

# The Horseman Optical Exposure Computer/Exposure Meter

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## Summary

This article presents the Horseman Exposure Meter system, for through-the-lens exposure metering with a large format camera.

## 1 Introduction

The Horseman Exposure Meter is an averaging exposure meter for through the lens readings with 6x9 and 4x5 cameras. The meter slips in like a sheet film holder, has grooved edges that Graflok sliders will engage.

The Horseman Technical Camera FAQ [1]  
at [http://www.kenko-pi.co.jp/horseman/e/faq\\_tc.html](http://www.kenko-pi.co.jp/horseman/e/faq_tc.html)

asks "What exposure meter should I use for 45FA and 45HD?" and replies:

*The Horseman Exposure Meter will be the right choice, as it allows for both shutter-priority and aperture-priority light measuring. The Horseman Exposure Meter measures average light that goes through the lens (TTL) at the film plane, which eliminates the needs for compensation for filter factors or bellows extension in close-up shooting. This is a very easy-to-use exposure meter, even for beginners.*



Figure 1: 1st and 2nd version Buehler meters, front view



Figure 2: 1st and 2nd version Buehler meters, rear view

## 2 Using the Horseman Exposure Meter

Using one is straightforward. Set up the camera, focus and compose. Leave the shutter open. Set film speed on the meter's calculator dial. Insert the meter in the camera. Turn it on.

To find the correct shutter speed given aperture, stop the lens down to the intended shooting aperture. Read the FSV value (see sec. 4 for the meaning of the FSV acronym), transfer to the calculator dial, read the shutter speed required. Set the shutter to the speed required, close shutter, remove meter, insert film holder, ...

To find the correct aperture given shutter speed, choose the shutter speed to be used, set the calculator dial to that speed. Read the FSV value required. Stop the lens down until the meter indicates that FSV value. Close shutter, remove meter, ...

For a video of one being in used in the field that includes pictures taken with its help, see Bryan Garris' video [2] at <https://www.youtube.com/watch?v=ERYGOXFkulc>

Horseman sold a 4x5 adapter for 6x9 meters. The meter plus adapter slips between a 4x5 camera's ground glass and back like a sheet film holder. The adapter has grooved edges so that meter plus adapter can be mounted on 4x5 cameras with Graflok/International backs using the backs' Graflok sliders.

When attached to a 4x5 camera a 6x9 meter is not centered in the 4x5 back's gate. The metering area is displaced  $\sim 29$  mm towards the back's insertion end.



Figure 3: Meter held to 2x3 Cambo back by Graflok sliders





Figure 6: Meter in adapter, held to 4x5 Cambo back by Grafflok sliders



Figure 7: Meter in adapter in 4x5 Cambo back, front view



Figure 8: Meter in adapter in 4x5 Cambo back, held by focusing panel

### 3 Problems with wide angle lenses

Horseman meters measure average illumination across the metering area. This can lead to exposure problems when the format isn't the same size as the metering area, the lens used doesn't illuminate all of the metering area or has significant falloff ("optical vignetting").

To see how important this can be I calculated average falloff over the metering area and frame for a number of focal lengths. I assumed that illumination falls off with  $\cos^4$  of the angle off axis and that the lenses illuminate the metering area.  $\cos^4$  is correct for most large format lenses, full illumination isn't always, especially with the 4x5 meter and telephoto lenses for 6x9.

My calculations for a 6x9 meter used in a 4x5 camera for 6x12 and 4x5 reflect where the metering area is located in the 4x5 camera's gate. They assume that the roll or sheet film holder is centered in the gate. As mentioned above, a 6x9 meter is considerably off-center in a 4x5 back. The difference between meter readings for 6x9 from a 6x9 meter in a 6x9 camera and from a 6x9 meter in a 4x5 camera are minimal –  $\sim 0.1$  stop for a 35 mm lens, less for longer lenses – so I present results only for a 6x9 meter in a 4x5 camera

Illumination falloff with wide angle lenses is a fact of life and a problem no matter how exposure is metered. There are good reasons to use center filters with extreme wide angle lenses to make illumination more even across the field. There are also good reasons why many photographers don't use center filters with w/a lenses that aren't extremely extreme, e.g., 65 mm on 6x9 and 90 mm on 4x5, especially with negative film.

Focal length	Exposure error (stops, rounded) when the meter's advice is taken								
(mm)	6x9 meter								
	6x9 in a 4x5 camera			6x12 in a 4x5 camera			4x5 in a 4x5 camera		
	Average	Center	Corner	Average	Center	Corner	Average	Center	Corner
35 <sup>note 1</sup>	-0.1	+1.4	-1.8	-0.4	+1.5	-2.6	n/a	n/a	n/a
47	-0.1	+1.0	-1.2	-0.3	+1.0	-2.0	-0.4	+1.0	-2.7
58	-0.1	+0.7	-0.9	-0.2	+0.7	-1.6	-0.3	+0.7	-2.2
65	-0.1	+0.6	-0.8	-0.2	+0.6	-1.3	-0.3	+0.6	-1.9
90	0.0	+0.3	-0.5	-0.1	+0.3	-0.8	-0.2	+0.3	-1.2
100	0.0	+0.3	-0.4	-0.1	+0.3	-0.7	-0.1	+0.3	-1.0
125	0.0	+0.2	-0.3	-0.1	+0.2	-0.5	-0.1	+0.2	-0.7
150	0.0	+0.1	-0.2	-0.1	+0.1	-0.4	-0.1	+0.1	-0.5
210	0.0	+0.1	-0.1	-0.1	0.0	-0.1	0.0	+0.1	-0.3
	4x5 meter								
35 <sup>note 1</sup>	+1.1	+2.5	-0.7	+0.6	+2.5	-1.7	n/a	n/a	n/a
47	+0.8	+1.7	-0.5	+0.5	+1.7	-1.3	0.0	+1.7	-2.0
58	+0.6	+1.2	-0.3	+0.5	+1.2	-1.0	0.0	+1.2	-1.6
65	+0.5	+1.0	-0.3	+0.3	+1.0	-0.9	0.0	+1.0	-1.4
90	+0.4	+0.6	-0.2	+0.2	+0.6	-0.6	0.0	+0.6	-0.9
100	+0.3	+0.5	-0.1	+0.2	+0.5	-0.5	0.0	+0.5	-0.7
125	+0.2	+0.3	-0.1	+0.1	+0.3	-0.3	0.0	+0.3	-0.6
150	+0.1	+0.2	0.0	+0.1	+0.2	-0.2	0.0	+0.2	-0.4
210	+0.1	+0.1	0.0	+0.1	+0.1	-0.1	0.0	+0.1	-0.2

**(note 1)** There are no 35 mm lenses that cover 4x5. But one can shoot a 35/4.5 Apo Grandagon on 6X9 or 6x12 with a 4x5 camera and use a 4x5 meter to find the correct exposure.

When a lens short for the format is used without a center filter a 6x9 meter offset as described above in a 4x5 camera will underexpose 6x12 and 4x5 slightly. If the meter were centered in the 4x5 gate, it would give worse underexposure. A 4x5 meter will overexpose 6x12 and 6x9. How badly depends on focal length. The shorter the lens, the worse the under-/over-exposure.

Both meters will do well with lenses that are normal or longer for the format used.

## 4 Different versions of the Horseman Exposure Meter

There are three 6x9 versions, most with seven digit serial numbers 174xxxx. All have three metering ranges, 2 - 6, 6 - 11, and 10 - 16 F.S.V., selected by a knob at the dial end of the meter. The knob also selects battery check (Exposure Computer, two positions for batteries "A" and "B"; Meter 69, one position) and off (Exposure Computer only). I believe that F.S.V. stands for Film Speed Value, could be mistaken. F.S.V. is a logarithmic scale that translates film speed and the amount of light coming through the lens to shutter speed for correct exposure. For ISO 100, F.S.V. 0 corresponds to 30 seconds.

The Horseman Optical Exposure Computer, uses two batteries, one each PX 26 and PX 640. Both are mercury cells and no longer available. The user manual warns "*Always turn the meter OFF when not in use. The batteries are rapidly exhausted if the meter is left turned on for long periods of time.*"

Horseman Exposure Meter 69 (4 MR 9) also uses unavailable mercury cells. It has a battery check push button next to the battery compartment cover. I've seen several with anomalous eight digit serial numbers. In fact, I have one such.

Horseman Exposure Meter 69 (4 SR 44 like Meter 69 (4 MR9) except for batteries.

Both Exposure Meter 69s differ from the Exposure Computer in two respects besides using only one kind of battery. They are all black; the Exposure Computer has a black front and a silver rear. They have a "check battery" push button, no obvious on/off switch and a knob for battery check and range selection; the Exposure Computer's metering range knob also has an off position. I think, haven't been able to confirm, that setting the Meter 69s' metering range knob to battery check turns the meters off.

Both Exposure Meter 69s seem to have been in production simultaneously. I've seen ones that use four MR 9s with higher serial numbers than meters that use four SR 44s. Since, however, Horseman offered an update service that modified meters from MR 9s to SR 44s the anomalous meters may be updated Meter 69 (4 MR9)s.

The Exposure Computer and Exposure Meter 69 (4 MR9) were rebadged Buehler Exposure Computer and sold by Adolph I. Buehler, Inc., of Lake Bluff, Illinois. The company made hardness testers and other metallurgical apparatus.

6x9 Horseman meters fit into a 4x5 adapter that fits 4x5 cameras. The 4x5 adapter can also be attached to Graflok/International backs with the back's Graflok sliders.

In a 4x5 camera a 6x9 meter is strongly center-weighted; everything outside of the 55 x 82 mm metering area has zero weight. With 6x12, ~ 15 mm at each end of the frame gets zero weight.

There seem to be two 4x5 versions, all with six digit serial numbers 45xxxx, both sold as Horseman Exposure Meter 45. Version one uses four MR 9 cells, version two four SR 44s.

4x5 meters differ from Exposure Meter 69s in two respects besides having a larger metering area. 4x5ers have a knob for on/off, battery check and range selection like the Exposure Computer. Their dial assembly rotates on its stalk. The 6x9 meters' dial assembly is fixed to the body.

Just when the various versions of the Horseman meter came to market is unclear. The earliest reference to the Optical Exposure Computer in Google Books is from 1965. SR 44 versions of Exposure Meter 69 and 45 are described in the Horseman Photographer's Catalog No. 2 (1988).

## 5 Batteries

The only Horseman exposure meters that use Mercury-free batteries are the last ones that use four SR 44 cells.

There are, however, several ways to use Mercury-free batteries in older Horseman meters. All replace the PX 26 or stack of four MR 9s with a stack of four MR 9 equivalents and the PX 640 with a single 640 equivalent. A Google search "exposure computer" OR "exposure meter" "horseman" will find many pages with advice on how to replace the meters' mercury cells with mercury-free ones.

The least expensive way to use a Horseman meter that requires mercury cells is to replace them with PX 675 zinc-air hearing aid cells. These have nearly the same voltage as MR 9s but are smaller, the same size as SR 44s. Using them requires adapters that center the cells in the meter's battery chamber(s) and a conducting spacer. Replacing a PX 640 with a hearing aid battery requires a centering adapter and a conducting spacer.

[http://www.paulbg.com/Nikon\\_F\\_meter\\_batteries.htm](http://www.paulbg.com/Nikon_F_meter_batteries.htm) offers reusable metal rings whose outer diameters match the MR 9's and that fit snugly on a PX 675. They make using a stack of four zinc-air PX 675s in place of a PX 26 or a stack of four MR9s easier, but a conducting spacer may be needed at one end of the stack. Some users recommend putting a rubber o-ring (10 mm ID x 13 mm OD), thin wire or a plastic tie as comes with a loaf of bread around a PX 675 to make it match an MR 9's diameter. Many are the ways.

Sellers on eBay offer battery holders that accept PX 675 zinc-air batteries and are direct replacements for, respectively, an MR 9 and a PX 640. These adapters do **not** step the voltage down. Search for "battery adapter" (mr9, "mr 9") and (px640, "px 640"). Read the listings carefully and remember that SR 44s and PX 675s are the same size.

A zinc-air cell is delivered with a seal that keeps air out. While sealed it makes no power. It is prepared for use by removing the seal. When cells are stacked the bottom of one cell may cover the next cell down's air holes, preventing proper operation. I haven't encountered this but some users have complained about it. After the seal has been removed a regular hearing aid cell will last for as little as one month. This can be a problem

WeinCells (see <http://www.weincell.com/>) are zinc-air cells whose maker claims they are longer-lived than the equivalent hearing aid battery. Users don't all agree. WeinCells are considerably more expensive than equivalent hearing aid batteries.

WeinCell offers a PX 675 replacement and an EPX 625/MRB 625, a direct replacement for an MR 9. It appears to be a 675 in a washer similar to the paulbg adapter.

Ken Rockwell [3] <http://www.kenrockwell.com/tech/wein-epx-625.htm> tested one, reports that it took around fifteen minutes to develop full voltage after the tab was pulled and had the correct voltage eleven months later. Exell says that their MRB 625 is a WeinCell. See <http://www.exellbattery.com/?portfolio=exell-battery-mrb625-zinc-air>.

A 2013 study [5] (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4423287/>) tested ten brands of hearing aid batteries. Duracell 675s were the longest lasting 675s by a considerable margin. Prices vary a lot so Duracells may not be the best buy.

675s' claimed shelf life varies by maker and depends on storage conditions, ranges from two to four years. Complaints that sellers deliver out-of-date batteries and that batteries are

dead on arrival are common. I've encountered short-dated 675s in local stores.

A more expensive alternative is using SR 44 cells in MR 9-sized adapters that step their voltage down to mercury cells' 1.35v. SR 44s last much longer than activated 675s.

Criscam.com

(see <http://shop.criscam.com/collections/mercury-battery-adapters/products/mr-9-mercury-battery-adapter> )

makes an adapter that holds a single SR 44 and steps its voltage down to 1.35v. It is the same size as a single MR 9. Criscam's price is ~ \$ 36. Slightly less expensive knock-offs that get very mixed reviews from users are offered on eBay.

[4] <http://www.butkus.org/chinon/batt-adapt-us.pdf>

has directions for making adapters like Criscam's.

Gossen made an adapter, GO 4145, that holds two SR 44s and reduces the voltage to 2.7v. Discontinued, hard to find.

Duane Becker

(<http://home.myfairpoint.net/~snowleop/merc/index.htm>)

has offered, may still offer, an adapter that replaces a PX 640. It mimics a PX 640, holds a 3v CR 1632 Lithium cell, steps the voltage down to 1.35v.

Batteries used in the meters			
Cell Type	Voltage	Diameter	Height
PX 26 (Mercury)	5.4v	15.9 mm	26.5 mm
PX 640 (Mercury)	1.35v	16.0 mm	11.2 mm
4MR9 (Mercury)	5.4v	16.2 mm	27.1 mm
MR 9 (Mercury)	1.35v	15.6 mm	5.95 mm
Potential replacements			
SR 44 (Silver oxide)	1.55v	11.6 mm	5.4 mm
ZA 675 (Zinc air)	1.45v	11.6 mm	5.4 mm
MRB 625 (Zinc air)	1.45v	15.25 mm	6.02 mm

It is physically possible to replace MR9s with 625A alkaline cells and to replace the Exposure Computer's PX 640 with an alkaline 640 cell. In general not a good idea because alkaline cells deliver 1.5v when fresh, much less as they're used. So the meter's calibration will be off from the start and the adjustment needed will shift over time. Users have done this anyway, sometimes with good results.

## 6 When might a Horseman meter be preferable to a hand-held meter?

Because it measures illumination at the field plane a Horseman meter simplifies shooting at near distances with ambient light. It eliminates the need to calculate bellows factors.

It also makes getting good exposure with a wide angle lens that has a center filter easy. There's no need to think about filter factors.

Metering for an extreme wide angle lens without a center filter will always be problematic. A 6x9 Horseman meter on 6x9 or a 4x5 on 4x5 will overexpose the center of the field more and underexpose the edges less than will a hand-held meter. When the meter's metering area matches the format, the difference between center and corner will be the same no matter which type of meter is used. All that will change is the distribution of exposure errors across the frame.

As pointed out above a 6x9 meter will underexpose 4x5 on average enough to matter with lenses much shorter than 90 mm. Similarly, a 4x5 meter will overexpose 6x9 and 6x12 enough to matter with lenses shorter than 65 mm.

A Horseman meter can also be helpful when shooting with a lens longer than normal. The angle the film sees can easily be narrower than a regular meter's angle of view and wider than a narrow angle/spot meter's angle of view.

The biggest reason not to use a Horseman meter in the field is its size.

## 7 Buying a Horseman meter

Horseman meters are offered at a wide range of prices on eBay and on dealers' sites. Buying one without the right of return, even if the seller claims it works, is a gamble.

[6] <http://www.kenko-pi.co.jp/horseman/funou.html> (use Google Translate if you don't read Japanese) says that Horseman meters are "unrepairable products." Sellers rarely know how to test them.

## 8 My experience with Horseman meters

I gambled on a Buehler-badged Exposure Meter 69 (4 MR9) offered on eBay as untested because batteries are not available, not guaranteed to work, not returnable. It came with a case, an Exposure Computer user's manual and a 4x5 adapter.

I don't know whether the 4x5 adapter I received is typical. The meter is a slightly loose fit in it and the latch that should retain it works very poorly. To be used carefully.

I have two of Gossen's 4145 adapters so tried the meter out with them. After a bit of fiddling - I had to put bits of aluminum foil between the adapters and at the bottom of the stack - it came to life. The battery check checked but otherwise the meter didn't function properly. In dim light, when looking through a lens stopped to f/32 all three ranges read off scale, high. Nippon PhotoClinic in New York City looked at it for me, reported that the part needed to make it work, a meter sensor circuit, is no longer available. Gamble lost.

Since I'd decided that I had to have one of these meters I bought an Exposure Computer, also badged Buehler, from another seller on eBay. It was advertised as tested and good but failed acceptance testing. The seller took it back.

And then I bought an Exposure Meter 69 (4 MR9) advertised as tested and good from an eBay seller in Japan. Not much of a gamble because eBay sales offer the right of return for goods not as described.

It seems a little flaky but works well. When the meter is horizontal the needle rests on the "Battery" window's "0" mark as the manual says it should - this is the position in which the meter can be zeroed - but moves past it when the meter is vertical. Similarly, the needle moves to the "good battery" mark when the meter is horizontal and the battery check button is pushed but moves beyond it when the meter is vertical. However, it functions properly and agrees well on all three metering ranges with a known good Sekonic L-328. As Horseman and Bryan Garris say, it is very easy to use.

## Notes & References

- [1] *What exposure meter should I use for 45FA and 45HD?*  
[http://www.kenko-pi.co.jp/horseman/e/faq\\_tc.html](http://www.kenko-pi.co.jp/horseman/e/faq_tc.html)
- [2] A demonstration by Bryan Garris on using the Horseman Exposure Meter  
<https://www.youtube.com/watch?v=ERYGOXFkulc>
- [3] Ken Rockwell's tests of Wein cells  
<http://www.kenrockwell.com/tech/wein-epx-625.htm>
- [4] Making an adapter to replace mercury cells with modern cells  
<http://www.butkus.org/chinon/batt-adapt-us.pdf>
- [5] A 2013 study on hearing aid batteries  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4423287>
- [6] <http://www.kenko-pi.co.jp/horseman/funou.html>