


Demonstrating Mugshot Image Compliance
To ANSI/NIST-ITL 1-2011 Update:2015
Using the Imaging Gauge™ Quality System

NIST Special Publication 500-290
Edition 3 (2015)


ANSI/NIST-ITL 1-2011
Update: 2015

Information Technology:
American National Standard for Information Systems



ANSI/NIST-ITL 1-2011 Update:2015
Data Format for the Interchange of Fingerprint, Facial
& Other Biometric Information

This publication is available free of charge from:
<http://dx.doi.org/10.6028/NIST.SP.500-290e3>

**ANSI**

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce



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Objective:

This paper will explain the mugshot image quality requirements contained in the latest ANSI/NIST-ITL 1-2011 Update:2015 standard and describe how the Imaging Gauge™ Camera Quality System can be used to easily assess compliance to the standard.

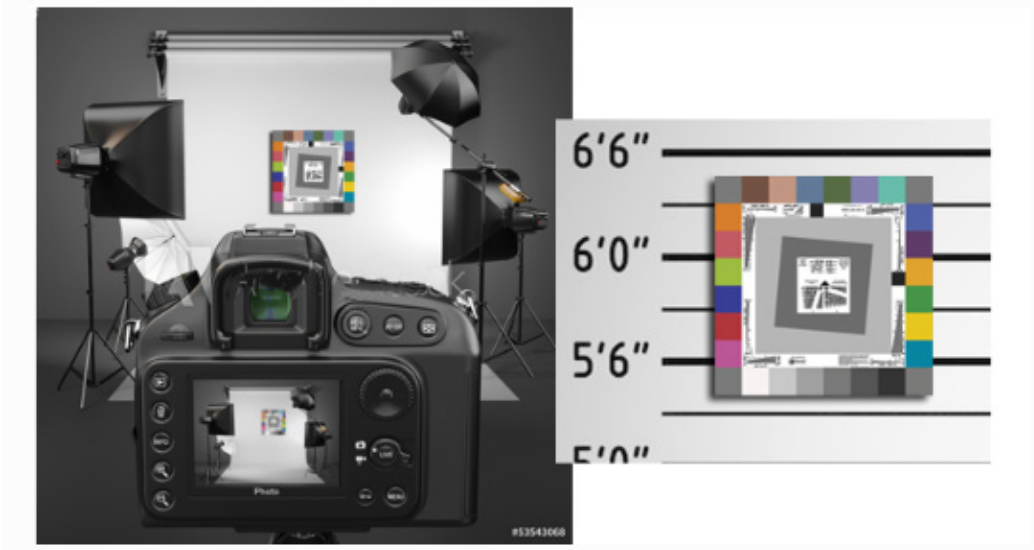
Background on the NIST Standard:

The NIST standard that was updated in 2013 included significant improvements to the two primary sections that address image quality for mugshots: “7.7.5.1 Subject acquisition profiles for face / SAP” and “Annex E: Facial Capture – SAPs 30 and above”. Many image quality specifications were clarified with objective measures that will drive better consistency among mugshot images and thereby improve the effectiveness of facial identification processes. These specifications, however, may also result in the need for new camera systems and photography methods, in order for some law enforcement agencies to ensure compliance with the standard.

The same NIST standard was updated again in 2015, but no significant changes were made in that update relevant to mugshot image quality.

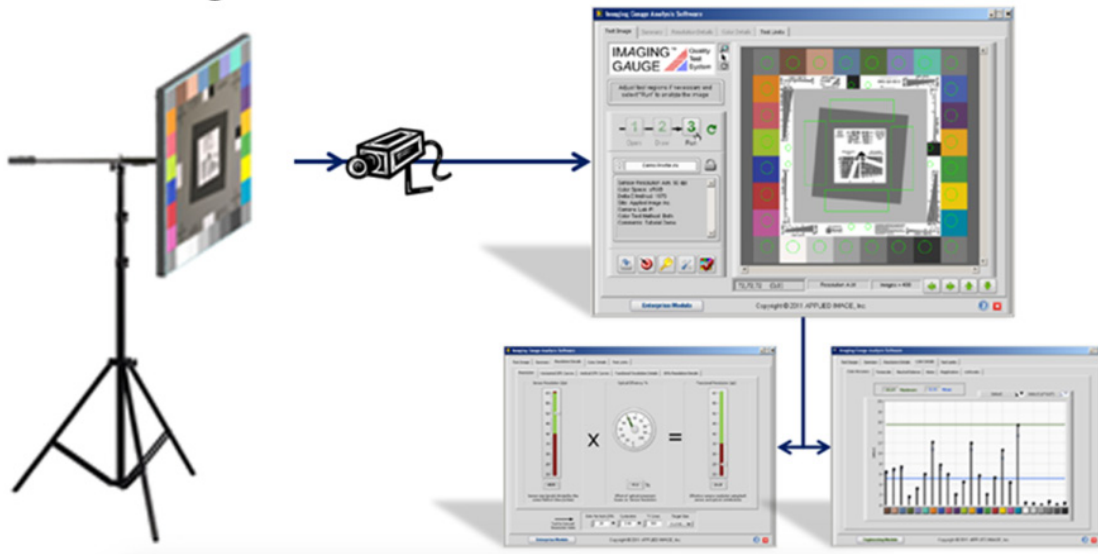
Basics of the Imaging Gauge™ System

The Imaging Gauge™ System was developed to make it easy for camera operators to evaluate image quality metrics for their camera systems, including the mugshot metrics specified in ANSI/NIST-ITL 1-2011 Update:2015. The “system” includes two basic components: “target” and windows based “software”. First an operator takes a test photo/image of the Imaging Gauge™ Target using his/her existing mugshot equipment and procedure. The Imaging Gauge™ Software knows what the target image should look like, so it then compares the test image to the known target image for all of the image quality metrics in the standard. The software then quickly displays the comparison result to the operator as a simple PASS or FAIL. If PASS, mugshots are then taken with same equipment and procedure. If FAIL, the Imaging Gauge™ Software provides more detailed information on the specific metric which caused the failure as well as simple graphs/tools/support to help remedy the situation.



Target

Software



Section 7.5.5.1 of the NIST Standard:

Section "7.7.5.1 Subject acquisition profiles for face / SAP" specifies various camera system configurations used for mugshots. There are three primary levels: Basic (30), Higher Resolution (40) and Best Practice (50). These are differentiated by their resolution requirements as shown below. Each of these primary levels must also conform to all specifications in Annex E of the standard. Specifications for Mobile applications (32, 42 and 52) are relaxed somewhat to allow for variable field conditions.

Subject Acquisition Profile	SAP Level	Comments
Legacy Mugshot	20	Formatted according to ANSI/NIST-ITL 1-2000, but not necessarily conforming to the best practice requirements given in level-30
Basic Mugshot	30	<ul style="list-style-type: none"> ▪ Must meet all specifications in Annex E ▪ Minimum 480 x 640 pixel image size ▪ Head and Shoulders composition
Mobile Device Basic Mugshot	32	Same as Level 30 without background or lighting restrictions
Higher Resolution Mugshot	40	<ul style="list-style-type: none"> ▪ Must meet all specifications in Annex E ▪ Minimum 768 x 1024 pixel image size ▪ 1 Megapixel camera ▪ Head and Shoulders composition
Mobile Device Higher Resolution Mugshot	42	Same as Level 40 without background or lighting restrictions
Best Practice Mugshot (Head and Shoulders)	50	<ul style="list-style-type: none"> ▪ Must meet all specifications in Annex E ▪ Minimum 3300 x 4400 pixel image size ▪ 15 Megapixel camera ▪ Head and Shoulders composition
Best Practice Mugshot (Head only)	51	<ul style="list-style-type: none"> ▪ Must meet all specifications in Annex E ▪ Minimum 2400 x 3200 pixel image size ▪ 8 Megapixel camera ▪ Head only composition
Mobile Device Best Practice Mugshot	52	Same as Level 50 without background or lighting restrictions

Operators should check the pixel specifications of their existing camera equipment versus the latest standard to confirm that they are still in compliance. The Imaging Gauge™ Target is sized to fit within the required Field-of-View of both “Head and Shoulders” and “Head Only” compositions (1 foot X 1 foot). The target should be positioned at the same distance from the camera as the subject's face would typically be.

Changes to Annex E of the NIST Standard:

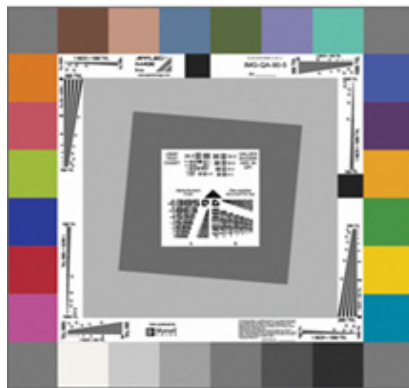
The new mugshot image quality requirements relate primarily to camera focus, lighting uniformity, exposure and color. Each of the remaining sections of this paper cover an element of image quality described in Annex E, further describing how the standard changed and how the Imaging Gauge™ System now assesses compliance to the latest standard.

Section E.3.1 Focus and Depth of Field (DOF):

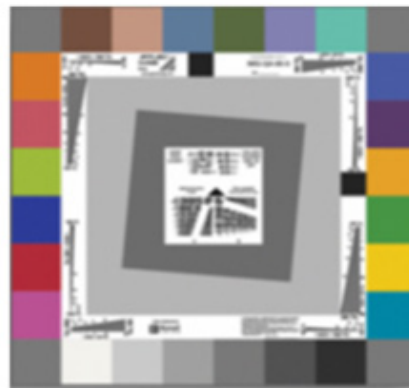
The pre-2013 NIST standard specified in Section E.3.1 that “The subject’s captured facial image shall always be in focus from the nose to the ears.” The 2013 release of the standard added that “An objective metric to ensure that the subject is in focus is to test that the Optical Efficiency is $\geq 90\%$.”

The Optical Efficiency of the imaging system is determined by the quality of the camera optics. Imaging Gauge™ System calculates the Optical Efficiency using the slanted-edge method described in ISO 12233 Standard. This requires a high quality test target that includes a slanted-edge feature and software to calculate the Spatial Frequency Response (SFR) of the image. Optical Efficiency is derived from the SFR. Note the visual difference between the center sections of the side-by-side samples below.

Optical Efficiency > 90%



Optical Efficiency < 90%

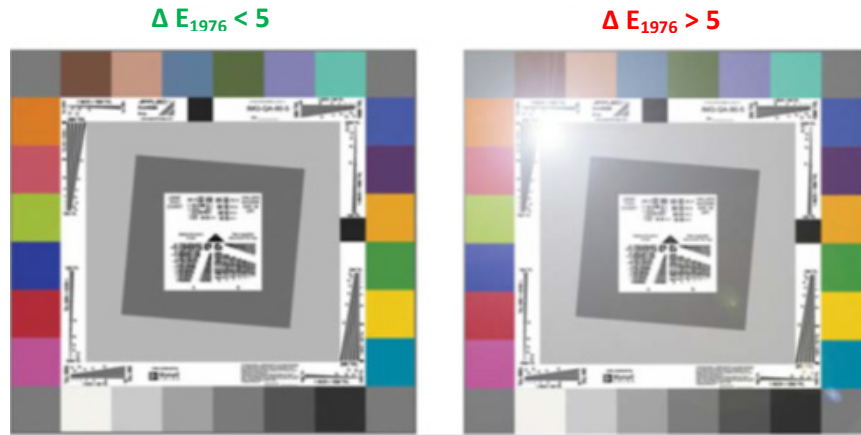


Section E.3.3 Background and Lighting Uniformity:

The *pre*-2013 standard contained a requirement for 18% gray background with only qualitative language regarding the uniformity of the lighting:

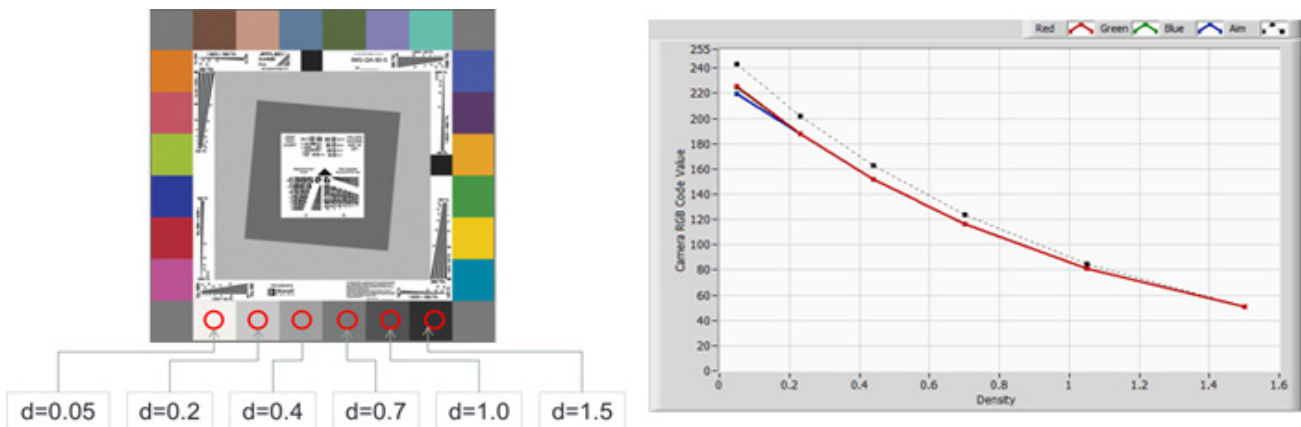
- Section E.3.2 states that “Lighting shall be equally distributed on the face. There shall be no significant direction of the light from the point of view of the photographer.”
- Section E.3.3 states that “There should be no shadows visible on the background behind the face image. Proper lighting shall contribute to the uniformity of illumination of the background.”
- Section E.3.3 also states “The subject whose image is being captured shall be positioned in front of a background that is 18% gray with a plain smooth flat surface. A Kodak or other neutral gray card or densitometer shall be used to verify this 18% gray reflectance requirement”

In 2013, Section E.3.3 was appended to state “An objective measure is to have the ΔE_{1976} between all points on a uniform gray card to be < 5 . ΔE values are calculated from the known CIE Lab value of the card and the sRGB camera code values”. The four corners of the Imaging Gauge™ target include 18% Gray Patches that are used to assess uniformity. The side-by-side samples below show an example of improper light uniformity. (ΔE is referred to as “Delta E” in the industry and is a measure of color difference.)



Sections E.3.4 and E.3.5 Exposure:

Brightness and contrast are specified in sections E.3.4 and E.3.5 regarding camera exposure. Prior to the latest release in 2013, the standard stated that “The exposure shall be keyed to the background. Several areas of the recorded 18% gray background shall be used to verify the proper exposure.” In 2013, the standard was changed to include five (5) additional gray levels, for a total of six (6) levels. The intention of adding these is to specify contrast and brightness.

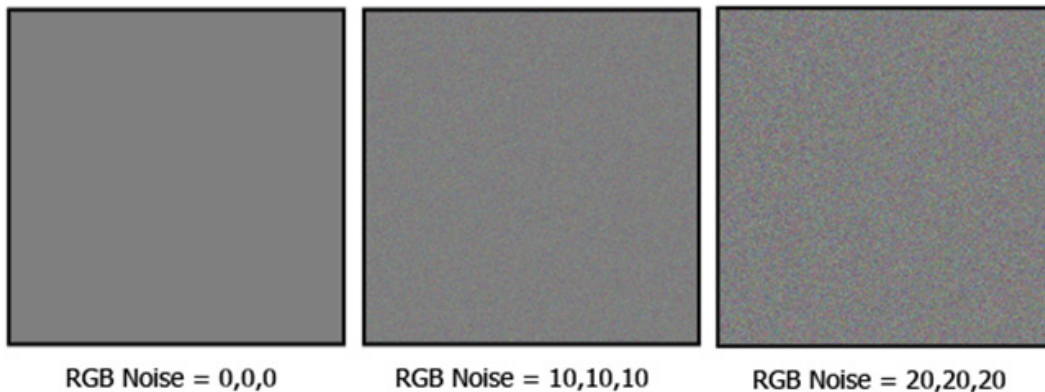


Section E.3.4 further states that “for every area examined, the maximum the difference between the means of any two of the RGB components shall not exceed 10.” This specification requires an additional

constraint on the *difference* between color channels, i.e. red-green, red-blue and green-blue for each neutral patch. ImagingGauge™ automatically calculates Red, Green, Blue (RGB) average and difference values for all six (6) gray values included in the latest standard.

Section E.3.4 Noise:

The pre-2013 standard included a specification for noise within a single gray patch. Section E.3.4 states that “The averages of the 8-bit Red, Green, and Blue (RGB) components within each area shall be calculated. Each of the RGB means shall fall between 105 and 125 with a **standard deviation of ± 10** ”. Using ImagingGauge™, noise is calculated for the six (6) neutral patches on the bottom of the target. The example below shows the visual difference between three levels of noise. The middle sample indicates the maximum limit for this standard at 10. ImagingGauge™ calculates RGB noise for each of the six neutral density patches.



Section E.3.6 No Saturation and E.3.10 Allowable Color Space:

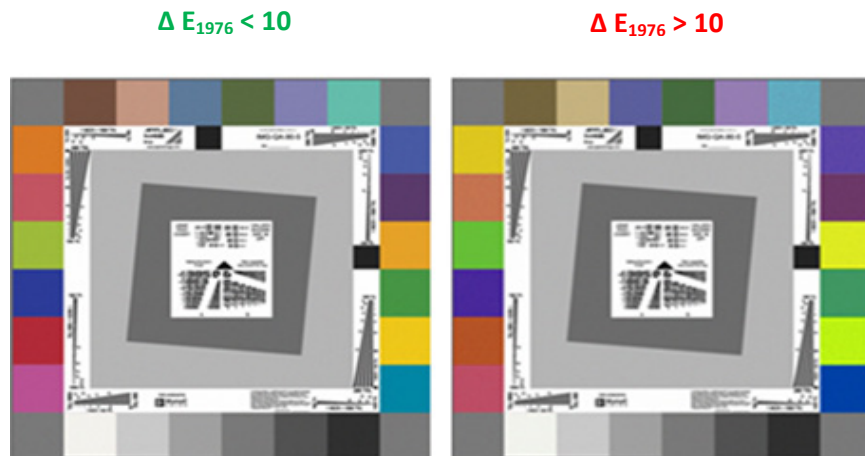
The *pre-2013* standard used only qualitative language in the specification of color:

- E.3.7 states “Unnaturally colored lighting (e.g., yellow, red) is not allowed.... The lighting shall produce a face image with natural looking skin tones when viewed in typical examination environments.”
- E.6.6 states “For each patch of skin on the person’s face, the gradations in textures shall be clearly visible. In this sense, there shall be *no saturation* (over or under exposure) on the face.”

The 2013 update to the NIST standard incorporated two significant additions: the use of color targets and a limit to the acceptable deviation from these colors in an image. Section E.3.6 states “A

quantifiable test is to use color targets to include red, green, blue, cyan, magenta, and yellow patches with known CIE Lab values. The ΔE_{1976} of each color for the **sRGB color space** is to be less than 10.”

The Imaging Gauge™ target includes 24 color patches with identical specifications to the Munsell ColorChecker™ Classic target. Imaging Gauge™ employs a ΔE comparison to determine the Color Accuracy of each color patch. Each color included in the Imaging Gauge™ target has a known set of **Aim CIE Lab** values (L^* , a^* and b^*). Note the color differences between images and respective differences in ΔE in the side-by-side images below.



Summary and Technical Support:

The mugshot image quality requirements of ANSI/NIST-ITL 1-2011 Update:2013 were significantly more challenging than the requirements in previous versions of the standard. The Imaging Gauge™ System has been developed to make it easy for law enforcement agencies to verify compliance of their camera systems to all requirements in the latest mugshot standard (update 2015). This paper has described how the standard has changed, including specifics and technical metrics for camera focus, lighting uniformity, exposure and color, while also providing an overview of how the Imaging Gauge™ System measures each relevant metric. Camera operators and administrators will appreciate the intuitive software design, training, on-line help, and documentation (including step-by-step tutorials) of the Imaging Gauge™ System, and the resulting seamless integration into their existing workflow. In cases where further support is needed, the image experts at Applied Image will be there to help.



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www.appliedimage.com/products/imaging-gauge-software-test-system

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