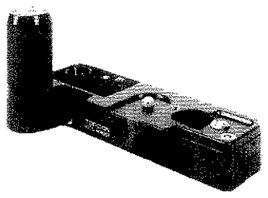
traditional Topcon bottom-mounted, camera-back-opening twist lock and a rewind button extension nestled under the battery compartment hinge, so both these functions can be performed without removing the motor.

Finally, the moment of truth. We've installed fresh batteries, checked them, screwed in the motor, refastened the grab strap and loaded the camera with film. Will it really fly? The answer is a resounding yes. With the strap over your knuckles, your index finger on the front-mounted shutter release and the rest of your fingers around the perfectly round grip, the Topcon DM fits comfortably and securely in your right hand. Raise the camera to eye-level horizontally with your left hand on the focusing ring and everything "falls readily to hand." Walk down the street with the strapped-on camera at your side



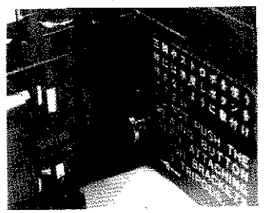
Topcon Auto Winder: World's most compact thumb saver.

and it feels like an extension of your hand. It's obvious that Topcon's engineers spend as much time field testing the DM as getting it sorted out on the drawing board. Oh, it's noisy alright, like all electric-motor SLR's, and the Topcon Super D's mirror-shutter noise level doesn't help the situation any. On the other hand, it's light (3 lb. 7 oz.) and relatively compact (5⅞ x 3¾ x 4⅞ in.) for a camera of its type. Shooting verticals with the DM is somewhat awkward and takes some getting used to but, on the whole, it's better than the vast majority of manual film-advance cameras we've tried for a rapid sequence of "on-the-spot" news photos (with or without flash) and most types of sports coverage. We were also quite impressed with the number of 36-exp. rolls of 35mm film we were able to run through the camera on a single load of four alkaline energizer batteries—over 30 rolls—which we attribute to an efficient circuit with very low current leakage

Often, motors require extensive surgical adaptations or special "motor-drive" bodies to function properly. If you have a Topcon Super D, it is one of the former, but it requires only relatively minor surgery (the installation of one switch to close the film-advance circuit as you release the shutter button, plus one electrical contact) to effectively convert it into a DM. The operation itself costs about $50. The Topcon Auto Winder is $123.50.

If you've gotten the impression that we were impressed by the Super DM's mechanical and metering capabilities, you're correct. We're happy to report that the DM fared equally well in our other lab examinations. The conventional horizontal Leica-type cloth shutter was commendably accurate, varying less than 20 percent at all marked speeds. We were particularly impressed with a 10 percent deviation at 1/1000 sec. Another indication of the Topcon's scientific background is the percentages of the actual recorded scene seen in the viewfinder: 99 percent vertically and 95 percent horizontally (though we wish they were both equal at 97 percent). The only discrepancy we found in the Topcon's optically precise construction was that this border of recorded picture area not seen in the finder was not evenly distributed around the rectangular frame, but shifted .4mm downwards.

And now the final innovation—in the lens focusing mount, of all places. In contrast to all other 35mm SLR's we've heard of, the DM's 50mm f/1.4 autoflash Topcor doesn't use helical focusing at all. Instead, a slotted spiral cam cut into the lens barrel accepts a matching peg-shaped cam follower which emerges from the inside of the lens' focusing ring. It's certainly a smooth and decisive focusing system which, no doubt, accounts for this system's widespread acceptance among the zoom rings of zoom lenses and the focusing rings of the latest crop of macro zooms.



Rewind button is tucked under battery pack for easy access.

Optically, the largish 1¾-in.-deep, 2⅝-in.-diameter lens performed very well under a wide variety of lab and field conditions. As you can see from the charts, lines-per-mm resolution was above average for an f/1.4 lens.

On the optical bench, our observations also indicated the f/1.4 Topcor's better-than-average design and good overall construction. On-axis color was visible wide open as a low-energy magenta fringe, while lateral color, also well-controlled, was barely observable as a slight violet fringe. The former was eliminated by stopping down to f/4. A normal amount of spherical-aberration-induced flare of fairly high intensity was also observable at f/1.4 but was virtually eliminated from f/4 on down. Off-axis skew-ray flare, strong at maximum aperture, was almost completely diminished at f/2.8.

Astigmatism and coma were both visible wide open, but were present in normal amounts and largely absent by f/4. Decentering was also observable wide open, but was much improved by f/4, and a focus shift of 0.06mm occurred on stopping down, a slightly better-than-average performance for a lens of this type.

Examining our test transparencies with our 50X Omag microscope corroborated our findings on the optical bench. Flare due to spherical aberration was fairly large at f/1.4, low at f/2.8 and virtually absent from f/4 on down. Color correction in the center of the field was very good, while off-axis color (purplish) was barely visible. No trace of decentering was observable in the picture and astigmatism was not observable even wide open. The well-baffled Topcon body was also free of ghost images. Coma flare, however, was rather prevalent wide open, mostly gone by f/4 and completely absent by f/5.6. From f/5.6 on down, the Topcon's imaging was particularly crisp and sharp.

Ultimately, we've got to get back to handling, for this in our opinion is the DM's reason for being. If a precision full-aperture, match-needle, behind-lens metering SLR—even one with a removable prism, sound engineering and construction, and an electric film wind—doesn't *sound* too exciting by today's standards, we can only say that using the Topcon Super DM proved to be infinitely more informative than reading the spec sheet. A motor drive—even a one-at-a-time motor drive—must be experienced to be appreciated. Of course, camera snobs will appreciate the gasps of the knowledgeable as they whir and click along like professionals, consuming great gobs of film. But anyone serious about taking lots of pictures in a hurry will appreciate less camera movement during rapid sequences, not to mention the saving in wear and tear on the film-advance thumb. The fact that this diabolically straightforward device happens to attach to one of the better 35mm SLR's in production doesn't hurt either.

CANON'S OPTICAL MARVELS: WIDE & SHIFTY, LONG & FAST

MANUFACTURER'S SPECIFICATIONS: 35mm f/2.8 TS Canon S.S.C. lens in Canon breech-lock mount. FEATURES: Apertures to f/22, focusing to 1 ft., lens barrel tilts to 8°, shifts to 11mm for perspective correction, accepts 58mm accessories. PRICE: $630.

300mm f/2.8 Canon FL-F S.S.C. in Canon breech-lock mount. FEATURES: Apertures to f/32, focusing to 12 ft., built-in filter holder for 32mm filters, supplied with two-distance preset focusing attachment, 2X tele converter. PRICE: About $1,600 on special order.

If ever there was an optical odd couple, it's Canon's latest pair of special-purpose lenses, the TS 35mm f/2.8 Canon that tilts, shifts and has floating elements, and the 300mm f/2.8 Canon which incorporates both a mechanical innovation and a genuine optical breakthrough.

Each is unique among lenses in current production (not a term we use lightly), and indicates Canon's commitment to extending the range of their SLR system as well as their overall optical design and manufacturing prowess. To illustrate what we mean by "unique," let's start with the TS Canon 35mm f/2.8.

Most 35mm photographers don't think of their SLR's as miniature view cameras capable of tilting and shifting the lens for perspective corrections. But there are more than a few architectural, industrial and scientific photographers who wish they could borrow these movements from their large, slow, but supremely flexible view cameras and graft them onto their nimble, compact 35's. It's hardly a new idea. A few camera and lens manufacturers, such as Schneider and Nikon, presently offer perspective correction lenses in the 35mm format. But because of the complex mechanical and optical requirements, nobody had heretofore succeeded in incoporating both shifting and tilting movements in one 35mm lens body. (The plastic Austrian Varioflex will get a tilting, shifting lens onto your 35mm SLR all right, but only a 65mm f/6.8 Schneider Angulon.)

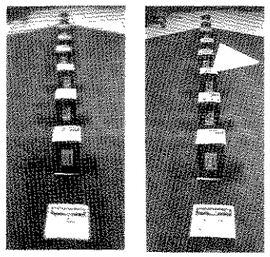
To build in both capabilities, you must start with a well-corrected lens having a very large covering power, and then mount it in a very complex, mechanically precise barrel. Canon finally took up the challenge.

Though hardly diminutive for a 35mm f/2.8, Canon's TS (for tilt and shift) lens looks rather small for such an involved mechanism because of its fine black finish. It is actually 3 1/16 in. long, 3⅓ in. wide (at the widest part where the shift control knob extends 1¼ in. from the barrel) and weighs a hefty 1 lb. 3 oz. Of course, you can hand hold the TS for field shooting, but it's primarily designed to do its job on a tripod-mounted camera where you can check the finder image with maximum precision. And while the Canon FTb's or F-1's viewing standard screen may also be used (minus the microprism with the lens in tilted position), Canon recommends that F-1 owners use a "D" screen with the TS lens. This is a completely matte screen which has graph paper style lines crossing its entire surface. The matte surface helps you focus to the corners of the field, while the cross lines show the degree of perspective correction.

This lens does not have an automatic diaphragm because the tilt-and-shift mechanism is so complex they couldn't fit it in. Fortunately, it really doesn't need one for the slow, deliberate type of shooting that is this lens' forte. A manual diaphragm is actually advantageous with a lens that must be stopped down frequently to check which planes of the subject are in focus at shooting aperture. So, when you meter with this lens, you also do so at the working aperture.

Now let's see how those tilting and shifting mechanisms work. Just behind the front-mount focusing and aperture rings is a curved arc-shaped metal flange which slides smoothly towards either side on a similarly shaped base as you turn a lightly-knurled, ⅝-in.-wide knob atop the lens. Right in front of this knob is a red-and-white degree scale, the central portion of which is white to indicate that shifting the lens (while tilting) is possible within this marked 6° (3° either side of center) range without going beyond the lens' image circle. Beyond the white scale area, there are red marks up to 8° on either side of the center line—the maximum tilt angle. On the bottom of the lens, exactly 180° from the tilt-control knob, is another knob which locks the lens in any tilted position. If you tilt the lens (see photo) toward the subject the proper amount, you can considerably increase the useful depth of field without stopping the lens down—just like a view camera. But here the view camera analogy breaks down. Most view camera lenses are of normal construction—that is, they have fixed nodal points. If you tilt such a lens at the central part of its barrel, the resulting image shift is very small and you usually don't need to refocus. But since the TS Canon is an inverted-telephoto-type lens, it sticks out rather far from the nodal point to begin with and even further when you tilt the lens toward the edge of its image circle. As a result, the nodal point is just not in the same place it was before. Put simply, quite a bit of image shift occurs when you tilt an inverted-telephoto lens and, consequently, you must recompose the framing of the picture and check corner-to-corner sharpness.

So far, we've been talking about this lens with its tilt mechanism oriented horizontally (the vantage point that allows you to view all clearly engraved white-on-black numerals on the 3/16-in.-wide, click-wholestopped aperture ring from directly above). But what if you want to tilt the lens vertically? No problem. Just grab it by the squared-off rear part of the barrel and turn it up to 90° clockwise or counter-clockwise for a total on-axis turning capability of 180°. For convenience, there are detents every 30° and yet another detent for the non-tilted position.



Tilted lens increases depth of field, even when set at f/2.8.

Now, on to the shifts. Obviously, the lens' turnability enables any shift movements to be used for rising and falling as well as sliding (or shifting) horizontally, depending on where you turn the lens mount. In any case, as you turn the knob nearest the camera body, the whole body of the lens (including the tilting mechanism) moves in a plane parallel to the film plane. The central 7mm shift on either side of the center position is indicated by white scales. Beyond 7mm, the shift is indicated by a red scale to warn you that you cannot shift that much while tilting. Otherwise, your pictures may suffer from image cutoff.

In our lab and field tests, these mechanical movements worked extremely smoothly and positively. But what about optical performance? Is covering power as large as the manufacturer claims? How about sharpness? Is it comparable to more pedestrian 35mm focal length lenses?

To find out, we first shifted the lens to the extreme limits of each movement (with the other movement positioned in the center of the scale, of course), tilted and took pictures. The results were surprising. We didn't expect corner sharpness would meet our standards, and it didn't. But resolution values were a hair below our limit at large apertures (up to f/8), and at f/11, resolution jumped to over 35 lines/mm which rates "very good" to "excellent" on our verbal evaluation scale. If you're familiar with view cameras, you're aware that stopping down the lens when you use one or more of the view camera's movements is mandatory if you want to cover the extended imaging angle. The same theory applies with this lens also.

Another important consideration with lenses that shift is distortion. If this aberration is excessive, you won't be able to achieve perfectly corrected perspective—one of the main reasons you'd buy such a lens in the first place. We are happy to report that the TS Canon passed this test with flying colors. Distortion (pin-cushion type) measured less than 1 percent, even at maximum shift position—much better than the average.

Resolution Power

35mm f/2.8 Canon TS No. 10099 At 1:47 Magnification

f/no.	Center	Lines/mm	Corner	Lines/mm
2.8	Exc	66	Exc	42
4	Exc	75	Exc	42
5.6	Exc.	66	Exc	42
8	Exc	66	Exc	47
11	Exc	66	Exc	53
16	Exc	59	Exc	47
22	V. Good	53	Exc.	47

Actual Focal Length: 35.8mm

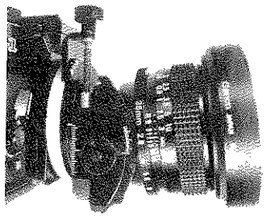
Image Contrast

35mm f/2.8 TS Canon FD

f/no.	Center	Percentage	Corner	Percentage
2.8	Medium	56	High	40
4	Medium	62	High	49
5.6	Medium	67	High	52
8	Medium	68	High	51
11	High	65	High	48
16	Medium	56	High	43
22	Low	45	Low	35

On the optical bench, we found that on-axis color was well-controlled and it resulted in only a very small amount of color fringing. Spherical flare was unusually small and the focus shift on stopping down was also reassuringly small. In spite of its floating elements, which often caused slight mechanical-optical misalignment, decentering was not visible at all. There's only one way to achieve this excellent assembly techniques. Off axis, lateral color was likewise very well-controlled and virtually no color fringing was observable even in our Kodachrome transparencies where we made use of the lens' movements. Astigmatism was very well-corrected and a normal amount of skew-ray flare was found on the optical bench. Nevertheless, the image did not lose its sharpness throughout the complete image circle. Not surprisingly, the TS Canon produced crisp, well-saturated images on Kodachrome II film

To make the most of the excellent overall performance of this lens, you have to be a skillful photographer. Fortunately, the instruction book is well-written and does a fine job in explaining its rather complex joys even to the somewhat uninitiated. But after you read the instruction booklet thoroughly, follow its



On special order, Canon will shift (long screw on top) and tilt controls to right, if you prefer.

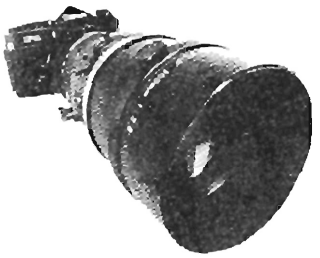
directions and practice the techniques for awhile, you'll probably discover an additional application not contained in this booklet. Normally, this lens comes with its tilting movement set at right angles to the shift. In extreme applications, you might prefer that both movements be controlled in parallel. Canon made the base flange of the lens (just in front of the shift mechanism) perfect for just such requirements. Just bring your TS Canon lens to any authorized Canon service station and they'll shift your tilts and shifts to suit you in about a minute. It's so simple we're tempted to tell you to do it yourself, but there's a snag. The screws on all late-model Canon lenses are locked in place by a special bonding substance that resists vibration and, unless you're experienced and have precisely the right tools, you'll probably scratch the beautifully finished lens barrel. By the way, if your TS Canon doesn't quite clear the tripod platform in tilted position, that's no problem—the lens comes with a Canon Tripod Adapter which raises the camera body clear of the mechanism.

As it turns out, Canon's fast 300 is as significant an optical breakthrough in its particular focal length as is the TS Canon. Though there are a few other 300mm f/2.8 lenses in existence designed for fast action and sports photography, most 300's fall within the f/4-f/5.6 range. But Canon's 300 is not only speedy, it's also the first lens of its type with image quality rivaling that of normal focal length (50mm) lenses. There's a simple-as-Simon reason.

As the focal length of a lens is increased, color aberrations affect image quality much more severely. Thus, sharpness generally decreases as focal length increases. This is especially true of large-aperture long teles where

the difficulty of design and construction also seems to increase exponentially as the lenses get faster. Unfortunately, there are limits to any designer's ability to lessen color aberrations as long as the lens is made of glass.

To overcome such barriers to improved chromatic correction, fluorite crystal has occasionally been used in designing long teles and this lens is just such a design. The advantage of crystal fluorite over glass in this application is that it has very low dispersion (the ability to separate light into its component colors, as with a prism). This makes it possible to design lenses with less chromatic aberration and greater sharpness.

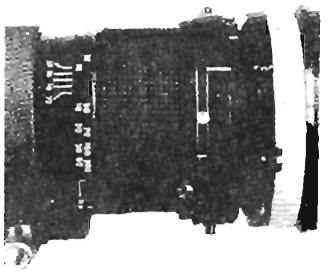


Canon's cannon measures full 9¾ in. Front knob locks hood.

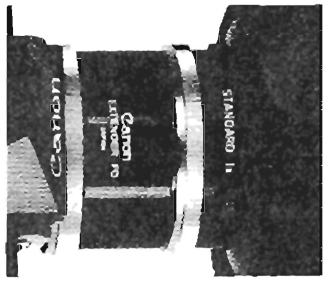
The first thing we looked for when we placed the 300 on the optical bench was secondary color (the residual color error in any color-corrected lens). It was sensationally low. The largest discrepancy between green and violet was merely 0.1mm. All other aberrations were so well-controlled, the star image on the collimator appeared as a perfect disc throughout the lens' image area—remarkable!

It was hardly surprising that Kodachrome II transparencies shot with this lens were the sharpest we've ever experienced with a long tele. At the very corners of the picture area we did find a touch of purple color fringing, but even this wasn't more than a slight bluish haze in most applications.

One peculiar characteristic of this lens that we discovered (after many field and resolution power tests) was that its overall sharpness did not increase as we stopped it down a couple of stops from maximum aperture. This is mainly due to the extremely low levels of secondary color, and partly because the lens' correction for spherical aberration is of the under-correction type. In other words, this lens actually delivers maximum sharpness and picture quality at the widest lens opening. But don't worry. It still increases depth of field on stopping down just like any other non-mirror lens. Of course, this interesting fact, once appreciated, should affect your *modus operandi* with this lens. Unlike others, you should definitely use it wide open whenever you can, as long as you don't mind shallow depth of field. Besides, this allows you to use the fastest possible shutter speeds, considerably reducing unsharpness caused by camera shake, which is particularly important with a large (9¾ in. long at infinity, 4½ in. in diameter at the built-in sliding sunshade), heavy (5 lb. 11 oz.), long focal length lens of this type. Of course, a big lens like this can still be quite a handful if it handles awkwardly atop a tripod. Canon apparently agrees since they designed in a special feature that considerably aids smooth field operation—a two-distance preset focusing mechanism that lets you locate clickstops at any two points along the focusing scale, all the way down to its rather close 12 ft. minimum distance. This device is especially beneficial in sports photography where you have to focus and follow action at the same time.



Pair of detents (white index marks) provide quick selective focusing at two preset distances.



Canon extender is made for 300mm. Will it work with other lenses?

If you already have two focusing distances preset on the focusing ring, you just turn the ring to the clickstopped detent, compose and shoot. Focusing by feel is obviously much quicker and more efficient than focusing by eye each time.

Here's how the system works. A special three-part ring comes with the lens that you can slide over the focusing collar and attach by means of a set screw and a single guide prong. Once attached, you then focus through the finder (on home plate, for example) and lock in your first focusing detent to that position on the focusing ring by aligning the white line on the inner-edge ring section with a similar line on the thicker central ring section. Then lock it in position with the screw. Now shift focus to your second subject distance (maybe it's first base), align the white lines the same way (using the outer-edge ring section in conjunction with the central indexing ring) and you're all set—just follow the action from your fixed vantage point and select the appropriate focusing clickstop. In our opinion it's one of the best quick-focusing systems around, but, like the lens itself, it works best atop a tripod.

Canon has accommodated the working photographer in other ways, too. The 300mm f/2.8 Canon comes with four filters that slide into a filter slot just in front of the breech-lock lens mount ring. These specially-mounted filters include UV, Y3 medium yellow, R1 (red) and ND 4 (4X neutral density). The lens is so constructed that you must insert a filter at all times to obtain proper focus. You must also focus the infinity setting carefully in the finder because fluorite crystal lenses are more sensitive to temperature changes. As a result, Canon's 300 has a variable infinity range wider than that of all glass 300's.

Resolution Power

300mm f/2.8 Canon FL-F S.S.C. No. 72111 At 1:31 Magnification				
f/no.	Center Lines/mm		Corner Lines/mm	
2.8	Exc.	69	Exc.	55
4	Exc.	62	Exc.	55
5.6	Exc.	69	Exc.	62
8	Exc.	69	Exc.	62
11	Exc.	62	Exc.	62
16	Exc.	55	Exc	55
22	Exc.	49	Exc.	49
Actual Focal Length: 290.0mm				

Image Contrast

300mm f/2.8				
f/no.	Center Percentage		Corner Percentage	
2.8	Low	39	Low	29
4	Low	55	Low	35
5.6	Medium	61	Low	42
8	Medium	65	Medium	44
11	High	66	High	43
16	High	59	Medium	42
22	Low	50	Low	36

The last member of the accessory array is a 2X converter specially designed for the 300. With the converter in place, it becomes a 600mm f/5.6. Our tests indicate it degrades picture quality only slightly. Even with the converter in place (which showed a slight amount of decentering in our tests), the sharpness of the lens is about average for a non-extended 600mm optic.

Even though this high-quality 2X converter was designed specifically for the 300mm f/2.8, it will be fascinating to see how it works on other Canon lenses.

If our enthusiastic report has whetted your appetite for this incredibly fine optic, all we can say is: Don't rush down to the nearest camera store and expect to find one. You can't. Understandably, Canon makes the lens only on special order. It's expensive but worth waiting for.

Resolution Power

35MM CAMERA LENSES
FISHEYE-16MM

Apertures	Center Lines/mm	Center Rating	Corner Lines/mm	Corner Rating
Two maximum apertures	36-39	Accept	24-26	Accept
	40-44	Good	27-29	Good
	45-51	V Good	30-37	V Good
	52+	Exc	38+	Exc
Medium apertures	40-46	Accept	26-28	Accept
	47-52	Good	29-32	Good
	53-59	V Good	33-35	V Good
	60+	Exc	36+	Exc
f/11 to smallest aperture	40-44	Accept	25-27	Accept
	45-50	Good	28-30	Good
	51-55	V Good	31-33	V Good
	56+	Exc	34+	Exc

35MM CAMERA LENSES
17MM-23MM

Apertures	Center Lines/mm	Center Rating	Corner Lines/mm	Corner Rating
Two maximum apertures	36-42	Accept	24-27	Accept
	43-49	Good	28-31	Good
	50-55	V Good	32-35	V Good
	56+	Exc	36+	Exc
Medium apertures	42-47	Accept	26-30	Accept
	48-53	Good	31-33	Good
	54-59	V Good	34-37	V Good
	60+	Exc	38+	Exc
f/11 to smallest aperture	40-44	Accept	25-28	Accept
	45-49	Good	29-31	Good
	50-55	V Good	32-35	V Good
	56+	Exc	36+	Exc

35MM CAMERA LENSES
24MM-44MM

Apertures	Center Lines/mm	Center Rating	Corner Lines/mm	Corner Rating
Two maximum apertures	36-42	Accept	26-28	Accept
	43-49	Good	29-32	Good
	50-55	V Good	33-35	V Good
	56+	Exc	36+	Exc
Medium apertures	42-50	Accept	28-31	Accept
	51-58	Good	32-35	Good
	59-65	V Good	36-39	V Good
	66+	Exc	40+	
f/11 to smallest aperture	40-44	Accept	25-28	Accept
	45-49	Good	29-32	Good
	50-55	V Good	33-39	V Good
	56+	Exc	40+	Exc

35MM CAMERA WIDE-ANGLE LENSES
f/2 AND FASTER

Apertures	Center Lines/mm	Center Rating	Corner Lines mm	Corner Rating
Two maximum apertures	36-39	Accept	24-26	Accept
	40-43	Good	27-30	Good
	44-47	V Good	31-35	V Good
	48+	Exc	36+	Exc
Medium apertures	42-44	Accept	28-31	Accept
	45-47	Good	32-35	Good
	48-50	V Good	36-39	V Good
	51+	Exc	40+	Exc
f/11 to smallest aperture	40-44	Accept	28-31	Accept
	45-49	Good	32-35	Good
	50-55	V Good	36-39	V Good
	56+	Exc	40+	Exc