INTERNATIONAL STANDARD

ISO 18941

Third edition
2020-07

Imaging materials — Colour reflection prints — Test method for ozone gas fading stability

Matériaux pour l'image — Tirages par réflexion en couleurs — Méthode d'essai de la stabilité de la décoloration à l'ozone

Reference number
ISO 18941:2020(E)

© ISO 2020



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Requirements **3**
5 Sample preparation **3**
5.1 Target selection 3
5.2 Use of replicates and reference samples 3
6 Holding and measurement conditions **3**
7 Test methods — Gas fading (ozone) **5**
7.1 General 5
7.2 Apparatus 5
7.2.1 Ozone test device 5
7.2.2 Source of ozonized air 8
7.2.3 Means for adjusting, controlling and maintaining ozone concentration 9
7.2.4 Means of determining the ozone concentration 10
7.2.5 Means of controlling gas flow 10
7.2.6 Test piece carrier 11
7.3 Test procedure 12
8 Test environment conditions **13**
8.1 Humidity control calibration 13
8.2 Relative humidity 13
8.3 Temperature 13
8.4 Ozone concentration 13
9 Test report **14**
9.1 General reporting requirements 14
9.2 Ozone test reporting 14
Annex A (normative) **Reciprocity considerations** **16**
Bibliography **18**

© ISO 2020 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 42, *Photography*.

This third edition cancels and replaces the second edition (ISO 18941:2017), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the test methods for environmental stress factors have been changed to align with ISO 18944:2018;

— the calculations and computations section has been removed as they are now contained in ISO 18944:2018;

— Annex A has been removed as the method for interpolation is now contained in ISO 18944:2018, Annex B;

— the usage and reporting requirements have been updated to ensure consistency within the ISO 189## family.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2020 – All rights reserved

Introduction

In image permanence testing, there are four environmental variables known to affect the stability of a photographic image: heat, light, moisture and air pollution, such as ozone[13][14][15][16][17][18][19][20][21][22][23][24][25][26]. Although natural ageing under "real-world" environmental levels of these variables is considered the only certain test for image permanence, the high stability of most modern photographic products makes testing under ambient conditions too lengthy a process to be of practical use. Thus, a widely used alternative to natural ageing is accelerated ageing, whereby a sample specimen is exposed to each environmental variable individually and at levels considerably greater than ambient, forcing degradation of the image by that single factor in a far shorter length of time.

This document covers the equipment, methods and procedures for generating a known ozone exposure and the subsequent measurement and quantification of the amount of change produced within a photographic image due to that exposure. It is important to note that if predictions of absolute product longevity are of concern to the experimenter, then further knowledge shall be gained regarding the reciprocal behaviour of the test product under the experimental accelerated ozone conditions. See Annex A for more information on reciprocity.

Additionally, there are other known variables in an ozone test setup that can affect the rate at which an image will degrade in the presence of ozone. These include air flow over the sample, the nature of the chemical reaction that is occurring, the relative quantities of the reactants (ozone and colorant molecules) and the humidity content and the pH of the image recording layer. Each of these variables can affect the reciprocal response and needs to be understood for a clear analysis of the accelerated data.

In some products, such as most dyes on swellable inkjet media and in silver halide products in gelatine, the ozone reaction can be considered to be "diffusion-controlled," whereby ozone first needs to permeate a protective surrounding matrix before coming in contact with a colorant molecule and reacting. Further, the reacted components then need to be desorbed and removed from the surface before fresh, unreacted molecules can again diffuse, adsorb and react. In this type of process, a simple increase in ozone concentration might or might not yield a proportional increase in reaction rate as diffusion, adsorption and, in some cases, desorption may be the dominant factor controlling the rate of reaction.

The relative quantities of the reactants (ozone and colorant) will also affect the rate of reaction and reciprocal behaviour. Under the assumed ambient conditions, a photographic image would undoubtedly contain a vast excess of colorant molecules relative to the local concentration of ozone molecules in the air. Here, ozone would likely be the limiting factor controlling the rate of reaction and, in the absence of other controlling factors, an increase in ozone concentration will produce a proportional increase in the rate of reaction. At some precise ozone concentration, the quantity of reactants would be equal and the reaction would proceed at a maximum rate. At this point, however, a further increase in ozone concentration would not accelerate the reaction rate, causing a failure in the reciprocal relationship that is required for converting accelerated data into predictions of ambient performance. For this reason, if product longevity predictions are to be made, this ozone concentration needs to be determined and never exceeded during testing.

This document has been primarily developed via testing with inkjet images on porous "instant-dry" photographic media, which have been shown to be susceptible to fading by oxidative gases present in polluted ambient air[13][14][19][20][21]. While many chemical species may be present in polluted air, it has been shown that most of the fade observed for current inkjet systems can be explained by oxidation by ozone[21][27][28]. Additionally, this method may reasonably be used for colour photographic images made with other digital and traditional "continuous-tone" photographic materials such as chromogenic silver halide, silver dye-bleach, dye transfer[26], dye-diffusion-transfer "instant" and other similar systems. However, since these systems have, in general, been shown to be much less sensitive to oxidative degradation by ozone, relatively small levels of image degradation with this accelerated test method may not be realized within the typical duration of such a test for these imaging systems.

High levels of ozone, often found outside major metropolitan areas in summer months, together with high levels of humidity, will greatly accelerate the fade. Since ozone is a highly reactive gas, storage of photographs in any kind of gas-impermeable enclosure, such as framed behind glass or in an album,

© ISO 2020 – All rights reserved

will greatly reduce image degradation due to ozone. This method therefore relates primarily to the display of unprotected photographs.

© ISO 2020 – All rights reserved

Imaging materials — Colour reflection prints — Test method for ozone gas fading stability

1 Scope

This document describes the equipment, methods and procedures for generating a known ozone exposure and the subsequent measurement and quantification of the amount of change produced within both digitally printed hardcopy images and traditional analogue photographic colour print images due to that exposure.

The test method described in this document uses increased levels of ozone to achieve an accelerated test. If the principal "gas fading" mechanism for a system is not ozone, this method might not be suitable and might give misleading results as to resistance of the test image to polluted air.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5-3, *Photography and graphic technology — Density measurements — Part 3: Spectral conditions*

ISO 5-4, *Photography and graphic technology — Density measurements — Part 4: Geometric conditions for reflection density*

ISO 1431-3, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 3: Reference and alternative methods for determining the ozone concentration in laboratory test chambers*

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO 18913, *Imaging materials — Permanence — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18913 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
volume turnover
complete replacement of the air/gas volume within the test chamber

© ISO 2020 – All rights reserved