

In Pursuit of Weston Light Meters

By John Bunyan



I would be willing to bet that there is not a single reader of this article who has not, at some time in their life, come across a Weston Exposure Meter, either in use, at a car boot sale or fair, or lurking forgotten somewhere in an equipment drawer. Wisely or not, a few years ago I decided to attempt to make the most complete collection of Weston Light Meters possible.

From the 1930s, Weston Electrical Instruments Corporation, with their introduction of the Selenium-based Photronic dry photo-voltaic cell, brought to the world the first truly reliable and definitive means of measuring light, whether for assessing workplace illumination, or establishing photographic exposure. The Weston meter became dominant in photography worldwide for the next forty years and examples endure to this day.

I would have been about nine years old when I would join my father as he worked in the photographic darkroom he had built in our attic. There I came across his Weston meter, a Master Universal type S74 from the Sangamo factory in Enfield. It was old and fragile then and he was apprehensive about me handling it. It looked incredibly scientific to me and 'Sangamo' as emblazoned on the back, seemed like an exotic and far off location. He explained its purpose, mentioning that the meter needle stuck sometimes but it was still reliable. A lot of the numbers on the dial had worn off but it didn't seem to worry him. I guess he could remember what they were, since he had been using it for so long.

Jump to my first job after leaving school. Working as a photographic assistant in a large manufacturing company in-house studio, I used my boss's Master V. The Perspex invercone had broken on more than one occasion and had been glued back together with Araldite. My boss was fairly heavy handed but I nearly broke it myself when it flicked off the meter when the opened cell baffle unhooked from its locking point. I quaked with terror as it headed at speed towards the concrete floor, but on that occasion I was lucky. A Euro-Master emerged in my next job at an arts college. Again I used this for several years but it retired along with the lecturer to whom it belonged.

By then I had bought my own Master V, which I continued to use, and do to this day, though I have had the cell replaced.

So Westons have been a part of my life, and still are. But at some point an interest in them turned into a collecting bug. The turning point was when I discovered a model 819 Photronic Cine Meter boxed and in perfect condition for £10 at a car boot sale. I was enraptured by its Art Deco styling, particularly the fan motif under the meter. A colleague showed me the similar model 650 Leicameter, which is much rarer. I wanted one.

Weston light meters can be arranged into a number of loose families. The most fundamental division is between pure light meters and those designed specifically to calculate photographic exposure. The general light meters are designed for workplace, scientific or environmental light level measurement, although the earliest models were also used by photographers and cinematographers who translated the readings into exposure values. The exposure meters are characterized by having a means of calculating exposure - the aperture and shutter speed for the camera and film - using either a dial or table integral to the meter. So as to bring some order to this group, at least for my own purposes, I have arranged them into the following families:

In Pursuit of Weston Light Meters (continued)

Early Exposure Meters: Covering those made only in Newark, U.S.A up to the introduction of the first 'Master'. Direct Reading: A small family of compact simplified meters without calculator dials, partly concurrent with the 'Master' series.

The Masters: The most famous and enduring series of meters made both in the U.S.A. and Great Britain. Later models made in Britain only.

Leicameters: An interesting set of four variants of other models calibrated specifically for use with early Leica rangefinder cameras.

The Rest: Includes named or licensed models made in Japan, principally by Sekonic, and some later American models not in the Master series.

My intention here is, after a brief technical introduction, to cover the early meters and the Masters.

An early patent of interest was lodged by a Samuel Wein and assigned to the Radiovision Corp. of New York. Patent no. 1,779,574 describes a Direct Reading Photometer (Filed Nov. 8, 1929; see <https://patents.google.com/patent/US1779574>) This mentions the selenium cell but crucially uses an electrolyte in an enclosed housing to generate sufficient current to move a meter needle. The cell that Weston developed that appears to be the basis of all their early meters is the model 594. Brooke Clarke identifies the 1935 patent 2000642 as that most closely relating to this selenium dry cell - the Photronic - and this name appears on many of the meters (<https://www.prc68.com/l/Weston594Photronic.shtml>). This patent is late coming, since the cell was clearly in use from 1932.

Up to that point the selenium cell had been considered too weak to give a measurable output in relation to light. In their first model of exposure meter, the 617 type 1 of 1932, Weston linked two cells together to give a measurable output at low light levels. It is probable that the success of this meter was also due to revolutionary developments they had also made in meter bearings and needle movements. Patent 1579849 (26 June 1925. Edward F Weston pat.US1579849A Pointer for Electrical measuring Instruments at <https://patents.google.com/patent/US1579849>) describes a pointer that is both accurate and more cheaply produced than earlier examples.

Weston also had another trick up their sleeve. A known issue with the dry photo voltaic cells was their mismatch to the human eye's response to the visible spectrum, and specifically a disproportionate response to the infra red. The VISCOR filter (VISable CORrection), responsible for the green hue noticeable on early meter cells, dealt with that, giving the meter a consistent response that the photographer could rely on. (See *New Color Corrected Photronic Cells for Accurate Light Measurements*, by Marlin E Fogle from Transactions of the I.E.S, 1932. From <https://www.prc68.com/l/Weston594Photronic.shtml#2073790>.)



The model 617 Photronic type 1 (1932) original twin cell exposure meter. Light Values (Candles per Square Foot) range up to 1300. The instruction roundel lists recommended speed ratings for some Kodak and generic films.

Separate ratings are given for daylight and tungsten use as earlier films, even if panchromatic, had a poor response to the red wave band.

With the excellent type 594 Photronic cell in their armory, Weston Electrical Instruments became the dominant player in the emerging and fast growing market for photographic exposure meters from the early '30s.

Early Westons

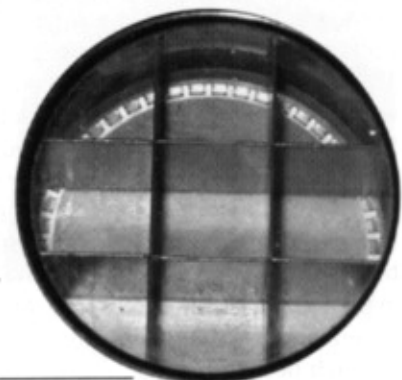
A Model 617 original Photronic Weston, if you can find one, is a truly beautiful thing to behold. Taking its cue from the circular form of the selenium cell, the bakelite housing design is a three-ring circus. The two outer rounds contain the twin cells with a crude metal baffle assembly giving a 60-degree capture cone. A push button on the meter top allows for either single or twin cell use for high and low light levels respectively. For low light levels the values on the meter - in Candles / Square Feet - were simply divided by 10. With the cells deeply recessed in the housing, this meter is for reflected light use only. A central V shaped groove on the top helps the user direct the meter with the light value easily read off the central meter roundel underneath.



The instruction legend on the earlier model 617/1, comprising of white ink in a recessed moulding in the Bakelite.

The later model in the main picture (top of page) used an embossed metal disc riveted on.

The crude metal baffle of the 617/1, which gave the cell its 60 degree cone of acceptance. This was replaced in the type 2 with a honeycomb baffle and, in later models, with a glass lenticular element.



Weston used their own speed rating system - Weston Speed - which would shortly gain the confidence of the photographic and cinematic community, and this meter is marked up to 45 - some indication of the expected maximum emulsion speeds of the time. Eclipsing the Hurter and Driffield and Scheiner ratings, the robustness of Weston Speed ratings would be proved on the introduction of the A.S.A. (American Standards Association) system later, where the values differed by just one third of a stop.

And then there was the calculator dial. A three-stage disc where the emulsion speed and measured light value were quickly rotated in to allow combinations of shutter speed and aperture to be read off, it proved to be a mark of design genius. Although the dial is populated by a large number of small closely packed figures, its ergonomic elan has never been bettered. The concept endures to this day and was adopted wholesale by other exposure meter manufacturers.



The three-stage calculator dial of the model 617. It has a number of pointers to help the photographer assess their subject. They reference the lightest or darkest subject areas, contrast levels and parameters for over and under exposure.

The twin cell meter was superseded by the single celled Photronic Model 617 type 2 of 1934. This had the up-and-over arrangement of meter and dial that would only come back with the Weston Master and not achieve the same level of compactness until the Master IV arrived in 1960. As we shall see, Weston's meter designs went in other directions in the intervening period before the introduction of the first Master.

It's unlikely that in 1934 they realized just how powerful and enduring this arrangement would be, ideal as it was for single-handed use. The crude metal baffle of the twin cell model has been replaced with a honeycomb bakelite baffle to make the cell response more directional.



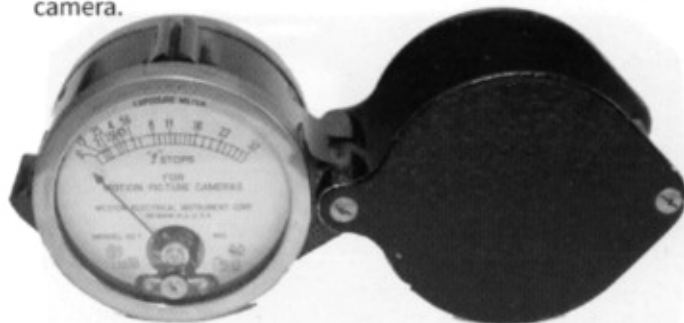
The single-celled model 617 Photronic type 2 (1934) which superseded the original twin celled model. It exhibits the classic design of meter with the calculator dial close underneath that would only be completely realised with the advent of the Master series.

Consider now, as no doubt Weston did, the plight of the cinematographer. A studio photographer could rely on their knowledge of their own lighting setup, plate and film stock and processing, doing clip tests on roll film and bracketing on exposures. Taking a light reading would have just been one component of this broader toolkit. The hapless filmmaker by comparison had to deal with ever changing lighting setups, little chance to do test shooting and film processing that was out of their hands.

Weston addressed this need with a simplified design of meter that, to my knowledge, has never been replicated in any other design by any manufacturer.

Based on the idea of a magnifying loupe, it is a simple circular cell and meter in a bakelite housing with no calculator dial in sight. A metal cover protects the meter when not in use.

From 1933, two models of the type 627 were produced with little difference between them. Instead of the meter face indicating light levels, it is directly marked up in f numbers. These correspond to a shooting rate of 16 frames per second. A small metal table on the side allows the user to compensate for a film different from that referred to in the centre row, and the shutter used on the camera.



Weston Model 627 Loupe Cine Meter (1933). A simple design of meter housed in bakelite with a chromed metal protection ring and crackle black finish swing-over protective cover.

It's not clear how much head scratching accompanied the camera operator's thoughts as they struggled to work out the weighting factor for their camera and film stock the first few times they used this table, and they had more calculations to do if they were shooting at a different framing rate. Still, this meter may have been reasonably successful since it makes the occasional appearance on auction sites even now, 85 years on.



Model 627 Reference Table. Two generic types of panchromatic film are represented here: Regular Pan and the faster Super Pan. The letters A and B refer to the two basic arrangements of the typical rotary shutter. The meter reading is referred to on the centre row and the compensation is read off vertically depending on which combination of film stock and shutter setting is in use.

In Pursuit of Weston Light Meters (continued)

In 1935 Weston introduced the **Photronic 650**. This was their classic Art Deco model that remains desirable and collectable to this day. Meter and dial are side by side and the needle pivot point is accentuated by the iconic fan motif molded into the bakelite.

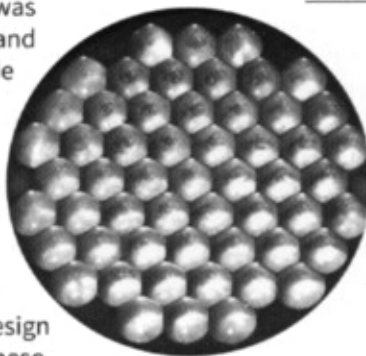
The Deco geometrical styling is strengthened by the cut-off corners, giving the meter a hard, octagonal aspect.

If this model didn't have the palm-in-the-hand ease of use of the model 617/2, there were many other design advances which more than compensated. Chief of these was the inclusion of a hexagonal glass lenticular array over the cell.

This regulated the cone of sensitivity as before, but crucially optimized the light gathering capability, making the meter more sensitive.

The multiple legends across five pointers have been replaced by one single pointer, the other positions being discreet pips along the dial edge.

A and C at the ½ normal and X2 normal represent the different scene parameters with U and O defining the under and over exposure points when zone exposure readings are made.

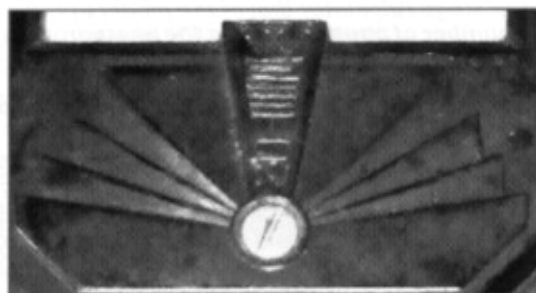


The Glass Hexagonal Lenticular Screen covering the Photronic Cell. Introduced on the Model 650 and subsequent models, this regulated the cone of sensitivity of the cell and optimized its light gathering capability, rendering the meter more sensitive.

Weston's accompanying instruction manual (*Weston Model 650 Universal Exposure Meter*. New Jersey: Weston Electrical Instruments Corp., 1936) goes into great detail explaining the zone system – how to establish the exposure by referencing the lightest and darkest parts of the subject.

Crucially it gives ratings for most proprietary film manufacturer's products of the time, valuable in an age where some may over-rate their emulsions to achieve sales.

For the first time Weston also used the term 'Universal' on the meters. The inclusion in the manual of effective shutter speeds for contemporaneous models of cine camera would also have been vital for confident use by cinematographers.



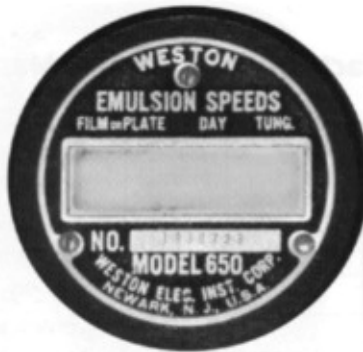
The Art Deco Fan Moulding on Models 650 and 819. Arranged about the meter needle pivot point, it displays the 'Weston' name.

As they had done with the model 627 cine meter, Weston produced a new meter for the film maker, based on the 650. The model 819 was, in physical terms, the same as the 650 with an identical bakelite shell and cell assembly. The meter scale however was marked up in a simple linear scale – Relative Brightness – in place of Candles / Square Feet. The dial worked differently as well.

Film speed and the framing rate for the camera were dialed in. The A or B setting for the shutter arc was also selected. The aperture number for use is then read off against the light reading.

This model was evidently of more utility with its comprehensive range of settings than the 627 Loupe with its limited and cryptic compensation table.

The Model 650 Universal (top two) and 819 Cine (bottom) Photronic Exposure Meters (1935/7). Variations in the dial pointer of the Model 650 are clear. The term 'Universal' appears for the first time on the centre roundel of the dial on the lower example.



The Masters

Since the turn of the century, photography had been growing as both a professional field and a general leisure pursuit. With the introduction of colour films, most notably Kodachrome from 1935 and Agfacolor print film from 1939, the need for accurate exposure metering for both the amateur and professional, grew exponentially. With Weston's pedigree in the field now well established, they were ideally placed to capitalize on this emerging market. The iconic Weston Master first appearing in 1939 was the right meter at the right time. In the post war period their success was such that they became ubiquitous in the photographic community worldwide. They were the benchmark by which all other meters were measured.

The original Master 715 Universal was surprisingly of substantial size and a little ungainly with a significant degree of separation between the dial and meter face. Although it replicates the vertical arrangement of the Model 617/2, it does not retain its compactness. Of very solid build, it appears more rugged than it actually is. The bakelite shell is surprisingly thin and easily cracked as a clumsy user may be unfortunate enough to find out.

Consistent throughout this large family, were a number of landmark innovations.

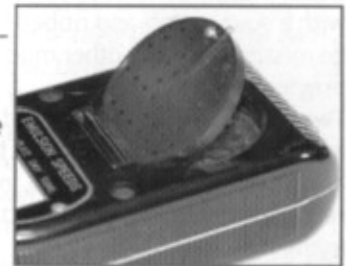
Three Variations of Back Plate Design on the Model 650. Ceramic and coated plates allow for note taking and some proprietary emulsion ratings are listed.

Although there was little immediate change to the calculator dial, the hinged baffle giving two ranges for the lenticular glass covered cell, combined with a roll-over change of the meter units, were significant.

The emergence of the Invercone, a white plastic unit that fitted over the cell and both integrated and attenuated the incoming light, was key.

With Kodachrome transparency film now available, this was necessary for accurately assessing the incident light – that falling onto the subject rather than being reflected from it.

The hinged baffle - a significant new feature of the model 715



The Two Models of Invercone for the Masters. Earlier model (left) introduced with the first model, 1939. Second model (above left) introduced with the model IV, 1960.



Weston Masters: First Model. (from left to right) Two American Universal 715's from 1939, the British Master Universal S74 from 1948/51 and an American Master Cine from 1939.

Note the two variants of the meter legend in the American Universals, the white meter face of the British model and the use of Relative Brightness units on the Cine model 720.

In Pursuit of Weston Light Meters (continued)

The dates and countries of manufacture of the Weston Master series

Weston Master Model	USA Manu.	UK Manu.	Japan Manu.
Universal 715 / S74*	1939	(1948)/51**	
Cine 720	1939	1951	
Leicameter 715	1941		
Universal II 735 / S141	1945	1952	
Cine II 736 / S141	1946	1954	
Universal III 737 / S141.3	1956	1956	
Cine III S217.3		1957	
Universal IV 745		1960	
Universal V 748		1963	
Universal 6 560***			1972
Euro-Master S461.6		1973	
Euro-Master II (Megatron Man.)****		1985	

Source Weston Chronology, compiled by: Lester A. Pfeffer, New Jersey, 1983. <http://www.westonmeter.org.uk/Chronology.html>.

* Model numbers prefixed by an 'S'; where they occur, refer to the British manufactured meter.

** The Chronology indicates a British post war date for the start of manufacture of the Master Universal model S74 at Sangamo as 1951. An Amateur Photographer issue of 1948 has an advertisement for what is clearly the British Sangamo model, 3 years earlier.

*** The Model 6 from Japan is a plastic cased meter of cheap fabrication made presumably under a temporary license for the name. Manufacturer unknown.

**** The Euro Master II does not use the Weston name and was manufactured by Megatron. After Sangamo ceased manufacture of Weston exposure meters, the tooling was transferred first to East Kilbride and then to Megatron who continued with this model.

As is clear from the table, the original Master Universal Model 715 / S74 was made first in America pre-war and additionally in Britain post-war. Of glossy finished bakelite with a squared-off and ribbed curved top aspect, it cannot be mistaken for any other model. (see illustrations on previous page)

Two variations of meter legend in the Newark model are evident and the orientation of the lettering of the word 'Light' and the meter figures, indicate that, when taking readings, the meter was expected to be held horizontally in the right hand.

The British model differs principally in having a white meter face and altered legend. The Cine version – the Model 720 – is physically the same, but the scale is marked up in the simpler 'Relative Brightness' units and the calculator dial works in the same manner as described for the earlier model 819.

The Master II model 735 / S141 was a significant advance on the original. It was smaller, thinner and lighter with a rounded off shape for greater comfort of use in the hand. The reduction in size must have been achieved through a complete redesign of the internal components. There is little change in the meter face and dial design but most importantly, this model is made out of metal and is subsequently more rugged. As well as a glossy black finish, the American model was also available in dark grey. While this model was in widespread use in America from 1945, it is sobering to realize that it would be at least another 3 years before Britons would have access to even the first model S74. It would be 1952 before the Master II Universal was manufactured in Britain and '54 for the Cine Model (also designated S141).

Master II



Master II's: Left to right: British Model S141 from 1952, American Model 735 from 1945 (matt grey finish variant) and the American Cine Model 736 from 1946. (Cine model also made in Britain as S141).



Master III

The Master III Model 737 / S141.3 (1956) differed little in shape or styling from the Model II. The Newark factory modernized it in 2 respects: The casing was now of striking silvery brushed steel, and the Weston Master heading on the meter was in a modern sans-serif type face. The Sangamo model retained the script face and gloss black finish. Some subtle additions were made to the decal of the dial. The major changes are not immediately apparent at a glance. On the calculator dial the film speed ratings are now in A.S.A (American Standards Association) and support is added for the newly introduced EV (Exposure Value) Scale. An interesting red dial variant was also made in Britain. The Model S217.3 Cine model was made in only in Britain and, for some reason, still used the Weston film speed ratings units.

Master III's: American model 737 (left) in striking brushed steel casing, red dial British variant S141.3 (centre) and the Cine model S217.3 (right) made only in Britain.

Masters IV, V and the Euro-Master

Subsequent models, the IV, V and Euro-Master, are much more modern in design, at last leaving the legacy of the pre-war Art Deco movement far behind. Squared off at the top like the original Master, they are more compact even than the II and III with the meter closer to, and following the line of the calculator dial. A substantial and robust lower bakelite casing is topped by a distinctive aluminum shell. And the changes don't stop there. The master IV Model 745 (1960), though British made, carries an American model number. The meter face is in black and this model is clearly styled for export back to America. The concentric arrangement of the calculator dial is now reversed with an inward facing pointer and



Masters IV, V and the Euro-Master. The Black meter faced model IV 745 (left) dispensed with intermediate exposure markings. They were restored on the long running model V 748 (centre) but dispensed with yet again on the Euro-Master S461.6 (right)

In Pursuit of Weston Light Meters (continued)

Masters IV, V and the Euro-Master (continued)

the f numbers on the outer ring. Meter readings are on the inside ring and shutter speeds are read off against the f numbers on a middle ring. The dial is simplified by removing the intermediate 1/3rd stop markings for shutter speeds and apertures. A long overdue meter needle lock button has now been added, making the meter easier to use when reversed with an invercone.

The Master V model 748 (1963) continues with these changes but replaces the black bakelite chassis with a grey one. The interim exposure value markings have been restored making the dial look busier than on the model IV. Core reference values for apertures and shutter speeds are marked up in black or red, making this meter quite intuitive to use. The firm black needle lock has been replaced by a smaller fiddly arrangement on the right. The inward facing pointer is now a solid red triangle. The candles / square foot scale has now been replaced by a simpler linear light value scale peaking at a value of 16, which is directly compatible with the Candles / Square feet scale, but not the same as the Relative Brightness scales of the former Cine meters. With ten years spanning the time from this meter's introduction to that of the Euro-Master, this meter may have had the longest production run of any Master.

The Euro-Master Model S461.6 of 1973 is very similar to the model V but returns to black bakelite of the model IV and again removes the intermediate exposure value legends so as to simplify the dial. With less red on the dial and a more sophisticated axial retainer, this was the last exposure meter made by Weston.

By the mid seventies the market for Selenium Cell exposure meters had diminished. Cadmium Sulphide CdS

meters were preferred for their much greater sensitivity to low light, and the small photo resistive cell was ideal for use inside cameras, especially the Through The Lens (TTL) Metering systems of Single Lens Reflex (SLR) cameras. The amateur, at least, no longer had to rely on a separate meter.

Master 6 and the Euro-Master II

Though not a true Weston, Megatron continued to produce the Euro-Master II quite successfully in Britain, applying their expertise in a re-engineered meter needle mechanism. Under a temporary license, from somewhere out of Japan, a Master 6 appeared. Although quite a serviceable meter, this model was housed in a cheap plastic casing and, because of that build quality, is considered by many purists as an illegitimate member of the Master family.

Weston in America did produce one model of CdS meter – the unique Ranger 9 of 1966. This amazing meter is still out there today in significant numbers, so it was probably quite successful, but then that's another story.

John's Weston Meter website is at:
<https://www.westonmeters.info>



The Euro-Master II was not an actual Weston, but made by Megatron. The name Weston does not appear on it.



The plastic bodied Master 6 560 from Japan returned to Candles / Square Foot unit markings, had a sliding rather than hinged range baffle, and its own design of invercone.

Further Reading

The Photronic Photoelectric Cell (Newark, New Jersey: Weston Electrical Instrument Corp., 1935)
Using Your Weston (Newark, New Jersey: Weston Electrical Instrument Corp., 1943)