CALUMET
PHOTOGRAPHIC

User Manual

for the

Solid-State Shutter Tester

The solid-state camera shutter tester is a convenient and easy to use test instrument. However, there are several precautions which should be taken to insure that it gives a long and reliable service life.

> Do not use any static eliminating devices on the shutter tester. The shutter tester contains an integrated circuit of the CMOS type and this might be damaged by using high voltage static eliminators (even though the current is extremely low). If the case of the shutter tester attracts dust, use a slightly damp cloth or paper towel to clean it.
>
> Do not allow the same battery to remain in the tester perpetually. If the batteries in cameras, light meters and shutter testers are changed on the owner's birthday there is always a good battery in these devices.

NOTE: While it is certainly possible to test camera shutters outside, it is not recommended. Testing shutters is something that should be done the evening before taking pictures. There are too many other things to think about when taking pictures to worry about a shutter. If a shutter worked correctly the evening before, it will almost always work correctly the next day when it is needed. There is also much more dirt and dust to get into a camera if it is opened for testing outside.

DIRECTIONS

1) Turn the tester on. The on-off switch is on the right side of the tester.

2) Set up a light bulb. Use a bare bulb without a reflector. A 100 watt soft white bulb usually works fine. A PH/211 or PH/212 enlarging bulb is ideal.

3) Open the shutter and the aperture.

There are different directions for different types of shutters. Directions for each type of shutter will be presented in turn.

FOCAL PLANE SHUTTERS WITHOUT A LENS ATTACHED TO CAMERA

When the shutter tester is brought towards the light bulb, **d** is the distance from the probe of the tester and the light bulb, such that the tester just starts to run.

The compound distance: [.71 x **d**] is the separation between the probe of the shutter tester and the light bulb to be used in testing focal plane shutters without a lens attached to the camera.

4F) Point the probe of the shutter tester directly at the light bulb.

5F) Bring the shutter tester towards the light bulb until the shutter tester just starts to run.

6F) Measure the distance between the probe and the light bulb.

7F) Multiply this measured distance by .71.

8F) Perform the shutter testing with the light bulb and the probe of the shutter tester this computed distance apart.

9F) Set the shutter to the setting to be tested. Cock the shutter and fire. The shutter tester automatically resets itself at the beginning of the exposure and displays the time the shutter was open in seconds.

Example: It is found that the shutter tester will just start to run with the probe of the shutter tester 32 inches away from a light bulb. 32 inches x .71 = 23 inches. The testing should be done with the probe of the shutter tester 23 inches form the light bulb. (The camera will be right next to the probe of the shutter tester. Hence, the camera will be slightly less than 23 inches away form the light bulb).

SINGLE LENS REFLEX LEAF SHUTTERS

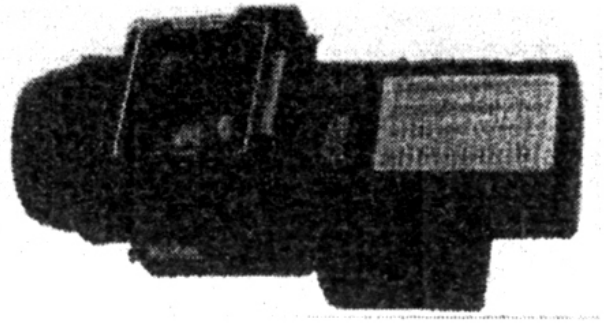
4L-SLR) Set the camera with the lens mounted on it facing the light bulb. The bulb should be about a foot away.

5L-SLR) Place the probe of the shutter tester in the image of the light bulb at the film plane.

6L-SLR) Close the aperture. Then open the aperture until the tester just starts to run. This should be at least 2 stops smaller than the maximum aperture. If it is not, use a

For the purpose of illustration only, a piece of ground glass was placed at the film plane of this camera to display the image of the light bulb. This ground glass is not used or required for testing. Focal plane shuttered cameras (e.g. as above) are normally tested without a lens attached to them. Directions for testing these cameras with a lens attached are given on pages 9 and 10.

higher wattage bulb. Open the aperture to its maximum. **Leaf shutters should always be tested at maximum aperture.**



7L-SLR) Set the shutter to the setting to be tested. Cock the shutter and fire. The shutter tester automatically resets itself at the beginning of the exposure and displays the time the shutter was open in seconds.

LEAF SHUTTERS FOR NON-SINGLE LENS REFLEX CAMERAS

4L) Place the probe of the shutter tester at the center of the front or rear lens element.

5L) Set the light bulb about a foot directly above the lens. The photoswitch in the probe is only sensitive to oncoming light and must be pointed directly towards the light source (this helps to reduce false signals caused by stray light).

6L) Set the shutter to the setting to be tested. Cock the shutter and fire. The shutter tester automatically resets itself at the beginning of the exposure and displays the time the shutter was open in seconds.

Example: If the shutter was tested at 1/8 of a second and the shutter tester displayed 0.17216 (see table), this is about equivalent to 1/8 of a second plus 1/2 f-stop. To compensate for the shutter error set the camera to 1/8 of a second and close the aperture down 1/2 f-stop.

The table on the next page converts common shutter speeds to their decimal equivalents.

The table on the back cover and the one attached to the face of the shutter tester are based on the geometric progression 1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, ... instead of the usual 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, ...While this latter series is commonly used on shutter speed dials it is just an approximation to the first series. It is preferred over the first series solely for aesthetic reasons! Since the light meter presumes exactly on f-stop jumps between shutter speeds, the table does also. This eliminates up to 6% of needless error. Both the table on the back cover and the table attached to the face of the shutter tester have actual speeds labeled by their nominal values. For example, 1/16 sec. = 0.0625 sec. is listed as 1/15 sec. 6250. Use this latter table exclusively on those shutters having this sequence of shutter speed values.

NOTATION

The leading zeros are omitted on the tables and on the display of the shutter tester. This makes the numbers easier to read without error. For the purpose of clarity all the zeros are listed in the examples given in this manual.

When doing a complete shutter test start at one end of the scale and work through 3 times. For instance, test at 1, 1/2, ..., 1/1000; 1/1000, ..., 1; 1, ..., 1/1000. Shutter speeds may be out of adjustment, but they should be consistent to within 15%.

Example: Testing 1/125 of a second might yield 0.01104, 0.01056, and 0.01089. These are all about 1/2 stop too slow, but they are all within 5% of each other. The shutter is out of adjustment, but there is no indication of malfunction.

NOTES:

When the display freezes, this indicates that the battery is worn out. The accuracy of the device is affected when the voltage of the battery is lower than that required by the voltage regulator. To prevent erroneous readings from being made the display will freeze until a fresh battery is placed in the shutter tester. Batteries can be replaced by removing the four screws in the bottom of the case.

Each time the on-off switch of the shutter tester is turned on, the LCDs may display symbols which are neither numbers nor letters. These symbols will no longer appear (until the shutter tester is turned off and then turned on again) once the probe of the shutter tester is exposed to light and the display is automatically reset.

The shutter tester's probe is placed slightly off center. This permits testing most 35mm cameras with the probe placed at the center of the film plane and the shutter tester flush with the film guides. On some cameras placing the tester's probe at the center of the film plane may require placing the shutter tester upside down.

FOCAL PLANE SHUTTER BOUNCE

The automatic reset feature allows shutter bounce to be indicated without the need for additional probes or circuitry. For definiteness it will be assumed that the shutter curtains travel horizontally from left to right. Test the shutter at the left edge, the center and the right edge (all at one shutter speed). If the left edge time and the center time are about the same, but the right edge time is much smaller, there is an indication of shutter bounce. The tester gives the exposure time at the left edge and the center, but if the curtain bounces, the tester resets itself at the beginning of the bounce exposure. Shutter curtain bounce is unusual and is normally not of concern.

Example: While testing at 1/125 of a second the left edge time is 0.01104, the center time is 0.01045 and the right edge time is 0.00097. These times indicate shutter bounce.

Shutter Speed	Decimal Equivalent	plus/minus 1/6 stop	plus/minus 1/3 stop	plus/minus 1/2 stop
4 seconds	4.00000	4.48985	5.03968	5.65685
		3.56359	3.17480	2.82843
2 seconds	2.00000	2.24492	2.51984	2.82843
		1.78180	1.58740	1.41421
1 second	1.00000	1.12246	1.25992	1.41421
		.89090	.79370	.70711
1/2 sec.	.50000	.56123	.62996	.70711
		.44545	.39685	.35355
1/4 sec.	.25000	.28062	.31498	.35355
		.22272	.19843	.17678
1/5 sec.	.20000	.22449	.25198	.28284
		.17818	.15874	.14142
1/8 sec.	.12500	.14031	.15749	.17678
		.11136	9921	8839
1/10 sec.	.10000	.11225	.12599	.14142
		8909	7937	7071
1/15 sec.	.06667	7483	8399	9428
		5939	5291	4714
1/25 sec.	.04000	4490	5040	5657
		3564	3175	2828
1/30 sec.	.03333	3742	4200	4714
		2970	2646	2357
1/50 sec.	.02000	2245	2520	2828
		1782	1587	1414
1/60 sec.	.01667	1871	2100	2357
		1485	1323	1179
1/100 sec.	.01000	1122	1260	1414
		891	794	707
1/125 sec.	800	898	1008	1131
		713	635	566
1/200 sec.	.00500	561	630	707
		445	397	354
1/250 sec.	400	449	504	566
		356	317	283
1/400 sec.	.00250	281	315	354
		223	198	177
1/500 sec.	200	224	252	283
		178	159	141
1/1000 sec.	100	112	126	141
		89	79	71
1/2000 sec.	50	56	63	71
		45	40	35
1/4000 sec.	25	28	31	35
		22	20	18
1/8000 sec.	13	14	16	18
		11	10	9

(The curtains are still presumed to travel from left to right in this example.)

Curtain travel direction may be determined by examining the shutter curtains (or blades) while cocking the shutter. The shutter curtains will move in the opposite direction when the shutter is released. For example, if the curtains move from right to left while cocking the shutter (horizontal motion), the curtains will travel from left to right when the shutter is released.

UNEVEN FOCAL PLANE CURTAIN TRAVEL

If the exposure times increase or decrease significantly across the path that the curtains travel, the curtains are traveling at different rates across the film plane.

Example: Testing at 1/1000 of a second gives the left edge time as 0.00126, the center time as 0.00092 and the right edge time as 0.00061. This indicates that the second curtain is catching the first curtain during the exposure. The left side receives over one f-stop more exposure than the right side. In this case the center exposure is almost perfect, but the shutter is not very useful for taking pictures!

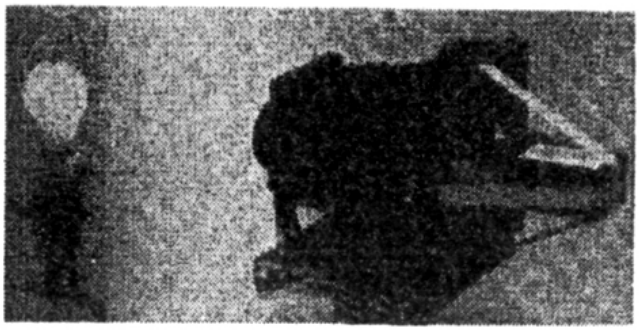
NOTE: If a shutter has uneven curtain travel, usually only the highest speeds show exposure problems because of it. The difference in shutter curtain transit times is inconsequential at the slower shutter speeds.

SHUTTER EFFICIENCY

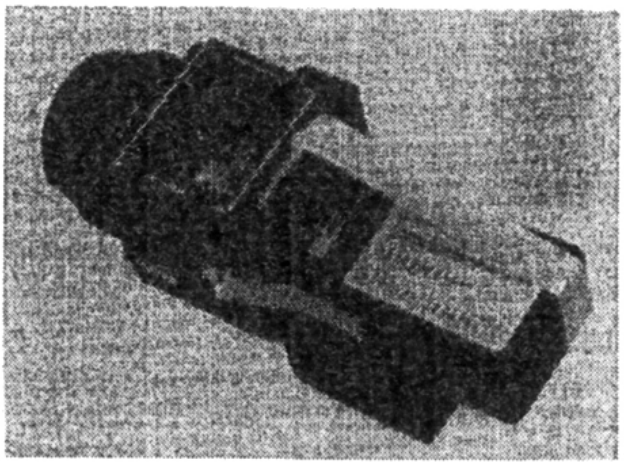
When testing a leaf shutter as previously directed, the measurement obtained is the entire time the shutter was open, including the time when it was partially open. On most #0 and #1 leaf shutters it takes roughly one millisecond (0.001 seconds) for the shutter blades to travel from fully closed to fully open and roughly one millisecond to do the reverse. These transit times are usually independent of the shutter speed selected. (Transit times may be slightly shorter at the fastest one or two shutter speeds). The shutter manufacturer designs leaf shutters to be FULLY open for the nominal time specified on the shutter. Hence a typical #0 shutter may give 0.00400 seconds (0.004=1/250) when tested at 1/500 of a second, but give 0.00200 seconds (0.002=1/500) when tested for effective shutter speed at the maximum aperture. This shutter is not in need of adjustment; it is working perfectly! When a lens is used with the aperture wide open and the shutter speed set to 1/500 of a second, the effective shutter speed is essentially the time the shutter blades are completely open. For this lens this is 1/500 of a second. When a lens is used with the aperture stopped down at least several stops and the shutter set to 1/500 of a second, the effective shutter speed is the entire time the shutter blades are open, including when they are partially open. For this shutter this is 1/250 of a second, the same as that measured by the shutter timer when used in the usual way.

When leaf shutters are used at the slower speeds, the aperture selected does not significantly affect the effective shutter speeds. The shutter efficiency at the slower speeds is usually near 100%.

Testing leaf shutters for effective shutter speed is done with an incandescent light bulb connected to a light dimmer. The light, shutter and the probe must remain in a fixed position throughout the testing procedure. This may be effected by mounting the shutter on a camera (the lens elements must remain in the shutter for this test), adjusting the light that its image is in the center of the film area and then taping the probe to the center of the film area. With the shutter open and the aperture closed 1/3 f-stop from open, adjust the dimmer until the tester just starts to run. Then open the aperture and test the shutter with the light adjusted to this intensity. This will give the effective shutter speed at the maximum aperture. To perform the next test, open the shutter and close the aperture 1⅓ f-stops from open. Adjust the dimmer until the tester just starts to run. Open the aperture and test with the light at this intensity. This will give the effective shutter speed at 1 f-stop less than the maximum aperture. Other aperture positions may be tested in a similar manner. However, usually only the first one or two f-stops from the maximum aperture differ significantly from the shutter speed at small apertures. (The procedure given on pages 2 and 3 of these instructions measures the effective shutter speed at small apertures). Also, when testing shutter efficiency it is usually only necessary to test the shutter at the fastest 3 shutter speeds. At slower speeds the efficiency is usually high enough not to be of concern.



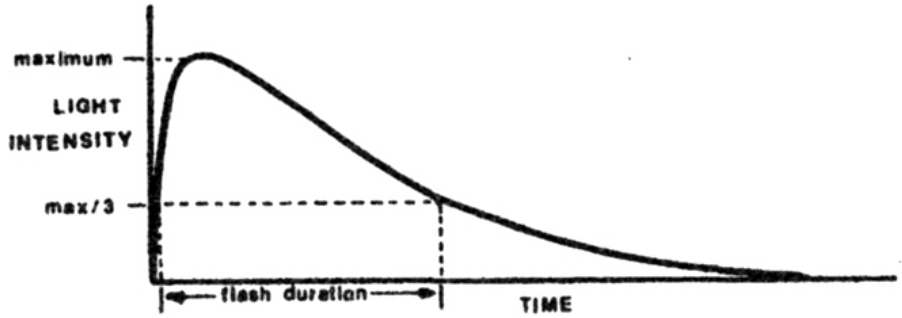
This camera back is just a piece of cardboard with a hole in the center.



Example: Testing a #1 leaf shutter set to 1/400 of a second yields 0.00466 seconds when tested as specified on pages 2 and 3 of these instructions, and 0.00254 seconds when tested as above for effective shutter speed at the maximum aperture. The 1/400 of a second setting is well within 1/6 f-stop from its nominal value when used at maximum aperture, but is about .9 f-stops slow when used at small apertures. NOTE: 1/400 of a second =0.00250. The shutter error in f-stops is equal to log {.00466/.00250}/log {(2} =.9.

ELECTRONIC FLASH DURATION MEASUREMENTS

Normally the term **flash duration** is defined as the length of time between the one-third of maximum light intensity points on the flash unit's light emission curve. The length of time that the flash unit is emitting light is much longer.



Since the intensity of the light from a flash unit normally decreases by approximately the square of the distance from the unit, measuring the duration of an electronic flash with a model B shutter timer may be performed as follows:

1) Point the flash unit directly at the probe of the shutter tester.

2) Turn the shutter tester off for several seconds and then turn it back on. On most testers this will change the display to something outside of the interval from 0.00001 to 0.00300. (most flash units have a duration within this range). It does not matter what is showing on the display as long as a change caused by discharging the flash can be detected. See step 4.

3) Discharge the flash unit.

4) If the discharge changes the display, move the probe farther away from the flash unit. If the discharge does not change the display, move the probe closer to the flash unit.

5) Repeat steps 1, 2, 3 and 4 until the probe is in such a position that if it is any closer to the flash, the display will be changed, and if it is any farther away, the display will not be changed when the flash is discharged.

6) Measure the distance between the probe and the flash unit. Multiply this distance by .58 (.58 is used because .58 x .58 = 1/3). Place the probe this computed distance from the flash unit.

7) Discharge the flash unit again. The resulting time shown on the display of the shutter timer is the measured duration of the flash unit.

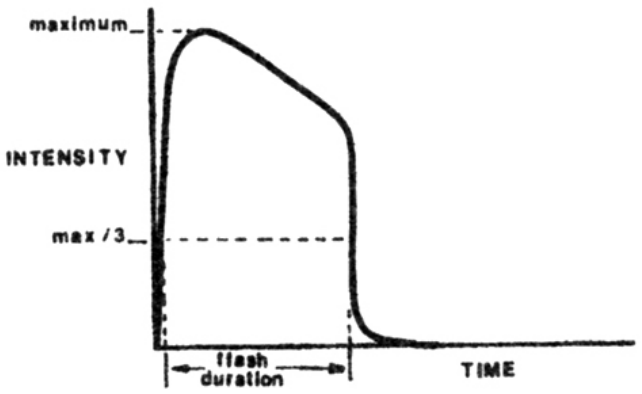
Example: Testing a flash unit required placing the probe 37 feet from the flash unit.

At 35 feet the display was changed by discharging the flash unit and at 39 feet the display was not changed by discharging the flash.

When the probe was placed at 21 feet (37 feet x .58 = 21 feet) and the flash was discharged, the display read 0.00112. This time interval (just about 1/1000 of a second) is what is normally called the **flash duration**.

HINTS: It may be helpful to tape several layers of paper, paper toweling or cloth over the flash to reduce the intensity of the output. Otherwise it may be necessary to perform the testing outside (in the evening or at night), as the distances involved with all but the smallest flash units preclude testing inside. An alternative is to tape several layers of paper or cloth over the probe of the shutter tester (5 to 20 layers of white paper works well for many flash units). This latter method has the advantage of reducing the effective sensitivity of the shutter tester and hence making it insensitive to room lights.

NOTE: The flash discharge graph previously shown is applicable only for flash units which are used in a manual mode. When flash units having thyristor circuitry are discharged with the thyristor controlling the length of the flash (permitting faster recycling times), the flash discharge curve has a different shape. However, flash duration can still be measured by the procedure just given. Make sure that in steps 4 and 7 the flash unit remains fixed and the probe is moved. The probe of the shutter tester must have sufficient paper or cloth taped over it to allow it to be used in the space in which the automatic flash is being tested. Moving the flash unit in an enclosed area affects the length of automatic flash. Also, a person should not hold the probe during the testing of a flash used in the automatic mode; a person is large enough to reflect significant amounts of light and this reflected light affects the length of automatic flash. Testing with a person holding the probe would change the duration of the flash each time the person changed position. The probe should be taped to a light stand or a similar small device and be placed in line with the output of the flash unit.



TESTING FOCAL PLANE SHUTTERS WITH A LENS ATTACHED TO THE CAMERA

Focal plane shutters can be tested with a lens attached to the camera.

1) Set up an incandescent light bulb or point the camera towards a uniformly bright area (florescent bulbs may <u>not</u> be used).

2) Place the camera with the lens attached pointed directly towards the bright area or towards the light bulb. When using a light bulb, place the camera about a foot away from the light bulb.

3) Place the probe of the shutter in the middle of the image of the light bulb at the film plane when using an incandescent light bulb (see the illustration on page 2). otherwise place the probe in the middle of the image of the bright area.

4) Open the camera shutter. Close the lens aperture. Open the aperture until the shutter tester just starts running and then open the aperture 1 more f-stop. Test the camera with the aperture in this configuration.

5) Set the shutter to the setting to be tested. Cock the shutter and fire. The shutter tester automatically resets itself at the beginning of the exposure and displays the time the shutter was open in seconds.

WARNING: When using this procedure it is very important that the probe of the shutter tester remain in the same position at the image of the light bulb during testing. Without taping the shutter tester to the camera with the camera mounted on a tripod, it is difficult to do this. For this reason this procedure is not recommended except where necessary.

EXPOSURE ERRORS OTHER THAN SHUTTER SPEEDS

Other sources of exposure error are light meters and aperture rings. Many light meters are precise near the middle of their range, but they are in error at both extremes. A common situation is for the meter to indicate towards overexposure at the high end of the scale and towards underexposure at the low end. Aperture scales are usually very close when the aperture is wide open or within a few stops of open. However, many aperture scales are in error by a full stop at the smaller settings (f/22 on 35mm camera lenses to f/64 on view camera shutters).

PROBLEMS

Simply placing a light bulb near the shutter, putting the probe near the film plane and testing away usually yields very accurate results at all but the 3 fastest shutter speeds. Careful testing is the only way to get precise results at the higher speeds. This is especially true of focal plane shutters.

If the testing light source and the probe are not aligned with each other, erratic testing may result.

The focus position of the lens is not critical, but it should remain fixed during the testing procedure.

FORMULAE

Fractional shutter speeds: To find the fractional speed from the result measured on the shutter tester, divide 1 by the measured value.

Example: 0.16695 seconds is measured. This is equal to 1/6 of a second since 1/.16695 = 6. In a different test 0.00442 seconds is measured. This is equal to 1/226 of a second since 1/.00442 =226.

Difference if f-stops: To find the f-stop difference between two times, take the log of their quotient and divide by the log of 2. For example: compare a measured time of 0.10126 seconds to 1/8 of a second. 1/8= .125 so the difference in f-stops is log (.10126/.125)/log (2) = -.3 f-stops. .10126 seconds is .3 f-stops faster (or less light, hence the minus sign) than 1/8 of a second. Likewise, compare 0.29618 seconds to 1/4 of a second. 1/4 = .25. The difference in f-stops is log(.29618/.25)/log(2) = .24 f-stops. So, 0.29618 seconds is .24 f-stops slower (or more light) than 1/4 of a second.

GUARANTEE

The solid-state shutter tester is guaranteed for 6 months from receipt of the shutter tester. During this time a defective product will be repaired or replaced without charge. After 6 months there will be a charge for repair work.

No other guarantee or warranty is implied or expressed. In particular Calumet Photographic will not be responsible for any consequential damage.

Questions concerning difficulties in using the shutter tester or in understanding the instructions should be sent to:

Calumet Photographic Inc.
890 Supreme Drive
Bensenville, IL 60106

Defective or broken shutter testers should be sent postpaid to:

Calumet Photographic Inc.
890 Supreme Drive
Bensenville, IL 60106

An estimate for any non-warranty repair work will be returned to the sender before any non-warranty repair work is performed.

Shutter Speed	Zero Error	plus/minus 1/6 stop	plus/minus 1/3 stop	plus/minus 1/2 stop
4 seconds	4.00000	4.48985	5.03968	5.65685
		3.56359	3.17480	2.82843
2 seconds	2.00000	2.24492	2.51984	2.82843
		1.78180	1.58740	1.41421
1 second	1.00000	1.12246	1.25992	1.41421
		.89090	.79370	.70711
1/2 sec.	.50000	.56123	.62996	.70711
		.44545	.39685	.35355
1/4 sec.	.25000	.28062	.31498	.35355
		.22272	.19843	.17678
1/8 sec.	.12500	.14031	.15749	.17678
		.11136	9921	8839
1/15 sec.	6250	7015	7875	8839
		5568	4961	4419
1/30 sec.	3125	3508	3937	4419
		2784	2480	2210
1/60 sec.	1563	1754	1969	2210
		1392	1240	1105
1/125 sec.	781	877	984	1105
		696	620	552
1/250 sec.	391	438	492	552
		348	310	276
1/500 sec.	195	219	246	276
		174	155	138
1/1000 sec.	98	110	123	138
		87	78	69
1/2000 sec.	49	55	62	69
		44	39	35
1/4000 sec.	24	27	31	35
		22	19	17
1/8000 sec.	12	14	15	17
		11	10	9