# Those bothersome colourplate charts. Some practical guidelines

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The quality of the digitised copy of a museum or library artefacts – both two- and three-dimensional – is determined by several factors, which can be boiled down to the level of skill of the photographer taking the pictures or the operator of the machine;[1] however, these skills play a particularly important role in the field of technical photography. Colour reproduction and fidelity is one of the most important factors. What is interesting is the fact that the popularisation of digital image recording and the trend of digitising museum collections did not coincide with the understanding that this factor needs to be controlled for. The colour reproduction accuracy was seen as important in the past, when pictures were taken using solely light-sensitive materials and then presented as photographs or printed reproductions. A colour chart or colour target placed in the frame enabled the assessment of the quality of the photographer's work, and the printing house personnel could use them to correctly set the printing parameters. The development of digital documentation technology led to the emergence of digital museum collections published for promotional, educational and research purposes – in a short time, this phenomenon has reached an unprecedented scale. The rapid development of technology has coincided with growing requirements concerning the technical quality of reproductions, including colour fidelity. As a result, the aspects of the process previously believed to be best practices and seen as a sign of excellence were increasingly included in universal standards and guidelines, which soon became recognised internationally.[2] These standards require the use of standardised tools: colour charts, test charts and targets, which enable checking the digitisation process and validating its outcome.

The requirement to place a colour chart or target in the frame leads to a number of practical issues concerning the type and size of the photographed object, and the type and dimensions of the chart. What is more, the decisions made by the photographer often impact the effectiveness of the tool used. This paper covers some of the possible solutions, along with a discussion of their impact on the quality of the resulting digital image.

1 This does not apply to situations where data is acquired using automated photogrammetric stations or as a result of other 3D data acquisition techniques, such as structured-light scanning or Time of Flight (ToF) laser scanning (editor's note).

2 Some of the standards in question include the US-based FADGI (Federal Agencies Digital Guidelines Initiative) standard (www.digitizationguidelines.gov/ [retrieved on 30 November 2023]), as well as the Dutch Metamorfoze Preservation Imaging Guidelines, www.metamorfoze.nl/sites/default/files/documents/Metamorfoze_Preservation_Imaging_Guidelines_1.0.pdf (accessed 30 Nov. 2023).

The issues outlined in the paper will be illustrated with examples of the following categories of objects and artefacts:

– two-dimensional: two prints and two paintings in different formats;
– three-dimensional: one object, with several positioning variants of the colour test chart.

The paper also includes various placements of colour test charts in the frame either when calibrating equipment or when photographing a given subject, based on the following test targets:

– a device-level parameter chart – A3-sized UTT Image Engineering chart, which serves a similar function to the DLT Golden Thread chart. These charts are also used to control other parameters of the equipment used for preparing the digital representation of the object, including resolution, noise, lighting uniformity, etc.
– an object-level parameter control chart – TE263 Image Engineering chart, which serves a similar function to the OLT Golden Thread chart. These charts enable validation of the quality of the resulting image;
– ColorChecker DSG – a standard 140-field colour test chart;
– ColorChecker Passport Photo – a colour test chart with 24 colour fields included in the classic ColorChecker chart.


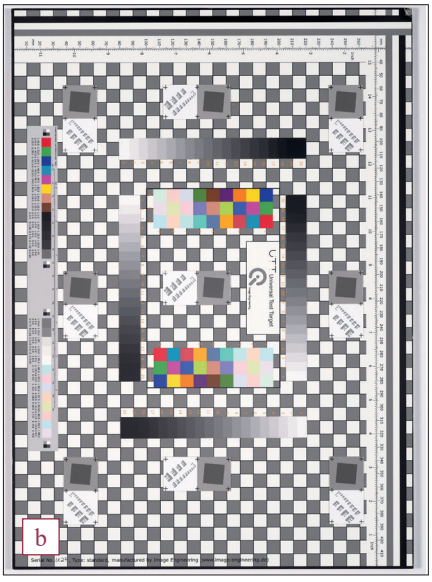


Fig. 1a–b

(a) X-Rite ColorChecker Digital SG with TE263 Image Engineering chart; (b) A3-sized Universal Test Target

**Two-dimensional objects: prints, drawings, paintings, maps, etc.**

Placing the UTT/DLT or the ColorChecker DSG chart next to an object may seem pointless, as in both cases their sheer size will greatly lower the quality of the reproduction by covering a significant part of the frame, which should be filled to the greatest possible extent with the photographed object.

In the process of digitising flat objects with dimensions up to A3 size (approx. 30 × 40 centimetres), the preferred process entails taking first a photograph of the ColorChecker DSG chart (Fig. 1a) for the purpose of colour profiling, followed by the photographs of the UTT/DLT charts (Fig. 1b). The photographer is then able to create an ICC colour profile and get comprehensive information concerning the quality of the reproduction obtained using a given piece of


Fig. 2a–b

The print *Jason Killing the Dragon* by Salvator Rosa from the collection of the National Museum in Gdańsk, photographed using the TE263/OLT target in two variants presenting the object's face: (a) with the passe-partout and (b) without the passe-partout

equipment in a given configuration. This process needs to be carried out once a month for each equipment system (camera, lens, lighting set-up), as long as the arrangement, layout and settings remain unchanged.

At that point, a photograph of the object can be taken with TE263/OLT[3] placed wherever it takes up the least space in the frame, depending on the aspect ratio of the sides of the object (Fig. 2).

**Prints in ca. A1 paper size**

In the case of a larger print, the UTT/DLT chart will not fill the entire frame of the intended picture (Fig. 3)[4] and thus will enable validation of the picture quality at the point of its placement in the frame. Even if the photographer obtains the correct exposure values at the location of the test targets, they cannot know what the exposure conditions

3 The TE263/OLT chart is made in line with the requirements for the UTT board – it is a smaller variant designed to be placed in the frame next to the photographed object. Since they are based on an open standard, UTT boards can be made by various manufacturers (editor's note).

4 The dimensions of the A1 format are 841 × 594 millimetres.

Fig. 3

An illustration depicting a situation where a 297 mm × 420 mm UTT chart provides information only in the centre of a frame covering the dimensions of an A1-sized print

are in the rest of the frame. In these circumstances, the recommended practice envisages taking four photographs with the chart placed in the corners of the frame.

If four test targets are available, they can be set up in the four corners; this will lower the number of required photographs to just one. Based on the resulting photograph, the photographer can check the quality achieved with the equipment in a given configuration.

Upon verifying the uniform exposure across the frame, the photographer can move on to verifying the colour reproduction quality using a colour target (e.g. ColorChecker Digital SG) placed anywhere in the frame (Fig. 4). Maintaining uniform lighting (validated in the previous step) ensures the proper quality of the ICC colour profile.[5] Once the chart has been removed from the frame, the subject can be photographer with the target (e.g. TE263/OLT) placed next to it (Fig. 5).

5 An ICC profile is a set of digital data that allows an unambiguous interpretation of colour data for each device (digital camera, scanner, display, etc.) used in the process of recording or reproducing colour. The profile is created in line with standards promulgated by the International Color Consortium (ICC); available at: www.color.org/index.xalter (accessed 30 Nov. 2023) (editor's note).

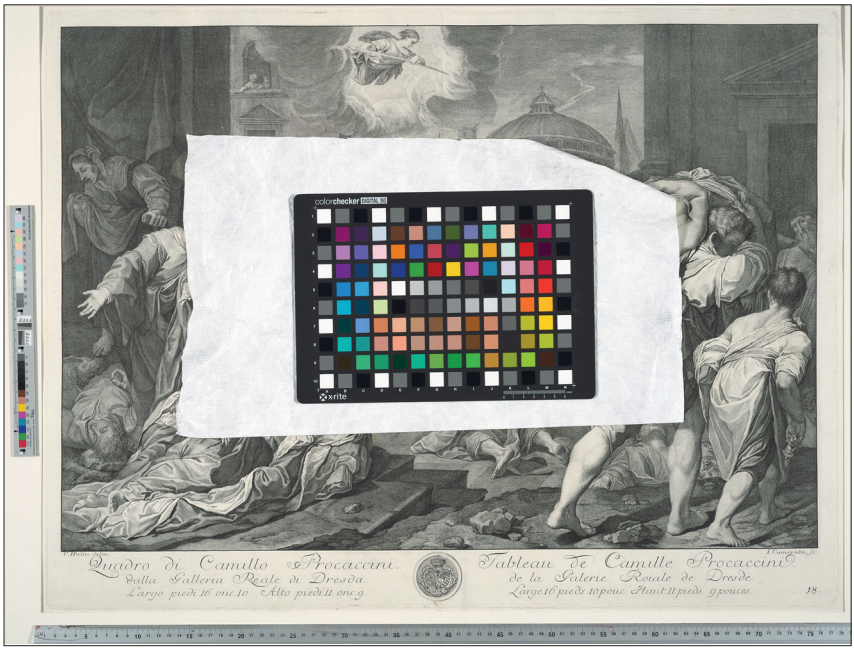


Fig. 4

A photograph of the print *St Roch Helping the Sick during the Plague* by Giuseppe Camerata from the collection of the National Museum in Gdańsk with the ColorChecker Digital SG colour target in the centre of the frame


Fig. 5

A photograph of the print *St Roch Helping the Sick during the Plague* by Giuseppe Camerata from the collection of the National Museum in Gdańsk with the narrow TE263 target to the left of the object, with a measure along the lower edge as a metric reference


Fig. 6

Three partial photographs of the print *St Roch Helping the Sick during the Plague* by Giuseppe Camerata from the collection of the National Museum in Gdańsk, covering the full frame of the camera used; in spite of the fact that the photographs were taken with a rather significant overlap (a common part that enables matching the photographs to be stitched together), the resulting resolution was at least doubled.

**The moiré problem**

In the process of digitising certain objects, such as prints, drawings, textiles and other artefacts characterised by densely-packed lines, the photographer often faces the moiré effect – a distortion of the image resulting from the overlapping (interference) of two layers of lines or grids. In this case, the effect is caused by the grid that exists on the surface of the photographed object being superimposed onto the grid of the camera sensor. In order to avoid this effect, the photographer needs to change the ratio of the density of the grids in relation to each other. If this proves impossible, the photographer needs to change the resolution of the photograph to the higher setting so that the same number of lines on the print or image is depicted with a greater number of pixels of the camera sensor.

This issue can also be solved by taking a series of stitched/panoramic photographs.[6] The figures below show approximately doubled resolutions of the resulting photographs achieved by taking partial images (left side, centre and right side) and then stitching them together in a graphics suite (Fig. 6).[7]

6 Stitching (image stitching or photo stitching) is a technique that enables combining multiple images with common parts into a single image file (editor's note).

7 Dedicated software for processing image files, such as Hugin.


Fig. 7

Four partial photographs of the print *St Roch Helping the Sick during the Plague* by Giuseppe Camerata from the collection of the National Museum in Gdańsk, taken in order to boost the optical resolution of the reproduction

If this method proves insufficient, the number of partial photographs needs to be increased until the moiré effect is alleviated. The example shown below illustrates the approximately threefold increase in resolution achieved by taking four partial photographs (Fig. 7).

In the case of partial reproduction, quality check at the equipment level should be carried out in the same way as when photographing the subject in its entirety – the given equipment configuration needs to be calibrated just once. The same rules should be followed when it comes to creating an ICC colour profile based on the ColorChecker Digital SG target. Placed at the bottom edge of the subject, the TE263/OLT target, which remains in the same place throughout the entire series, will ensure proper quality of the entire reproduction once the pieces have been stitched together.

**Paintings – A3-sized and smaller**

When creating digital reproductions of paintings, the same rules concerning the use and placement of test charts and colour targets should be followed as for prints, drawings, maps and similar flat objects.

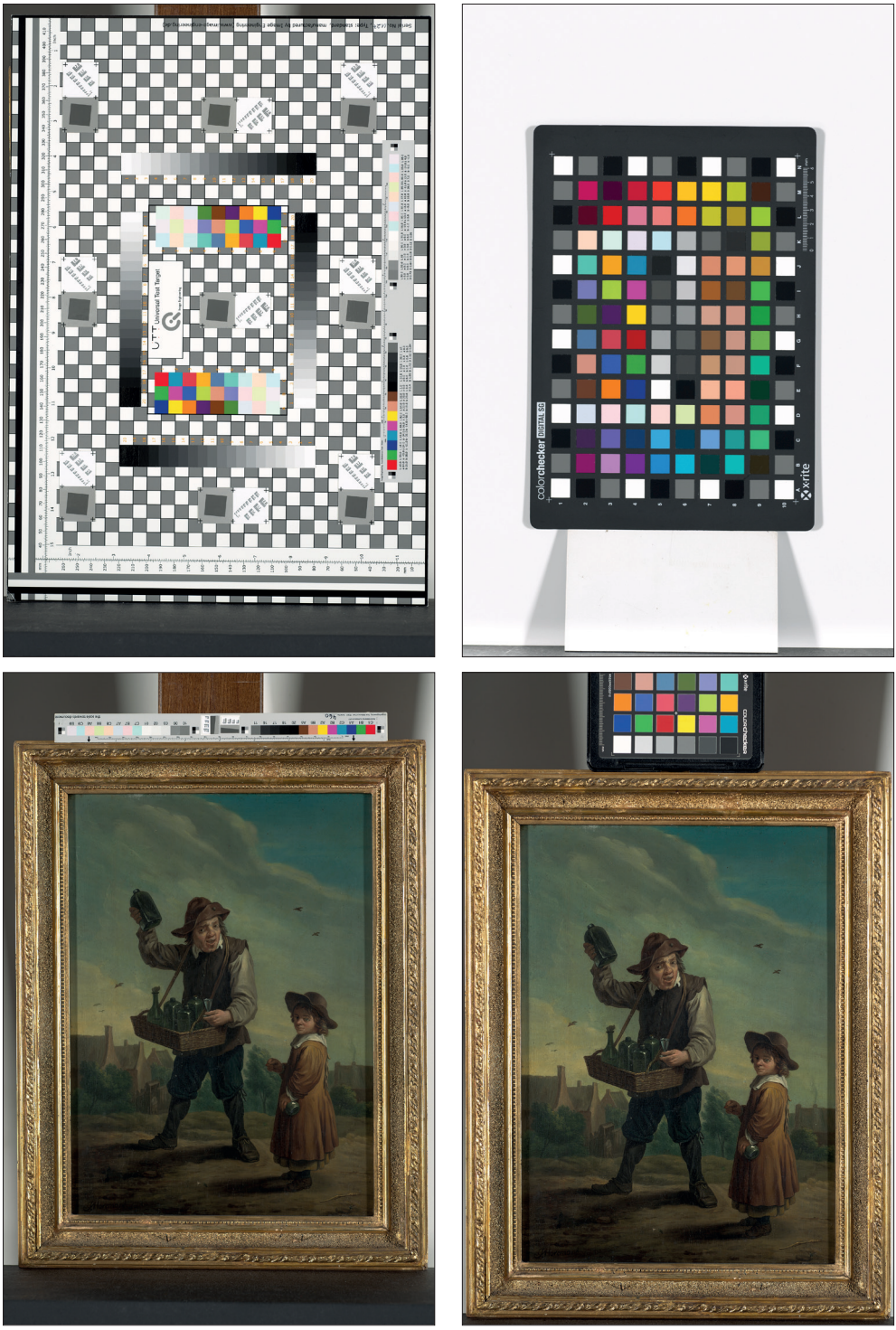


Fig. 8

The process applied during photographing the graphic object shown in Figs 3–5, this time for the oil painting *A Vodka Seller* by Jan Horemans from the collection of the National Museum in Gdańsk

Fig. 9

The process of validating the quality of reproduction when taking a documentary photograph of the oil painting *The Paradise* by Adriaen van Stalbemt from the collection of the National Museum in Gdańsk; the longer edge of the painting is 102 centimetres long

**Example of digitisation of a 70 × 100-centimetre painting**

Although there is no risk of a moiré effect in the photographs of paintings, the resolution of the reproductions is rarely sufficient. This is due to the fact that a painting usually contains a significant number of details that are of key importance to the viewer of the reproduction (fine elements, surface texture or the author's signature). Such details, which are small in relation to the size of the piece, can only be reproduced if the resolution of the reproduction is high enough. In order to maintain the same level of accuracy, larger paintings need to be reproduced in higher resolutions. Given these requirements, even using some of the best medium-format digital cameras available on the market, equipped with 150-megapixel sensors, the required quality of the digital reproduction might not be achieved, especially not when taking a single photograph of the entire object. In this case, stitching technique is generally used as an acceptable solution (Fig. 10).

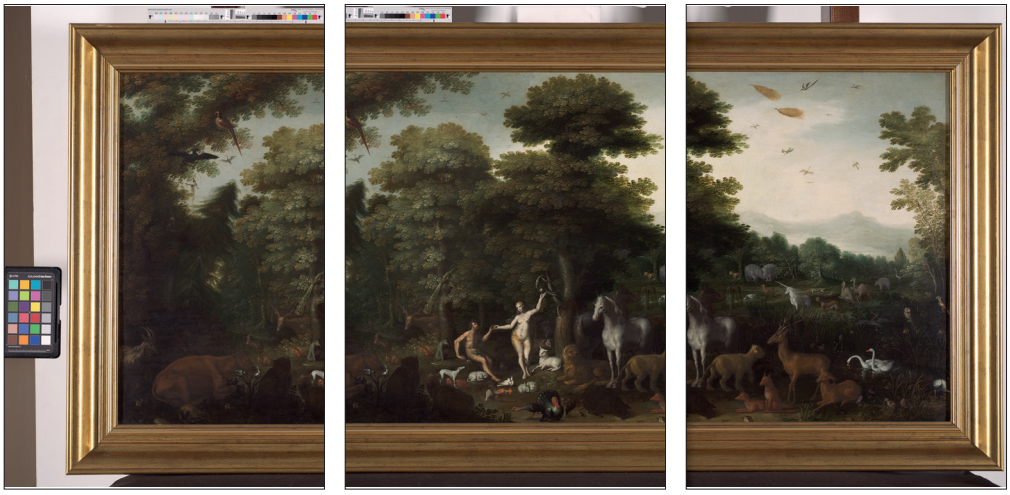

Fig. 10

Three photographs of the obverse of the oil painting *The Paradise* by Adriaen van Stalbemt from the collection of the National Museum in Gdańsk (the longer edge 102 cm in length), taken to obtain a file with resolution exceeding that of the camera sensor

Unfortunately, there are no standards or recommendations in Poland that mandate any minimum parameters for the process of the creation of digital documentation of national heritage objects in relation to the size of the documented piece. Suggesting any specific figures is beyond the scope of this paper; however, there is a significant need to develop such a solution (Figs 11 and 12).


Fig. 11

Enlarged section of the A3-sized UTT, photographed at a resolution that is too low (camera sensor resolution: 50 Mpix)

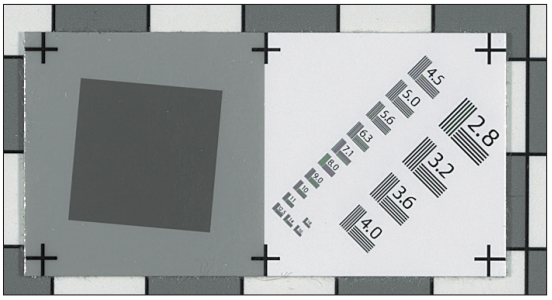


Fig. 12

Enlarged section of the A3-sized UTT, photographed using the same camera (camera sensor resolution: 50 Mpix), with resolution boosted by creating a panorama (stitching)

**Three-dimensional objects**

When photographing three-dimensional objects, ensuring comprehensive quality control of the digital representation using UTT/DLT is an exercise in futility. This is due to the third dimension, which makes it impossible to determine the correct placement of the target. Nevertheless, it is worthwhile to carry out an equipment calibration procedure based on e.g. the ColorChecker Digital SG chart in a manner similar to that for two-dimensional objects. This process does not provide information concerning the reproduction parameters at every point in the frame; however, it still enables the photographer to create an ICC colour profile at one selected point in the frame (where the colour target is placed).

When creating photographic documentation of 3D objects (such as sculptures or furniture), the colour target can be placed in several spots. Each of the locations comes with its own set of pros and cons.

Positioning the colour target in front of the object, at the right angle to the optical axis, makes the creation of a proper ICC colour profile impossible. At this position, the object will not be illuminated evenly (which is required for correct colour calibration), as 3D objects are usually photographed using a lighting set up with a single dominant light source. Ensuring such conditions is needed for showcasing all three dimension of the photographed object (Fig. 13).

Placing the colour target at the right angle to the optical axis of the camera, and to the side of the photographed object or directly above it, results in uneven lighting of the colour chart and prevents the creation of a proper ICC colour profile (Fig. 14).

Fig. 13

A silver tankard made in the workshop of J. D. Schleissner & Söhne, from the collection of the National Museum in Gdańsk, with the X-Rite ColorChecker Passport and X-Rite ColorChecker Digital SG colour targets in front; in this setup, the right side of the colour target will always be illuminated with a different intensity than the left side

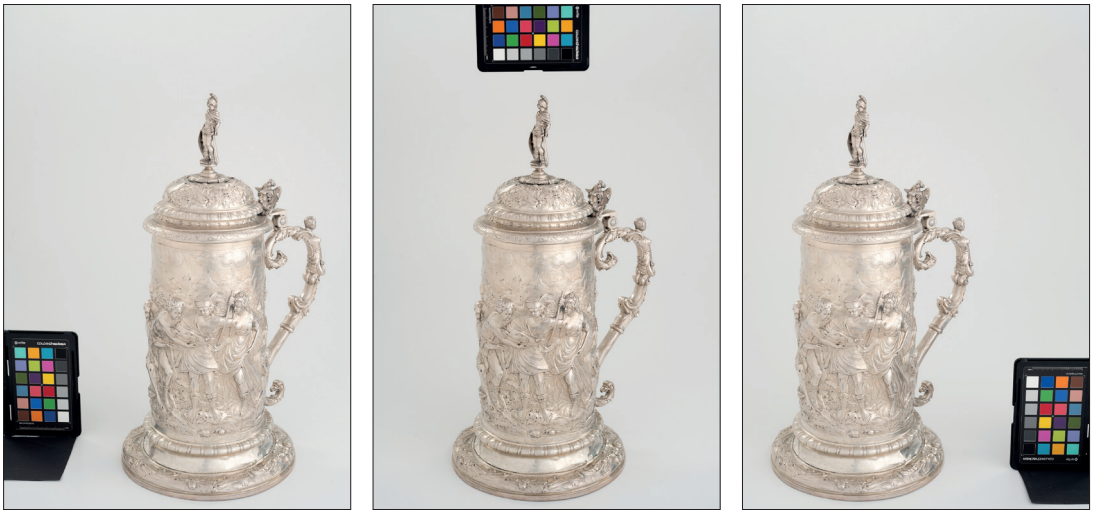

Fig. 14

A silver tankard made in the workshop of J. D. Schleissner & Söhne, from the collection of the National Museum in Gdańsk, with the X-Rite ColorChecker Passport located to the right, to the left and above the object

On the other hand, uniform illumination of the colour target and the resulting ability to create a correct ICC colour profile will be ensured by positioning it in front of or above the object; however, this needs to be done at a specific angle (perpendicular to the secant line of the angle between the optical axis of the lens and the direction of the main light source; see Fig. 15).

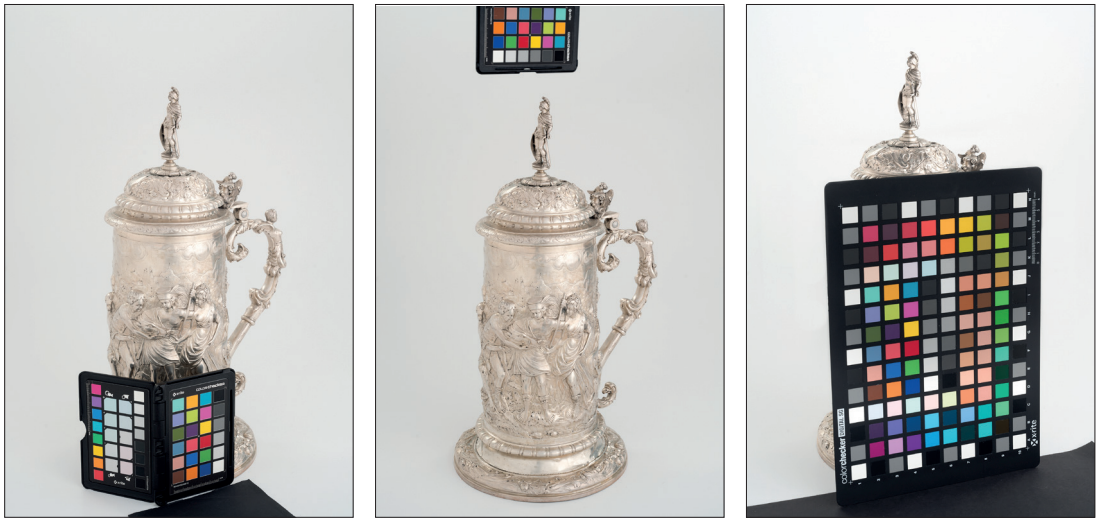

Fig. 15

A silver tankard made in the workshop of J. D. Schleissner & Söhne, from the collection of the National Museum in Gdańsk, with X-Rite ColorChecker Passport and ColorChecker Digital SG colour targets positioned in front of the object to ensure uniform illumination

In spite of the fact that documentation of the artefacts has been employing studio digital photography techniques for many years, there are no universal standards that describe a recommended process. Some of the questions can be answered by referring to the ISO standards, as well as other documents, including FADGI and Metamorfoze; however, they do not tackle the issue of photographing 3D objects – the recommendations therein concern situations in which the entire frame is illuminated

evenly. This state of affairs only highlights the need to continue working on developing the solutions to the problems indicated in this paper.

## LIST OF ILLUSTRATIONS

National Museum in Gdańsk (the longer edge 102 cm in length), taken to obtain a file with resolution exceeding that of the camera sensor. Photo by G. Nosorowski

p. 98. Enlarged section of the A3-sized UTT, photographed at a resolution that is too low (camera sensor resolution: 50 Mpix). Photo by G. Nosorowski

p. 98 Enlarged section of the A3-sized UTT, photographed using the same camera (camera sensor resolution: 50 Mpix), with resolution boosted by creating a panorama (*stitching*). Photo by G. Nosorowski

p. 99 A silver tankard (object label: *Tankard*) made in the workshop of J.D. Schleissner & Söhne in Honau (MNG/SD/806/Mt), from the collection of the National Museum in Gdańsk, with the X-Rite ColorChecker Passport and X-Rite ColorChecker Digital SG colour targets in front; in this set up, the right side of the colour target will always be illuminated with a different intensity than the left side. Photo by G. Nosorowski

p. 100 A silver tankard (object label: *Tankard*) made in the workshop of J.D. Schleissner & Söhne in Honau (MNG/SD/806/Mt), from the collection of the National Museum in Gdańsk, with an X-Rite ColorChecker Passport placed to the right, left and above the object. Photo by G. Nosorowski

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A photographer working for the National Museum in Gdańsk. In years 1990–2008, he ran a commercial photography studio and a photography laboratory using Kodak Q-Lab-certified photochemical process control system. He specialises in analogue and digital reprography. To date, he has carried out numerous digitisation projects concerning the collections of public and private institutions, as well as reproductions for publishing and scientific studies. He regularly collaborates with various cultural and research institutions. An active member of the DigiMuz Cross-Museum Digitalisation Group. Since 2012, he has been a member of expert teams and working groups carrying out training, standardisation, advisory and evaluation tasks as part of the National Institute of Museums (NIM) activities.

The study was carried out within the framework of the author's individual work.

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