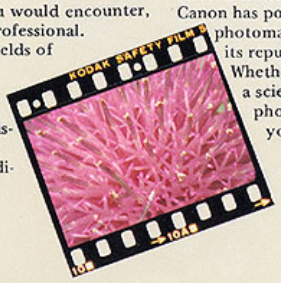
Canon's Close-up System: Closer Encounters with Your World

Canon

Many of you will never know what a complicated task it once was to do close-up photography. Not too long ago you had to be a good technician and a fair mathematician – and that was before the days of the hand-held calculator! Once you had your equipment all set up, you would pull out your separate exposure meter and then, after some sweaty moments of tricky calculations, you would correct the exposure reading according to the lengths of accessories inserted between the camera and lens. But, no, you still weren't on your way. You would still have to stop the lens down manually, and if that was the last of the problems you would encounter, you were either very lucky or a well-seasoned professional.

Only a few years ago that is exactly where the fields of close-up photography, photomacrography and photomicrography were – in the hands of the experienced professional. And so it was that a whole microscopic world of vivid colors, surrealistic images and microcosmic secrets was virtually closed to most ordinary and even many extraordinary photographers.



Obviously, this is no longer the case. Modern photographic technology has brought us the through-the-lens metering SLR, which includes all recent Canon models, making exposure correction with exposure factors a thing of the past. All you have to do is stop down and meter. And stopping down? With the right equipment, diaphragm coupling is automatic and you can meter at full aperture as usual. And with the Canon A-1 and AV-1 even stopped-down metering is automatic. These cameras will automatically select a shutter speed based on the aperture you have set.

Canon has poured all of its energy into producing a close-up/photomacrographic system worthy of its fine SLRs and of its reputation as a forerunner in photographic technology. Whether you are a commercial or industrial photographer, a scientist, doctor or dentist, or simply interested in new photographic effects, Canon has the equipment to give you excellent results with a minimum of frustration.

Canon Takes the Worry out of Pictures like This


Canon

The Why of a Close-up System

Why is a special system for close-up photography needed anyway? It makes sense that the closer the lens gets to the subject, the bigger the subject will be in the image. To a certain extent this is true except that you won't be able to focus and image quality probably won't be so good. There are both optical and mechanical reasons for this.

Normal lenses are designed for shooting subjects at relatively great shooting distances with relatively low magnifications. Actually, they are designed for no magnification at all — rather, a reduction of the subject, since in normal photography the subject is always recorded on film in less than life-size.

A normal lens is generally designed for the best aberration correction balance at a shooting distance about fifty times its focal length. The closer the shooting distance, the more this balance is thrown off and the worse the lens definition is. This tendency is especially marked in retro-focus wide-angle and large-diameter lenses but eventually takes its toll in any type of lens. Hence, the lens' minimum focusing distance is manufacturer-regulated to the closest distance at which you can expect good results. Unfortunately, in a normal lens this distance is never close enough for close-ups.

If you have ever watched a lens as it focuses on a close subject, you probably have noticed that it extends outwards. When it is focused on infinity, it is in its most retracted position. From this we can see that focusing on a close subject or obtaining higher magnifications hinges on extending the lens, and this is where we encounter some mechanical problems. Extending the lens will lengthen the focusing mechanism and adversely affect automatic diaphragm coupling to say nothing of increasing its weight — all to the detriment of good performance and easy maneuverability. This is a big problem with standard lenses much less telephoto lenses which are naturally large.

To overcome these lens limitations, manufacturers of cameras and photographic equipment produce special accessories for high-magnification photography.

Introduction to the Canon Close-up System

The Canon close-up/photomacrographic system is a large, up-to-date one characterized by easy-to-use, multifunctional equip-

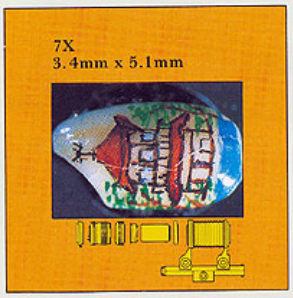
▼Visual Changes in Image Magnification of a Grain of Rice Giving Magnification, Field of View and Possible Combinations of Equipment

FD 50mm f/3.5 Macro

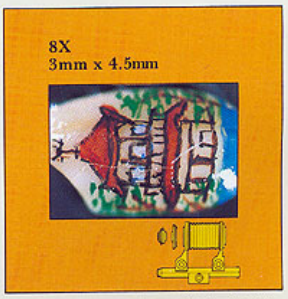
FD 50mm f/3.5 Macro + Extension Tube FD 25-U

FD 50mm f/1.4 + Bellows M

Macro Auto Ring + FD 50mm f/3.5 Macro (reversed) + Macrophoto Coupler FL 52 + Lens Mount Converter B + Screw-type Extension Tube + Lens Mount Converter A + Auto Bellows



Macro Auto Ring + FD 50mm f/3.5 Macro (reversed) + Macrophoto Coupler FL 52 + Lens Mount Converter B +Screw-type Extension Tube + Lens Mount Converter A + Auto Bellows



Macrophoto Lens 20mm f/3.5 with Adapter + Auto Bellows

ment. The Auto Bellows stands at the center of over thirty system accessories including a large copy stand, the Focusing Rail and Macro Stage, duplicators for 8 mm, 16 mm, 35 mm and 110 film, and the Double Cable Release for automatic diaphragm control.

Of and by itself, Canon's close-up system is a boon for high-magnification photography with any SLR camera. However, the characteristics of the camera itself also play an important part in the ease of shooting close-up pictures, and Canon has not neglected this aspect either. Canon has extended the meter coupling ranges of its SLRs to usually enable through-the-lens metering in even relatively dark situations such as those in photomacrography. The A-1 is outstanding in this respect. For the F-1 and the FTb, boosters are available. Depending on the camera and the equipment used, AE photography and automatic diaphragm are still possible.

With such characteristics, the Canon system is helping to change the image as well as the techniques of high-magnification photography. Exposure considerations and mechanical operations no longer consume the majority of the photographer's time. Now he can devote his energy to choice and framing of subject, lighting and special techniques which are the keys to a great picture.

The Realm of High-Magnification Photography

Typical subjects chosen to be photographed with higher magnifications include small plants and animals, small parts of machinery, small art objects and various parts of the human anatomy. Professionally speaking, this falls into industrial, scientific and commercial photography as well as copying of printed matter.

Magnification in photography refers to magnification of the subject on film. Needless to say, a great range of magnifications is involved. The various photographic categories are defined in terms of magnification as follows:

General Photography: This includes magnifications up to about 0.1X which are possible with a normally-mounted standard lens alone. Possible shooting distances are those within the range of the lens' distance scale.

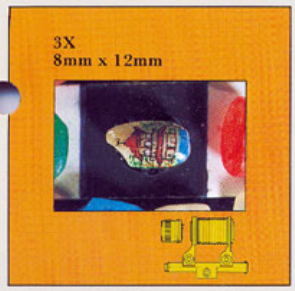
Close-up Photography: Includes magnifications of about 0.1X to 1X or life-size which are usually achieved with close-up lenses or extension tubes.

Photomacrography: Until recently, this category included magnifications from life-size to 10X. Now it is sometimes considered to include magnifications up to 20X. The term "macrophotography" is often used interchangeably with this term. The main accessory is the bellows.

Photomicrography: Shooting with a microscope objective instead of a camera lens for magnifications ranging from 10X to 2,000X.

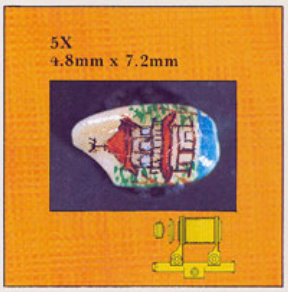
Copying: This type of photography is an exception in that it is defined in terms of subject rather than magnification due to the different photographic techniques needed. It includes the photography of any planar subject. Magnifications range from those in general photography to those in photomacrography.

As hinted at in these definitions, the choice of equipment depends on how much magnification you want and, hence, what kind of photography you are doing. Canon offers all the equipment you need to get the best results in any of these categories of photography.



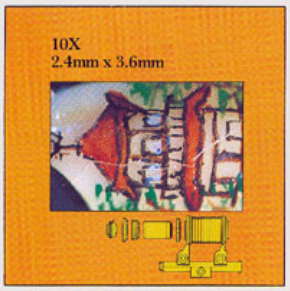
FD 50mm f/3.5 Macro + Auto Bellows

Macrophoto Lens 35mm f/2.8 with Adapter + Auto Bellows

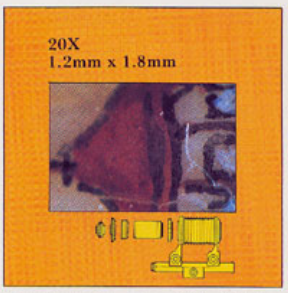


Macrophoto Lens 35mm f/2.8 with Adapter + Auto Bellows

acrophoto Lens 20mm f/3.5 with Adapter + Auto Bellows



Macrophoto Lens 35mm f/2.8 with Adapter + Lens Mount Converter B + Screw-type Extension Tube + Lens Mount Converter A + Auto Bellows



Macrophoto Lens 20mm f/3.5 with Adapter + Lens Mount Coverter B + Screw-type Extension Tube + Lens Mount Converter A + Auto Bellows

AV-1, FD 50mm f/1.4 with Extension Tube FD 50-U and flash, f/16, ASA 64, 1X

Extension Tubes

Canon offers three sets of extension tubes fo for close-up use.

Extension Tube M Set

This is a set of four chrome breech-mount extension tubes including one each of 5 mm and 10 mm lengths and two 20 mm tubes. They are compatible with all recent Canon SLRs and lenses, and require manual diaphragm control.

Life-size magnification can be attained with a standard 50 mm lens by attaching the 10 mm and both 20 mm tubes.

The lens extension can be varied every 5 mm from 5 to 55 mm using different combinations of the tubes.

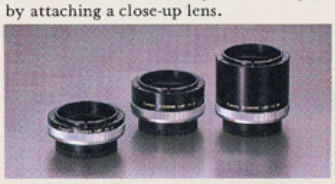
Vari-Extension Tubes

The Vari-Extension Tubes M15-25 and M30-55 each have a built-in helicoid which enables extensions up to 10 mm and 25 mm respectively. These tubes' special merit, therefore, is that an extensive and gradual range of image magnifications can be achieved. Magnifications can be further increased by attaching a close-up lens or other extension tubes to either of these tubes.

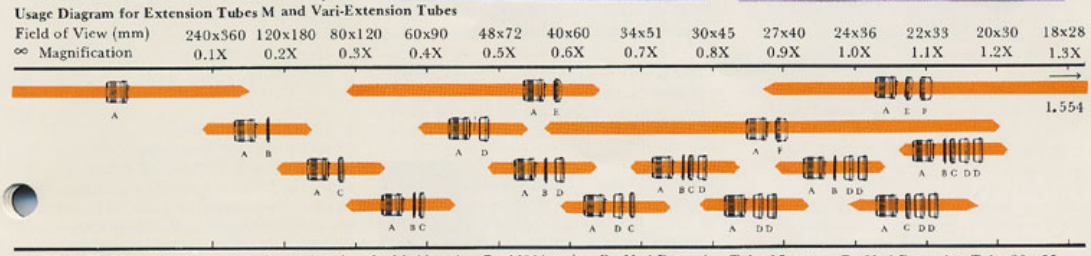
These tubes can be used with any fixed focal length FD lens having a focal length from 28 mm to 200 mm except for the FD 85 mm f/1.2 L and FD 85 mm f/1.2 S.S.C. ASPHERICAL lenses. Since these tubes have no coupling mechanisms, manual diaphragm control is necessary.

Extension Tubes FD-U

These three tubes, the FD 15-U, FD 25-U and the FD 50-U, have all the signals necessary for full-aperture metering, automatic diaphragm coupling and AE photography when mounted between an FD lens and a suitably-equipped Canon SLR. With the exception of 28 mm lenses, the extension tubes FD 25-U and FD 50-U can be used on those lenses mentioned above; the FD 15-U tube can be used on 28 mm lenses as well. Although these tubes, like the vari-extension tubes, cannot be combined, higher magnifications can be achieved with sharp results simply by attaching a close-up lens.



Usage Diagram for Extension Tubes M and Vari-Extension Tubes



A: FD & FL 50mm f/1.4 Lenses B: M5(mm) C: M10(mm) D: M20(mm) E: Vari-Extension Tube 15~25 F: Vari-Extension Tube 30~55

Canon Macro Lenses

The Canon FD 50 mm f/3.5, FD 100 mm f/4 and FD 200 mm f/4 Macro lenses are indispensable to those who have a serious interest in close-up work and copying. Alone, the 50 mm Macro focuses down to 23.2 cm from the film plane and the 100mm Macro to 45 cm, each at a magnification of 0.5X. With the appropriate FD Extension Tube, the magnification of each lens increases to 1X, or life-size, with their focusing range extending down to 20.5 cm and 40 cm respectively. The 200 mm Macro focuses down to 58 cm and provides life-size magnification without the need of an extension tube.

These lenses can be used in general photography at shooting distances to infinity. Because they are specially aberration-corrected to give excellent image quality at close shooting distances, they are ideal for close-ups and photomacrography and will also give top performance in copying. The standard Macro is the fastest and lightest of the three, and is especially recommended when reproducing slides using a bellows. The 100 mm and 200 mm, being telephoto as well as Macro lenses, provide a narrower angle of view and allow a greater working distance than does the 50 mm Macro. This is especially advantageous when you're trying to shoot a restless insect or when you need a little more light on the subject.

Since they permit normal, full-aperture metering, automatic diaphragm coupling, and AE photography on a Canon SLR so-equipped, they provide the best results in close-up photography while maintaining handling ease.

Zoom Lenses with Macro Mechanism

Two of Canon's short zooms, the FD 35 - 70 mm f/2.8 - 3.5 and the FD 28-50 mm f/3.5, are equipped with a special close-focusing feature for low close-up magnifications of three-dimensional subjects. Perfect for shots of insects and flowers, they are not intended for copying.

	Magnification	Field of View
FD 35mm–70mm f/2.8–3.5	0.07X–0.2X	343mmx515mm–120mmx180mm
FD 28mm–50mm f/3.5	0.06X–0.23X	382mmx572mm–105mmx155mm

Photomacrography

Even the Widely Despised Fly Can Be a Thing of Beauty

Shooting with magnifications less than life-size can be pretty much like general photography—especially if you are using close-up lenses. You have to keep an eye on depth of field and pay special attention to the shooting distance, but that is about it.

It's when the magnification increases to over life-size and you get into the field of photomacrography that unexpected problems arise. Not only will image quality worsen with decreased shooting distance and increased magnification, which is especially a problem with retrofocus wide-angle and large-diameter lenses, but, to get really high magnifications, you might find the lens actually bumping into the subject. Equipment is another problem. Of course, you could just go on adding extension tube after extension tube. To get 10X magnification that means only 500 mm of extra length between a standard lens and the camera body. That is, a mere 500 mm of unmanageable, unholdable, unbraceable length. Plus, with extension tubes, which do not have adjustable lengths, the magnification is restricted by the tube's length. Intermediate magnifications are impossible.

This is why photomacrography necessitates sophisticated equipment and also why results greatly depend on the photographer's knowledge of the equipment. An experienced photographer will know that reversing some lenses will improve image quality as well as permit higher magnifications and that a bellows allows greater extension with more stability while the extension is also continuous for intermediate magnifications.

In the Canon system, the Auto Bellows is therefore the center of all accessories for photomacrography. Most of the other accessories are used with it either for further improving image quality, increasing magnification still more, increasing the camera's stability or providing a suitable holder for the subject. When shooting with photomacrographic magnifications, Canon recommends the use of either its Macro lenses or the extra-high-magnification Macrophoto lenses.

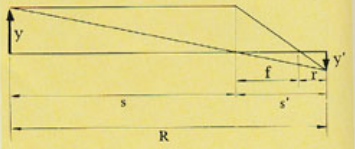
AE-1, Macrophoto Lens 20mm f/3.5 on Auto Bellows, with flash, 1/60 sec. at f/11, ASA 64, 6X

The Scientific Method

In photomacrography the lens' distance scale is useless. Pertinent questions arise such as: How do I know the shooting distance? What equipment do I need? The best way to go about it is first to decide how big and in what position you want your subject to be. From there photographers have figured out an easy, sure-fire method:

1. First figure out the magnification.
2. Choose appropriate equipment to get that magnification.
3. Set the shooting distance for the magnification.
4. Focus at full aperture.
5. Meter with the lens stopped-down.
6. Check depth of field and shoot.

From the following simplified diagram and equations you can find all the information you need to complete the first three steps above.



(1) $M = \frac{y'}{y} = \frac{s'}{s} = \frac{f}{s-f} = \frac{s'-f}{f}$

(2) $s' - f = r = fM$

(3) $R = \frac{(r+f)^2}{r}$

(4) $R = \frac{f(M+1)^2}{M}$

f = lens focal length
s = subject distance (lens to subject)
s′ = image distance
y = size of subject
y′ = size of image on film surface
M = magnification
R = shooting distance (film to subject)
r = lens extension

(1) Magnification
Let's suppose you want to shoot a flower that is 3 cm. in diameter so that it fills up the picture frame from top to bottom. Remembering that the picture frame is 24x36 mm, use the 24 mm vertical dimension in calculating the magnification. By equation (1) above, magnification becomes:

$$M = \frac{y'}{y} = \frac{24\text{ mm}}{30\text{ mm}} = 0.8X$$

(2) Equipment
Now that you know how much magnification you need, first decide what lens you will use, in this case a 50 mm lens, and use equation (2) above to decide how much lens extension you need:
$r = fM = 50 \times 0.8 = 40$ mm
As for equipment, two 20 mm M-tubes will do the job.

(3) Shooting Distance
Now using equation (4), you can calculate the shooting distance you need:

$$R = \frac{f(M+1)^2}{M} = \frac{50\ (0.8+1)^2}{0.8} = 202.5\text{ mm}$$

So, you can fill up your picture with this flower using a standard lens if you use 40 mm' worth of M tubes and a shooting distance of 202.5 mm.
Of course, you can also turn these equations around, so that if, for instance, you have your equipment, you can figure out how much magnification it will give. If you are using an FD 25-U tube (25 mm) with a 50 mm lens, by equation (2), the magnification possible is 0.5X.

These equations may be very helpful at times, but, if you prefer to avoid the math, you will find all of the information you need in Canon's close-up accessory instruction booklets.

Other Considerations

Knowing the scientific method, how to find the magnification and shooting distance, etc., is certainly a big step forward. It is not the last word in photomacrography. Before you can proceed with confidence you should know a few more peculiarities about shooting with photomacrographic magnifications.

Focusing and Positioning Camera

Focusing is of particular interest in photomacrography. The lens' distance scale is useless, and relationships are not what they are in general photography. In general photography the camera body follows the lens wherever it goes. Once you get into higher magnifications, focusing is a matter of moving the lens and camera body apart, and the amount of lens extension as well as the shooting distance must be accurate to obtain a specific magnification.

In photomacrography lens extension is usually set by lengthening the bellows. For this purpose, the bellows is equipped with a scale in both millimeters and various magnifications. All necessary data can be found in the bellows' instruction booklet. As far as shooting distance is concerned, it should be measured from the subject to the film plane indicator engraved on the camera body, and actually measuring with a ruler is not a bad idea.

In copying, other problems arise. With the destruction of aberration balance at close distances, it will become almost impossible to focus using the central split-image/microprism rangefinder. Focusing should be done using the matte area just surrounding the microprism ring. A small aperture will have to account for putting the central area and edges in perfect focus as well. With the F-1, which has readily interchangeable focusing screens, focusing screen C (all matte) is recommended. Remember that the Canon Macro lenses are designed especially for copying.

Exposure

In the past lots of space has been allotted to the subject of exposure in photomacrography. The fact is that when an accessory is inserted between the lens and the camera body, the amount of light reaching the film plane diminishes and the lens speed is likewise reduced. The effective aperture and the one set on the lens are no longer the same. You could find out the effective aperture with the following equation:

$$F = F_\infty (M+1)$$

where F = effective aperture
F_∞ = aperture set on lens
M = magnification

If, for instance, you had the lens aperture ring set to f/8 and were set up for a life-size magnification, the true aperture would be $F = 8(1+1) = f/16$.
This difference between set and effective apertures could play havoc with exposure in pre-through-the-lens metering days. Exposure obviously had to be a little more than what the meter said. The difference in exposure is called the exposure factor which is equal to $(M+1)^2$. Multiplying the shutter speed reading by the exposure factor would give the correct exposure.

Through-the-lens metering cameras have made exposure correction with exposure factors obsolete. Since the camera's through-the-lens meter measures the light after it has traversed the lens, the exposure reading is correct. Of course, if you are dealing with an old-model camera without a through-the-lens meter, if you are using a flash or if you are using a separate exposure meter for some other reason, you will have to know how to use exposure factors. Pertinent Canon instruction manuals give tables of exposure factors as a function of magnification. Since the effective aperture changes with magnification, exposure should be metered only after focusing. And, since the lens' coupling mechanisms are abrogated by intermediate accessories, stopped-down metering is necessary.

Depth of Field

The basic characteristics of depth of field are the same in photomacrography as in general photography. That is, the larger the aperture and the shorter the shooting distance, the shallower the depth of field. Obviously, depth of field poses a special problem in photomacrography where the shooting distance is very close indeed. Generally, a relatively small aperture is recommended for best results.

Lighting and Related Factors

With the lens moving ever closer to the subject as magnification increases, the lens-to-subject distance, better known as the working distance, gets ever shorter. Not only is less light reaching the film because of lens extension but the shorter working distance makes lighting difficult. If only for exposure reasons alone, some kind of artificial lighting or reflectors usually becomes necessary. The kind of lighting treatment you give your subject will depend, in part, on its shape and your intention. It will differ depending on whether the subject is flat or in low or high relief and also whether you want to emphasize its shape, its texture or separate it from its surroundings among other factors. A flash may become necessary for freezing the motion of a moving subject. In copying, the evenness of lighting is particularly important. Entire books have been devoted to the subject. Suffice it to say here that it is worth some careful study for the favorable effects it will have upon your results.
To help the situation along since small apertures are required for deeper depth of field, and especially when no flash or tripod is handy, the use of high speed film may be necessary. Even with high speed film and artificial lighting, however, correct exposure may still dictate slow shutter speeds to get that important small aperture. With color film, particularly color slide film, watch out for reciprocity failure at shutter speeds of 1 sec. or slower. Information concerning reciprocity failure and how to correct it can usually be obtained from the film manufacturer. With color film it results in underexposure as well as color shifts and may require increased exposure as well as corrective filtration.

At the Center—The Bellows

Canon offers three bellows units, the simple Bellows M, the ultra-sophisticated Auto Bellows and an intermediate model, the Bellows FL. Since the Auto Bellows is the most versatile of these units, it is considered the true center of Canon's photomacrographic system.

Auto Bellows

This relatively new bellows unit features a single double-dovetail rail for exceptional stability. Both its camera and lens panels can be moved for setting the magnification, and a built-in focusing rail moves the whole bellows assembly for super-precise focusing without upsetting the magnification and without the need for moving the tripod or copy stand arm. Once the magnification and focus are set, all movable parts can be locked with separate lock knobs.

The bellows track is provided with a magnification scale for the FD50mm Macro lens when either normally-mounted or reverse-mounted and a millimeter scale up to 175mm for the most convenience in setting bellows extension with other lenses. With a standard lens, magnifications from 0.7X to 3.4X are normally possible, more when the lens is reverse-mounted and still more if you use a special Canon Macrophoto lens.

A key to the whole system is the stopper with screw at the front of the bellows rail. The stopper can be removed and the screw used to attach the Macro Stage or Duplicator 35. It also allows reversal of the lens panel for easy lens reversal. In addition, this lens panel can be fitted with the Double Cable Release for automatic diaphragm coupling.

For a quick change from horizontal to vertical format, the camera can be rotated 90°. This is possible even with motor drive or power winder attached.

Besides the Macro Stage and Duplicator 35, other accessories which mount directly onto the bellows include the Canon Macrophoto lenses, these lenses with Duplicators 8 or 16 and the Microphoto Hood with Lens Mount Converter A. With such far-ranging capabilities and with the responsibility of supporting many accessories, you can be sure the Auto Bellows is built for lasting stability.

Magnification Table for Auto Bellows with Normally-mounted Lens Focused at Infinity (Data in Parentheses for Reverse-mounted Lens)

Lens	Magnification Range
FD 50mm f/3.5 Macro	0.75X–3.39X (1.35X–3.42X)
FD 50mm f/1.8	0.76X–3.34X (1.12X–3.58X)
FD 50mm f/1.4	0.76X–3.40X (1.41X–3.68X)
FD 50mm f/1.2	0.76X–0.88X
FD 85mm f/1.8	0.46X–2.08X
FD 100mm f/4 Macro	0.39X–1.74X
FD 100mm f/2.8	0.39X–1.75X
FD 135mm f/2.8	0.29X–1.30X
FD 135mm f/3.5	0.29X–1.30X

Bellows FL

This unique bellows has many of the features of the Auto Bellows. Like the Auto Bellows, both its lens and camera panels are movable, and it has a convenient built-in focusing rail. With its diaphragm charge lever, it is the only Canon extension device, besides the FD-U Extension Tubes, which maintains the automatic diaphragm control of a normally-mounted FD or FL lens even without the use of the Double Cable Release. Shooting is possible only in the horizontal format.

The Bellows FL has a slightly shorter extension range of 150mm which permits magnifications from 0.67X to 2.76X with a normally-mounted standard lens and up to about 4X when the lens is reverse-mounted. Lens reversal requires a macrophoto coupler. The Canon Slide Duplicator screws directly into the front of its rail, and a built-in strut steadies the bellows for blur-free images when it is attached to a copy stand.

Accessories for Increased Image Quality

For the best image quality in photomacrography Canon recommends the use of the FD 50mm Macro or the FD 100mm Macro lens or one of its Macrophoto lenses. Canon also offers accessories for reversing the lens. Reversing most lenses will improve lens performance at close shooting distances. An extra advantage in reversing the lens is that slightly higher magnifications become possible while the working distance is also slightly increased so that the lens won't have to bump into the subject to achieve them. Likewise you will later find that some accessories aimed at achieving higher magnifications will also improve image quality.

Although the lens is easily reversed on the Auto Bellows by turning the lens panel around, special accessories called "macrophoto couplers and macrophoto adapters" are necessary for reversing a lens directly on the camera body, on extension tubes or on Bellows Unit FL.

The Macrophoto Couplers FL and Macrophoto Adapters MA come in three diameters for mounting onto various lenses. They screw directly into the lens' filter thread and have a bayonet mount at the other end for attachment to other accessories with a bayonet-type mount such as Auto Bellows and either of the Vari-Extension Tubes.

Once the lens is mounted in reverse with a macrophoto coupler, the Macro Auto Ring can be mounted onto the rear of the lens and the Double Cable Release attached for automatic diaphragm control. Otherwise, the Macro Hood should be attached to unlock the diaphragm blades for manual diaphragm control.

Compact and simple to use, the Macrophoto Adapters are designed for use with such extension accessories as a vari-extension tube or a bellows unit. When used with a standard 50 mm lens and the Vari-Extension Tube M15-25, for instance, magnification slightly over life-size are possible.

A special feature of the FL Macrophoto Couplers is their built-in helical movement of 13mm for focusing. When the length of the coupler itself is added to its 13mm extension, magnifications of 1.3-1.5X are possible with the coupler alone between the camera body and a standard lens.

	Coupler Length	Helical Extension	Usable Lenses
FL52	20mm	13mm	FD 50mm f/1.4, FD 50mm f/1.8, other lenses with 52mm filter thread
FL55	20mm	13mm	FD 50mm f/1.4 S.S.C., FD 50mm f/1.8 S.C., other lenses with 55mm filter thread
FL58	20mm	13mm	FD 55mm f/1.2 S.S.C., FL 50mm f/1.4, other lenses with 58mm filter thread

Accessories for Automatic Diaphragm Control

In general photography diaphragm operation is totally automatic. If you have an FD lens on a full-aperture metering camera, exposure metering takes place at full aperture. Credit for this convenience, which is of special help in focusing and composing, goes to various signals at the rear of the lens and inside the camera body.

With the exceptions of the FD-U Extension Tubes and Bellows FL, this is not possible when accessories are inserted between the lens and camera body to obtain higher magnifications. This is because, in view of the possibility of a delay in diaphragm coupling which could lead to incorrect exposure, these accessories usually lack the necessary signals.

For this reason Canon has developed some special accessories for automatic diaphragm control with FD and FL lenses when shooting with high magnifications. These are the Double Cable Release and the Macro Auto Ring. If you do not use these accessories with the bellows, macrophoto couplers or extension tubes other than when the lens is mounted in the normal direction directly on the Bellows FL or FD-U Extension Tubes, diaphragm control is manual. This means that the lens aperture ring acts directly on the diaphragm. Setting most FD lenses without a chrome mount ring for manual diaphragm control requires a stopper-like accessory called a Manual Diaphragm Adapter.

F-1, Macrophoto Lens 35mm f/2.8 on Bellows FL, with flash, 1/60 sec. at f/22, ASA 64, 2.4X.

AE-1, Macrophoto Lens 35mm f/2.8 on Auto Bellows, with flash, 1/60 sec. at f/22, ASA 64, 3X

Double Cable Release and Macro Auto Ring

The Double Cable Release is a normal cable release save for the fact that it has two plungers. One of the plungers screws into the camera's cable release socket as usual. If you are using the Auto Bellows, the other plunger screws into the lens panel. If you are using an FD or FL lens with other accessories, such as extension tubes or macrophoto couplers, the Macro Auto Ring mounts onto the rear of the lens, and the other plunger of the cable release screws into a socket of the ring.

The Double Cable Release is a two-stroke release. At the first stroke, the lens stops down to the preset aperture for metering. At the second stroke, the shutter is released. To make stopped-down metering easier, the Double Cable Release can be locked at the first stroke which is also convenient for checking the depth of field.

The Macro Auto Ring itself has two convenient mounts: a bayonet mount for the lens and a mount for bayonet-mount accessories such as M Extension Tubes and Bellows M. Its 10 mm length will help to increase the magnification unless the lens is reverse-mounted.

Accessories for Increased Magnification

The bellows itself allows greater magnification. So does reversing the lens. Other than that, Canon offers the Macro lenses which are useful in both close-up photography and photomacrography and especially for copying purposes. And all of these accessories offer improved image quality as well as greater magnifications. The same is also true of the Canon Macrophoto Lenses.

Macrophoto Lenses

It's hard to believe that these tiny lenses of little over 20 mm in length can provide magnifications with a bellows of 2—10X. But with the Auto Bellows, for instance, Macrophoto Lens 20 mm f/3.5 will give magnifications of 3.93—10.72X and Macrophoto Lens 35 mm f/2.8, magnifications of 1.96—5.84X. Possible magnifications are only slightly less with the shorter Bellows Units FL and M.

Despite such high magnifications, the Macrophoto Lenses, like the Macro Lenses, are specially corrected for those aberrations which are usually prevalent in photomacrography. Coma, in particular, is minimized for the sharpest possible image. Other characteristics, too, make these lenses particularly suited to photomacrography. Their short focal lengths permit much higher magnifications than standard lenses with comparable amounts of lens extension while their compact, tapered design makes it easier to control lighting.

Both Macrophoto Lenses are provided with a minimum aperture of f/22 for maximum depth-of-field control. And, with its adapter, either Macrophoto Lens mounts onto the bellows just like any other lens.

Attachment to a bellows is necessary for focusing. Diaphragm control is manual. Considering their special features, these lenses are also especially suited to slide reproduction from movie films.

Extension Tubes

Another way to achieve higher magnifications in photomacrography is to insert

extension tubes between the bellows and the lens. M, Vari-Extension, and FD-U Extension Tubes are suitable for this purpose, although the coupling functions of the FD-U tubes will become useless.

Canon also produces a set of Screw-type Extension Tubes which are aimed at increasing magnification on a bellows. With lengths ranging from a mere 6 mm to 200 mm, these tubes are capable of a wide range of magnifications. Available are A, B and C extension rings of 6 mm, 9 mm and 12 mm lengths respectively and six extension tubes, 25mm, 50mm, 75mm, 100mm, 150mm and 200mm in length.

Since these tubes were originally designed to be used with screw-type rangefinder cameras, lens mount converters will be necessary for making connections with bayonet-mount bellows and lenses. Lens Mount Converter A, with a lens extension of 2.8 mm, is used for attaching a screw-mount accessory to a bayonet-mount accessory, and Lens Mount Converter B, with a lens extension of 13.2 mm, is designed to make the opposite connection.

Accessories for Holding the Subject

Some subjects have special requirements. Slides, for instance, must be held in a position parallel to the film. An even distribution of light is especially important. Some subjects are shown to better advantage if they receive diffused lighting from behind. To meet these difficult demands, Canon offers a Macro Stage and four duplicators.

Macro Stage

The Macro Stage is designed for use with the Auto Bellows where it screws into the front rail with the stopper screw. Thus mounted onto the bellows it can either be

used in an upright position or lying flat like a small copy stand.

Equipped with an opal diffusion plate and clips, the Macro Stage is particularly suited for shooting a transilluminated subject.

Macrophoto Lens	20mm f/3.5	35mm f/2.8
Magnification Range	4X – 10X	1.8X – 5X
Data with Auto Bellows Magnification Film-to-subject distance Front vertex-to-subject distance	 3.93X – 10.72X 123.5mm – 256.3mm 16.65mm – 19.9mm	 1.96X – 5.84X 149.1mm – 273.2mm 31.1mm – 43.0mm
For enlarging and duplicating movie films	Use Duplicator 8 for 8mm film	Use Duplicator 16 for 16mm film
Aperture Control	Manual, with lever	Manual, with lever
Aperture Scale	f/3.5 – f/22	f/2.8 – f/22
Macrophoto Lens Adapter	Optical length: 2.6mm	Optical length: 2.6mm
Dimensions	20mm (overall length) x 32mm (max. φ)	22.5mm (overall length) x 40mm (max. φ)
Weight	35g	60g

Transillumination is possible by placing the light source behind the opal diffusion plate when the Macro Stage is in its upright position and is most effective for bringing out details in a transparent/translucent subject, such as a shell, or for eliminating background shadows. You will also find it handy for reproducing a 6 x 4.5 cm or smaller format slide.

Usable Lenses	Magnification Range
Macrophoto Lens 20mm f/3.5	3.93 – 10.95X
Macrophoto Lens 35mm f/2.8	1.96 – 5.45X
FD 50mm f/3.5 Macro	0.75 – 2.69X

Opal Glass: 80mmΦ
Dimensions: 151.5 x 100 x 37mm
Weight: 300g

Duplicators

Canon offers five duplicators for duplicating or reproducing various film formats into 35mm slides. They are especially useful for making reproductions in volume, such as for educational or research purposes.

Duplicator 35 attaches to the front end of the Auto Bellows rail for the basic purpose of duplicating a 35 mm slide. Like the Macro Stage, it has a diffusion screen for providing even illumination to the subject, and, since slides are flat, the use of the FD 50 mm f/3.5 Macro lens is recommended. When this lens is reverse-mounted for higher magnifications, it is possible to produce a 35 mm slide from a 110 film frame. This duplicator features a special two-directional shift mechanism for cropping.

The Canon Slide Duplicator is designed for use with the Bellows FL for duplicating 35mm slides in either mounted or film strip form. Magnifications of 0.97X - 1.74X are possible with the 50mm Macro lens normally mounted.

A special Roll Film Stage can be attached to the front of Duplicator 35 or the Canon Slide Duplicator for reproducing slides in strip form. It ensures that the film is kept tautly in position while also making it much easier to manage.

For producing a 35 mm slide from movie film, Canon proposes Duplicators 8 and 16. Both are designed for use with a bellows and one of Canon's Macrophoto lenses. Duplicator 16 must be used with Macrophoto Lens 35 mm f/2.8 for 16 mm film and Duplicator 8 with Macrophoto Lens 20 mm f/3.5 for 8 mm film. Both duplicators have built-in Köhler optics to prevent overheating while providing the most even illumination. They mount onto the Macrophoto lenses with connecting tubes by means of which fine adjustments in focus can also be made.

The Duplicator G is designed specially for reproducing the film frame of a gastro camera for medical use. It, too, employs Köhler optics for superior image quality, and is used with the Macrophoto Lens 20mm f/3.5.

Duplicator 35:

Maximum Subject Size: 24 x 36mm
Photographic Magnification: FD 50mm f/3.5 Macro normally mounted: 0.8X – 1.4X, reverse-mounted with Attachment Ring 52: 1.4X – 3.1X
Trimming Mechanism: Vertical – 8mm, Horizontal – 12mm
Diffusion Plate: Opal glass; removable; use of gelatin filter possible.
Dimensions: 142x72x(48.5–150)mm
Weight: 370g

Roll Film Stage:

Dimensions: 71x210x56.5mm
Weight: 90g

Duplicators 8 and 16:

	Duplicator 16	Duplicator 8
Max. Magnification	3.7X	6.6X
Bellows Scale	101.1mm	92.3mm
Field of View	7.21mmx9.65mm	4.01mmx5.46mm
Dimensions	40mmΦ(max.)x72mm (total length)	40mmΦ(max.)x56.2mm (total length)
Weight	100g	75g

Accessories for Stabilizing the Camera

When you have a camera loaded down with extension tubes, macrophoto couplers, bellows, etc., you are running a high risk of unavoidable camera shake. When your subject is highly magnified, the least bit of movement will result in a really discouragingly blurred image. After going through all the trouble to set things up for photomacrography, that is the last thing you need. Canon answers this problem with various stands and holders for holding the camera steady to get the sharp images you worked so hard for. Almost mandatory in copying and photomicrography, these accessories are also helpful in photomacrography and even in general photography. Some of them also have a secondary function of holding the subject firmly in place.

Copy Stand 5

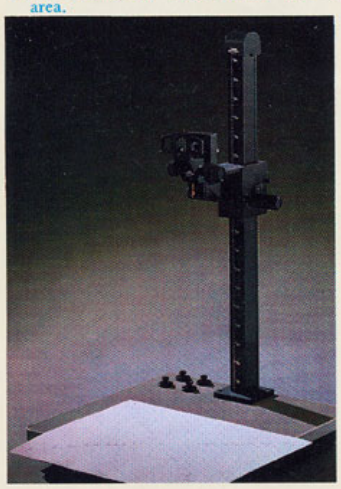
This new, super-stable copy stand has a number of special features making it exceptionally easy to handle. The extra-large, thick, 595 mm-square base will support

even the largest standard-format documents, and it is magnetized with magnets provided to hold the subject in place. Its large, square stanchion ensures stable camera support. Arm movement to change the camera position is facilitated by a convenient grip and a built-in balancer for unaccustomed smoothness. A sheet scale is provided to help in figuring magnifications. The Copy Stand 5 is one accessory that will come in handy for all types of photography.

Main Specifications

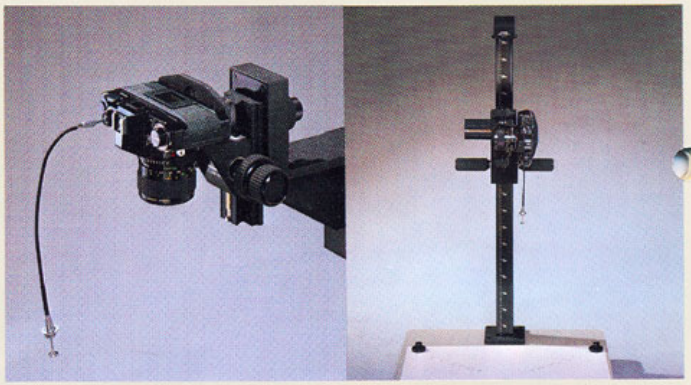
Base:
Real Dimensions: 595 x 595 x 33.5 mm
Effective Size: 475 x 595 mm
Magnification: 0.06X
Stanchion: Height: 900 mm
Scale: 5 mm graduations with numerical indication every 50 mm.
Arm: Movement controlled by double hand grip; built-in balancer.
Legs: Three rubberized, shock proof. Fourth is for height adjustment.
Dimensions: 595 x 595 x 1063.5 mm
Weight: 15 kg.

Note: Availability differs from area to area.



Copy Stand 4

This is Copy Stand 5's smaller ancestor, a basic, popular-type stand which is very handy for copying and for steadying the camera when extension tubes are attached for close-ups or a bellows for photomacrography. It consists simply of a base with stanchion and arm. With a maximum field of view of 280 mm x 420 mm, it is capable of copying a document as large as an A3 format (297 x 420mm).
Base: 450 x 420 mm
Effective Size: 280 x 420 mm
Magnification: 0.08X
Stanchion: 617 mm
Arm: Vertical displacement possible
Weight: 3.5 kg.



Focusing Rail

This camera holder attaches to the copy stand arm. However, no simple holder, it has an 85 mm travel activated by a knob for making fine adjustments in focus. When perfect focus calls for moving the camera only a fraction of a centimeter, you will really appreciate the continuous, smooth travel and accuracy of the focusing rail as compared to moving the copy stand arm itself. What's more, it accepts a camera equipped with power winder or motor drive for unusual convenience in large-quantity copying.

Since the Focusing Rail was developed simultaneously with Copy Stand 5, these two accessories go particularly hand in hand. Copy Stand 5's arm is equipped with a special groove for the Focusing Rail so that the camera can be positioned vertically as well as horizontally. In the vertical format, a document as large as 393 mm x 590 mm can be copied with the FD 50 mm f/3.5 Macro lens. While this special function is not possible when the Focusing Rail is used with Copy Stand 4, its focusing functions will be just as convenient. You will find it very useful for focusing and steadying the camera on a tripod as well.
Dimensions: 135 x 160 x 71.5 mm
Weight: 1,030 g.

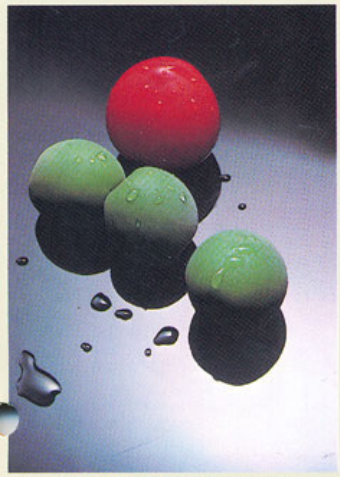
Camera Holder F3

Like the Focusing Rail, Camera Holder F3 has an adjustable screw for attachment to almost any Canon SLR. Unlike the Focusing Rail, it is a simple camera holder with no capabilities other than its main, indispensable purpose of holding the camera rock-steady on Copy Stand 4 or a tripod. Canon has endowed it with two tripod screw holes for photography in either a horizontal or a vertical format.
* This accessory is not designed for use with the Canon AV-1.

Handy Stand F

This is a lightweight desk-top stand which is particularly useful when you are copying standard format documents since its legs feature the necessary indications for making swift adjustments. It consists of four legs, a camera holder with adapter and Extension Tube M5 which can be disassembled for compact carrying. With a standard lens, you can make faithful copies of any subject ranging from the B6 format (128 x 199 mm) to the B4 format (257 x 397 mm).

F-1, FD 100mm f/4 Macro with Extension Tube FD 50-U and flash, 1/60 sec. at f/32, ASA 64, 1X



A-1, FD 100mm f/4 Macro, with flash, 1/60 sec. at f/22, ASA 25, 0.5 X

A-1, FD 50mm f/3.5 Macro, 1/125 sec. at f/4, ASA 64

Photomicrography

The World through a Microscope—for Scientist and Photographer Alike

Since photographic lenses and the bellows just aren't equipped to handle reproduction ratios of photomicrographic magnitude, the microscope becomes the standard piece of equipment. Because the microscope objective is used instead of the camera lens, accessories are needed to connect the camera to the microscope. In this line, Canon offers the Photomicro Unit F and the Microphoto Hood. A combination of this equipment will give both scientifically and aesthetically rewarding results.

Photomicro Unit F

This is a fixed-length tube for connecting the camera directly or with a bellows to a microscope with an outer sleeve diameter of 25 mm. Photomicrography is possible with or without the microscope's eyepiece.

Shooting Distance (from eyepiece's principal point to film plane): 108.4 mm without bellows.
Magnification: Approx. 0.5 x magnification of microscope.
Dimensions: 107.5 mm x 59 mm
Weight: 320 g.

Microphoto Hood

This hood can be extended up to 35 mm, and, to take advantage of this extra extension, must be used with a copy stand. When a bellows is attached between the camera and the hood, the shooting distance between film plane and eyepiece is adjustable from 115 mm to 260 mm permitting magnifications from 0.5X to 1X the magnifications possible with the microscope proper. Connection to the camera or bellows requires Mount Converter A.

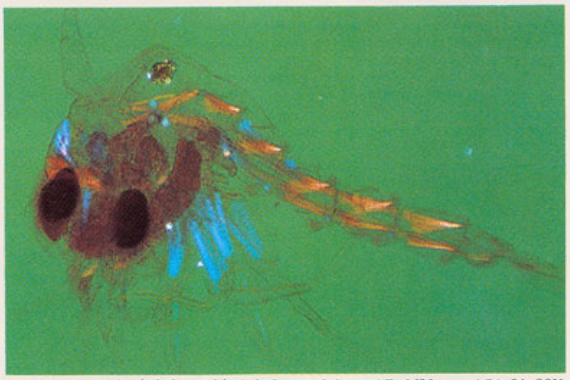
Total Camera Length: 115 mm – 260 mm, composed of camera (42 mm), Converter A (2.8 mm), Bellows FL (34.5 – 142.5mm), Hood (35 mm).

A Word on Other Equipment

Ordinary biological and metallurgical microscopes are suitable for photography. Although these microscopes are generally capable of magnifications up to 2000X, it is better to limit magnification to 1000X at the most for photographic reproduction.

Generally, microscope optics are not designed for photographic purposes. For best results, only eyepieces bearing a "P" mark should be used and the objective should be coded "PL" or "APO". You will find it much easier to photograph if the objective has a large numerical aperture, and, the results will be better if it has a magnification of 20X or under. The microscope and lenses should be of the same brand.

In photomicrography, from choice of equipment to technique, technical knowledge becomes important and it would be best to refer to a detailed technical manual.



Photomicrography (a baby crab), A-1, Stopped-down AE, 1/30 sec., ASA 64, 33X

Accessories
to Make Life Easier

In the lines that follow you will find accessories that will help to make the actual doing of close-up photography, photomacrography and photomicrography as much of a joy as seeing the results. After all, that's what it's all about.

Macrolite ML-1

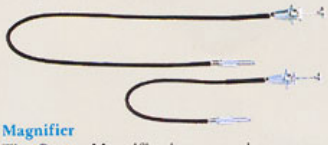
This two-headed flash is designed to provide the most appropriate distribution of light in close-up photography. It is made especially for the Canon FD 80-200mm f/4 lens and is also very useful with the FD 50mm f/3.5 Macro and FD 100mm f/4 Macro Lenses.
What does a non-macro zoom lens have to do with close-up photography? Combine the FD 80-200mm f/4 lens with the Macrolite and the new Close-up Lens 500T and watch it turn into a perfect solution for close-ups in the medical and dental fields. Its wide zoom range gives a wide range of close-up magnifications. And since the zoom range consists of long focal lengths, it's possible to keep a distance in delicate operations. It's also fast and easy to use. Special features of the Macrolite include a wide adapter for softening highlights, a swivel switch for rotating the flash around the optical axis and the possibility of cutting off light from either of the two flash heads. Up to three auto apertures are available.

Angle Finders A2 and B

These angle finders attach to the camera's eyepiece where they can be rotated for viewing from above or from the side. While Angle Finder A2 gives a correct image top-to-bottom but reversed left-to-right, Angle Finder B gives a completely correct image. Both are especially useful in that they show the entire field of view as well as viewfinder information. They are of special merit when shooting close-ups from a low position and for comfortable viewing when the camera is attached to a copy stand.

Canon Releases 30 and 50

These simple accessories are absolutely indispensable for preventing blurred images in any kind of high-magnification photography. These two cable releases, of 30 cm and 50 cm respective lengths, are offered in addition to the special Double Cable Release.

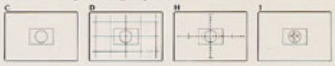


Magnifier

The Canon Magnifier is an eyepiece accessory which magnifies the center of the image 2.5X for precise focusing. It is particularly useful in copying or shooting close-ups where perfect focus is a must. Dioptric adjustment is possible, and the Magnifier swings upwards on an adapter for viewing the entire picture field once focusing is accomplished. Magnifier R is for cameras with a round eyepiece; Magnifier S, for cameras with a rectangular eyepiece.

Focusing Screens

Canon produces four focusing screens designed for convenient focusing in high-magnification photography with the Canon F-1. They are of a new L-type which is extra bright to make focusing all the easier. Focusing Screen C is an all-matte screen recommended for photomacrography. Focusing Screen D is similar to Screen C but with horizontal and vertical reference lines for copy work in which accurate composition is essential. Focusing Screen H has a fine matte center divided by horizontal and vertical scales in millimeters. It is recommended for close-ups, copy work and photomacrography where it is useful to know the size of the subject or the magnification involved. Focusing Screen I has a clear center containing a double cross-hair reticle for precise focusing in photomicrography and astrophotography.



Speed Finder

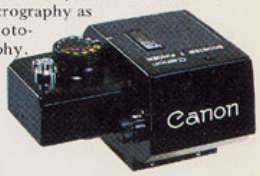
This is one of the F-1's interchangeable finders and can be used only for that camera. A souped-up angle finder, it has all the advantages of that accessory plus the extra special feature that the entire field of view and viewfinder information can be seen when the eye is a full 6 cm from the eyepiece. Not only does it allow viewing from a more comfortable position when using a copy stand or shooting from a low position, but it also helps to reduce eye fatigue during a big job.

Waist Level Finder

Another F-1 finder, the Waist Level Finder permits viewing from above at waist level while it also has a 5X magnifier to aid in focusing. With foldable hood.

Booster T Finder

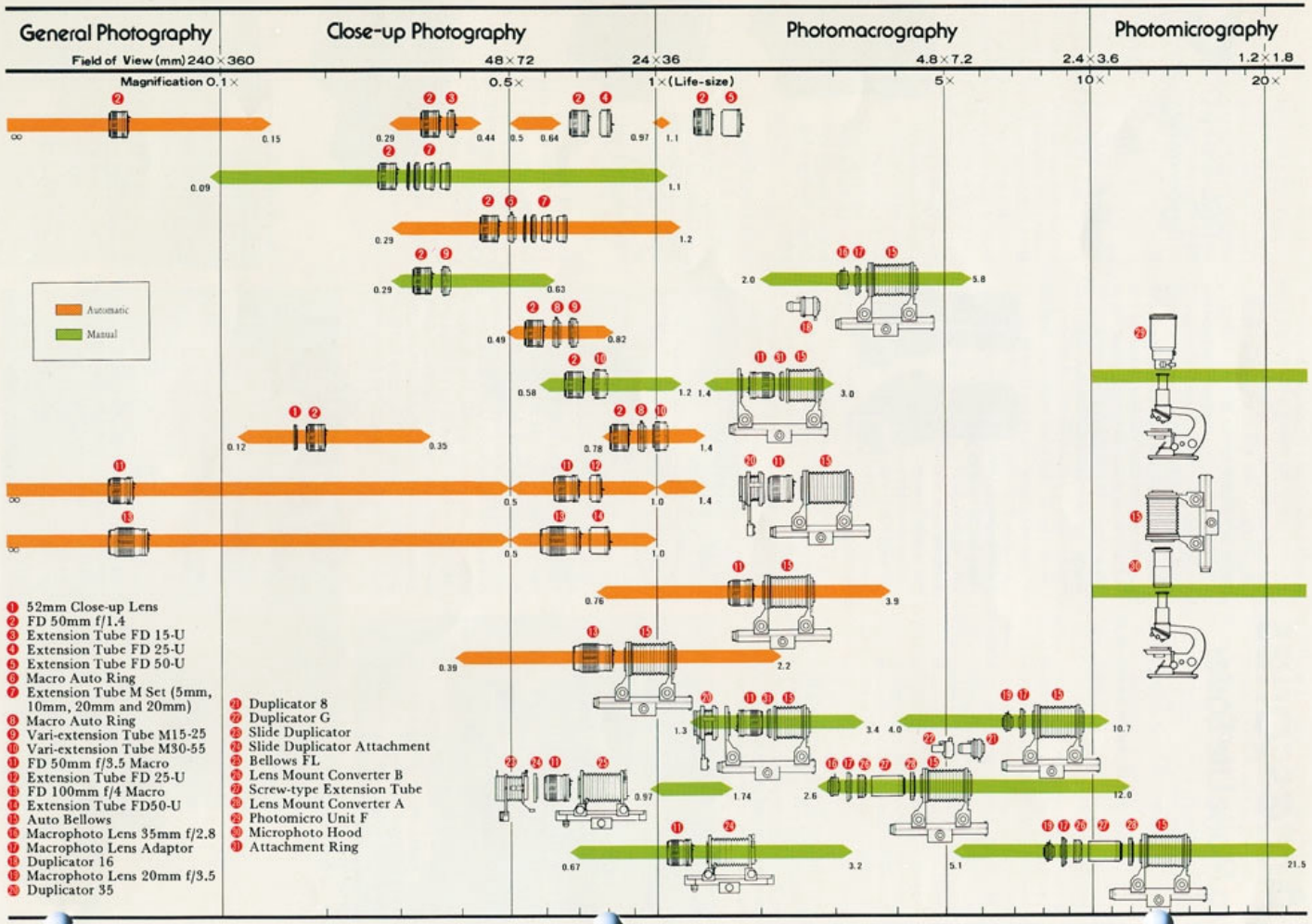
This is an interchangeable finder, designed for the F-1 only, which permits through-the-lens metering in conditions as dark as EV-3.5. Equipped with this finder, the F-1 becomes a very versatile camera in photomacrography as well as photomicrography.



Other Useful Accessories

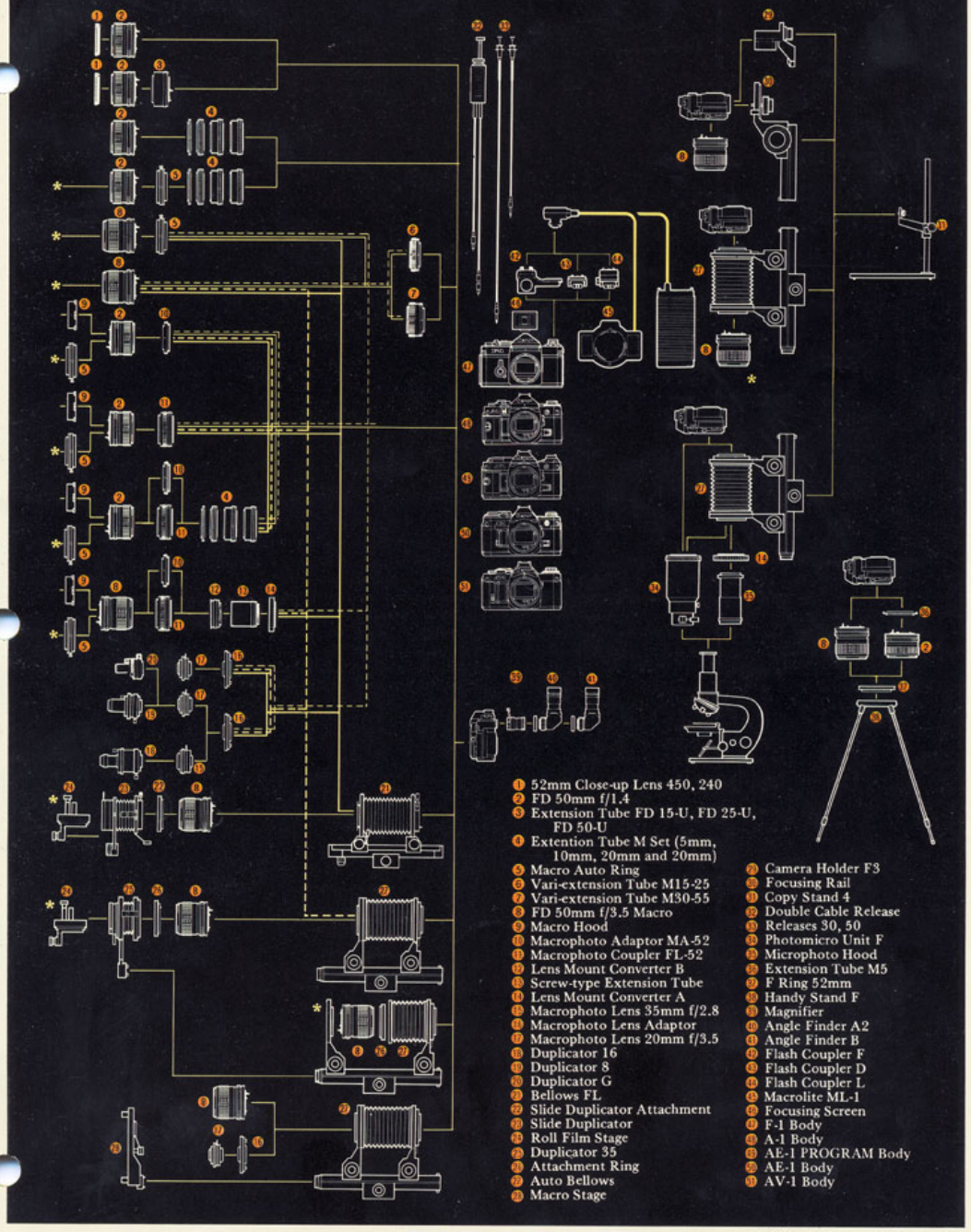
Application	Accessory	Usable Camera Body
Motorized Film Winding	Motor Drive MF	F-1
	Motor Drive MA	A-1, AE-1 PROGRAM
	Power Winder F	F-1
	Power Winder A	A-1, AE-1 PROGRAM, AE-1, AV-1
Remote Control with Motor Drive	Remote Switch 60 MF	F-1
	Wireless Controller LC-1	F-1, A-1, AE-1 PROGRAM
Unmanned Interval Shooting	Interval Timer L	F-1
	Time Lapse Programmer A-Unit, B-Unit	F-1, A-1, AE-1 PROGRAM
Data Imprinting	Data Back A	A-1, AE-1 PROGRAM, AE-1
	Data Back F	F-1

Some Examples of Lens/Accessory Combinations for Various Reproduction Ratios



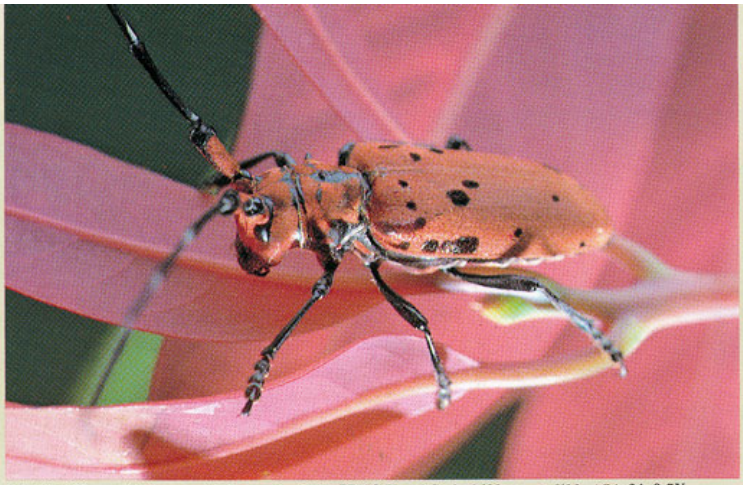
System Accessory Compatibility Chart

*This combination requires the use of the Double Cable Release for automatic diaphragm coupling.



1. 52mm Close-up Lens 450, 240
2. FD 50mm f/1.4
3. Extension Tube FD 15-U, FD 25-U, FD 50-U
4. Extention Tube M Set (5mm, 10mm, 20mm and 20mm)
5. Macro Auto Ring
6. Vari-extension Tube M15-25
7. Vari-extension Tube M30-55
8. FD 50mm f/3.5 Macro
9. Macro Hood
10. Macrophoto Adaptor MA-52
11. Macrophoto Coupler FL-52
12. Lens Mount Converter B
13. Screw-type Extension Tube
14. Lens Mount Converter A
15. Macrophoto Lens 35mm f/2.8
16. Macrophoto Lens Adaptor
17. Macrophoto Lens 20mm f/3.5
18. Duplicator 16
19. Duplicator 8
20. Duplicator G
21. Bellows FL
22. Slide Duplicator Attachment
23. Slide Duplicator
24. Roll Film Stage
25. Duplicator 35
26. Attachment Ring
27. Auto Bellows
28. Macro Stage
29. Camera Holder F3
30. Focusing Rail
31. Copy Stand 4
32. Double Cable Release
33. Releases 30, 50
34. Photomicro Unit F
35. Microphoto Hood
36. Extension Tube M5
37. F Ring 52mm
38. Handy Stand F
39. Magnifier
40. Angle Finder A2
41. Angle Finder B
42. Flash Coupler F
43. Flash Coupler D
44. Flash Coupler L
45. Macrolite ML-1
46. Focusing Screen
47. F-1 Body
48. A-1 Body
49. AE-1 PROGRAM Body
50. AE-1 Body
51. AV-1 Body

Subject to change without notice.



F-1, FD 100mm f/4 Macro with Extension Tube FD 50-U and flash, 1/60 sec. at f/11, ASA 64, 0.7X

Canon

CANON INC. 7-1, Nishi-Shinjuku 2-Chome, Shinjuku-ku, Tokyo 160, Japan
Mailing address: P.O. Box 5050, Dai-ichi Seimei Building, Tokyo 160, Japan

U.S.A.
CANON U.S.A., INC. HEADQUARTERS
One Canon Plaza, Lake Success, N.Y. 11042, U.S.A.
CANON U.S.A., INC. MANHATTAN SERVICE CENTER
600 Third Avenue, New York, N.Y. 10016, U.S.A.
CANON U.S.A., INC. ATLANTA BRANCH
6300 Peachtree Industrial Blvd., Norcross, Georgia 30071, U.S.A.
CANON U.S.A., INC. CHICAGO BRANCH
140 Industrial Drive, Elmhurst, Illinois 60126, U.S.A.
CANON U.S.A., INC. LOS ANGELES BRANCH
123 Paularino Avenue East, Costa Mesa, California 92626, U.S.A.
CANON U.S.A., INC. LOS ANGELES SERVICE CENTER
3321 Wilshire Blvd., Los Angeles, California 90010, U.S.A.
CANON U.S.A., INC. SAN FRANCISCO OFFICE
770 Market Street, San Francisco, California 94102, U.S.A.
CANON U.S.A., INC. HONOLULU OFFICE
Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814, U.S.A.

CANADA
CANON CANADA INC. HEADQUARTERS
3245 American Drive, Mississauga, Ontario L4V 1N4, Canada
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