Conservation and Preservation Standards for Paintings

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Abstract. Nowadays, protection of cultural heritage is a main subject of discussion all around the world. The methodologies for conservation and preservation of cultural heritage vary depending on the cultural property being studied at the time.

Conservation is a process focused on stabilizing the present situation of cultural property and restoring one or more important characteristics of it. It is an operation that aims to remove and stop its deterioration, emphasizing that its structure and history are not affected or radically altered.

On the other hand, preservation is the set of all measures and actions which are intended to prolong the useful lifetime, as well as avoiding its distortion either from an accident or a natural or man-made disaster. This includes all procedures for the safe handling, use, transport, storage and exhibition of these goods.

In this paper, paintings, on canvas, paper or wood, are studied. The main purpose is to record the basic conservation and preservation specifications, as they arise from international organizations, such as ICCROM, or ISO standards.

The result is a detailed record of the basic processes for identifying the deformations, maintenance, restore and preserve painting and their history.

Keywords: Conservation, Preservation, Paintings, ISO Standards, ICCROM.

1 Introduction

Since ancient times, standards have been used worldwide, mainly in construction. Most of them are documents embodying the formal statements of rules or principles for manufactures, the harmonization of procedures, or the instructions to achieve a required or specified level of excellence.

For example, Hammurabi defined acceptable building practices, English shipyards followed specific construction guidelines and Spanish artisans had specifications for the construction of altarpieces. [1]

Thus, early standards helped people communicate their ideas and spread their methods that had proven effective locally. With the Industrial Revolution the use of standards increased while the establishment of specific organizations for greater flexibility also started. [2]

The International Organization for Standardization (ISO) is a worldwide organization of national standards committees from more than 160 countries, founded in 1947. Its goal is the development of standardization with the aim of intending to help promote goods and services between countries, as well as any the kind of intell, sci, tech and economic activity. [3]

Additionally, the American National Standards Institute (ANSI) was founded in 1918 and is a private non-profit organization that is responsible for the development of standards for products, services, procedures etc. in the United States. It is America's official representative to ISO so as to create standards that are used worldwide. [4]

Finally, many times, countries also structure their own Standardization Institutions for specific sectors, such as the British Standards Institution (BSI) or the French Standardization Association (Association Française de Normalization - AFNOR) which also participate in the international organization. [5, 6]

In the case of conservation and preservation of cultural heritage, the creation of standards is an even more complex process, since the most basic principle of conservation is that each object is unique and its treatment should be adapted to its particularities.

The first attempts were made during the 1940s where certain levels of temperature, relative humidity and light were suggested for the preservation of large collections. During the 1960s, more articles were written which used the word "standards" in relation to preventive conservation measures. [1]

During the 1950s and 1960s, when the conservation profession began to be developed in Europe and the United States, there was a lack of control over treatments carried out by technicians as anyone could offer the services of as a conservator. So in 1963, the American Institute for Conservation (AIC) adopted the first set of "standards of practice" guidelines. The purpose of this document was to provide special criteria against a particular process. It was later completed by “Code of Ethics and Standards of Practice”, published in 1979, which set out the general principles for conservator's behavior towards a cultural property. [1, 7]

Thus, in the following years, more and more organizations began to be active worldwide so as to draw up international standards and guidelines on the conservation and restoration of cultural heritage.

2 Materials and Methods

For the present manuscript a detailed research for the main conservation principles and code of ethics is taken place. This includes a bibliographic search of the databases of conservation institutions and organizations as well as published papers of various conservation’s projects. For the paintings, a detailed analysis of the conservation and restoration steps is carried out, while important conclusions are drawn about the standards used today.

3 Organizations and basic principles of conservation

In order to understand the organizations and basic principles of conservation, it is important to mention some definitions.

Firstly, conservation is responsible for the cure of cultural heritage while ensuring its accessibility to present and future generations. Its activities can include preservation, restoration, examination, documentation, research, advice, treatment, preventive conservation, training and education. [8, 9]

On the other hand, preservation is the act of protecting cultural property through activities which help minimize any chemical and physical deterioration and damage which may lead to valuable information being lost. The actual purpose is to prolong the existence of cultural material. In addition the preventive conservation retard or prevent deterioration by controlling its environment. This can include policies for storage, exhibition, packing, transport or use. [8, 9]

3.1 Organizations of conservation

For the conservation of cultural goods and especially paintings, there are global organizations that issue guidelines and rules for optimal results. The most well-known are:

- The International Council on Museums (ICOM) which was founded in 1946 and is responsible for conducting part of UNESCO's museum program. [10]
- The International Institute for Conservation of Historic and Artistic Works (IIC) which was founded in 1950 and seeks new methods and working standards necessary for the protection and conservation of historic and artistic works around the world. [11]
- The Intermuseum Conservation Association (ICA), which was built in 1952, is the oldest non-profit art conservation center in the USA and offers conservation and restoration treatments for paintings, murals, documents, sculpture etc. [12]
- The International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) was established in 1959, and intends to raise awareness and standards concerning preservation and conservation of cultural property. [13]
- The American Institute for Conservation (AIC) which first launched in 1972. It is a national membership organization of conservation professionals. [14]
- The European Confederation of Conservator-Restorers' Organizations (ECCO) which is a European non-governmental professional organization. It was established in 1991 and aims to preserve cultural heritage through the use of conservation-restoration techniques. [15]
- The Institute of Conservation (Icon) which was formed in 2005 and supports the practice and profession of conservation of heritage objects and buildings. [16]

The superior organizations of these are ICCROM and ICOM, which have representatives in many countries worldwide. All the organizations mentioned issue their own guides and standards for the standardization of conservation, but they must comply with those of UNESCO, ICCROM and ICOM. These standards arise from confer-

ences or studies of applications over the years and also from consultations. Most of them have to do with the ethics of the conservator's profession and the basic principles of conservation.

3.2 Code of ethics and Basic principles of conservation

The code of ethical behavior in conservation, according to AIC, is that [8, 17]:

i. All actions must be defined by an informed respect of cultural property and its unique character of people who created it.
ii. The conservation must be governed by physical, historic, aesthetic and cultural integrity of the object.
iii. All actions of examination, research, documentation, conservation, treatment, training and education must be attained by the highest standards.
iv. All conservators have to recognize their skills and limitations.
v. The conservation practice must continue the development of knowledge, skills and sharing of information and experience.
vi. The conservators must respect their colleagues and adhere to this code of ethics.

Moreover the basic principles in conservation are [8, 17]:

a. The minimal intervention with the least intrusive ones.
b. The reversibility, where interventions must be as reversible as possible, or not to preclude subsequent operations
c. The distinct interventions and new materials must be perceived even by non-specialists.
d. The new materials and techniques applied must be as compatible as possible with the original materials.

Based on these codes and principles, preservation and conservation can be distinguished into the following steps. (see Fig. 1)

Fig. 1. Conservation and Preservation steps

4 Conservation steps for paintings

As mentioned, conservation of cultural property has several steps in order to be completed. The most of them have emerged from publications of conservation project. Below there are detailed descriptions of the steps as well as the standards that describe them, if any.

4.1 Examination

The first step in order to conserve a painting is to examine and identify its structure, materials or the main reasons of its deterioration. This technical examination is carried out either on the surface or in the internal structure of the object, while they are divided into categories according to their structure and content. It is also worth noting that the methods used are non-destructive because it is important to examine materials and constructions without changing or differentiating the physical state of the object. The methods used can be optical, metric, and spectroscopic, while some of them are listed in table 1. [8, 10, 14, 18, 19]

Table 1. Non-destructive examination methods [20]

Non-destructive Methods	**Results**
Infrared analysis	Revealing previous stages of the project or drawings hidden under the paint
Thermal analysis	Detection of internal damage such as fading or tears
FODR spectroscopy	Identification of colors and pigments in paintings
XRF spectroscopy	Identification of pigments and information on paintings dating
EDX analysis	Identification the chemical composition of the pigments
ATR-FTIR spectroscopy	Identification of pigments when sampling is impossible
Micro-Raman spectroscopy	Determination of the molecular structure of pigments and colors
FO Microscopy	Revealing the morphology of the surface of the materials
Analysis in the visible spectrum	Color identification
Ultraviolet analysis	Identification of varnish. Revealing faded areas
X-Ray analysis	Revealing problems in painting's support
Photogrammetry analysis	2D and 3D models with texture of paintings
Geodetic analysis	3D models with texture of paintings

4.2 Research

After the examination of the paintings, research concerning conservation status is made. In this step, all the above knowledge is combined for the assessment of the conservation status, the future restoration steps, and preventive conservation measures. [18, 19]

4.3 Treatment

Conservation treatments are related to the repair, stabilization or conservation of a painting. These must be stable and reversible. They should be well integrated visually into the final result, but distinguishable by a trained eye. This part also called restoration and may include reassembling displaced parts, removing foreign materials, or reintegrating using new materials. [8]

In paintings, as specified by projects' publications, the main steps of the procedure of treatment are [21-27]:

a. The careful surface cleaning, that dirt, surface marks and mold are removed. (see Fig. 2b)
b. The varnish removal, that the incompatible varnishes from previous restorations are removed. Over the time, the varnishes may yellow and darken, changing the total visual effect of the painting, so by removing them, the original painting and its historic layer of paint is revealed. (see Fig.2c)
c. The tear mending, that canvas' damage is restored. In this step, if it is possible, the restorers inject adhesives and applying heat to soften the paint and replace it back to the canvas. The result is a painting without tears and flaking. If craters or divots are created, they are infilled with a type of putty or composite material in order to create a cohesive surface for future work. (see Fig. 2d)
d. The inpainting, where conservators limit the areas of paint loss. Several types of inpainting techniques may be applied, but they must perfectly match the original artwork. It is important to use pigments to match the original painting, as near as possible, and also to style the brushwork to maintain the authenticity of the work. (see Fig. 2e)
e. The varnishing, that top quality varnishes are added to protect the conservation work. In this step, the painting treatment is over and the restoration is completed. (see Fig. 2f)

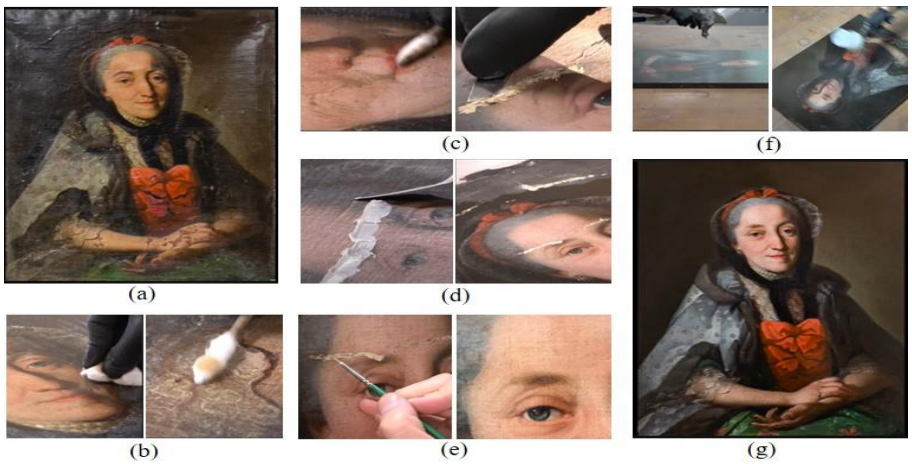

Fig. 2. (a) Painting before restoration, (b) Cleaning surface, (c) Varnish removal, (d) Tear mending, (e) Inpainting, (f) Varnishing, (g) Painting after restoration [27]

It is worth mentioning that in addition to the restoration of the painting itself, the support or the frame, if it exists, is also repaired. The restretching, the relining or frame shining are some of them. [21-26]

For the paints and varnishes there are almost 40 different ISO standards concerning the determination (ISO 2812), the exposure and assessment (ISO 2810) or the colorimetry (ISO 7724). [3]

4.4 Preventive Conservation

After restoring a painting, it is important to consider the "agents of deterioration" that may affect it in the years to come. These may include fire, flood, physical forces, thieves and vandals, pollutants, incorrect temperature and relative humidity. Most actions are taken to retard or prevent deterioration by control the environment of the painting. [8, 9, 21]

There are plenty of surveys concerning these issues from the ancient years. According to all these publications, ICC and ICOM published Environmental Guidelines for museums or personal collections. It is required that [28]:

- According to Bizot Interim Guidelines, for canvas paintings the stable relative humidity must be in the range of 40–60% and the stable temperature in the range of 16–25°C with fluctuations of no more than ±10% RH for a 24 hour span.
- According to AICCM and AIC recommendations for acceptable storage and display conditions the temperature must be between 15–25°C allowing for fluctuations of ±4°C during a 24-hour span. In addition Relative Humidity should keep between 45-55%, allowing for a fluctuation of ±5% during a 24hour span. When there is seasonal drift the RH change to a wider range limited to 40% – 60%.

But despite of these recommendations, conservators can suggest different environmental conditions for paintings, according to the materials, condition, and history of each work. [28]

Furthermore, according to ISO 19814:2017 and other local standards [29, 30]:

- For physical forces it is important to install backing boards and glazing, be careful with handling and wrapping and also manage the storage or display. Before unwrapping a painting must be allowed 24 hours to acclimatize to indoor conditions to prevent condensation.
- For thieves and vandals, the paintings should be placed behind tempered glass or Lexan and a proximity alarm and barriers should be added.
- For the fire, it is important to set a fire alarm system and fire extinguishers. Otherwise, the installation of a fire suppression system is less catastrophic than fire.
- For flood or water, in order to avoid the mold, the paintings should be removed in a cool area with temperatures below 20°C and the space must be adequately ventilated.
- For the pollutants, the handling must be done using gloves, and display locations mustn't be exposure to smoke, greasy and other pollutants. For unvarnished surfaces it is necessary to use non-glare (anti-reflective) glass and acrylic sheets.

- For light exposure, according to the sensitivity of the pigments and the light level there are specific time for exposure. There are plenty of surveys and standards and also a calculator.

4.5 Documentation

Documentation is defined as the recording of information about the conservation activities such as examination, research, treatments and conservation for every painting. These records may be textual, graphical or visual and they are permanent. [8, 18, 31]

It is the most important step in conservation because it includes:

- Documentation of examination that all the details about the existing condition of the painting are recorded. These may comprise the identity of the painting, a description of its structure and material or information about characteristic marks. Additionally a detailed analysis of the examination methods, documentation of deterioration, or other application results are presented. [8, 18, 31]
- Documentation of Treatment that records all the restoration operations. These can be the materials used during treatment or other administrative details about the "new" conditions of the painting. [8, 31]
- Documentation of Preventive Conservation that recommendations about storage, transport or display are presented. [32]

4.6 Education and Training

In order to educate and sensitize about conservation it is important to raise visual and cultural awareness not only at the university, but also at schools. Because of the absence of International standards for the conservation steps, new conservators and restorers must join specialist courses and have practical experiences. The profession of conservation is learned from one to another through observing the process but also studying and publishing further projects so as to spread the knowledge worldwide. [33]

5 Results and Discussion

Taking everything into consideration, it is found that there are few international standards concerning the conservation and preservation of cultural property and especially paintings. Most of them are suggestions and guidelines from local organizations and are based on the code of ethics and basic principles of conservation, published in 1979.

In particular, for restoration treatments there are no guidelines for the main process and the steps are derived from projects or publications rather than organizations. The only ones that exist concern paints and varnishes, while local organizations also publish standards for preventive conservation and museum ethics.

6 Conclusions

Thus, in conclusion, it is important to update the existing guidelines but also to draw up new, more modern and uniform ones for the entire world. It is necessary to create a standard with the treatment steps for paintings giving specific instructions to the conservators regarding the removal of varnish, the application of new paint and tear mending. More specifically, this ISO may include the steps shown in Fig. 3.

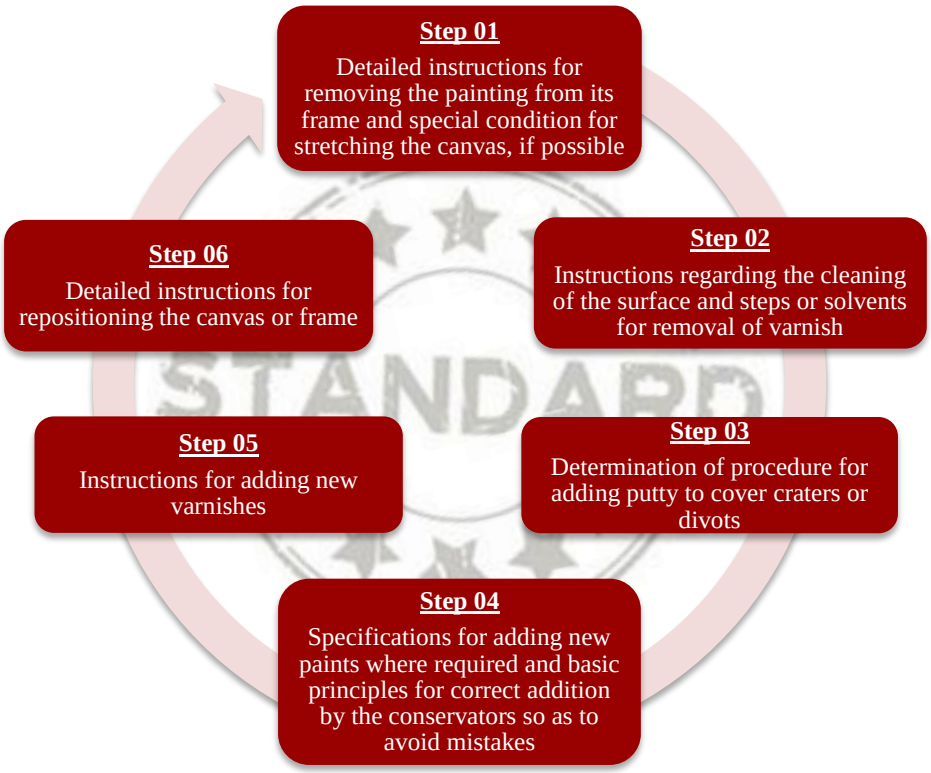

Fig. 3. Treatment steps using in proposed ISO standard

The guides of various organizations should also be registered by the International Organization for Standardization so as to be available to all. Standardization of conservation work is necessary in order to avoid mistakes and optimize the conservation of cultural heritage.

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Abbreviations

AFNOR:	Association Française de Normalization
AIC:	American Institute for Conservation
AICCM:	Australian Institute for the Conservation of Cultural Material
ANSI:	American National Standards Institute
ATR-FTIR:	Attenuating Total Reflection-Fourier Transform Infrared Spectroscopy
BSI:	British Standards Institution
ECCO:	European Confederation of Conservator-Restorers' Organizations
EDX:	Energy Dispersive X-Ray
FO:	Fiber Optic
FODR:	Fiber Optic Diffuse Reflectance
ICA:	Intermuseum Conservation Association
ICCROM:	International Centre for the Study of the Preservation and Restoration of Cultural Property
ICOM:	International Council on Museums
Icon:	Institute of Conservation
IIC:	Institute for Conservation of Historic and Artistic Works
ISO:	International Organization for Standardization
RH:	Relative Humidity
UNESCO:	United Nations Educational, Scientific and Cultural Organization
XRF:	X-ray Fluorescence

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