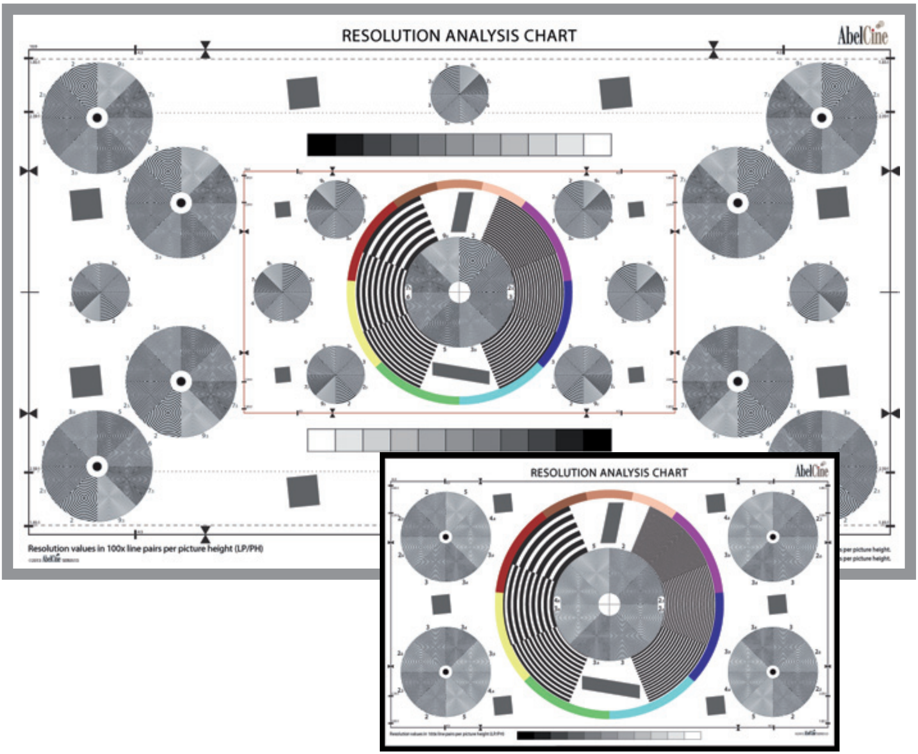
User Guide

AB-LENSCHART40-100 / 20-100

Resolution Analysis Charts



PATENT PENDING

AbelCine

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Setting Up for Best Results

The AbelCine Resolution Analysis Chart is designed to show many critical lens characteristics in a way that is easy to understand visually.

To get consistent and accurate results with the chart, it is important to follow these guidelines.

- Be sure that the camera is always perpendicular to the chart and that both the chart and the camera are level.
- The center of the lens should be at the same height as the center of the chart.
- If you are comparing the accuracy of the lens focus scale marks to the focus you achieve by eye, you should always measure the specific distance from the image plane of the camera to the center of the chart.

Care and Maintenance

Over time, the dyes used in the chart will fade, and the paper will change color. The rate at which this happens is highly dependent on the conditions to which the chart is exposed. To maximize the life of the chart, minimize its exposure to heat, humidity and light with high ultraviolet content, such as sunlight.

Avoid getting the chart wet, and clean with a dry cloth.

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Some Notes on What's Normal

As you begin to use this tool, you may be distressed to see artifacts and aberrations in even the highest quality lens. Don't worry! The chart generally shows optics at their worst so that you can distinguish subtle differences between lenses. Consider the following:

- Most lenses will demonstrate less resolution and more chromatic aberrations in the corners of the image than in the center. You may also find, especially with wide angle lenses, that the field of focus is curved. This will make the corners look even worse than they might appear in an actual scene.

  Try setting focus for the corners of the image rather than the center – you may find best focus at a different point. Remember that you probably won't be filming flat surfaces very often in your productions!

- Chromatic artifacts will be most noticeable when shooting a black-and-white pattern. What looks obvious on the chart might not be as noticeable in a real-world situation.

- Aliasing that is obvious on a focus pattern may be absent or more subtle on most real-world content.

Analyzing Focus

As you turn the focus barrel on the lens and reach the point of optimum focus, the image will "pop" into focus. You'll see greater detail, and the image will be sharper and have higher contrast. When the lens is optimally focused, you will see high contrast in low to medium spatial frequencies, which have wider, less frequent lines in the resolution pattern, and maximum detail in higher frequencies, which have finer, more frequent lines in the resolution pattern. Also, the image as a whole will show a minimum of chromatic artifacts, which are seen as colored fringes on the edges of black lines.

These aspects can be observed individually on the chart. (See Fig. 1&2)

- Start by looking at the patterns representing lower frequencies (exactly which patterns will depend on the resolution of the camera and lens, as well as the size of the pattern relative to the frame.)
- As you rotate the focus barrel on the lens, the coarser patterns will increase in sharpness and contrast. You may see a slight shift in color when you pass the point of maximum focus.
- Slowly change the focus on the lens while looking at the finest pattern that shows any detail, and find the point that exhibits maximum sharpness.

Our sense of sharpness is heavily influenced by the contrast of an image. Therefore, it is generally best to favor the point where there is the highest contrast and least amount of color fringing in the image, as these images will look the sharpest.

To further increase accuracy during your testing, you may wish to engage the image zoom function of your camera and/or monitor, if available.

Measuring Resolution

- Frame the chart so that the upper and lower frame lines exactly match the upper and lower edges of the frame lines in the camera.
- Record some images of the chart, making sure that the camera is perfectly still.
- Looking at the recorded image, find the finest fully resolved circle-pattern in each section of the image.
- The number on this pattern represents the image resolution in that area in hundreds of line-pairs per picture height.

  For example, if the finest fully resolved pattern of circles is the one labeled “3.9” then the camera and lens are resolving about 390 line-pairs per picture height.

  As this is a frame-relative measurement, the number can be compared between cameras of different designs while still representing the apparent resolution of the final image.

Fig.1. Focus Sharp

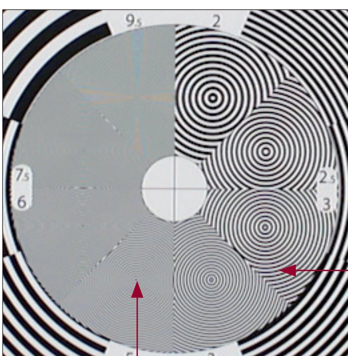
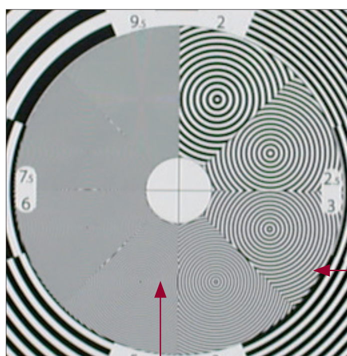


Fig.2. Focus Soft

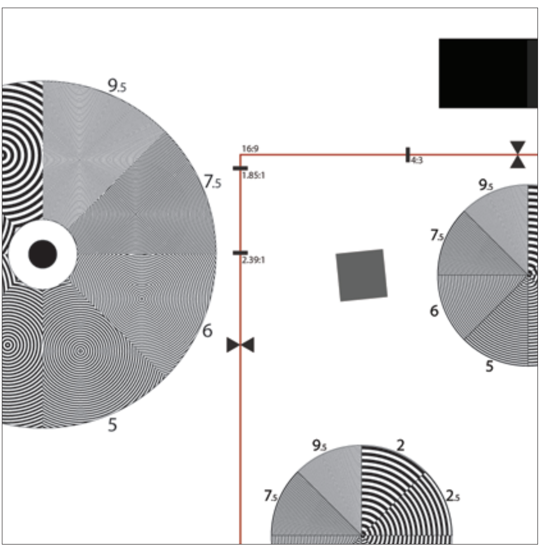


Working with Various Focal Lengths

The 40” chart also has an inner red framing rectangle that can be used for working with longer focal length lenses. If you can’t move far enough away from the chart to frame the outer rectangle, then you can use the smaller red frame instead. In this case, divide the number of the finest pattern by 2 to get the resolved resolution.

For example, when framing using the red rectangle, the pattern labeled 7.5 corresponds to 375 line-pairs per picture height (7.5 × 100 ÷ 2).

Fig.3. Inner Frame



Characterizing Chromatic Artifacts

After focusing the lens on the chart, look at the black circles in the centers of the focus patterns on either side of the chart.

Color fringing that appears on the edges of the circles is called *chromatic aberration*. (Fig. 4)

Fringing that occurs throughout the image (including the center) is called *axial chromatic aberration* and will generally improve at higher f-stops on the lens.

Fringing that only appears towards the edges of the frame is called *transverse chromatic aberration* and will probably be less affected by the f-stop.

Fig.4. Color fringing caused by chromatic aberration

Observing Gamma

Digital cameras apply what is called a *transfer function* that maps the brightness levels captured by the sensor to brightness levels that are displayed on a monitor.

Often digital cameras apply a different function to the images that are recorded. This curve may serve several purposes; it will usually make the contrast of the image on the monitor more closely match the observed contrast of the scene in front of the camera, and sometimes a curve is applied that will preserve more data in the recording for later color correction.

Technically, *gamma* refers to a particular kind of transfer function, but it is often used to refer to any transfer function, whether it is an exponential function, logarithmic function or hand-made contrast curve.

- Normal HD video uses gamma of 2.2 (sometimes referred to by its inverse of 0.45). When a camera is set up with 2.2 gamma, the steps created on a waveform monitor by the patches of the grayscale of the chart should be evenly spaced.

Fig.5. Gamma 2.2

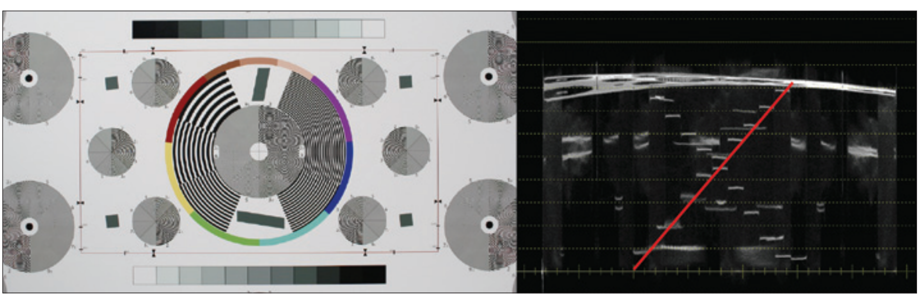


Fig.6. Log Gamma

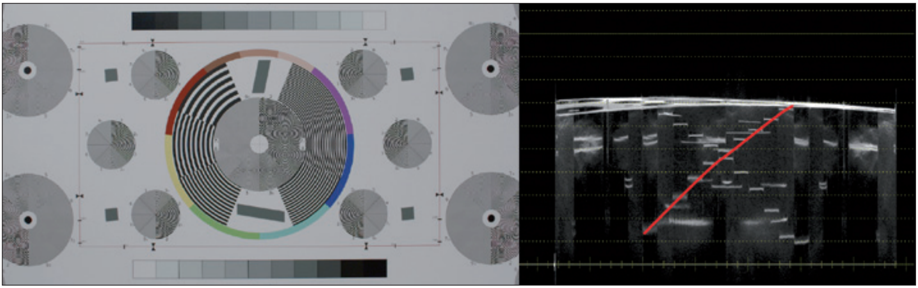
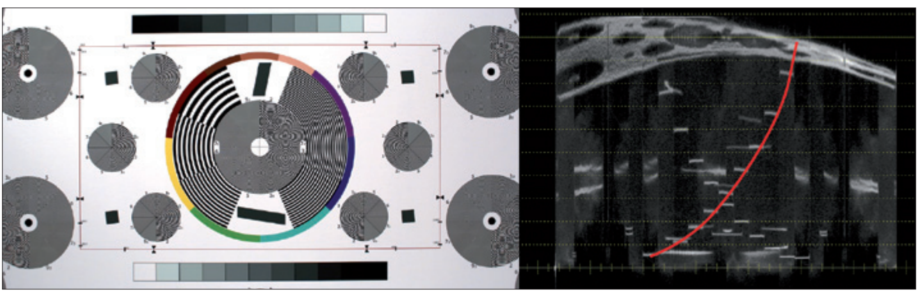


Fig.7. Gamma Off (Linear)



- A camera set up with a log curve will also result in the steps being approximately linear on a waveform monitor. If the steps are substantially curved in the shape of the positive half of a parabola, it is an indication that gamma is either off or close to linear.

Measuring MTF

Perceived sharpness is a combination of the resolution of an image (the ability to resolve fine detail) and the contrast of an image. There is a single mathematical function that combines these two aspects into a single measurement called the *Modulation Transfer Function*, or MTF. Essentially the MTF represents the maximum possible contrast in an image for features of a specific size (or frequency) in the image.

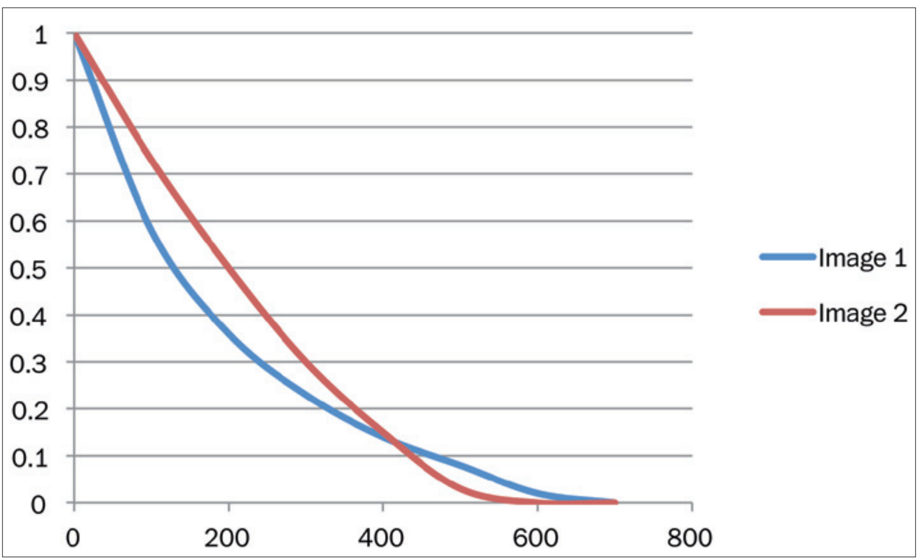
By graphing MTF over a range of frequencies, it is possible to represent the perceived sharpness of an imaging system. Conventionally, the graph is drawn with the vertical axis representing MTF and the horizontal axis representing frequency. The MTF of lower frequencies (i.e. coarser detail) is always higher in an image than higher frequencies, so the graph of MTF will look like a downward sloping line or curve. The greater the area under this curve, the sharper the image will appear.

In Fig. 8, Image 2 will appear sharper than Image 1 despite the fact that Image 1 has higher resolution.

The dark gray slanted squares and rectangles that are positioned throughout the chart are used for MTF analysis. Fairly accurate MTF measurements of the entire imaging system (lens, camera and recorder) can be obtained by analyzing a recorded image of the chart with software, such as Imatest, which can generate MTF readings from the edges of the slanted squares throughout the image.

By analyzing several edges across the image, you can get detailed measurements of system performance throughout the frame (for instance, exactly how much sharpness is lost in the corners of the image compared to the center).

Fig.8.



Warranty

AbelCine warrants the Resolution Analysis Chart to be free of defects in materials and workmanship for a period of one year from the date of purchase.

This warranty does NOT cover:

- Damage or malfunction resulting from accident, misuse, abuse or neglect
- Wear and tear resulting from normal use and exposure to the elements
- Failure to follow the supplied instructions
- Repair or attempted repair by a third party
- Adjustment, disassembly or modification of the unit

In case of a warranty claim, contact the AbelCine service department at 888.223.1599 or service@abelcine.com.

The Resolution Analysis Chart is a Non-Consumer, Industrial Product.

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