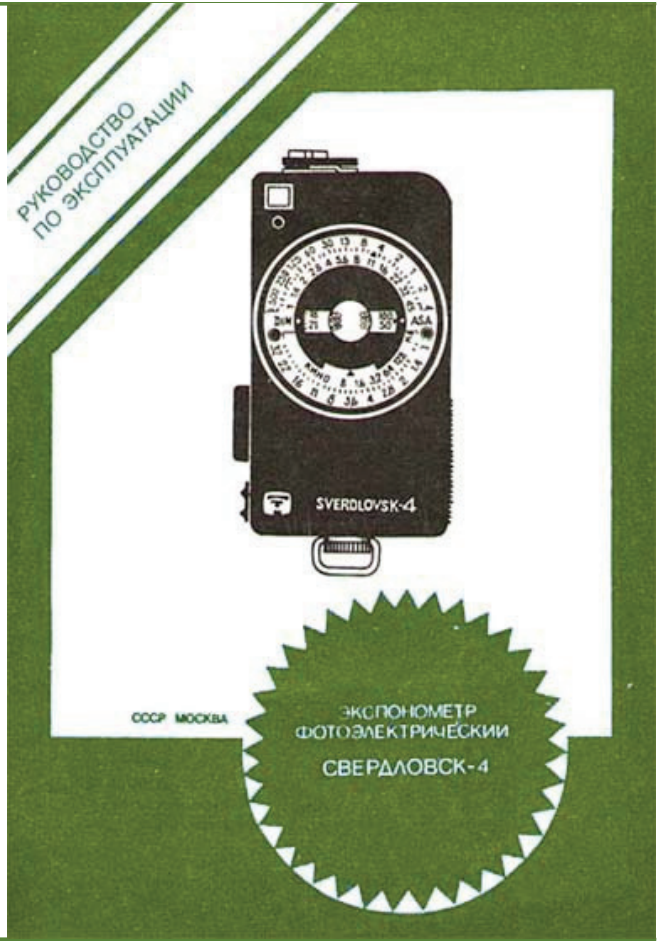
Photoelectric exposure meter

Sverdlovsk-4 instructions

(English translation)

This manual has been translated and edited
from the Russian original



Contents

1. Description and features

The Sverdlovsk-4 – a high-quality photographic exposure meter – is intended for determining exposure settings in amateur photography and ciné film making.

Summary of features: small size, narrow angle of view, high accuracy, wide range, two methods of measurement (incident and reflected), LED indicator, telephoto viewfinder with frame-lines, exposure compensation scale, simple and convenient to use, rapid determination of exposure, supplemental 316 battery pack.

This exposure meter, like any precision instrument, requires careful handling, but it is less vulnerable to damage from vibration and shocks than meters using a fragile electromechanical galvanometer.

The instrument may differ in minor details from this manual owing to ongoing improvements.

2. Kit contents

Exposure meter (without battery) 1
Carrying cord 1
Leather case 1
Battery holder for 316 cells 1
Battery (3RTS53) 1
Instruction manual 1
Packing box 1

3. Technical specifications

Angle of view	1 2° × 8°
Measurement range:	
reflected light (cd/m^2)	0.15–19,700
incident light (lux)	3.3–432,000
Accuracy in the reflected light range 0.15–9840 cd/m^2	±0.5 EV
Scale ranges:	
film sensitivity, GOST/ASA	3–3200
shutter speed	1/2000 s – 2 h
aperture	*f*/1–*f*/45
ciné frame rate (fps)	8–125
exposure compensation range	±1.6 EV
Dimensions (mm)	55 × 24 × 100
Weight (kg)	0.12
Supply voltage (V)	3.75 (+0.25, –0.75)
Power source (3RTS53)	1
The standard battery can be replaced by the following (three of each):	
RTS53 cells	3
RH625 or RH13 (imported) cells	3
D-0.09 storage batteries	3
316 cells (using the accessory battery pack)	3

Notes

1. The reflected light range 0.15–19,700 cd/m^2 correspond to the shutter speed range 1 min – 1/2000 s at an aperture of *f*/8, a photosensitivity 100 units and zero correction.
2. A one-stop interval corresponds to a twofold change in the exposure (e.g. shutter speed).
3. The meter conforms to the GOST 9851-79 class A exposure standard with the exposure constant equal to: reflected light range, 15; incident light range, 330.

[**Note**: see Addendum 2008 – p. 20, Home market and export models (GOST and ASA scales); p. 21 – Alternative batteries and calibration]

4. How to use the meter

Measuring the exposure

1. Rotate disc **12** (Fig. 1) to set the exposure compensation on scale **7**, as shown in Fig. 2 (for no compensation, set the scale to 0).

   The recommended exposure compensation depends on the illumination and the film type being used, as indicated on the housing of the exposure meter (table absent from the export model). The exposure compensation scale can be used to set a permanent correction dependent on an individual's requirement for the quality and tonal density of photographs.

   [**Note**: see Addendum 2008 – p. 19, Exposure compensation]

2. Rotate the aperture scale **10**, using the projections **5**, to set the film sensitivity on scale **11** or scale **6**, as shown in Fig. 3.

   [**Note**: see Addendum 2008 – p. 20, Home market and export models (GOST and ASA scales)]

3. Based on the selected method of measurement, lift and rotate the hinged diffuser **15** into the appropriate position.

   The light sensor window **22** must be uncovered for reflected light measurements, and covered with the diffuser for incident light measurements (Fig. 4).

4. For reflected light measurements, look through the viewfinder **2** at the subject (distance from the eye to the viewfinder: 8 mm) – the area of the subject being measured must be within the viewfinder frame-lines. For incident light measurements, the meter should be pointed towards the camera from the subject's location.

5. Use the middle finger of the right hand to press the power switch **23** to turn the meter on, without moving the exposure meter:

   — if the LED indicator is on, turn the rotary control **16** clockwise until the indicator goes out;

   — if the LED indicator is off, turn the rotary control anticlockwise until the indicator illuminates, and then clockwise until it goes out. This operation can be done 2–3 times.

6. Let go of the power switch and note the scale reading (shutter speed for a selected aperture, or aperture for a selected shutter speed or ciné frame rate).

7. The shutter speed scale (Fig. 5) is marked in fractions of a second, seconds, minutes and hours. In the fractions of a second range, only the denominators of fractions are used, for legibility (e.g. 2000 instead of 1/2000).

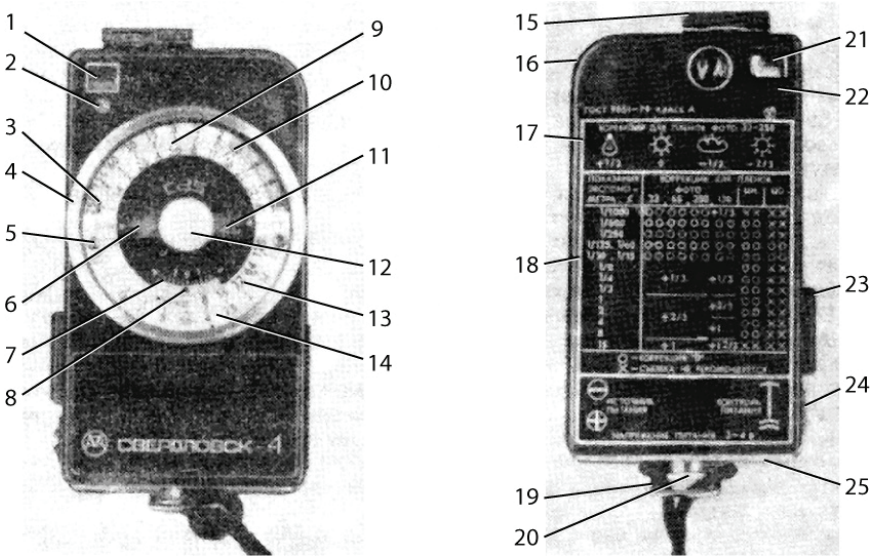


Fig. 1. Exposure meter components

1, viewfinder; **2**, LED indicator; **3**, battery level indicator (on the shutter speed scale, below 1/250 s); **4**, shutter speed scale; **5**, projections for rotating the film sensitivity scale; **6**, film sensitivity scale (DIN); **7**, exposure compensation scale; **8**, exposure compensation index mark; **9**, battery level index mark (on the aperture scale above *f*/5.6 [early model] or *f*/8 [late model]); **10**, aperture scale; **11**, film sensitivity scale (GOST [or ASA for the export model]); **12**, disc for setting the exposure compensation; **13**, ciné film speed scale; **14**, ciné aperture scale; **15**, translucent white glass diffuser; **16**, rotory control for the aperture scale; **17**, table of recommended corrections for different lighting conditions (absent from the export model); **18**, table of recommended corrections for different shutter speeds (absent from the export model); **19**, ring for attaching the carrying cord; **20**, battery cover screw; **21**, viewfinder exit window; **22**, light sensor window; **23**, exposure meter power switch; **24** , battery level switch; **25**, battery cover

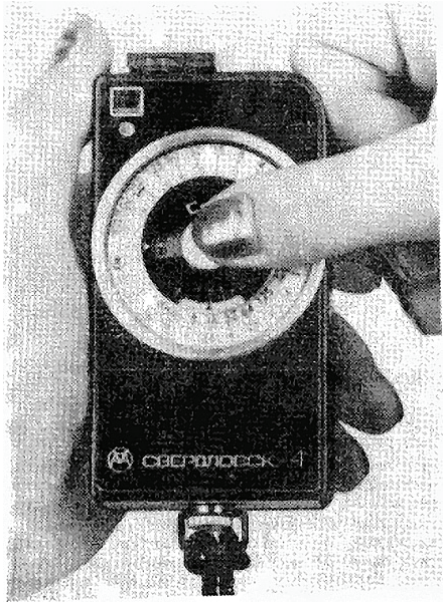


Fig. 2. Setting the exposure compensation

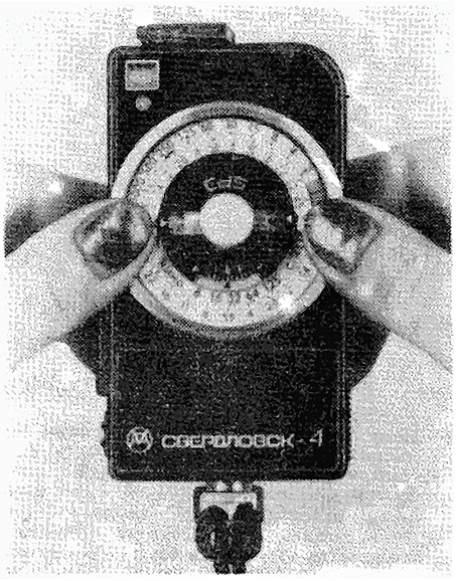


Fig. 3. Setting the film sensitivity

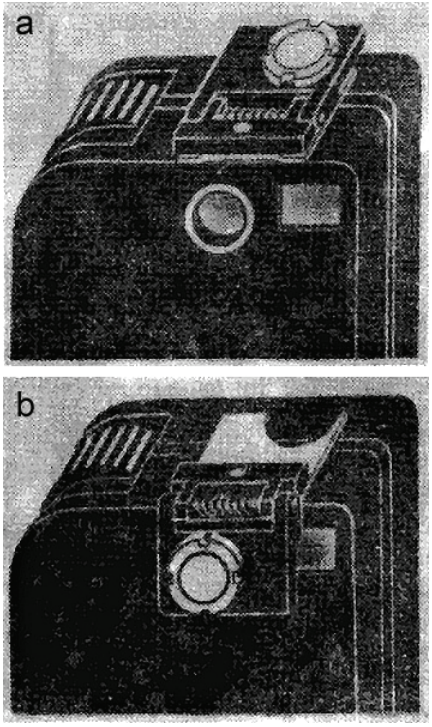


Fig. 4. Diffuser position: (a) reflected light measurements; (b) incident light measurements

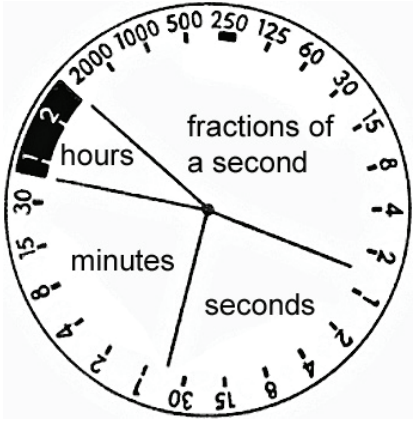


Fig. 5. The shutter speed scale

Checking the battery level

Set the exposure compensation to 0 and the film sensitivity to the index mark, located at either 65 GOST (80 ASA on the export model) or 100 GOST (100 ASA on the export model), then:

- cover the sensor window **22** (see Fig. 1) with any opaque material;
- press in the power switch **23** for 10–15 s then, keeping the power switch pressed, slide the battery level switch **24** upwards;
- turn the rotary control **16** anticlockwise until the LED indicator lights, then rotate the control clockwise until the LED goes out;
- check that the triangular index mark **9** on the aperture scale is inside the battery level scale **3**. if the index mark is outside this scale, replace the battery with a new one.

The LED not illuminating is also a sign that the battery needs replacing.

[**Note**: see Addendum 2008 – p. 21, Battery level index marks; p 22, Alternative batteries and calibration]

Replacing the battery

Follow the sequence below (Fig. 6):

- unscrew screw **20** and remove cover **25**;
- replace the battery, noting the polarity shown on the exposure meter;
- replace the cover and its screw.

316-type batteries can be used as an alternative power source. The accessory battery pack is attached to the lower part of the exposure meter in place of cover **25** with the aid of screw ***2*** (Fig. 7). [**Note**: see Addendum 2008 – p. 22, Alternative batteries and calibration]

Install the accessory battery pack as follows:

- undo screw ***5*** and remove lower clamp ***3***;
- unscrew spacer ***1*** and remove upper clamp ***4***;

- open the halves of the battery pack housing, and insert three 316-type batteries in the housing with the contacts, following the polarity indicated;
- close the halves of the housing, and replace the upper and lower clamps and their screw fasteners.

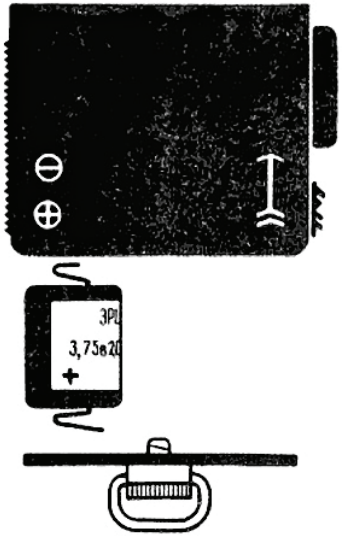


Fig. 6. Replacing the battery

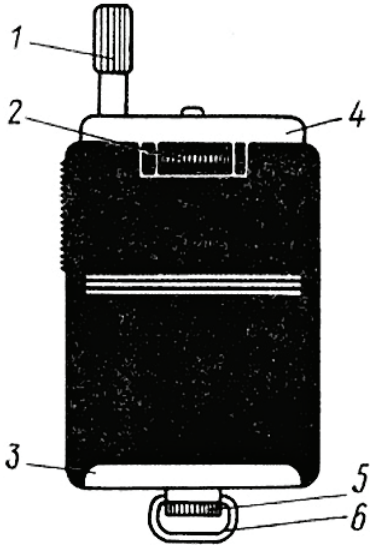


Fig. 7. The accessory battery pack

1, battery spacer; ***2,*** screw for attaching the battery to the meter housing; ***3,*** lower clamp; ***4***, upper clamp; ***5***, screw; ***6***, ring for attaching the carrying cord

Methods for measuring exposure

When measuring reflected light, the CdS sensor (without the diffuser) is pointed towards the subject from the camera's location. The principle of reflected light measurement is based on light reflected or emitted from the subject falling on the sensor (a photo-resistor) and changing its resistance. As subjects differ in size, brightness and colour, the meter will indicate different exposures even with one light source, depending on which part of the subject is measured. For accurate results, look through the viewfinder and place part of the scene which matches the size, brightness and colour of the area of interest within the frame-lines (Fig. 8).

When photographing a subject on snow, as little snow as possible should be visible in the viewfinder.

When measuring incident light, the exposure meter is used at the location of the subject, and the CdS sensor covered by its diffuser is pointed towards the camera (since high accuracy it is not required, there is no need to use the viewfinder). This method is appropriate when the subject cannot be metered (e.g. the expected appearance of a running athlete) or the subject has high contrast (e.g. a drawing).

If there is a single light source (the sun or a lamp), the CdS sensor can be pointed towards this source from the camera's location when taking an incident reading (Fig. 9).

In both cases, to achieve the desired results use your own experience or recommendations in the photographic literature.

If the subject is inaccessible or cannot be metered, take a reading from a similarly lit object, if necessary from an alternative location with similar illumination.

[**Note**: see Addendum 2008 – p. 19, Exposure compensation]

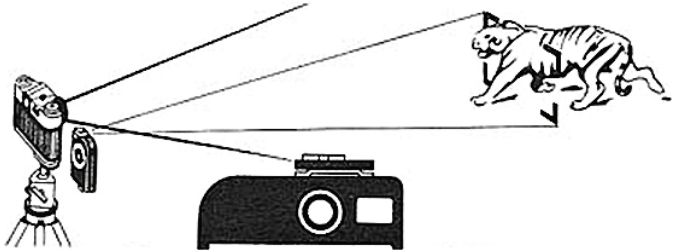


Fig. 8. Reflected light measurement

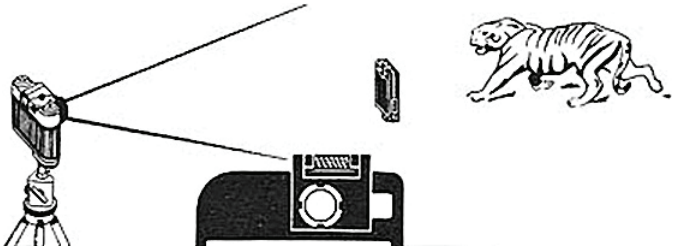


Fig. 9. Incident light measurement (note use of the diffuser)

Contrast measurement

It is possible to measure contrast with the exposure meter, i.e. the range in brightness across different parts of the subject, and the results used to adjust the illumination to reduce the contrast to match the photographic materials (film and paper) being used (i.e. by illuminating the darker parts of the subject more strongly). Reduction in contrast allows more flexibility when photographing in black and white, and improves colour reproduction when photographing in colour.

Contrast is measured by metering the lightest and the darkest parts of the subject and evaluating the difference in exposure (e.g. shutter speed) in stops (i.e. in EV [exposure value] units).

Selection of shutter speed–aperture combinations

Using the exposure meter, different shutter speed–aperture combinations can be obtained that correspond to the same exposure. However, the photographic situation determines the appropriate combination. If you are photographing without a tripod, shutter speeds above 1/30 s should be used, to prevent blurred images. To photograph moving subjects, for example at sporting events, shutter speeds above 1/125 s are necessary.

Similarly, the requirement for either a narrow or a wide depth of field limits the selection of the aperture.

Therefore, from a large number of possible shutter speed–aperture combinations, only one or two can be selected as suitable.

Sometimes, because of weak illumination of the subject, the ideal shutter speed–aperture combination cannot be used: either a wide depth of field has to be abandoned or a blurred image risked owing to movement of the subject or the camera.

Evening or night photography

In order to show night or evening effectively in photograph, it is necessary to reduce the exposure indicated by the meter, otherwise the image will be similar to a photograph taking during the day, except that the background will be dark. There are no foolproof recommendations in this case, except to gain experience of photography under such conditions and noting the deviation from the indicated exposure meter readings (taking into account reciprocity failure – see p. 17).

Further uses for the exposure meter

Determination of the average brightness and illumination of a subject

The average brightness of a subject (within the limits of the angle of view of the meter) and its illumination can be determined with the aid of Table 1. To do this, set the film sensitivity to 100 GOST (or ASA for the export model) and the exposure compensation to 0, and measure either the reflected or incident light exposure. Note the shutter speed at an aperture of *f*/8. The shutter speed can then be used determine the average brightness or illumination using Table 1.

Table 1 is correct for a light source with a colour temperature 4800 K, film sensitivity of 100 GOST (or ASA), an aperture of *f*/8 and 0 exposure compensation.

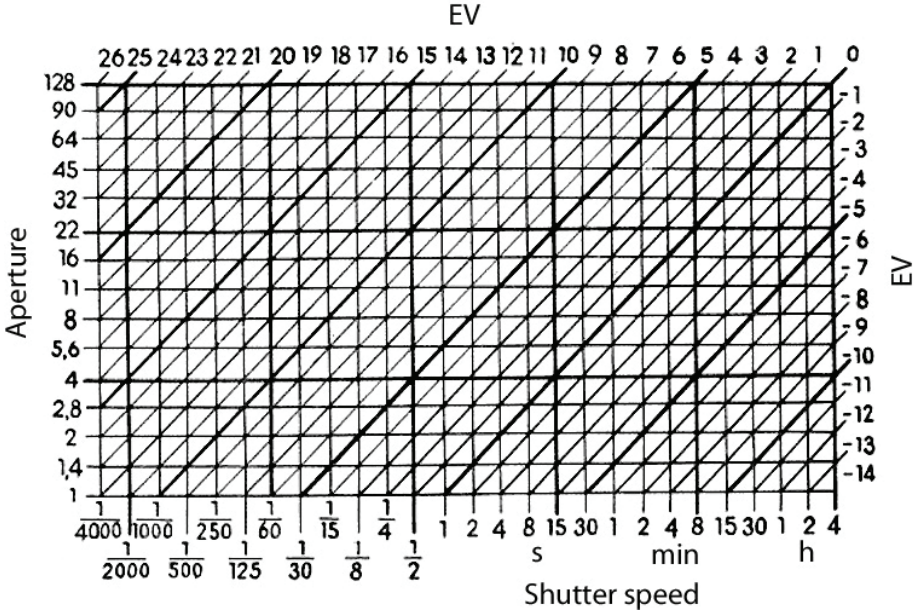
Table 1. Average brightness and illumination of a subject

Shutter speed (s)	Average brightness (cd/m^2)	Illumination (lux)	Shutter speed (s)	Average brightness (cd/m^2)	Illumination (lux)
60	0.15	3.3	1/8	77	1690
30	0.3	6.6	1/15	154	3380
15	0.6	13.2	1/30	308	6760
8	1.2	26.4	1/60	615	13,500
4	2.4	53	1/125	1230	27,000
2	4.8	105	1/250	2460	54,000
1	9.6	211	1/500	4920	108,000
1/2	19.2	422	1/1000	9840	216,000
1/4	38.5	844	1/2000	19,700	432,000

Determination of the exposure value (EV)

The EV can be determined with the aid of a nomogram (Table 2) using the shutter speeds and apertures obtained when measuring the exposure. Each EV corresponds to a number of possible shutter speed–aperture combinations that will ensure a correctly exposed photograph. By determining the EV using the nomogram, it is possible to select the optimum combination of shutter speed and aperture, even for exposures outside the range of the exposure meter. A change in the EV of one interval doubles (or halves) the exposure.

Table 2. EV nomogram



Determination of developing times for photographic paper

Make some initial test developments of photographic paper to determine the development time that gives the desired density, then determine the print exposure as follows:

- Turn off the red safety light, and point the exposure meter towards the image of the negative produced by the enlarger so that either the whole image or the part of interest is within the field of view of the meter. The angle between the viewfinder axis of the exposure meter and the optical axis of the enlarger lens should be as small as possible.
- Turn the rotary control on the exposure meter until the LED indicator goes out.
- Rotate the aperture scale so that the development time obtained from the test developments aligns with the aperture of the photographic enlarger lens (if unknown, use *f*/8).

If changing the type of paper, the average illumination can alter significantly, so the above procedure, including making test strips, will need repeating.

5. Summary and recommendations

When assessing exposure, bear in mind that the Sverdlovsk-4, like other photographic exposure meters, does not take into consideration: deviations in the sensitivity of photographic film from its specified values; deviations from standard conditions; errors in a camera's shutter speeds and apertures; subjective evaluation of the results; special requirements for projected images; and so forth.

New users should set the correct film sensitivity, follow the procedures in this manual, and use the shutter speeds and apertures indicated by the exposure meter. Using the meter in this way, develop several films, and note down and analyse the results, and make any appropriate corrections (increase or the decrease the shutter speed). To make corrections to the exposure meter reading, an adjustable exposure compensation scale **7** is provided (see Fig. 1), and adjustments for the type of light are given in table **17** (not on the export model), which uses symbols denoting artificial light, full sun, hazy sun, cloudy but bright.

Some information is given below on some aspects of photography that will facilitate use of the exposure meter and help obtain high-quality photographs.

Light sources

Light sources are characterised by their colour temperature, measured in kelvins (K). When the colour temperature decreases, it moves into the long-wave region of the spectrum (dominated by red and yellow light), and when it increases, it shifts into the short-wave region (dominated by blue light).

When a subject is illuminated by the sun in the cloudless sky, the colour temperature of the light depends on the height of the sun above the horizon, the season, and local topographic and geographical of conditions. As the height of the sun above the horizon changes, the colour temperature can alter from 2800 K (angle of the sun above the horizon = 5°) to 4500 K or more (angle = 15°). Cloud has a significant impact on the colour temperature of sunlight.

Recommendations for the correction of exposure depending on the type of light are given in the table (not on the export model) on the housing of the exposure meter.

Reciprocity failure (Schwarzschild's effect)

Reciprocity failure – the deviation from the expected exposure by photographic materials at very long and very short exposures – is noticeable for shutter speeds longer than 1/2 s and shorter than 1/500 s. Recommendations for increasing the shutter speed to counter this effect are given in the table on the housing of exposure meter (not on the export model).

[**Note**: see Addendum 2008 – p. 22, Modern films and reciprocity failure]

6. Care

The Sverdlovsk-4 exposure meter is a precision instrument that requires careful handling. It is recommended that the meter is carried in its case. To avoid discharging the battery, the case is designed so that the power switch is protected by a projection inside the case (Fig. 10).

Do not point the exposure meter towards bright light sources in the reflected light mode This can cause a short-term effect of temporary loss of accuracy, and can permanently damage the CdS sensor.

Protect the exposure meter from dust and moisture. Dirty optical components can be cleaned by gentle rubbing with a clean, soft cloth. Do not use alcohol, ether, cologne or other solvents to clean the optics or other parts of the instrument.

Store the exposure meter in dry conditions at a normal temperature. In wintry weather, keep the exposure meter under the outer clothing and take it out only to measure exposure, since cold decreases the efficiency of the battery. When entering a warm room after being outside in winter, keep the instrument in its case for one hour.

The exposure meter is a solid-state device, and, if the above restrictions are followed, it will provide problem-free use for a long time.

If a fault develops, the exposure meter is repairable only by a specialised workshop.

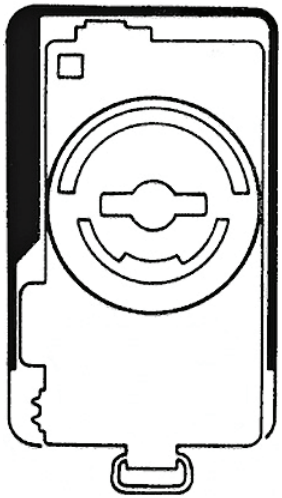


Fig. 10. The exposure meter in its case.

7. Addendum 2008

Exposure compensation

When measuring reflected light, exposure meters work on the principle that the overall brightness of the metered area is a medium (18%) grey. Most scenes have a fairly equal distribution of light and dark objects, so the meter is usually correct. However, if the subject is very light, the meter will expose the subject so that it appear medium grey, i.e. underexposed – this is the reason for those disappointing grey snow scenes. Similarly, the meter will overexpose dark subjects (e.g. a black horse).

In incident light mode, exposure meters are less prone to incorrect readings since they measure the light falling on the subject, and are independent of the colour and reflectance of the subject.

Also, some lighting conditions are difficult to meter. For example, you want to silhouette a subject against the sky (under-exposure needed); or in a scene with a sunlit area and an area in deep shade, you want both areas exposed well (the sunny area needs slight overexposure and the shade slight underexposure).

Sometimes, metering something other than the subject will give the desired exposure (e.g. expose for the sky to silhouette the subject). For those occasions when the scene contains nothing suitable to meter, rules of thumb are given in the table below.

Compensation	Characteristic
–5	Pure black
–4	
–3	
–2	Darkest tone with detail
–1	
0	Middle grey (meter reading)
+1	
+2	Lightest tone with detail
+3	
+4	Pure white

Examples. Using this table, a snow scene could be brightened by over-exposing it by $+1^{2}/_{3}$ stops, and a black horse darkened by $-1^{2}/_{3}$ stops underexposure, whilst retaining detail in both cases.

Home market and export models (GOST and ASA scales)

The Sverdlovsk-4 is available in two versions: one for the domestic Soviet market, the other for export. The differences are cosmetic: the export model is labelled in English, omits the exposure compensation tables on the back of the meter housing (they apply only to Soviet films), and uses ASA instead of GOST for the film sensitivity scale.

A minor issue with using the home market model is that the early GOST film speed standard is not identical to the ASA standard – although both scales are linear, GOST divisions are 10% smaller. In 1987, the GOST standard was redefined to be identical to the ASA scale. Early Sverdlovsk-4 meters use the old GOST standard, and these can be identified as follows: the film speed scale has a green background with traditional GOST values (32, 65, 130, …), and the dial is prominently marked with 'CdS'. Later meters have a film speed scale with a white background, and 'CdS' is absent – some of the very late meters have a GOST scale that uses the revised standard identical to the ASA standard, and are labelled with GOST numbers of 50, 100, 200, etc. (See also p. 23, Versions.)

Both home market and export models have a DIN scale, so this can be used instead.

Table 3. Equivalence between the original GOST film speed standard and ASA

GOST	ASA
32	40
65	80
130	160
260	320
520	640

ASA	GOST
50	45
100	90
200	180
400	360
1600	1440

Battery level index marks

Meters using the different GOST standards have battery level index marks in alternative positions: in early meters, the index marks are at *f*/5.6 (or, occasionally, *f*/11) and 65 GOST (80 ASA); in late meters using the updated GOST standard, the index marks are at *f*/8 and 100 GOST/ASA.

Alternative batteries and calibration

Replacing the original 3RTS53 battery

The original 3RTS53 three-cell mercury battery is no longer manufactured owing to environmental concerns. However, any 3–4 V battery can be used as an alternative. An ideal replacement is two 357 silver watch batteries – these are cheap and widely available and, more importantly, have a very stable, linear voltage output over a significant time-span that ensures accurate meter readings. These batteries are much smaller than the original, so use some card to increase their diameter and some metal washers to pack out the battery compartment.

The meter will need calibrating (see below) if the battery output deviates from the 3.75 V of the original cell.

The accessory battery pack

The original Soviet 316 cells are equivalent to AA cells.

Battery calibration

Alternative batteries that do not produce 3.75 V will give exposure readings that deviate from the correct value; for example, two 357 cells (= 3.10 V) produce exposures that require +0.6 EV compensation.

To calibrate the meter to the battery, read p. 10 on checking the battery level, then rotate the small disc **12** to adjust the exposure compensation until the battery level index mark **9** is centred inside the battery level scale **3**.

Modern films and reciprocity failure

Modern film emulsions react more linearly to light over a wider exposure range than the old Soviet ones, so reciprocity failure is now relevant only when shutter speeds are longer than about a second or shorter than 1/5000 s. Tables 4a and 4b show the exposure compensation needed by two typical modern films. As can also be seen, colour film has a more linear response to light than black-and-white film.

Table 4a. Tri-X 400 ISO black-and-white film

Exposure time (s)	Adjustment (EV)
1/10,000	–0.5
1/1000	0
1/10	0
1	+1
10	+2
100	+3

Table 4b. Fujicolor Pro 400H colour film

Exposure time (s)	Adjustment (EV)
1/4000	0
1	0
4	+0.5
16	+1

History

Like many products of the USSR, the Sverdlovsk-4 was manufactured by a company within the secretive military–industrial complex, so the meter bears no manufacturer's name – the only identifying mark is an owl logo on home market models (export models used Technointorg's logo – a Soviet international trade organisation). We know now that this owl logo belongs to UOMZ (Uralskiy Optiko-mekhanicheskiy Zavod – 'The Urals Optical and Mechanical Works') in Sverdlovsk (now renamed Ekaterinburg). UOMZ had its roots in a shop in Moscow in 1850 selling optical equipment, which, as it grew, started to manufacture optical products itself; under the Soviet regime, it specialised in military optical equipment, and was relocated to Sverdlovsk in 1941. UOMZ survived the break up of the Soviet Union and is still in existence.

The Sverdlovsk-4 is one of three related exposure meters made by UOMZ: the Sverdlovsk-2 was made in 1980 to about 1985, the Sverdlovsk-4 in about 1985–89, and the Sverdlovsk-6 in the early 1990s. All the meters use the same basic design: rugged

solid-state circuitry with a CdS photoresistor and an LED indicator. This was an innovative design, as most exposure meters in the early 1980s, even in the West, still used fragile moving-needle meters. The Sverdlovsk-4 cost 47 roubles.

The Sverdlovsk-4 is more sophisticated than the Sverdlovsk-2; for example, it has both incident and reflected metering modes (the Sverdlovsk-2 is only a reflected light meter), a wider exposure range, a narrower metering angle (12° versus 20°), and includes a ciné frame rate scale. The Sverdlovsk-6 is essentially a repackaged and simplified Sverdlovsk-4, possibly to reduce production costs: no viewfinder (it has a wider metering angle), a slightly restricted exposure range, and more use of plastic.

Versions

There are two main versions of the Sverdlovsk-4: early and late. In early versions, the film sensitivity scale has a green background (white in late versions), the dial is prominently marked 'CdS' (unlabelled in late versions) and the small, rotating central exposure compensation disc is white (black in late versions). All early non-export versions, and many late versions, have a GOST scale that follows the original Soviet standard with divisions that do not correspond to the ASA scale, and labelled 32, 65, 130, …; however, meters in the final years of production use the revised GOST scale that is identical to the ASA scale, and are labelled 25, 50, 100, …

Buying a Sverdlovsk-4 meter

Of the three models, the Sverdlovsk-4 is the most popular – it can be used as a spot meter and has the best design and construction – and its second-hand price reflects this, being twice as costly as the other models.

Sverdlovsk meters are common in former Soviet countries, and complete boxed Sverdlovsk-4 kits appear regularly on eBay, often in excellent condition and described as 'new old stock', costing about £20. As the meter is so robust, if it looks in good condition, it probably works perfectly.

Unless you're sure that the meter you're interested in uses the revised GOST standard for the film speed scale, buy an export version meter with an ASA scale, for convenience (alternatively, you can, of course, use the DIN scale instead of the GOST scale).

First published (except addendum) in Russian by UOMZ, USSR, 1979. This English translation and addendum by Rich Cutler, UK, 2008.