

Lens	Mounting position	Subject field Magnification	72 ×	36 ×	18 ×	12 ×	9 ×	7.2 ×	6 ×	5.1 ×	4.5 ×	4 ×	3.6 ×	
			48	24	12	8	6	4.8	4	3.4	3	2.7	2.5	
			1/2×	1×	2×	3×	4×	5×	6×	7×	8×	9×	10×	
20mm f/4 f/3.5	Reverse	Extension						72	83	103	123	144	164	169
		Working distance						38	38	37	36	36	36	36
24mm f/2.8 f/2	Reverse	Extension					83	111	135	160	173			
		Working distance					40	38	38	38	37			
28mm f/3.5 f/2.8 f/2 f/4 PC	Normal	Extension		48	57	88								
		Working distance		8	5	0								
	Reverse	Extension			83	105	133	162	172					
		Working distance			42	41	39	38	38					
35mm f/2.8 f/2 f/1.4 f/2.8 PC	Normal	Extension		48	72	108	144	154						
		Working distance		19	10	4	1	0						
	Reverse	Extension			89	105	141	163						
		Working distance			48	46	43	41						
45mm f/2.8 GN	Normal	Extension		48	93	140	162							
		Working distance		73	51	43	41							
	Reverse	Extension		57	94	141	163							
		Working distance		72	57	49	47							
50mm f/2 f/1.8 f/1.4 f/1.2	Normal	Extension		48	103	156								
		Working distance		64	34	26								
	Reverse	Extension			78	106	159							
		Working distance			69	59	51							
55mm f/3.5 Micro f/1.2	Normal	Extension		48	110	144								
		Working distance		65	29	23								
	Reverse	Extension			92	121	155							
		Working distance			71	61	54							

- Notes: 1) AI-Nikkor lens is used; with non-AI-Nikkor, the values may be slightly different.
2) Magnifications are those obtained at the infinity setting.
3) If more than one lens is included in each lens column, magnifications apply only to the first lens.
4) 28mm f/4 PC lens cannot be used in the reverse position.

PS-6 Data

Lens	Mounting position	Subject field Magnification	72 × 48	36 × 24	18 × 12	12 × 8	9 × 6	7.2 × 4.8	6 × 4	5.1 × 3.4	4.5 × 3	4 × 2.7	3.6 × 2.4
			1/2×	1×	2×	3×	4×	5×	6×	7×	8×	9×	10×
20mm f/4 f/3.5	Reverse	Extension						72	83	103	123	144	166
		Working distance						38	38	37	36	36	36
24mm f/2.8 f/2	Reverse	Extension					83	111	135	160	170		
		Working distance					40	38	38	37	37		
28mm f/3.5, f/2.8 f/2	Reverse	Extension				83	105	133	162	170			
		Working distance				42	41	39	38	38			
35mm f/2.8, f/2 f/1.4, f/2.8 PC	Reverse	Extension			89	105	141	165					
		Working distance			48	46	43	41					
45mm f/2.8 GN	Normal	Extension		48	93	140	158						
		Working distance		73	51	43	41						
	Reverse	Extension		57	94	141	159						
		Working distance		72	57	49	47						
50mm f/2 f/1.8 f/1.4 f/1.2	Normal	Extension		48	103	153							
		Working distance		64	34	26							
	Reverse	Extension			78	106	156						
		Working distance			69	59	51						
55mm f/3.5 Micro f/1.2	Normal	Extension		48	110	144							
		Working distance		65	29	23							
	Reverse	Extension			92	120	152						
		Working distance			71	61	55						

- Notes: 1) AI-Nikkor lens is used; with non-AI-Nikkor, the values may be slightly different.
2) Magnifications are those obtained at the infinity setting.
3) If more than one lens is included in each lens column, magnifications apply only to the first lens.

PB-4 Data

Lens	Position	Reproduction Ratio Range											Remarks
		1/2×	1/1×	1/10×	1/9×	1/8×	1/7×	1/6×	1/5×	1/4×	1/3×	1/2×	
20mm f/4	Normal										0	0.2	The further the lens is stopped down, the better the image quality. Unsuitable for copying.
	Reverse	3.6								3.9			Image quality is best at f/8 and deteriorates at smaller apertures.
24mm f/2.8, f/2	Reverse		3.7							4.0			Image quality is best at f/8 and deteriorates at smaller apertures. Cannot be used in normal position.
28mm f/2, f/3.5, f/2.8	Normal										0	0.6	The further the lens is stopped down, the better the image quality. Unsuitable for copying.
	Reverse				4.5					5.0			Image quality is best at apertures from f/8 to f/11, and deteriorates at smaller apertures.
35mm f/2.8	Normal								0			2.3	The further the lens is stopped down, the better the quality.
	Reverse					4.0				4.7			Image quality is best at f/8 and deteriorates at smaller apertures.
35mm f/2	Normal								0			2.2	Same as above
	Reverse					4.2				4.9			
35mm f/1.4	Normal								0			1.8	The further the lens is stopped down, the better the image quality.
	Reverse					4.7				5.4			Image quality is best at f/11 and deteriorates at smaller apertures.
35mm f/2.8 PC	Normal							0.2				2.5	Corner image quality deteriorates at low reproduction ratios. Unsuitable for copying.
	Reverse					4.8				5.5			Image quality is best at f/8 and deteriorates at smaller apertures.
45mm f/2.8 GN	Normal								3.9			7.7	Image quality is best at apertures from f/8 to f/11 and deteriorates when the lens is stopped down further than f/11.
	Reverse							4.6				6.8	Image quality is best at f/8 and deteriorates at smaller apertures.
50mm f/2	Normal								2.5			7.2	The further the lens is stopped down, the better the image quality.
	Reverse							4.8				6.8	At high reproduction ratios corner image quality deteriorates somewhat when the lens is stopped down further than f/8.
50mm f/1.4	Normal								1.0			5.7	The further the lens is stopped down the better the image quality. Unsuitable for copying.
	Reverse							5.0				6.5	Corner image quality deteriorates at low reproduction ratios.
55mm f/1.2	Normal								1.4			6.9	Suitable for normal close-ups but unsuitable for copying. Since corner image quality is poor, it is advisable to stop down the lens as far as possible.
	Reverse							5.1				7.0	Corner image quality deteriorates at low reproduction ratios.
55mm f/3.5 Micro	Normal								1.8			7.2	Image quality is best at f/8 and deteriorates at smaller apertures.
	Reverse							5.5				7.5	

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Lens	Position	Reproduction Ratio Range												Remarks
		7×	6×	5×	4×	3×	2×	1×	1/2×	1/3×	1/4×	1/5×	1/10×1/∞×	
85mm f/1.8	Normal						9.0			22				The further the lens is stopped down, the better the image quality.
	Reverse						7.8			21				Corner image quality deteriorates at low reproduction ratios.
105mm f/2.5 f/4 Micro	Normal						10			32				The further the lens is stopped down, the better the image quality.
	Reverse						12			42				Image quality is good at high reproduction ratios but corner image quality deteriorates at infinity.
135mm f/3.5 f/2.8	Normal						22			55				The further the lens is stopped down, the better the image quality.
	Reverse						23							Image quality is good at high reproduction ratios but corner image quality deteriorates at infinity.
135mm f/2	Normal						23			55				The further the lens is stopped down, the better the image quality.
180mm f/2.8	Normal						33			91				The further the lens is stopped down, the better the image quality.
200mm f/4	Normal						56			127				The further the lens is stopped down, the better the image quality.
300mm f/4.5	Normal						103			264				The further the lens is stopped down, the better the image quality.

- Notes:**
- 1) Non-AI-Nikkor lens is used; with AI-Nikkor, the values may be slightly different.
 - 2) Magnifications are those obtained at the infinity setting.
 - 3) Figures at each end of the bars indicate the free-working distance in cm (i.e. the distance between subject and front edge of the lens barrel).
 - 4) If more than one lens is included in each lens column, magnifications apply only to the first lens.

TABLES—cont'd

PB-4 Data

(mm)

Lens	Position	Read off Values on Scale																	
		50	60	70	80	90	100	110	120	130	140	150	160	170	180	190			
20mm f/4	Normal	2.1×(0.2) 2.5×(0)																	
	Reverse	5×(3.9) 6×(3.8) 7×(3.7) 8×(3.7) 9×(3.7) 10×(3.7) 11×(3.6) 12×(3.6)																	
24mm f/2.8 f/2	Reverse	4.5×(4) 5×(3.9) 6×(3.8) 7×(3.8) 8×(3.7) 9×(3.7) 10×(3.7)																	
28mm f/2 f/3.5 f/2.8	Normal	1.5×(0.6) 2×(0.1)																	
	Reverse	4×(4.9) 4.5×(4.8) 5×(4.8) 5.5×(4.7) 6×(4.7) 6.5×(4.6) 7×(4.6) 7.5×(4.6) 8×(4.6) 8.5×(4.5)																	
35mm f/2.8 f/2 f/2.8 PC	Normal	1.2×(2.2) 1.5×(1.6) 2×(1) 2.5×(0.6) 3×(0.4) 3.5×(0.2) 4×(0.1) 4.5×(0)																	
	Reverse	3×(4.9) 3.5×(4.7) 4×(4.6) 4.5×(4.5) 5×(4.4) 5.5×(4.4) 6×(4.3) 6.5×(4.3)																	
35mm f/1.4	Normal	1.5×(1.2) 2×(0.6) 2.5×(0.2) 3×(0)																	
	Reverse	3×(5.4) 3.5×(5.2) 4×(5.1) 4.5×(5.0) 5×(4.9) 5.5×(4.9) 6×(4.8) 6.5×(4.8)																	
45mm f/2.8 GN	Normal	1×(7.4) 1.5×(5.9) 2×(5.1) 2.5×(4.6) 3×(4.3) 3.5×(4.1)																	
	Reverse	1.5×(6.7) 2×(5.9) 2.5×(5.4) 3×(5.1) 3.5×(4.9) 4×(4.7)																	
50mm f/2	Normal	1×(6.4) 1.5×(4.7) 2×(3.8) 2.5×(3.3) 3×(3) 3.5×(2.7)																	
	Reverse	1.6×(6.9) 2×(6.3) 2.5×(5.8) 3×(5.4) 3.5×(5.2) 4×(5.1) 4.3×(4.9)																	
50mm f/1.4	Normal	1×(4.6) 1.5×(2.9) 2×(2) 2.5×(1.5) 3×(1.2) 3.5×(0.9)																	
	Reverse	2×(6.3) 2.5×(5.8) 3×(5.4) 3.5×(5.2) 4×(5) 4.5×(4.8)																	
55mm f/1.2 f/3.5 Micro	Normal	1×(5.1) 1.5×(3.2) 2×(2.3) 2.5×(1.8) 3×(1.4) 3.3×(1.2)																	
	Reverse	2×(6.4) 2.5×(5.8) 3×(5.5) 3.5×(5.3) 4×(5)																	
85mm f/1.8	Normal	0.6×(18) 0.8×(16) 1×(14) 1.2×(12) 1.4×(11) 1.6×(10) 1.8×(9.8) 2×(9.3)																	
	Reverse	0.6×(16) 0.8×(14) 1×(12) 1.2×(11) 1.4×(10) 1.6×(9.2) 1.8×(8.6) 2×(8.1)																	
105mm f/2.5 f/4 Micro	Normal	0.4×(33) 0.6×(24) 0.8×(20) 1×(17) 1.2×(15) 1.4×(14) 1.6×(13) 1.8×(12)																	
	Reverse	0.4×(30) 0.6×(21) 0.8×(17) 1×(14) 1.2×(12) 1.4×(11) 1.6×(10)																	
135mm f/3.5 f/2.8	Normal	0.4×(46) 0.6×(35) 0.8×(29) 1×(26) 1.2×(24) 1.3×(23)																	
	Reverse	∞ 0.2×(74) 0.4×(41) 0.6×(29) 0.8×(24)																	
135mm f/2	Normal	0.4×(47) 0.6×(36) 0.8×(30) 1×(27) 1.2×(25) 1.4×(23)																	
180mm f/2.8	Normal	0.3×(75) 0.4×(57) 0.5×(51) 0.6×(45) 0.7×(41) 0.8×(38) 0.9×(35) 1×(33)																	
200mm f/4	Normal	0.3×(101) 0.4×(84) 0.5×(74) 0.6×(68) 0.7×(63) 0.8×(60) 0.9×(57)																	
300mm f/4.5 f/4.5 ED	Normal	0.15×(254) 0.2×(204) 0.3×(154) 0.4×(129) 0.5×(114) 0.6×(104)																	

- Notes:** 1) Non-AI-Nikkor lens is used; with AI-Nikkor, the values may be slightly different.
 2) Magnifications are those obtained at the infinity setting.
 3) Figures in parentheses indicate the free-working distance in cm (i.e. the distance between subject and front edge of the lens barrel).
 4) If more than one lens is included in each lens column, magnifications apply only to the first lens.

PS-4/PS-5 Data

Lens	Position	Reproduction Range												
		12 X	11 X	10 X	9 X	8 X	7 X	X	5 X	4 X	3 X	2 X	1 X	1/2 X
20mm f/ 4	Reverse													
24mm f/ 2、f/2.8	Reverse													
28mm f/ 2、f/2.8、f/3.5	Reverse													
35mm f/2.8	Reverse													
35mm f/ 2	Reverse													
35mm f/1.4	Reverse													
35mm f/2.8 PC	Reverse													
45mm f/2.8 GN	Normal													
	Reverse													
50mm f/ 2	Normal													
	Reverse													
50mm f/1.4	Reverse													
55mm f/1.2	Reverse													
55mm f/3.5 Micro	Normal													
	Reverse													
85mm f/1.8	Normal													
	Reverse													

- Notes:
- 1) Non-AI-Nikkor lens is used; with AI-Nikkor, the values may be slightly different.
 - 2) Magnifications are those obtained at the infinity setting.
 - 3) If more than one lens is included in each lens column, magnifications apply only to the first lens.

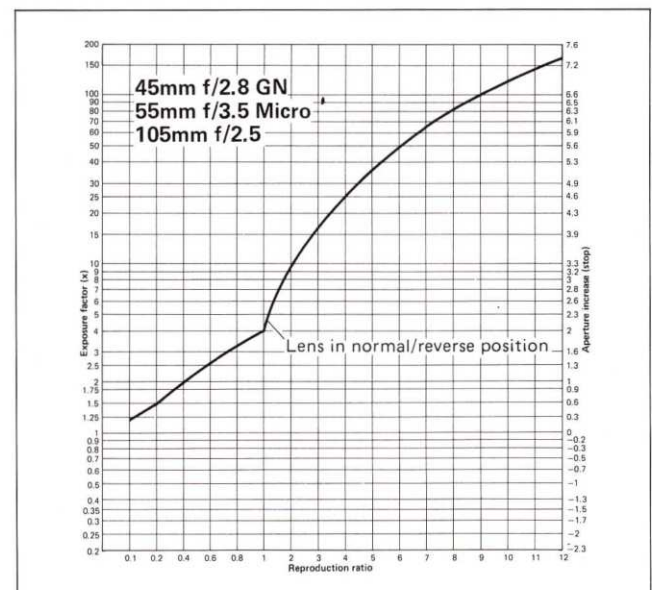
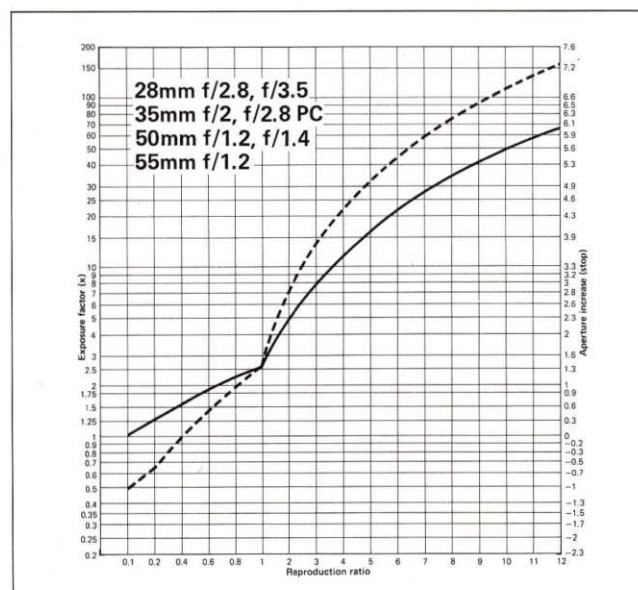
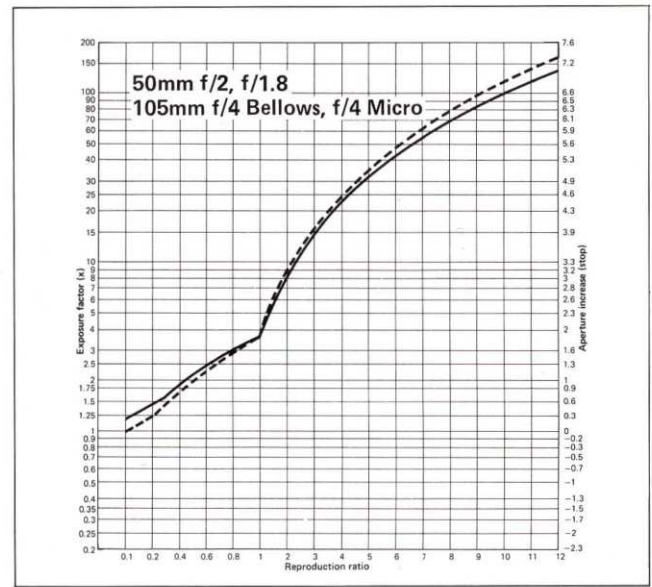
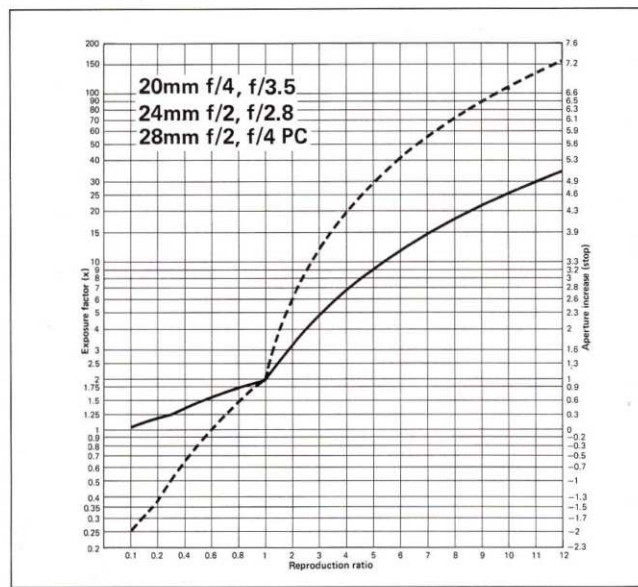
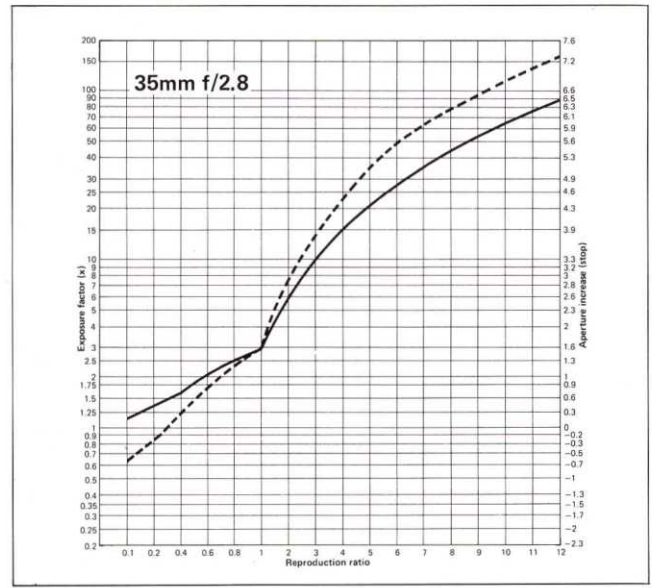
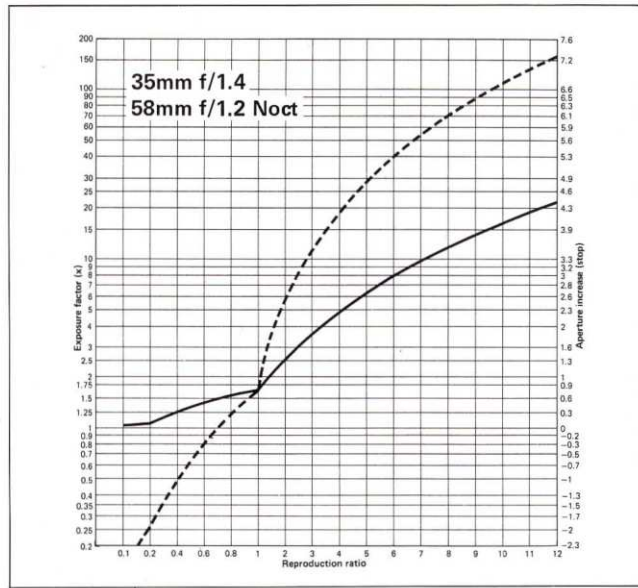
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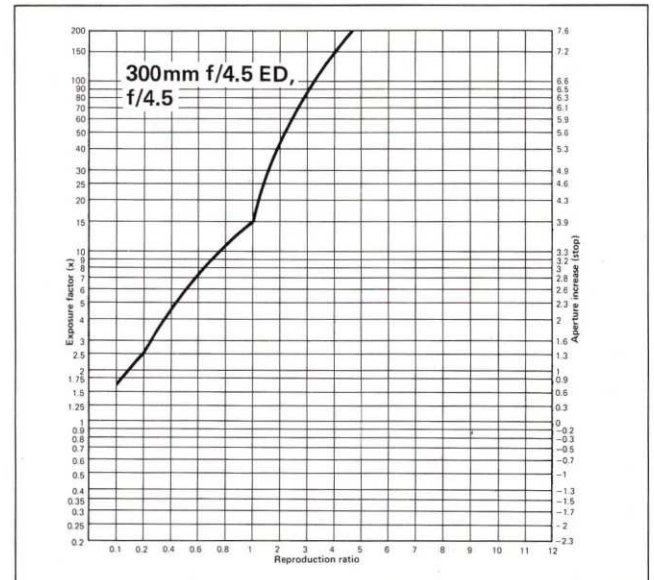
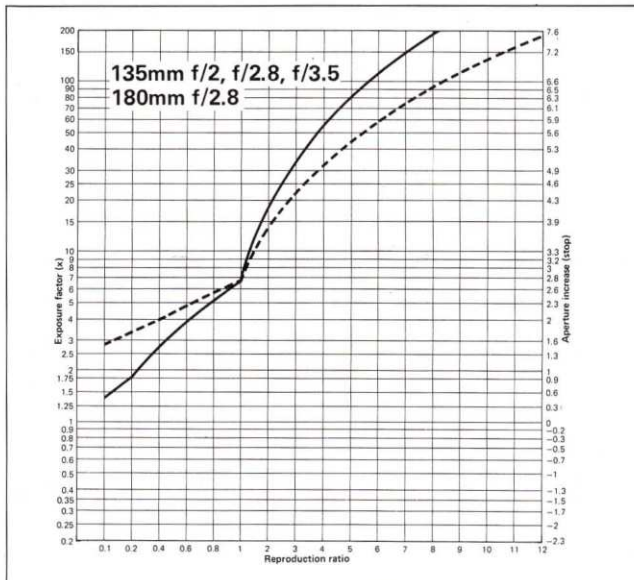
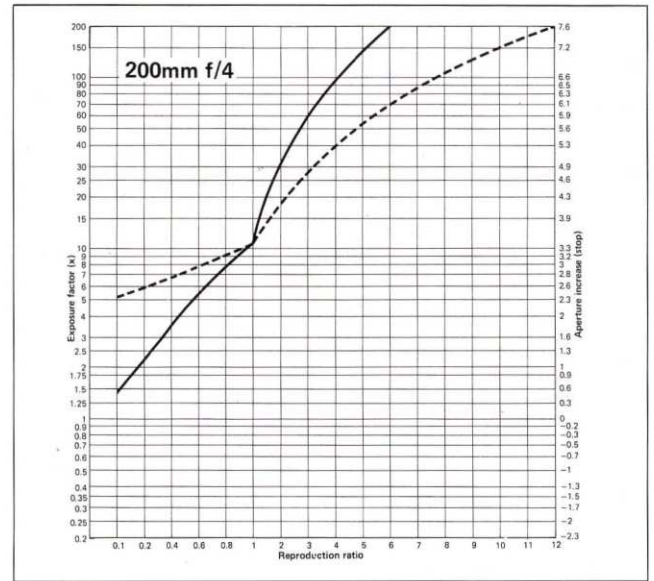
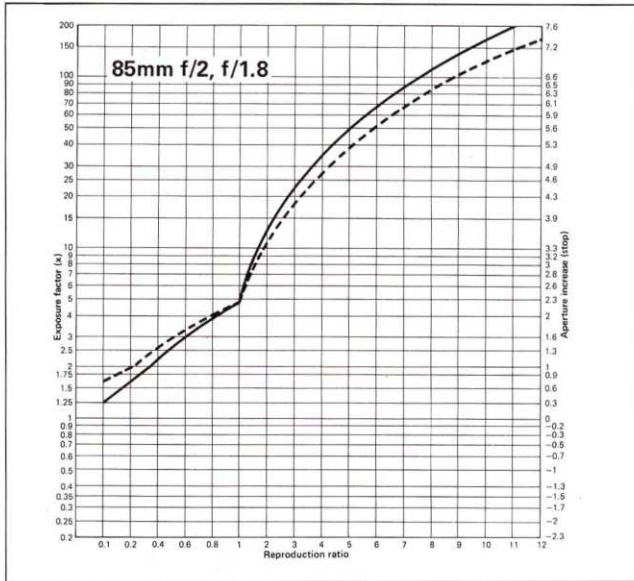
Lens	Reproduction Ratio Range											
	6 X	5 X	4 X	3 X	2 X	1 X	1/2 X	1/3 X	1/4 X	1/5 X	1/10 X	1/30 X
28mm f/ 2, f/2.8, f/3.5					0	0.2						
35mm f/1.4				0		1.3						
35mm f/2			0			1.7						
35mm f/2.8	0.2					2.0						
35mm f/2.8 PC	0.3					2.1						
45mm f/2.8 GN			3.8			6.9						
50mm f/1.4			0.9			4.7						
50mm f/2			2.5			6.2						
55mm f/1.2			1.2			5.4						
55mm f/3.5 Micro			1.7			6.0						
85mm f/1.8				9		19						
105mm f/2.5, f/4 Micro					12	28						
105mm f/4 Bellows					15							374
135mm f/2					23	49						
135mm f/2.8, f/3.5					22	47						
180mm f/2.8					32	78						
200mm f/4					55	111						
300mm f/4.5, f/4.5 ED						99					227	

- Notes:
- 1) Magnification ranges obtained with PB-4 bellows and BR-4 ring with the lens mounted in normal position; when the BR-4 is attached to a lens mounted in reverse, the magnification remains the same as that given by the PB-4 bellows alone.
 - 2) Non-AI-Nikkor lens is used; with AI-Nikkor, the values may be slightly different.
 - 3) The figures at the ends of the lines denote the free-working distance in cm (i.e. the distance between subject and front edge of the lens barrel).
 - 4) If more than one lens is included in each lens column, magnifications apply only to the first lens.

TABLES—cont'd

Exposure Factor Graphs





— Lens in normal position
 --- Lens in reverse position

CODE NUMBERS

• Description	• Code No.	• Item
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Close-Up Attachment Lenses

• No. 0 Close-Up Attachment Lens C	100-01-316
• No. 1 Close-Up Attachment Lens C	100-01-317
• No. 2 Close-Up Attachment Lens C	100-01-318
• CP-3 Plastic Case for No. 0 Close-Up Lens	100-01-308
• CP-4 Plastic Case for No. 1 or 2 Close-Up Lenses	100-10-309

Micro-Nikkor Lenses

• 55mm f/3.5 Micro-Nikkor Lens Al.	108-03-150
• PK-13 Auto Extension Ring	100-07-312
• PK-3 Auto Extension Ring	100-07-302
• 105mm f/4 Micro-Nikkor Lens Al	108-03-152
• PN-11 Auto Extension Ring	108-03-610
• PN-1 Auto Extension Ring	108-03-600

Medical-Nikkor Lens

• 200mm f/5.6 C Medical-Nikkor Auto Lens	108-03-132
• AC Power Unit for 200 f/5.6 Medical	108-03-605
58 • DC Power Unit for 200 f/5.6 Medical	108-03-606
• Leatherette Compartment Case for 200 f/5.6 Medical and AC or DC Unit	108-03-306
• Leatherette Case for DC Unit of 200 f/5.6 Medical	109-05-066
• Accessory Shoe Safety Cover	109-05-039
• 2.5V Light Bulb	109-05-040
• 1.5m Power Source Cord	109-05-056
• 1/2X Auxiliary Lens	109-05-057
• 1/4X Auxiliary Lens	109-05-058
• 1/6X Auxiliary Lens	109-05-059
• 1/8X Auxiliary Lens	109-05-060
• 1X Auxiliary Lens	109-05-061
• 2X Auxiliary Lens	109-05-062
• 38mm Screw-In Front Lens Cap for 200 f/5.6 Medical	109-05-063
• Sync Cord for 200 f/5.6 Medical	109-05-064
• 4m Power Source Cord	109-05-065

Extension Rings

• K Extension Ring Set W/Leather Case	100-01-322
• K1 Extension Ring	109-05-001
• K2 Extension Ring	109-05-002
• K3 Extension Ring	109-05-003

• Description	• Code No.	• Item
• K4 Extension Ring	109-05-004	
• K5 Extension Ring	109-05-005	
• Leather Case for K Extension Ring Set	100-01-324	
• PK-11 Auto Extension Ring	100-07-310	
• PK-12 Auto Extension Ring	100-07-311	
• PK-13 Auto Extension Ring	100-07-312	
• PK-1 Auto Extension Ring	100-07-300	
• PK-2 Auto Extension Ring	100-07-301	
• PK-3 Auto Extension Ring	100-07-302	
Bellows & Accessories		
• PB-6 Bellows Focusing Attachment	100-01-363	
• PS-6 Slide Copying Adapter	100-01-364	
• PB-6E Extension Bellows	100-01-365	
• PB-6M Macro Copy Stand	100-01-366	
• AR-4 Double-Cable Release	100-01-955	
• PB-4 Bellows Focusing Attachment	100-01-356	
• PS-4 Slide Copying Adapter	100-01-357	
• PS-5 Slide Copying Adapter	100-01-359	
• BR-2 Macro Adapter Ring	100-01-353	
• BR-3 Adapter Ring	100-01-354	
• BR-4 Auto Adapter Ring	100-01-360	
Repro-Copy Outfit		
• PF-3 Repro-Copy Outfit	100-01-407	
• PH-3 MD Holder	100-01-409	
• PC-3 Table Clamp	100-01-410	
• Gray Card for PF-3	109-05-231	
Ringlight Units		
• SR-2 Ringlight Unit	124-01-224	
• SM-2 Macro Ringlight Unit	124-01-225	
• AC Power Unit for 200 f/5.6 Medical	108-03-605	
• DC Power Unit for 200 f/5.6 Medical	108-03-606	
Photomicrographic Equipment		
• Micro Adapter Tube Model 2 with 33mm Filter and Eyepiece Adapter B	224-11-117	
• Leather Case for Microscope Adapter	228-13-400	
• C Type Focusing Screen	100-01-222	



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