

Executive Summary

This report contains image quality test results for the 8 megapixel (MP) Camera A and two popular point-and-shoot cameras with similar MP counts: the 10MP Camera B; and the 8 MP Camera C. The report focuses primarily on objective image quality factors and provides only limited coverage of subjective factors. This section provides a summary of the analysis and results detailed in the main body of the report.

Sharpness

Sharpness is a measurement of an imaging system's ability to render detail, and from a consumer perspective, is arguably the most important performance metric. Customers expect increased megapixel counts to correlate with increased sharpness, although this is often not the case.

Sharpness for Camera A at wide angle (no digital zoom), bright light, and low ISO is excellent; it is definitely competitive with top-performing compact digital cameras, such as Camera B, and clearly better than Camera C.

However, sharpness in Camera A is degraded by use of the digital zoom, which is inferior to the optical zooms of the comparison cameras. Sharpness in Camera A drops off considerably at medium zoom, and suffers severely at long zoom.

Camera sharpness is typically degraded as ISO speed increases because of increased software noise reduction. This degradation was present in all cameras tested, but somewhat worse for Camera A than for Camera B or Camera C.

It is likely that most consumers will be delighted by the sharpness of Camera A pictures taken without use of the digital zoom, but that many consumers will be substantially less pleased with pictures taken using the zoom feature.

Noise

Noise is a random variation of image density, visible as grain in film and as pixel level variations in otherwise smooth portions of digital images. It is a key image quality factor that is nearly as important as sharpness to typical consumers. While noise can never be completely eliminated, cameras are designed to minimize noise as much as possible.

All cameras have low noise at low ISO speeds, and Camera A is no exception. At low ISO speeds, consumers would likely have no concerns about picture noise in Camera A.

At high ISO speeds, cameras typically use lowpass filtering to reduce noise. Lowpass filtering blurs the noise and does not remove a secondary source of noise called chroma noise. Camera A appears to use such a lowpass filter, and resulting noise levels are quite visible.

In contrast, Camera B appears to use a highly effective, sophisticated, and newer noise reduction algorithm, which does little obvious lowpass filtering, maintains excellent edge sharpness, and removes all chroma noise.

Consumers would easily be able to notice significant noise differences between Camera A pictures taken at high ISO speeds, and those taken with Camera B at similar speeds and perceptions of Camera A would likely suffer from such a comparison.

Loss of fine detail at high ISO speeds

Digital cameras with tiny (i.e., noisy) pixels employ software noise reduction at high ISO speeds that can cause a loss of low contrast detail at high spatial frequencies. This loss is slightly worse in Camera A than in the other cameras, but performance differences are not likely to be noticeable to the typical consumer.

Color and Exposure Accuracy

Color accuracy is the degree to which the colors in a captured image match the colors of a scene. Accurate color is rarely the most pleasing color for consumers, so most cameras deviate somewhat from perfect color. This is the case for Camera A, Camera B, and Camera C.

Testing indicates that Camera A has excellent color quality in bright and dim light levels for all for ISO speeds. Consumers comparing color between pictures taken with Camera A and either Camera B or Camera C would likely be very pleased with Camera A color quality and would likely find it superior to Camera C, which introduces a yellow cast to most images.

Exposure accuracy is the degree to which the grayscales in a captured image match the grayscales of a scene. Consumers typically prefer relatively accurate exposure. Camera A exhibited excellent exposure accuracy in bright light, but demonstrated severely underexposed images in dim light (8 Lux; comparable to a dimly-lit bar) when ISO was set to auto (resulting in ISO = 200). While use of the camera flash would improve customer perceptions in most instances, consumers would likely consider pictures taken without flash usage to be significantly poorer than similar pictures taken with either Camera C, or Camera B. We recommend that the auto ISO speed algorithm in the firmware be set to increase the effective ISO speed in dim light to 800 or 1600.

Distortion

Distortion is an aberration that causes straight lines to curve. Distortion tends to be most serious in extreme wide angle, telephoto, and zoom lenses. It can be highly visible on tangential lines near the boundaries of the image, but it is not visible on radial lines.

No significant distortion was found in Camera A under any test conditions. Typical consumers would likely find distortion levels in Camera A, Camera B, and Camera C to be imperceptible.

Lateral Chromatic Aberration

Chromatic aberration (CA) occurs because the index of refraction of glass varies with the wavelength of light—glass bends different colors by different amounts (see figure below). Although minimizing chromatic aberration is one of the goals of lens design, it remains a problem, most notably in ultrawide, long telephoto, and extreme zoom lenses. Lateral chromatic aberration (LCA) is color fringing that occurs because the magnification of the image changes with wavelength. It is most visible near the edges on the image.

Camera A exhibited low to moderately low chromatic aberration under various test conditions and was comparable to both Camera B and Camera C. Typical consumers would likely find chromatic aberration levels in Camera A, Camera B, and Camera C to be either imperceptible or at least not objectionable.

Anti-shake (image stabilization)

Image stabilization, often called Anti-Shake (AS), is intended to improve perceived image quality when pictures are taken as the user/camera is moving. AS can be implemented via either software algorithms or hardware devices in a camera. Hardware AS is typically more effective, but also more expensive. Camera A implements AS via software.

Test results show that AS in Camera A improves performance in dim light but degrades it in bright light. As the default setting for AS on Camera A is *off*, most consumers are likely to appreciate use of the AS mechanism if user instructions clearly indicate that it is to be applied in low light. As detailed in the body of the report, we recommend that AS be turned on when the Light Value falls below a specified level (perhaps around 5.5) and turned on when it goes above a specified level (around 7). This would likely improve user experiences with AS.

SQF (Subjective Quality Factor)

SQF is a measurement of perceived print or display sharpness that has been used for years in the photographic industry. SQF relates MTF (device sharpness) and the human visual system to perceived sharpness of images displayed at different sizes.

For 8x11 inch print (display) size—about the largest to be expected for Camera A, performance was excellent at the wide angle setting (no zoom) at ISO 100.

However, performance of Camera A was significantly degraded compared with Camera C and Camera B when zoom (digital in Camera A; optical in the others) was applied. These differences are likely to be quite noticeable to the typical consumer who is likely to find Camera A SQF levels for pictures taken using either zoom or high ISO speeds to be objectionable.

Operational Times

In autofocus delay and time between shots, both with and without flash, Camera A was significantly slower than either the Camera B or Camera C and will likely prove frustrating to the typical consumer.

Summary

In summary, Camera A demonstrated performance in most image quality factors tested that compared well with both Camera B and Camera C. However, most consumers are likely to perceive Camera A pictures taken using the zoom feature, or pictures taken at high ISO speeds, to be substantially poorer than pictures taken using either Camera C or Camera B under similar conditions. Likewise, shot-to-shot delay times for Camera A are also likely to frustrate typical consumers. The following table compares key image quality factors among Camera A, Camera B, and Camera C.

Image Quality Factor	Camera A	Camera B	Camera C
Sharpness	Weak under zoom and high ISO	Excellent	Very good
Noise	Weak at high ISO	Excellent	Very good
Fine detail at high ISO	Weaker	Stronger	Stronger
Color accuracy	Excellent	Excellent	Weaker
Exposure accuracy	Very Good	Excellent	Very Good
Distortion	Excellent	Excellent	Excellent
Lateral chromatic aberration	Excellent	Excellent	Excellent
Subjective quality factor (SQF)	Weak under zoom and high ISO	Excellent	Very Good
Operational times	Weaker	Excellent	Very Good

Contents

Executive Summary.....	1
Introduction.....	8
Devices Tested.....	8
Camera A	8
Camera B	8
Camera C	8
Objective Image Quality Findings	9
Sharpness (MTF)	10
Summary of Sharpness Results.....	11
Sharpness – No Zoom / Wide Angle	12
Sharpness - Medium Zoom.....	20
Sharpness - Long Zoom.....	26
Sharpness summary for low ISO speeds.....	30
High ISO Sharpness	31
Noise, and noise reduction.....	35
Test Results.....	36
Noise reduction, fine detail, and ISO speed.....	39
Test Results.....	41
Color and Exposure Accuracy	43
Test Results.....	43
Distortion	47
Test Results.....	47
Lateral Chromatic Aberration	48
Test Results.....	49

Anti-Shake (image stabilization)	50
Test Results	50
Subjective Quality Factor	53
Test Results	53
Operational Performance Times	56