TECHNICAL REPORT

# ISO/TR 19263-1

First edition
2017-03

# Photography — Archiving systems —

## Part 1: Best practices for digital image capture of cultural heritage material

*Photographie — Systèmes d'archivage —*

*Partie 1: Meilleures pratiques pour la capture d'images numériques du matériel de patrimoine culturel*

Reference number
ISO/TR 19263-1:2017(E)

# Annex B
(informative)

# Subjective interpretive imaging (aesthetics)

## B.1 Overview

An image of an artwork created following ISO 19264 methodologies will record an object with improved accuracy and repeatability but there will always be situations and projects that demand a subjective aesthetic interpretation of an original. ISO 19264 imaging methods help museums, archives and libraries worldwide create and share content that is measurably consistent. Minimizing subjectivity improves consistency and throughput but does not replace the creation of visually pleasing photographic interpretations. Interpretive imaging requires skilled photographers able to combine technical abilities with the creativity and lighting skills needed to reach a desired aesthetic.

The decision to implement ISO 19264 methods or creative subjective capture practices should be carefully considered as they are not mutually exclusive. It is common for institutions to apply both methods to the same collections. For example, digitization of a large collection of objects offers important access, but the creation and promotion of a curated exhibition or publication of the same objects may require a specific interpretive photographic campaign.

ISO 19264 system validation can certainly provide the necessary technical foundation for systems utilized for interpretive imaging. Systems can be systematically configured and validated to provide a consistent starting point for interpretive stylization and illumination. It is highly recommended for program managers to define and document both technical specifications and stylization methods to ensure more consistent visual representations of original artworks over time.

## B.2 Assessment of a collection for digitization

The nature of the materials (including size, format, surface, metadata) to be digitized, their significant characteristics, value and quantity all impact the requirements for the imaging system. Important criteria to consider when developing an imaging strategy: Material Size, Size directly impacts hardware selection, physical space requirements, as well as overall productivity.

A well-configured digital imaging system may be capable of thousands of captures a day, but it is critical to understand the collection in terms of handling before addressing equipment needs, because productivity can be severely limited by the handling requirements of original works.

— Size. Can the collection be parsed by size? (what are the largest/smallest originals).

— Surface Qualities (matte, glossy, gold leaf or other reflective metallic surfaces, embossing, tool work).

— Framed/Unframed.

— Bound/unbound.

— Mixed medium.

— Depth/texture.

— Colour/gray.

— Continuous tone/halftone/line art.

— Format.

— Reflection/transmission.

— Single/multiple pages.

— Condition/special handling requirements.

— Operator Qualifications:

  — Is the operator proficient using ISO 19264 and image analysis?

  — How much training will the operator require?

  — Can a camera/scanner operator handle the materials or are other experts required?

— Other Considerations:

  — Are the works organized and labelled?

  — Are there object level records of the individual items?

  — Are there issues with transportation to and from storage?

  — How much time does it take to place the work on the imaging stage and return it to its storage?

  — Are special tools required to place the works, magnets, glass, string, weights, supports?

## B.3 Developing a digitization hardware strategy

Understanding the collection in terms of size, material, condition and quantity is the first critical step in determining appropriate hardware. The maximum original size impacts multiple specifications and will help determine appropriate hardware. For relatively uniform sized originals a flatbed scanner that supports user controls necessary for ISO 19264 is appropriate. Digital still cameras or scanners being considered should support appropriate user controls and readouts outlined in 4.3. In cases where objects vary in dimension, surface quality or are unable to lay flat, a digital still camera may be more appropriate.

When specifying a digital still camera solution, there are additional considerations:

— sensor resolution:

  — size of originals at required PPI (see table);

— lens focal length:

  — field of view;

  — camera working height;

  — lens type and quality (distortion);

— camera distance and appropriate support:

  — camera stability;

  — camera alignment;

— lighting:

  — should be configured to provide an even pool of illumination up to the maximum original size;

— determining an appropriate digitization lab floor plan:

  — appropriate area to accommodate even illumination of originals;

— appropriate area for operator;

— appropriate area for safely transporting and handling original works.

When determining an appropriate imaging system sensor resolution it is helpful to audit your collection based on the size of the original materials and desired output resolution. It is common for users to purchase digital cameras or scanners for digitization only to find that the sensor resolution is inadequate for the work at hand. This table simply illustrates the relationship between the sensor pixel long dimension and original sizes at 300 PPI and 400 PPI. It is not intended as an absolute requirement for specific object types.

**Table B.1 — Sensor size relative to 1:1 original image reproduction at 300 PPI and 400 PPI**

| **Sensor Long Dimension** | **1:1 Original Size** (Inches @300 PPI) | **1:1 Original Size** (Inches@400 PPI) |
|---|---|---|
| 2 000 | 6.67 | 5 |
| 4 000 | 13.3 | 10 |
| 6 000 | 20 | 15 |
| 8 000 | 26.67 | 20 |
| 10 000 | 33.33 | 25 |

## B.4 Other considerations when implementing ISO 19264 imaging

Paintings with deep impasto, books with gold leaf, bound documents that are not able to lay flat may require special handling and consideration. An imaging system configured to satisfy the technical ISO 19264-1 requirements may still be utilized as a starting point for imaging these more complex materials because some or all of the basic concepts and technical criteria may still apply. Using ISO 12624-1 as a baseline, individual parameters can be modified to suit the unique requirements of certain object types. Those modifications should be documented in order to achieve consistent results. An acceptable scenario would be the decision to utilize cross-polarized illumination to eliminate surface glare. The imaging system could be configured to meet ISO 19264-1 tolerances for both normal light and cross-polarized light. If the requirements of a certain material type or visualization stray too far from ISO 19264-1 (such as raking light) additional “interpretive” captures may be required. A painting may be digitized with polarized light and “normal” light adhering to ISO 19264-1 tolerances, while additional captures could be created using asymmetric or even raking light with the camera system in registration to create a more complete description of the artwork. At some point it is difficult to combine creative lighting techniques and interpretive imaging with objective capture practice simply because targets and tolerances become impossible to utilize.

Specific digitization use cases, such as imaging text for OCR, are occasionally required based on institutional goals. Program managers may always choose to optimize systems for a specific single use case but when the ultimate end use is unknown it is advisable to aim high in terms of digitization. A high quality image may serve as a true digital surrogate and even a physical access copy at any time in the future. Considering it’s not always feasible to re-image a collection it is wise to aim towards the highest precision possible. While it is not advisable to aim below ISO 19264-1 quality criteria, it is acceptable to image beyond the image quality criteria set forth in the ISO 19264-1 and is ultimately a program management decision to exceed the specifications.

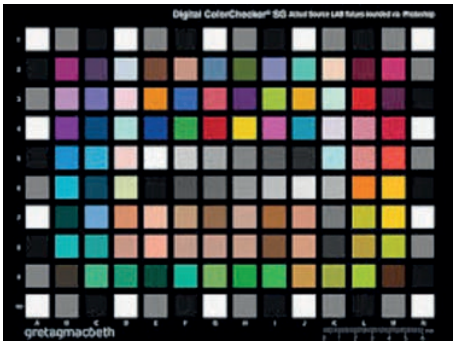


**Figure 11 — ICC colour profile**

— After having established correct chart illumination and exposure, capture the colour chart. If your software does not support built in ICC colour profiling export the file as a 16bit RGB Tiff in a colour encoding space that is larger gamut than the colour chart you wish to utilize for profiling (Note it is possible to characterize cameras using raw image data, but the process can become complicated due to a lack of standardization for raw data and its interpretation).

— Using any software capable of creating ICC input profiles, follow the manufacturer's steps to generate an ICC profile.

— After loading the ICC input profile, select the profile in the DSC or host control software.

— Re-Verify Neutral Balance, Exposure, and Tone Reproduction (OECF).

— Capture a new chart image and re-check neutral balance, exposure, and tone reproduction. Export the file making sure to embed the custom ICC device profile or working colour encoding space.

### 5.7 Analyse colour and tone

The image of the colour chart can be compared to the chart reference data manually or via open source or commercial analysis tools. For colour evaluation the $\Delta E$ 2000 formula is recommended using a SL 1 in the calculations*. The $\Delta E$ 2000 colour difference formula as published was not specifically engineered for scene referred imaging analysis and assumes a non linear transform for lightness that is not appropriate for calculating $\Delta E$ values for scene referred imaging applications. Specifically, without modification, the $\Delta E$ calculation will report inaccurate $\Delta E$ values even when source $L^*$ target values perfectly match $L^*$ values in an image. Ensure that the software you are utilizing for image analysis supports this particular $\Delta E$ calculation method.

When configuring an imaging system it is a good idea to validate the capture of a colour chart to its reference data as well as comparing spectral measurements of sample artworks with their representations. It's essential that the chart and reference data are verified or known.

## 6 Application of image quality analysis

### 6.1 Selection of imaging systems: preflighting equipment or vendors

The best time to implement an imaging strategy is after your project scope has been clearly defined and the collection has been assessed. If the collection goals are appropriate and the size of original work is known, one can evaluate equipment strictly based upon technical performance criteria and by analysing test targets. Due to the complexity of imaging systems it is common for imaging systems to easily pass certain criteria while failing other criteria, the results of ISO 19264 analyses will help identify and resolve problems. For example: A failure to pass illumination uniformity aims can be traced to the incorrect positioning of a light source. Failure in a single chart MTF region may reveal that the imaging system plane is not parallel to the artwork plane. If an imaging system does not pass certain

criteria, a determination can be made to accept the results or not based on the material to be digitized. If an exception is made, the exception should be documented for future reference.

Taking an objective approach to equipment selection is the most effective way to define equipment needs. It is absolutely critical to evaluate internal or external vendor imaging systems against the pre-defined project criteria. It is all too common for cultural heritage sites to "clone" systems based on polling peer institutions or hardware vendors. Equipment changes too rapidly for this to be a viable approach. If new equipment is to be purchased it needs to be pre-qualified in order to avoid a worst case scenario such as finding out that a newly purchased imaging system does not satisfy project requirements. It is also critical to validate the imaging equipment and workflow BEFORE purchasing or committing to a digitization vendor. Imaging performance criteria may be defined in purchase contract language as well as a specific deliverable for new equipment configuration and installation. ISO 19264-1 is an ideal approach for the qualification of imaging systems as it is based on objective reports that can become part of contractual deliverables.

In the early days of imaging only the most costly systems were capable of high quality digitization. Today users have many options to achieve high quality results using tools readily available worldwide. As long as the digitization system satisfies the quality criteria outlined in ISO 19264-1 image quality will generally be acceptable. It is rare that a project stands alone so cameras and/or scanners need to be considered in context with larger programmatic goals. Smaller institutions may need to identify equipment that is capable of serving multiple applications as opposed to dedicated turnkey imaging systems.

## 6.2 Using ISO 19264 target: Initial system configuration

System validation is part of the system configuration process. Before one invests the time to configure a new imaging system, or contracts an outside vendor, digitizing and analysing the ISO 19264-1 target chart will provide valuable insight into the systems performance. Most systems require a certain degree of configuration in order to meet predefined quality levels. After configuring the imaging system for uniformity, colour and tone response the ISO 19264-1 target can be re-imaged and these criteria will typically show dramatic improvement. Note: The ISO 19264-1 target colour patches are not designed to validate system colour accuracy-they are incorporated to aid in establishing system baselines and ongoing quality control. The chart is captured and analysed. The analysis helps guide the process of fine-tuning system parameters until the best possible quality has been achieved.

## 6.3 Using ISO 19264 target: System performance evaluation (benchmarking)

Once the imaging system and or vendor has reached the desired level of imaging performance, the ISO 19264-1 target is utilized to capture and record the performance at a point in time. Typically this would be at the outset of a digitization effort. Once the results have been reported, it is a good time to document and back up all relevant equipment settings, profiles, metadata etc. this will serve as a valuable archival resource in the event of an equipment failure, change in vendor or other variable.

## 6.4 Using ISO 19264 target: Ongoing performance monitoring

ISO 19264-1 centers on analysing and reporting imaging system performance. It does not require a specific quality control schedule or reporting, this is left to program managers to establish. It is not uncommon to capture and analyse an ISO 19264-1 target chart on a per-system daily basis or even per operator shift basis. In practice, imaging systems and operators can introduce a number of variables that could lead to unpredictable image quality. Systems are analysed against the predefined quality criteria outlined ISO 19264-1. This approach helps ensure that the imaging systems perform well relative to other systems around the world-configured to meet the same criteria.

In practice it is common to first establish that a system meets or exceeds the ISO 19264-1 published tolerances, and then to utilize specific system baselines as a tool to resolve technical issues. In programs with multiple digitization systems each system will have its own "fingerprint" and it is helpful to understand the systems strengths and weaknesses. For example: a camera/copystand configuration is much more susceptible to illumination uniformity issues than a flatbed scanner. A

digital camera/copystand configuration may need to be monitored more closely to verify illumination uniformity.

A scheduled system analysis gives program managers understanding of the most important image quality criteria.

## 7 Technical metadata for image quality analysis

When scanners and cameras create image files, they also generate a range of technical metadata about the image. Most systems write such metadata according to the Exif standard[1)]. In common image formats, such as JPEG, TIFF, and JP2000, the technical metadata are embedded in the file header, whereas for RAW formats the technical metadata can be written to a separate file (sidecar) or embedded as XMP data in the case of a DNG (Adobe Digital Negative) format image.

The technical metadata enables successive programs to process and render the images correctly. In addition, the technical metadata are useful for image quality analysis and control. Some image quality analysis programs compare the claimed sampling rate, which is written in the technical metadata, to the measured (obtained) sampling rate and calculate the difference to verify if it is within given tolerances. As for image quality assurance it is recommended to save the following technical metadata together with the results of the image quality analysis:

— date and time (when the test image was captured);

— creator (name/id of operator);

— imaging device (manufacturer and model);

— imaging software (name and version);

  — camera settings (if applicable):

    — aperture;

    — shutter speed;

    — ISO (sensitivity/speed);

  — image data:

    — image width and image height;

    — resolution (claimed sampling rate);

    — bits per sample (bit depth);

    — colour space;

    — colour profile.

The results of the image quality analysis may be embedded in the image test file together with the technical metadata and saved for future reference. The metadata and the results may also be exported to a spreadsheet or a database for a more effective monitoring of imaging system performance[1].

1) Exchangeable image file format for digital still cameras, Exif Version 2.3, Standard of the Camera and Imaging Products Association (CIPA), Revised 2012, http://www.cipa.jp/std/documents/e/DC-008-2012_E.pdf ExifTool is a useful application for reading, writing and editing embedded metadata, http://www.sno.phy.queensu.ca/~phil/exiftool/