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**Plastics — Methodology for assessing  
polymer photoageing by FTIR and  
UV/visible spectroscopy**

*Plastiques — Méthodologie d'évaluation du photovieillissement des  
polymères par spectroscopie IRTF et UV/visible*



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ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

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## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 10640 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

## Introduction

One of the main interests in the use of artificial accelerated weathering tests is to provide an estimate of the lifetime of polymeric materials exposed in outdoor conditions. This is a very difficult task, and ISO 4892-1<sup>[1]</sup> describes some of the reasons why it is difficult and why the use of simple “acceleration factors” relating time in an accelerated test versus time in an outdoor exposure is not recommended without special care.

One way to evaluate whether an artificial accelerated test can predict the relative performance of materials used in outdoor applications is to compare the chemical changes caused by the artificial accelerated test with the chemical changes that occur in outdoor exposure.

Changes in visual appearance (gloss, discoloration, yellowing, bleaching, micro-cracks, etc.) and deterioration in physical (or functional) properties are consequences of chemical changes, even if there is not always a direct relationship between the chemical changes and the mechanical changes. The use of Fourier transform infrared (FTIR) spectroscopy to follow the chemical changes can facilitate the research of correlations between different ageing tests (natural or any kinds of accelerated devices).

This International Standard describes the methodology and a procedure for using FTIR spectroscopy and UV/visible spectroscopy.



# Plastics — Methodology for assessing polymer photoageing by FTIR and UV/visible spectroscopy

## 1 Scope

This International Standard provides a methodology to assess the ageing of polymeric systems during exposure to laboratory accelerated weathering as well as in outdoor exposures.

NOTE This methodology applies mainly to photoageing, but it can also be applied to thermal ageing.

This methodology identifies analyses that follow the chemical changes which control the deterioration of physical properties of materials during photoageing. The main procedure is based on infrared (IR) spectroscopy analysis and is described in this International Standard. In addition, UV spectroscopy is used for monitoring the behaviour of some additives and to identify the origin of discoloration in polymeric materials (degradation of pigments and colorants, or polymer yellowing).

Examples of applications of this methodology are given in Annex A as guidance for the interpretation of the results.

## 2 Terms and definitions and abbreviated terms

### 2.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 2.1.1

##### **photoageing**

entirety of the irreversible chemical and physical processes occurring in a material over the course of time that are initiated by radiation and that can be affected by heat, oxygen and moisture

#### 2.1.2

##### **artificial accelerated weathering**

exposure of a material in a laboratory weathering device to conditions which can be cyclic and intensified over those encountered in outdoor or in-service exposure

NOTE 1 This involves a laboratory radiation source, heat and moisture (in the form of relative humidity and/or water spray, condensation or immersion) in an attempt to produce more rapidly the same changes that occur in long-term outdoor exposure.

NOTE 2 The device can include means for controlling and/or monitoring the light source and other weathering variables. It can also include exposure to special conditions, such as acid spray to simulate the effect of industrial gases.

#### 2.1.3

##### **natural outdoor weathering**

exposure of a material to global solar radiation under outdoor climatic conditions