ANSI/ASABES644 JUN2025
Design of Electromagnetic Radiation Systems for Plants

ASABE
American Society of Agricultural and Biological Engineers

Approved American National Standard
ANSI

STANDARD

ASABE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASABE Standards are consensus documents developed and adopted by the American Society of Agricultural and Biological Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

NOTE: ASABE Standards, Engineering Practices, and Data are informational and advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. The ASABE assumes no responsibility for results attributable to the application of ASABE Standards, Engineering Practices, and Data. Conformity does not ensure compliance with applicable ordinances, laws and regulations. Prospective users are responsible for protecting themselves against liability for infringement of patents.

ASABE Standards, Engineering Practices, and Data initially approved prior to the society name change in July of 2005 are designated as “ASAE”, regardless of the revision approval date. Newly developed Standards, Engineering Practices and Data approved after July of 2005 are designated as “ASABE”.

Standards designated as “ANSI” are American National Standards as are all ISO adoptions published by ASABE. Adoption as an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by ASABE.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

CAUTION NOTICE: ASABE and ANSI standards may be revised or withdrawn at any time. Additionally, procedures of ASABE require that action be taken periodically to reaffirm, revise, or withdraw each standard.

Copyright American Society of Agricultural and Biological Engineers. All rights reserved.

ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA, phone 269-429-0300, hq@asabe.org

ANSI/ASABE S644 JUN2025
Approved June 2025 as an American National Standard

Design of Electromagnetic Radiation Systems for Plants

Developed by the Plant Growth LED Lighting Committee. Approved as an ASABE standard June 2025; approved by ANSI June 2025.

Keywords: *Electromagnetic radiation device, Energy performance*

0 Introduction

In response to the rapid developments in LED technology and the increased use of LED devices in plant growth applications, new ASABE standards have been developed. Two other standards precede this standard:

- Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms) (ANSI/ASABE S640 JUL2017); and

- Recommended Methods for Measurements and Testing of LED Products for Plant Growth and Development (ANSI/ASABE S642 SEP2018).

This standard recommends how to analyze the performance of devices and installed systems on the basis of both output and input parameters. Primary performance metrics in this standard are predicated on plant response to the electromagnetic spectrum in contrast to the responses of humans and other animal species. For lighting applications to meet direct human needs, device output and energy performance metrics utilize the human eye response to visible radiation (light). The most common practice is to measure or calculate useful light output versus electricity input rendered as luminous efficacy (lumen per watt). This approach is not applicable to horticultural applications where radiant flux or photon flux are more appropriate measures to accurately predict plant responses. Furthermore, research has demonstrated that not all plant species respond to a given distribution of radiation wavelength in the same way. Therefore, electromagnetic radiation systems performance characteristics are defined so that they can be applied to particular horticultural applications rather than general “plant” growth. Such characteristics include but are not limited to the spectral output, intensity, Photosynthetic Photon Flux Density (PPFD) and PPFD uniformity. The purpose of this standard is to provide the users with guidelines for device selection and system evaluation relative to different plant growth applications.

1 Scope

This standard establishes appropriate performance criteria for designs of electromagnetic radiation systems intended for horticultural applications. This standard requires a minimum set of criteria and recommends optional, advanced criteria. This standard also provides methodologies to compare the anticipated plant responses and energy performance among alternative devices and installed systems when applied to diverse horticultural operations.

2 Normative References

The following referenced documents are indispensable for the application 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.

ANSI/ASABE S640, Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)

 Copyright American Society of Agricultural and Biological Engineers