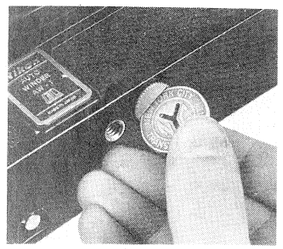
centered and properly assembled. Off-axis, we observed a combination of coma and astigmatism, but their size was judged to be smaller than average. At f/5.6, the image became free of these major aberrations, leaving only a very tiny amount of lateral color. *In field test slides:* As expected, this Nikkor performed admirably. Shots at wide open apertures were sharp, although at f/1.4, the corner images had some comatic streaking. But, at f/2.8 and smaller apertures, pictures were sharp, and well as "crisp," edge to edge. There were virtually no traces of the color aberrations. Residual ghosts and flare were fairly well controlled. In transparencies shot towards strong light sources, a small pink ghost appeared as well a one colorless diaphragm reflection. Image quality overall is very good to excellent.

One accessory that we felt had to be tried along with the camera is the Nikon Auto Winder AW-1, which we did note elsewhere in MODERN when it was first introduced on the Nikkormat ELW. The same unit fits the Nikon EL2, fastening directly beneath the camera's base plate. It's held in place by a tripod anchor screw which you tighten by a coin edge, or similar object, in the slotted screw top beneath the winder. Unlike using winders on other SLRs, we found that attaching it seemed to be virtually foolproof.

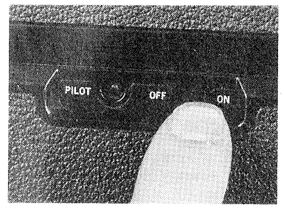
Nikon AW-1 winder couples directly to camera body. No body coupling cover to remove and



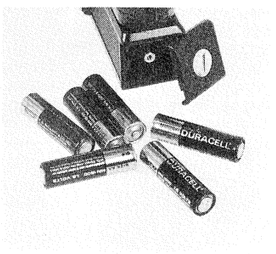
To fit the auto winder securely to the Nikon EL2, you'll need the edge of a coin or similar object.

Even if the coupling lugs of the motor and the slotted auto winder coupler on the camera bottom are mismatched, you can still couple winder and camera for proper operation with little difficulty. We also appreciated the absence of any removable coupler covers. The winder, which is some 5¾ in. long, 1½ in. wide and 1⅝ in. high, weighing some 15 oz. with its six AA batteries in place, has very simple controls. There's an on-off switch and a red diode light. The camera's own shutter release controls the winder. When you allow the shutter-release button to return upwards, the motor winder operates to wind the shutter and move the film to the next exposure. Maximum winder speed is 2 frames per sec. at shutter speeds above 1/60 sec. However, even if you do take your finger from the release (or remove pressure from the cable release), the winder will not operate until after the shutter is closed.

The LED at the back of the winder lights during film advance and will remain lit at film end if there isn't sufficient film to wind to the next exposure. In such a case the winder should be shut



Controls on auto winder couldn't be simpler. There's an off-on switch and pilot light.



Auto winder takes six AA cells. Alkaline energizers work best for normal use, unless it gets cold.

off immediately and the film rewound by pressing in the button on the bottom of the winder and using the folding rewind crank to return the film to its cartridge. Wtih alkaline energizer batteries, about 150 rolls of film can be handled. At freezing temperatures this drops to about 20 rolls. Below this, only 1 or 2 rolls can be run (and the batteries must be fresh to do so). With heavy-duty manganese batteries you can run through 40 rolls or so at normal operating temperatures, about 10 at freezing and 5 or so at lower temperatures.

When the auto winder is attached, the shutter release locking collar becomes the only proper method of turning on the exposure meter system. The rapid wind lever should not be used except to advance film manually (with the auto winder turned off). If you do attempt to use the lever when the winder is operating, the winder may stop in which case you just turn off the winder, push the lever in towards the body and then flip the winder back on again. There is some additional cautionary advice to prevent problems with the winder, which is given in the instructions accompanying the unit, but, following directions, we had no troubles ourselves. The winder performed nicely at all times. If you are hooked on winders, like more and more photographers, you'll want it. It certainly is a great convenience, albeit (like all auto winders) a noisy convenience.

Certainly Nikon designers have brought the Nikon EL2 along slowly but well with (as many owners can tell you) few growing pains or errors caused by haste and untried systems. There is no more rugged, reliable auto exposure SLR around.

28MM f/1.9 VIVITAR SERIES I

Mounts: Nikon, Canon, Minolta, Konica, Olympus, Pentax bayonet, universal screw-thread
Filter size: 58mm screw-thread
Apertures: f/1.9 to f/16
Min. focus dist.: 30cm (11.8 in.)
Features: VMC Vivitar multicoating, floating element design
Serial no: 37604122
Size: 65 mm diam., 61 mm long (2.56 x 2.4 in.)
Weight: 340g (12 oz.)
Price: $260; may be available at a discount price

Performance

Our Standard	Tested
Focal length: ±5% (26.6-29.4mm)	29.18mm
Max. aperture: ±5% (f/1.81-f/1.99)	f/1.93
Distortion: ±2.5%	less than 1% (pincushion)
Light falloff: at f/5.6 ±1 stop from theoretical limit (–1.3 stops)	–1.1 stops

Practical comments: We've come to expect daring optical designs from Vivitar in its Series 1 optics, and certainly this splendid, fast wide-angle lens is no exception. Proper modern optical engineering almost makes close-range optical correction manditory for high-speed wide-angle lenses if the image isn't to deteriorate. In the Vivitar, for close focusing only, the front lens elements move, thus correcting for aberrations which would ruin definition. Additionally, the lens incorporates an internal focusing system quite similar to what you might expect to find on a telephoto lens (but not on a wide-angle). As a result, the lens focuses quite close while the length of the lens does not increase as it focuses to the close-focusing point. By moving internal lens elements in a double helical mount, the mechanical complexities, weight and bulkiness of the double helicoid focusing mount

Trim for its super-fast speed, this wide-angle incorporates a floating element design to maximize close focusing performance.

employed on most wide-angles has been eliminated.

Visually, the lens is finished in a bright black with large, easy-to-read distance, aperture and depth-of-field scales. A full inch wide rubberized grid focusing ring provides smooth focusing.

In practical picture taking, the lens not only provided fine performance at its large aperture but also furnished a bright viewing and focusing image. It was a pleasure to use after the usual slow f/2.8 or f/3.5 apertures most of us must employ with our 28mm lenses. This is a truly fine and optically unusual lens.

On the Optical Bench: On axis, this fast, wide-angle lens exhibited overcorrected spherical aberration at f/1.9. The flare which resulted from this defect was above average in amount but very low in intensity and color. As we stopped the lens down to f/2.8 the image became quite compact, but some red color fringing due to spherochromatism remained visible. By f/4, the lens appeared to be diffraction limited, showing no signs of decentering. Off-axis, we observed a mixture of astigmatism and skew ray flare. The "wings" of the skewed rays were quite large but virtually colorless. Stopping down to f/2.8 improved the image somewhat; at f/4, the flare was eliminated, leaving only a smaller than average astigmatism. Red-green lateral color was visible, but fairly small. *In field test slides:* Wide open, the centers of the pictures were amazingly sharp with good edge details, but slowly grew worse toward the corners. The lens aberrations produced soft twisted images here, but only one stop down, the improvement was tremendous. At f/5.6 and

Resolution

at 1:48 magnification				
f/no.	Center Lines/mm		Corner Lines/mm	
1.9	Excellent	48	Excellent	34
2.8	Excellent	54	Excellent	38
4	V/Good	60	Excellent	43
5.6	V/Good	60	Excellent	43
8	Excellent	68	Excellent	48
11	Excellent	60	Excellent	48
16	V/Good	54	Excellent	43

Contrast

at 30 lines/mm				
f/no.	Center %		Corner %	
1.9	Low	30	Low	20
2.8	Low	46	Low	20
4	Low	55	Low	25
5.6	Low	58	Low	38
8	Low	60	High	52
11	Medium	57	High	54
16	Low	47	High	56

smaller apertures, there was nothing to be found on the slide that could be improved. Residual ghosts and flare appeared on film when shooting toward strong light sources. Orange and green ghosts were seen on film (in the viewfinder, too) as well as an above average amount of flare. Still, we judge this lens' overall image quality to be excellent.

85MM f/2 NIKKOR

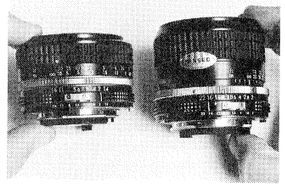
Mounts: Nikon F
Filter size: 52mm screw-thread
Apertures: f/2 to f/22
Min. focus dist.: 0.85 m (3 ft.)
Features: Multicoating, accessory sun shade
Serial no.: 176526
Size: 63 mm. diam., 52.5 mm. long (2.48 x 2.06 in.)
Weight: 312g (12 oz.)
Price: $315; may be available at a discount price

Performance

Our Standard	Tested
Focal length: ±5% (80.75-89.25mm)	85.43mm
Max. Aperture: ± % (f/1.9-f/2.1)	f/2.07
Distortion: ±2%	less than 1% (pincushion)
Light falloff: at f/5.6 ±1 stop from theoretical limit (–0.18 stops)	–0.27 stops.

Practical Comments: While the average amateur photographer often sticks to 35mm and 135mm focal lengths, certainly the two favorite moderate tele lenses among serious photographers have been the 105 and 85mm focal lengths. No company has lavished higher optical research and development on these two than Nikon. But while the famed 105mm f/2.5 Nikkor, even in its latest version, remains a hefty piece of glass (15.3 oz.), the Nippon Kogaku optical designers have wrought some miracles in the 85mm department. The previous lens was an 85mm f/1.8 some 2¾ in. in length, weighing 15.3 oz., focusing to 3½ ft. With the introduction of the new AI (auto-indexing) Nikkors, the old 85mm lens was suddenly replaced with a much smaller and lighter one which focuses closer. The new data show a length of 2⅜ in., weight of 12 oz. and close focusing to 3 ft. The number of elements is reduced from six to five thanks to modern optical design. As a result, we have a remarkably compact tele which is particularly useful for low-light photography indoors and for portraiture (although some photographers prefer to use this lens virtually as their "normal" focal length). With the closer focusing of this redesigned 85mm lens,

The lens is finished in traditional Nikon bright satin black with chrome aperture-setting ring, heavy ribbed rubberized fo-



Ultracompact Nikkor: New 85mm f/2, right, is only slightly larger than standard 50mm f/1.4 Nikkor, left.

cusing ring, and clear, well-engraved numerals. Needless to say, the lens functioned with Nikon smoothness.

On the Optical Bench: The central star image exhibited signs of overcorrected spherical aberration resulting in a smaller-than-average amount of flare. Due to spherochromatism, the flare had a slight red coloration. One stop down, the flare was reduced substantially, but a red color fringe around the now compact dot of light remained. At f/5.6, the star image formed a diffraction pattern, and showed no signs of optical decentering. At the corners of the field, we observed a smaller than average coma combined with skew ray flare. Stopping the lens down to f/2.8 eliminated the skew ray flare's bow-tie shaped "wings." The comatic aberration remaining was very compact, showing a dot of light but with a comet-like tail. At f/8, the off-axis star image was excellent. Also visible on the bench was an extremely small amount of red-green lateral color. *In field test slides:* At f/2, images were soft due to the flare observed on the optical bench. One stop down, the transparencies sharpened up, but there were signs of comatic streaking at the corners. At f/5.6 and smaller apertures, this lens reproduced excellent images center to edge. Lateral color was observable in the test pictures. Shooting toward strong light

Resolution

at 1:48 magnification				
f/no.	Center Lines/mm		Corner Lines/mm	
2	Excellent	48	Excellent	43
2.8	V/Good	48	Excellent	43
4	Good	48	Excellent	48
5.6	V/Good	54	Excellent	48
8	V/Good	54	Excellent	54
11	Excellent	54	Excellent	48
16	V/Good	48	Excellent	43
22	Good	43	V/Good	38

Contrast

at 30 lines/mm				
f/no.	Center %		Corner %	
2	Low	30	Low	30
2.8	Low	40	Low	32
4	Low	48	Low	41
5.6	Low	50	Medium	46
8	Low	50	Medium	48
11	Low	46	Low	42
16	V/Low	38	Low	38
22	V/Low	32	V/Low	28

sources, this lens produced a very tiny green ghost. Flare resulting from backlit shooting situations was noticeable but generally in low amounts and without color. Out-of-focus images were soft, having no definite circular patterns, which is considered to be good. Overall image quality is very good to excellent.

Performance

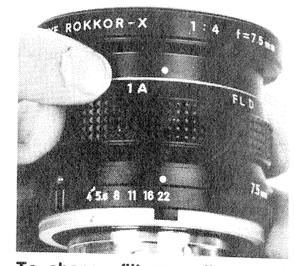
Our Standard	Tested
Focal length: ±5% (7.1-7.9mm)	7.6mm
Max. aperture: ±5% (f/3.8-f/4.2)	f/4.05
Distortion: ±3%	fisheye
Light falloff: at f/5.6 ± 1 stop from theoretical limit (-stops)	-2.5 stops

7.5MM f/4 MC ROKKOR X FISHEYE FOR MINOLTA

Mounts: Minolta bayonet
Filter size: Internal filter turret
Apertures: f/4 to f/22
Min. focus dist.: fixed focus at 4 ft. (1.2 m)
Features: Multicoating, internal filter set (85 orange, 80B blue, R60 red, Y52 yellow, FL-D pink)
Serial no.: 1015693
Size: 2.7 in. diam., 2.5 in. long (68 x 63 mm)
Weight: 13.5 oz. (399g)
Price: $680; may be available at a discount price

Practical Comments: Minolta's full-circle fisheye lens is compact and incorporates some novel features—we have few complaints. The 4-ft., fixed-focus distance is meaningless, however, because at f/4 (maximum aperture) depth-of-field limits reach from 19⅝ in. to infinity. You can get in even closer by stopping all the way down to f/22. (A depth-of-field chart is supplied with the lens.)

The problem of fitting filters over the exposed front element is



To change filters, pull up and turn ring, aligning a white dot to desired position. Red warning ring shows below ring when filters aren't fully "clicked" in.

solved by an internal wheel with six filters that covered most common photographic situations. Included with the more usual red (R60), yellow (Y52) and skylight (1A) filters are: an 85 color corrector, for shooting tungsten film outdoors; its complimentary 80B, for indoor shooting with daylight film; and finally, an FL-D filter, for shooting daylight film under fluorescent lighting. The filters are indexed into place with a solid, detented ring that must be pulled back toward the camera to release it before turning. If a filter isn't properly indexed, a bright-red warning ring becomes visible on the lens barrel. The filters are obviously intended for conventional applications with specific film types, but unintended combinations can be used for special effects when desired.

Because the lens covers the full 180° field of view, the front element sticks out way past the barrel. The lens cover is concave and screws in to provide proper protection. It's somewhat bothersome, however; a bigger, screw-thread would have been better. Keep it *on* the lens unless you're shooting. On the SRT 202 we found that the exposure-control needle could barely be seen in the viewfinder. It's best to meter the subject with the 7.5mm mounted on the camera. With a normal lens, use a separate hand-held meter, or consult your film's data sheet. (Of course, you could buy one of Minolta's auto-exposure cameras and alleviate this problem.) In fact, the only way to clearly see the metering measurement in the viewfinder is with the AE-S finder, available on the Minolta XK or XK motor drive body (it has LEDs) or XD-II. As you can see from the Performance Chart data on this lens, regardless of petty grievances, it performs without a fault.

The 23mm diameter circular image can be striking for advertising, but it can also be used as a scientific tool for surveillance, meteorology and astronomy.

On the Optical Bench: The axial star image is sharp and free of color and flare. Slight spherical-aberration flare was noticed at f/4, but we judged it to be small

modern tests

Always use your lens cap to protect protruding front element—courser thread would make it easier for quick removal though.

and expect no observable effect on the film images. All of the filters were well made and produced no increase in flare or color aberration.

Looking at the corner image of a fisheye lens requires some compromise in setup and observation. We chose to examine the corner image when the target was set at about 60° off axis. This is only part of the distance to the edge of the circular image. It showed very little significant aberration. Slight touches of lateral color (less than 0.015mm) and astigmatism were noticed. These should have little effect on the photographic images. The overall impression is that of a well-corrected image out to the edges. *In field test slides.* The pictures we obtained verified the excellent image quality expected from the lab tests. The circular image in this Minolta fisheye follows the uniform angle rule, which tends to squeeze the corner subject images a bit.

The fluorescent filter pictures tended to be slightly red in color, indicating a modest amount of over-application of the pink correction. The others were within acceptable tolerances for their assigned colors. The compact size and six-filter arrangement make it very attractive and useful to Minolta camera users.

Resolution

at 1:50 magnification				
f/no.	Center Lines/mm		Corner Lines/mm	
4	Exc.	64	Exc	33
5.6	Exc.	80	Exc.	33
8	Exc.	80	Exc.	33
11	Exc.	72	Exc.	33
16	Exc.	64	Exc.	33
22	Exc.	56	Exc.	28

Contrast

at 30 lines/mm				
f/no.	Center %		Corner %	
4	Low	33	Low	21
5.6	Low	50	Low	21
8	Med.	56	Low	21
11	Med.	50	Low	21
16	Low	45	Low	21
22	Low	40	Low	21

MODERN's test standards and how some have been evolved.

Shutter-speed accuracy: Based on many years' tests of color-slide film latitude, we have set the total exposure accuracy limit at the film plane to one f/stop. Within this error, adequate exposure of color film should be achieved. Each separate exposure control—shutter speed, lens f/number and meter—must be in error by no more than ½ f/stop. You might wonder why we didn't make it ⅓ f/stop so all three would add up to a total error of one f/stop.

The reason? These three factors rarely go totally wrong in one direction at the same time. Therefore, an individual requirement of ± ½ f/stop for each control is more realistic for the needs and achievable tolerances by engineers.

Light falloff: We have decided not to place a limitation now on full-aperture light falloff since there are many factors which contribute to this fault (see Modern Photography Feb. 1977).

Certainly, with extreme wide-angle lenses, high-speed lenses and mirror tele optics, there must be more forgiveness. However, we will offer some criticism of most lenses which show more than a one-stop illumination falloff from the center to the edges and corners when closed down to f/5.6. (When lenses have a maximum aperture of f/5.6 or smaller, we will give additional criteria and estimates at that time.)

Apparent viewing distance: This is usually measured in diopters (an optical term used to express eye accommodation). However, for purposes of simplification, we convert them into inches. This means, for instance, that if we say a finder image appears to be at 30 in., you will view the focusing screen or range-finder image as if it were on a plane 30 in. away from your eye. We also estimate the distances of other finder information for you. Meter needles, shutter-speed designations and apertures (if shown) should all be within a reasonable distance from the focusing screen, so that you can view the screens and other information comfortably without having to refocus your eye. Ideally, everything should be on exactly the same plane so you will have no trouble seeing it all at once. For optical and mechanical reasons, this is usually impossible, but engineers should keep the information together as close as possible. We have placed a ½-diopter limit on the finder indication from the focusing screen, but we'll calculate the actual distance for each camera.

Viewing area: Seldom in any camera does the viewfinder show in area, exactly what the film sees. In a few cameras, such as the Nikon, every attempt is made to render the finder and picture area exactly the same, or 100 percent. However, most camera makers provide a finder area that's somewhat smaller, allowing for part of the picture area to be covered by slide mounts or enlarger negative carriers. We feel that the finder must show no less than 90 percent of the actual picture area on film in the case of single-lens reflex cameras, and 85 percent of the area in the case of rangefinder or viewfinder cameras.

Parallax error: While most viewfinders show less than the actual picture area, this view is seldom centered exactly within the picture-area frame. Usually there is some error to the right or left, up or down. The limit of parallax error varies depending on the finder vs. picture-area percentage. However, we feel parallax is permissible, provided the view does not extend beyond what the film can actually record. We calculate the error with each camera in millimeters, as well as the direction in which the error occurs.

Focusing error: When your camera is accurately focused with the aid of a focusing screen or rangefinder, there inevitably will still be some error between this point of focus in the finder and the actual point of focus on the film itself. We allow this focusing error discrepancy, provided its total falls within the actual depth of field of the lens at maximum aperture.

Image magnification: While there is no standard needed here, this information is most helpful to photographers. Early 35mm SLR's for instance, prided themselves on giving 1X image magnification, which meant that the image in the finder appeared to be the same size as if you were looking directly at the image with the naked eye. Today, with most cameras and normal lenses, the images are somewhat smaller. We measure this magnification by comparing finder-image size and subject size at infinity. Using a traveling microscope to help us compare photographs, we measure the actual photograph shot directly by the camera with a picture made through the finder itself.

Picture size: We allow a 2.5 percent error in actual vs. stated size. For instance, in a 35mm full-frame camera, 24 x 36mm would be the stated size. Any error horizontally or vertically must be within 2.5 percent of this figure.

Shutter-travel accuracy: With focal-plane-type shutters, we must check exposure error across the entire film plane because the shutter curtains move all the way across the film during exposure. Therefore, there is a possibility of uneven exposure. We measure this as evenness of curtain travel, and we allow an exposure error of ⅓ f/stop through the film plane.

Camera body insulation: Proper insulation from the synchronization is a safety indication for the cameraman and indicates the possible danger of accidental flash-unit firing. In electrical terms, more than 7 megohms resistance between the camera body and the synchronizer contact with 500 volts will be our requirement.

Synchronizer contact efficiency: This insures the perfect firing of the flash unit when the camera shutter is clicked. We will require that the flash contact of the shutter be capable of passing at least 60 percent of the flash unit's energy.

Synchronizer delay time: This is generally expressed in the number of milliseconds (ms.) that elapse between ignition and the actual opening of the shutter. It originated with flashbulbs, since most required some delay so they could reach adequate burning brightness before the shutter operated. This delay is called M sync. We give both the manufacturer's specifications and our measurements. X sync, used mostly for electronic flash, should provide instant ignition during the time the shutter is totally opened. We indicate whether this is achieved or not.

Self-timer: We list manufacturer's specifications and our maximum tested time.

Lens focal length: A 5 percent error is allowable.

Zoom-lens focal length ratio: Again, a 5 percent error.

Lens aperture f/number: This is a sticky area. In actual exposure control, transmission should be measured in T/numbers (actual light transmitted) instead of f/numbers (theoretical light transmitted). There are many arguments pro and con, but no fixed testing conditions we can use now. In the future, whenever authoritative standards are adopted internationally, we will consider evolving a testing system in T/numbers. Meanwhile, we will report our findings on the maximum f/number of each lens.

Camera size and weight: A few years ago, while faithfully reporting on a camera's weight by taking the word of the manufacturer, we found that what was said to be the weight simply wasn't. We therefore resolved to do our own weighing and measuring. With camera makers competing to produce smaller and lighter cameras, we feel this information has become more vital than previously.