

The Putora Sharpness Indicator Instructions

About the Sharpness Indicator.

Description

The Sharpness Indicator is the most advanced and accurate test chart available. Any photographer will be able to accurately evaluate the sharpness and resolution of all types of motion picture, video, and still camera.

The Sharpness Indicator is made up of test-targets with concentric circles printed on a Reference Field Level background. The background has the same reflectance as the average reflectance of the targets. This means that when a target appears to blend with the background then, it indicates that that target is beyond the sharpness of the system being tested.

The concentric circles that make up each of the test targets on the Sharpness Indicator are calibrated in the degree of sharpness (DS) and represent the following graduated pairs of lines per millimeter:

Target	Lines per mm*
DS 1	10
DS 2	13.3
DS 3	18
DS 4	23.5
DS 5	31.3
DS 6	42
DS 7	55.5
DS 8 (on Sharpness Indicator type 7A9 only)	73.6
DS 9 (on Sharpness Indicator type 7A9 only)	97

* The information in this table is valid when the distance between the film plane and the Sharpness Indicator is measured using "60 times" formula. (Exactly it should be 60+1.) The "60 times" formula is explained under the section titled "Evaluate the degree of sharpness using negative film.."

The value of all the targets may be shifted one step up by multiplying the recommended distance by 1.33 and DS 1 changes to DS 2, and so on. For two steps up, multiply by 1.77. If the distance is doubled, multiply the number of lines per millimeter by 2.

Evaluate the degree of sharpness using negative film.

Comment

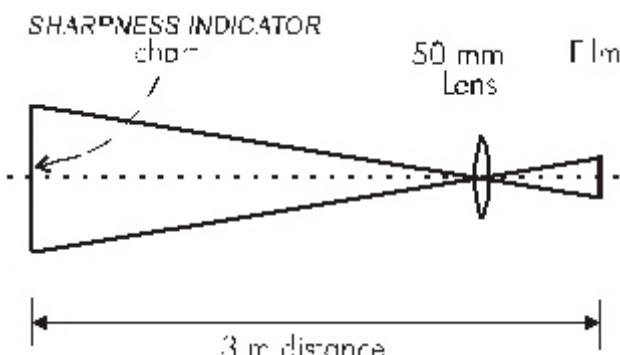
For examining lenses, use high quality, black and white or 50 ASA high resolution color film, and standard development techniques. For verifying camera and film before shooting, use the film you will use. Over-development or over-exposure will decrease the sharpness and resolution.

Because the lens aperture may influence the result, we recommend that you conduct two tests: one at $f/2$ and one at $f/5.6$. (You can also use any aperture of your choice.)

Procedure

Use the “60 times”* formula in the steps below to place the Sharpness Indicator the proper distance from any type of still, motion picture, or video camera:

* Correctly it is $60 + 1$.

Step	Action
1	<p>Place the Sharpness Indicator at a distance from the image plane 60 times the focal length of the lens to be tested (in either millimeters or inches). Example: For a 50mm lens: $60 \times 50 = 3000\text{mm} = 300\text{cm} = 3 \text{ meters}$ or for a 2” lens ... $60 \times 2" = 120" = 10 \text{ ft.}$</p> <p>*The “60” times formula was chosen for convenience of calculating. The more accurate multiplier is 62, assuming a simple lens. Since the front and back principal plan of a lens compound can vary by the lens construction, as well the back focus, it is not simply to set an accurate universal number. Also, the actual focal length may slightly be different from what is written on the lens. The best way is to use a Background for Sharpness Indicator which has arrows to match camera aperture. Five or more Sharpness Indicator charts can be placed on, to check key zones on the film.</p>
2	<p>Always place Sharpness Indicator parallel to the image plane!</p>  <p>The diagram illustrates the setup for testing lens sharpness. On the left is a 'SHARPNESS INDICATOR chart'. In the center is a '50 mm Lens'. On the right is 'Film'. A horizontal dashed line represents the optical axis. A double-headed arrow below the axis indicates a '3 m distance' between the chart and the film.</p>
3	<p>Light the Sharpness Indicator from one or both sides. Important: Never use frontal light or light from a camera flash.</p>
4	<p>Measure the light from the grey background and targets. **</p>
5	<p>Focus as sharply as possible on the chart.</p>

6	Snap the picture and develop the negative.
7	Examine the negative with the naked eye and determine the degree of sharpness according to the information below.

The reflectance of the Sharpness Indicator is about 43%. Working with a spot meter, use this value for exposure of the Sharpness Indicator (not 18% grey) and you may chose to open the lens ½ stop. Be sure you do exposure and develop the film every time the same way.

Generally, the grey on the Sharpness Indicator is reliable and can be also used as a substitute for the 18% grey - just open lens 1 and 1/3 stop. Note: The standard for exposure of S.I. was not yet set as a rule. Experiment samples have shown, that the result of sharpness was better if exposure setting was taken from S.I. grey than standard 18%. If the sharpness is in your concern make your decision accordingly.

Analyze the negative

You will see that the targets on the negative image of the Sharpness Indicator have different densities:

- Targets that appear lighter than the background are proof of sharp lines. The other targets appear to merge into the background.
- The highest numbered DS target that is still lighter than the background indicates the degree of sharpness of the lens/film combination.
- If the last visible target on the negative image of the Sharpness Indicator is weak while the one before it is clearly visible, the last one can counted as ½ of a DS unit.

Degree of Sharpness (DS) is a function of the clarity between the lines.

Interpret what you see

Use the following table to interpret the degree of sharpness:
(Guide only.)

If target appear lighter than the background...	The degree of sharpness is...
DS 8 or 9 <small>(On Sharpness Indicator type 7A9 only)</small>	excellent
DS 6 or 7	excellent
DS 5	very good (a standard camera)
DS 4	good to acceptable
DS 3 or less	poor

Analyze the resolving power To determine the resolving power of the lens/film:
 Enlarge the negative or use a magnifying device.

Resolving Power is a function of the number of lines seen.

Evaluate the degree of sharpness from prints

Comment We recommend, shoot a sharpness test for each f: stop.

1. The sharpness of the lens is usually best around f/5.6.
2. At f/8 to f/11 and above, the depth of field and contrast will increase, but the sharpness may decrease. This can be more significant with larger formats (6x6cm, IMAX), although higher contrasts may contribute to the subjective perception of better sharpness.

Procedure Follow each of the procedural steps under “Evaluate the degree of sharpness using negative film” then ...

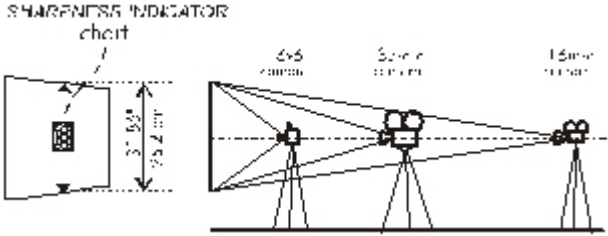
Make a print and analyze the image of the Sharpness Indicator in the print using the table below:

If you see that ...	Then ...
The <i>background</i> (grey) in the print has the same density as the <i>background</i> of the Sharpness Indicator itself ...	The print is made properly.
The target blend with the <i>background</i> on the Sharpness Indicator...	The target failed to resolve on the negative.
Targets 1, 2, and 3 have sharp, clearly visible lines ...	The print is made properly.
Targets 4, 5, 6, 7 (and 8 or 9 on type 7A9) appear darker than the background ...	The print is made properly and those frequencies represented by the targets were resolved on the negative.

Evaluate sharpness as a function of format.

Comment Compare the performance of other formats to the standard 35mm (cinematography) Academy format. The name for this function is “DS-35 compared”.
(Degree of Sharpness - “DS” or “DS-35 compared” for 35mm Academy format is the same value.)

Procedure Follow these steps to compare the gain or loss of sharpness from format to format:

Step	Action
1	On a large piece of grey paper, or on a wall meant to display the Sharpness Indicator draw a vertical line 96.2cm (37.86") long.
2	At the top and bottom of this line make clear horizontal marks (template is included with this package).
3	Place the Sharpness Indicator in the center of the vertical line. The chart and the film plane should be parallel. 
4	Line up the marks with the top and bottom of the frame as seen through the viewfinder, by adjusting the distance of the camera from the Sharpness Indicator.
5	Shoot and process the film.
6	Repeat from step 4 with the formats you wish to compare. Note: 16mm will have a lower <i>DS-35 compared</i> to 35mm Academy format. IMAX will have the highest <i>DS-35 compared</i> .

Note: Some professional studios, renting and servicing companies, may have available BACKGROUND FOR SHARPNESS INDICATOR CHARTS with marks for 35 mm and 16 mm cinematography formats. This will speed your work.

Evaluate The degree of sharpness with video cameras.

Comment The Sharpness Indicator is extremely sensitive to minute focus changes.

Procedure Follow these steps to determine the degree of sharpness with video cameras:

Step	Action
1	Use the “60 times” formula to place the Sharpness Indicator test chart the correct distance from the camera. (Follow procedural steps 1 through 4 under “Evaluate the degree of sharpness using negative film.”)
2	Look through the viewfinder and focus the video camera.
3	Analyze the degree of sharpness according to the information below.

Analyze what you see Video imaging is based on horizontal lines which make the lines in the target appear wavy. Therefore ...

When a target is sharply in focus, its concentric circles create crossing wave patterns that stand out clearly from the background of the Sharpness Indicator. The other targets will disappear into the background.

Evaluate The degree of sharpness on a monitor.

Comment Sharpness can be evaluated on a monitor. A special sized chart is available to evaluate TV 2/3 cameras for direct reading in DS or for comparing the performance of other formats to TV 2/3. No distance calculation is necessary. Just fit framing from arrow to arrow. Note.: The chart is also equipped with grey scale for video camera setup and line frequency scale (MC=multi cycle).

Procedure Observe the image on the monitor and evaluate the degree of sharpness according to the table below:

When ...	Then ...
The wave pattern of a target or full circles are visible	both the camera and the monitor resolve this target
a target appears darker than the background but without lines * * not all targets will appear in full circles; higher DS values will appear as a “butterflies”. The higher angle, the better.	it is evidence that the camera resolves the lines but the monitor does not.

Adjust the front and back focus of video zoom lenses.

Procedure The Sharpness Indicator makes adjusting the front and back focus of video zoom lenses extremely easy and precise.

Follow these steps:

Step	Action
1	At wide -angle, place the Sharpness Indicator in front of the camera so the DS 1 target can be seen. Use the fanned lines in the upper left hand corner of the chart if the DS 1 target is too small to see. Note: A distance of 3 to 5 meters is indicated, but may be farther depending on the zoom ratio.
2	Zoom in and adjust the focus on target DS 7 (or 9 on Sharpness Indicator type 7A9)
3	Zoom out and adjust the back focus.
4	Zoom in again to check whether target DS 7 (or 9 on Sharpness Indicator type 7A9) is still sharp. If not repeat steps 2 to 4 until both ends o the focal range are sharp.
5	When both ends of the focal range are sharp, tighten the back focus ring. Important: If the lens does not stay in focus through the zoom range, call ZGC Corp., USA at (973) 335- 4460 or similar company in your Country.

Sharpness Indicator and out of balance color.

If TV camera is balanced for daylight and the chart is lighted with 3200° K, than the grey background will be “pinkish” in the view finder or on the monitor, comparing to the sharp targets which appearance will be achromatic. Targets which camera does not recognizes, will merge with the pinkish background. This would work with any combination of out of balance color. This means, that you can recognize both - sharpness and light balance. Explanation: Black lines or other black elements have no color. White will also shows no color (unless is underexposed), so average of black and white we percept as neutral color while neighboring grey reveals incorrect color.

Camera stability and registration.

Degradation of sharpeners can be caused also by vibrations of running movie camera. (unbalanced motor, shutter or pull down mechanisms itself and/or by poor frame registration.

The Sharpness Indicator can helps to find camera unsteadiness by **double exposure**.

Assuming ideal camera, there will be no difference comparing single with double exposure take.

If camera unsteadiness occurs, the circular lines will show changing “patterns” inside affected circle targets in each frame. Higher frequencies will be afflicted first, then lower. Higher frequencies may show also no lines at all after double exposure. In movie projection, the “patterns” will be in constant change. An unsteadiness of projector will not effect evaluation.

If there is a proof of unsteadiness, consult it with your camera supplier about allowed tolerance for particular camera. However in 35 mm format, at least DS 5 should appear steady.

Procedure for double exposure.

Light the chart and take exposure reading from reflected light from the Chart.

(Note: It is not recommended to use 18% gray chart as a reference. The film will be unnecessarily overexposed what in turn will cause the loss of definition.)

1. Run few meters (feet) as a single exposure take. Stop.
2. Make a new slate or separate the first take shooting three - four meters with closed lens. Stop.
3. Prepare for the double exposure take:

Mark meter indicator (footage) for the start of double exposure take.

Close the lens one stop from the original exposure. (If your single exposure take was F: 5.6 now will be F: 8.)

Run few meters (so many as you wish). Stop. Note the meter position (footage).

Rewind the film to the start position of the double exposure take.

Run the camera again up to the end of double exposure take.

Let develop the film.

Evaluate using magnifying glass or use a movie projector to examine whether the “patterns” inside frequency targets do not move.

Not all the cameras have the reverse run feature. In such a case:

1. Fix first the sharpness position on the lens with a tape.
2. Run single exposure take. Stop.
3. Detach magazine from the camera and separate the first single exposure take.
4. Install the magazine back on the camera and make ready for the run.
5. Carefully detach the lens and with a pen mark a few frames (manually forward the film).
Carefully Reinstall the lens.
6. Run first take of double exposure take. Stop.
7. Detach magazine and in a dark room rewind the film on the begin.
8. Install the magazine back on the camera and detach the lens.
9. Make film loop the way that your previously marked framing will match the same registration.
10. Run the second exposure.

Make sure, that during all the manipulation neither the camera nor the lens sharpness position have been moved.

Note:

Charts are printed on a black and white photography paper and each chart is carefully checked. The grey background is gradually scaled, averaging D 0.37. The higher frequencies have darker background - lower lighter. The black is usually around D 2.0 on the Glossy paper. D 1.1.6 -1.85 on the Matt paper. Charts are made within economically and technically reasonable tolerance for photography an TV. The surface is sensitive for scratches. If necessary, the chart can be very carefully washed using soft paper tissue and clean water. Allow to air dry. The grey changes the Density if wet.

Durability: Avoid high humidity, overheating and frequent exposure to UV light. The chart should last several years if properly cared for. However, professional photography charts are customarily replaced after 1- ½ - 2 years. There is no product warranty. It is understood that the user is aware of the suitability of the product for its intended use. Producer has rights to make any changes to improve these charts.

Appendix.

The chart Sharpness Indicator was invented by Ivan Putora in 1966, in former Czechoslovakia.

The theory about the Sharpness Indicator charts was first published in the Journal of the SMPTE, USA, November, 1969 : The Sharpness Indicator, by Ivan Putora, abridgement by Pablo Weinschenk - Taberner. Reprint: February 1998.

Further: IMAGE Technology, UK, February and March 1998.

A new method for evaluating TV and digital cameras was described in the IMAGE Technology, UK, in the issue July/August, September and October 2000.

All articles describe theory, new view on sharpness and are rich of images. It is highly recommended to read them.

Present design of Sharpness Indicator charts was developed in Canada in 1996.

In 1996, Les Zelan, from ZGC Corp. USA, has promoted and spread the chart around the world.

Since 2008, Putora Sharpness Indicator charts are printed in Slovakia - Europe.

For the Sharpness Indicator, MgA. Ivan Putora received Denis Wratten Award, given by BKSTS, UK, in 1999 and Bill Hilson Award, given by C S C, in Canada, 2003.

Warning!

ALL SHARPNESS INDICATOR CHARTS ARE PROTECTED BY COPYRIGHT !

Any reproduction, imitation or copy of a whole chart or some parts of it in any form is illegal and will be prosecuted!

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Distance Guide for using Sharpness Indicator test chart.

DEGREE OF SHARPNESS (DS) *
for 35 mm camera
and all formats

**SHARPNESS AS A FUNCTION OF
FORMAT "DS-35 compared" ****
for 16 mm camera

Lens in MM	Distance in		Distance in	
	Meters	Feet & Inches	Meters	Feet & Inches
8	0.48	1' 7"	1.03	3' 5"
9.5	0.57	1' 10"	1.23	4'
9.8	0.59	1' 11"	1.27	4' 2"
10	0.60	1' 12"	1.30	4' 3"
10.5	0.63	2' 1"	1.36	4' 5"
12	0.72	2' 4"	1.55	5' 1"
14	0.84	2' 9"	1.81	5' 11"
14.5	0.87	2' 10"	1.87	6' 2"
16	0.96	3' 2"	2.07	6' 10"
17	1.02	3' 4"	2.20	7' 3"
17.5	1.05	3' 5"	2.27	7' 5"
18	1.08	3' 7"	2.33	7' 8"
20	1.20	3' 11"	2.59	8' 6"
21	1.26	4' 2"	2.72	8' 11"
24	1.44	4' 9"	3.11	10' 2"
25	1.55	5' 1"	3.35	11'
27	1.62	5' 4"	3.50	11' 6"
28	1.68	5' 6"	3.63	11' 11"
29	1.74	5' 8"	3.76	12' 4"
32	1.92	6' 4"	4.15	13' 6"
35	2.10	6' 11"	4.54	15'
40	2.40	7' 10"	5.18	17'
50	3.00	9' 10"	6.48	21' 3"
55	3.30	10' 10"	7.13	23' 5"
60	3.60	11' 10"	7.77	25' 6"
75	4.50	14' 9"	9.72	31' 11"
85	5.10	16' 9"	11.0	36' 1"
100	6.00	19' 8"	12.96	42' 6"
125	7.50	24' 7"	16.2	53' 2"
135.	8.10	26' 7"	17.5	57' 5"
150	9.00	29' 6"	19.44	64'
180	10.80	35' 5"	23.33	76' 6"
200	12.00	39' 4"	25.92	85'
300	18.00	59'	38.88	127' 7"
400	24.00	78"	51.84	170'
500	30.00	98' 5"	64.8	212' 7"

*The distance for *examining* DEGREE OF SHARPNESS or RESOLVING POWER for all camera formats is the same.

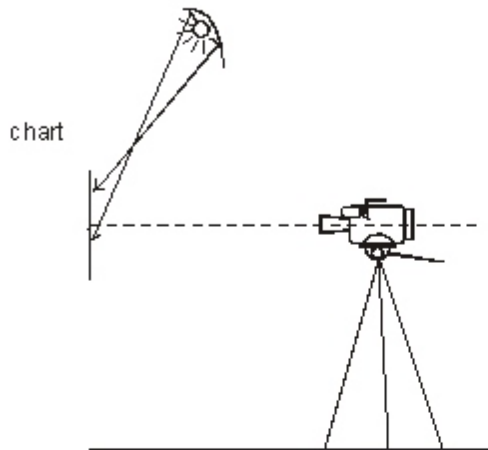
** The image aperture of 16 mm camera has vertical size 2.16 x smaller than the 35 mm Academy format, therefore the performance of sharpness -"DS-35 compared"- will be lower. In contrary, larger format than the Academy format will have "DS-35 compared" higher.

Note: The Focal Length, as marked on lenses, may not be accurate and the calculation by multiplier 60 is an approximate. For serious examination we recommend .

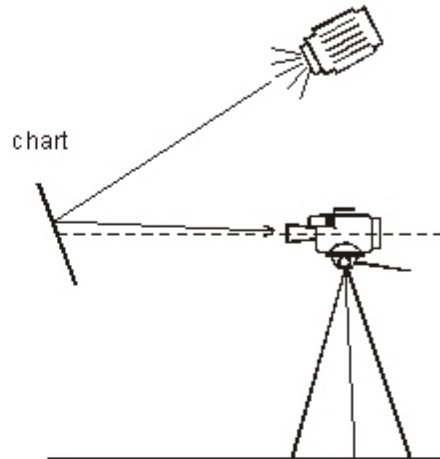
SHARPNESS INDICATOR
Instructions

POSITIONING AND LIGHTING

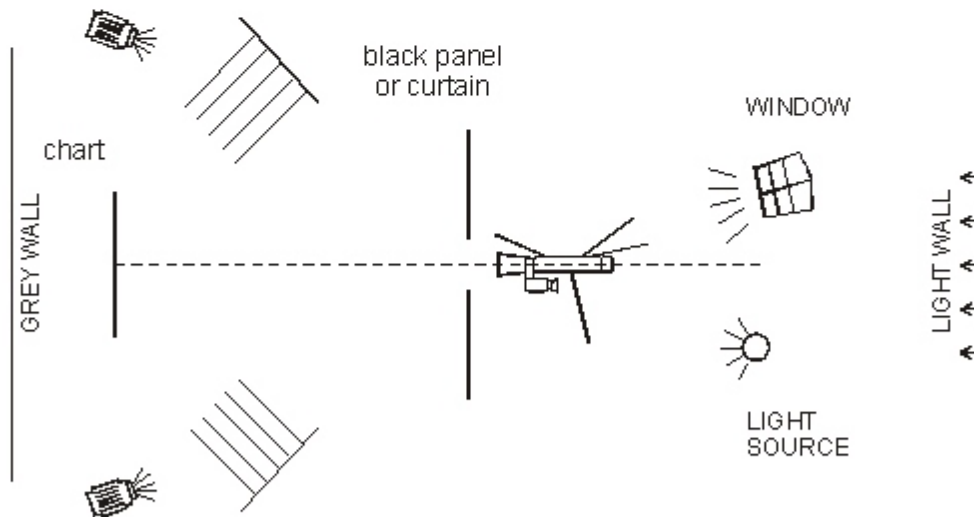
CORRECT



WRONG



RECOMMENDED



WRONG

The lighting should be carried such a way that not reflection from the light source strike towards the lens.
It is not the same to put chart on the white or black background.
Recommended is a grey background similar to the grey of Sharpness Indicator.

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