

Interpretation If the indicator paper turns magenta, iron (II) ions are present in the tested area. The intensity of the magenta colour formed on the indicator paper is depending on several factors such as the concentration of iron (II) ions in the tested area, the amount of water applied, the contact time and the contact pressure. Therefore, a contact test never can be used as a quantitative test.

Caution / Interference

- only use stainless steel equipment and avoid any contact with iron and rust
- do not touch the test strips with bare fingers
- do not use excess water in contact with the original, since this always will cause a water stain and possibly will cause bleeding of the indicator to the original
- interference of the reading is expected from water soluble, coloured substances like ink additives (e.g. logwood) or ink and paper degradation products that could migrate to the indicator paper and disturb the observation of the magenta colour. Since the indicator and its iron (II) complex only have a low solubility in water, these disturbing substances can simply be removed by rinsing the reacted area of the strip with water.

Modification to detect iron(III) ions In order to detect whether water-soluble iron(III) ions are present in the tested area of the object, drip a 1% aqueous solution of ascorbic acid (Vitamin C) on the indicator paper *after* it has been in contact with the original. If present, the iron (III) ions will be reduced by ascorbic acid to iron (II) ions, which are bound to the indicator, causing an enhancement of the magenta colour.

Availability The test is commercially available from Preservation Equipment Ltd., Vinsces Road, Diss, Norfolk IP22 4HQ, U.K., Tel: + 44 (0) 1379 647400, Fax: + 44 (0) 1379 650582, E-mail: info@preservationequipment.com
Website: www.preservationequipment.com
Product Code: 539-3000

Reference Neevel, J.G. & Reissland, B.: *A new, non-destructive test for water-soluble iron salts*, Restaurator **22** (2002), to be published

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INDICATOR PAPER FOR IRON (II) IONS

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General The non-bleeding indicator paper for iron ions has been developed as a simple and rapid micro-test method to detect iron ions in hydrophilic substrates. Iron ions are harmful to paper and parchment because they catalyse the oxidative degradation of cellulose and collagen. They can be present in two oxidation states: as iron (II) or as iron (III) ions. To be harmful, the ions have to be dissolved in the water absorbed to the substrate ("free"). The test can be applied for instance on paper artefacts in order to see if iron gall inks stains, foxing or tidelines contain "free" iron ions. Furthermore, it can be applied to evaluate the effect of a treatment aiming the removal of "free" iron ions. In contrast to commercially available iron indicator papers, this newly developed iron test contains an indicator with a very low water solubility. Therefore, if applied with only a very small quantity of water, it can be used in direct contact with the original without the risk that the indicator will bleed to the original. It is necessary to point out that a positive reaction of the iron test is no definite identification of iron-gall inks, because other inks, e.g. bistre, can be contaminated with iron. If iron ions are bound in a pigment like Prussian Blue or Red Ocre, they are not water soluble and therefore cannot be detected with this test.

Principle Water-soluble iron salts will migrate into a dampened test strip that is brought in contact with the surface of an artefact. The test paper contains the indicator bathophenanthroline, which forms an intensely magenta-coloured complex with iron (II) ions. The complex, as well as the indicator, have a very low water-solubility. Therefore, if only water adhering to the test strip is used to cause the transport of soluble iron salts, there is no risk of bleeding to the object during the contact.

Procedure Necessary materials and equipment: Iron (II) indicator paper, distilled water, capillary pipette, pair of scissors (stainless steel), tweezers (stainless steel or plastic), inert plastic foil (Mylar, Melinex), timer, blotting paper

- place the object on an inert, clean support like glass or plastic
- cut out an appropriate size piece of the indicator paper
- place a drop of distilled water on the indicator paper with a pipette
- remove the excess water by blotting - the indicator paper must be damp, not wet
- place the indicator paper on the ink, cover it with a piece of inert plastic foil as a barrier against contamination
- press the indicator paper on the support for 30 seconds - use a weight or fingers, low pressure
- remove the indicator paper from the object - if iron (II) ions are present, the strip will become magenta. During drying the colour change will intensify and be complete after 2-5 minutes