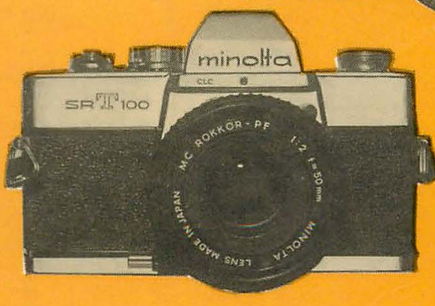
THE MINOLTA BOOK

XE-1 & SR-T

CLYDE REYNOLDS



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The Minolta SR-T Book

THE MINOLTA SR-T BOOK

for XE-1 and SR-T camera users

CLYDE REYNOLDS

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Contents

Where to look for . . .

The single-lens reflex

In a single-lens reflex camera, the single lens both focuses light onto the film and forms the viewfinder image. Except at the instant of taking the picture, light passing through the main lens is reflected by a mirror set at 45° to form an image on a ground glass screen above the mirror box. While the film is being exposed, the mirror moves out of place, resulting in complete blacking out of the viewfinder image. For viewing, the mirror is exactly mid way between the film plane and the viewfinder screen, so the image is exactly what will be recorded on the film when a picture is taken. It shows the area of subject covered (allowing a small margin for framing tolerances) whatever lens is fitted to the camera, and the exact focus (but is laterally reversed).

Eye-level viewing

On early single-lens reflex cameras this image was always viewed at waist (or chest) level, but most modern models allow eye-level viewing. This is achieved usually through a five-sided pentaprism—or roof prism—which also turns the image back the right way round. Some cameras allow the pentaprism to be exchanged for other types of viewfinder, but on most 35 mm reflexes, like the Minolta SR-T and XE-1 cameras, it is a permanent fixture.

The eyepieces is fitted with a magnifying lens so that the image on the screen appears at a comfortable distance from the eye, and nearly life size when the standard lens is fitted to the camera.

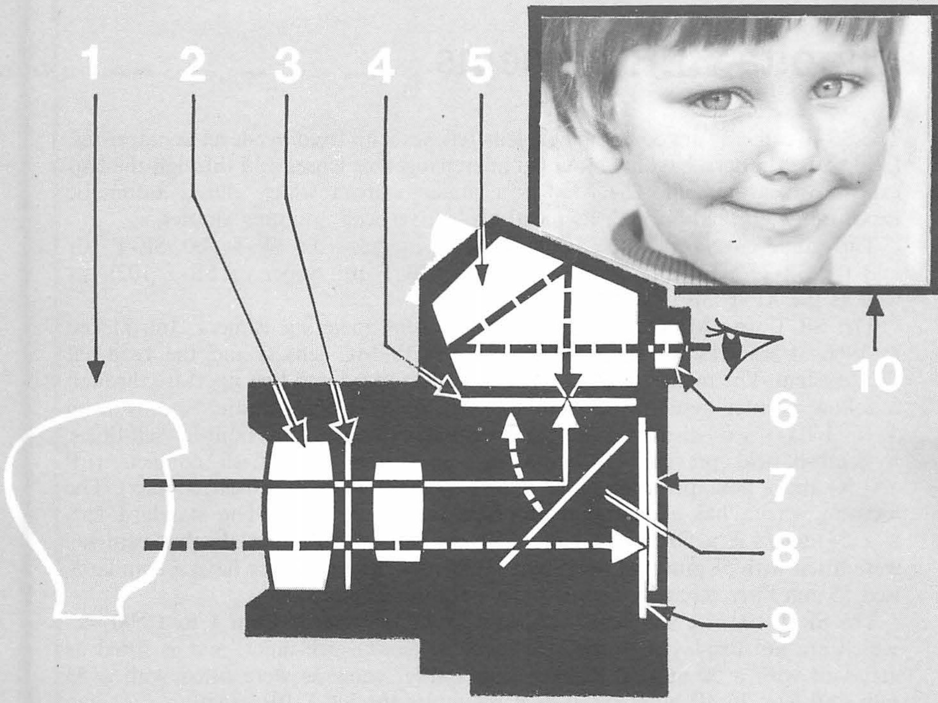
Single lens reflex features

TOP

1 Subject
2 Lens
3 Diaphragm
4 Viewing screen
5 Pentaprism
6 Eyepiece
7 Pressure plate
8 Mirror
9 Film
10 Image seen in viewfinder

BOTTOM

The film records just a little bit more than is seen in the viewfinder to allow for slide mounts or negative masks slightly smaller than the image area on the film.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35 mm
24 mm
36 mm

Minolta SLR cameras

The SR-T cameras are 35 mm single-lens reflexes with fixed eye-level pentaprisms, focal plane shutters, bayonet mounted interchangeable lenses and through-the-lens exposure measurement. The XE-1 is a similar camera which allows automatic exposure determination with its metal-bladed, vertically-running shutter.

This guide covers all three available SR-T models—the SR-T 100, SR-T 101 and the SR-T 303 (which is also called the SR-T 101 Super or SR-T 102)—as well as the XE-1 (also called XE-7 or XE).

The SR-T was Minolta's first through-the-lens metering camera. Introduced in 1966, it features full aperture metering (with MC lenses) and the twin-cell CLC system. The meter is coupled to the shutter speed and lens aperture through a follow pointer system visible in the viewfinder. It has shutter speeds from 1 to 1/1000 sec, displayed in the viewfinder. There is a built-in self-timer, a depth-of-field preview button, a pair of 3 mm (PC) flash contacts (FP and X) and a pentaprism-mounted accessory shoe (without a flash contact). The focusing screen has a central microprism rangefinder spot. The standard lens is a 58 mm *f* 1.2, a 50 mm *f* 1.4 or a 50 mm *f* 1.7 MC Rokkor. Earlier cameras were fitted with 58 mm *f* 1.4 or 55 mm *f* 1.7 lenses. Recent lenses have a standardised 55 mm filter screw, but some older ones use 52 mm filters.

The SR-T 100 is a simplified version with shutter speeds from 1 to 1/500 sec, which are not displayed in the viewfinder. It has no self-timer, and is fitted as standard with a 50 mm *f* 2 Rokkor lens. Earlier cameras were fitted with a 55 mm *f* 1.9 lens. In all other respects, it resembles the SR-T 101 exactly.

The SR-T 303 is basically the same as the SR-T 101, but has a few refinements: the pentaprism is modified so that the lens aperture (*f*-number) as well as shutter speed is displayed in the viewfinder; the accessory shoe is fitted with a flash contact, switchable between FP and X synchronization, as is the single 3 mm (PC) socket; the film rewind mechanism is modified to permit multiple exposures to be made at will; the focusing screen has a split-image and microprism rangefinder. The alternative names (SR-T 102, SR-T 101 Super) indicate the areas of the world in which individual models are sold. Apart from the name plates, the cameras are of identical specification. The name SR-T 303 is used throughout this book to indicate all three models.

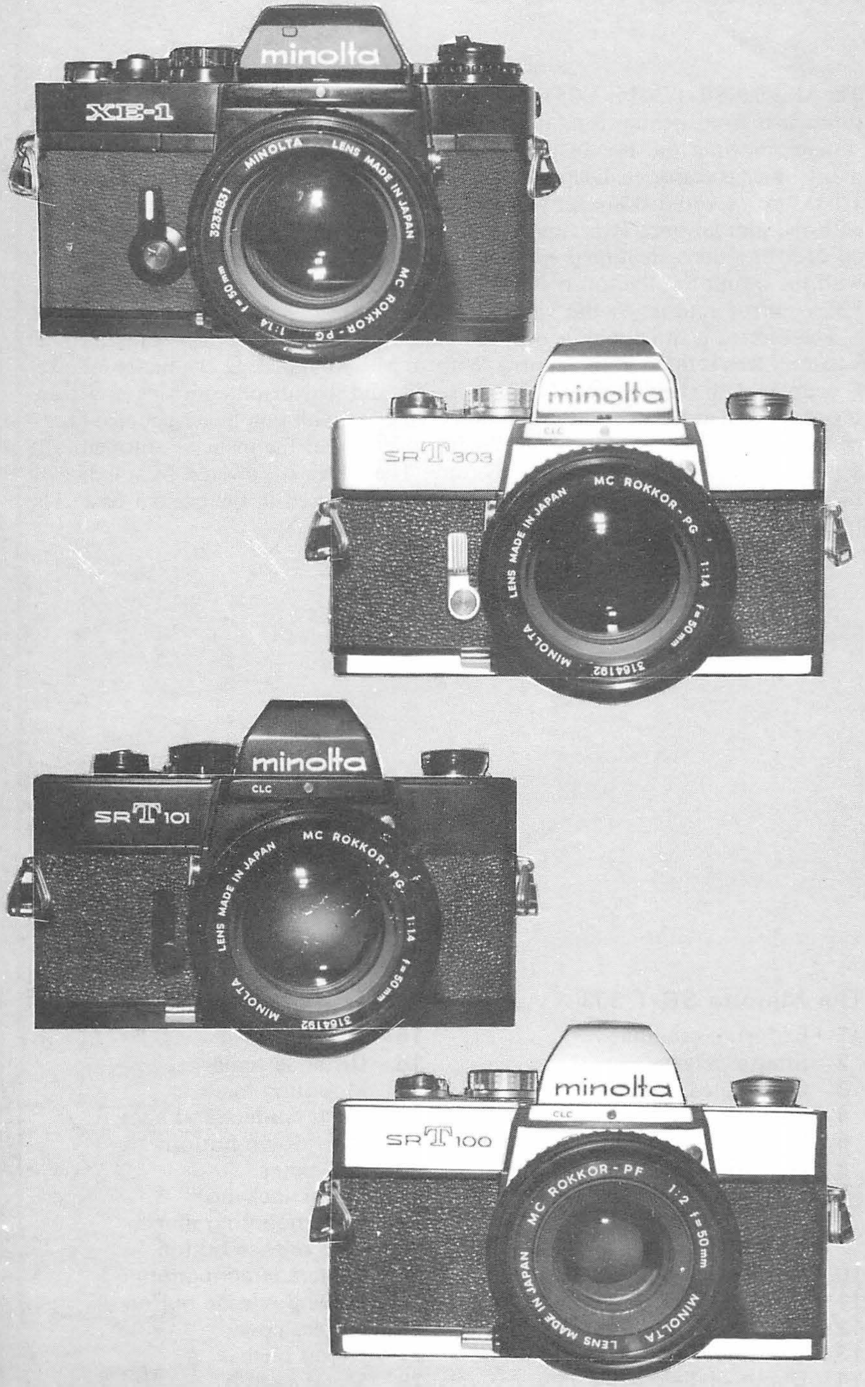
The XE-1 has a vertical-run shutter coupled directly to its exposure measuring system. When the camera is set to the automatic mode, shutter speeds from 4 sec to 1/1000 sec are determined to suit the film speed, lens aperture and subject brightness. The speed in use is indicated on a scale in the viewfinder. Alternatively shutter speeds may be set manually, when they are also indicated in the viewfinder. Otherwise it offers all the features of the SR-T 303. The alternative names XE and XE-7 again indicate sales areas.

Other Minolta SLRs

Minolta SR-T cameras were developed from the SR range, which had no through-the-lens exposure meters. The SR-M is a motor drive version without a meter. With the exception of these differences, their operation is similar to that of the SR-T range.

The Minolta XM (X-1 or XK) is a highly sophisticated electronically controlled camera developed from the SR-T range. It features interchangeable viewfinders, including one which gives fully automatic exposure control, and focusing screens.

Minolta XE-1 and SR-T cameras.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XE-1
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MC ROKKOR-PG 1:1.4 f=50mm
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SR T 303
MC ROKKOR-PG
LENS MADE IN JAPAN
1:1.4 f=50mm
MINOLTA 3164192
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SR T 101
MC ROKKOR-PG
LENS MADE IN JAPAN
1:1.4 f=50mm
MINOLTA 3164192
minolta
CLC
SR T 100
MC ROKKOR-PF 1:2 f=50mm
MINOLTA LENS MADE IN JAPAN

Minolta SR-T 303

The Minolta SR-T 303 is a 35 mm single-lens reflex camera with eye-level viewing through a fixed pentaprism. Its lenses interchange using the Minolta bayonet system, allowing the use of a vast variety of focal lengths, and the fitting of many other accessories. Diaphragm operation is automatic. Shutter speeds from 1/1000 to 1 sec and B are set with a dial on the top plate; the shutter is cocked with the film advance lever, and the double-exposure prevention mechanism can be overruled for intentional multiple exposures. The shutter is released either with the button on the top plate, or with the self-timer on the front panel. The reflex mirror returns to the viewing position immediately after each exposure.

The camera is fitted with a twin-cell CdS exposure meter which reads through whatever lens is fitted to the camera. With an MC Rokkor lens, the meter follower is coupled with the film speed, shutter speed, and lens diaphragm ring and readings are taken at full aperture. With other lenses or with non-meter-coupled accessories, the shutter and film speeds remain coupled, but the meter is automatically set to read at the picture-taking aperture. The meter is powered by a 1.35 volt mercury battery (Mallory PX-625 or equivalent) housed in the camera base. The meter switch is also on the base plate.

The Minolta SR-T 303

1 Exposure counter
2 Shutter release
3 Cable release socket
4 Film advance lever
5 Film plane indicator
6 Film speed setting
7 Eyepiece
8 Flash contact
9 Accessory shoe
10 Rewind knob and back release
11 Rewind crank
12 Shutter speed dial
13 Aperture setting ring
14 Depth-of-field scale
15 Focusing ring
16 Distance scale
17 Mounting mark
18 Flash contact and switch
19 Stop-down button
20 Self-timer
(21 Mirror lock-up)
22 Lens mounting mark
23 Lens release button
24 Camera strap mounting
25 Rewind release button
26 Battery cover
27 Tripod bush
28 Meter switch

1 2 3 4 5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24
minolta
CLC
SR T 303
MC ROKKOR-PG 1:1.4
LENS MADE IN JAPAN
f=50mm
MINOLTA
3164192
25 26 27 28
JAPAN
B.C.
OFF
ON

Minolta SR-T 101

The Minolta SR-T 101 is a 35 mm single-lens reflex camera with eye-level viewing through a fixed pentaprism. Its lenses interchange using the Minolta bayonet system, allowing the use of a vast variety of focal lengths and the fitting of many other accessories. Diaphragm operation is automatic. Shutter speeds from 1/1000 to 1 sec and B are set with a dial on the top plate; and the shutter is cocked using the film advance lever. The shutter is released either with the button on the top plate, or with the self-timer on the front panel. The reflex mirror returns to the viewing position immediately after each exposure.

The camera is fitted with a twin-cell CdS exposure meter which reads through whatever lens is fitted to the camera. With an MC Rokkor lens, the meter follower is coupled to the film speed, shutter speed and lens diaphragm ring; and readings are taken at full aperture. With other lenses, and non-meter-coupled accessories the film and shutter speeds remain coupled, but the meter is automatically set to read at the picture-taking aperture. The meter is powered by a 1.35 volt mercury battery (Mallory PX-625 or equivalent) housed in the camera base. The meter switch is also on the base plate.

The Minolta SR-T 101

1 Exposure counter
2 Shutter release
3 Cable release socket
4 Film advance lever
5 Film plane indicator
6 Film speed setting
7 Eyepiece
8 Accessory shoe
9 Shutter speed dial
10 Rewind knob and back release
11 Rewind crank
12 Mounting mark
13 Aperture scale
14 Depth-of-field scale
15 Focusing ring
16 Distance scale
17 Aperture setting ring
18 Flash contacts
19 Stop-down button
20 Self-timer
(**21** Mirror lock-up)
22 Lens mounting mark
23 Lens release button
24 Camera strap mounting
25 Rewind release button
26 Battery cover
27 Tripod bush
28 Meter switch


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MINOLTA CAMERA CO., LTD.
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minolta
CLC
SR T 101
MC ROKKOR-PG
LENS MADE IN JAPAN
1:1.4 f=50mm
MINOLTA
3164192
25 26 27 28
JAPAN
B.C.
OFF
ON

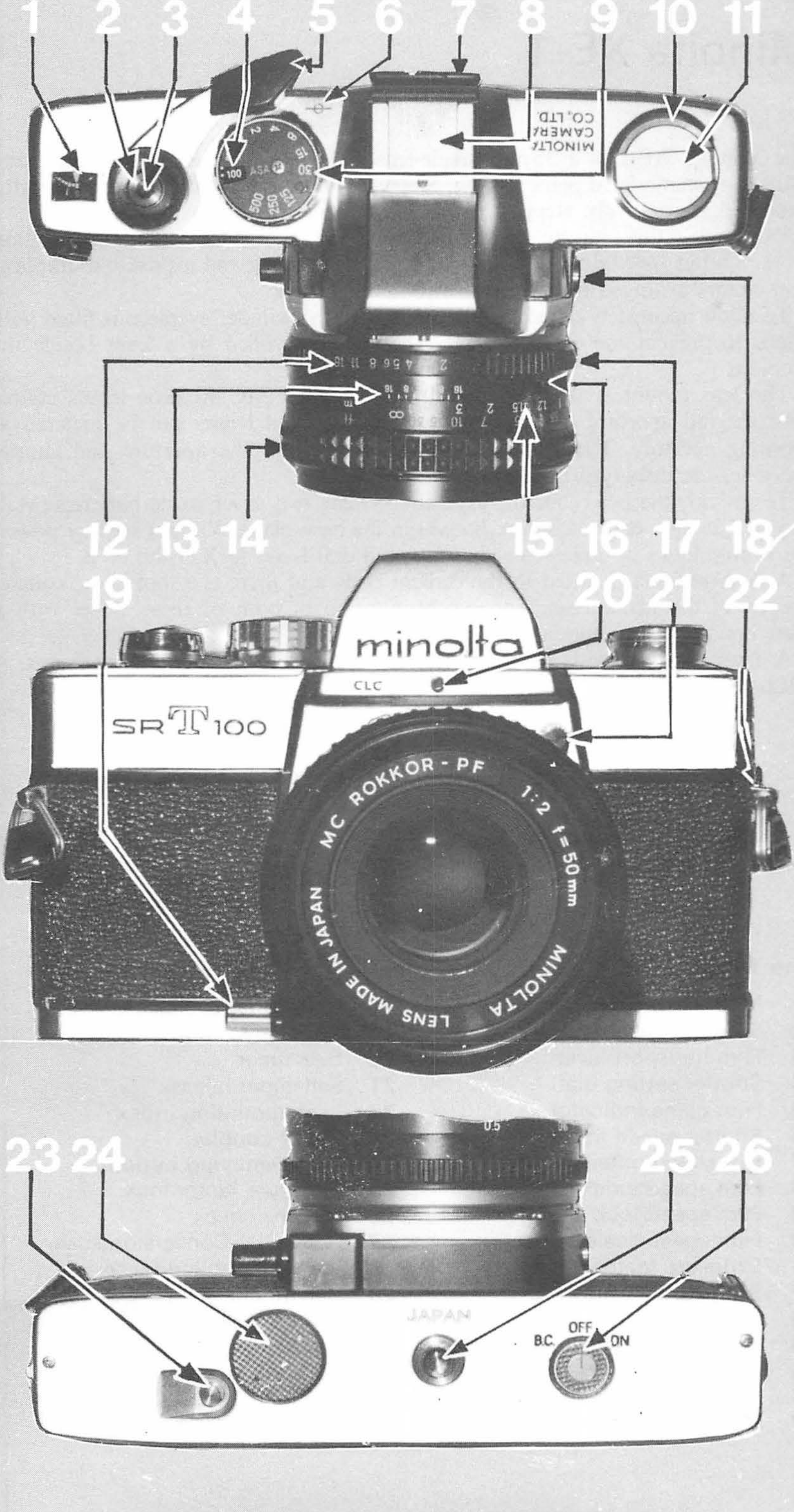
Minolta SR-T 100

The Minolta SR-T 100 is a 35 mm single-lens reflex camera with eye-level viewing through a fixed pentaprism. Its lenses interchange using the Minolta bayonet system, allowing the use of a vast variety of focal lengths and the fitting of many other accessories. Diaphragm operation is automatic. Shutter speeds from 1/500 to 1 sec and B are set with the dial on the top plate; and the shutter is cocked using the film advance lever. The shutter is released with the button on the top plate, and the reflex mirror returns to the viewing position immediately after each exposure.

The camera is fitted with a twin-cell CdS exposure meter which reads through whatever lens is fitted to the camera. With an MC Rokkor lens, the meter follower is coupled to the film speed, shutter speed and lens diaphragm ring; and readings are taken at full aperture. With other lenses, and non-meter-coupled accessories, the film and shutter speeds remain coupled, but the meter is automatically set to read at the picture-taking aperture. The meter is powered by a 1.35 volt mercury battery (Mallory PX-625 or equivalent) housed in the camera base. The meter switch is also on the base plate.

The Minolta SR-T 100

1 Exposure counter
2 Shutter release
3 Cable release socket
4 Film speed setting
5 Film advance lever
6 Film plane indicator
7 Accessory fitting grooves
8 Accessory shoe
9 Shutter speed dial
10 Rewind knob and back release
11 Rewind crank
12 Aperture scale
13 Depth-of-field scale
14 Focusing ring
15 Distance setting scale
16 Mounting mark
17 Aperture setting ring
18 Flash sockets
19 Stop-down button
20 Lens-mounting mark
21 Lens release button
22 Camera strap mounting
23 Rewind release button
24 Battery cover
25 Tripod bush
26 Meter switch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SR T 100
MC ROKKOR-PF 1:2 f=50mm
MINOLTA LENS MADE IN JAPAN
23 24 25 26
JAPAN
B.C. OFF ON

Minolta XE-1

The Minolta XE-1 is a 35 mm single-lens reflex with eye-level viewfinder and a fully automatic focal plane shutter. Stepless shutter speeds are set automatically, although, alternatively, stepped speeds may be selected manually.

Externally, this feature is characterised by the AUTO setting position on the shutter speed dial; and the film speed setting ring and exposure multiplication factors arranged round the film rewinding crank.

To allow accurately timed long exposures, the viewfinder eyepiece is fitted with blinds to prevent the entry of light. They are controlled by a lever beside the eyepiece.

The lens mount is the Minolta bayonet and all MC Rokkor lenses couple with the full aperture metering system—non-coupled lenses can be metered at shooting aperture. The metered exposure times, and the aperture and shutter speed set are displayed in the viewfinder.

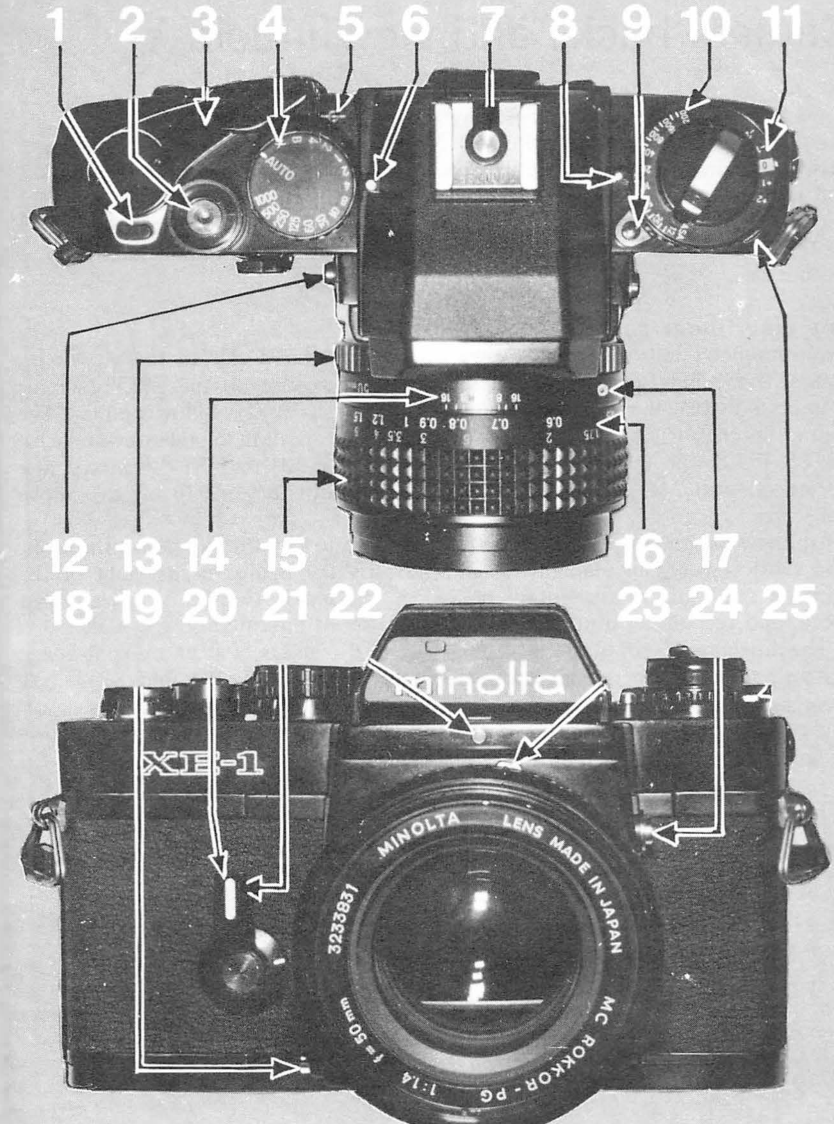
To provide the power for the exposure system, two silver oxide batteries (Mallory MS-76H or equivalent) are housed in the base plate. Without battery power, the mirror locks up unless the shutter speed dial is set to X (1/90) or B.

A flash terminal is fitted to the camera body and there is a 'hot shoe' contact on top of the pentaprism. The synchronisation of both of these is set with a lever beside the lens mount.

A lever co-axial with the film transport lever allows multiple exposures. A self-timer is fitted.

The Minolta XE-1 (XE-7, XE)

1 Multiple-exposure lever
2 Shutter release button
3 Film transport lever
4 Shutter setting dial
5 Film plane indicator
6 Shutter speed index
7 Hot shoe contact
8 Film speed index
9 Film speed lock
10 Film speed scale
11 Exposure factor scale
12 Stop-down button
13 Aperture setting ring
14 Depth of field scale
15 Focusing ring
16 Focusing scale
17 Lens mounting mark
18 Neck strap eyelet
19 Stop-down button
20 Selt-timer
21 Self-timer release
22 Lens mounting index
23 Meter coupler
24 Lens removing button
25 Exposure factor lock
26 Battery check
27 ASA/DIN Conversion scale
28 Viewfinder blind lever
29 Viewfinder
30 Auto exposure lock
31 Power switch
32 Safe-load indicator
33 Frame counter
34 Film reminder slot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AUTO
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18 19 20 21 22 23 24 25
minolta
XE-1
MINOLTA LENS MADE IN JAPAN
MC ROKKOR - PG 1:1.4 f=50mm
3233831
26 27 28 29 30 31 32 33 34
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Camera backs and viewfinders

Minolta SR-T and XE-1 cameras use 35 mm film either in film manufacturers' cassettes or in reloadable cassettes. The cassette is put in on the left-hand side, and the film runs across the focal plane shutter to the take-up mechanism on the right. Guide rails and film guides position the film, and a pressure plate on the camera back ensures accurate register. The picture is the standard 24 × 36 mm size.

The viewfinder screen

Exposure-meter information is shown on the right-hand side of the viewfinder screen. If the film speed has been set, correct exposure on the SR-T cameras is indicated when the meter needle crosses the circle on the follow pointer. The shutter speed set is shown on the scale along the bottom of the viewfinder of the SR-T 303 and the SR-T 101, and in the SR-T 303 and XE-1 the aperture setting of most MC Rokkor lenses is reflected from the lens to appear above the screen.

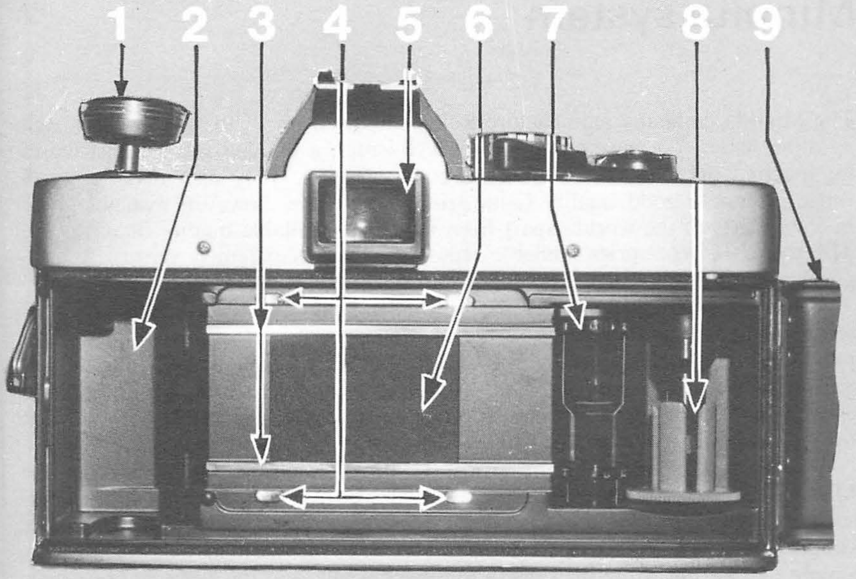
On the XE-1 the metered shutter speed is indicated by the needle on the scale. The shutter speed set manually is indicated by the figure to the right of the aperture read-out. In the automatic model, the letter A appears instead of a speed, and the shutter automatically gives the speed indicated on the scale.

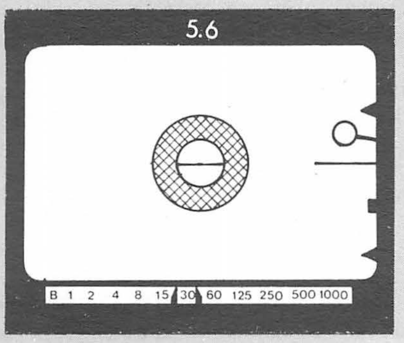
The rangefinder spot of the SR-T 303 and XE-1 consists of a central split-image system surrounded by a microprism collar. On the SR-T 101 and SR-T 100, it consists of a central microprism area surrounded by a plain ground-glass collar. The rest of the screen is ground glass with a fresnel condenser lens, which shows as faint concentric lines. It can be used for focusing.

Minolta camera backs and viewfinders

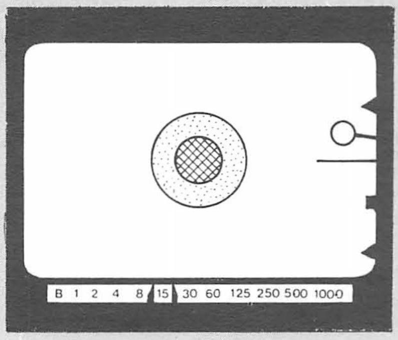
TOP
1 Rewind knob and back release
2 Film cassette chamber
3 Film guide rails
4 Film guides
5 Viewfinder eyepiece
6 Focal plane shutter
7 Film wind sprockets
8 Film take-up spool
9 Camera back

BOTTOM
Viewfinder screens

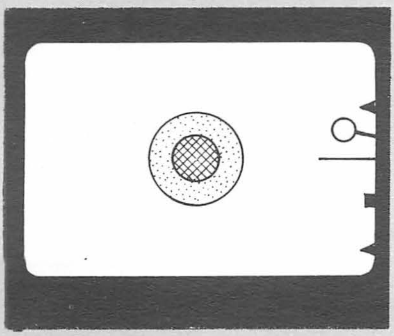




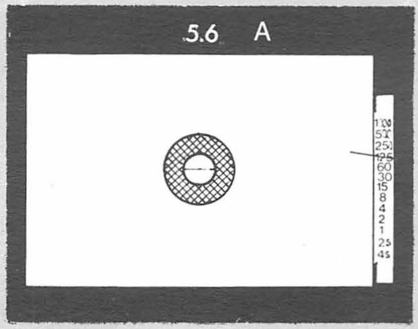
SR-T 303



SR-T 101



SR-T 100



XE-1

Minolta system

The Minolta company manufacture Rokkor lenses from 17 to 1600 mm, as well as zoom lenses, 7.5 mm and 16 mm fisheye lenses, a number of specialist lenses for macro work, and a variable field curvature lens. They also make a small range of simple good quality Celtic lenses. These are, however, available only in some parts of the world. Apart from lenses and suitable quality filters to use with them, the accessories available make the Minoltas extremely versatile photographic instruments.

A number of accessories alter the viewfinder image: the clip-on focusing telescope, which can be hinged out of the way, allows critical focusing of the central part; the right-angle finder, which can be swivelled through 360°, allows you to see in awkward situations, such as low level or microscope work; and the eyepiece correction lenses, in nine dioptre strengths from −4 to +3 can be fitted for spectacle wearers who don't like wearing them for photography.

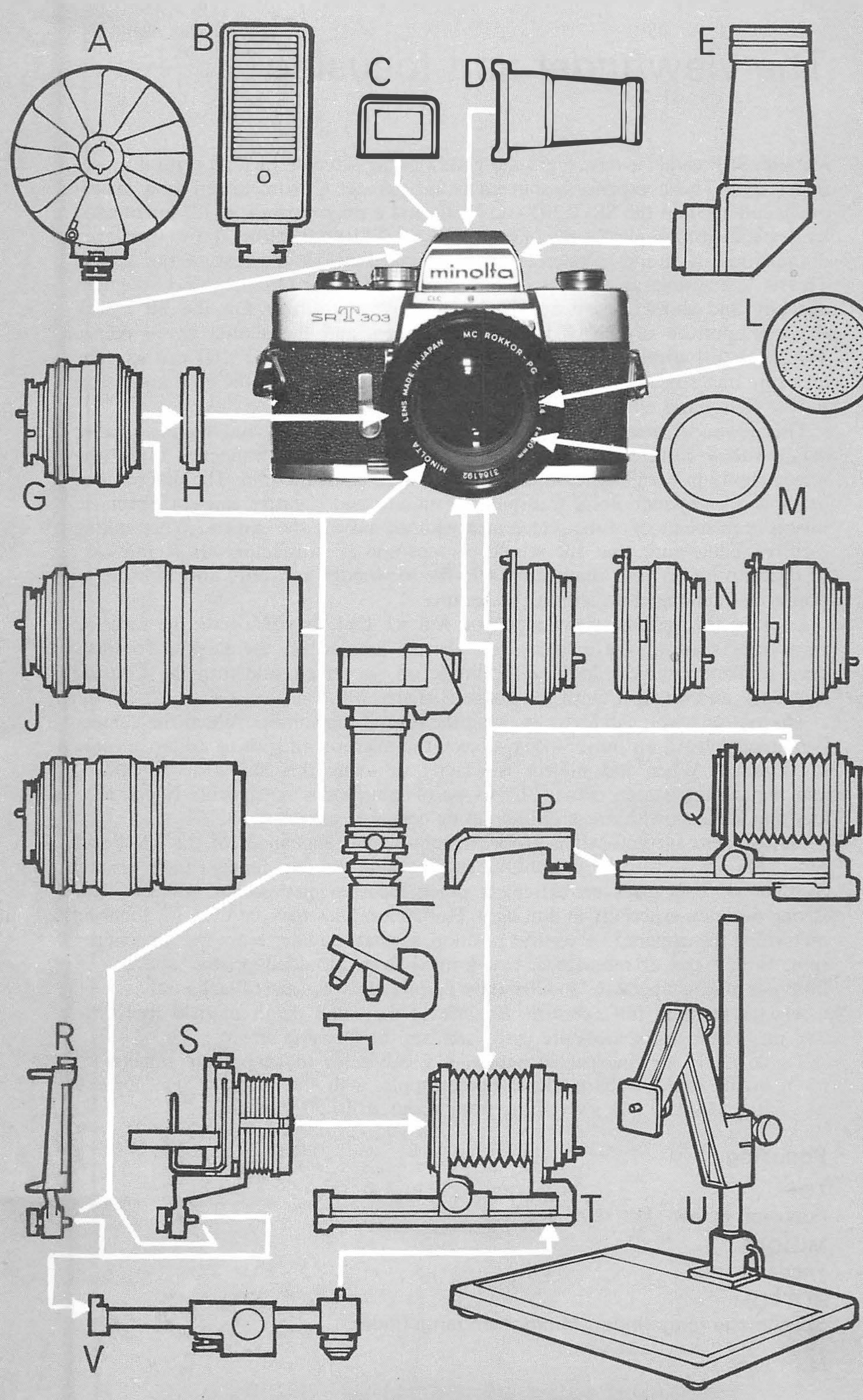
A major field of photography involves getting extra close to the subject. The Minolta range of equipment is especially wide because of the manufacturer's association with Leitz of Wetzlar. It includes: close-up lenses; automatic meter coupled and manual extension tubes; automatic and manual bellows units; a simple adapter for fitting the camera to a microscope, and the Leitz micro-attachment for more sophisticated microscopy; and macro lenses of 12.5, 25, 50 and 100 mm focal lengths. The MC Auto coupled tubes are particularly useful as they allow normal full aperture metering and automatic diaphragm operation. The Auto-bellows is a sturdy unit, which gives fully automatic diaphragm operation without needing to be charged, or used with a double cable release, making it particularly suitable for use with the 100 mm f4 Auto Bellows Rokkor lens. The manual extension tubes and bellows are simpler and lighter than their automatic counterparts, and are photographically their equal, but not so convenient to use. Either bellows may be fitted with a slide copier or the macro stand for supporting small specimens.

For more general copying, the Copy Stand II provides a firm support for vertical photography. Its versatile mounting arms accommodate a variety of camera heights. Designed especially for the Auto Bellows Unit III, the focusing rail makes camera movement easy, either on the Copy Stand or on other supports. For the scientist, there is the Photomicroscope Unit II which can be fitted to virtually any microscope to provide simple and accurate photomicrography.

For flash photography, Minolta equipment includes a simple folding battery-capacitor flash for use with all the common types of bulb; a number of small electronic units, several of which have built-in sensors; and a high powered rechargeable professional style automatic unit with a remote sensor unit.

Minolta system accessories

- **A** Bulb flash
- **B** Electronic flash
- **C** Eyesight corrections
- **D** Focusing magnifier
- **E** Angle finder
- **G** Macro lenses
- **H** Reverse adapter
- **J** Interchangeable lenses
- **L** Filters
- **M** Close-up lenses
- **N** Extension tubes
- **O** Microscope adapter
- **P** Bellows connector
- **Q** Bellows unit III
- **R** Macro stand
- **S** Slide copier
- **T** Auto Bellows
- **U** Copy stand
- **V** Focusing rail


A
B
C
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minolta
SR-T 303
MC ROKKOR-PG
LENS MADE IN JAPAN
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The viewfinder and focusing

Minolta SLR cameras have a ground-glass viewing screen (1) with a central rangefinder spot. This comprises a split image rangefinder (2) surrounded by a microprism collar (3) on the SR-T 303 and XE-1, and a microprism spot (2) surrounded by a plain ground-glass collar (3) on the SR-T 100 and 101. To ensure even illumination, a fresnel condenser lens is formed below the rest of the screen. This is just visible as a series of fine concentric rings. On the XE-1, the lens aperture and shutter speed are displayed above the screen. On the SR-T 303, the lens aperture is displayed above the screen, and the shutter speed below. The SR-T 101 displays only the shutter speed, and the SR-T 100 neither. The exposure meter needle, and its follow pointer (with a ring on the end) are visible on the right-hand edge, as is the battery check mark.

The viewfinder image is about life-size with a 58 mm lens, and slightly smaller (84%) with a 50mm lens. Whatever lens (from the whole range) is fitted, the screen shows just slightly less than will be recorded on the film. The difference is to allow a safety margin for transparency mounts and negative carriers. Spectacle wearers can see most of the screen area without moving the camera. When taking pictures, make sure that the whole composition is satisfactory. It is too easy to concentrate on your main subject in the viewfinder and only after processing notice distractions elsewhere in the picture.

Looking through the viewfinder, you will see that, as you rotate the focusing ring, objects at varying distances are sharply focused on the screen. To focus on a particular subject, look at the image on the screen, and turn the focusing ring back and forward, until the image is sharp.

Alternatively, you can focus by using the central rangefinder. When the camera is pointed toward an out-of-focus subject, the microprism spot or collar appears to shimmer. When the subject is exactly in focus this shimmer disappears, and the subject is seen clearly. This type of rangefinder is particularly good for focusing subjects with areas of alternating contrast, such as trees.

Out-of-focus subjects which cross the split-image rangefinder of the XE-1 and SR-T 303 are seen to be discontinuous. Focusing the lens renders them exactly continuous. This gives an extremely quick focusing method for subjects with strong outlines, especially in dull light. Horizontal lines may be used for focusing by turning the camera to a vertical position, so that the lines cross the rangefinder split. Both types of rangefinder are formed from moulded prisms, and are of little use at lens apertures smaller than *f*4 or *f*5.6, when part blacks out.

Always focus at full aperture. Because of the small depth of field (see page 28), small changes of focus are easily seen on the focusing screen.

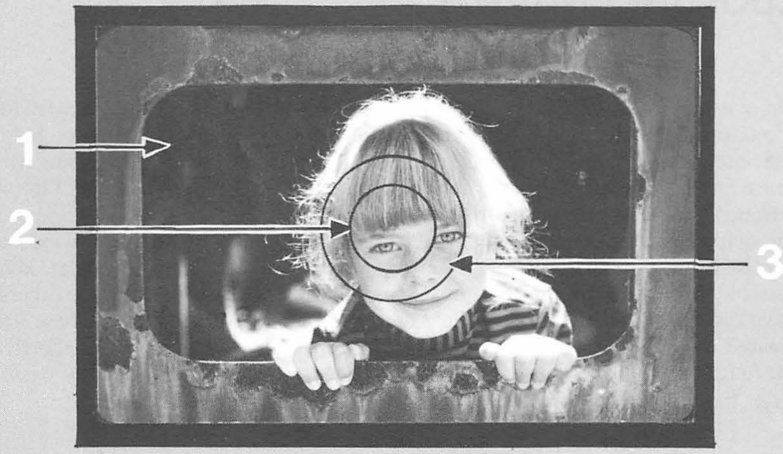
To be ready for unexpected action, it is advisable to keep your camera set for a useful zone of sharp focus. For example, with the standard lens focused at 15 ft. and set to *f* 11, everything from about 10 to 30 ft. is sharp.

Focusing

TOP
Focusing screen. For keys, see text.

MIDDLE
Focusing ring.

BOTTOM
Split-image rangefinder. Microprism rangefinder.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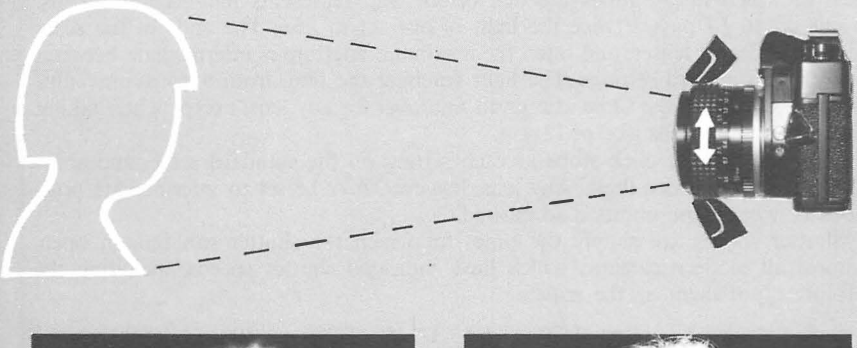
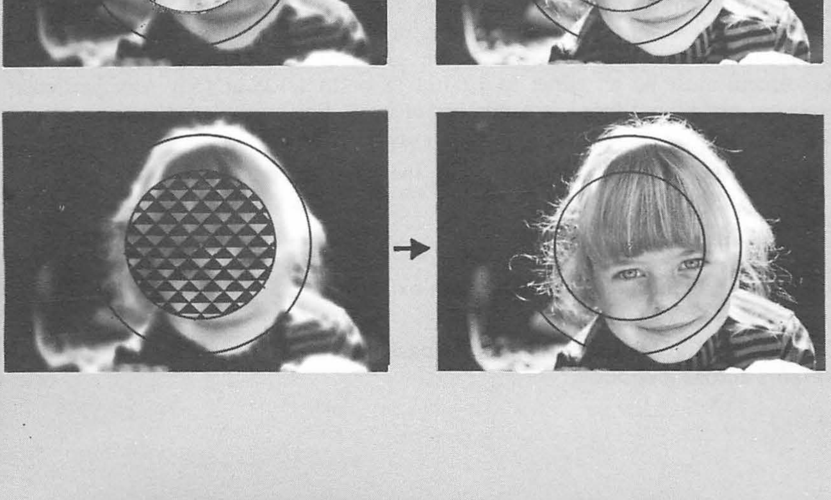




Exposure controls

A film of a particular sensitivity, or speed (see p. 106) will only produce a satisfactory picture on processing if it has been exposed to the right amount of light.

The intensity of light actually reaching the film is adjusted by altering the aperture in the lens diaphragm, and the length of time it falls on the film is determined by the shutter speed.

The diaphragm reduces the light rather like drawing curtains across a window, but consists of a number of metal leaves, which form a roughly circular hole of variable size (the limiting aperture). Minolta camera lenses, and most others, are marked with an aperture scale in *f*-numbers or relative apertures. These are calculated as the focal length of the lens divided by the diameter of the effective aperture (the area of the light beam striking the front glass which actually passes through the diaphragm at each setting). Most *f*-numbers are on the scale:

1 1.4 2 2.8 4 5.6 8 11 16 22 32 45

each of which is $\sqrt{2}$ times the one before, and represents half its area. Thus, a lens set to *f* 4 passes twice the light of one set to *f* 5.6. The ends of the scale vary for different lenses, and often the maximum aperture is intermediate between two of the standard settings. The light reaching the film, from a constantly illuminated subject, is the same at a given *f*-number for any lens, except when taking close-up photographs (see p. 121).

Most lenses have click stops at each setting on the standard scale, and some also half-way between these. Any lens, however, may be set to intermediate positions between these points if so desired.

Shutter speeds are simply the times for which the shutter can remain open. Almost all modern cameras which have indicated shutter speeds, including the Minoltas, put them on the scale:

1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, 1/15, 1/30, 1/60, 1/125, 1/250, 1/500, 1/1000 sec

on which each successive speed is half the one before. Thus changing by one speed either halves or doubles the light which falls on the film. Some cameras do not allow all the settings, some others allow more, extending the range at one or both ends of the scale. The fractions of a second are indicated by their denominators only, thus 1/250 sec is marked on the SR-T shutter speed dials as 250. Intermediate settings cannot be set manually on the Minoltas but the XE-1 sets the continuous range of speeds from 4 sec to 1/1000 sec on automatic.

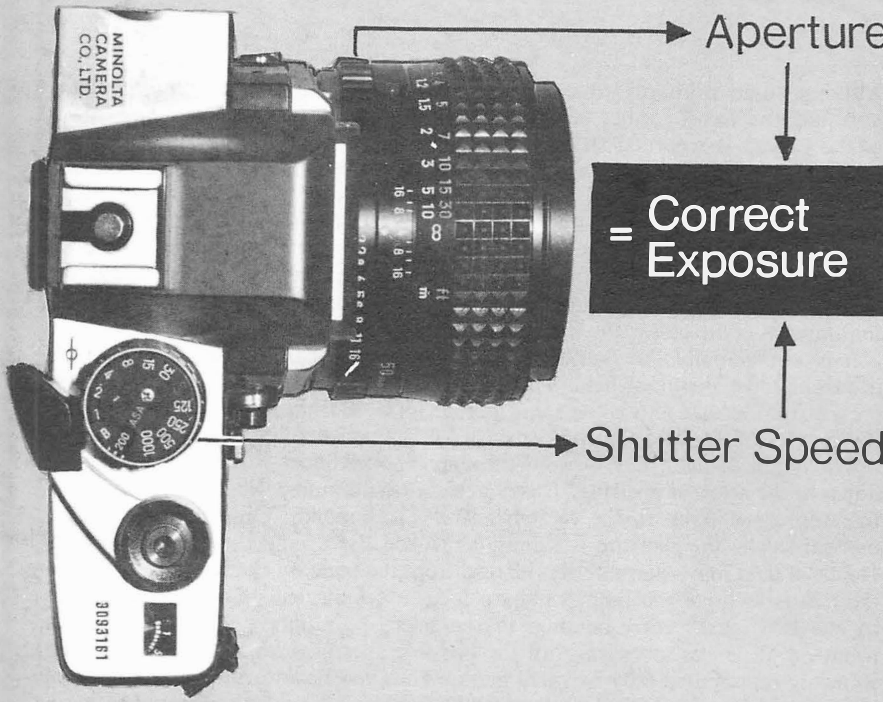
A change from one *f*-stop to another, or from one shutter speed to another, is called one *stop*. Thus, to increase an exposure of 1/125 at *f* 8 by one stop, the camera must be set either to 1/60 at *f* 8 or to 1/125 at *f* 5.6. Any particular exposure can be produced in a number of ways. For example:

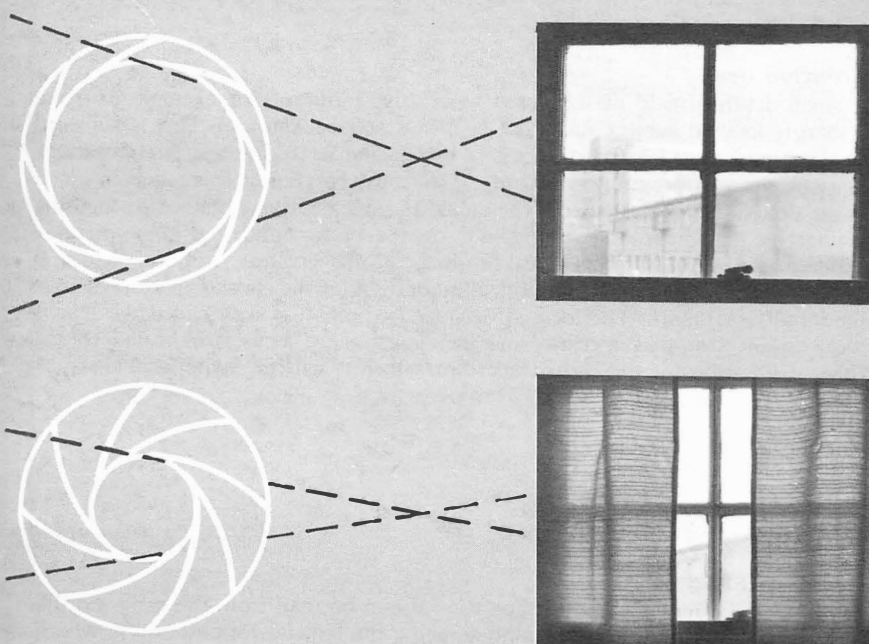
$\frac{1}{4}$, *f* 22; $\frac{1}{8}$, *f* 16; 1/15, *f* 11; 1/30, *f* 8; 1/60, *f* 5.6; 1/125, *f* 4; 1/250, *f* 2.8; 1/500, *f* 2; and 1/1000, *f* 1.4 all expose the film the same amount.

Exposure adjustment

TOP
Aperture and shutter speed determine exposure.

BOTTOM
Closing the diaphragm reduces light passing through the lens; like drawing curtains across a window.


Aperture
= Correct Exposure
Shutter Speed



Aperture and depth of field

Although used primarily to control the exposure (with the shutter speed) the lens aperture has a further effect on the final picture. It determines how much of the subject is recorded sharply. Anything exactly at the focused distance will be rendered absolutely sharp, provided there is no camera or subject movement. However, objects closer and further away will theoretically be not quite sharp. In practice, there is always a zone of sharp focus from somewhere in front of the subject to somewhere behind it. This is called the depth of field, and its magnitude is determined by the lens aperture and the focused distance. The larger the aperture (smaller the *f*-number), the smaller the depth of field for a particular lens, and also the closer the focused distance, the smaller the depth.

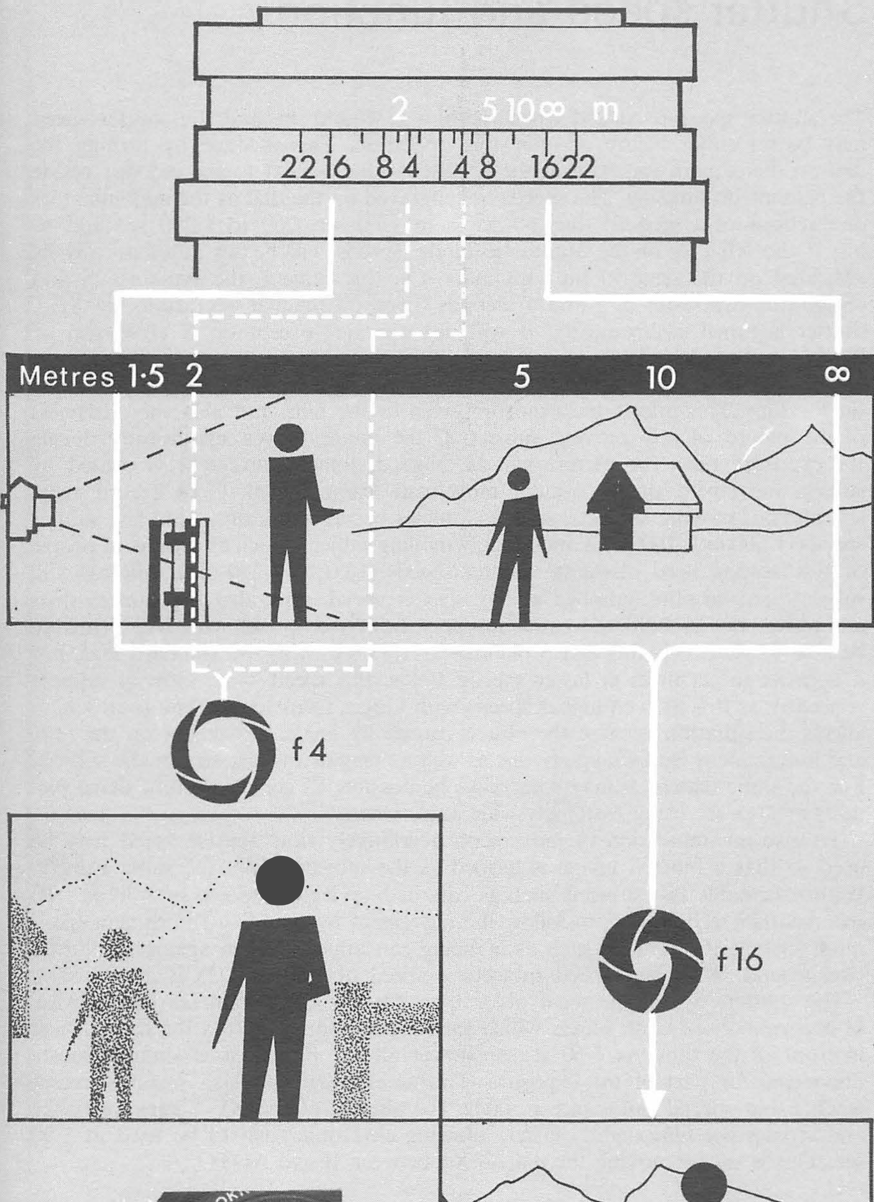
It is not actually the *f*-number but the effective aperture (see p. 26) which determines the depth of field. Thus, the depth (at any given focused distance) for a 50 mm lens at *f*5.6 is the same as that for a 200 mm lens at *f*22. Of course, the depth of field for a 200 mm lens at *f*5.6 is much smaller.

The depth of field may be seen through the viewfinder if the lens is stopped down to the selected aperture. This is achieved with automatic lenses by pressing the stop down lever on the right below the lens mount. On pre-set and other manual lenses, the aperture is simply controlled by turning the diaphragm ring. Depth of field may, alternatively, be read from the scale on the lens barrel. When the lens is focused, the limits of sharp focus are indicated on the distance scale by the two marks corresponding to the selected *f*-number. Since there is not room on all lenses to engrave all the possible apertures, some are left out, and some are represented only by small marks. Thus you have to interpolate between the marked numbers. The small red "R" indicates the infra-red focusing mark (see p. 50).

Creative uses

A small depth of field may be used to creative purpose—for example to make a sharply focused subject stand out against a soft background. This is achieved by choosing a large lens aperture (e.g. *f*4 on a 50 mm lens). In other circumstances, as small an aperture as practical (e.g. *f*16) must be chosen to render as much as possible of the subject sharp. The greatest usable depth is obtained by focusing neither on the foreground subject, nor on the background, but somewhere in between. If distant subjects must be in focus, the greatest depth of field will be attained by setting the depth-of-field calibration for the chosen aperture against the infinity (∞) mark. The focused distance (see p. 24) is then called the hyperfocal distance for that aperture, and the closest sharp focus is indicated by the other calibration for the chosen aperture, which is half the hyperfocal distance.

Depth of Field
Depth of field varies with lens aperture. It can be read from the scale on the lens (top); or seen on the focusing screen if the lens is stopped down, which can be done by pressing the stop-down button (bottom).


2
5 10 ∞ m
22 16 8 4 4 8 16 22
Metres 1·5 2
5
10
∞
f 4
f 16
MC ROKK
LENS MADE IN JAPAN
TA

Shutter speed and function

The shutter speed is cocked when the film is wound on, and the shutter speed may be set either before or after this operation. This is done by turning the dial on the camera top so that the required value is next to the red dot beside the pentaprism housing. The speeds are engraved on the dial as the denominators of fractions of a second; thus 60 refers to 1/60 sec, 250 to 1/250 sec and so on. If the XE-1 is in the automatic mode, speeds will be set automatically as indicated on the scale in the viewfinder. On this camera, the symbols 2S and 4S indicate exposures of 2 and 4 seconds. Even on manual operation, the XE-1 shutter is timed electronically. It will not operate—except on X (1/90 sec) or B—without good batteries.

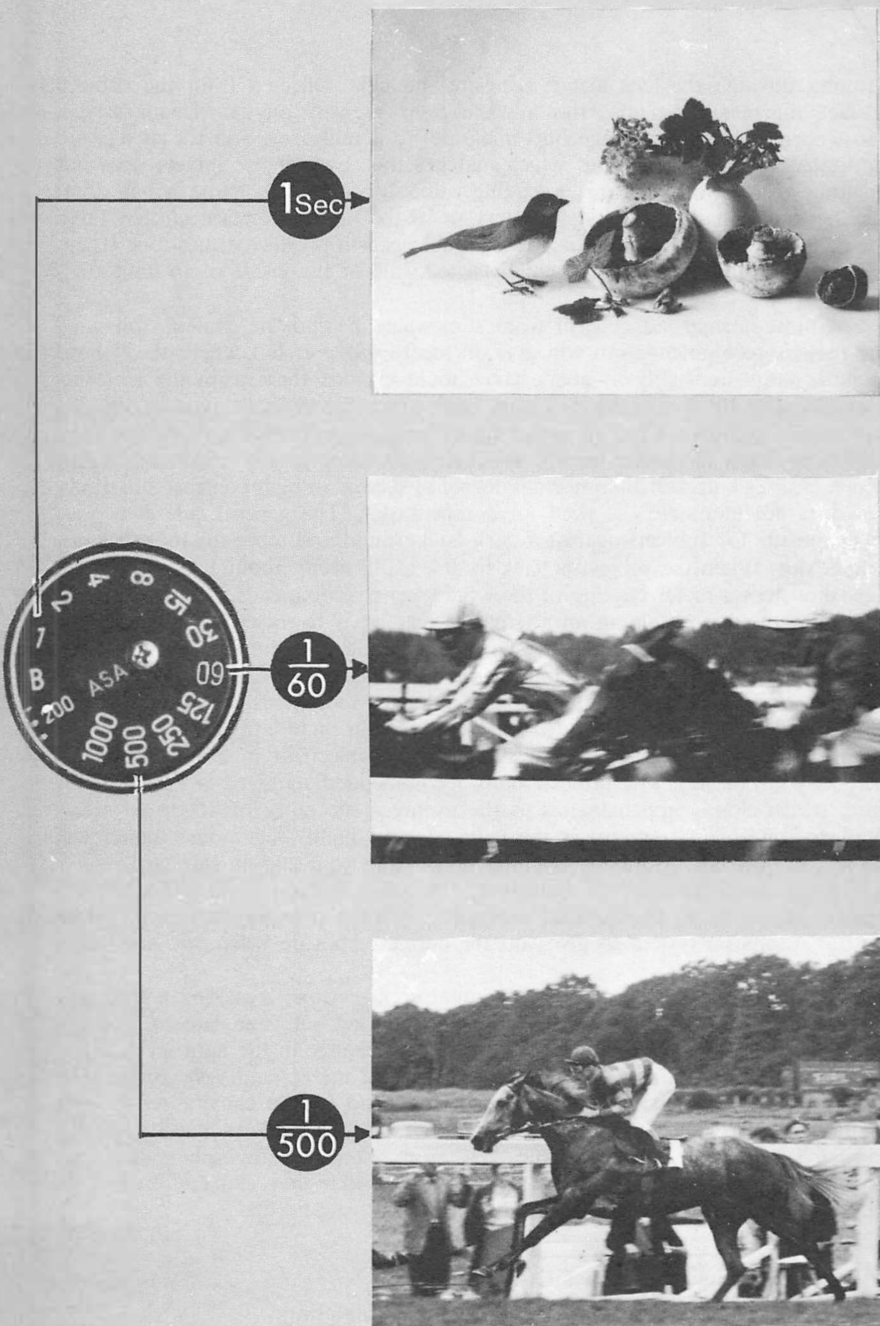
The shutter speed determines the time that the light from the subject is focused on the film. This affects the exposure given to the film, and also the sharpness of the record of any moving subject. If the image moves significantly during the exposure time, the picture will be blurred. Image movement is caused by subject movement or by camera movement (camera shake). To record them sharply, fast moving subjects, such as athletes or railway trains, need fast shutter speeds (1/500 or 1/1000 sec); moderately moving subjects, such as groups of people or townscapes, need moderate shutter speeds (1/60 to 1/250 sec), whereas still subjects can be photographed at any shutter speed—provided the camera does not move. If you hold the camera very steadily (see p. 42) you will probably be able to get acceptably sharp pictures at 1/30 sec, with the standard lens, but it is easier to get them at faster speeds. Below this speed some form of support is needed, as it is at even higher speeds with longer focus lenses. The focal length affects the situation because the blur is caused by image movement on the film, and longer focus lenses magnify this as well as magnifying the size of the subject. For the same reason, it may sometimes be possible to get reasonably sharp pictures at 1/15 sec using extremely wide angle lenses.

To give an impression of movement, a relatively slow shutter speed may be used so that a blurred image is formed as the subject passes the static camera. With reasonably fast subjects such as cars or bicycles, try speeds of 1/30 or 1/60 sec. Another technique is to follow the movement by swinging the camera (panning) so that the subject, such as a racing car, appears sharp against a blurred background. With high-speed subjects, a speed of 1/60 or 1/25 is about right.

The shutters are of the focal plane type. On the SR-T cameras they consist of two rubberised cloth blinds which follow one another across the camera just in front of the film. At 1/60 sec or slower all the film area is simultaneously uncovered for part of the exposure. This is essential for flash pictures except when using special bulbs (see p. 000). The shutter of the XE-1 runs vertically and crosses the film slightly faster, allowing electronic flash to be used at 1/90 sec. This is set by moving the dial to X—between B and AUTO.

Shutter speed must suit the subject

TOP
Slow speeds are suitable for static subjects.
MIDDLE
Moving subjects are blurred even with quite fast speeds.
BOTTOM
Fast speeds freeze motion.


1 Sec
1/60
1/500
B
1
2
4
8
15
30
60
125
250
500
1000
ASA
200

Measuring exposure

Minolta through the lens meters measure the light reflected from the subject. In fact, the meter measures the 'average' light intensity on the viewing screen. Most normal subjects average out (integrate) to a mid grey, and the meters are calibrated to produce a result which matches this. Even if the subject does not integrate to mid tone, the meter reading will still produce a picture which does; whether set manually, matching pointers, or by the XE-1 automatic shutter. Thus, the meter's recommendation for any even subject will produce a mid-tone result, whether the subject be a sunlit white-washed wall, or the inside of an unlit coal-mine.

For most normal subjects, lit from somewhere behind the camera, following the meter's recommendation will give an ideal exposure; but where the subject includes large unusually lit areas, you should exclude them from the metering area (A). The SR-T and XE-1 meters compensate for difficult type of lighting with their exclusive CLC (contrast light compensator) twin cell system. The system prevents the meter from over-reacting to exceptionally bright highlights, which ensures a greater than normal degree of success in high contrast situations, but does not eliminate the need for compensation. The general rule is to give less exposure for subjects against a dark background and more for those against a light one. When the subject is back-lit, it usually needs about two stops more exposure than a meter reading of the whole scene recommends.

One method of obtaining an alternative reading is to meter only part of the subject (B)—for example, a person's face when taking an against-the-light portrait (1). Focus the camera so that the chosen part fills the viewing screen (2). For this you will have to go closer, or use a longer focus lens. Take your meter reading, and use the recommended exposure for your picture (3). Another method is to take a meter reading from a standard test object, lit in exactly the same way as your subject. The professionally recommended standard is an 18% grey card, which closely approximates to the average reflectance of a normal scene. A more convenient standard is the palm of your hand. A few test frames will show you how best to modify readings taken from your chosen standard.

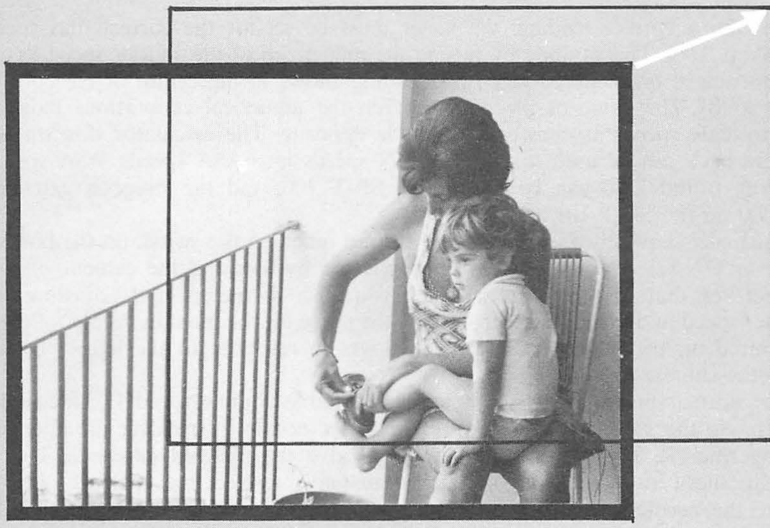
There is no exposure lock button on the XE-1, so you must either set the camera manually to the metered exposure; or use the exposure factor dial to set the automatic system to give you the correct exposure when you are in the shooting position.

When you are taking a number of similar shots on one location, it is usually best to take meter readings before you start shooting, set your camera, and not to alter the exposure again unless there is a great change in the light level. When using the XE-1 (provided that you can accept the meter readings) you can set the dial to AUTO, choose a suitable aperture, and let the camera set its own shutter speeds. The exposure factor control (see p. 36) allows you to set the camera to under-or-over-expose up to 2 stops. Some photographers prefer to do their shooting with the meter switched off, so that they can concentrate on the subject without being distracted by an ever-moving needle.

Measure exposure from suitable places

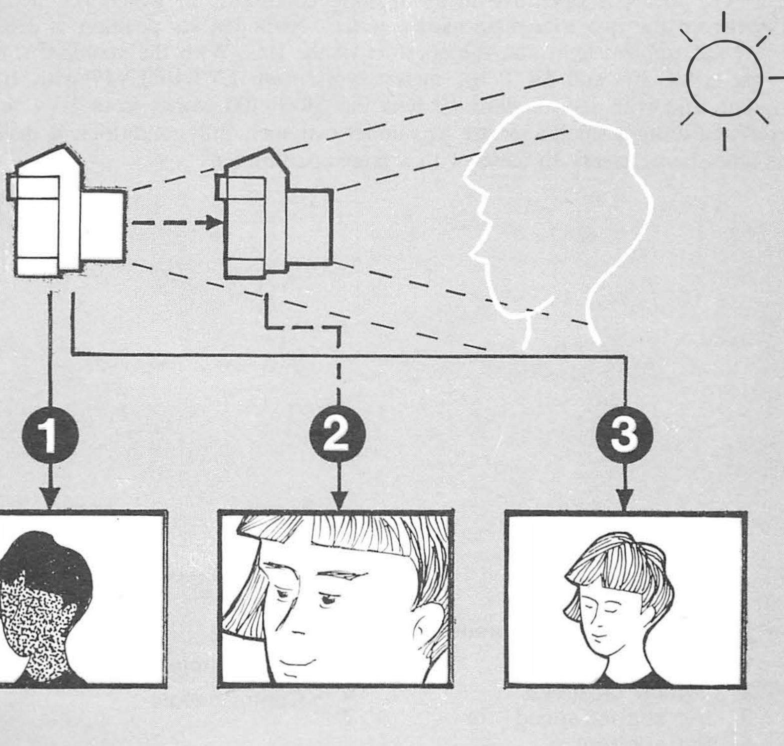
A Avoid large brightly-lit areas when you are metering.

B An overall meter reading will under expose a backlit subject (1). Go in close (2) to take a reading which will give a suitable exposure (3).



A

B



Operating the meter: SR-T cameras

To obtain a correct reading, the meter must be set for the correct film speed (1) (see p. 106). This is done by raising the milled rim of the shutter speed knob, and turning it until the correct ASA reading shows in the centre of the cut-out (next to B). The value of the dots between the numerical calibrations indicate intermediate speeds as shown in the table opposite. The calculator disc on the camera back can be used to convert DIN speeds into ASA speeds. ASA speeds between 6 and 3200 can be set on the SR-T 100, and the range is extended to 6400 on the SR-T 101 and SR-T 303.

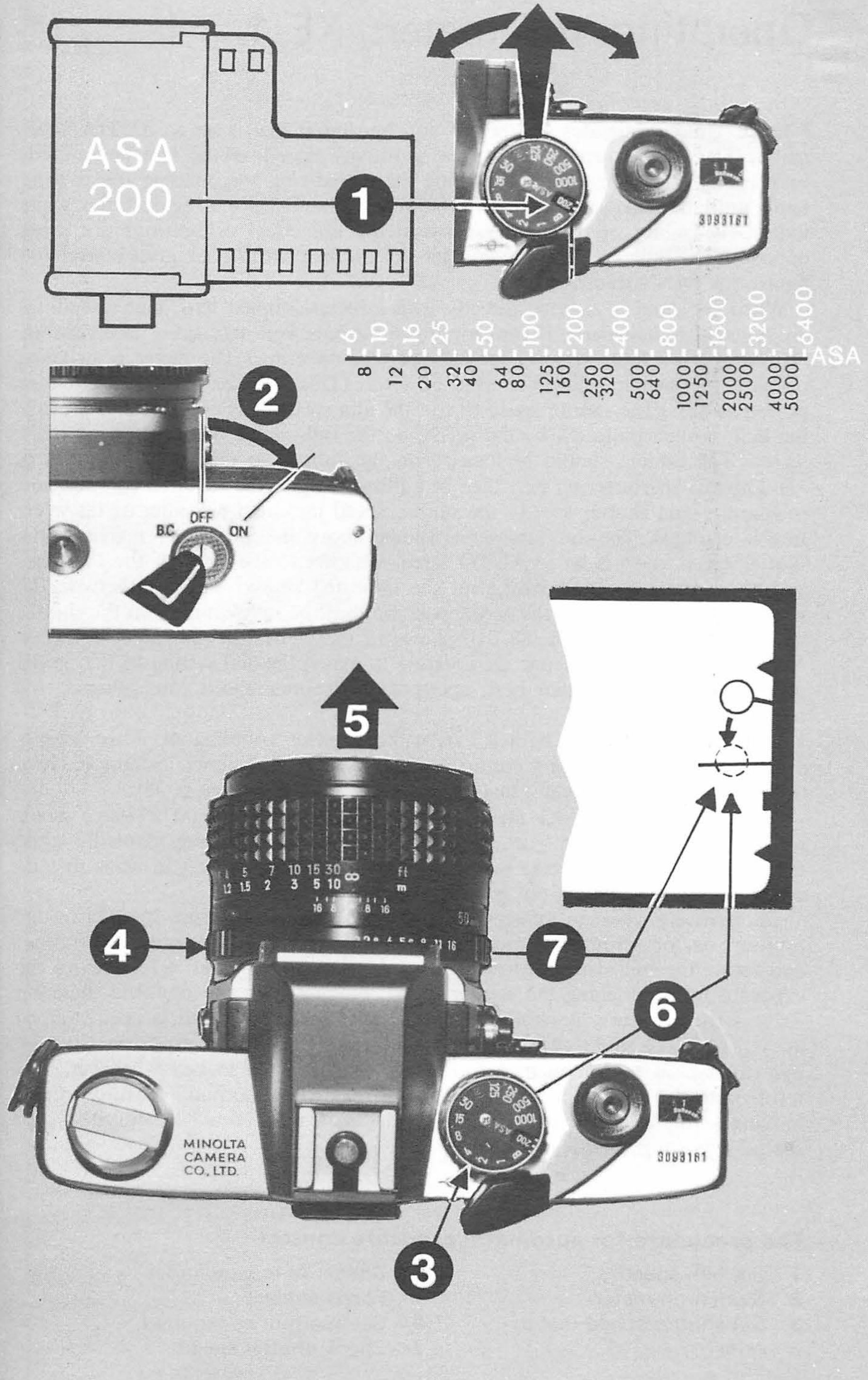
The meter is switched on by moving the red index on the switch on the bottom plate to ON (2). The exposure is then selected by focusing the camera on the subject—or that part of it from which you wish to meter—and adjusting the shutter speed and aperture controls until the circle on the moving needle follower is centred on the meter needle, which moves in response to the light reflected from the subject.

The normal procedure is to preselect a suitable shutter speed (3), focus the camera on the subject (5) and centre the meter needle by moving the aperture setting ring (7). The camera is then set to give the metered exposure. If you wish to shoot at a particular aperture, you may preselect the aperture (4) and centre the needle with the shutter speed dial (6). The dial must not, however, be set to any position between the marked speeds.

The meter is operative in all lighting conditions in which the needle falls between the two triangular marks in the viewfinder. Its position is determined by the ambient light and the aperture of the lens. With the standard (f1.4) lens the SR-T 303 and SR-T 101 meters work from EV3 to EV17 with 100 ASA film, and with its standard f2 lens the SR-T 100 works from EV4 to EV17. When using a small-aperture lens under extremely dull conditions, it may sometimes be necessary to meter with a large-aperture lens.

The procedure for measuring exposure

1	Set film speed	**5**	Focus subject
2	Switch on meter	**6**	Centre needle
3	Set shutter speed or	**7**	Centre needle
4	Set aperture		


ASA
200
1
6 10 16 25 50 100 200 400 800 1600 3200 6400
ASA
8 12 20 32 40 64 80 125 160 250 320 500 640 1000 1250 2000 2500 4000 5000
2
B.C
OFF
ON
5
4
7
6
3
MINOLTA
CAMERA
CO., LTD.
3098161

Operating the meter: XE-1

The XE-1 meter operates whether or not the shutter dial is set to AUTO (automatic). The meter must be set for the sensitivity (speed) of the film being used; by pressing down the lock and turning the milled ring surrounding the re-wind knob until the correct ASA figure (between 12 and 3200) is against the white index. The values of the dashes between the numerical calibrations are given opposite. The table in the film reminder slot on the camera back gives conversion figures for DIN speeds.

When the camera is fitted directly with a meter-coupled lens, meter readings are taken at full aperture. If you stop down the lens, you may get a false reading. (The stop-down lever stays *in* for full aperture metering.) The meter is switched on with the switch below the wind-on lever. (This unlocks the shutter release button as well.) The shutter speed to suit the film speed, lens aperture and prevailing light is then indicated by the needle on the right-hand side of the viewfinder screen. The camera should be focused on the subject to take a reading (see p. 32). The lens aperture ring may then be adjusted to give the required combination of aperture and shutter speed—the shutter speed indicated will alter as the aperture is changed. The aperture set is shown above the viewfinder image. If the shutter speed knob is set to AUTO a red A shows to the right of the *f*-number and the camera automatically gives the indicated shutter speed. Otherwise the shutter speed indicated by the needle position must be set manually on the shutter speed dial. The setting of the dial shows in the viewfinder in place of the A. Alternatively, you can change the aperture to match the dial setting to the needle position, remembering that both aperture and shutter speed can influence the final picture.

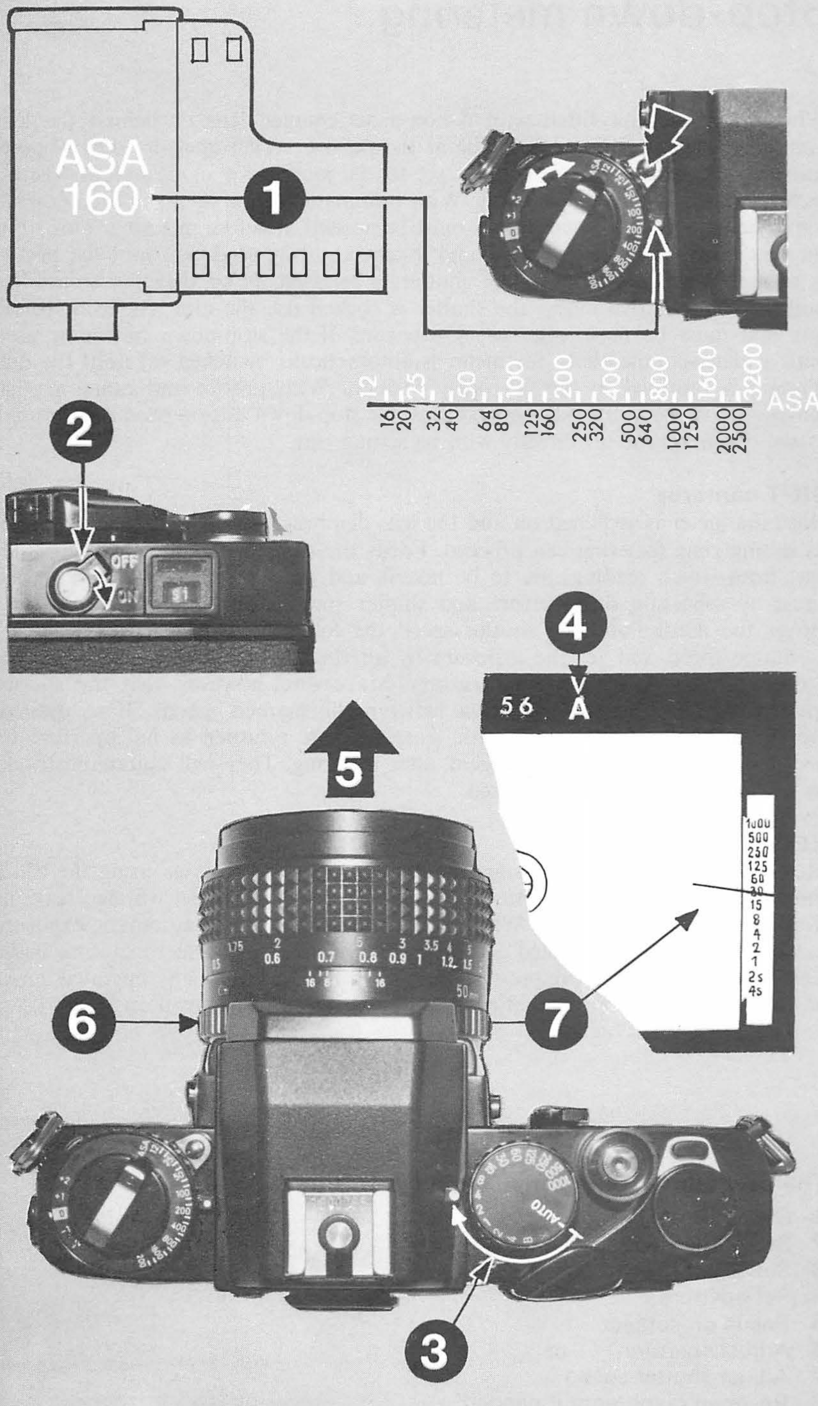
If the camera is fitted with a lens without meter coupling or if the lens is mounted on non-coupling close-up accessories such as bellows, extension tubes or microscope adapter, you must use stop-down metering (see p. 38).

There is no memory lock facility on the XE-1, so if you want to use a meter reading from a specific subject area you must set your exposure manually while taking a normal full-aperture reading. This you can also do if you want to take a whole series of pictures not based on the overall lighting.

Alternatively, you can influence the automatically set exposure by altering the exposure factor setting. To move the index from 0 position, press the release and rotate the milled ring. Moving the index toward +1 and +2 increases the exposure by lengthening the shutter speed; moving it in the opposite direction reduces the exposure by shortening the shutter speed. The dial is click-stopped at +1, +2, −1 and −2 (the figures indicating whole stop exposure changes) but can be set to intermediate positions. The index is locked whenever it is returned to the 0 position. Thus you can go back to the normal exposure without looking at the dial. Always return the index to 0 when you have finished your special exposures.

The procedure for automatic exposure control

1 Set film speed
2 Switch on meter
3 Set shutter speed dial to Auto
4 Check 'A' in viewfinder
5 Focus subject
6 Set aperture as required
7 Check shutter speed


ASA
160
1
12 25 50 100 200 400 800 1600 3200 ASA
16 20 32 40 64 80 125 160 250 320 500 640 1000 1250 2000 2500
2
OFF
ON
4
56 A
5
1000
500
250
125
60
30
15
8
4
2
1
2s
4s
6
7
AUTO
3

Stop-down metering

When the camera is fitted with a non-meter-coupled lens or behind the lens accessory, meter readings are made at the picture taking aperture. On Minolta cameras, the meter is automatically set to the stop-down mode except when a meter-coupled lens is in position. With automatic lenses or accessories, on all the cameras, the stop-down button must be pressed in before metering. This stops the lens down to its set aperture, and it remains stopped down until the button is pressed a second time, or the shutter is released. Note that the stop-down button is inoperative unless the shutter is cocked (i.e. the film has been wound on), and must be re-set after every exposure. If the stop-down button is used with a meter-coupled lens, the meter is automatically switched off until the diaphragm is returned to the full open position. With pre-set and other manual lenses, or with non-automatic accessories, the stop-down button need not be used, as the diaphragm is set directly with its setting ring.

SR-T cameras

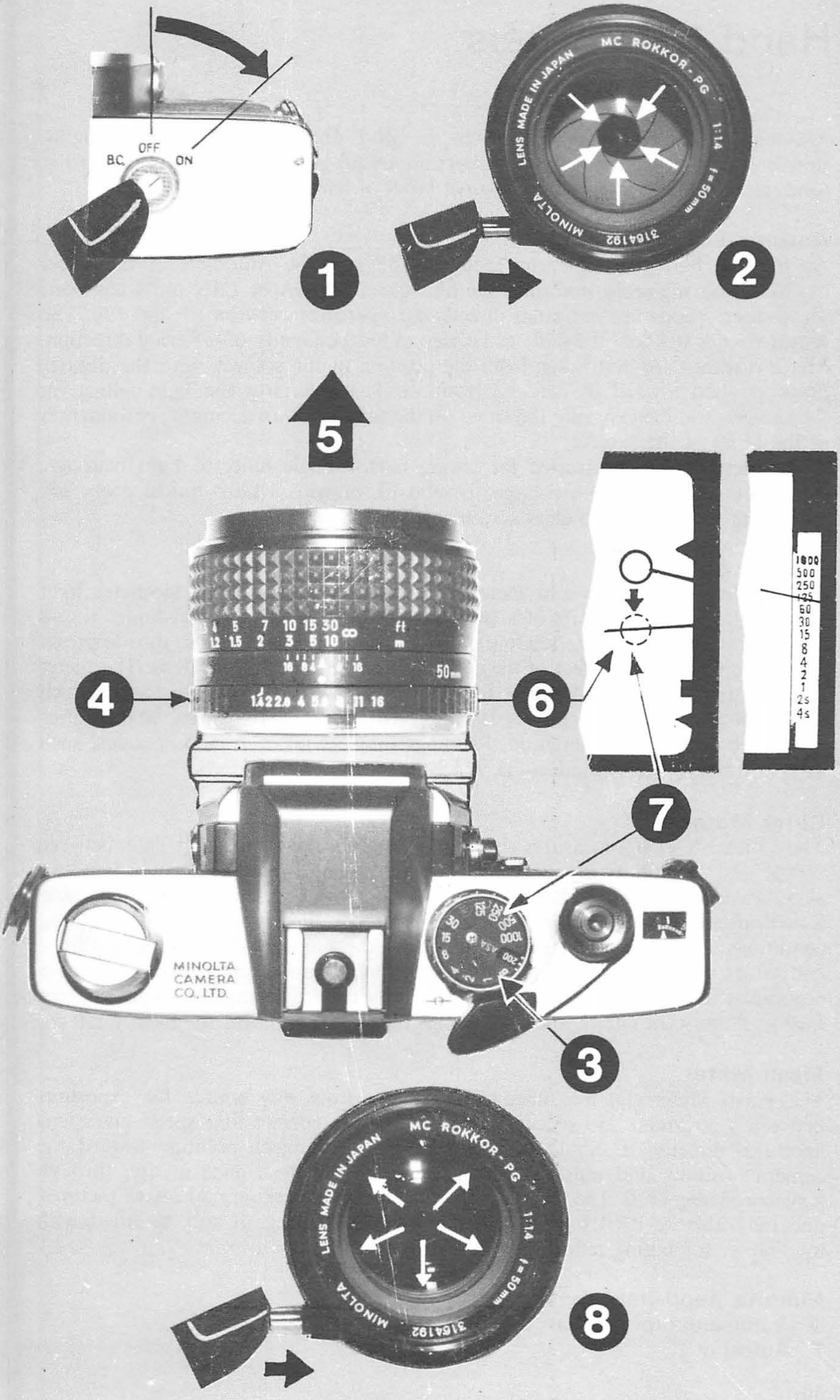
Once the meter is switched on and the lens diaphragm can be closed down with its setting ring, metering can proceed. Focus the camera on the subject (or that part from which readings are to be taken), and centre the meter needle in the circle by adjusting the aperture and shutter speed dials. The aperture setting moves the needle, and the shutter speed the follower. It is usual to preselect a shutter speed and set the exposure by altering the aperture, but the reverse procedure may be used when necessary. Make sure, however, that the shutter speed dial is not set to a position between the marked speeds. If so desired, for viewing and focusing, automatic lenses may be returned to full aperture by pressing the stop-down button again, after metering. They will automatically do so whenever the shutter is released.

XE-1

Metering the XE-1 for the manual mode is exactly the same as using the SR-T cameras, except that the shutter speed is indicated on the viewfinder scale as with open aperture metering. When the camera is used in the automatic exposure mode with non-meter-coupled accessories, it will give the correct exposure if the lens is stopped down before pressing the shutter release. (Manually operated lenses or automatic lenses on manual accessories will be stopped down anyway.)

The procedure for stopped-down metering

1 Switch on meter
2 Stop down with automatic lenses
3 Set shutter speed or
4 Set aperture
5 Focus on subject
6 Adjust aperture or
7 Adjust shutter speed
8 Re-open diaphragm if needed.



B.C.
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ON
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CO., LTD.
ASA
3
MC ROKKOR-PG
LENS MADE IN JAPAN
1:1.4
f=50mm
MINOLTA
3164192
8

Hand-held meters

Although the built-in exposure meters in SR-T and XE-1 cameras are highly suited to most situations, separate meters are useful in difficult or unusual lighting conditions. Minolta supply four distinct types of hand-held meter.

Autometer Professional
An incident light reading meter using a CdS cell, the Autometer Professional (A) has a moving scale, and once the film speed in ASA or DIN units has been set, shutter speeds are indicated directly for apertures between *f* 1 and *f* 90. The sensor rotates to allow the scale to be viewed independently of metering direction. Meter readings are best taken from the position of the subject, with the diffuser dome pointed toward the camera position. This measures the light falling on the subject, and the exposure indicated on the scale gives an accurate reproduction of the tones of the subject.

The meter can be converted for taking narrow-angle reflected light readings. It can also be used on an enlarger baseboard, or with a fibre-optical probe for measuring from a ground-glass screen.

Auto-Spot 1°
A single-lens reflex type spot meter, the Auto-Spot (B) is used to meter light reflected from selected parts of a (usually distant) subject. The viewfinder shows an image 8° across, but the reading is taken from a 1° central spot, thus approximately duplicating the effect of the camera fitted with a 2000 mm lens. The meter is set to the required ASA speed, the subject is viewed through the meter, which can be focused. The brightness is registered in exposure values, and shutter speed and aperture combination. Readings may be taken from key areas, such as skin tones, or deep shadows in which detail must be retained.

Color Meter
The Color Meter (C) measures the colour temperature of incident light between 2500K and 12500K (see p. 107) over a wide range of light levels (which it can also measure). The meter can be used to assess the filters needed for obtaining a neutral colour balance when using transparency films under unusual lighting conditions. This, however, also requires a wide range of specialist colour filters, and tables supplied by filter manufacturers should prove quite adequate for the occasional use. The Color Meter can be deceived by discontinuous light sources such as fluorescent lamps, and its readings then can only form the basis for tests.

Flash Meter
The Flash Meter (D) measures incident light from any source for exposures between 1/30 and 1/250 sec and when set to the correct film speed gives lens apertures directly. It should be used close to the subject, pointing toward the camera position, and must be connected to all the flash guns in use, through a synchronising cord. The flash-meter is invaluable for taking multi-flash pictures, and may also be used for fill-in flash, or other lighting. It can be fitted with an adapter for taking reflected light readings.

Minolta hand-held meters
A Autometer professional
B Autospot 1°
C Color meter
D Flash meter


A
minolta
B
C
minolta
D
minolta
FLASH METER

Holding the camera

The way you hold your camera can influence the quality of your pictures. If the camera moves, even minutely, while the shutter is open, the picture will not have quite the absolute sharpness you would expect from a good quality instrument. Camera shake, as such movement is called, is one of the most common causes of lack of definition—even in pictures taken by experienced photographers. The effect is not necessarily the serious multiple-image effect produced when a beginner waves around a camera while using a long shutter speed; it may just be a slight thickening of lines and smudging of fine detail.

Naturally the danger of camera shake is greatest at long (slow) shutter speeds, as is the magnitude of its effects. However, image blur caused by movement is possible at all shutter speeds, and the risk is proportionally greater the longer the focal length of the lens in use.

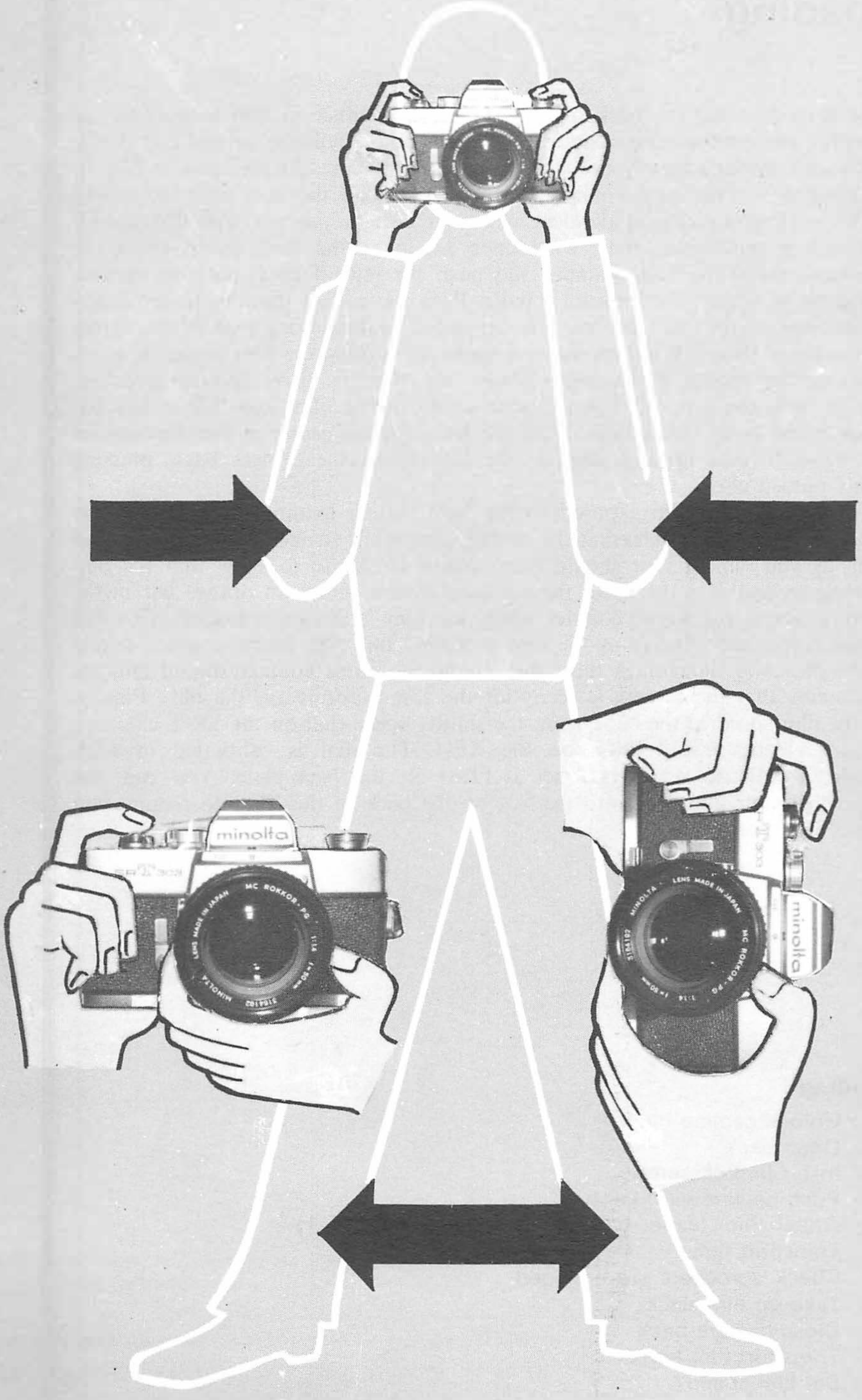
The only way to be absolutely sure of eliminating movement is to support the camera firmly—on a tripod or other solid object—and use a cable release or the self-timer (see pages 52, 50) to release the shutter. This is, of course, impractical in many situations; but when hand-holding, you should try to find a firm support for yourself or the camera. For example, you may be able to lean against a wall or a lamp-post, or perhaps sit or lie on the ground.

However, whether or not you use any additional bracing, make sure that you are in a comfortable and stable position. Generally the steadiest unsupported stance is that pictured opposite, with the weight evenly distributed on slightly parted legs. Your elbows should be kept well in to your sides, and the camera held firmly against your face with both hands.

While the right hand should be in a comfortable position to operate the shutter release and wind on the film, the left hand operates the focusing and aperture selection rings on the lens. In general, at the instant of picture-taking, this hand should hold the camera more tightly than the right. Convenient grips for both hotizontal and vertical pictures are shown opposite. Some photographers prefer to hold the camera the other way up for vertical photos, using their right thumb to release the shutter.

Finally, don't hold the camera too tightly, or your fingers will soon get fatigued and start to shake; and, when the right moment comes, hold your breath and squeeze the release button very gently to take the picture.

Holding the camera
Stand in a firm comfortable position; and hold the camera steadily and safely.


minolta
minolta

Loading

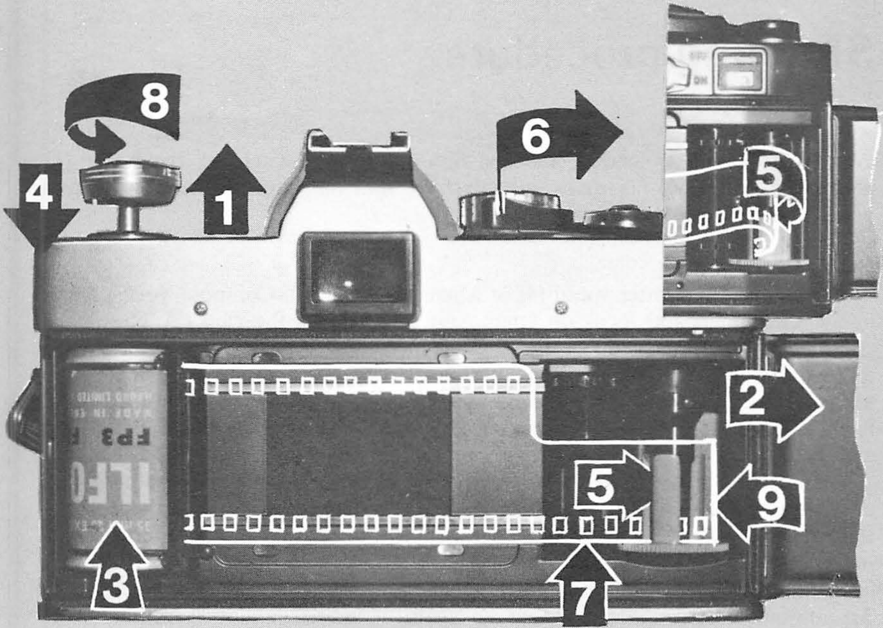
Film is loaded into the back of Minolta cameras either in film manufacturers' cassettes, or in reloadable cassettes. The operation should be carried out in the shade; if necessary turn your back to the sun. If you already have a film in the camera, it must be rewound before you can load the next one (see p. 48).

The loading sequence is identical whichever camera you use. Yor first unlock the back by pulling up the rewind knob and open the back cover. Place the film cassettes in the film chamber and push the rewind knob back in, turning it slightly to engage the cassette spindle. Push the end of the film leader firmly behind one of the bars on the take-up spool, making sure that it sits firmly on the lower flange. Wind on the film leader by turning the film transport lever, releasing the shutter if necessary. Make sure that the drive spindle sprockets engage both the top and bottom perforations of the film, and that it lies flat between the outer film guides. Turn the rewind knob *gently* in the direction of the arrow to take up any slack in the film. Close the camera back, pressing firmly until it clicks.

To wind on the film exposed to the light during loading, operate the film transport lever twice, releasing the shutter after each stroke. Watch the rewind knob as you wind on; it should turn counter-clockwise to show that the film is being wound. (On the XE-1, the safe-load system shows an orange bar in the window above the frame counter when the film is correctly loaded. This bar moves across the window as the film is wound on.) The frame counter should now indicate 0. Wind on a third stroke, and the frame counter should indicate 1, showing that the camera is ready for the first exposure on the film. Finally, set the film speed in the cut-out on the shutter speed dial on the SR-T cameras, or around the rewind knob on the XE-1. The dial is calibrated in ASA speeds; a DIN to ASA converter is fitted on the back-plate. You can put the end of your film-pack into the slot on the back of the XE-1 to remind you of the film type.

Loading

1 Unlock camera back
2 Open back
3 Insert film cassette
4 Push back rewind knob
5 Attach film leader to take-up spool (inset, XE-1)
6 Transport film
7 Check sprockets are engaged
8 Take up film slack
9 Close camera back
10 Transport film twice
11 Set film speed


8
6
5
4
1
2
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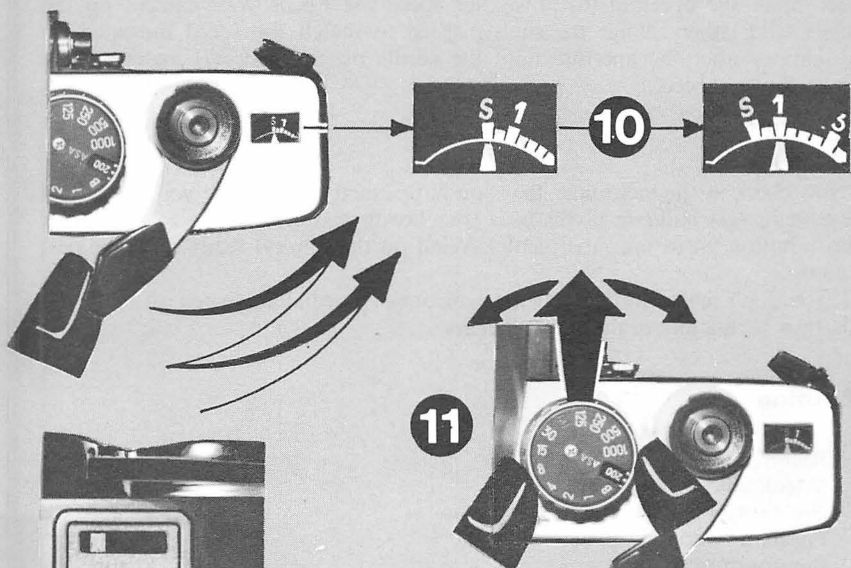
9
3
7


10
11

Shooting procedure

When the camera is loaded, and the film speed set, switch on the meter (1), take off the lens cap (2), make sure that the film has been wound on (3), and you are ready to make the first exposure.

SR-T Cameras

Preselect either a shutter speed (4) or a lens aperture (6). Compose your picture in the viewfinder, and focus on your main subject with the ring (5). Now alter either the aperture ring (6) or the shutter speed dial (4) until the meter needle follower is centred on the needle (7). (Remember that the choice of both aperture and shutter speed influence the final picture.) This gives you optimum exposure for a normal subject; if the subject differs from the usual contrast range you may need to modify the exposure (see p. 32).

With a non-meter-coupled lens, take your meter reading by preselecting either a shutter speed (4) or an aperture (5) and, having focused your picture with the ring (6), stop down the lens diaphragm to the setting on the aperture ring (using the stop-down switch with automatic lenses), and alter the aperture ring or the shutter speed dial until the follower is centred on the meter needle (7). An automatic lens may be opened up again, if desired, and will automatically be opened when the shutter is released.

XE-1

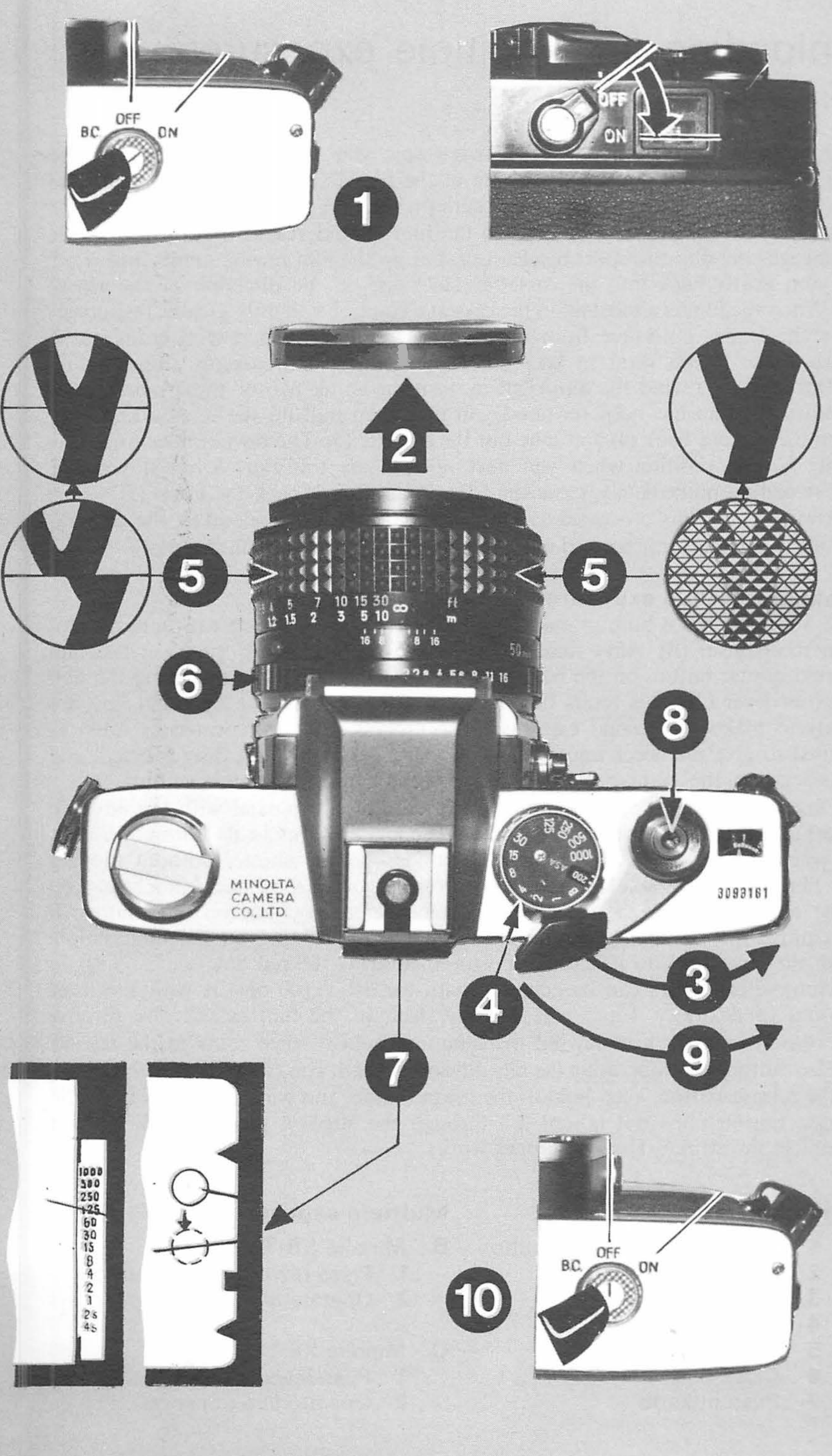
Make sure the power is switched on. For automatic operation, focus the camera on your subject (5), and alter the aperture (6) until you have the required aperture setting and shutter speed (as indicated on the scale, 7). For manual operation, select either the aperture (6) or shutter speed (4). Focus your camera on the subject, and either change the shutter speed to match the speed indicated on the scale or alter the aperture until the needle on the scale (7) matches your chosen shutter speed.

Now check in the viewfinder that you have exactly the picture you want, hold the camera very still (see p. 42), hold your breath and gently squeeze the shutter release button (8) to take the picture. Wind on the film (9) ready for your next picture.

If you don't intend to take any more pictures immediately, switch off the meter (10), thus saving any drain on the battery.

Shooting

1 Switch on meter
2 Remove lens cap
3 Check shutter tension
4 Set shutter speed on SR-T cameras
5 Focus on subject
6 Set aperture to
7 Centre needle or ideal speed
8 Take picture
9 Wind on film



B.C.
OFF
ON
1
OFF
ON
2
5
5
6
8
3
4
9
7
MINOLTA
CAMERA
CO., LTD.
3098161
ASA
1000
500
250
125
60
30
15
8
4
2
1
2s
4s
10
B.C.
OFF
ON

Unloading and multiple exposures

Although the frame counter should warn you, you will probably discover the end of the film by a sudden tightening of the film transport lever. Do not force the lever to try to get one more exposure on the film.

To unload the camera (A), depress the film rewind release button (1), which disengages the film transport mechanism. Lift up the film rewind crank, and wind the film gently back into the cassette—clockwise, in the direction of the arrow (2). When the film is almost all in the cassette, you feel a slightly greater resistance; then the leader pulls free from the take-up spool and the rewind crank turns more freely. If you want to keep the leader outside the cassette, stop winding at this stage. To wind the film right in, turn the crank two or three more times.

When the film has been rewound you may then pull up the rewind knob (3), open the camera back (4) and take out the cassette (5). The rewind button returns to its normal position when you next operate the transport lever. If you are not reloading immediately, close the back (6) and push back the knob (7).

Always have films processed as soon as practicable after unloading the camera. If forced to store unprocessed colour films put them in a cool, dry place.

Making multiple exposures

The SR-T 303 has a built-in mechanism to overcome its double exposure prevention mechanism (B). After making the first exposure, simply press in the film rewind release button on the base-plate (1) immediately before operating the film advance lever (2). This resets the shutter without moving the film and you are ready to make the second exposure. The process may be repeated as often as needed to give the effect wanted. The exposure counter is not disconnected, and thus registers the number of exposures, not the number of frames of film.

On the XE-1 (C) move the multiple exposure lever (co-axial with the advance lever) to the right to reveal a red dot (1). The lever returns to its normal position as you operate the transport lever (2) to tension the shutter without moving the film. You can make as many exposures as you like on one frame, but you must move the lever to the right each time before you tension the shutter. If you move the multiple exposure lever, then want to wind on the film, simply push the lever back to its normal position, covering the red dot.

Multiple exposures can be achieved with the SR-T 100 or 101 with a certain amount of dexterity. First, take up any slack in the film cassette by turning the rewind knob as if to rewind the film, and hold it; then press in the rewind release button while operating the film advance lever. If you can't manage this, press in the release button, keep hold of the rewind knob, and wind on slowly until the release button pops out (about 2/3 through the stroke); push it back in, and complete the stroke. This sometimes works.

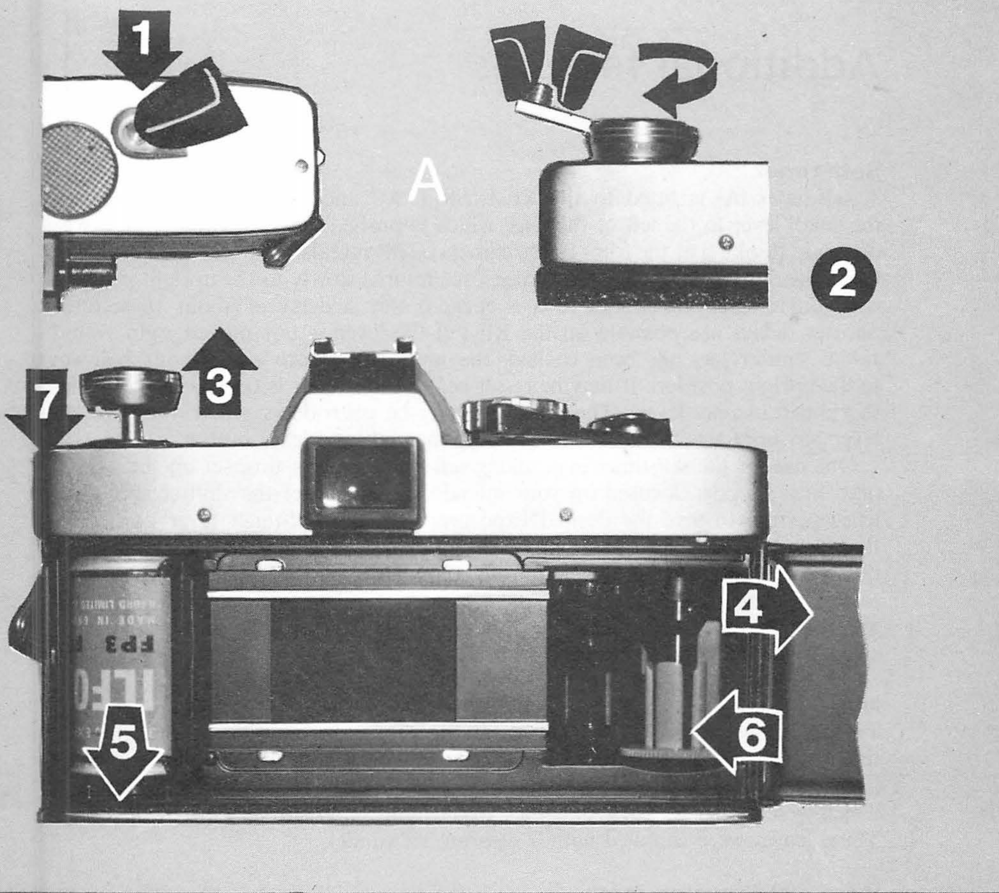
Unloading

A
- **1** Press rewind release button
- **2** Rewind film
- **3** Pull up knob
- **4** Open back
- **5** Remove cassette
- **6** Close back
- **7** Push in knob

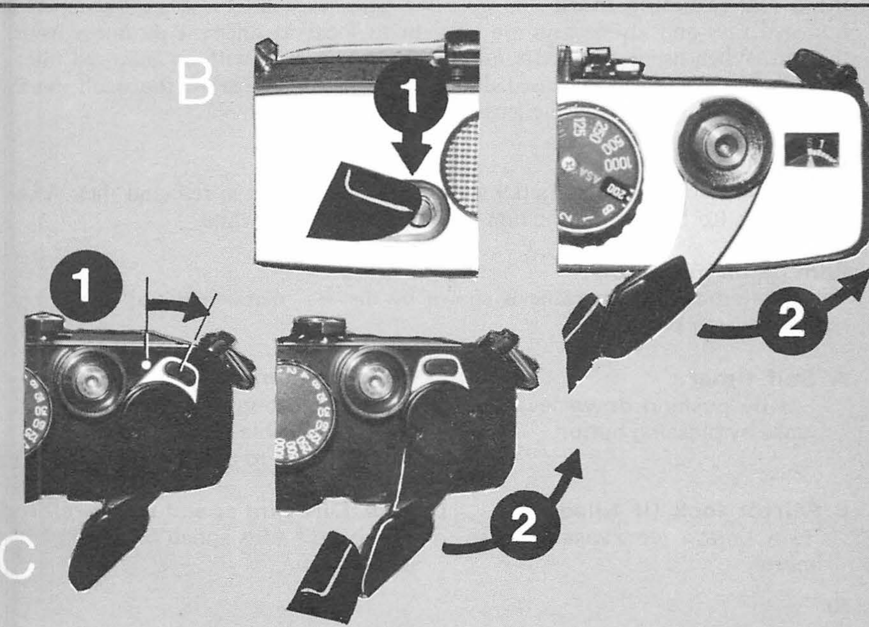
Multiple exposures

B Minolta SR-T 303
- **1** Press rewind release button
- **2** Operate film transport

C Minolta XE-1
- **1** Push lever to right
- **2** Operate film transport



A
1
2
3
4
5
6
7



B
1
2
C
1
2

Additional features

Self-timer

A self-timer (A) is fitted to the XE-1, SR-T 303 and SR-T 101. It is set with the small lever to the left of the lens, which is pushed down in counter-clockwise direction (looking at the front of the camera). This reveals the timer release button. Once this button is pressed, the timer lever returns slowly to the upright position, where it releases the shutter (if it is cocked) after a delay of about 10 seconds. Shorter delays are possible on the XE-1 if the lever is not moved right round. If the shutter has not been cocked, the lever will return only about half-way to the upright position. It may be re-set before the shutter is cocked (by operating the film transport lever). The self-timer may be overridden, whether or not the lever has been set in motion, by pressing the shutter release button.

One use for the self-timer is in taking self-portraits. For this, set up the camera on a firm support, focused on your intended position; set the shutter speed and lens aperture to give the desired exposure; turn the self-timer lever down, and then release it. Use the delay to get into position in front of the lens. Another use is when taking pictures requiring a long exposure. If you have no cable release, you can set the camera on a tripod or other firm support and allow the self-timer to trip the shutter. This avoids the danger of introducing camera shake when pressing the shutter release button.

Mirror lock

The small switch (B) to the left-hand side of the lens mount, above the self-timer, on some SR-T 303 and SR-T 101 cameras raises the reflex mirror. This is essential when using some older extremely wide angle lenses (up to 21 mm) which were set so far back that they would foul the mirror in normal operation. These lenses were supplied with a separate viewfinder.

Infra-red focusing mark

Infra-red rays and visible rays are brought to focus at different distances from the lens. When using infra-red sensitive film, particularly with an infra-red filter or an infra-red flash, the focused distance should be set against the small mark labelled with a red "R" on the lens (C).

Film speed converter

The dial on the camera backs (D) shows DIN film speeds in red, and their ASA equivalents (to be used on the film speed setting dial) in white.

Film plane indicator

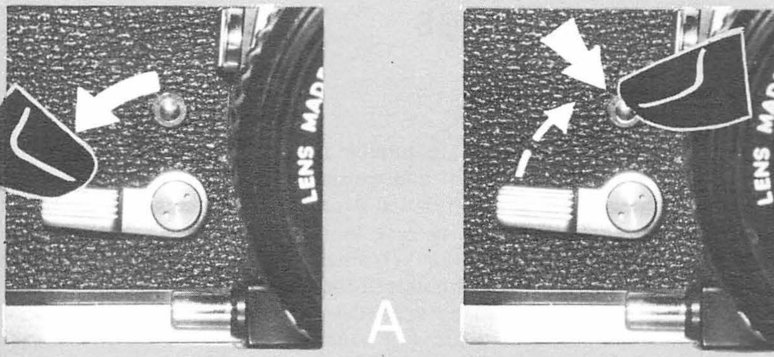
The position of the film plane is shown by the -⊖- mark engraved in red on the camera top plate.

A Self-timer
Set by pushing down lever release by pressing button

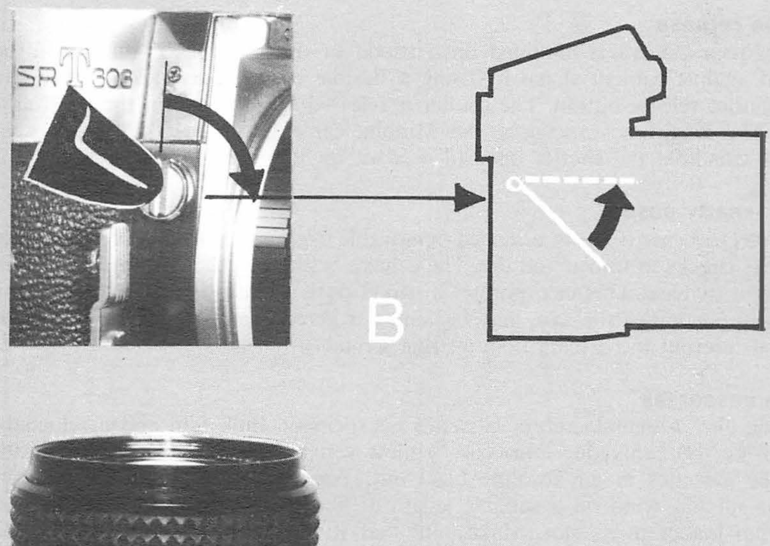
B Mirror lock (if filled)
Turn button clockwise to raise mirror

C IR focus mark
IR is not brought to the same focus as visible light. Distance should be set to red R.

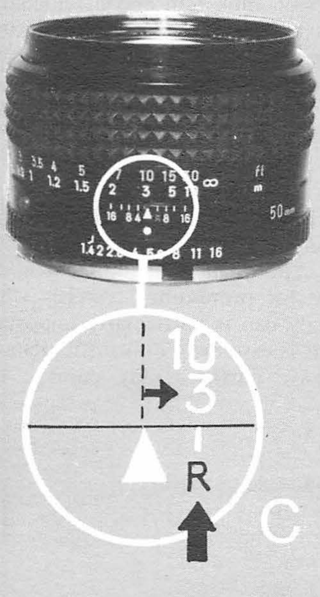
D ASA/DIN film speed conversion dial
To read off ASA speed for DIN-coded film



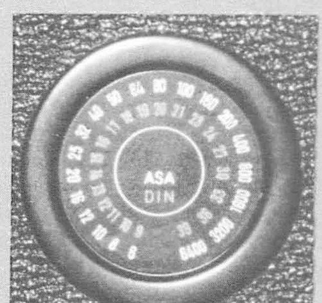
A



B



C



D

Useful accessories

Lens hoods

Lens hoods, or lens shades (A), are tubular fittings used to prevent off-angle light striking the front lens element and causing unwanted flare. It is advisable to use a lens hood whenever there is a strong light-source close to, but not within, the picture area. Some lenses have built-in extendable hoods, others are supplied with special hoods, and for yet others you can buy hoods to mount on the filter threads. Not only must hoods fit the lens—in the current MC Rokkor range all standard lenses and many accessory lenses have 55 mm filter mounts —but they must suit the lens angle. For example, if you use a hood designed for a 135 mm lens on a standard lens your picture will show vignetting (darkening or cut-off) in the corners; conversely, the standard lens hood will not be very efficient on the 135 mm lens.

Cable release

When your camera is mounted on a tripod or other support, you can further guard against camera shake by using a flexible cable release (B) screwed into the shutter release button. The shutter is released by pressing on the protruding end. For long time exposures, the Minolta cable release has a locking screw which can hold the shutter open (if it is set on B) until it is unscrewed again.

Ever-ready case

A protective case (C) with a hinged, removable front serves to protect the camera against knocks in transit and use. The camera is fitted to the case by the knurled screw in its base. This incorporates a tripod bush for use if necessary. The front (hinged) portion of the case may be removed if required, leaving the rest of the case to prevent the camera body getting scratched.

Film cassettes

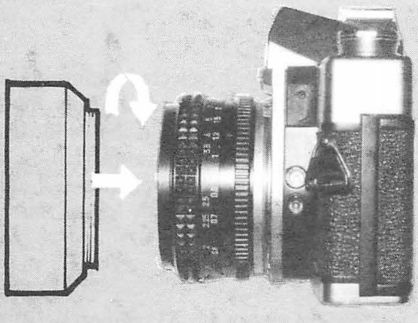
Buying film in manufacturers' cassettes is expensive. Bulk film and a reloadable magazine (D) can reduce this cost. Unless you have a bulk loader, you must fill the cassettes in an absolute black-out. You fit the end of the film firmly to the spindle, wind on a suitable length of film; put the cassette together with the film loader in its slot. Make sure that it is firmly closed before you put on the light.

Lens and body caps

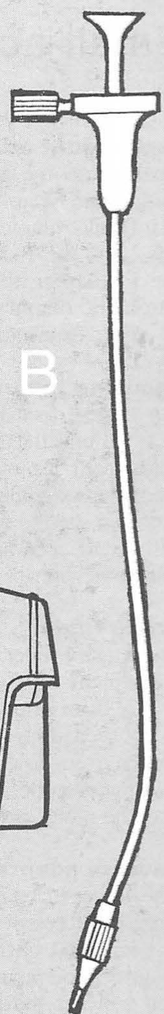
Minolta supply caps (E) for the front and back of all MC Rokkor lenses. They also supply camera body caps, so that dirt can be kept out when no lens is mounted. It is advisable to use the appropriate caps whenever equipment is not in immediate use. The lens caps are important for preventing scratches when lenses are carried loose in a gadget bag. The body cap is particularly important if you store or carry the camera without a lens. It is extremely difficult to remove dirt from the mirror housing, and any abrasive particles may damage the mechanism.

Minolta accessories

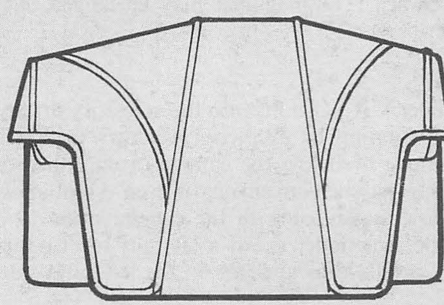
A Lens hoods
B Cable release
C Ever-ready case
D Reloadable cassette
E Lens caps



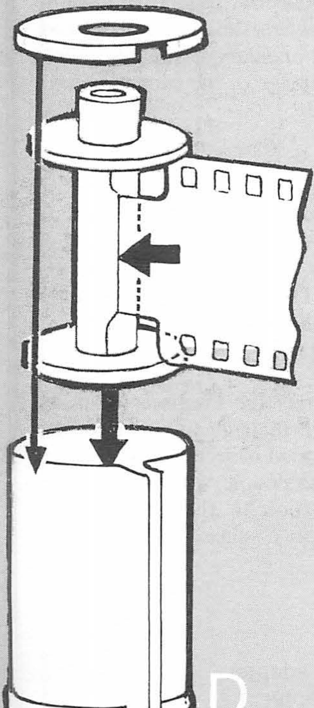
A



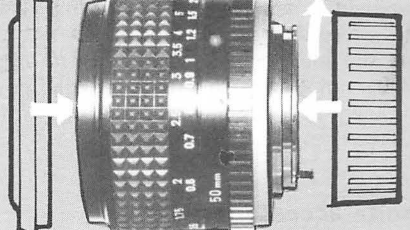
B



C



D



E

Small accessories

Lens mount adapters
Apart from the Leitz adapters which are supplied with selected items of Leitz equipment, Minolta supply three special adapters for using lenses in other mounts (A). The L-Adapter allows the use of screw-mounted Leica thread lenses for close-ups only, the P-Adapter allows the use of Praktica (42 mm) mount lenses, and the E-Adapter the use of Exakta mount lenses. These adapters do not allow automatic diaphragm operation, and thus can only be used with lenses that can be set to the manual mode.

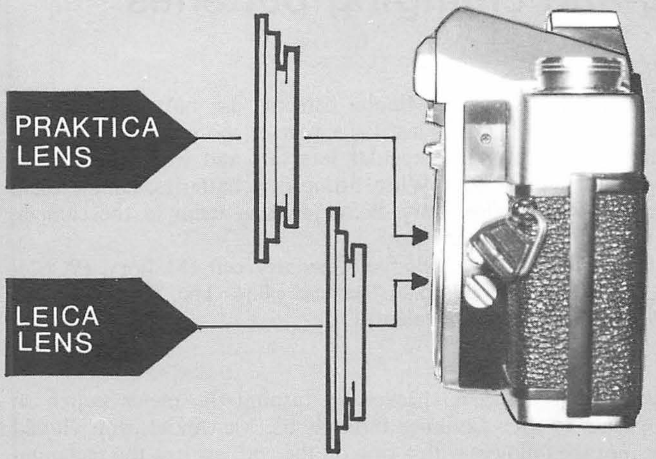
Focusing magnifier
For critical focusing, especially useful in close-up work, the Magnifier V (B) can be fitted into the accessory fitting grooves surrounding the eyepiece. It has dioptric adjustment for eyesight correction. Focus the camera on a static subject, then focus the magnifier on the camera's focusing screen by rotating its eyepiece. You can then see the centre of the screen magnified 2.5×, and thus focus your subject with great accuracy. The magnifier may be hinged out of the way to allow full screen viewing.

Angle finder
The Angle Finder V (C) also fits into the accessory fitting grooves and has dioptric adjustment by rotating its eyepiece. It allows the screen to be viewed at right angles from above or below the camera, from either side or from any position in between. This may be convenient, or even essential, when shooting in confined spaces, from low angles, or with the camera fitted to ancillary equipment such as a microscope. The finder shows a laterally reversed image of the camera screen and the meter needle thus appears on the left-hand side.

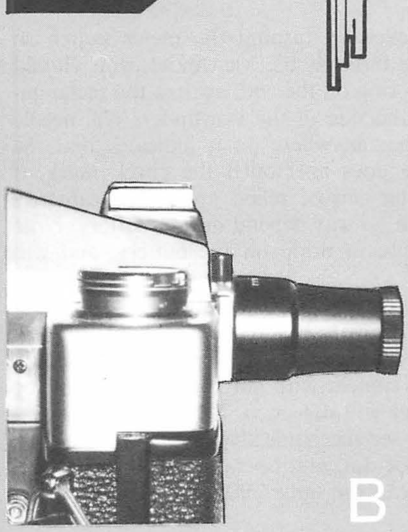
Reverse adapter
The Reverse Adapter (D) lets you mount the lens backwards on the camera or close-up accessory (2). The adapter (1) screws into the 55 mm filter mount of any lens and bayonets into the lens mount. Normal camera lenses are designed to give good images of comparatively distant subjects. With very close subjects you will get sharper pictures if you reverse the lens. This is normally advisable with subjects reproduced larger than life size on the film (see p. 121).

Eyesight correction
The Eyepiece Corrector Lenses V are designed to correct the eyepiece for near- or far-sighted persons who do not like viewing through their glasses. The lenses, made in nine dioptre strengths from −4 to +3 are mounted in rectangular holders which slip into the slots in the camera eyepiece. Some people with a restricted focusing range may find that a slight positive correction to the eyepiece will allow them to focus the screen clearly with their "distance" glasses.

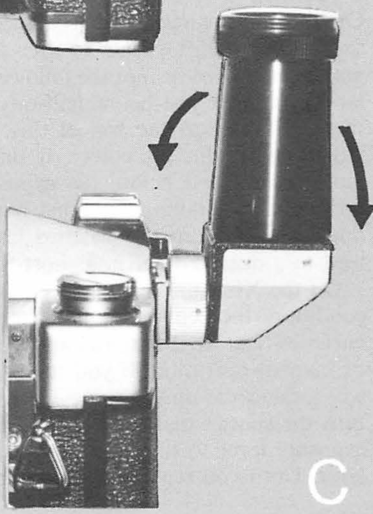
Minolta accessories
A Lens mount adapters
B Focusing magnifier
C Angle finder
D Reverse adapter
  1 Adapter
  2 Extension tube



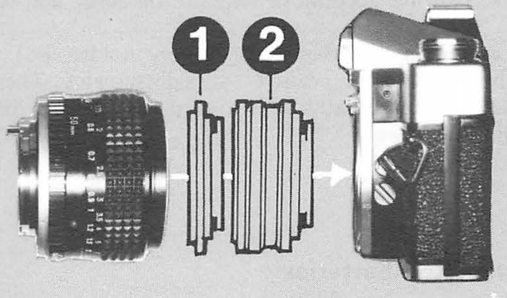
A



B



C



D

Checking and changing batteries

The exposure metering systems of the Minolta cameras use batteries for their operation. In normal use these batteries last for a year or more, but they should be checked immediately after fitting, at regular intervals and when the camera has been stored for any length of time. When fitting new batteries, handle them as little as possible and by the edges only. Before putting them in the camera, give them a good rub with a rough dry cloth.

The SR-T meter is powered by a 1.35 volt mercury cell (Mallory PX-625, Ever-ready E625N or equivalent) housed in the base plate. The XE-1 uses two silver oxide cells (Mallory MS 76 or equivalent).

Checking

On the SR-T cameras, the battery is checked by turning the meter switch so that its red index points to BC. Looking through the viewfinder, you should see the meter needle (not the follower with a ring on the end) against the rectangular check mark just below half-way down the side of the viewfinder. The needle often sits close to the top of this mark, but anywhere on it indicates that the battery has sufficient power. If the needle does not touch the check mark, it must be replaced before the exposure meter can be relied upon. The camera's normal picture-taking functions, however, in no way depend on the battery. Note that leaving the meter switched to BC causes a drain on the battery, and will lead to a dead battery in a short time.

On the XE-1 press the battery check switch down. If the batteries are in good condition, the centre of the switch lights up red. If it does not light, fit new batteries. The XE-1 batteries are needed for setting the shutter speed on automatic or manual operation. If you try to use the camera with flat batteries, the mirror will lock in the up position; and the shutter will not open. To reset the camera, turn the shutter dial to X (which sets 1/90 sec mechanically); move the multiple exposure lever to the right (revealing the red dot) and operate the film transport lever. Until you replace the batteries, you can use only 1/90 sec or B.

Changing

When it is necessary to fit a new battery, on the SR-T cameras, unscrew the milled battery cover using the flat of your thumb. Put the new battery in with the positive (+) side showing uppermost. Replace the cover and screw it firmly with your thumb.

On the XE-1, use a coin to unscrew the battery holder. Put two batteries into the insulated holder with the positive (+) side showing. Then replace the holder (so that the + side of the batteries is toward the top plate of the camera) and screw it in with a coin.

Checking and changing batteries

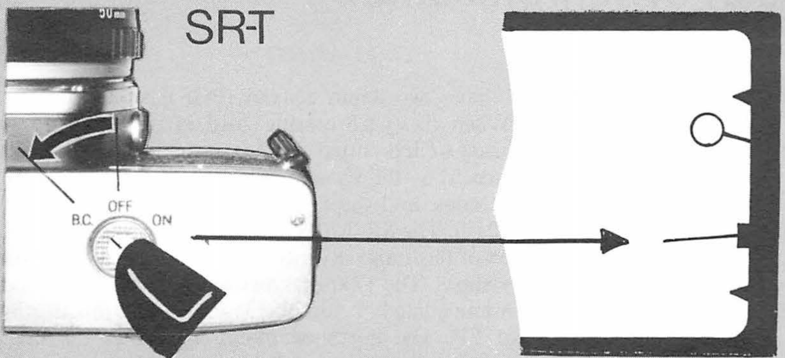
TOP

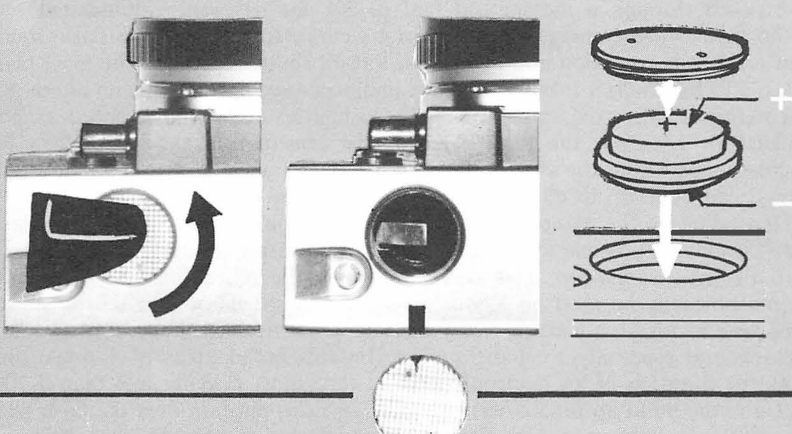
SR-T battery check is on meter switch.

BOTTOM

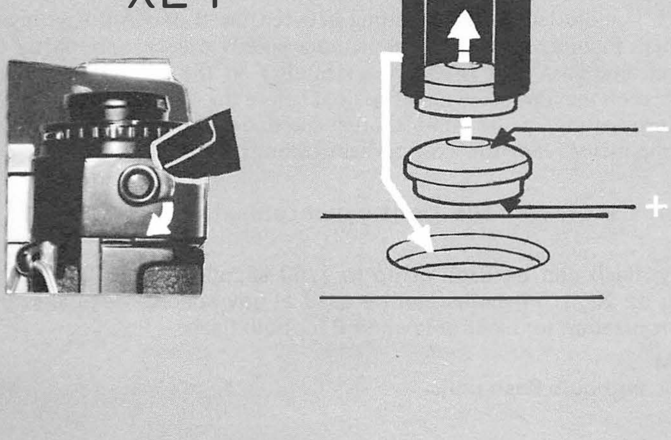
XE-1 battery check switch on camera side.

SR-T





XE-1



Flash synchronisation

The SR-T 100 and SR-T 101 have two 3 mm coaxial (PC) flash terminals on the side of the lens mount. When its synchronising cord is plugged into one of these, a flash gun may be used—either fitted to the accessory shoe or, with an extension cord, at a distance from the camera. The upper terminal (FP) is synchronised for FP class flashbulbs, and the lower one (X) for any other type of flashbulb and for electronic flash. The SR-T 303 and XE-1 have single contacts on the lens mount for any type of flash and a centre (hot shoe) contact in their pentaprism-mounted accessory shoes. The type of synchronisation for both contacts is determined by a switch immediately below the 3 mm (PC) terminal, which may be set either to X or to FP. The hot shoe mounting allows the use of a cordless shoe-mounting unit, and may also be used as a normal accessory shoe.

However the unit is connected, flash pictures are correctly exposed only at certain shutter speeds, depending on the type of flash. This is because at shutter speeds above 1/60 sec on the SR-T cameras and 1/90 sec on the XE-1 the film is exposed through a moving slit (see p. 30) and is evenly illuminated only if the light source remains constant for its entire travel. The one flash source that fulfils this condition and can be used at all shutter speeds is the focal plane (Class FP) flashbulb. FP bulbs are large and expensive, but there is no alternative in conditions where the ambient light is too high to use a shutter speed as slow as 1/60 (or 1/90) sec. On the FP setting the camera fires the flashbulb a few microseconds before the shutter blinds begin their travel, so that the bulb's light output can build up to the constant level needed for even exposure.

Depending on the manufacturing tolerances in your camera, and in the flashbulbs, it may be possible to get acceptable pictures using ordinary (M-class) bulbs with FP synchronisation. This cannot, however, be relied on, and such bulbs should normally be used on X-synchronisation at speeds of 1/15 sec or slower, otherwise pictures may be unevenly lit. This is particularly noticeable in colour pictures and especially so if the subject contains broad areas of a single tone.

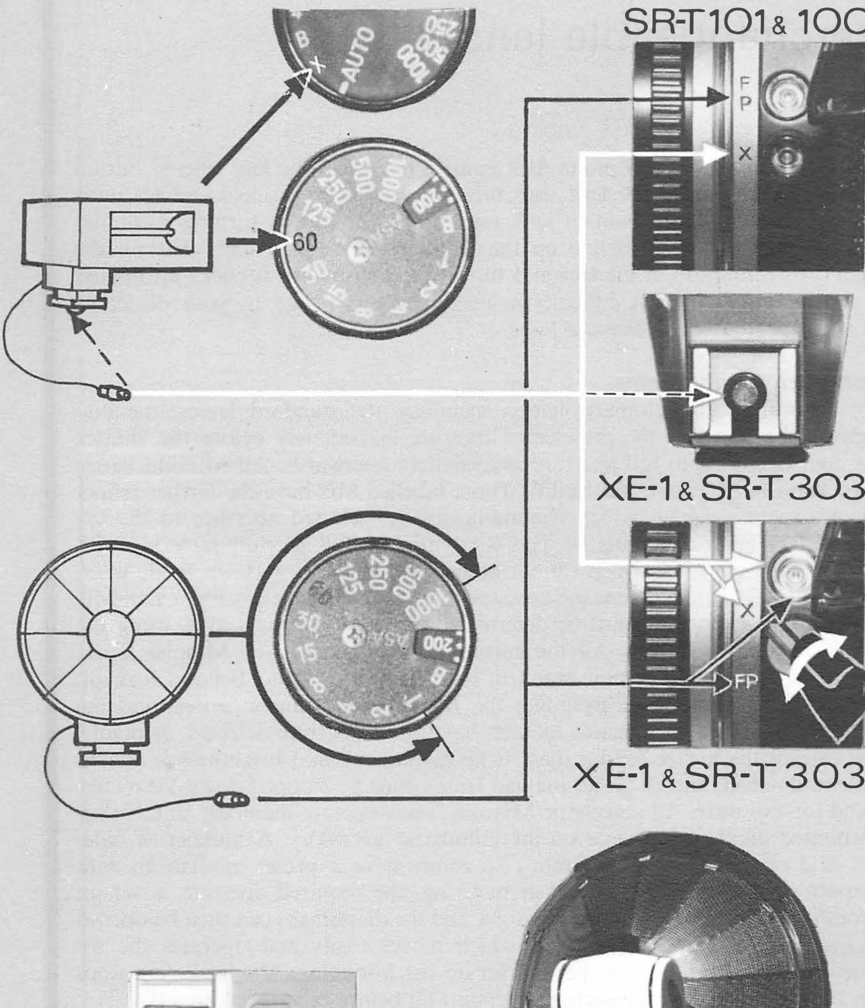
As the duration of an electronic flash is very short (usually less than 1/1000 sec), and the build-up time is virtually nil, X-synchronisation fires the flash when the shutter is fully open. However, electronic flash can only be used at shutter speeds slow enough for the whole film to be exposed simultaneously. The fastest speed at which it can be used on the SR-T cameras is 1/60 sec, which is marked in red on the shutter speed dial. The fastest speed usable on the XE-1 is 1/90 sec, which is indicated by the X setting between the B and Auto settings on the shutter dial. Pictures taken at higher shutter speeds will be only partly exposed. If an electronic flash unit is used (accidentally) on the FP setting, none of the flash will reach the film, since it will be fired before the shutter begins to open.

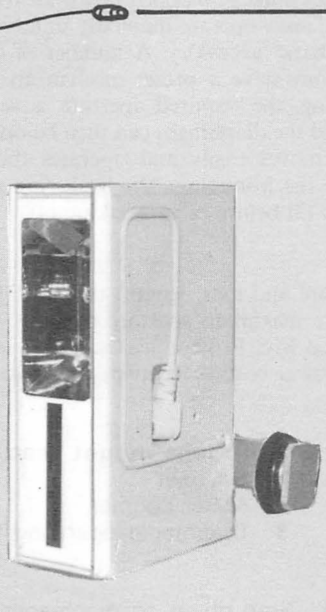
The Auto setting of the XE-1 shutter speed dial cannot be used with flash because the meter reads the existing light before the flash is fired.

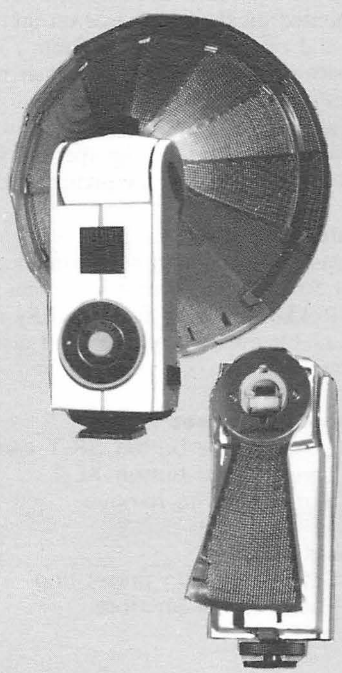
Flash only works at the right synchronisation

TOP
Electronic flash can be used at up to 1/60 second on SR-T cameras. Use X-setting on XE-1. FP bulbs can be used at any speed. Make sure you use X-synchronisation for electronic and FP for bulb flash.

BOTTOM
Electronic and bulb flash units.


SR-T 101 & 100
FP
X
XE-1 & SR-T 303
X
FP
XE-1 & SR-T 303





Interchangeable lenses

Lens changing

To remove a lens from a Minolta SLR camera (A), press the lens release button (1, 1A on XE-1) toward the lens, and turn the lens counter clockwise (2) until it can be removed. To fit another lens, remove its rear cap by turning it counter clockwise until it lifts, then line up the red dot on the lens with that on the camera (3), gently push in the lens and turn it clockwise until it clicks into place.

If you have the slightest difficulty in making a lens fit, go to your dealer to have the lens adjusted. *Never use force.*

Diaphragm mechanisms

When shooting with automatic lenses, including the standard lenses, the diaphragm closes down to the preselected aperture immediately before the shutter opens, and opens up to full aperture immediately afterwards. All Minolta lenses labelled Auto or MC have this facility. Those labelled MC have the further refinement of a meter coupler, which communicates the selected aperture to the exposure meter's aperture simulator. This is essential for full aperture metering with SR-T and XE-1 cameras, which cannot be metered in the stop-down mode when fitted directly with an MC lens (or accessory). Conversely, when using a non-MC automatic lens, exposures must be determined in the stop-down mode, using the camera's stop-down button. All the current range of automatic Minolta lenses are meter coupled, with the exception of the 100 mm *f*4 Auto Bellows Rokkor.

Certain specialised lenses, including the RF Rokkors (mirror lenses) and the Leitz lenses supplied in Minolta mounts have their aperture selected manually. In the case of the mirror lenses, there is no diaphragm, and brightness is altered with neutral density filters. Other manual lenses must be stopped down for metering, and for exposure. All automatic Minolta lenses operate manually unless they are mounted on the camera or on an 'automatic' accessory. A number of older lenses, and one current 100–200 mm *f*5.6 zoom, have a preset mechanism with two aperture setting rings (C). When metering, the required aperture is set on the front ring (1), which has still click-stops, and the diaphragm can then be opened for focusing (2) with the back ring, which moves easily and operates the iris between full aperture and the aperture set on the front ring. The back ring stops down the diaphragm to the preselected point (3) before picture taking (4).

Lens designations

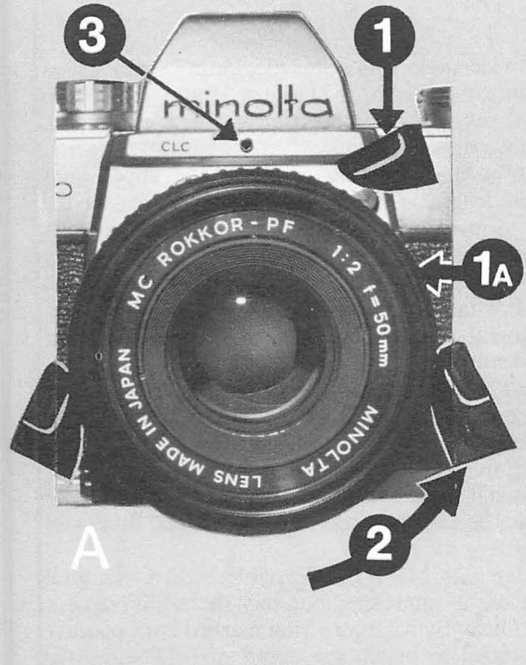
Each lens is marked with its maximum aperture and focal length; thus MC Rokkor 1:1.7 *f* = 85 mm is an 85 mm lens with a maximum aperture of *f*1.7.

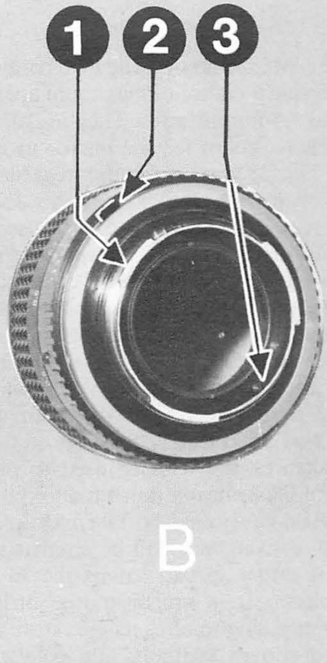
MC-Rokkor-X lenses are externally restyled MC Rokkor lenses. Celtic lenses (not available everywhere) are good quality lower cost alternatives to the superb Rokkors.

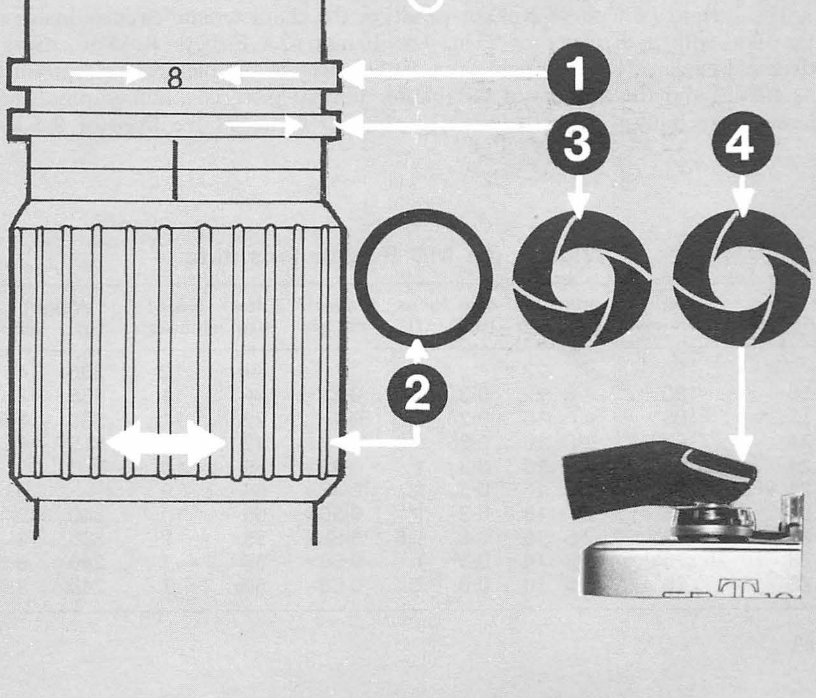
A Removing lenses
- **1** Lens release button SR-T cameras
- **1a** Lens release button XE-1
- **2** Rotate lens to remove

B Auto lens mount features
- **1** Bayonet
- **2** Meter coupler
- **3** Diaphragm operating lever

C Preset lenses
- **1** Set aperture on preset ring
- **2** Focus at full aperture
- **3** Stop down on diaphragm ring
- **4** Release shutter


3
1
minolta
CLC
MC ROKKOR-PF 1:2 f=50mm
MINOLTA LENS MADE IN JAPAN
1A
2
A


1
2
3
B


C
8
1
3
4
2

Wide-angle and fisheye lenses

The MC Rokkor range of really wide-angle lenses includes four 28 mm lenses offering a choice of maximum aperture, two 24 mm, a 21 mm, a 17 mm and 16 mm and 7.5 mm fisheyes. They are all of 'reversed telephoto' (retrofocus) construction, to leave room for the mirror to move up and down.

The 28 mm lenses are regarded by many photographers as the upper limit of true wide angles, and this focal length is increasingly being chosen as the first accessory lens. It can be used to give a broad view, although distant objects may in some cases appear so small as to be insignificant. It is also extremely useful when shooting in confined spaces, but such conditions demand care to produce natural looking pictures. For most purposes, the f3.5 lens is quite adequate, but if you commonly photograph under low light conditions, the extra cost and bulk of one of the faster lenses may be justified.

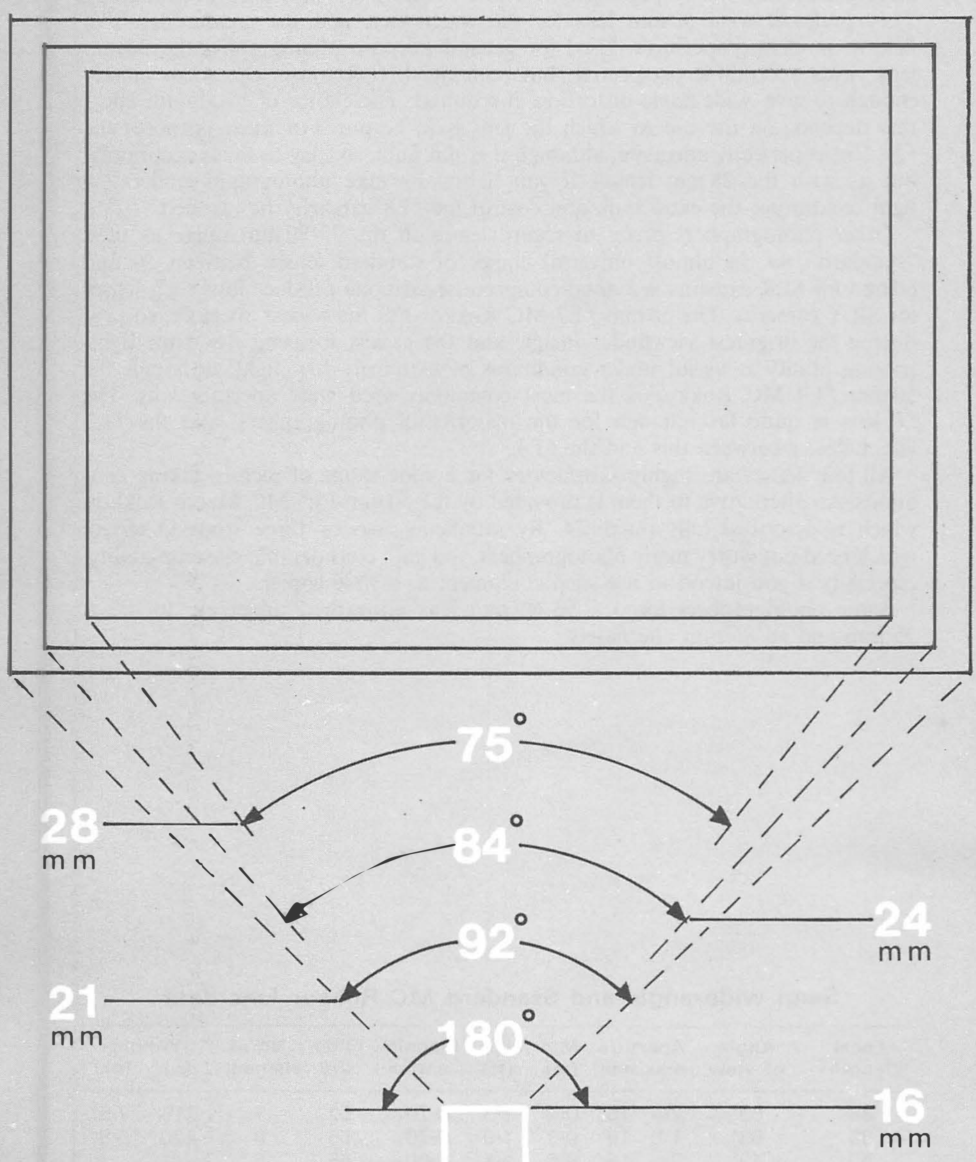
The extremely wide angle 24 mm f2.8, 21 mm f2.8 and 17 mm f4 MC Rokkors are more likely to be used for special effects than just to include as much of a view as possible. Because of their extensive depth of field even at quite large apertures, they can be used to picture small close-by objects sharply and larger than life against a much reduced but still sharp background. As with all wide-angle lenses, care must be taken to keep the camera back exactly vertical, otherwise any convergence will be emphasised.

A rather special lens is the 24 mm f2.8 MC VFC (Variable Field Curvature) Rokkor. It is similar to the ordinary 24 mm lens, but has the addition of a control ring to alter its curvature of field. By rotating a ring marked with concave and convex symbols, and colour coded to match the depth of field scale, the 'plane' of sharp focus can be altered from concave through flat (for normal use) to convex as the subject requires. This is particularly useful for making sharp close-ups of roughly spherical objects such as flowers.

The 7.5 mm f4 Fisheye Rokkor produces the characteristic circular image on the film, with a diameter of 23 in. The 16 mm f2.8 Fisheye Rokkor covers a diagonal angle of 180°. Straight lines at the edges of the picture are reproduced as curves, and the lens is not suitable for normal pictorial photography. These lenses have built-in filters, selected by rotating a ring at the front of the lens.

Wide angle MC Rokkor lens data

Focal length	Angle of view	Aperture max	min	Min focus (m)	(ft)	Magnification	Filter size	No of elements	Weight (g)	(oz)
7·5	180°	4	22	fixed			—	12	395	14
16	180°	2·8	22	0·3	1	0·33×	—	11	455	17
17	103°	4	16	0·25	1	0·4×	72	11	330	11·6
21	92°	2·8	16	0·25	0·8	0·42×	72	12	510	18
24	84°	2·8	16	0·3	1	0·48×	55	10	280	10
24 VFC	84°	2·8	16	0·3	1	0·48×	55	9	—	—
28	76°	2	16	0·3	1	0·56×	55	10	340	12
28	76°	2·5	16	0·5	1·6	0·56×	55	9	365	13
28	76°	2·8	16	0·3	1	0·56×	55	7	240	8·5
28	76°	3·5	16	0·6	2	0·56×	55	7	245	8·7


75°
28 mm
84°
24 mm
92°
21 mm
180°
16 mm

Semi wide-angle and standard lenses

The choice of a normal lens for general purpose photography is a subject of great contention. Many photographers like to use a 35 mm lens as 'standard'. They prefer it to a 50 mm lens for the wider view and the greater depth of field at moderate apertures. Used for general purpose photography, the 35 mm lens yields acceptable perspective, but both the MC Rokkors can focus closely enough to give 'wide-angle distortion' if required. The choice of maximum aperture depends on the use to which the lens is to be put. For most purposes the *f* 2.8 lens is perfectly adequate, although it is not quite so easy to focus accurately; but as with the 28 mm lenses, if you habitually take photographs under low light conditions, the extra bulk and cost of the *f* 1.8 lens may be justified.

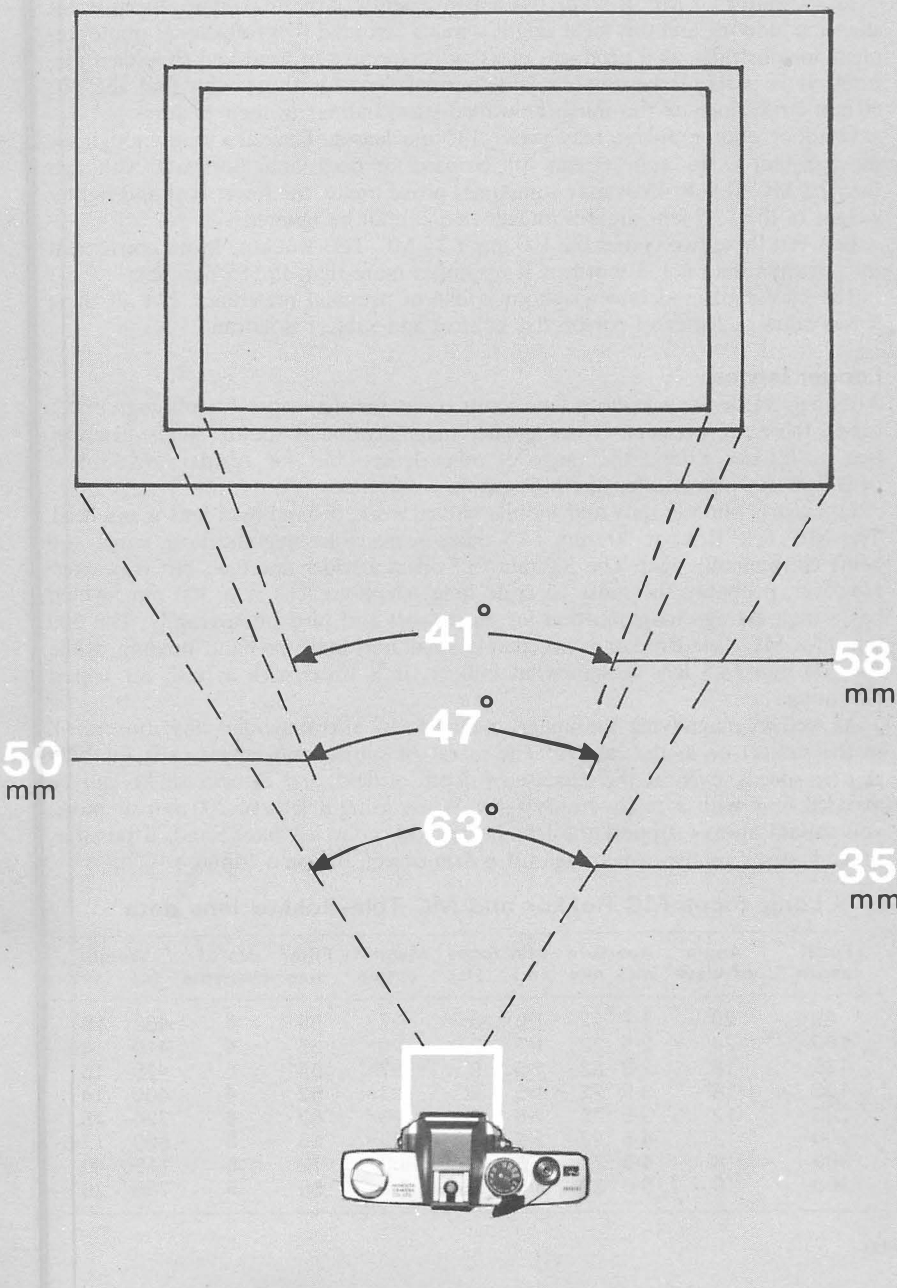
Other photographers prefer to regard lenses in the 75–90 mm range as their "standard", so the almost universal choice of standard lenses between 50 and 60 mm for SLR cameras is a good compromise. Minolta produce four such lenses for SR-T cameras. The 58 mm *f* 1.2 MC Rokkor has the widest aperture, so producing the brightest viewfinder image, and the easiest focusing. Its extra light-passing ability is useful under conditions of extremely low light, although the 50 mm *f* 1.4 MC Rokkor is the most commonly used wide aperture lens. The *f* 2 lens is quite fast enough for the majority of photographers, and the *f* 1.7 falls halfway between this and the *f* 1.4.

All four lenses are highly satisfactory for a wide range of picture taking situations. An alternative to them is provided by the 50 mm *f* 3.5 MC Macro Rokkor, which is described fully on p. 74. By sacrificing two or three stops in speed, which need not worry many photographers, you gain considerable close-up ability, especially if you intend to use such equipment as a slide copier.

Some photographers forgo a 50–60 mm lens altogether, preferring to use a 35 mm and an 85 mm alternately.

Semi wide-angle and Standard MC Rokkor lens data

Focal length	Angle of view	Aperture max	min	Min focus (m)	(ft)	Magnification	Filter size	No of elements	Weight (g)	(oz)
35	63°	2·8	16	0·4	1·3	0·70×	52	7	215	7·5
35	63°	1·8	16	0·3	1·0	0·70×	55	8	420	16·5
50	43°	2	16	0·5	1·7	1·00×	55	6		
50	47°	1·7	16	0·5	1·7	1·00×	55	6	240	8·5
50	47°	1·4	16	0·5	1·7	1·00×	55	7	305	12
58	41°	1·2	16	0·6	2·0	1·16×	55	7	475	18·5


41°
58 mm
47°
50 mm
63°
35 mm

Long focus lenses

Moderate telephotos

The most commonly used moderately long focal length lenses are those between 85 and 135 mm. There are four MC Rokkors between these limits.

The 85 mm *f* 1.7 MC Rokkor has a conveniently large maximum aperture for shooting indoors, and this focal length is much favoured by professional photographers for portraits, as it produces pleasing perspective in head-and-shoulders pictures. It is particularly suitable as a 'normal' lens for those who find the 50–60 mm lenses include too much unwanted surroundings in their pictures.

Outdoor photographers may prefer 135 mm lenses. They are long enough for most distant views, and yet can still be used for occasional portraits. Although the *f* 2.8 MC Tele Rokkor may sometimes prove useful, the lower cost and lighter weight of the *f* 3.5 lens are advantages that cannot be ignored.

Between these two comes the 100 mm *f* 2.5 MC Tele Rokkor. More convenient for portraits than a 135 mm lens it magnifies more than the 85 mm lens.

The choice of moderate telephoto is one of personal preference, but all these lenses allow a degree of perspective control and subject isolation.

Longer lenses

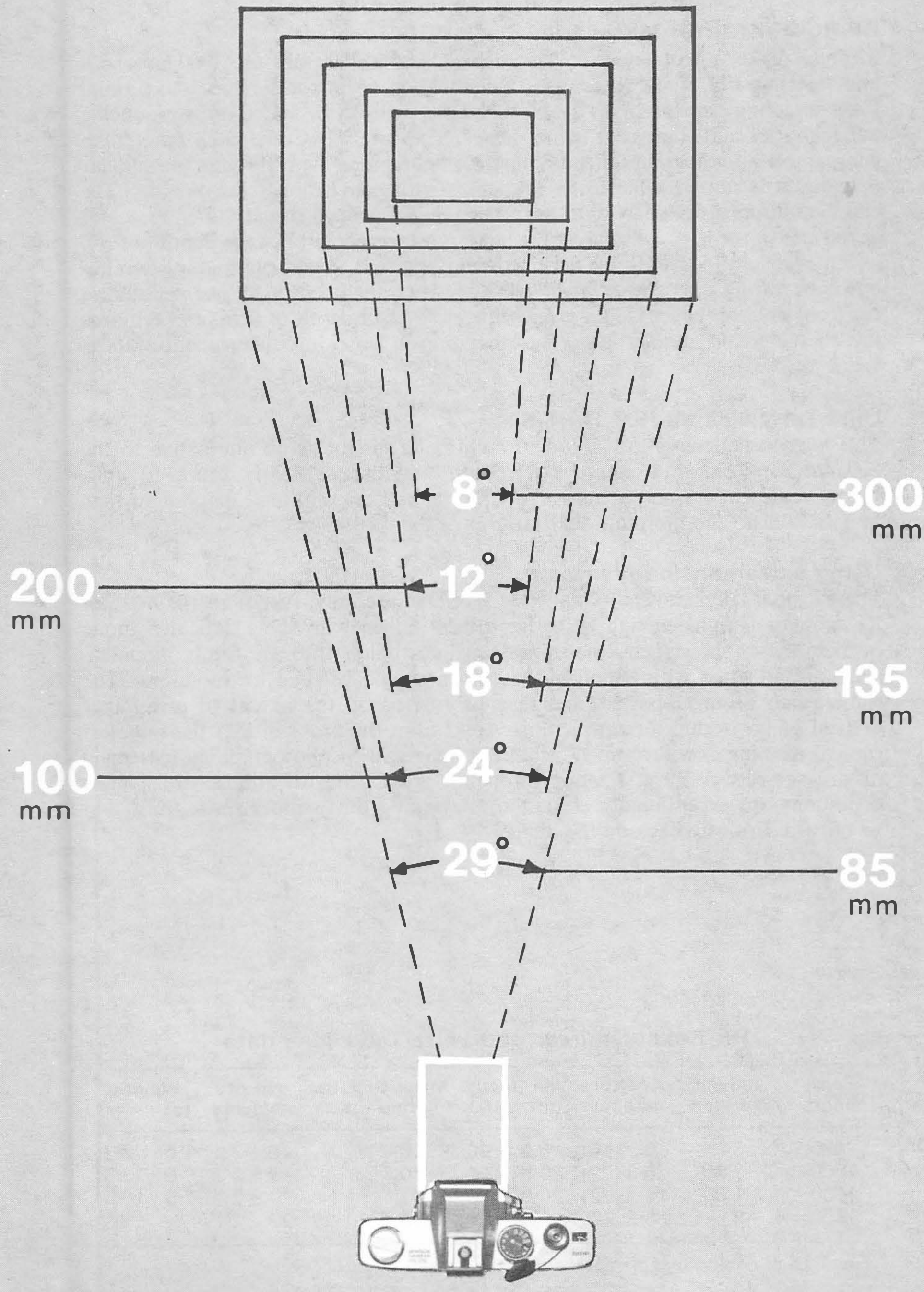
Although moderate telephoto lenses can cover the majority of a photographer's needs, there are occasions when greater magnification is useful. A tele-extender (see p. 72) can extend the range of other lenses, but for regular use, a lens of 200 or 300 mm is often the best answer.

For sports photography and mobile nature work, a hand-held lens is essential. The MC Tele Rokkor 200 mm *f* 4.5 offers reasonable magnification, while still being conveniently light. The 200 mm *f* 3.5 offers a wider aperture, but is heavier. However, probably the most versatile long telephoto lens is a 300 mm, which has a high enough magnification for most sport and bird photography. The 300 mm *f* 5.6 MC Tele Rokkor is acceptably small and light for hand holding, while the 300 mm *f* 4.5 lens is somewhat bulkier. It is fitted with a bush for tripod mounting.

As well as magnifying the image, a long focus also magnifies any movement, in the subject or in the camera. The arrest of subject movement calls for high shutter speeds, even at the expense of depth of field, and camera shake can be avoided only with a really steady hold. When using a lens of 200 mm or more, you should always support the lens barrel with your left hand; and, if possible, brace yourself or the camera against a firm object, or use a tripod.

Long focus MC Rokkor and MC Tele-Rokkor lens data

Focal length	Angle of view	Aperture max	min	Min focus (m)	(ft)	Magnification	Filter size	No of elements	Weight (g)	(oz)
85	29°	1·7	22	1·0	3·3	1·7×	55	6	460	16
100	24°	2·5	22	1·2	3·9	2·0×	55	6	410	14·5
135	18°	2·8	22	1·5	5	2·7×	55	6	425	15
135	18°	3·5	22	1·5	5	2·7×	52	4	400	14
200	12°	3·5	22	2·5	7·5	4·0×	62	6	720	25
200	12°	4·5	22	2·5	7·5	4·0×	55	5	500	17·5
300	8°	4·5	22	4·5	15	6·0×	72	6	1150	40
300	8°	5·6	22	4·5	15	6·0×	55	5	730	25


8°
300 mm
200 mm
12°
18°
135 mm
100 mm
24°
29°
85 mm

Extreme long focus lenses

RF Rokkor Mirror lenses.

Minolta make mirror lenses in three focal lengths: 800 mm *f*8, 1000 mm *f*6.3, and 1600 mm *f*11. These lenses use a combination of mirror surfaces and normal glass refracting elements. This enables the light paths to be folded, thus producing much shorter and somewhat lighter lenses. They are, however, much fatter than comparable all-refracting units. Because the light enters them through an annular opening, it is not possible to fit the lenses with conventional diaphragms. The effect of stopping down is obtained by placing a neutral density filter in a slot at the rear of the lens. This affects the light transmission, but not the depth-of-field, which is determined only by the maximum aperture. Some photographers stop down by fitting an opaque cover which restricts light entry to one quarter of the front area of the lens. This gives some increase in depth of field, and removes the characteristic annular highlights that mirror lenses produce in out-of-focus areas.

Leitz Telyt 800mm *f*6.3 Telyt-S

This long focus lens is available with a Minolta mount as an alternative to the 800 mm RF Rokkor. It is not a telephoto, and thus is nearly 1 m (3 ft) long. Under some circumstances, its narrow profile and conventional diaphragm may be preferred to the more unusual features of the mirror lens.

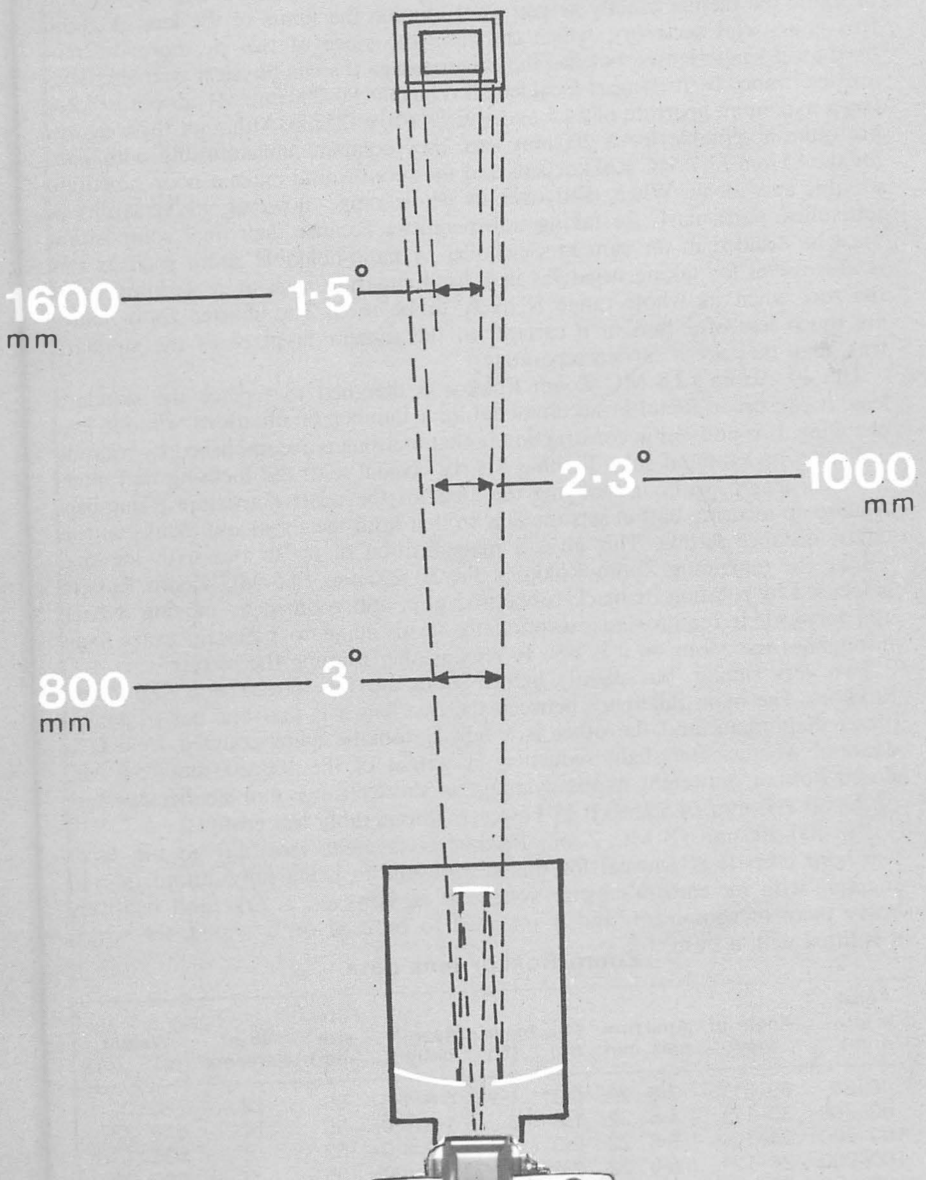
Using extremely long lenses

These "super-telephotos" are really for specialist use only. Although the 800 mm RF Rokkor is light enough to be hand held—albeit with some difficulty—none of these lenses show their true optical qualities unless they are firmly mounted. They are all fitted with tripod bushes which should be used for mounting. The camera can be unsupported, and may be rotated on the mount to give either vertical or horizontal format pictures. Apart from the problem that the minutest camera movement will result in a blurred image, when photographing extremely distant subjects you are shooting through a great depth of atmosphere. Unless conditions are exceptionally clear, the intervening dust, smoke, haze, mist and so on will seriously degrade the image.

RF Rokkor mirror and Leitz Telyt lens data

Focal length	Angle of view	Aperture max	Aperture min	Min focus (m)	Min focus (ft)	Magnification	Filter size	No of elements	Weight (g)	Weight (oz)
800	3°	8	(16)	8·0	26	16×	*	8 + 2	1·5	3·3
1000	2°20	6·3	(22)	30·0	100	20×	*	7 + 2	10·6	23·5
1600	1°30	11	(22)	20·0	70	32×	*	7 + 2	7·5	18·5
800	3°	6·3	32	12·5	41	16×	1·38	3		

* Filters to fit behind rear element supplied with lens.



1600 mm
1·5°
2·3°
1000 mm
800 mm
3°

Zoom lenses

Zoom lenses are constructed so that you can alter their focal length while the image remains in focus and the *f*-number remains the same. This allows you to frame the picture exactly as you want—within the limits of the lens. A zoom lens is a useful accessory, which can take the place of two or more different fixed focal length lenses, but has the disadvantage that its physical characteristics are determined by its longest focal length. Thus the 80–200 mm MC Zoom Rokkor has a maximum aperture of *f*4.5 and weighs 650 g (23 oz). Although these figures are quite acceptable for a 200 mm lens, they compare unfavourably with data for the 85 mm *f*1.7 MC Rokkor lens and the zoom would make a poor substitute for this lens alone. When used over its whole range, however, its versatility is unrivalled, particularly for taking transparencies because their final composition must be decided in the camera viewfinder. A hand-holdable zoom such as this is also useful for taking negatives in a fixed situation such as a wedding or at the zoo, when its whole range is likely to be used. The shorter zoom lenses are much less of a burden if carried on the camera in place of the standard lens, than they are if carried separately.

The 40–80 mm *f*2.8 MC Zoom Rokkor is designed to replace the standard lens. It can prove useful in accommodating a number of situations without lens changing. It is unusual in construction in that focusing is accomplished by rotating a dial on its left-hand side. Turning a lever coaxial with the focusing dial alters the focal length, without changing the focus or the relative aperture (*f*-number). A close-up focusing button sets the lens so that both the zoom and focus controls adjust distance setting. This gives a magnification of up to one-sixth life size.

Like the remaining Zoom Rokkors, the 80–200 mm *f*4.5 MC Zoom Rokkor is focused by rotating its black rubberised grip, and zoomed by moving it back and forward. It requires an exceptionally steady hand to maintain exact focus throughout the zoom, so it is best to refocus after framing the picture.

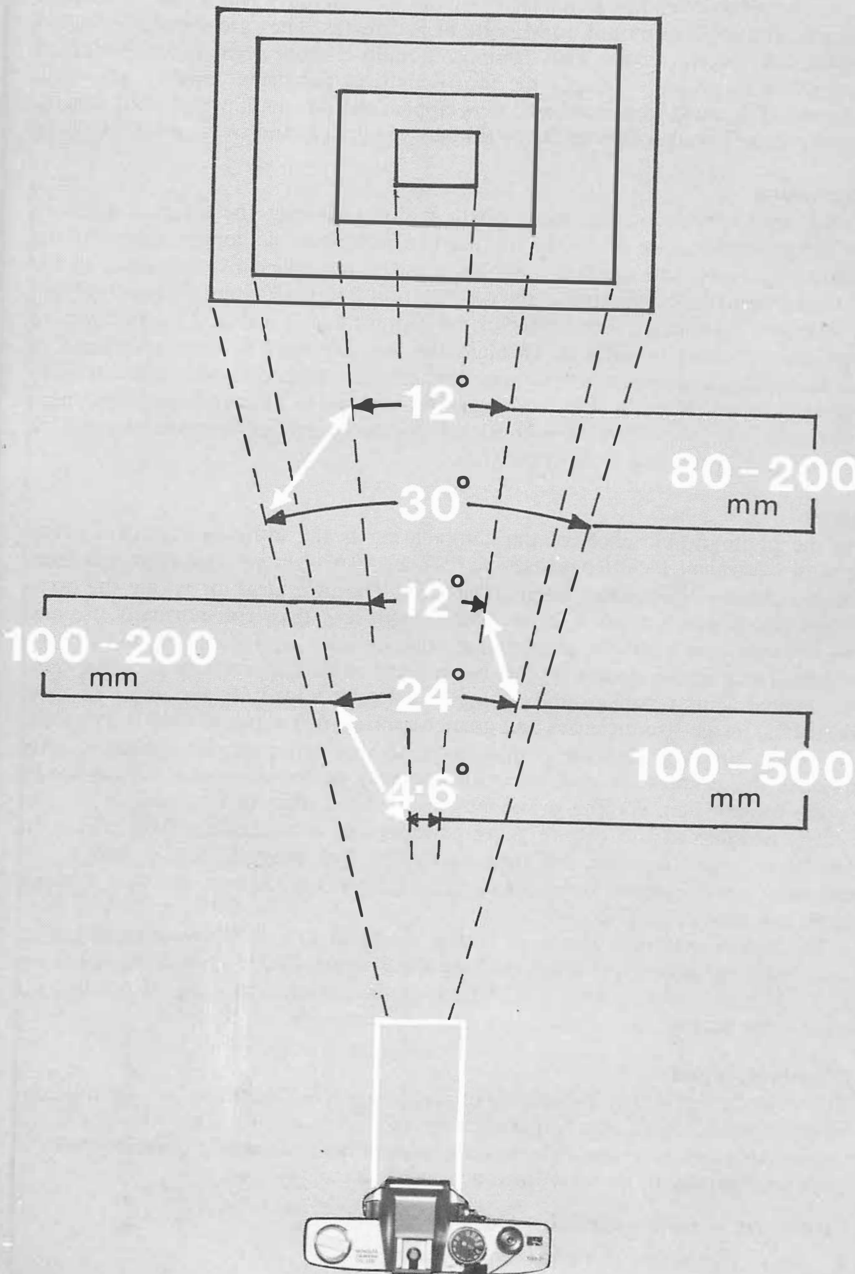
Two very similar, but slightly lighter lenses are the 100–200 mm *f*5.6 Zoom Rokkors. The main difference between the two lenses is that one has a manual preset diaphragm, and the other is a fully automatic meter-coupled lens. It is doubtful whether the slight reduction in weight of the 100–200 mm *f*5.6 MC Zoom Rokkor outweighs its disadvantage of shorter range and smaller aperture of the 80–200 mm *f*4.5 lens. It is, however, considerably less costly.

The 100–500 mm *f*8 MC Zoom Rokkor gives great versatility to the super telephoto user. It is unusual for this size of lens in being fully automatic and coupling with the camera's meter system. It is, however, a large and relatively heavy piece of equipment, and is intended to be used on a tripod, for which it is fitted with a bush.

Zoom Rokkor lens data

Focal length (nm)	Angle of view	Aperture max	Aperture min	Min focus (m)	Min focus (ft)	Magnification	Filter size (mm)	No of elements	Weight (g)	Weight (oz)
40–80	59–31°	2·8	22	0·37*	1·25*	0·8–1·6×	55	12	580	20
80–200	30–12°	4·5	32	1·8	6	1·6–4·0×	55	14	650	23
100–200	24–12°	5·6	22	2·0	6·5	2·0–4·0×	52	8	535	19
100–200	24–12°	5·6	22	2·5	8	2·0–4·0×	55	8	600	21
100–500	24–4°40	8	32	2·5	8	2·0–10·0×	72	16	1850	65

* Using close-focusing button.



12°
80-200 mm
30°
12°
100-200 mm
24°
100-500 mm
4·6°

Tele-extenders

A number of independent lens makers supply tele-extenders which can fit between the lens and the lens mount on Minolta SLR cameras. They are sometimes called behind-the-lens converters. They comprise a multi-element negative lens mounted in a short barrel and multiply the focal length of the prime lens by a specific amount. The most common extenders approximately double the focal length. Others treble it and some can be varied between double and treble multiplication.

Exposure

Tele-extenders increase the focal length without altering the effective aperture of the prime lens (see p. 26) so the marked *f*-numbers no longer represent the relative aperture. The marked *f*-number must be multiplied by the power of the extender to give the *f*-number of the combination. Thus a 50 mm *f* 1.4 lens becomes a 100 mm *f* 2.8 with a 2× extender or a 150 mm *f* 4 (4.2) with a 3×. All aperture settings are similarly affected. Through the lens exposure systems take account of this effect and indicate the exposure actually needed. Some tele-extenders are available with automatic diaphragm mechanisms to allow normal diaphragm operation; but few will couple with the full-aperture metering system and metering is normally in the stop-down mode.

Uses

As the photographic effect of the combination is the same as that of a prime lens of equivalent focal length (see p. 124), tele-extenders provide relatively inexpensive means of obtaining telephoto results. They are ideal for taking the occasional photo which needs a longer focal length lens than you normally use and do not add much to the weight and bulk of your equipment. Shot with the standard lens on the camera (1), for instance, the animal opposite looks unimpressive against a fussy background. With the extender added (2), the angle of view decreases, image size increases and greater control over depth of field is available. A further bonus is that the combination of lens and extender focuses exactly as does the prime lens, and thus can normally be focused on a subject closer to the camera than could a prime lens of the same effective focal length.

It is possible to use two or more extenders in combination; their effects on focal length and aperture are then multiplied. For example, a 2× and a 3× extender together would turn a 58 mm *f* 1.2 lens into a 350 mm unit with a maximum aperture of *f* 8 (7.2).

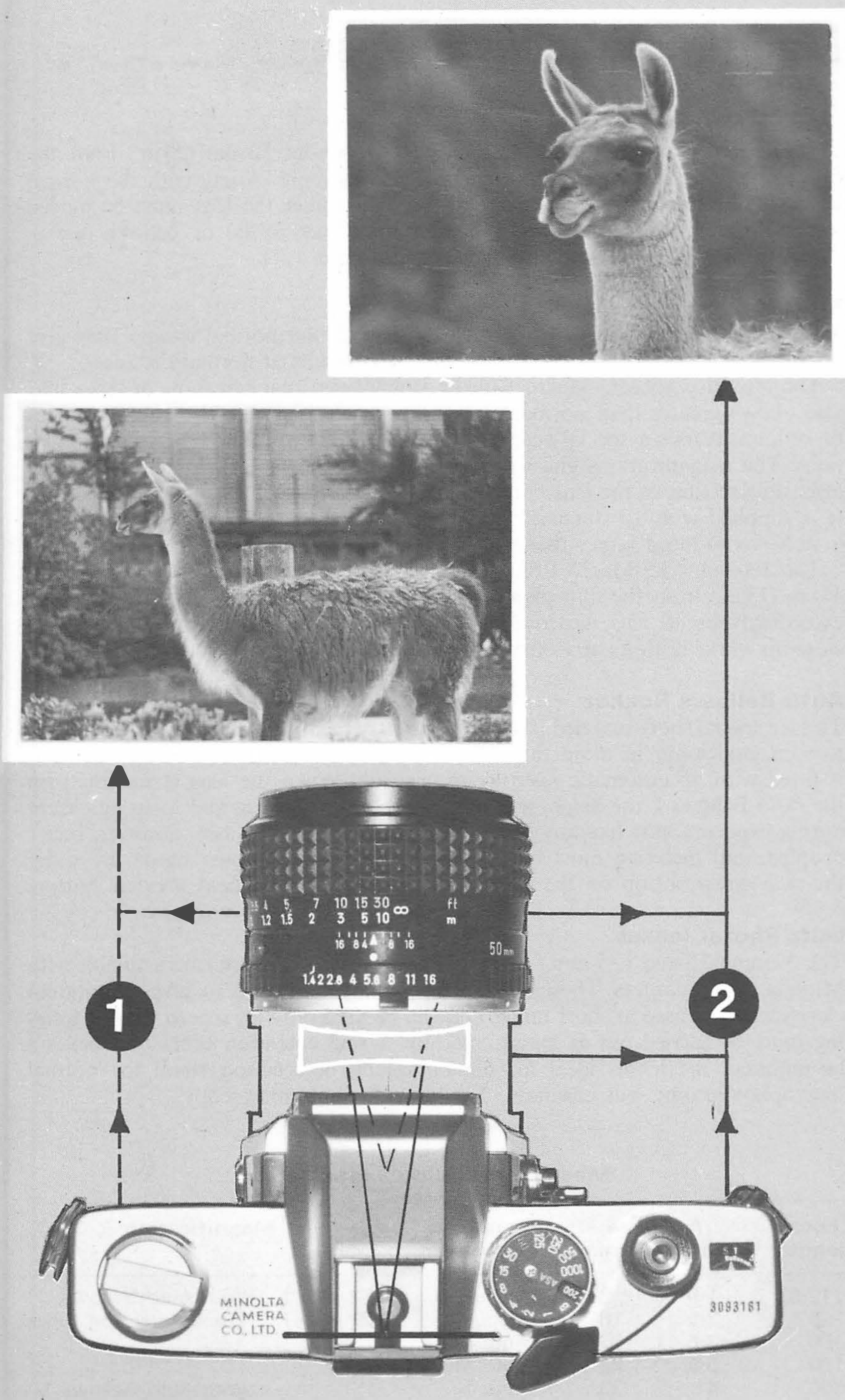
The use of extenders is not, of course, confined to extending standard lenses. They have an equivalent effect on long focus lenses (a 2× converter makes an *f* 2.8 135 mm lens into an *f* 5.6 270 mm combination); and even, if needed, on wide-angle lenses.

Disadvantages

Tele-extenders multiply the effects of the prime lens, including any aberrations or other faults. Also, many extenders are of poorer quality than Minolta prime lenses. As a result, extender/lens combinations do not usually produce pictures quite as sharp as those taken with a prime lens.

Effect of a tele-extender

1 Area covered by standard lens.
2 Magnification increased with a 2x extender


1
2
4 5 7 10 15 30 ∞ ft
1.2 1.5 2 3 5 10 m
16 8 4 8 16
50mm
1.4 2 2.8 4 5.6 8 11 16
MINOLTA
CAMERA
CO., LTD.
ASA
3093161

Macro and bellows lenses

The standard lens on Minolta SLRs focuses to about 50 mm (20 in.) from the film plane (indicated by the -⊖- mark). To focus more closely with the normal lens, thus producing a larger image on the film, either the lens must be moved further from the camera—using extension tubes (see p. 76) or bellows (see p. 78) or it must be fitted with an auxiliary lens (see p. 121).

Macro lenses

MC Macro Rokkor lenses (A) focus closer than similar normal lenses. They give optimum performance at close range, and good results at normal distances.

The 50 mm *f*3.5 MC Macro Rokkor lens gives a magnification of 0.5 × and also allows greater than normal magnification when used with extension tubes or bellows. It uses a special accessory extension tube to allow life-size reproductions. The magnifications given with or without the adapter are marked on the extensible section of the lens barrel, and are revealed as the lens is focused out. It is supplied with a reversing ring which should be used whenever the subject is to be reproduced larger than life-size, ie on bellows or extra extension tubes.

The 100 mm *f*3.5 Macro Rokkor lens focuses unaided from infinity down to 45 cm (18 in.) from the film plane, also giving a magnification of 0.5 ×. It is an exceedingly useful lens, suited to portrait and candid photography as well as close-up work. With its accessory extension tube it can give life-size reproduction.

Auto Bellows Rokkor

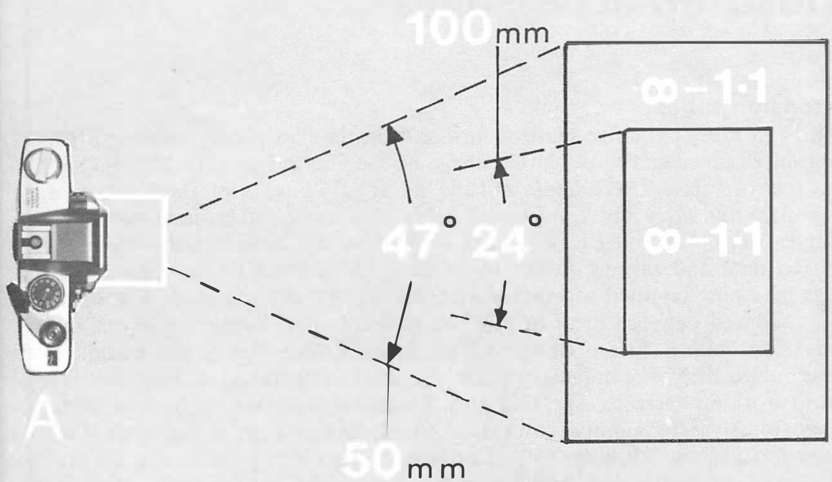
This is a special short-barreled 100 mm *f*4 lens (B) which allows focusing from infinity to a magnification of more than life size when mounted on a bellows unit. It is fitted with an automatic aperture mechanism. When the lens is mounted on the Auto Bellows I, the diaphragm remains open for viewing and focusing except during exposure, just like any other auto Rokkor lens. It is not, however, meter coupled, and metering must be carried out in the stop-down mode, by using the stop-down button on the camera or its own depth-of-field preview button.

Leitz Photar lenses

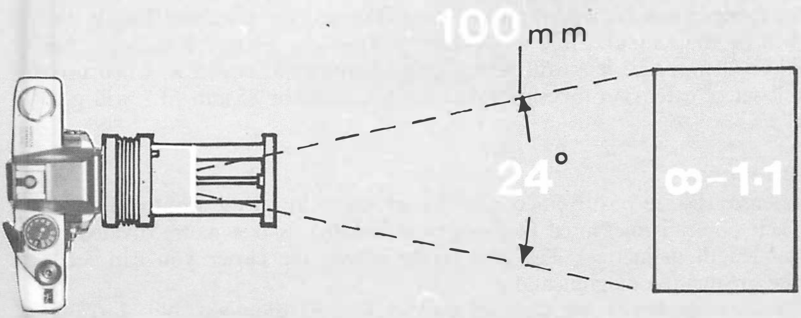
The 25 mm *f*2.5 and 12.5 mm *f*1.9 Leitz Photar macro lenses (C) are available with Minolta SLR adapters. These lenses are specially computed to give exceptional clarity when focused at short range, and can be used only for macro work. Metering must be carried out at taking aperture. Using extension tubes and bellows as required, the lenses ideal for photographing objects too small for normal macrophotography, but unsuitable for full-scale photomicroscopy.

Macro and Bellows lens data

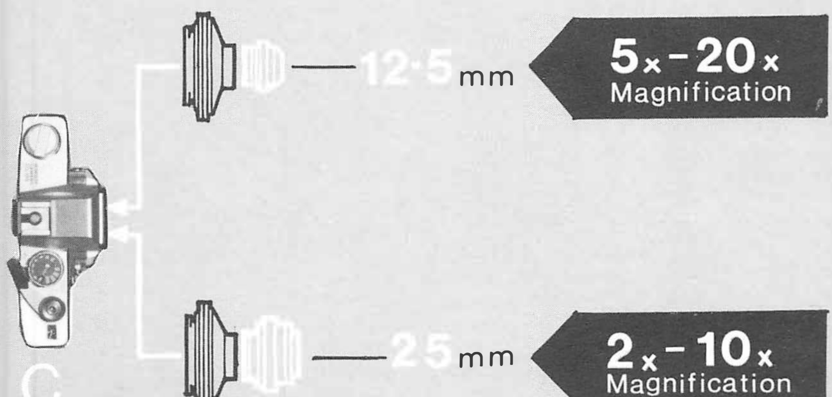
Focal length	Aperture max	Aperture min	Diaphragm mechanism	Magnification	
12·5	1·9	8	Manual	5×–20×	With Auto Bellows 1 and extension tubes
25	2·5	16	Manual	2×–10×	
50	3·5	22	Auto MC	1:1	With Adapters
100	3·5	22	Auto MC	1:1	
100	4	32	Auto	1:1	With Auto Bellows 1


100 mm
∞-1:1
47°
24°
∞-1:1
50 mm

A


100 mm
24°
∞-1:1

B


12·5 mm
5x-20x
Magnification
25 mm
2x-10x
Magnification

C

Close-up accessories

Extension tubes

Extension tubes (A) move the lens further from the film plane, allowing a closer focusing distance and thus a larger image on the film (see p. 121). Minolta supply two sets of tubes. The Extension Tube set II (2) consists of three tubes of 7, 14 and 28 mm ($\frac{1}{3}$, $\frac{2}{3}$ and 1 in.), which screw into one another, and two bayonet adapter rings, EB and EL. Ring EB is fitted to the camera body by aligning the red dots and turning in the usual way; EL is fitted to the lens. The two rings may now be fitted together (giving 7 mm ($\frac{1}{3}$ in.) extension), or one or more tubes screwed between them to give the required magnification between 0.14× and 1.21× with a 50 mm standard lens. When Rokkor lenses are mounted on these tubes, their diaphragms operate manually, and metering must be carried out at working aperture. The MC Auto Extension Tube set (1) consists of three tubes (14, 21 and 28 mm). They extend the focusing range in the same way as the manual tubes, but allow full aperture metering (and exposure control on the XE-1) and automatic diaphragm operation. Each tube has bayonet mounts, and they do not use adapter rings.

Extension tubes can be used with any lens. The shorter the focal length, the greater will be the magnification at any given extension. Thus, for example, the MC Rokkor 28 mm f2.5 lens will give a magnification of about 2× when used with a full set of extension tubes, whereas the MC Rokkor 85 mm f1.7 will give about 0.75×.

Close-up lenses

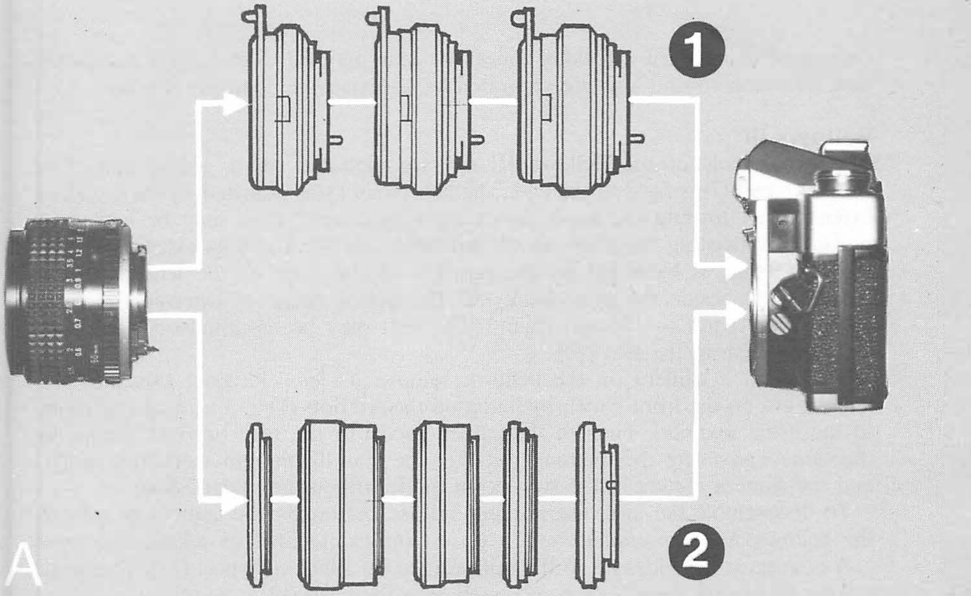
Close-up lenses (B) are positive accessory lenses which fit on the front of normal lenses. Their power is measured in dioptres (calculated as one metre divided by their focal length in metres). The greater the power, the closer you can focus and so the greater the magnification.

Minolta close-up lenses are supplied as No. 0 (0.95 diopters), No. 1 (2.0D) and No. 2 (3.8D). Lenses No. 1 and 2 in combination give a focused distance of 23 mm (9 in.) from the subject. Lens No. 0 is normally used only to reduce the focus distance of telephoto lenses, as its effect on standard and wide-angle lenses is seldom useful.

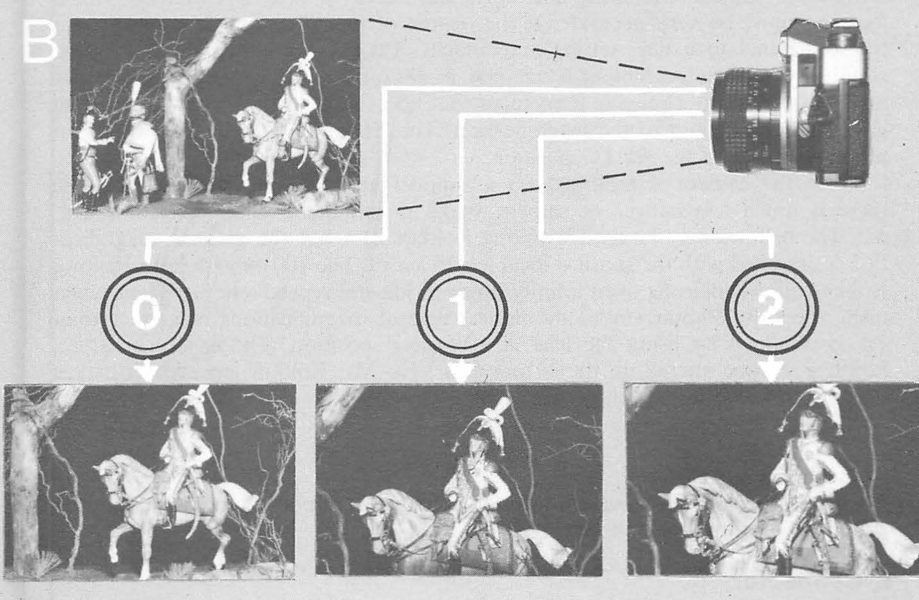
A Extension tubes
1 Auto extension tubes
2 Manual extension tubes

B Close-up lenses
Approximate magnifications of numbers 0, 1 and 2 close-up lenses

A



B



Extension bellows

Instead of using fixed extension tubes, the lens may be extended on a bellows unit. The camera and lens are separated by an extensible light-proof tube.

Bellows III

The two panels of the Bellows III (A) are mounted on a geared rail. The camera panel (7) is fixed at the end. The lens panel (3) is adjusted to the required extension by turning the knob on its right-hand side (4); it may be locked in position by twisting the knob on the left-hand side (9). The lens extension, from 30 to 160 mm, is indicated by the position of the front of the lens panel on the scale (6) beside the gear track (5). The actual range of extension is from 36 mm (1 7/16 in.) to 155 mm ($6\frac{1}{8}$ in.). The unit may be mounted on a support using the bush in the seat (10).

To mount a camera on the bellows, remove its lens; bayonet this into the lens mount on the front panel (by lining up the red dots (1) and turning clockwise in the usual manner). Then fit the camera body to the rear bayonet mount in the same way using the aligning dot (8). The lens diaphragm works manually, and the camera meters in the stop-down mode without any adaptation.

To disassemble the unit, use the lens release button on the camera to release the bellows, and the similar button (2) on the front panel to release the lens.

A connector (B) slides on to the rail, secured by a locking wheel (11). The Slide Copier or Macro Stand (see p. 82) screw into the bush (12).

Taking photographs

Unlock the lens panel and, using the right-hand knob (4), rack it forward to give the extension you need. Move the whole unit backward and forward to bring your subject into sharp focus. As the depth of field is extremely small, focusing must be very accurate. If the degree of magnification is wrong, move the lens panel to a new setting and refocus. Take a stop-down meter reading simply by setting the lens aperture (see p. 38), adjust the camera as necessary and press the shutter release. Remember that no extra adjustment to the exposure is needed on account of the magnification. The XE-1 operates in the stop-down mode when set to the AUTO position.

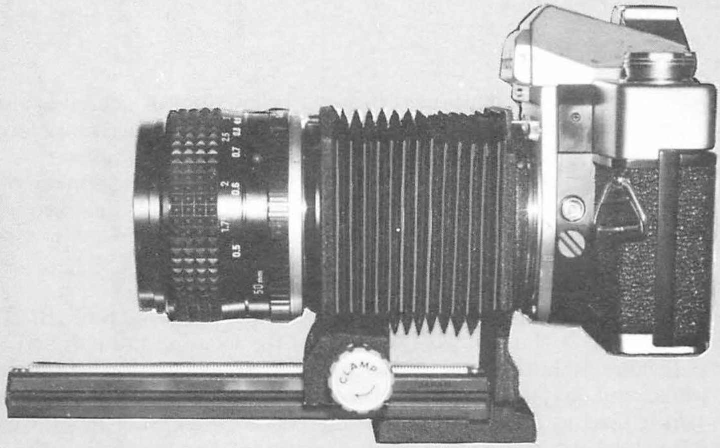
When the camera is mounted on a support and the shutter speed is slow, there is much less danger of camera shake if you use a cable release (see p. 52). The bellows may be used with any Rokkor lens, but the greatest magnification is obtained with the shortest focal length lenses. The 100 mm *f*4 Auto Bellows Rokkor allows focusing from infinity down to life-size reproduction. Except when using the Leitz Photar lenses, the flattest field at magnifications of greater than 1:1 is obtained by using the lens in a reversed position. The exact curvature, however, can be altered on the 24 mm *f*2.8 VFC MC Rokkor lens, which makes it highly suitable for use in taking extreme close-ups.

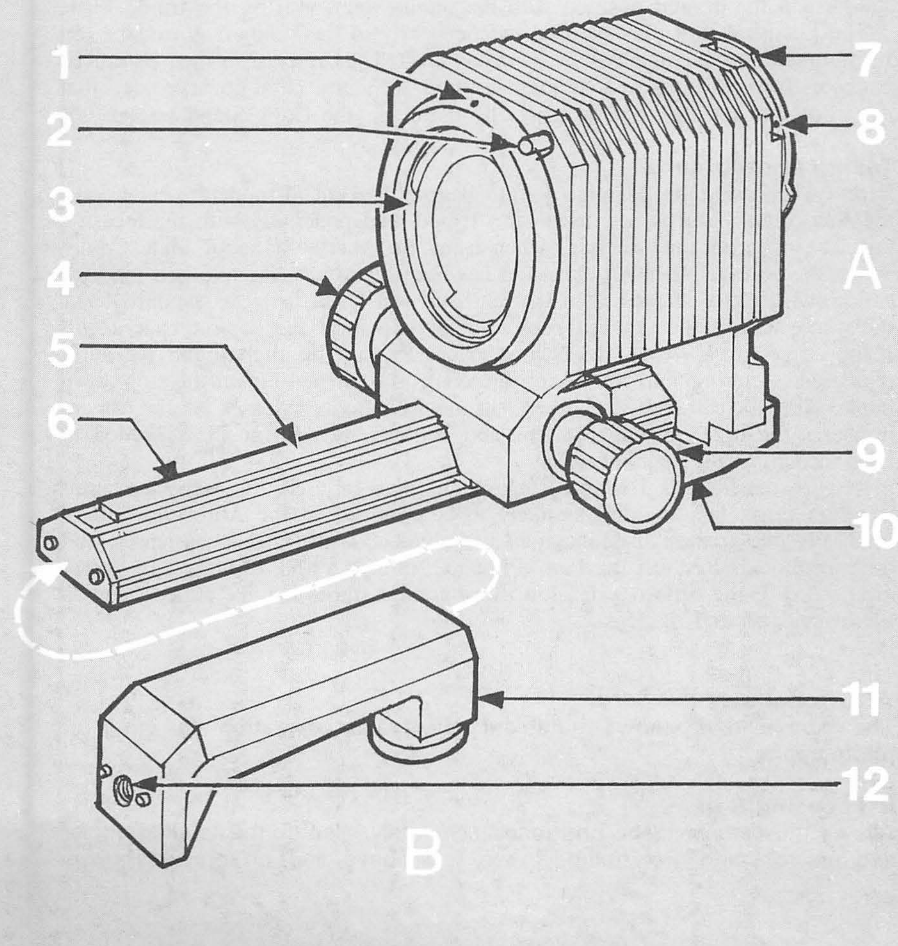
A Bellows unit III

A straightforward bellows unit suitable for most types of close-up photography. For numbers, see text.

B Connector

For fitting slide copier or macro stand.


CLAMP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Autobellows I

The Autobellows I (A) is a sophisticated twin-rail bellows unit which gives automatic lens diaphragm operation. It is designed to fit simply to an accessory focusing rail, which in turn holds the macro stand or slide copier as required.

The unit works just like the Bellows III (see p. 78) with the addition of a coupler (II) for automatic diaphragm operation. The left-hand rail is marked with approximate magnifications for a standard lens set to infinity.

Focusing rail

The bellows is designed especially to be fitted on the Focusing Rail (B). The front rail mounting (12) hooks under the front of the focusing rail (14) and the rear of the Bellows is held down by the tripod type screw (18) fitted to the rail. The whole unit may then be mounted on a tripod. The large right-hand rail knob (16) is used to move the camera and bellows back and forward, and the small left-hand knob (17) to lock them in position. The triangular piece on the front of the unit (13) is for mounting accessories such as the slide copier or macro stand (see p. 82). It can be moved in or out on its supports, and clamped in the desired position with the thumb screw (15) by the tripod bush.

The Focusing Rail may be used independently of the bellows. A camera can be mounted on the rear block by its tripod bush. The camera can then be racked back or forward as needed. It may be used with any close-up accessory that does not foul the rail, and is especially useful on the Copy Stand (see p. 90).

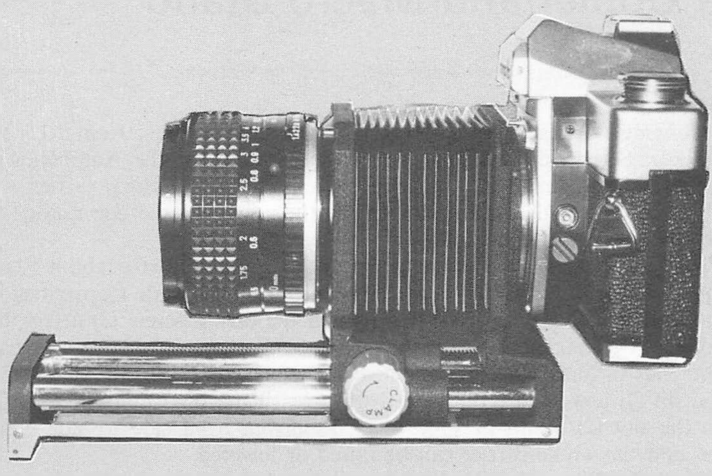
Taking photographs

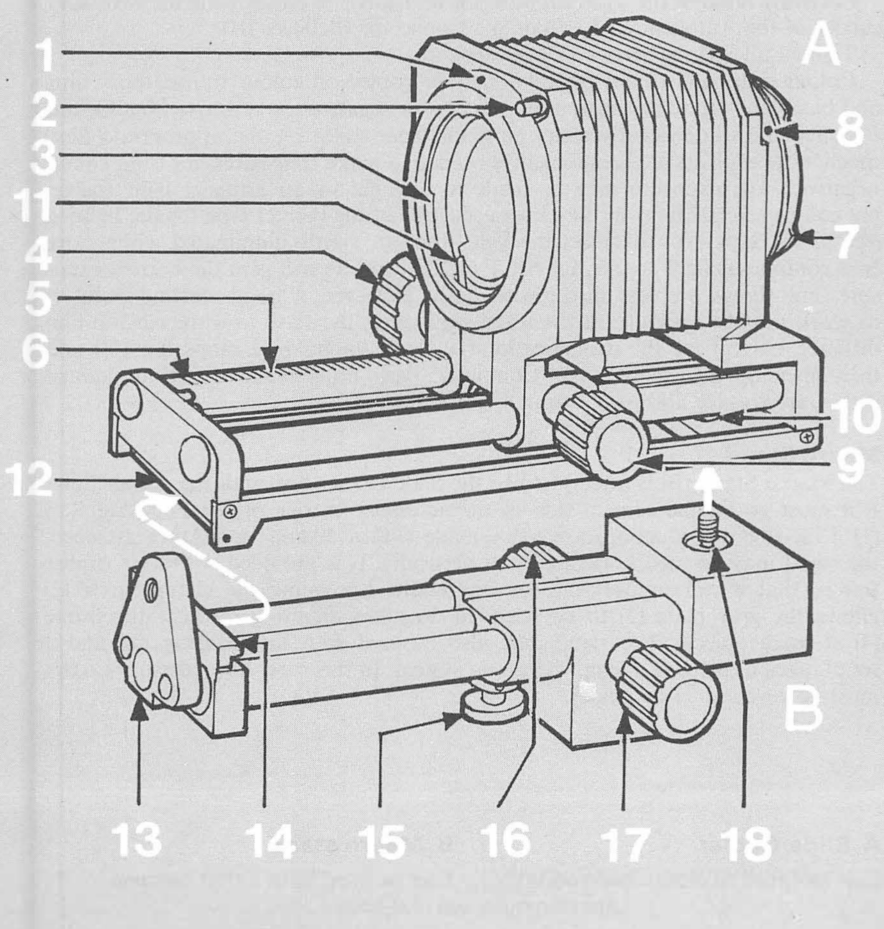
Except when using the 100 mm f4 Auto Bellows Rokkor at moderate extensions, the Autobellows unit is best used on a tripod, and preferably with the focusing rail. The tripod is not necessary when using the Macro Stand or Slide Copier When the necessary bellows extension has been set to give the required magnification (which can be read from the left-hand rail when using a standard lens), the whole unit is then racked back and forward until the subject is in focus. If the image size is wrong, the bellows extension must be altered, and the outfit refocused. Metering (and XE-1 exposure control) is carried out in the stop-down mode, using the camera's stop-down button with automatic lenses. As the camera measures the light through the lens and bellows, no adjustment is needed to take account of the magnification.

As with the Bellows III, any Rokkor lens may be used, but since the outfit is rather large, hand-holding is likely to be confined to the Autobellows lens. Naturally, the greatest magnifications are obtained with short focus lenses, and for exceptional close-ups the Leitz Photar 25 mm f2.5 and 12.5 mm f1.9 lenses are needed. If the bellows extension is not enough, tubes may be added between the front panel and the lens.

A Autobellows I
The Autobellows allows automatic diaphragm operation in close-up photography.

B Focusing Rail
Allows the camera to be positioned accurately, also connects slide copier and macro stand. For numbers, see text above and on previous page.

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Slide Copier and Macro Stand

Slide copying

For slide copying (A), use one of the standard lenses, or the 50 mm f3.5 MC Macro Rokkor. Set up the bellows in the normal way. Fit the Autobellows I on the Focusing Rail and bolt the slide copier to the accessory carrier with the thumb wheel (9). With the Bellows III, fit the copier to the connector, and slide the connector over the bellows rail.

Set the bellows extension to give the magnification you require (i.e. about 50 mm for 1:1 reproduction with a 50 mm lens). Now unclip (5) the Slide Copier bellows (4), fit them over the lens filter ring and tighten the clamp screw (3) at the top.

Two holders (6) are clamped into their holes with the two thumb screws (1) to hold the coils of film strips. These must be removed for copying slides. Film goes in the slit (7) just behind the hinged front (with the opal diffuser, 8); slides are put in the slot (2). Films or slides may be moved from side to side within the carrier, and the whole carrier can be raised or lowered.

Focus by moving the slide copier back and forward either with the accessory carrier of the Autobellows I (10) or the Connector (Bellows III).

Tighten all locking screws before exposure.

Colour slides and colour negatives may be copied on colour transparency film, and black-and-white transparencies made from negatives on negative film. Colour or black-and-white negatives can be made from slides on the appropriate film; much more sophisticated equipment is needed to make transparencies from colour negatives. The exposure may be made to daylight or an artificial light source, but colour reversal films in the camera must be of the correct type for the lighting (see p. 95). It is best to reflect the light from an evenly illuminated white card. In a continuous light source, the SR-T or XE-1 meters will give the correct exposure, but things are less direct with flash. However, a good starting point is to work out the aperture in the usual way using the flash-to-white-card-to-film distance, correct for the magnification (i.e. open up by $1\frac{1}{2}$–2 stops for 1:1) and then open up one more stop. 'Computer' flash units *must* be set to manual if they are to give a known output.

Macro Stand

The Macro Stand (B) is fitted just like the Slide Copier but, with the Autobellows I, it must go on the camera side of the accessory carrier of the Focusing Rail (1) if life-size reproductions are to be made with a 50 mm lens. Once attached, the stand may be used horizontally or vertically. It is provided with four rubber feet so that it can support the camera rigidly. Loosening the clamp screw (2) allows the grey plate (3) to be removed, to allow shooting through the frame (4) at small objects. The stand may also be used with the focusing rail and a set of tubes to provide a simple close-up system. In this case, the accessory carrier must be reversed in its guides.

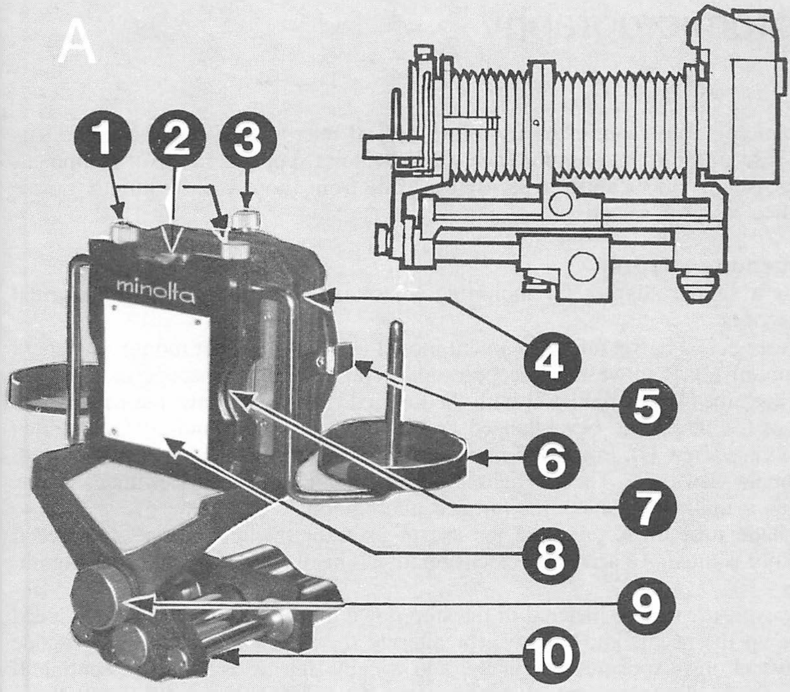
A Slide Copier

Can be fitted to either bellows unit.

B Macro stand

Can be used with either bellows.

For numbers, see text above.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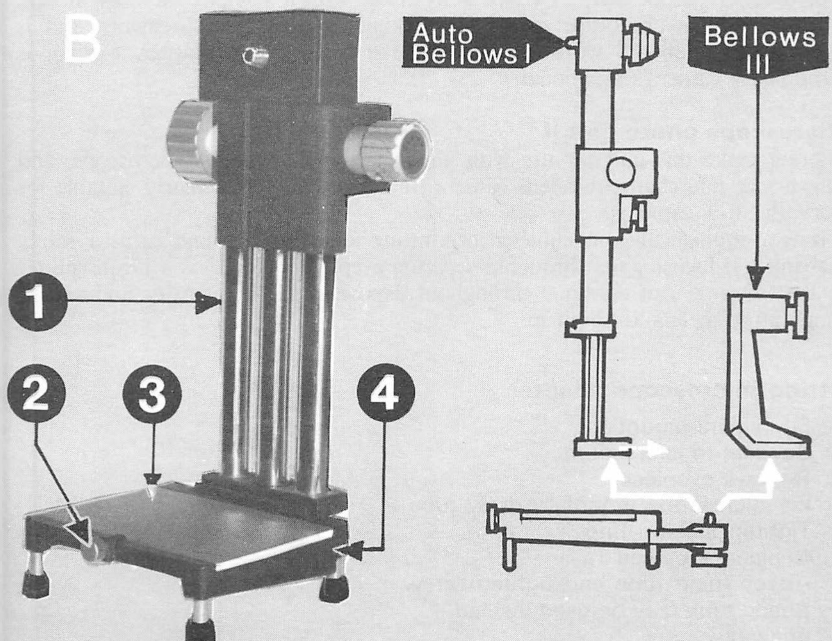
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Auto Bellows I
Bellows III
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Photomicrography

Photomicrographs require the use of an optical microscope, and the single lens reflex is ideal for adaptation for such work. Minolta supply a range of equipment of increasing sophistication to satisfy everyone from those who require a simple record to research scientists.

Microscope adapter

This is a simple adapter for mounting Minolta SR camera bodies on normal microscopes.

To use: Screw barrel into the camera mount (1); then bayonet mount to camera lens mount (2). Remove microscope eyepiece (3), fit the microscope mount over the draw tube (4) and tighten it with the knurled ring (5). Replace the microscope eyepiece (6), insert the bevel-flanged end of the microscope mount and tighten the locking screw (7). Focus the microscope in the normal way, looking through the camera viewfinder. The low light levels may cause an uneven viewfinder image, but this is unlikely to affect the finished photograph.

A shade tube (8) is provided for use in place of the microscope eyepiece if this is not wanted. An accessory extension tube is available to give greater magnification.

The exposure can be metered in the stop-down mode, altering the shutter speed to line up the needle and follower, or altering the light entering the microscope objective. Long exposures are likely, and a cable release is almost essential. If one is not available use the self-timer on the XE-1, SR-T 303 or SR-T 101.

Leitz Micro-Attachment

This is a microscope adapter which is available with a Minolta bayonet mount. It has a built-in phototube sensor for making exposure measurements, and is constructed to absorb vibration. As with the Microscope Adapter, viewing is through the camera's viewfinder.

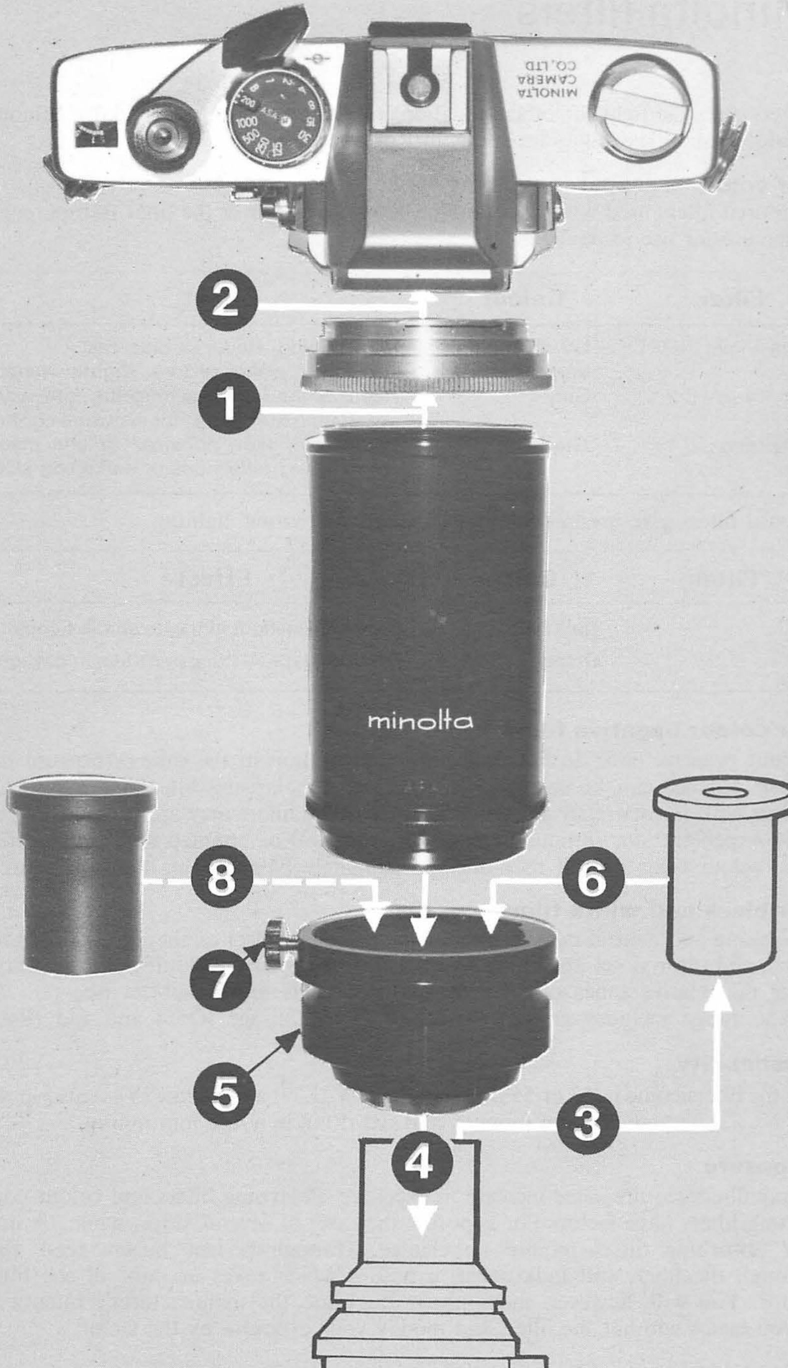
Microscope photo unit II

Minolta make this unit for use with almost any conventional microscope, and almost any interchangeable lens camera. It is, however, particularly suitable for use with SR-T cameras.

It is a sophisticated machine incorporating a microscope and camera stand. Viewing and focusing are through a separate eyepiece which uses a beam splitter so that viewing can continue throughout exposure. Light intensity and colour temperature meters are built in.

Fitting microscope adapter

1 Fit camera mount
2 Bayonet to lens mount
3 Remove eyepiece
4 Fit microscope mount to draw tube
5 Tighten locking ring
6 Replace eyepiece
7 Attach main tube and tighten screw
8 Shade tube may be used instead of eyepiece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Minolta filters

Filters alter the light (or other radiation) reaching the film (see p. 116). Minolta produce solid glass filters for use with Rokkor lenses.

For colour transparency films
Coloured filters used with reversal films alter the colour of the final transparency. Some are for use in daylight.

Filter	Colour	Effect
Ultra-Violet (L39)	UV-absorbing	Haze cutting, Reduces blue cast.
1A	Very pale pink	A UV filter, makes pictures slightly warmer.
ND × 4	Grey	Reduces the light reaching the film without altering the colour; for exposure control.
Polarizing	Grey	Passes only light polarized in one plane; for reducing reflections or darkening skies.

Special filters give normal colour balance in the 'wrong' lighting.

Filter	Colour	Effect
80B	Dark blue	For using daylight film with studio floods.
85	Orange	For using type A (tungsten) film in daylight.

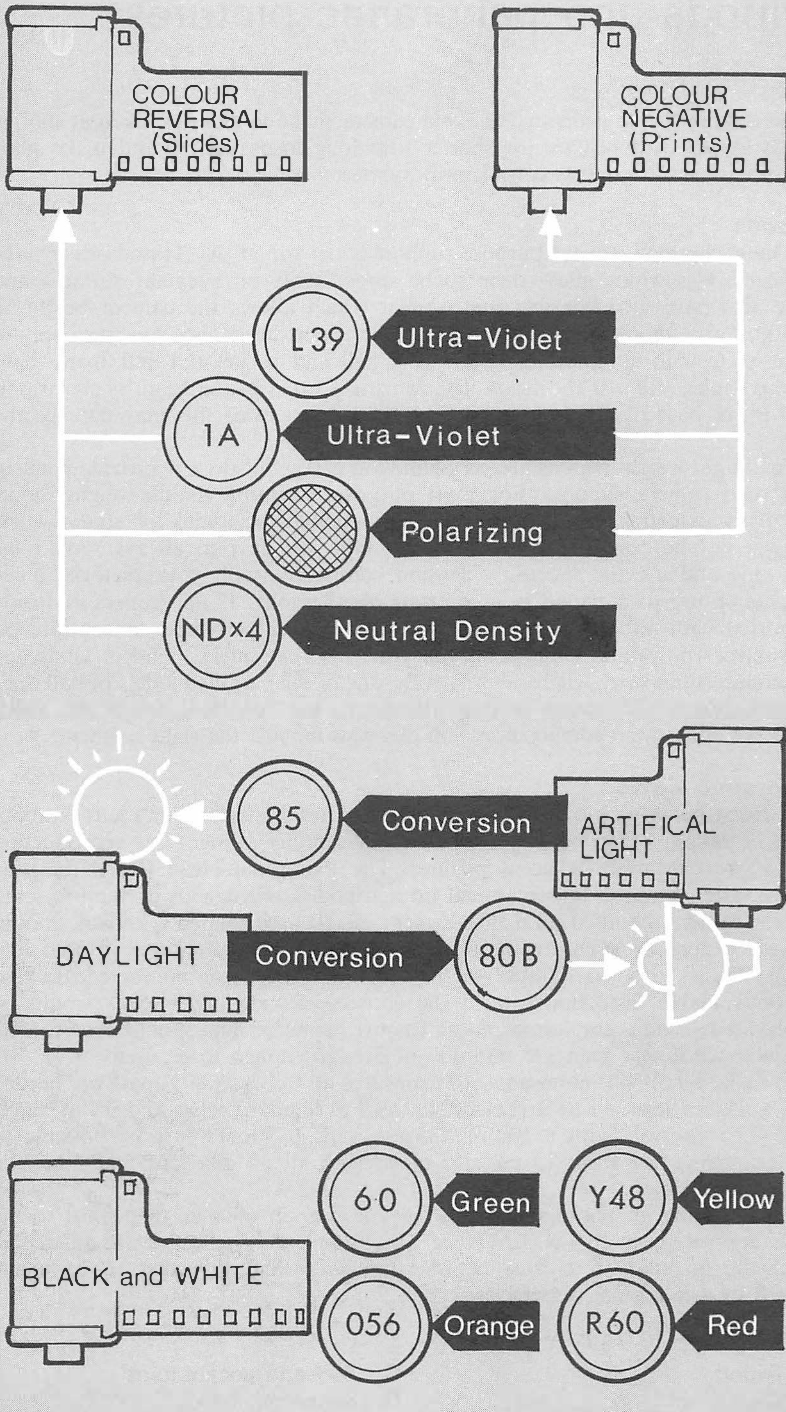
For colour negative films
Colour negative films do not need accurate filtration in the camera because the colour balance can be corrected in printing. A polarising filter acts exactly as it does with transparency films, and UV-absorbing filters may afford some degree of haze penetration. Optimum colour, however, will be attained with professional type colour films only if they are approximately balanced to the light source.

For black and white films
Polarising and neutral density filters have the same effect as they do with colour films, and ultra-violet absorbing filters may reduce haze. Coloured filters, simply alter the relative tones of different coloured parts of the subject (see p. 116).
The range includes green (60), yellow (Y48), orange (O56) and red (R60).

Availability
All the filters come in 52 or 55 mm mounts. UV (L39) and yellow (Y48) also in 46, 62, 67, 72, 77 and 126 mm mounts, and red (R60) in a 126 mm mount.

Exposure
Many filters require some increase in exposure. Polarising filters and colour converting filters have factors (for exposure increase) of several stops, while 1A and UV absorbing filters require no change. Through-the-lens meters read also through the filter, and indicate an exposure which takes account of the filter factor. You will, however, more nearly duplicate the manufacturer's intentions if you meter without the filter, and modify your exposure by the factor.

Minolta filters
Filters are available to suit most types of film.


COLOUR
REVERSAL
(Slides)
COLOUR
NEGATIVE
(Prints)
L39
Ultra-Violet
1A
Ultra-Violet
Polarizing
NDx4
Neutral Density
85
Conversion
ARTIFICAL
LIGHT
DAYLIGHT
Conversion
80B
BLACK and WHITE
60
Green
Y48
Yellow
056
Orange
R60
Red

Tripods and panoramic pictures

Camera supports are necessary to avoid camera shake in pictures taken at shutter speeds longer than 1/30 sec (or shorter with long focus lenses), and make photography of static subjects considerably simpler.

Tripods

The most common general purpose support is the tripod (A). Tripods have three extensible legs which allow them to be stood stably on irregular surfaces and some also have an extensible centre pillar which allows the camera height to be adjusted without disturbing the legs. The tripod head may consist simply of a flat plate with a mounting screw, or a ball and socket (C), but many have more complex *pan and tilt* heads. The camera is fitted to the head by the tripod bush in the base plate. Don't overtighten tripod screws as this may damage the bush.

Small light-weight tripods are very handy to carry, but do not provide particularly rigid camera support. For most purposes a sturdy middle-weight model will repay its extra bulk. A large heavy tripod may be useful for studio work, but will not be easily portable. Whatever type you favour, always spread the legs wide and use the shortest extension compatible with your pictorial aims.

A major use of a tripod is in portrait photography. If the camera is firmly supported with all its controls set, the photographer can then concentrate on the subject's poses and expressions. They are also extremely useful in landscape and architectural work where, alternatively, one of the various models of ball-and-socket supports with clamp or spike (B) can be used on trees, fences, etc. Once you have chosen the composition, you can wait for just the right moment.

Panoramic views

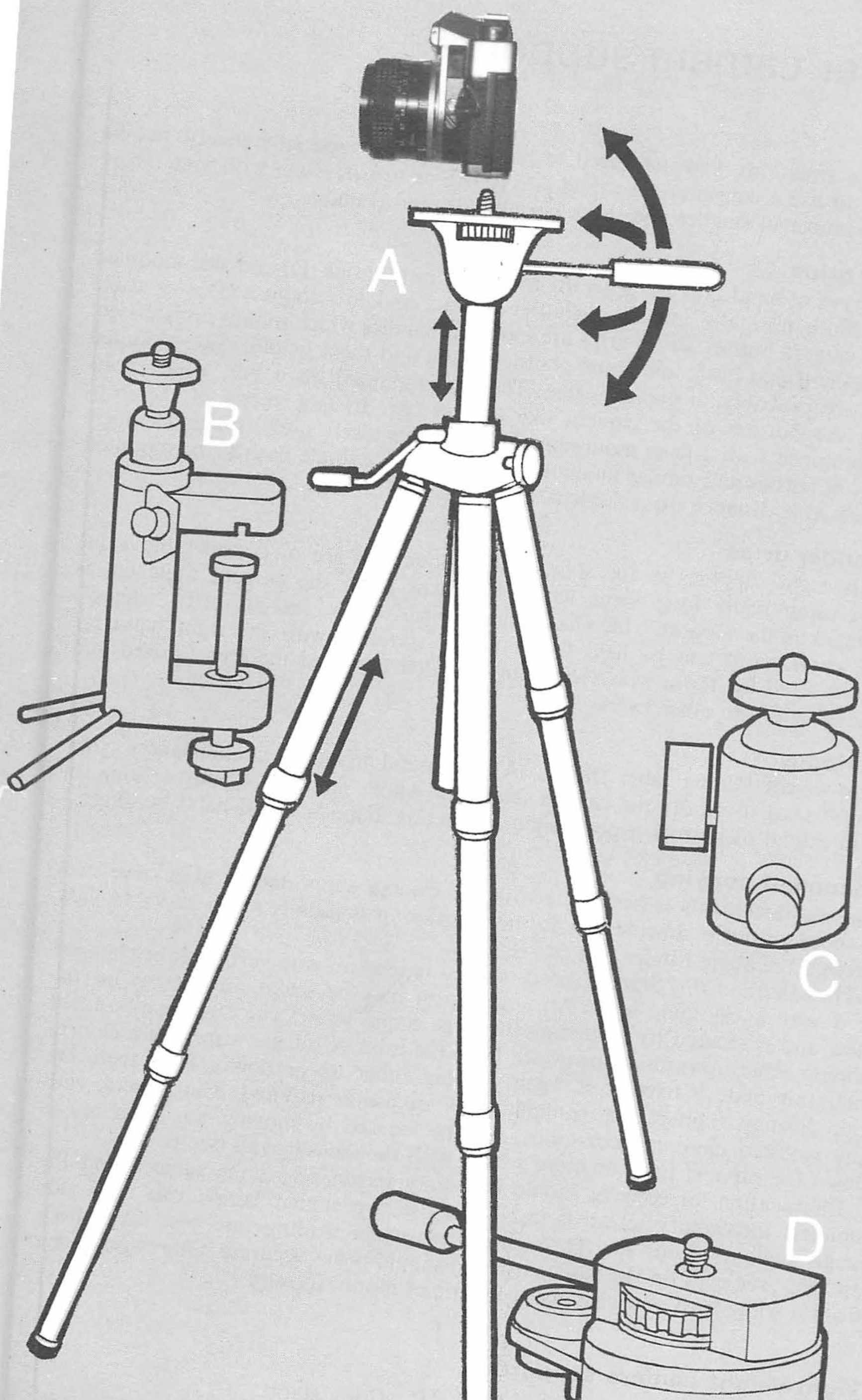
The widest horizontal angle available with a normal (straight-line) lens is about 100°. To obtain wider views, you must either sacrifice straight-line reproduction or take two or more adjacent pictures. The Panorama Head (D) is designed for the latter purpose. It is mounted on a tripod, levelled with its built-in level, and the camera mounted on it. The camera can then be rotated a known amount between exposures to ensure the necessary overlap. The rotation is divided into thirty 12° clicked positions, alternate (i.e. 24°) positions being numbered. Because the unavoidable distortion toward the corners of wide-angle lenses would be emphasised in adjacent frames, focal lengths below 35 mm should be avoided. Lenses much longer than 135 mm do not overlap enough to be used.

To make a full 360° panorama, 10 exposures at 3 clicks (36°) apart are needed with a 35 mm lens; 15 at 2 clicks (24°) with a standard lens; and 30 at single click (12°) intervals with a 100 or 135 mm lens. It should just be possible to create a panorama from 15 pictures taken with an 85 mm lens, but 30 make things much easier.

When joining up photographs, cut *half* the overlap off one, then fix it to the adjacent print in exactly the right place. This minimises the effect of size differences which are unavoidably created between the centre and the edge of the image formed by any normal camera lens.

Tripods and fittings

A Tripod
B Clamp
C Ball-and-socket joint
D Panoramic head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Other camera supports

In some situations, you may need to hold the camera especially steady, but be unable to use a conventional tripod (see p. 88), or to carry one with you. There are a number of smaller and more portable devices available.

Hand grips

Two types of hand grip are generally available: pistol grips (D) and side-mounted grips. Both normally include a shutter release, and are connected by a cable to the camera button. Pistol grips are moulded handles which mount immediately below the tripod bush, and some photographers find them helpful. Side-mounted grips are probably of greater value. They are mounted on a bar, which bolts along the bottom of the camera like a flash bar. In fact, many of the grips are combined with a flash mounting, and are particularly useful for quick operations at parties and similar functions, as they allow a single flash to be mounted a reasonable distance from the lens.

Shoulder grips

Light-weight supports in the style of rifle stocks (B) are of considerable value when using really long focus lenses. The lens (with the camera attached) is mounted on the support, which has a shoulder pad and a hand-grip with "trigger". The whole outfit can be held firmly to the shoulder with the right hand (or the left hand for those who view with their left eye) and the lens focused and steadied with the other hand.

Minipods

Light-weight folding table tripods (A) are useful in many circumstances; they can be used to steady the camera against a whole range of supports. Some of them extend to normal tripod height and act as unipods to aid hand holding.

Document copying

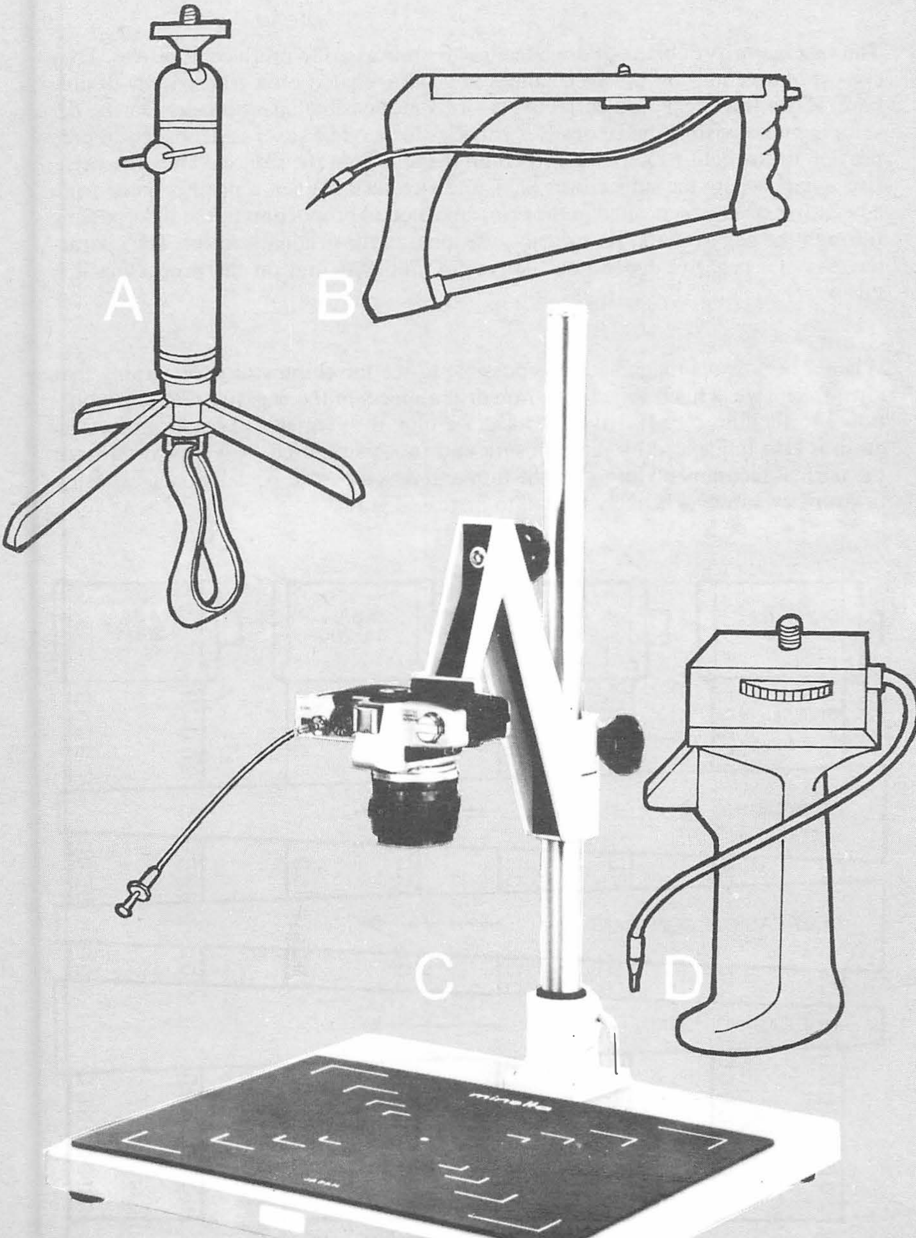
Copying documents is best done with the camera supported at about eye-level to shoot vertically downwards. In this position, it is usually much easier to view through the angle Finder (see p. 54).

The Minolta Copy Stand (C) consists of a baseboard with vertical tube clamped to it with a clamping lever. An angled arm may be set at any height on the tube, and is secured by tightening the large clamp screw. The arm may be fitted sloping either upward or downward from the tube. A shorter arm with a camera mounting plate is fixed to it, again sloping either up or down. Thus there are four different support arm configurations for use as required. The camera, with any required close-up accessories, may be focused by moving the arms up or down the support tube, or more simply with the focusing rail (see p. 80).

Illumination for copying should be evenly spread across the subject, and the simplest satisfactory set-up is usually to use two similar lamps, one each side at an angle of about 45°. Through-the-lens meter readings are best taken from an 18% grey card on the baseboard, and should prove accurate. Otherwise, meter from a white card and give about five times more exposure.

Lightweight camera supports

A Table tripod
B Shoulder pad
C Copy stand
D Pistol grip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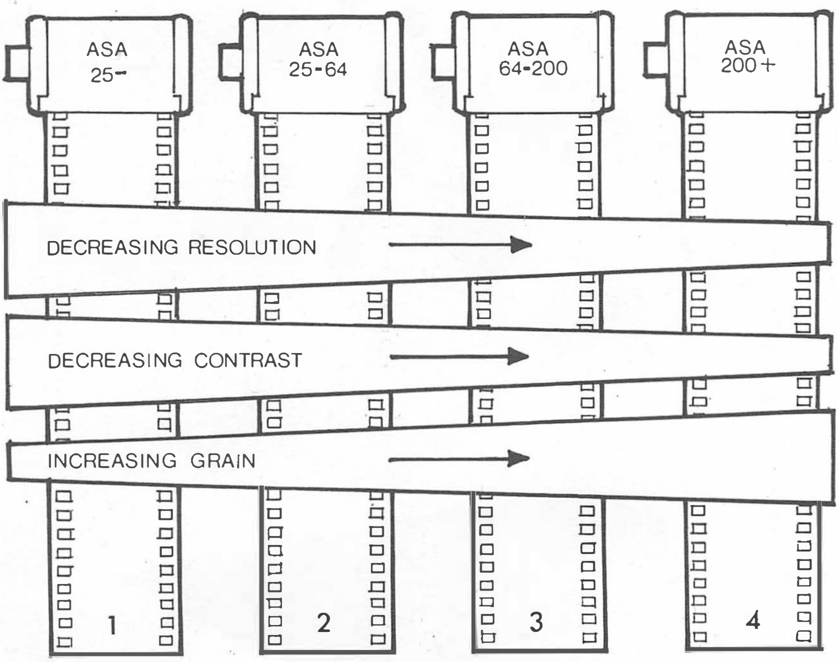
Black-and-white films

The vast majority of black-and-white films are processed to produce negatives. They consist of an emulsion of silver halides in gelatin, coated on a transparent flexible base. When this is exposed correctly, it forms an invisible *latent* image. During development the visible image of silver particles forms. The silver is deposited in proportion to the light which was focused on the film from the subject. Thus the negative is dark where the subject was light, and vice versa. When a print is made from a negative, silver is deposited in the print emulsion in proportion to the light passing through the negative and thus depicts the tones of the original subject. The characteristics of a negative depend on the type of film used, and on the processing it is given.

Grain

When a negative is magnified, it is possible to see the clumps of silver grains that form the image. This is called the grain or graininess of the negative and is proportional to the film speed; that is, the faster a film, the greater will be its grain. The grain is also influenced by the exposure and processing used. Any deviation from the normal recommendations for the film and developer—especially over-exposing or over-developing—is likely to lead to increased grain.



Generally speaking, films of low sensitivity to light are formed from smaller and more evenly spaced silver halide grains. Thus, the slower the film, the less noticeable the granular structure on enlargement and the higher the resolution. Common uses are: 1, very slow films, fine copying work. 2, slow films, static or brilliantly lit subjects. 3, medium speed, average photography. 4, fast, low-light photography.

Contrast

The range of grey tones a film can produce between black and white is called its contrast. Extremely high contrast materials record most of a subject as either black or white, whereas low contrast materials can give a wide range of greys between the two extremes. Normal camera films all have an acceptable contrast for general pictorial use, although the more contrasty ones give less highlight and shadow detail in pictures of high contrast subjects. As a rule, the faster a film, the lower its contrast. Prolonging the processing increases the contrast at the expense of increasing the grain.

Colour sensitivity

Untreated silver halides are sensitive only to blue light (and ultraviolet radiation). Modern photographic emulsions incorporate dyes which make them sensitive to other colours. General-purpose camera films have a sensitivity roughly the same as the human eye—and are designated *panchromatic*. High speed films have an extended red sensitivity, and some specialised emulsions are sensitive either only to blue, or to blue and green. The latter are called *orthochromatic*. The reaction of a film to different colours can be altered by the use of filters.

Exposure latitude

The best negatives are produced when the film is given the optimum exposure. However, errors of up to one stop make little difference, and printable negatives can be produced with exposures up to three stops away from the ideal, but such negatives are more difficult to print. They also have little shadow detail, if they are underexposed, or little highlight detail if they are overexposed— nor do they give as good enlargements as correctly exposed negatives. Deviation from normal processing recommendations may alter the effective speed, and special processing may be used to "retrieve" drastically mis-exposed films. It does not, however, give excellent results.

Other characteristics

Film manufacturers refer to the *acutance* or edge sharpness and *resolving power* of their films. These are two characteristics which affect the sharpness of a photographic image, but all modern films produce so sharp an image that they are characteristics of interest only in specialist applications. All modern general-purpose films also carry an anti-halation backing to prevent light that has passed through the emulsion being reflected back and degrading the image.

Choice of film

The contrast and graininess of a negative determine the degree to which the image can be enlarged. For most purposes a medium speed film (80–160 ASA, 20–23 DIN) will prove ideal. Carefully processed 35 mm negatives can yield virtually grain-free prints up to 15 × 12 inches. Slow films (20–40 ASA, 11–14 DIN) are best if you need big enlargements, and fast films 400–500 ASA, 27–28 DIN) are needed for dull conditions or fast action photography. Films faster than this (or special processing for extra speed) usually give unacceptably grainy images, and should be avoided except when there is no alternative.

Colour films

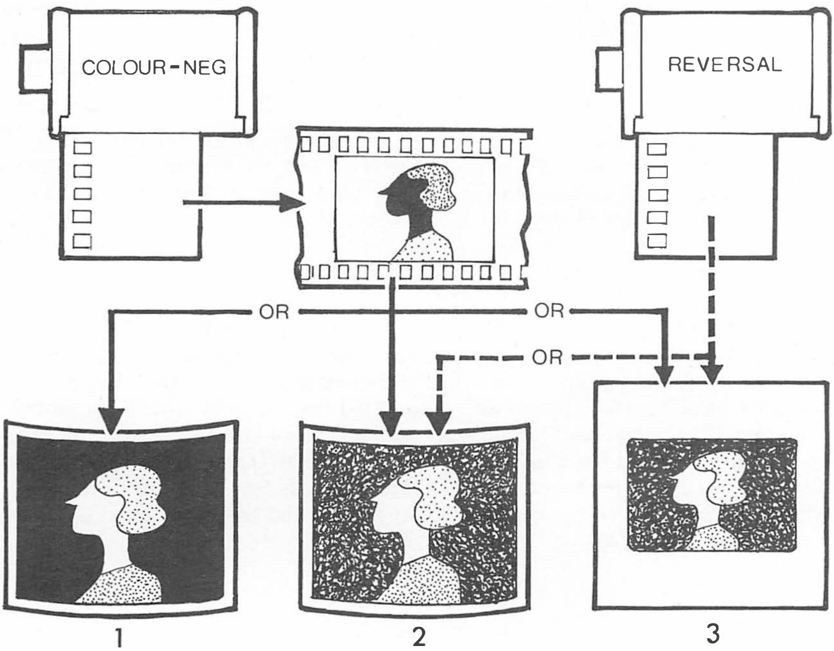
There are two types of colour film in common use—negative and reversal. Negative films are processed to produce images which are reversed in both colour and tone from the original subject. These are then used to produce colour prints. Reversal films are processed to produce a positive image closely resembling the original subject. The image is viewed either by transmitted light or projected on to a screen.

How they work

When a colour film is exposed, it produces a latent image in the same way as a black-and-white film. During processing, this is converted to a coloured dye image, the dyes being formed together with silver grains. The silver is then removed to leave the coloured dyes. In a colour negative film, the dyes correspond to the silver formed from the original latent image. They are designed also to be of complementary (opposite) colours to the original subject. In a reversal film, the original latent image is developed, and the film then re-exposed to light. On re-development, coloured dyes are produced only when (and where) the second image develops.

Exposure latitude

Just like black-and-white films, colour films must be given the right exposure. This is particularly important for reversal films, because there is no intermediate printing stage. The density of the final transparency is determined by the exposure in the



Colour negative film is for colour prints (2) *but colour slides* (3) *or black-and-white prints* (1) *can be made. Colour reversal film is for slides but can be used for prints, too.*

camera, which for optimum results should be correct to within half a stop. Colour negative films can produce adequate colour representation if over exposed up to two stops, or underexposed one stop. Film manufacturers supply meter settings (ASA and DIN ratings) for colour films. These will give normal results but, like any other exposure recommendation, should be modified to suit your equipment and viewing preferences.

Colour of lighting

Lighting varies greatly in colour, from the almost red light of an open fire to the strong blue of a blue sky (without sunlight). Normal daylight is a mixture of blue skylight and yellow sunlight. Our eyes adapt to the colour of lighting, but colour films do not. Compensation can be made when printing from colour negatives, but transparency films must be balanced for the light source in use. Manufacturers produce different types: Daylight—for use in daylight and with electronic flash or blue flashbulbs; Tungsten, Type A—for photolamps (3400 K) and Type B for use with studio lamps or tungsten halogen lamps (3200 K). A white object lit by a 60 watt bulb and and pictured on a daylight type film comes out a bright orange colour; whereas lit by daylight it comes out blue on a tungsten light film. Filters are available to provide correct colour balance when using a film in lighting other than that for which it is balanced.

Film speeds and image qualities

As their speed rises, colour films increase in graininess, while decreasing in contrast and colour saturation. The change in graininess and contrast being more marked than it is on black-and-white films for the same change in film speeds. Because the grain is multi-coloured, it may be considered more objectionable than that on black-and-white photographs. All commonly available colour negative films are of moderate speed (64–100 ASA, 19–21 DIN), and give results comparable with medium speed black-and-white films. Transparency films are available in slow (20–32 ASA, 14–16 DIN), moderate (64–100 ASA, 19–21 DIN) and fast (160–200 ASA, 23–24 DIN). Faster films and special processing should be reserved for cases of necessity. Many photographers use the slowest possible transparency films to give them the greatest colour saturation and sharpest images. This is particularly important if any of the pictures are to be offered for reproduction. The fast films have a distinguishable grain, but this is not noticeable at normal projection distances.

Choice of film type

Apart from the choice of (reversal) film speed, one must choose between reversal and negative films for any particular use.

Colour transparencies are ideal for group viewing, and projected images are more closely comparable to the original than are prints. They are also suitable for use as originals for photomechanical reproduction. The finest colour prints can be made from transparencies, but they are extremely expensive. Conventional colour prints made from transparencies, however, are not usually as good as those made from colour negatives.

Colour negatives can be printed directly to give either prints or transparencies of equal quality. Negative films are thus the first choice for making prints or when the final form is undecided. The main disadvantage of negative films is the cost of printing. This can be significantly reduced, however, by making (or having made) only those prints you want to keep. A number of laboratories will process a film and return it with a contact sheet so that you can select the negatives before any prints are made.

The colour pictures

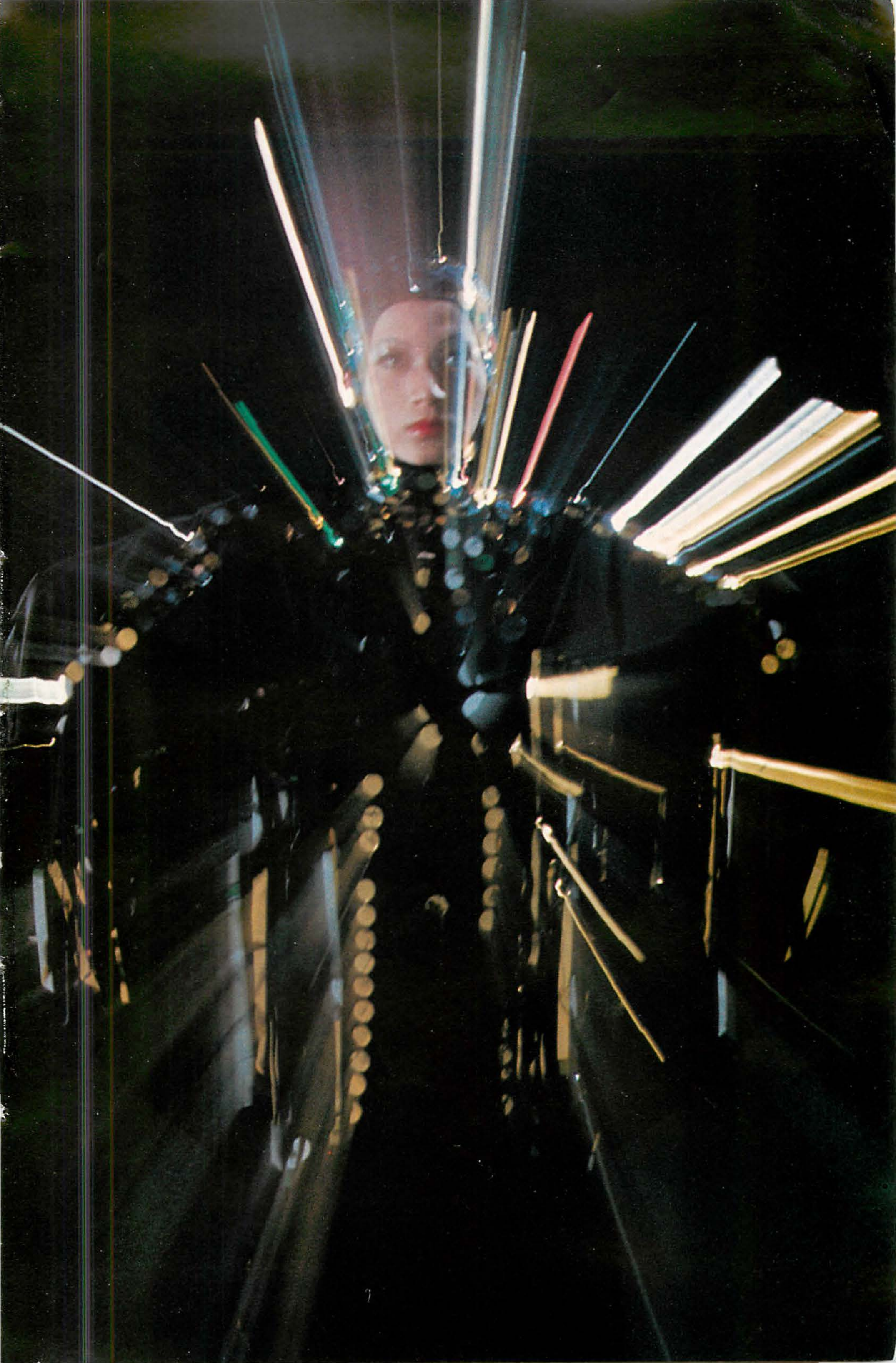
Your Minolta is for taking pictures. You can follow all the advice in this book; get perfectly exposed, sharp photographs every time; yet never take a really good picture. Whether you use colour or black-and-white, it is the image on the viewfinder screen that matters most. Try to see the scene as a picture. With colour film, be particularly careful about the range of colours you include. The plain uncluttered background lets these little animals stand out, despite their rather drab colouration. Notice how the photographer has waited for a static pose, so that he could use quite a slow speed to get a correctly exposed picture, even on a dull day.

Movement

For the ferris wheel the photographer again has used a comparatively slow speed to reveal the movement. This has turned a rather ordinary picture into an exciting composition. The photographer has kept the camera absolutely still, so that the static parts are completely sharp.

Zoom lenses

You can impart movement to a static scene by moving the camera or by altering the focal length of a zoom lens during exposure. The girl surrounded by lines of light was taken with the 80–200 mm f4.5 Rokkor. While the shutter was open, it was zoomed from 200 to 80 mm, where it remained for the rest of the ¼ second exposure.



Mirror lenses

With a mirror lens, you get rings from out of focus highlights. In the centre picture, the photographer used red and yellow filters over parts of a 1000 mm f 6.3 RF Rokkor. This has coloured the picture, and broken the rings into curves. Thus he has produced a picture of sparkling brilliance without the rings obtruding.

Normal lens

Effective photography is not confined to special lenses. The picture with the child standing on the tree was taken with a standard lens. Notice that, even though the background was not too well chosen, the general shape of the picture draws your attention immediately to the child.

Dull weather

Like the previous subject, the crowd crossing the street was pictured on a dull day. Only here it was raining too. Dull weather should not stop you taking pictures, but does introduce a few problems. In this case, it has made a long shutter speed necessary. So, with the long focus lens used here, the faster-moving parts of the subject have come out unsharp.

Look around for subjects

There are pictures all around you. Even the most mundane subjects can produce striking results—if you concentrate on careful selection of the right composition. A macro lens helps, as with the green peppers. Note also that although it is almost entirely green and white it makes as effective colour picture.

Film speeds

Whatever film you use in your camera, it must be given the correct exposure if it is to produce the picture you want. Exposure is the amount of light that falls on the film, and correct exposure is calculated from the light intensity reflected from the subject, and the sensitivity—or speed—of the film in use. Many systems have been used to express film sensitivity, but two are now used widely—ASA (or BS) and DIN.

ASA speeds

The ASA speed is based on testing devised by the American National Standards Institute (formerly the American Standards Association). It is an arithmetical system in which a doubling of the film's sensitivity is denoted by a doubling of the speed rating. Thus in any given condition 100 ASA film requires one stop more (twice) exposure than 200 ASA film, and one stop less (half) than that required by 50 ASA materials.

DIN speeds

The DIN speed ratings are based on German standards, and are expressed on a logarithmic scale. An increase of three points indicates a doubling of the film's sensitivity; thus 50 ASA film is rated at 17 DIN, 100 ASA film at 20 DIN, and 200 ASA film at 23 DIN. The numerical scales cross over at the figure 12, i.e. a 12 ASA film is also rated at 12 DIN.

The scales then go on:

ASA	12	15	20	25	32	50	64	80	100	125	160	200	320	400
DIN	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Film manufacturers do not in fact give strict scientifically determined film speed ratings. They quote the ASA and DIN *meter settings* that they calculate will give optimum exposure. When using a new type of film, you should make some test exposures to discover whether the manufacturers meter settings give optimum results with your equipment. The figure you finally use should take account not only of the operation of your camera and exposure meter, but also of your preferences for negatives or transparencies of a particular density. You may have to use different settings in different conditions. For example, CdS meters tend to over-react to tungsten lighting and in such light a slightly lower meter setting may produce more satisfactory results.

Processing variations

The optimum meter setting is influenced by the processing which is anticipated. Many films can be specially processed to enable a higher setting to be used, but such processing almost always results in some loss of image quality. Black-and-white films may be processed in special fine-grain developers which necessitate the use of a lower meter setting. Using specific processing times to give you the contrast you want may also necessitate using a different film speed.

Colour temperature

Films may be exposed to any light source, and—provided that they receive the correct exposure—will produce an image. Whatever the source, black-and-white films normally produce a satisfactory picture, but colour films require more carefully selected sources. The most important quality of a light source for colour photography is its colour. Everyday light varies from strong orange produced by household tungsten lamps to the pronounced blue of a clear blue sky—such as illuminates subjects in the shadow on a sunny day. Our eyes can compensate for different colours of overall lighting: we see white objects as white with any normal light source. Colour films, however, cannot compensate, and the colour balance of pictures is influenced by the colour of the light source.

The colour quality of light may be defined as its colour temperature. This is achieved by referring to the colour of light radiated by a theoretically perfect radiator heated to any particular temperature, which is measured in kelvins (K). Thus a light source radiating light of the same quality as the radiator at 5000 K is said to have a colour temperature of 5000 K. Low colour temperature (e.g. 2500 K) indicates a yellow or orange colour, and high colour temperature (e.g. 10 000 K) a blue colour.

Colour films

Colour films are balanced for particular light sources. Unless they are used with the right source, or the correct filter is used, they will not give a normal colour balance. For most purposes this is important only with reversal films—the colour balance of negatives can be corrected at the printing stage. Three types of reversal film are in common use: Daylight; type A, for use with 3400 K photolamps (over-run lamps such as Photofloods); and type B for use with 3200 K studio lamps or tungsten halogen lamps. Daylight type film is suitable for use with electronic flash (although a pale yellow filter is desirable with some units) and with blue coated flashbulbs.

Colour temperatures of some light sources

Light source	Colour temperature (K)
Skylight	12000–18000
Overcast sky	8000
Photographic 'white flame' carbon arc	7400
World average daylight	6500
Sunlight (noon)	5400
Daylight (sky and sun)	5500
English standard daylight	4800
Electronic flash	5500–7000
Blue coated flashbulb	5300
Flashcube and Magicube	4950
Low temperature carbon arc	4000
Clear flashbulb (aluminium filled)	3800
Photolamp 3400 K	3400
Tungsten studio lamp	3200
*Tungsten halogen lamp	3200
1000 watt & 500 watt floods	3000
General service bulb 200 watt	3000
General service bulb 100 watt	2900

* Photographic Studio type—others are variable

Fluorescent light sources do not always produce a continuous spectrum (i.e. light of all colours may not be equally represented), and give unpredictable results with colour films. After careful tests specially made "colour matching" tubes may prove satisfactory, but normal general service tubes are unlikely to give good pictures. When their use is unavoidable, a rough guide is to use daylight film and a red filter of the type designed for colour printing (about a 40R) with cold white tubes, and to use type B film (no filter) with warm white tubes.

The only way of ensuring accurate colour pictures when using an unknown combination of film and light source is to make a series of test exposures. For such a purpose you need a complete set of pale coloured filters--which must be of optical quality. Such filters are usually of real value only to the professional photographer.

Do not, however, be overcautious in matching even transparency films to light sources. For example, although you should use a pale blue filter, you can get quite acceptable results using unfiltered type B films with household lamps. In fact, some people prefer the warmer flesh-tones produced by this technique to correct colours. Slight over-exposure tends to minimize colour imbalance by lightening the overall density.

Mixed light sources

One very important factor, if you are to obtain an even colour balance overall, is to ensure that all the lighting used in one picture is the same colour temperature. This is just as important for colour negative films as it is for transparency films, because the colour balance of one part of a picture cannot be altered without altering the rest. The normal rule of thumb is that light sources should not differ in colour temperature by more than 100 K. Studio photographers use large pieces of filter in front of lights if they want to alter colour temperature. This is beyond most other photographers, but the use of small filters over electronic flash tubes can solve some problems. For example, using type A film an electronic flash could be mixed with photolamp (3400 K) illumination if the requisite (type A film used in daylight) filter were fitted over the flash head.

Lighting principles

With modern lenses and films, special photographic lighting is rarely necessary and there are innumerable photographers who never use any form of additional lighting.

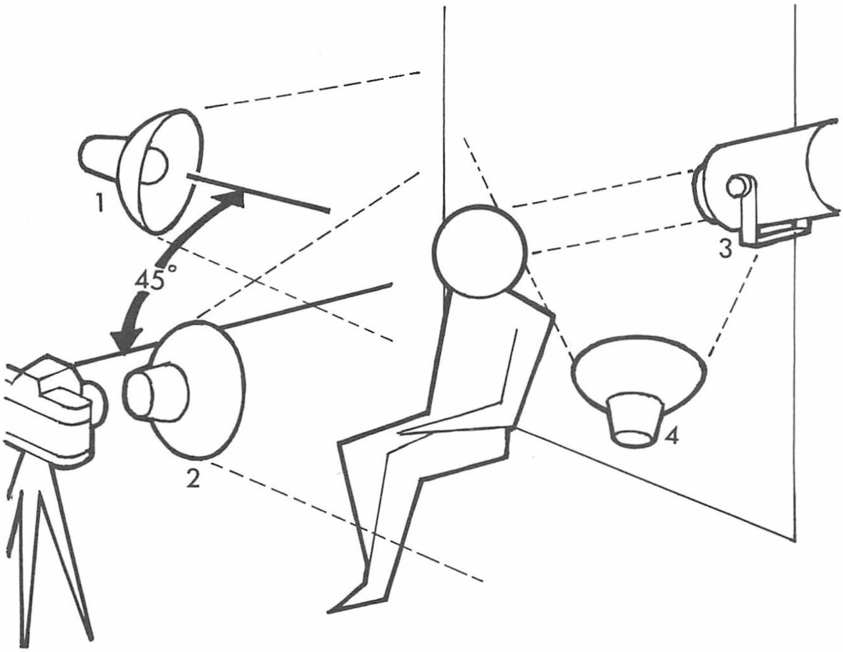
Nevertheless, there are occasions when a specific task is made easier by arranging the subject to be photographed under controllable light sources. It is, therefore, as well to know what the conventions are.

Key light

Most subjects have form and shape and many have texture that needs to be shown. To convey form and shape, you need to arrange the lighting so that shadows are thrown in conventional way. With most objects, this means that the main or most powerful light (often call the key light) is positioned to one side up to 45° from the camera-subject axis and perhaps slightly above the subject. For spheres, faces, cubes, boxes, etc. such a single light is sufficient to indicate that the subject is three-dimensional and in most cases to show its actual shape, because shadows appear on the side of the subject farther away from the light.

Fill light

The shadows are generally very deep compared with the fully lighted parts so it is customary to add a fill light at or near the camera position. If the fill light is made about one-quarter of the intensity (on the subject) of the main light, the film is generally able to produce adequate detail in the shadows where necessary and overall



Conventional lighting arrangement. 1, main or key light. 2, fill light. 3, effect light. 4, background light.

contrast is lowered to a more acceptable level. For colour work a fill light of half the intensity of the main light may be preferable.

Effect light

These two lights can convey an effective impression of form and shape of virtually any subject but there may be subjects that need additional lighting to emphasise a particular feature. In formal portraits, for example, it is common practice to add a light to bring sparkle to the hair. This is generally a carefully directed spotlight, shielded so that its light does not spill over on to other parts of the picture. It is generally placed high up and may shine from front, back or side. This is an effect light. It might similarly be used to add a highlight to pottery, polished wood, metal objects, etc.

Background light

The only other commonly used light is the background light. It can take many forms, from simple even illumination to provide accurate colour rendering, to special effects with spots, screens and shadow masks.

These are the basic lights and their common uses but there are, of course, many ways in which they can be arranged for special effects. Where the texture of a subject—a piece of material for example—must be conveyed, the main light must be very low and directed across the surface of the material. The less the angle between the lamp beam and the surface, the more marked the texture effect becomes. In such cases, fill light where used must be kept as weak as possible.

Such shallow angle lighting can also convey mood in portraits as in the now rather hackneyed underlit effect of the horror shot.

It is always the main or key light that is moved to provide the major effect. The other lights continue to perform their functions of fill-in, special effect or background illumination. Back lighting is not uncommon, for example, to give translucent or rim-lighting effects where the light creeps round the edge of the subject. Most such shots, however, still require fill lighting from the front.

Lighting units

Many types of lighting unit are available, from simple clip-on spun metal reflector bowls and troughs of various sizes to elaborately constructed lensed spotlights. They can take either single lamps or clusters. The lamps themselves can be of the overrun type with a short life but high light output. They are generally no bigger than a small household lamp. Studio lamps on the other hand have a much longer life, consume a very heavy current, and are considerably more expensive.

Using flash

Many modern cameras have an accessory shoe mounted on the pentaprism with a centre flash contact. A cableless flashgun can fit directly into the shoe and make contact with the flash switch linked to the shutter blind movement. Cameras with no built-in accessory shoe can usually be fitted with an attachable type. The flashgun is then plugged in to the appropriate flash socket on the camera.

A flashgun on the camera does not, however, provide a very satisfactory lighting arrangement. It throws harsh shadows on nearby backgrounds and possibly under the nose, chin, hairline, etc. according to the camera position. It provides little or no modelling to features.

A simple solution to these problems is to tilt the flashgun upward or sideways to reflect light back on to the subject from a large surface, which must be white or neutral-coloured if you use colour film. Special accessories for tilting camera-mounted flash units can be obtained from photo dealers.

Whenever possible, it is better to remove the flash unit from the camera and place it to one side on an extension lead. This serves the dual purpose of separating the shadow from the subject, perhaps allowing it to be excluded from the picture area, and at the same time giving some modelling to the features by a greater variation of light and shade.

Using a second flash

Even when off the camera, however, the single flash still throws heavy shadows and, when placed for the best modelling effect, may leave parts of the subject in almost complete shadow. Such shadows can be relieved by placing a reflecting surface, such as a large card, on the other side of the subject so as to throw light back on to it or by using a second flashgun or extension head, where available, at the camera position.

The second flash should be weaker than that used for modelling because its function is to lighten the shadows slightly, not to obliterate them. It should, therefore, be farther away than the main light or should be covered by a layer or two of clean handkerchief. The second flash (plugged into a Y-connector) should preferably be of the same make and model as the first, and the method is not fully recommended owing to the possibility of overloading the flash contacts in the camera. Flash manufacturers can usually supply slave sensors which give the second flash automatically on receiving light from the first.

Flash can also be used as a fill-light in daylight, particularly to relieve the shadows thrown by an unclouded sun. You should preferably take your subject into the shade but where that is not possible, shadows thrown by back or side lighting from the sun can be relieved by a weak frontal flash. When using flash in this way, the guide number for exposure purposes should be at least doubled.

The guide number has to be modified for bounced flash too. The effective flash distance is from flash to reflecting surface and thence to the subject. There may be losses by absorption at the reflecting surface, but these are generally offset by some direct light reaching the subject from the edge of the flash beam.

Where two flashguns or an extension head are used, it is not usually necessary to take any account for exposure of the fill-in flash.

Flash equipment

The flashbulb is a glass envelope filled with finely shredded metal or metal foil in an atmosphere of oxygen. Two electrodes (wires) pass through the glass to form contacts outside the envelope to which a voltage can be applied. Current passes through the wires to a primer paste at their other ends (inside the envelope). The current causes the paste to ignite, so firing the metal filling which burns rapidly in an intense flash of light. A great deal of heat is generated and the glass envelope is shattered. The pieces are, however, held together by a heavy varnish on the outside of the envelope.

Flashgun circuitry

Flashbulbs can be fired by very low voltages but they need a high current. The average low-voltage battery could provide this high current reliably only for a very few firings. Consequently, bulb flashguns usually have a capacitor in their power circuit to act as a current store. When a suitable capacitor is connected to a battery, it rapidly charges up to the battery voltage with a relatively low current flow. When the capacitor terminals are connected to a flashbulb, they are effectively short circuited and the capacitor discharges almost instantaneously with a high current flow. While you change the bulb the capacitor charges up again.

Thus, reliability is improved and the necessary high current is always available while the battery lasts.

The flashbulb is, of course, expendable. It can be fired only once. But it comes in many sizes, from tiny bulbs like the AG-3B to the light-bulb sized monsters such as the PF100, with an output more than 12× greater. The very large bulbs generally have a screw fitting and need to be fired from a larger flashgun but small, pocketable units are adequate for several of the smaller sizes up to the PF5, which has more than double the power of the AG-3B, or special focal plane bulbs such as the PF6.

Bulb flashguns are inexpensive and can be extremely small, with folding reflectors and miniature components, the power unit consisting only of a small battery, capacitor and resistor.

All small flashbulbs are now blue-coated to simulate daylight so that they can be used with daylight colour film. Clear types are available in the larger sizes and are sometimes preferred for negative colour and black-and-white work.

The most significant difference between the flashbulb and the electronic flash tube is that the bulb takes a measurable time to ignite, needing, on average, about 20 milliseconds to reach full brilliance. The usable output of light lasts for 10–20 milliseconds, except with special long-burning focal plane bulbs designed for use with focal plane shutters at the faster speeds.

Synchronisation

The ordinary bulb can be used only at the slower speeds of a focal plane shutter because it is only at those speeds that the film is totally uncovered. At faster speeds the shutter blinds uncover only part of the film at any given moment so that the effect is of a slit travelling across the film. Only the special focal plane bulbs burn long enough to provide even illumination throughout the travel of the shutter blinds.

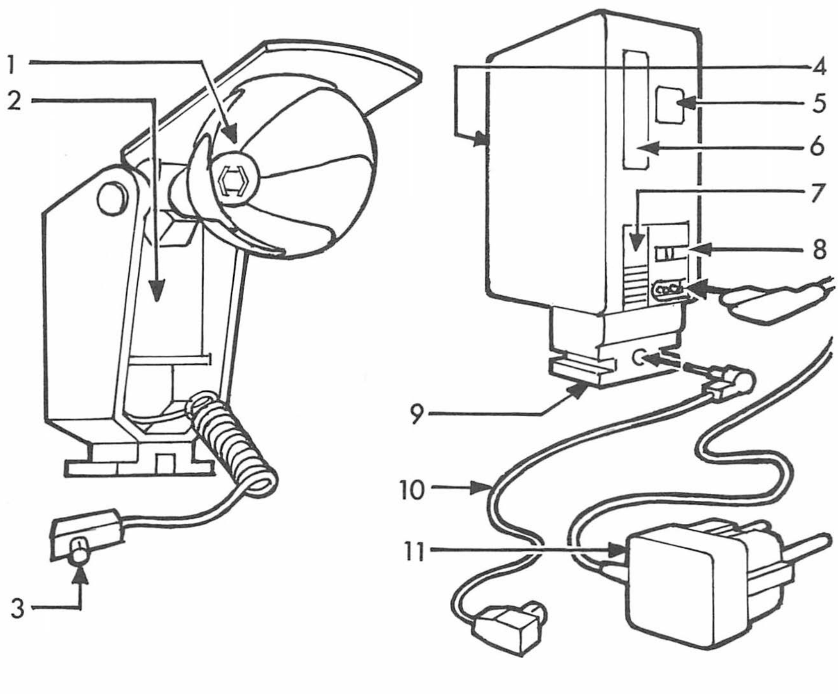
On all modern cameras, the firing of the flashbulb is synchronised with the shutter opening by contacts in the camera connected to a coaxial socket on the camera body and/or a contact in the accessory shoe (the "hot shoe" contact). All flashguns are provided with a cord to plug into the coaxial (PC) socket, while many have the additional hot shoe contact that needs no cord. Adapters are available to allow cord-only guns to be used on cameras with only a hot-shoe contact.

How electronic flash works

Electronic flash is basically a spark discharge between two electrodes. It relies on the fact that if two electrical conductors are brought close together and a voltage is applied to one of them, current will flow between the two conductors via a spark. Such a simple spark gives very little light, however, so for electronic flash the electrode ends are sealed into a glass tube filled with a suitable gas (usually xenon). A third electrode clamped or wound round the outside of the tube carries a very high current which ionises the gas and lowers its resistance to the spark discharge. By this means the spark can be lengthened and its brilliance enormously enhanced.

Electronic flash tubes are available in a wide variety of shapes and sizes to suit various designs of equipment from the low-power pocketable unit to the large floor-mounted equipment of the professional studio.

The weight and bulk of an electronic flash unit is governed principally by its power unit. The greater the light output required, the bigger and bulkier the power unit, which is basically similar to that of the bulb flashgun but is much more complicated because high voltages are required to fire an electronic flash tube. The trigger voltage needed to ionise the gases in the tube runs to thousands of volts while few tubes need less than 500 volts applied to the internal electrodes.



Most bulb flashguns are now very small with folding reflectors. 1, *reflector.* 2, *battery compartment.* 3, *connecting cable and plug. There are also many relatively small electronic units.* 4, *flash tube.* 5, *film speed setting.* 6, *exposure calculator.* 7, *ready light.* 8, *power switch.* 9, *accessory shoe fitting.* 10, *connecting cable and plug.* 11, *charging unit.*

Nevertheless the now commonly used transistor circuitry allows small electronic flashguns to operate from built-in rechargeable batteries of 1–1.5 volts. Others use two or four small dry batteries of the traditional type or the newer, high-capacity alkaline type. Many flashguns are also available with the additional facility of working from household current.

The main advantage of electronic flash is that the tube will fire thousands of times before burning out. So no bulb changing is necessary and the cost per flash is minimal over the life of the equipment. The disadvantage is that, weight for weight, the bulb flash can be considerably more powerful. An electronic flash unit able to provide a light output equivalent to that of, say, a PF5, would be very bulky indeed, while nothing short of a really heavy floor-mounted power unit could provide anything approaching the output of the largest flashbulbs.

Nevertheless, even the smaller electronic units can be sufficiently powerful for a variety of uses and they have the added advantage of controllability that comes with automatic operation in the latest models.

Automatic or "computer" flash

The guide number system of flash exposure calculation calls for a certain agility with figures that many people find irksome. Even the calculator discs incorporated in most small electronic flashguns made the necessary calculations only slightly easier. Various semi-automatic methods have been tried by camera manufacturers but the only really simple and fully automatic method applied to the flashgun itself is that of the so-called computer type. The word is here used in its normal sense in that the flash unit circuitry calculates the amount of light needed in given circumstances and terminates the output from the flash tube when that amount of light has been emitted from the tube.

Basically, the procedure is that the light reflects back from the subject to a sensor in the flashgun which, with its allied circuitry, measures the amount of light and switches off the tube when the correct amount of light has been received. Naturally, such units can operate only within the range of their available light output and must be pre-set to take account of the speed of the film in the camera. This is usually achieved by allocating one lens aperture value (*f*-number) or a limited range of *f*-numbers for use with each film speed. On a typical small unit, for example, the lens aperture must be set to *f*8 or *f*5.6 when using a 125 ASA film. A switch on the flashgun is moved to the appropriate position for either of these settings and a third position allows the unit to be used manually in the normal way.

Disadvantages of these units are that they should generally be mounted on or very near to the camera and few of them allow indirect lighting because the light measured by the sensor would in that case be the light from the reflecting surface used to provide the indirect lighting. There are a few units, however, which allow the head to be swivelled independently of the sensor, which can still point at the subject. Again, however, as the sensor should remain close to the camera, the value of such units is limited. Some units can be connected to a separate sensor mounted on the camera.

There are two types of automatic flashgun. In the earlier models, the light not used was diverted through a so-called black tube and was wasted. In later models, this unused power is returned to the power unit capacitor, providing the twin advantages of more flashes per set of batteries or battery recharge and a faster recycling time. Naturally, however, these advantages are considerable only if you carry out a large proportion of ultra close range work calling for short exposures. With colour materials in particular, such methods are not advisable, owing to the possible effects of reciprocity failure.

Flash exposures

Unlike other light sources, a flashbulb or single firing of an electronic flash tube emit a finite, constant and measurable amount of light. In general use the flash is also small enough to be regarded as a point light source, which means that it is subject to the inverse square law—the amount of light reaching the subject is in inverse proportion to the ratio between the squares of the flash-to-subject distances. With the flash at 9 ft the light on the subject is $(3/9)^2$ or one-ninth the strength of the same flash at 3 ft from the subject.

Lens apertures work in a similar way. At *f*/2 the light transmitted is $(8/2)^2$ or 16 times the light transmitted at *f*/8.

Thus, whenever flash distance and *f*-number multiplied together give the same result the amount of light reaching the film is the same, i.e. *f*/2 and 20 ft, *f*/4 and 10 ft, *f*/8 and 5 ft etc., because, for example, changing from *f*/4 to *f*/2 *increases* light transmission fourfold while changing the flash distance from 10 ft to 20 ft *decreases* the light falling on the subject fourfold.

If these factors provided correct exposure, therefore the figure 40 could be ascribed to that particular flash unit as an exposure guide number.

That is how the guide number system works. Every flashbulb and electronic flash unit has guide numbers applicable to various film speeds. Flashbulb packings also quote different guide numbers according to shutter speed but these do not normally apply to focal plane shutters, with which the faster speeds cannot be used. You take the open flash or 1/30 sec number. When using focal plane type bulbs, you should use the guide number for your chosen shutter speed.

To calculate the aperture required for correct exposure, you simply divide the flash distance (not the camera distance, unless the flash is on the camera) into the guide number and round off to the nearest *f*-number. Alternatively, if you wish to shoot at a particular aperture you divide the *f*-number into the guide number to find the distance at which you have to place the flash.

If that means that the flash has to be used at a greater distance than that from which you wish to shoot, you can use an extension flash cable, obtainable from any photo dealer.

Typical flash guide numbers (feet/metres)

Flash source	Film speeds (ASA)				
	25–40	50–80	100–160	200–320	400–640
MF Class bulbs					
Small bulbs, magicubes flashcubes (Type 1B AG1B, AG3B etc)	60/18	80/24	120/36	160/48	240/72
Medium (Type 5B etc)	100/30	160/48	200/60	320/96	400/120
FP-Class bulbs					
Medium (Type 6B etc)	45/14	65/20	90/27	130/39	180/54
Electronic flash					
Small pocket guns	25/8	40/12	50/15	80/24	100/30
Medium pocket guns	40/12	60/18	80/24	120/36	160/48
Large 'pocket' guns	50/15	70/21	100/30	140/142	200/60
'Professional' type guns	70/21	100/30	140/42	200/60	280/76

Guide numbers for bulbs apply only to shutter speeds of 1/30 second or longer (1 /60 with FP bulbs). At shorter speeds the number must be reduced.
Electronic flash guide numbers apply at all suitable speeds.

Filters and screens

Filters for mounting on camera lenses must be of the highest optical quality. There is no point in buying a specially coated lens accurately made from selected high quality glasses and then fitting over it a filter little better than a piece of window glass. Optical quality gelatin filters are ideal for occasional use, but are too delicate to be used continuously. For constant use glass filters (often a gelatin filter cemented between two pieces of glass) are essential. Filters manufactured for fitting over light sources (either photographic or theatrical) or in colour enlarger heads may produce distorted or degraded pictures if used on the camera. Intentional distortion may be introduced by using a dirty filter, or specially constructed lens attachments and screens. By such means, you can produce blurred images, flare, stars from bright points, multiple images and many other effects. Together with brightly coloured filters, these attachments play an important part in creative photography, but care should be taken to avoid accidentally emulating their effects. You should be specially careful of the condition and quality of a UV filter if, like many photographers, you keep it permanently in place.

Glass filters are supplied in rims which screw into the filter threads on the front of the lenses. The rims are manufactured in a standard range of sizes to suit most lenses. Adapter rings are available to allow the use of larger filters on lenses with smaller filter threads. Because of the standardization, you may be able to use one filter on several lenses, thus justifying the expense of buying a top quality filter.

As filters reduce the light reaching the film, they usually necessitate an increase in exposure time (or lens aperture). This increase is given as the *factor* by which the exposure time should be increased.

Aperture alterations can be calculated from this factor. Thus, for example, a 2× filter requires twice the exposure time or one stop larger aperture etc. Some manufacturers also give exposure increases in *thirds* of a stop. The simplest way of using these with a separate exposure meter (or one built into the camera which uses its own light window) is to decrease the film speed setting by one unit for each $\frac{1}{3}$ stop. Thus a $\frac{2}{3}$ stop increase would need an alteration from 80 ASA (20 DIN) to 50 ASA (18 DIN). Cameras with built-in through-the-lens meters also read through the filter, and thus give the correct exposure without any modification to the film setting. The meter can be used in its normal way.

Filters for black-and-white film

When they are used with black-and-white films UV and polarizing filters reduce haze and reflection respectively, just as they do with colour films. Coloured filters, however, affect the relative tonal rendering of different coloured parts of the subject. Because a filter acts by reducing the passage of light of complementary (opposite) colour, it reduces the image density produced on the negative from an object of that colour. The object thus comes out darker in the final print. If—as is usually the case—the camera exposure is increased to take account of the light absorbed by the filter, objects the same colour as the filter will be rendered lighter than normal in the final print.

The complements of red, green and blue are cyan (blue-green), magenta (red-purple) and yellow respectively; intermediate colours have intermediate complements. From this you can work out the colour of filter you need to give particular emphasis to any part of the subject. Yellow filters are widely used to darken blue parts of the subjects—in particular blue skies to emphasise white clouds.

Without any filter, blue parts of a subject tend to be rendered somewhat lighter than we see them because blue light tends also to contain some ultra-violet radiation, to which the film is sensitive, and the eye is not very sensitive to blue light. For this reason, a medium yellow filter may give a more natural tone rendering on panchromatic film, and is sometimes called a correction filter. The effect may be exaggerated by using a dark yellow or orange filter, or for greatest exaggeration a red filter. Such filters give increasingly darkened skies, with clouds standing out dramatically. The accepted "correction" filter for use with tungsten light is a yellow-green colour.

Because haze tends to reflect blue light and ultra-violet radiation in preference to green or red light, the use of yellow, red or orange filters can reduce its effect on the film. Deep red filters give the strongest haze penetration, but require considerable exposure increase, and of course affect the overall tonal rendering of the photograph.

Neutral density filters, naturally, do not affect the tone rendering. They simply allow you to increase the aperture or lengthen the shutter speed without overexposing the film.

Filters for colour photography

Filters are used in colour photography to alter the colour balance of the image on the film. Their use is mainly confined to reversal films because the colour balance of a print can be determined at the printing stage. Polarizing and ultra-violet absorbing filters, however, are commonly used with negative films as well.

Polarizing filters. The effect of a polarizing filter is the same with all types of film. It can—in some circumstances—reduce reflections; and can darken a blue sky, without otherwise altering the balance in a colour picture.

Light coming directly from the sun or other light source is not polarized: the rays vibrate in all directions. Sometimes, however, light can be restricted to rays all vibrating in one plane. It is then said to be polarized. For the photographer there are two important polarizers: polarizing filters, which restrict the passage of all light not vibrating in their plane of polarization; and smooth reflective non-metallic surfaces which polarize light reflected at certain angles. Although polarizing filters may be fitted over light-sources for special applications, they can normally be regarded as camera fitments used to take advantage of light polarized by reflection.

The most common use is in restricting the passage of polarized light, thus reducing its influence on the film. From certain angles this can result in a dramatic reduction in reflections from glass, water and similar substances (but not from metal surfaces). A special instance of this is the blue light reflected from the sky on a sunny day. An area of the sky at right angles to a line from the sun to the camera position polarises the sun's rays strongly, and thus careful use of a polarizing filter can selectively darken a blue sky in a colour picture.

The effect of a polarizing filter depends on its orientation to the polarized light. It passes almost all light polarized parallel to its polarizing plane, and is opaque to light polarized at right angles.

To simplify their use, polarizing filters for camera use are usually supplied in rotatable mounts. With a single lens reflex camera, you simply view the subject and rotate the filter until you see the effect you want. Some types also have a small extra filter on the rotation handle. This allows you to check the polarizing action independently of the main filter. Polarizing filters require an exposure increase of about $2\frac{1}{2}$ times ($1\frac{1}{3}$ stops).

Ultra-violet filters. Ultra-violet absorbing (UV) filters reduce the effect of atmospheric haze which would otherwise be exaggerated because photographic emulsions are sensitive to ultra-violet radiation (which is invisible to the eye). The radiation is scattered strongly by haze and records on colour film as a blue veiling of distant objects.

With colour reversal film an ultra-violet filter has the same haze-cutting effect, and also reduces the blue cast sometimes found in transparencies taken close to large reflecting masses such as water or snow. Such filters require no exposure increase.

Sky-light filters. Skylight filters are ultra-violet absorbing filters coloured a pale salmon or rose. They are used with reversal films to give slightly warmer colours in transparencies, as well as the normal UV filter effects. They require no exposure increase, and are a more useful alternative to plain UV filters.

Colour conversion filters. To obtain a normal colour balance when using a colour reversal film with a light source other than that for which it is intended to be used, you must use a coloured filter. Filters designed for this purpose are known as conversion filters. Many manufacturers supply them for using commonly available film types in normal types of illumination. In general, filters for use with daylight films are blue in colour, and those for use with artificial light films are orange. The filters are normally used on the camera lens, but are equally effective when used to filter the light-source. If you are to use two light sources of different colour temperatures, one of them must be filtered to the colour of the other.

Colour balancing filters. For special effects and for accurate colour matching, it may be necessary to change the colour balance slightly. Manufacturers supply two types of filter which are suitable: special pale filters designed for the purpose, and filters designed for colour printing. Almost invariably the necessity for particular filters can be determined only by testing, and information should be sought from the filter manufacturers.

Neutral density filters. Neutral density filters (or attenuators) reduce equally the transmission of all wavelengths of the visible spectrum. They come in two forms —*photographic silver density*, which is simply accurately exposed and developed film; and *dyed filters*—often using colloidal carbon. Because of its high light-scattering effect, silver density is not suitable for use over the camera lens. Dyed neutral density filters are, however, intended for this purpose, and can be used to produce high quality images.

Neutral density filters do not affect the colour balance whatever film they are used with. They simply allow the lens aperture to be widened, or the shutter speed lengthened, while restricting the exposure to its normal level. They are normally available in a range of densities from 0.1 to 4.0 (transmitting from 80% to 0.01% of the available light) with filter factors varying from just over 1 to 10,000. A density between 1.0 and 2.0 (10%–1% transmission) enables you to use full aperture in bright sun with medium speed films. A density of 3.0 (0.1% transmission) allows exposures up to 30 sec under the same conditions.

Focusing methods

One of the few camera operations that has not yet been satisfactorily automated is the task of adjusting the lens position to provide a sharp image on the film—known slightly inaccurately as focusing the lens. It is not always a simple operation.

When you have a single main subject or the whole of the subject is more or less in the same plane, there is no problem, but many subjects occupy some depth in space (as in landscapes) and the focus has to be placed with some care. When, for example, the landscape has the classic open gate in the foreground to lead the eye into the picture and out to the line of hills beyond, you do not focus on either the gate or the hills. You have to choose an aperture and focused distance to give you the depth of field required. If any sacrifice in sharpness is to be made it should usually be in the background rather than the foreground. A similar principle applies to almost any subject in depth. The usual advice is to focus at a point about one-third into the zone required to be sharp but it is generally easier to set the distance of your farthest required sharp plane to the "far" aperture number at which you are shooting on the depth of field scale (or preferably at one stop larger). Then check that the depth of field provided is adequate to cover the nearest required plane.

With reflex cameras you can, of course, check the screen image by using the depth of field preview button, but screen texture does tend to sharpen the image and at small apertures it is not easily seen.

Action and movement

Focusing a moving object can raise problems because the delay between focusing and shooting can result in the subject moving well out of focus again.

When the subject is moving within or can be confined to, a reasonably restricted area, the technique of zone focusing is useful. This makes use of depth of field again. You set your lens to the smallest practicable aperture and set the lens distance scale to a mid-point that allows the depth of field to cover the required zone. A football photographer, for example, might wish to cover action within the penalty area from behind the goal. If he focuses on 20 ft at *f*/8 with a 50 mm lens he will just about cover that zone. You can work out your own zones for your own purposes by consulting depth of field tables or the indicator on your lens.

Objects that move in a predictable direction, such as racing cars, athletes, etc., are more easily dealt with by focusing on a spot that the subject has to pass and releasing the shutter as the spot is reached. A sports or frame finder is a useful accessory for such shots to enable you to keep your eye on the subject before it reaches the selected spot.

Depth of field

In theory, a lens placed at a given distance from the image plane (the film) produces a sharp image of objects in a single plane at a certain distance in front of the lens. Objects in front of or behind that plane are rendered less sharply.

In practice, each image point formed by a lens is, in fact, a disc of finite size and, up to a certain degree of enlargement for a given viewing distance, the difference between the smallest possible disc and various slightly larger discs is indistinguishable to the human eye. The relative sizes of the various discs or image points formed by a lens can be envisaged by regarding the light reflected from the point and concentrated by the lens as a solid cone, with the effective aperture of the lens as its base. Thus, when the aperture is small and/or the lens-to-subject distance is large, the cone is relatively slender. At its apex (the crossover point for objects behind the focused plane), there is a relatively deep zone both fore and aft in which the discs formed by a section through the cone are still small enough to be rendered as discs indistinguishable from points on the film and, indeed, on considerably enlarged images.

This zone is the depth of field. As our explanation implies, it is greater when the effective lens aperture is smaller and when the focused distance is greater.

Enlargement and viewing distance

A complication arises with the comparatively small negative or slide sizes used today. Most final images, whether prints or projected slides, are considerably larger than the images produced on the film. Moreover, many prints are made from only part of the negative image and the degree of enlargement is not proportional to the print size. But most final images are viewed from a distance appropriate to their size, not, as they ideally should be, to their degree of enlargement. The complication then is that detail which looks sharp when enlarged less or viewed from a greater distance looks distinctly less sharp when enlarged to a greater degree or viewed from closer range.

Depth of field formulae and tables, therefore, must always be regarded as approximations. Although it is possible to make exact mathematical calculations based on focal length, *f*-number, focused distance and the size of the acceptable disc (known in this context as the circle of confusion), it is self-evident that you do not produce a sharp image of an object at 10.1 metres and an unsharp image of an object at 10.11 or even 10.2 metres. Depending on the use you wish to make of depth of field or the lack of it, you should always use at least a stop smaller or larger than calculators, indicators or tables recommend.

Changing the focused distance

In many cases, you can manipulate depth of field by changing your focused distance. When you want to throw the background out of focus, for example, you can focus forward a little, so that the subject is within the depth of field but the background is well behind it. The opposite also applies. If you focus slightly beyond the subject you extend the zone of sharpness behind it.

When you wish to obtain the greatest depth of field at any given aperture you set the focus at the hyperfocal distance for that aperture. This distance can be calculated or looked up in tables but the easiest method is to set the lens distance scale so that the infinity marking is opposite the *f*-number at which you are shooting on the depth of field scale. You are then focused at the hyperfocal distance and the depth of field stretches from half that distance to infinity.

Shooting at close range

To enable a lens to focus objects close to it, the distance between the film and the lens needs to be increased. That is what you do when you turn the focusing ring on the average lens. The glass components of the lens move forward in their mounting within the lens barrel. With most lenses the amount of travel thus provided is restricted and the closest focus allowed with the average standard lens barely reaches the true close-up field. A wide angle lens generally focuses closer, while the longer the focal length the more distant the minimum focusing plane.

If you wish to focus at really close range, therefore, you have two alternatives:

1. You can add a lens to the camera lens to shorten its focal length so that the existing travel has a greater effect.
2. You can interpose extension tubes or an extension bellows between lens and camera to increase the separation between camera and film.

Close-up lenses

Close-up lenses are relatively inexpensive, usually single-glass constructions in filter-type mounts to attach to the front of the camera lens. They are rated in dioptres, indirectly indicating the focal length, which is the dioptre number divided into one metre. Thus a 1-dioptre lens has a focal length of one metre or $39\frac{1}{4}$ in; the focal length of a 3-dioptre lens is 30 cm or about 13 in. Strengths above 3 dioptres are less common and generally need to be of higher quality and price.

With the camera lens set to infinity you can focus objects at a distance equal to the focal length of the close-up lens, measured from the front of the lens. The normal focusing travel allows a restricted range of closer focusing.

Exposure is not affected by the close-up lens. There is no increase in lens extension so the aperture values remain as in normal photography.

Extension tubes and bellows

Extension tubes are, exactly as their name implies, metal rings or tubes to provide a fixed amount of additional distance between lens and film. They are usually supplied in sets of three, typical values being 7, 14 and 28 mm. Automatic types are now available for most reflex cameras, connecting the auto-diaphragm mechanisms of camera body and lens.

Extension bellows perform the same function but allow variable extension between the limits of the bellows length and the minimum extension provided by the front and rear standards and the fully compressed bellows. Automatic diaphragm facilities are not generally available with bellows except by an external linkage or the use of a double cable release.

Exposure factors

As the function of extension tubes and bellows is to increase the distance between lens and film and therefore the distance the image-forming rays have to travel, there is a loss of light intensity at the film surface. This means that the lens *f*-numbers do not give an accurate impression of the exposure effect. Rather than adjust the *f*-number for each degree of extension, however, it is easier to use an exposure factor calculated from $(E/F)^2$, where E = total extension, i.e. focal length plus additional extension provided by bellows or tubes, and F = focal length of the camera lens. Thus, when 7 mm and 28 mm extension tubes are used together on a 50 mm lens, the exposure factor is $(85/50)^2 = 2.89$. The normally calculated exposure should thus be increased threefold, i.e. open up the lens by $1\frac{1}{2}$ stops. No such calculation is necessary, however, where the camera has a through-the-lens meter.

Close-up depth of field

Aperture f	Depth of field in inches for scale of reproduction 0·1 (1 : 10)	0·17 (1 : 6)	0·25 (1 : 4)	0·5 (1 : 2)	1 (1 : 1)	2 (2 : 1)	3 (3 : 1)
2	0·22	0·084	0·040	0·012	0·0040	0·0015	0·0009
2·8	0·31	0·12	0·056	0·017	0·0056	0·0021	0·0012
4	0·44	0·17	0·080	0·024	0·0080	0·0030	0·0018
5·6	0·62	0·23	0·11	0·034	0·011	0·0042	0·0025
8	0·88	0·34	0·16	0·048	0·016	0·0060	0·0036
11	1·21	0·46	0·22	0·066	0·022	0·0082	0·0049
16	1·76	0·67	0·32	0·096	0·032	0·012	0·0071
22	2·42	0·92	0·44	0·13	0·044	0·016	0·0098
32	3·5	1·34	0·64	0·19	0·064	0·024	0·014
45	4·9	1·90	0·90	0·27	0·090	0·034	0·020

Aperture f	Depth of field in millimetres for scale of reproduction 0·1 (1 : 10)	0·17 (1 : 6)	0·25 (1 : 4)	0·5 (1 : 2)	1 (1 : 1)	2 (2 : 1)	3 (3 : 1)
2	5·5	2·10	1·00	0·30	0·10	0·038	0·022
2·8	7·7	2·94	1·40	0·42	0·14	0·052	0·031
4	11·0	4·2	2·00	0·60	0·20	0·775	0·044
5·6	15·4	5·9	2·80	0·84	0·28	0·10	0·062
8	22·0	8·4	4·0	1·20	0·40	0·15	0·089
11	30	11·5	5·5	1·65	0·55	0·21	0·12
16	44	16·8	8·0	2·40	0·80	0·30	0·18
22	60	23·1	11·0	3·3	1·10	0·41	0·24
32	88	34	16·0	4·8	1·60	0·60	0·36
45	124	47	22·5	6·7	2·25	0·84	0·50

Circle of confusion 0·001 in/0·025 mm. The depth of field shown is at each side of the plane of sharp focus. The total depth is twice these figures.

Working methods

Important points to bear in mind when working at close range is that depth of field is extremely shallow and perspective distortion of three-dimensional objects is inevitable. You can reduce the perspective distortion by shooting from a greater distance with a longer focus lens but you can do little about the reduced depth of field beyond focusing precisely on the plane of most importance and stopping down as far as possible.

In most set-ups, a tripod is essential, because of the requirement for accurate focusing. It is quite possible to hand-hold, however, when using very little extra extension on longer focus lenses to shoot, for example, wild flowers or plants. You may well be able to use a small flashgun on such occasions and shoot at small apertures.

Tele-extenders can be used in close-range work to magnify the image without moving closer and risking perspective distortion. In static set-ups, the light loss is rarely of great importance.

Multiple exposures

For normal purposes, modern cameras will give one exposure—and one exposure only—on each frame of the film. However, deliberate double exposures may be used to record intermingling images, or to enliven an otherwise dull part of a picture.

When two different subjects are to be merged, the total exposure should be more or less correct for the film in use. Thus, to portray a "ghost" on an otherwise bare beach, take a portrait at about 1 stop under-exposed (set exposure factor scale at $\frac{1}{2}\times$, alter aperture to 1 stop smaller or shutter to one speed faster). Reset the shutter, and then under-expose the overall scene by one stop.

Another use is in making title transparencies. The background may be a normally exposed picture. The title is then set up in white letters on a matt black background. This is given a normal exposure (or slight over-exposure) so that the white letters "burn out" to give a white image superimposed on the background.

Bare areas of blue sky may be filled with suitably exposed clouds, but this is not easy without spoiling the rest of the picture. With some acquired skill, however, suns or moons can be added to a scene by double exposure (as long as they are set in an area of blank sky). Remember that the sun in particular must be given the shortest practicable exposure so as to reproduce the sky as nearly black as possible. The sun or moon can be exaggerated in size by using a longer focus lens.

A series of pictures

When you need a number of multiply-exposed pictures, you can take one series of exposures, rewind the film, and then take the second series. For example, if you take a reel of background shots out of doors, you can then set up your titling equipment and superimpose titles on them. To do this, the first time you load it, you must mark the film position accurately before you close the camera back. Use a felt-tip pen, either indicating which sprocket holes are on the sprockets, or drawing a line across at the cassette lips. After the first series of exposures, rewind the film but ensure the tongue stays outside the cassette. When you reload the film, make sure it is in exactly the same position when you close the camera back, and then wind it on the same number of times to get back to the first frame.

Few mechanisms for obtaining double exposures can be considered 100% accurate, and allowance should be made wherever possible. For instance, if titles are only half frame width, you can be sure that they will come out complete. If they turn out to be off-centre, the slide can be masked on one side or the other.

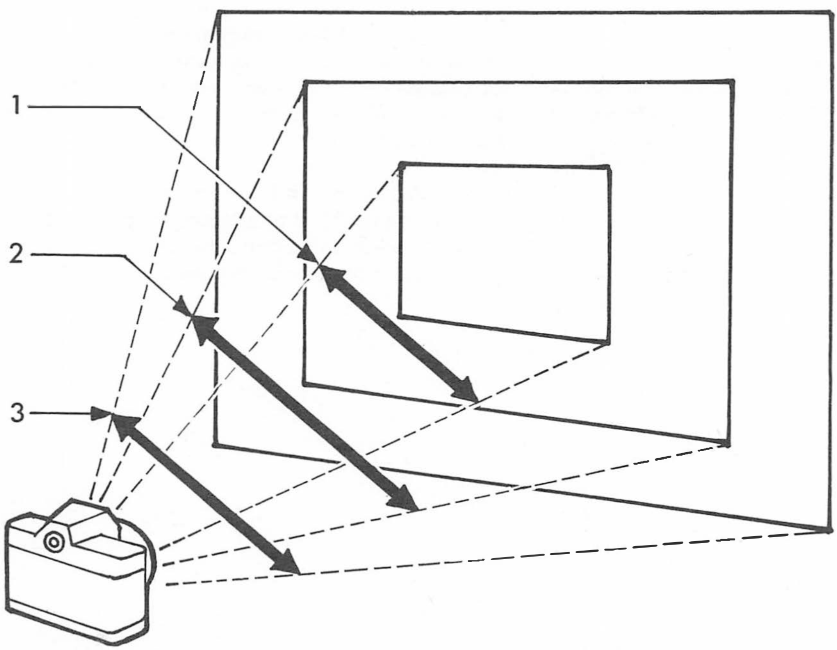
Interchangeable lenses

One of the major reasons for buying a system camera, particularly a single-lens reflex, is to enable you to choose the lens to suit the picture. The most important feature of a lens is its angle of view. For any given format, this is directly related to its focal length. The angle of view is normally measured across the diagonal of the format. The angles of view of normal lenses for 35 mm cameras vary from about 110° to 1°. The quoted angles of view for really short focus lenses (less than 20 mm) tend to vary from one manufacturer to another, partly because slight variations in actual focal length greatly affect the angles and partly because of differing measurement techniques. The only way to determine whether a lens is suited to your purpose is to test it on your camera.

Different focal lengths

Choosing the focal length—and thus the angle of view—of a lens allows you to choose the area of a scene you include from a particular viewpoint. Wide-angle lenses allow you to include a broad sweep in one picture, whereas long-focus (narrow-angle) lenses allow you to concentrate on one small part—thus magnifying a distant object. If you can alter your viewpoint, altering the focal length allows you to vary the perspective in your picture while still showing the important part of your subject the same size. Another reason for changing from one lens to another is to change the depth of field while maintaining a usable *f*-number.

Although individual photographers tend to regard other lenses as their standard, most 35 mm cameras are supplied with a lens of between 45 and 55 mm. These



Interchangeable lenses allow more or less to be included in the picture at different ratios of reproduction. 1, *long-focus.* 2, *standard.* 3, *wide-angle.*

lenses approximate to the angle of view of the human eye (50–43°), and so under most circumstances produce pictures with pleasing perspective (when they are viewed from a "normal" distance). Some photographers advocate wider angles, such as 55–62° (40–35 mm), whereas others prefer to take most of their pictures with an 85 or 90 mm lens giving an angle of about 27 or 28°, so the 45–55 mm seems to be a good compromise.

Long-focus lenses

Most non-photographers immediately assume that extra lenses are telephoto lenses, because some of their attributes are obvious. They allow the user to take photos of distant subjects, or to isolate the important parts of a scene. Telephoto lenses are, in fact, long-focus lenses which have a physical length shorter than their focal length, and they behave in exactly the same way as ordinary long-focus lenses of the same focal length. They are, however, smaller and lighter.

Moderately long-focus lenses—about 85 to 150 mm—have two functions. They magnify parts of the subject too distant to be pictured with the standard lens and allow the photographer to use a viewpoint which gives pleasing perspective in portraits. These two features combine to make them excellent lenses for taking pictures of children playing or of relatively unsuspecting adults. Lenses from 80 to 105 mm are usually regarded as optimum for normal portrait work.

Longer-focus lenses are useful for sports or nature photography, as they give quite large images even when you cannot get near the subject. Because they also magnify the effects of subject or camera movement, however, they need some care in handling, and lenses longer than 300 mm focal length are unlikely to give their best performance without a firm support.

Shooting from a distance has the effect of compressing the perspective of the final picture. This is purely an effect of magnifying part of the scene, as may be seen by enlarging a small sector from a negative taken with the standard lens, but the "crowding" effect should be remembered when composing your picture. You can use the effect, for example, to picture an enormous moon apparently just behind a close-up of a tree, which was actually some distance from the camera.

Wide-angle lenses

For many photographers, the first accessory lens is a wide-angle. Wide-angle lenses for single lens reflex cameras are normally of reversed telephoto construction. This construction allows them to focus an image on the film from a distance greater than their focal length, thus allowing room for the mirror to move up and down.

The most popular wide-angle lens has long been the 35 mm, but 30 or 28 mm lenses are becoming much more widely used. Such wide angle lenses allow you to get more in a picture without moving back further, and are particularly useful when shooting in confined spaces. One particular use is to take pictures of tall buildings, without the converging verticals which would be caused if you were to tilt the camera to include the top.

The other important feature of wide-angle lenses is their great depth of field. Careful use can give pictures in which the whole subject is sharp from a few feet to infinity. Such pictures, however, often show "wide-angle distortion" because of the close viewpoint needed to picture objects at a large size. The effect is often used creatively, but wide-angle lenses—especially extreme ones of 24 mm or less—must be treated with respect if this effect is not to spoil your normal pictures.

Building up a system

A "system" camera is only the basis of a system. The ease and efficiency with which you can deal with your picture taking depends largely on the accessories you select. An important factor in such selection must be portability. It is no good attempting nature photography if you can't carry your equipment without a car!

Lenses

Accessory lenses are an essential part of any system, but they should be selected with care, taking account of how they relate to one another and what other lenses you may need later. It is also important to choose a range which you can carry with you and which covers all your likely uses.

Most cameras are supplied with a standard lens, and others should normally be chosen to complement it. The most useful wide-angle to supplement this for the 35 mm photographer is probably a 28 mm, which gives greatly increased coverage and depth of field and can be used without the special care needed with ultrawide (15--25 mm) lenses. A suitable long-focus companion to these is a 100 to 150 mm lens. If you don't intend to buy any more long focus lenses, the choice will depend only on the expected uses. A lens of around 100 mm is best for portraits, but a longer one is probably more useful for picturing distant objects. For most photographers, 125 or 135 mm is a good compromise.

If you intend to build further, your first purchases should be considered more carefully. For example if you envisage using a 200 mm lens at some later date, a 100 mm would be a better choice than a 150 mm, whereas if you were contemplating a 300 mm lens, perhaps for sports photography, a 150 mm may be a better companion. Lenses much longer than 300 mm, or much shorter than 28 mm should only be considered for specialist purposes, and may be of less influence on your choice of general purpose lenses.

If you are starting from scratch you might consider buying a camera body without a standard lens, and then a selection of lenses. Thus you might choose a 35 mm and 85 mm to start, adding perhaps a 24 mm and 150 mm at a later date. This would be a particularly valuable saving if you ever intended buying a 50 mm macro lens, which makes a perfectly good "standard" lens.

There are two major types of lenses useful for increasing your versatility: teleconverters and zooms. The major disadvantage of teleconverters is that they reduce the light reaching the film, but under daylight conditions with fast prime lenses, this may be inconsequential. For example, an expedition photographer could probably cover most situations with a 28 mm f2.8 and a 100 mm f2.8 lens if he had a 2 and 3 times converter. This would give 28 mm f2.8, 56 mm f5.6, 84 mm f8, 100 mm f2.8, 200 mm f5.6 and 300 mm f8 combinations; not particularly impressive until you remember that with one lens on the camera the rest will go in one pocket. If absolute definition is of the utmost concern, however, the prime lenses and the converter must be of the highest quality. Zoom lenses allow you to cover a range of focal lengths, but their sizes, weights and maximum apertures are governed by their longest focal length. Thus an 85--200 mm lens is a versatile substitute for a 200 mm lens, but a clumsy one for an 85 mm. If you expect to use all the range quite often, a zoom lens may be a good addition to your system. If, however, most of your work is at one end or other, you would probably be better served by a suitable prime lens—and possibly a teleconverter for the odd occasion. Both these accessories are covered in more detail in the sections on equipment for your camera.

Close-ups and special accessories

Close up equipment ranges from simple accessory lenses to microscopes. While accessory lenses are useful for the occasional job a set of extension tubes will give more versatility. To increase this further a set of extension bellows is useful but we are coming to equipment which needs a bag of its own, and if portability is the prime concern, the choice requires careful thought. Remember that it is difficult to use the full capabilities of even small bellows without a firm tripod or similar support. For many field shots, a longish lens (say 85–125 mm) with a small extension tube gives adequate image size without being a burden.

SLR cameras are simple to use on microscopes, usually with adapters supplied. However, photography is normally considered as an extension of microscopy, rather than vice versa, and a microscope would not normally be considered part of a camera system. Likewise, many astronomers—amateur and professional—use a camera with their telescopes, but the latter could not really be thought of as camera accessories.

Filters

Many photographers keep an ultra-violet absorbing filter permanently on their lenses to prevent damage. This is normally unnecessary except under hazardous conditions, and unless the filter is of superb quality, will probably reduce the absolute definition of negatives. Other filters should be considered as the occasion arises. If your lens set needs several different sizes, you may be able to economise by buying large filters and adapter rings.

Cases

Cases fall into two categories—ever-ready camera cases, lens cases etc. usually supplied by the equipment manufacturer, and gadget bags or equipment cases.

Ever-ready cases are a matter of taste—many photographers find them a nuisance, and often the best compromise is to remove the front flap and leave it at home, thus retaining some protection without inconvenience. They are, however, good for protecting the camera in storage, as are the round zip or clip up lens cases supplied with most lenses.

However, if you want to carry several items with you, the simplest way is to put them all into one case. If you carry the camera separately, a small gadget bag is very handy. The sort that are supposed to hold a camera and two accessory lenses will hold about three lenses, a small flashgun and several cassettes of film, together with filters, extension leads and other small items. For real strength, however, there is no substitute for foam-lined aluminium cases. These can be bought in a number of sizes, and have foam inserts which are cut to provide tight-fitting compartments for all your pieces of equipment. Professional photographers, who are not unduly worried about the looks of their equipment, tend to carry it loose in a leather hold-all. Whatever form your system case takes, you should leave all the individual cases behind—they take up space and get in the way. Lenses are quite safe with caps on both ends if they are kept in small polythene bags to prevent surface markings.

Camera care

So many cameras now use batteries for one purpose or another that they have become an important point in camera care. If you do not expect to use your camera for a prolonged period, remove all batteries. None of them are totally leakproof and a long period of disuse could cause them to corrode and damage the camera contacts.

With the batteries removed, store the camera away from damp and dust, preferably sealed in a plastic bag.

Ideally, no camera should be stored. The camera is designed to be used. If it is not, its mechanism can become sluggish and unreliable. If possible, operate the mechanism a few times each month even if you don't actually take any pictures. If storage is inevitable, when you take the camera out, check it over thoroughly, operating all shutter speeds several times with the lens removed or back open so that you can observe the shutter action. If you use flash, plug a flashgun in and make a few test shots, again watching for synchronisation through front or back with the lens in place.

Insert new batteries and check the exposure meter and any other battery-powered operation.

Cleaning operations

In normal use, the camera needs little attention. The best treatment, in fact, to keep it in good condition is constant use. Avoid any cleaning operation unless it is absolutely essential. A few specks of dust on the lens will do no harm at all. Frequent careless cleaning with a handkerchief can cause considerable damage that is progressive and insidious. If dust or sand does find its way into the camera in significant quantities, you would be better advised to take it to a competent mechanic for complete overhaul. The same applies if you are so unfortunate as to drop your camera into water, particularly salt water. The chances are, in both cases, that at least partial dismantling will be necessary to get the water, sand, etc. out of inaccessible parts and to effect thorough cleaning and regreasing.

When carrying the camera, keep it close to the body on a tight strap so that it does not swing out into brick walls or tree trunks. Whether you use the so-called ever-ready case or not is a matter of personal preference. It is useful for storage and transport but rather cumbersome when actually shooting. Few now open and close easily and even when you can remove the front portion you have a problem in disposing of it.

There are similar difficulties with lens cases and there is a lot to be said for carrying your equipment in polythene bags in a small gadget bag, leaving the cases at home for storage purposes. All these cases and the gadget bag itself tend to attract dust and fluff and the polythene bag offers better protection.

Never, under any circumstances, attempt to repair a camera that is malfunctioning unless you are absolutely certain that you know what you are doing. Camera repairs are expensive but they can become a great deal more expensive if inexpert repairs are attempted first.

Glossary

Aberration. Failing in the ability of a lens to produce a true image. There are many forms of aberration and the lens designer can often correct some only by allowing others to remain. Generally, the more expensive the lens, the less its aberrations.

Angle of view. The extent of the view taken in by a lens. For any particular film size, it varies with the focal length of the lens. Usually expressed on the diagonal of the image area.

Aperture. The opening in the lens, usually provided by an adjustable iris diaphragm, though which light passes. See Limiting aperture, Effective aperture, *f*-number.

Aperture priority. Automatic exposure system in which the lens aperture is set by the photographer, and the camera sets the shutter speed. Can be used in the stop-down mode with any lens that does not interfere with the metering system.

Artificial light. Light from a man-made source, usually restricted to studio, photolamp and domestic lighting. When used to describe film (also known as Type A or Type B) invariably means these types of lighting.

ASA. Film speed rating defined by the American National Standards Institute.

Automatic iris. Lens diaphragm which is controlled by a mechanism in the camera body coupled to the shutter release. The diaphragm closes to any preset value before the shutter opens and returns to the fully open position when the shutter closes.

Balanced. Description applied to colour films to indicate their ability to produce acceptable colour response in various types of lighting. The films normally available are balanced for daylight (5500–6000K), photolamps (3400K) or studio lamps (3200K).

Cadmium sulphide (CdS). Photo conductive material used in exposure meters as alternative to selenium-based or silicon blue photocells. Its electrical resistance decreases as the light falling on it increases. Cds meters use current from an external power source, such as a battery.

Camera shake. Movement of camera caused by unsteady hold or support, vibration, etc., leading, particularly at slower shutter speeds, to a blurred image on the film. It is a major cause of unsharp pictures, especially with long focus lenses.

Capacitor. Electrical component once more commonly known as a condenser. Stores electrical energy supplied by a power source and can discharge it more rapidly than the source itself. Used in flash equipment, providing reliable bulb firing even from weak batteries, and supplying the surge needed for electronic flash tubes.

Cassette. Light-trapped film container used with 35 mm cameras.

Cast. Abnormal colouring of an image produced by departure from recommended exposure or processing conditions with a transparency film, or when making a colour print. Can also be caused by reflection within the subject as from a hat on to the face.

Click stop. Ball bearing and recess or similar construction used to enable shutter speeds, aperture values, etc. to be set by touch.

Colour negative. Film designed to produce colour image with both tones and colours reversed for subsequent printing to a positive image, usually on paper.

Colour reversal. Film designed to produce a normal colour positive image on the film exposed in the camera for subsequent viewing by transmitted light or projection on to a screen.

Colour temperature. Description of the colour of a light-source by comparing it with the colour of light emitted by a (theoretical) perfect radiator at a particular temperature expressed in kelvins (K). Thus "photographic daylight" has a colour temperature of about 5500K. Photographic tungsten lights have colour temperatures of either 3400K or 3200K depending on their construction.

Component. Part of a compound lens consisting of one element (single lens) or more than one element cemented or otherwise joined together. A lens may therefore be described as 4-element, 3-component when two of the elements are cemented together.

Computer flash. Electronic flash guns which sense the light reflected from the subject, and cut off their output when they have received sufficient light for correct exposure. Most units must be used on or close to the camera for direct lighting only. and the camera lens must be set to a specific aperture (or a small range of apertures) determined by the speed of the film in use.

Condenser. Generally a simple lens used to collect light and concentrate it on a particular area, as in enlarger or projector. Frequently in the form of two plano-convex lenses in a metal housing. A condenser, normally of the fresnel type, is used to ensure even illumination of the viewing screens on SLR cameras.

Contrast. Tonal difference. More often used to compare original and reproduction. A negative may be said to be contrasty if it shows fewer, more widely spaced tones than in the original.

Delayed action. Mechanism delaying the opening of the shutter for some seconds after the release has been operated. Also known as self-timer.

Depth of field. The distance between the nearest and farthest planes in a scene that a lens can reproduce with acceptable sharpness. Varies with effective aperture (and thus with focal length at any particular *f*-number) focused distance and the standards set for acceptable sharpness.

Developer. Solution used to make visible the image produced by allowing light to fall on the light-sensitive material. The basic constituent is a developing agent which reduces the light-struck silver halide to metallic silver. Colour developers include chemicals which produce coloured dyes coincidentally with reduction of the silver halides.

Diaphragm. Device consisting of thin overlapping metal leaves pivoting outwards to form a circular opening of variable size. Used to control light transmission through a lens.

DIN. Film speed rating defined by the Deutscher Normenausschuss (German standards organisation).

Effective aperture. The diameter of the bundle of light rays striking the first lens element that actually pass through the lens at any given diaphragm setting.

Electronic flash. Light source based on electrical discharge across two electrodes in a gas-filled tube. Usually designed to provide light approximating to daylight.

Element. Single lens used in association with others to form a compound construction.

Emulsion. Suspension of light-sensitive silver salts in gelatin.

Exposure. The act of allowing light to reach the light-sensitive emulsion of the photographic material. Also refers to the amount (duration and intensity) of light which reaches the film.

Exposure factor. A figure by which the exposure indicated for an average subject and/or processing should be multiplied to allow for non-average conditions. Usually applied to filters, occasionally to lighting, processing, etc. Not normally used with through-the-lens exposure meters.

Exposure meter. Instrument containing light sensitive substance which indicates aperture and shutter speed settings required.

Extension bellows. Device used to provide the additional separation between lens and film required for close-up photography. Consists of extendible bellows and mounting plates at front and rear to fit the lens and camera body respectively.

Extension tubes. Metal tubes used to obtain the additional separation between lens and film for close-up photography. They are fitted with screw thread or bayonet mounts to suit various lens mounts.

f-number. Numerical expression of the light-transmitting power of a lens. Calculated from the focal length of the lens divided by the diameter of the bundle of light rays entering the lens and passing through the aperture in the iris diaphragm.

Film base. Flexible support on which light sensitive emulsion is coated.

Filter. A piece of material which restricts the transmission of radiation. Generally coloured to absorb light of certain colours. Can be used over light sources or over the camera lens. Camera lens filters are usually glass—either dyed or sandwiching a piece of gelatin—in a screw-in filter holder.

Fisheye lens. Ultra-wide angle lens giving 180° angle of view. Basically produces a circular image—on 35 mm, 5–9 mm lenses showing whole image, 15–17 mm lenses giving a rectangular image fitting just inside the circle, thus representing 180° across the diagonal.

Fixer. Solution, usually based on sodium thiosulphate, in which films or prints are immersed after development to convert the unexposed silver halides in the emulsion to soluble products that can be washed out. This prevents subsequent deterioration of the image.

Flashbulb. Light source based on ignition of combustible metal wire in a gas-filled transparent envelope. Popular sizes are usually blue-coated to give light approximating to daylight.

Flashcube. Self-contained unit comprising four small flashbulbs with own reflectors. Designed to rotate in special camera socket as film is wound on. Can be used in a special adapter on cameras without the socket, but will not rotate automatically.

Focal length. Distance from a lens to the image it produces of a very distant subject. With a compound lens the point from which it is measured depends on the construction of the lens. It is within the lens with those of normal construction, but may be in front of telephoto lenses, or behind inverted telephotos. Whatever the lens construction, the focal length determines the size of the image formed.

Focus. Generally, the act of adjusting a lens to produce a sharp image. In a camera, this is effected by moving the lens bodily towards or away from the film or by moving the front part of the lens towards or away from the rear part, thus altering its focal length.

Format. Shape and size of image provided by camera or presented in final print or transparency. Governed in the camera by the opening at the rear of the body over which the film passes or is placed. The standard 35 mm format is 36×24 mm; half-frame, 18×24 mm; 126 size, 28×28 mm; 110, 17×13 mm; standard rollfilm (120 size), $2\frac{1}{4} \times 2\frac{1}{4}$ in.

Fresnel. Pattern of a special form of condenser lens consisting of a series of concentric stepped rings, each being a section of a convex surface which would, if continued, form a much thicker lens. Used on focusing screens to distribute image brightness evenly over the screen.

Full aperture metering. TTL metering systems in which the camera simulates the effect of stopping down the lens when the aperture ring is turned, while leaving the diaphragm at full aperture to give full focusing screen brilliance. The meter must be "programmed" with the actual full aperture, and the diaphragm ring setting.

Grain. Minute metallic silver deposit, forming in quantity the photographic image. The individual grain is never visible, even in an enlargement, but the random nature of their distribution in the emulsion causes over-lapping, or clumping, which can lead to graininess in the final image.

Graininess. Visible evidence of the granular structure of a photographic reproduction. Influenced by exposure, development, contrast characteristics and surface of printing paper, emulsion structure and degree of enlargement. Basically increases with increasing film speed.

Grey card. Tone used as representative of mid-tone of average subject. The standard grey card reflects 18 per cent of the light falling on it.

Guide number. Figure allocated to a light source, usually flash, representing the product of aperture number and light-to-subject distance required for correct exposure.

Halation. The production of "halos" round bright spots in an image, by light reflecting from the back of the film-base. General film bases are given a light-absorbing coat—the anti-halation back—to prevent this.

Highlight. Small, very bright part of image or object. Highlights should generally be pure white, although the term is sometimes used to describe the lightest tones of a picture, which, in that case, may need to contain some detail.

Image. Two-dimensional reproduction of a subject formed by a lens. When formed on a surface, i.e. a ground-glass screen, it is a real image; if in space, i.e. when the screen is removed, it is an aerial image. The image seen through a telescope, optical viewfinder, etc. cannot be focused on a surface without the aid of another optical system and is a virtual image.

Incident light. Light falling on a surface as opposed to the light reflected by it.

Infinity. Infinite distance. In practice, a distance so great that any object at that distance will be reproduced sharply if the lens is set at its infinity position, i.e. one focal length from the film.

Interchangeable lens. Lens designed to be readily attached to and detached from a camera.

Inverted telephoto lens. Lens constructed so that the back focus (distance from rear of lens to film) is greater than the focal length of the lens. This construction allows room for mirror movement when short focus lenses are fitted to SLR cameras.

Iris. Strictly, iris diaphragm. Device consisting of thin overlapping metal leaves pivoting outwards to form a circular opening of variable size to control light transmission through a lens.

Leader. Part of film attached to camera take-up spool. 35 mm film usually has a leader of the shape originally designed for bottom-loading Leica cameras, although most cameras simply need a short taper.

Lighting ratio. The ratio of the brightness of light falling on the subject from the main (key) light and other (fill) lights. A ratio of about 3:1 is normal for colour photography, greater ratios may be used for effect in black-and-white work.

Limiting aperture. The actual size of the aperture formed by the iris diaphragm at any setting. Determines, but usually differs from, the effective aperture.

Long-focus. Lens of relatively long focal length designed to provide a narrower angle of view than the normal or standard lens, which generally has an angle of view, expressed on the diagonal of the film format, of about 45 deg. The long focus lens thus takes in less of the view in front of it but on an enlarged scale.

Magicube. Special form of flashcube which is fired by mechanical (not electrical) means. Can be used only on cameras fitted with the appropriate socket.

Manual iris. Diaphragm controlled directly by a calibrated ring on the lens barrel.

Microprism. Minute glass or plastic structure of multiple prisms set in a viewfinder screen to act as a focusing aid. Breaks up an out-of-focus subject into a shimmer but images a focused subject clearly. Will not work satisfactorily at lens apertures smaller than *f* 5·6.

Mirror lens. Lens in which some (usually two) of the elements are curved mirrors. This construction produces comparatively lightweight short fat long focus lenses. They cannot be fitted with a normal diaphragm.

Modelling. Representation by lighting of the three-dimensional nature of an original in a two-dimensional reproduction.

Neutral density filter. Grey filter that absorbs light of all colours equally and thus has no effect on colour rendering with colour film or tonal values with black and white film. Primarily used with mirror lenses or to enable large apertures to be used in bright light conditions.

Parallax. Apparent change in position of an object due to changed viewpoint. In a camera with separate viewfinder, the taking lens and the viewfinder view an object from slightly different positions. At close range, the image produced on the film is significantly different from that seen in the viewfinder. Completely eliminated in single-lens reflex cameras.

Perspective. Size, position and distance relationship between objects. Varies according to viewpoint so that objects at different distances from the observer appear to be closer together with increasing distance. Thus, a long-focus lens used at long range and a wide-angle lens used very close up provide images very different from that of the standard lens used at a normal working distance.

Photolamp (3400K). Photographic lamp giving more light than a normal lamp of the same wattage, at the expense of filament life. Often referred to by the trade mark Photoflood. Are used with type A colour films.

Plane. Level surface. Used in photography chiefly in respect to focal plane, an imaginary level surface perpendicular to the lens axis in which the lens is intended to form an image. When the camera is loaded the focal plane is occupied by the film surface.

Polarized light. Light waves vibrating in one plane only as opposed to the multi-directional vibrations of normal rays. Natural effect produced by some reflecting surfaces, such as glass, water, polished wood, etc., but can also be simulated by placing a special screen in front of the light source. The transmission of polarized light is restricted by using a screen at an angle to the plane of polarization.

Preset iris. Diaphragm with two setting rings or one ring that can be moved to two positions. One is click-stopped, but does not affect the iris, the other moves freely and alters the aperture. The required aperture is preset on the first ring, and the iris closed down with the second just before exposure.

Rangefinder. Instrument for measuring distances from a given point, usually based on slightly separated views of the scene provided by mirrors or prisms. May be built into non-reflex cameras. Single-lens reflexes may have prismatic range-finders built into their focusing screens.

Refill. Length of film usually for loading into 35 mm cassettes in total darkness. Daylight refills are not now generally available.

Relative aperture. Numerical expression of effective aperture, also known as *f*-number. Obtained by dividing focal length by diameter of effective aperture.

Resolution. Ability of film, lens or both in conjunction to reproduce fine detail. Commonly measured in lines per millimetre as ascertained by photographing, or focusing the lens on, a specially constructed test target. The resolution of modern lenses and films is so high that differences have no bearing on normal photography except with the simplest lenses and fastest films.

Safelight. Light source consisting of housing, lamp and screen of a colour that will not affect the photographic material in use. Safelight screens are available in various colours and sizes for specific applications.

Scale. Focusing method consisting of set of marks to indicate distances at which a lens is focused. May be engraved around the lens barrel, on the focusing control or on the camera body.

Screen. In a camera, the surface upon which the lens projects an image for viewfinding and, usually, focusing purposes. In SLR cameras, almost universally a fresnel screen with a fine-ground surface. Often incorporates a microprism or split-image rangefinder.

Selenium. Light-sensitive substance which, when used in a barrier-layer construction, generates electrical current when exposed to light. Used in exposure meters. Needs no external power supply.

Self-timer. Mechanism delaying the opening of the shutter for some seconds after the release has been operated. Also known as delayed action.

Semi-automatic iris. Diaphragm mechanism which closes down to the taking aperture when the shutter is released, but must be manually re-opened to full aperture.

Sensitivity. Expression of the nature of a photographic emulsion's response to light. Can be concerned with degree of sensitivity as expressed by film speed or response to light of various colours (spectral sensitivity).

Sharpness. Clarity of the photographic image in terms of focus and contrast. Largely subjective but can be measured to some extent by assessing adjacency effects, i.e. the abruptness of the change in density between adjoining areas of different tone value.

Short-focus. Lens of relatively short focal length designed to provide a wider angle of view than the normal or standard lens, which generally has an angle of view, expressed on the diagonal of the film format, of about 45 deg. The short focus lens takes in more of the view in front of it but on a smaller scale.

Shutter priority. Automatic exposure systems in which the shutter speed is set by the photographer, and the camera selects the lens aperture appropriate to the film speed and the light reflected from the subject. Such systems must meter the light at full aperture and use specially connected lenses.

Silicon. Light-sensitive substance which generates a minute current when exposed to light. Requires no external power source, but, in exposure meters, uses an externally powered amplifier.

Split-image. Form of rangefinder image, bisected so that the two halves of the image are aligned only when the correct object distance is set on the instrument or, in the case of a coupled rangefinder, when the lens is correctly focused. SLR cameras may have a prismatic split-image system in their viewing screen. Works on the same principle as a microprism, and is restricted to apertures of *f* 5·6 or greater.

Stabilizer. Alternative to fixer where permanence is not required. Used in automatic processing machines and can now provide prints that will not deteriorate noticeably over many months if kept away from strong light.

Stop-down metering. TTL metering in which the light is measured at the picture-taking aperture. As the meter just measures the light passing through the lens, there is no need for any lens-camera interconnections.

Studio lamps (3200K). Tungsten or tungsten halogen lamps designed for studio use. Have a longer life than photolamps, but a lower specific output and colour temperature. Are used with type B films.

Supplementary lens. Generally a simple positive (converging) lens used in front of the camera lens to enable it to focus at close range. The effect is to provide a lens of shorter focal length without altering the lens-film separation, thus giving the extra extension required for close focusing.

Synchronisation. Concerted action of shutter opening and closing of electrical contacts to fire a flashbulb or electronic flash at the correct moment to make most efficient use of the light output. Roughly speaking, FP or M-synchronisation is constructed to fire flashbulbs just before the shutter is fully open, allowing a build-up time, and X-synchronisation fires electronic flash exactly at the moment the shutter is fully open.

Telephoto. Special form of long-focus lens construction in which the back focus (distance from rear of lens to film) is much less than the focal length of the lens.

Through-the-lens (TTL). Type of exposure meter built into the camera body and reading through the camera lens. May measure either at full aperture or at picture taking aperture.

Type A. Colour film balanced for use with photolamps (3400K).

Type B. Colour film balanced for use with studio lamps (3200K).

Ultra-wide angle lens. Extra-wide angle lens, usually those with an angle of view greater than 90°. For 35 mm cameras the description usually applies to lenses of shorter focal length than about 24 mm.

Variable focus lens. Lens of which the focal length can be continuously varied between set limits. The lens must be refocused with each change in focal length.

Viewfinder. Device or system indicating the field of view encompassed by the camera lens. The term is sometimes used as a description of the type of camera that does not use reflex or "straight-through" viewing systems and therefore has to have a separate viewfinder.

Vignetting. Underexposure of image corners produced deliberately by shading or unintentionally by inappropriate equipment, such as unsuitable lens hood or badly designed lens. A common fault of wide-angle lenses, owing to reflection, cut-off, etc. of some of the very oblique rays. May be caused in some long-focus lenses by the length of the lens barrel.

Wide-angle. Lens designed to provide a wider angle of view than the normal or standard lens. Generally has an angle of view, expressed on the diagonal of the film format, of about 60 deg. or more. The wide-angle lens thus takes in more of the view in front of it but on a reduced scale.

Zoom lens. Lens of which the focal length can be continuously varied within stated limits while maintaining the focus originally set.

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