Vision Based vs. Laser Based Bar Code Verification

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For certified bar code verification, most industries use the ISO/IEC 15416:2000(E) standards for linear bar codes and ISO/IEC:15415:2004(E) standards for 2-D codes. Within these standards there are 6 general optical requirements that need to be followed in order to be certified. They are:

1. Reflectance measurements must be expressed in percentage terms that are calibrated to a recognized international standard. (i.e. A Calibrated Conformance Test Card.)[1]
2. A 45º illumination of the bar code with diffusely reflected light (typically called a flood light) being collected perpendicular to the surface.[2]
3. The color of the light should approximate its intended use.[3]
4. The aperture size must be set in accordance to the Application Standard. In the absence of an Application Standard, the ISO standards must be used.[4]
5. For linear codes, a 45º angle of flood light must be used. For 2-D codes, 45º is desired but 30º or 90º may be required in order to minimize unwanted surface reflections. If anything other than 45º is used, it must be stated.[5]
6. A minimum of 10 scans is required. These scans shall be taken at 10 positions within the bar code that are approximately equally spaced.[6]

Typically, people who need to verify a bar code according to the ISO standards must rely on a Calibrated Conformance Test Card. This Test Card has several bar codes printed on it all of which have stated grades for contrast, modulation, decodability and defects. All verifiers, whether vision based (Area or CCD sensors) or laser based, must be able to grade a Calibrated Conformance Test Card to within $\pm$0,2 of its stated overall grade point average.[7]

Applied Image, located in Rochester, NY,[8] creates the only Calibrated Conformance Test Card recognized internationally. In order to accurately measure their test cards, a system called “The Judge” is used. “The Judge” is an electro-mechanical device that uses a white halogen lamp as its light source, a red 670nm interference filter, and is set at a 45% angle.

When a customer orders a Calibrated Conformance Test Card from Applied Image, they must indicate what frequency of light and what size aperture is to be used. Typically, bar code readers use a laser light source that outputs a red light frequency range between 660nm and 680nm. [9] The “Judge” will emulate the red light of a laser by using a red interference filter. The aperture size used will be in accordance with the ISO/IEC15416:2000(E) standards.[10]

Vision vs. Laser: The light source

Many vision based systems use a white light source for proper verification and will use a 670nm red filter unless an Application Standard requires some other frequency (Infrared, ultra-violet) to be used. Within the ISO/IEC 15416:2000(E) documentation (Annex F) it states that a Wratten 26 filter could be used for applications where the laser beam frequency of 620-633nm is used.[11] In the 2-D specifications it states that when an Application Standard calls for a red light source, a filter may be used to modify the frequency of the light source.[12] This is typically called a "flood light" method of illumination. This type of light source (white light with a red filter) correlates to the standards and emulates how "The Judge" is designed to verify.

Laser based systems do not use a "flood light" method. Nor do they use a white light with a red filter. Their light source is a RED light laser beam having a frequency anywhere between 630nm to 660nm.[11] Laser based systems will also use another red filter in order to diminish the effects of ambient light entering into the system. Using a laser beam as a method of illumination does not correspond to the optical geometry of the standards but it is considered to be an appropriate alternative system.[13]

A 45º angle must also be maintained in order to comply with the standards.[14] Vision based systems use lights that are placed at the proper angle. Laser based systems may or may not comply optically to the standards but tests have proven they can correlate accurately to the standards.

Vision vs. Laser: The Aperture size

In order to grade a bar code correctly, the proper aperture size must be used. An aperture basically limits how much of the bar code image surface is being analyzed.[15] On the Judge, this is a pin-hole opening located very close to its internal light sensor.

Vision based verifiers do not use an aperture. Instead, software averages pixels together in order to reproduce the same results created by a pin-hole aperture and effectively correlate to the rules as stated for bar code verification in the ISO/IEC 15416:2000(E) methodology documentation.

A laser based system uses a moving dot of laser light to detect bars and spaces. This means that the aperture settings must be controlled by changing the size and shape of the laser spot size. Since the spot of light is moving, software must also be able to adjust its results to minimize the ill-effects of motion. This method of setting the aperture size will also effectively correlate to the rules as stated for bar code verification in the ISO/IEC 15416:2000(E) methodology documentation.

Vision vs. Laser: Number of scans

Laser based systems require an operator to scan a bar code at different positions within its bar height. A minimum of 10 scans is required in most cases. According to the standards, this is acceptable.[16] But, because a grading decision is being made with only 1% of the bars height being analyzed, it is unclear how repeatable a measured grade can be.

Vision based verifiers generally scan every .05mm (.002") of bar height.

In conclusion, it is clear that a vision based verifier or a laser based verifier will effectively correlate to all standards. Vision based systems will have an added advantage over laser due to its increase in resolution.

Reference Notes:

1: ISO/IEC 15416:2000(E) Section 5.2 and ISO/IEC 15426-1:2000(E) Section 6.2 and 8.3
2: ISO/IEC 15416:2000(E) Section 5.2.3
3: ISO/IEC 15416:2000(E) Section 5.2.1
4: ISO/IEC 15416:2000(E) Section 5.2.2
5: ISO/IEC 15415:2004(E) Section 5.4 and Appendix D.3
6: ISO/IEC 15416:2000(E) Section 5.2.4 and 5.2.5
7: ISO/IEC 15426-1:2000(E) Section 2A
8: Applied Image, Inc.
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Rochester, New York, 14609 USA
Phone: 716-482-0300
9: ISO/IEC 15416:2000(E) Annex F Section F.1
10: ISO/IEC 15416:2000(E) Section 5.2.2
11: ISO/IEC 15416:2000(E) Annex F Section F.1(d)
12: ISO/IEC:15415:2004(E)) Section D.1.4
13: ISO/IEC 15416:2000(E) Section 5.2.3b
14: ISO/IEC 15416:2000(E) Section 5.2.3a
15: ISO/IEC 15416:2000(E) Section 3.10
16: ISO/IEC 15416:2000(E) Section 5.2.5

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