



Designation: F1356 – 22

Standard Guide for Irradiation of Fresh, Frozen or Processed Meat and Poultry to Control Pathogens and Other Microorganisms¹

This standard is issued under the fixed designation F1356; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The purpose of this guide is to present information on the use of ionizing radiation in treating fresh, frozen, or processed meat and poultry products to eliminate or reduce the numbers of vegetative, pathogenic microorganisms and parasites, and to extend the refrigerated shelf-life of those products by reducing the numbers of spoilage microorganisms.

This guide is intended to serve as a set of recommendations to be followed when using irradiation technology where approved by an appropriate regulatory authority. It is not to be construed as setting forth rigid requirements for the use of irradiation. While the use of irradiation involves certain essential requirements to attain the objective of the treatment, some parameters can be varied in optimizing the process.

This guide has been prepared from a Code of Good Irradiation Practice published by the International Consultative Group on Food Irradiation (ICGFI) developed under the auspices of the Food and Agriculture Organization (FAO), the World Health Organization (WHO), and the International Atomic Energy Agency (IAEA) (1).²

1. Scope

1.1 This guide outlines procedures for the irradiation of fresh, frozen, or processed meat and poultry.

NOTE 1—The Codex Alimentarius Commission defines meat as “the edible part of any mammal” and poultry as “any domesticated bird, including chicken, turkeys, ducks, geese, guinea-fowls, or pigeons” (CAC/MISC 5).

NOTE 2—Current U.S. regulations limit the definition of meat and poultry as listed in 9 CFR Section 301.2 and 381.1, respectively. (2, 3).

1.2 This guide covers the use of ionizing radiation to eliminate or reduce the numbers of vegetative, pathogenic microorganisms and parasites, and to extend the refrigerated shelf-life of those products by reducing the numbers of spoilage microorganisms in fresh, frozen, or processed meat and poultry. The absorbed dose for this application is typically less than 10 kGy.

1.2.1 This guide covers gamma, electron beam, and X-radiation treatment.

¹ This guide is under the jurisdiction of ASTM Committee E61 on Radiation Processing and is the direct responsibility of Subcommittee E61.05 on Food Irradiation.

Current edition approved Jan. 15, 2022. Published February 2022. Originally approved in 1991. Last previous edition approved in 2016 as F1356 – 16. DOI: 10.1520/F1356-22.

² The boldface numbers in parentheses refer to the list of references at the end of this standard.

1.3 This guide addresses irradiation of pre-packaged product for retail sale or for use as an ingredient in other products. It also addresses the in-line irradiation of unpackaged product. Other specific ISO and ASTM standards exist for the irradiation of food. In those areas covered by ISO 14470, that standard takes precedence.

1.4 This document is one of a set of standards that provides recommendations for properly implementing and utilizing radiation processing. It is intended to be read in conjunction with ISO/ASTM 52628.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:³

E3083 Terminology Relating to Radiation Processing: Dosimetry and Applications

F1416 Guide for Selection of Time-Temperature Indicators

F1640 Guide for Selection and Use of Contact Materials for Foods to Be Irradiated

2.2 ISO/ASTM Standards:³

51261 Practice for Calibration of Routine Dosimetry Systems for Radiation Processing

51539 Guide for Use of Radiation-Sensitive Indicators

51608 Practice for Dosimetry in an X-Ray (Bremsstrahlung) Facility for Radiation Processing at Energies between 50 keV and 7.5 MeV

51649 Practice for Dosimetry in an Electron Beam Facility for Radiation Processing at Energies Between 300 keV and 25 MeV

51702 Practice for Dosimetry in a Gamma Facility for Radiation Processing

51818 Practice for Dosimetry in an Electron Beam Facility for Radiation Processing at Energies Between 80 and 300 keV

52303 Guide for Absorbed-Dose Mapping in Radiation Processing Facilities

52628 Practice for Dosimetry in Radiation Processing

52701 Guide for Performance Characterization of Dosimeters and Dosimetry Systems for Use in Radiation Processing

2.3 Codex Alimentarius Commission Recommended International Codes and Standards:⁴

CAC/RCP 1-1969, Rev. 4-2003, Recommended International Code of Practice—General Principles of Food Hygiene including Annex on Hazard Analysis and Critical Control Point (HACCP) System and Guidelines for its Application

CAC/RCP 19-1979, Rev. 2003, Recommended International Code of Practice for the Radiation Processing of Food

CX STAN 1-1985, Rev. 2010, General Standard for the Labeling of Prepackaged Foods

CX STAN 106, Rev. 2003, General Standard for Irradiated Food

CAC/MISC 5-1993, Amd. 2003, Glossary of Terms and Definitions (Veterinary Drug Residues in Food)

CAC/GL21-1997, Rev. 2013, Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Food

2.4 ISO Standard⁵

ISO 12749-4 Nuclear energy — Vocabulary — Part 4: Dosimetry for radiation processing

ISO 14470-2011 Food irradiation—requirements for the development, validation and routine control of the process of irradiation using ionizing radiation for the treatment of food

2.5 International Commission on Radiation Units and Measurements (ICRU) Reports:⁶

ICRU Report 80 Dosimetry Systems for Use in Radiation Processing

ICRU Report 85a Fundamental Quantities and Units for Ionizing Radiation

2.6 Joint Committee for Guides in Metrology (JCGM) Reports:

JCGM 100:2008, GUM 1995⁷ with minor corrections, Evaluation of measurement data - Guide to the Expression of Uncertainty in Measurement

JCGM 200:2012⁸ VIM International Vocabulary of Metrology—Basic and General Concepts and Associated Terms

3. Terminology

3.1 Definitions:

3.1.1 absorbed dose—quotient of $d\bar{\epsilon}$ by dm , where $d\bar{\epsilon}$ is the mean energy imparted by ionizing radiation to matter of mass dm , thus

$$D = d\bar{\epsilon}/dm \quad (1)$$

3.1.1.1 Discussion—The SI unit of absorbed dose is the gray (Gy), where 1 gray is equivalent to the absorption of 1 joule per kilogram of the specified material (1 Gy = 1 J/kg).

3.1.2 D_{10} value—absorbed dose required to reduce the microbial population in a given food by 90 %.

3.1.3 dose distribution—variation in absorbed dose within a process load exposed to ionizing radiation.

3.1.4 process load—volume of material with a specified loading configuration irradiated as a single entity.

3.1.5 transport system—conveyor or other mechanical system used to move the process load through the irradiator.

3.2 Definitions of other terms used in this standard that pertain to radiation measurement and dosimetry may be found in ISO/ASTM Practice **52628**. Other terms that pertain to radiation measurement and dosimetry may be found in ASTM Terminology **E3083** and ISO Terminology ISO 12749-4. Where appropriate, definitions used in these standards have been derived from, and are consistent with, definitions in ICRU Report 85a and general metrological definitions given in the VIM.

4. Significance and Use

4.1 The principal purpose of irradiation is to help ensure the safety of these foods for human consumption. Irradiation

³ For referenced ASTM and ISO/ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ Available from the Joint FAO/WHO Food Standards Programme, Joint Office, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁶ Available from International Commission on Radiation Units and Measurements, 7910 Woodmont Ave., Suite 800, Bethesda, MD 20814, USA.

⁷ Document produced by Working Group 1 of the Joint Committee for Guides in Metrology (JCGM WG1). Available free of charge at the BIPM website (<http://www.bipm.org>).

⁸ Document produced by Working Group 2 of the Joint Committee for Guides in Metrology (JCGM WG2). Available free of charge at the BIPM website (<http://www.bipm.org>).