



Preservation and Conservation (PAC) Programme Frequently Asked Questions

Iron gall ink

Prepared by PAC North America

Q: What is iron gall ink?

A: Iron-gall ink dates from antiquity and was the primary writing ink used throughout the Western world from the 12th century until the beginning of the 20th century. From the 15th century onward it gained in popularity as an artistic medium. Iron-gall ink was made with four basic ingredients: iron sulphate, tannins, water, and a gum binder. The ink forms when iron sulphate and tannins are combined with water to produce a coloured solution with a very acidic pH. Upon drying on a paper or parchment support, the ink gradually oxidises, creating a water-insoluble pigmented complex that darkens from a purple-grey colour to a deep, indelible black. The quality of historical inks depended on the quality and the proportions of the ingredients, both of which varied greatly in recipes. Naturally occurring impurities could unintentionally alter the appearance and the properties of the ink. Prior to the 19th century, additives, such as logwood and indigo, were used to enhance or alter the ink colour, and after the mid-19th century, these were gradually replaced with aniline dyes. Other additives included gums and adhesives for gloss; acids to slow precipitation of solids; humectants, such as glycerine, to slow drying; and alcohol to inhibit mould growth and prevent freezing.

Q: What materials and collections contain iron gall ink?

A: Iron gall ink was used to create a myriad of written and artistic works. Before the introduction of the printing press in Europe, manuscripts in all academic disciplines were written with iron gall ink. It was used by governments and businessmen for official records and to create personal letters, diaries, and ephemera. Maps were drawn with it, and European artists used it for preliminary and finished sketches. In addition, iron gall ink documents were produced to further European commercial and imperial interests in Africa, Asia, the Americas and Oceania. As a result documents, manuscripts, maps and art works are found in libraries, archives and museums around the world.

Q: What are the preservation concerns with iron gall ink?

A: The formulation of the ink

The deterioration of parchment and paper by iron gall ink is a result of oxidation and hydrolysis reactions, promoted by excess iron, from iron salts and the acidic nature of the ink. This

deterioration is referred to as ink corrosion. The extent of ink corrosion varies for paper and parchment, due to differences in their fibre composition, thickness, and their chemical properties. Some of the signs of ink corrosion are:

- a gradual change in the ink colour from black to brown
- the brown discoloration and gradual embrittlement of supports;
- friability or cracking of inked lines
- loss of inked areas of the support
- the spread of the degradation reactions to adjacent materials.

Uncontrolled environmental conditions:

- High humidity promotes acid hydrolysis reactions, leading to embrittlement of the paper associated with a decrease in pH. It also encourages the movement of iron ions into non-inked areas of the support, creating additional sites for oxidation.
- Fluctuating or cycling humidity with elevated temperature compounds the deterioration of both ink and paper, and may result in flaking and losses of the ink layer on parchment.

Other deleterious factors:

- A bad formulation of the ink leading to fading
- Historical efforts to enhance fading inks leading to eventual loss of ink legibility
- Previous restoration or conservation treatments, especially the use of water alone.

Q: What efforts have been made to address preservation of iron gall ink?

A: Early efforts to address iron gall ink corrosion focused on reinforcement and repair, such as silking, which the Vatican developed in the late nineteenth century, and cellulose acetate lamination, which was adopted in the U.S. starting in the 1930s. As the field of book and paper conservation was established, interventive treatments like washing and alkalinisation became standard practice in many institutions by the 1970s and 1980s.

Conservation research science centres in Europe have led multiple international efforts to research iron gall ink and address its preservation over the last twenty years. One of the main contributors has been the Netherlands Cultural Heritage Agency (RCE), along with European Union-funded partnerships, like InkCor, and related projects in Austria, France, Germany, Slovenia, the U.S., and Canada among others. Conservators and scientists have collaborated on numerous initiatives including

- the development of tools for examination, identification, and imaging of iron gall ink
- investigations into the molecular structure of the ink molecule
- survey and risk assessment tools to manage preservation of collections
- research into housing materials and environmental storage conditions

- studying treatments for iron-gall ink, in particular of the 'phytate treatment' to slow ink corrosion reactions, and repair techniques.

Q: How can the condition of iron gall ink be assessed?

A: Assessment of condition of iron gall ink begins by documenting the physical appearance of the ink. Visual assessment and degree of damage are used to evaluate the condition of ink and support, as the preservation requirements of both must be considered together. Observation with the naked eye and under magnification yield important information about the two main preservation concerns for iron gall ink, ink corrosion and fading.

One of the simplest tools for surveying iron gall ink collections and determining basic information about condition is the Condition Rating System (CRS) for iron gall ink, a classification system with four condition categories that are selected based on the appearance and handling characteristics of artefacts. <https://www.scribd.com/document/27703598/Condition-rating-for-paper-objects-with-iron-gall-ink-ICN-info-1>

More in-depth assessment requires the use of examination forms that are specific to iron gall ink. Conservators determine the treatment needs of artefacts by thorough systematic evaluation of various characteristics of the ink and support guided by such forms or templates. Examples of forms and additional information can be found at: <http://cool.conservations.org/coolaic/sg/bpg/annual/v27/bp27-20.pdf>

https://irongallink.org/igi_index2b0f.html and http://www.cac-accr.ca/wp-content/uploads/2018/12/Vol37_doc2.pdf

Q: What strategies exist for the preservation of iron gall ink collections?

A: There are three main strategies for preserving iron gall ink collections.

- Providing stable environmental conditions iron gall ink collections is fundamental to preserving them. In the past, consistent temperature and relative humidity of 21°C (70° F) and 50% RH were considered ideal environmental conditions to preserve collections. More recently, for paper- or parchment- based collections containing iron gall ink, cool temperatures and RH at 30 to 40% have been recommended. However, providing stable conditions which can be achieved reliably by the institution is a better preservation strategy than aiming for values that cannot be realized or maintained over the long term. Collections with specific need. A resource for managing the collections environment is time-weighted preservation index technology (TWPI), developed by the Image Permanence Institute (IPI) at the Rochester Institute of Technology in the United States. <https://www.imagepermanenceinstitute.org/environmental/research/preservation-metrics>
- Proper housing for collections containing iron-gall ink is necessary as it can mitigate some aspects of damage and deterioration. A housing, such as a box can protect collections from damage by environmental elements, such as water, dust, light. Boxes also act as a buffer between collections and environmental conditions, slowing the effects of humidity and temperature extremes. Housings for works containing stable iron gall ink do not differ

fundamentally from other paper- and parchment-based materials, and should be manufactured from chemically stable materials, free of lignin and bleaching residues, and alkaline-buffered (pH greater than 7.5).

- Safe handling to provide access to iron gall ink documents. The choice of correct housing materials can make collection items more accessible as they can provide support to fragile documents. Training staff and researchers in proper handling procedures will minimise damage to iron gall ink collections.
- Interventive treatment can have significant implications for the preservation of iron gall ink artefacts but it is best to contact a conservator experienced in the treatment of iron gall ink. Iron gall ink is sensitive to water and certain components in the inks may also be sensitive to other solvents. In addition, water alone and repairs with water-based adhesives can promote corrosion. A conservator will be able to advise whether treatment is necessary, to weigh the benefits of treatment against the risks, and to guide the decision-making process.

Q: How can you address iron gall ink preservation in your institution?

A: A well-developed preservation plan is the best method to institute strategies to minimise the risk to the longevity of iron-gall ink collections. Risk is assessed by reviewing the impact of temperature, relative humidity, light and other environmental factors, surveying the physical condition of the collection; ascertaining the research, monetary or legal value of the collection, and how often it will be used. Resulting plans may focus on preservation management, including passive preservation measures, such as environmental conditions, or on conservation strategies, such as interventive treatment. Tools for risk assessment include the Image Permanence Institute's Preservation Metrics and Time Weighted Preservation Index (TWPI), and, specifically tailored to iron gall ink, the Ink Corrosion Prognosis – Computer Simulation, available through the Iron Gall Ink website, <https://irongallink.org/>. The software tool estimates the risk of ink corrosion on specific objects, based on uploaded images and basic information, such as age, and anticipated environmental conditions and handling.

Q: What exhibition and display conditions are recommended for items containing iron gall ink?

A: The following are a few recommendations for the displaying iron gall ink artefacts:

- Light exposure should be limited to 3 to 5 foot-candles, or approximately 30 to 50 lux depending on the intensity of the ink. All ultra violet radiation should be screened out. A currently accepted recommendation for the exhibition of iron gall ink artefacts is once every 5 years at the above light exposure for 6 months.
- Controlling RH and temperature
- Creating passive sealed microenvironments that are unaffected by the gallery environment. The recommended microenvironment for a single document or artwork is a sealed package comprising appropriate matting materials, a silica gel sheet pre-conditioned to 40%RH, a polypropylene corrugated board, and glazing with either UV-filtering acrylic or glazing. The package may be framed for display.

Q: Where can you find more information about iron gall ink?

A:

n.d. Birgit Reissland, Frank Ligterink, Claire Phan-Tan-Luu. "Ink Corrosion: Object Characteristics"

<https://www.youtube.com/watch?v=0ocmFw9D--c>

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2002. *The broad spectrum: studies in the materials, techniques, and conservation of colour on paper*, edited by Harriet Stratis and Britt Salvesen. London: Archetype Publications, 2002.

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n.d. Image Permanence Institute, Rochester Institute of Technology, Environmental Management, Overview Statement

<https://www.imagepermanenceinstitute.org/environmental/overview>

n.d. Image Permanence Institute, Rochester Institute of Technology, Environmental Management, Preservation Metrics

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n.d. Image Permanence Institute, Rochester Institute of Technology, *IPI's Guide to Sustainable Preservation Practices for Managing Storage Environments*

n.d. Image Permanence Institute, Rochester Institute of Technology, *IPI's Methodology for Implementing Sustainable Energy-Saving Strategies for Collections Environments*

Print or

PDF at <https://www.imagepermanenceinstitute.org/resources/publications/ipi-methodology-guidebook>

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