

IEEE Std 1720: Near-Field Measurement Standard 2025 Update

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Abstract— Near-field measurements are widely recognized as an accurate and versatile technique for antenna and device testing. Since their introduction, these methods have become one of the preferred approaches for evaluating a broad range of antennas and devices. Today, hundreds of near-field test facilities are in operation worldwide, underscoring the technique’s maturity and widespread adoption. IEEE Std 1720™, originally approved in 2012 by the IEEE Standards Association Standards Board (SASB), was developed to provide foundational guidance for near-field antenna measurement practices [1]. As of this writing, the revised IEEE P1720 is undergoing the IEEE balloting process, a key milestone toward formal approval. The progress of the revision effort has been regularly documented in dedicated publications [2]-[7]. This paper provides an update on recent developments and reports on the outcome of the balloting process.

Index Terms—antenna, antenna measurements, calibration, near field, standardization

I. INTRODUCTION

In light of recent technological advancements and evolving industry needs, such as the extension of near-field techniques to device testing, a revision of IEEE Std 1720™ was initiated [1]. In 2019, the IEEE Standards Association Standards Board (SASB) approved the Project Authorization Request (PAR) for P1720, officially launching the revision effort. A dedicated Working Group (WG), operating under the IEEE Antennas and Propagation Society Standards Committee (APS/SC), has since led this effort. Comprising approximately sixty volunteer experts from academia, industry, and government, the WG reflects the broad expertise and diversity of the near-field measurement community. The group has met regularly, primarily through virtual meetings, with occasional in-person gatherings, to revise the original material and incorporate new technical developments.

To support this work, several sub-groups were established, each tasked with reviewing and enhancing specific sections of the standard. The WG chairs coordinated the overall effort, focusing on the integration and alignment of all contributions to ensure the final manuscript is both coherent and comprehensive. To facilitate an effective collaboration, the IEEE-SA provided a dedicated online workspace with access to document history, draft versions, and tools for discussion and electronic voting. This infrastructure has significantly contributed to the WG’s progress.

II. CHRONOLOGY OF THE DEVELOPMENT PROCESS

The project began with the approval of the Project Authorization Request (PAR) on June 13, 2019. Development progressed over the following years, and by December 2022, the original IEEE Std 1720-2012 officially became inactive [1]. This date also marked the original target for completing the revised standard. In January 2023, Draft 1 of the new standard was completed. A Ballot Group consisting of 64 members was formed by May 12, 2023, with the goal of completing the balloting process and finalizing the standard by the end of the year.

Draft 2 was released in June 2023, which also marked the end of the technical content collection from the working group. The remaining work focused on formatting the document according to IEEE-SA standards. However, progress stalled due to instabilities in the Microsoft Word template provided by IEEE-SA. As a result, a PAR extension request was submitted in September 2023, reviewed by NesCom on October 25, and a 1-year extension was granted, shifting the new completion deadline to December 31, 2024. By November 12, 2023, the original ballot group became inactive due to the lack of a submitted draft.

Most formatting and typesetting issues were resolved during the winter break, enabling the creation of Draft 3 in February 2024, followed shortly by Draft 4 with additional changes and document stabilization.

To minimize the risk of receiving overwhelming editorial comments during the official balloting process, the working group initiated an internal macro-reviewer activity in May 2024, involving experienced balloters reviewing the “live” document. This process produced over 1,000 comments, primarily related to grammar, clarity, and consistency. It became clear that the draft reflected the input of multiple authors with varied backgrounds in written English. Technical comments, including suggestions on variable naming consistency, were also addressed and incorporated into an updated draft.

Draft 5 underwent Mandatory Editorial Coordination (MEC) review by IEEE SA on October 2, 2024. Given the project’s continued complexity, a second PAR extension request was submitted on October 15, 2024. The PAR and permission to initiate balloting was approved the same day by the IEEE APS/SC committee.

During the AMTA 2024 Symposium on October 27, 2024, an editorial meeting was held where copyright clearance for figures and graphs was flagged as a remaining requirement before final submission.

A new Ballot Group was formed in December 2024, and initial balloting began in March 2025. The new balloting group contained 80 members representing academic, government and industrial interest and groups. By May 2025, the draft was finalized. In the initial balloting 69 of the 80 members of the

balloting return their vote with a 93% approval of the standard and a total of 309 comments.

As of today, the editorial team is addressing the last outstanding ballot comments. Pending comment and copyright resolution, the final balloting and submission to NesCom are targeted for late 2025. The full chronology of the initiation and development process of IEEE Std 1720™ “Recommended Practice for Near-Field Antenna Measurements” is illustrated in Figure 1.



Figure 1: Chronology of the development process of IEEE Std 1720™ “Recommended Practice for Near-Field Antenna Measurements”. As of this writing, the revised standard is undergoing balloting process, a key milestone toward formal approval.

III. CONTENT OF THE REVISED IEEE STD 1720™

Although the original intent was to make a minor revision, the scope expanded as the work evolved. The result is a comprehensive update: all original content has been revised, and a substantial amount of new material has been incorporated, reflecting the latest advancements in near-field measurement. The outline of the new document closely follows the original standard [1]. The main NF scanning geometries, planar, cylindrical, and spherical are covered in detail. This original material is being updated, reviewed, or rewritten depending on the level of review performed. The changes are intended to renew, update, and reflect widely accepted changes in technology and post-processing techniques. The final outline is shown in Figure 2 along with annotations indicating the level of change from the original 2012 version of the standard.

The IEEE standard uses the engineering time convention for time-harmonic fields, defined as $\exp(+j\omega t)$, which leads to a phase factor of $\exp(-jkr)$. This differs from the physics convention, where the signs are reversed. Both notations appear throughout the standard, reflecting foundational references that use either approach. As long as each is used consistently, the choice of convention has no impact on results. New content follows the engineering convention, and the selected convention is always clearly stated in the standard.

In Clause 3 (“Background”), the physics convention is primarily used, while the rest of the document mostly adopts the engineering convention. Mixed conventions are common in antenna measurement, but it is critical that hardware and software implementations use the same convention to avoid

errors—especially during near-field to far-field (NFFF) transformations.

Clause 4 focuses on near-field measurement systems, covering essential components such as RF transmit/receive hardware, scanning systems, data acquisition, and analysis tools. The setup may vary depending on measurement needs and priorities. The section begins with data collection over standard geometries (plane, cylinder, sphere) to guide users in selecting suitable systems. A key addition is a new section on modern anechoic chamber design, with recommendations to ensure accurate results.

Clause 5 covers planar near-field theory and its practical implementation. This method is ideal for antennas with moderate to high directivity, where a probe scans a planar surface in front of the antenna under test (AUT). A fast Fourier transform is typically used to convert near-field data to far-field results. Planar scanning benefits from well-established probe correction theory, applied direction by direction for accuracy.

Clause 6 addresses cylindrical near-field scanning, which adds moderate complexity compared to planar scanning but enables reconstruction of nearly the full radiation pattern (excluding endfire directions). It is well-suited for fan-beam antennas, with data acquired along a cylindrical grid. The clause also introduces advanced scanning techniques aimed at reducing measurement time and data volume.

Clause 7 focuses on spherical scanning, providing theoretical background and emphasizing the use of $\mu = \pm 1$ symmetric probes for improved accuracy. It includes a detailed discussion on

higher-order probe compensation, enabling precise measurements even with more complex probe types.

Clause 8, titled Non-Regular Scanning Techniques, presents methods for non-redundant sampling across planar, cylindrical, and spherical geometries to reduce measurement time. It also covers scanning over non-canonical surfaces, including the use of drones and robotic systems.

Clause 9 focuses on the selection and calibration of probes. Accurate far-field results require careful consideration of probe characteristics such as gain, polarization, and cross-polar patterns. The clause provides guidance on measuring these properties and selecting probes based on scan geometry and accuracy requirements

Clause 10 focuses on gain analysis in near-field measurement systems. Accurately determining gain remains a key challenge, as different techniques vary in precision depending on factors like setup, environment, and equipment. The clause discusses trade-offs between measurement accuracy and cost, and provides guidance on selecting the most appropriate gain measurement method for a given antenna and test scenario.

Clause 11 addresses uncertainty analysis in near-field measurements. It helps practitioners identify and manage sources of uncertainty and reflects recent updates aligned with recognized international guidelines for uncertainty evaluation.

Clause 12 is dedicated to “special topics,” various subjects of relevance to near-field antenna measurements and techniques are listed. New techniques that are widely accepted in near-field antenna measurement post-processing are included in this clause.

Clause 12.1 Antenna System Testing. Describes methods for measuring transmit and receive power of systems where antennas are connected to active electronic devices. Recommendations are provided for practical testing approaches.

Clause 12.2 Back Projections & Diagnostics. Introduces field expansion techniques for diagnostics, including use of equivalent currents for non-canonical surfaces and spatial filtering applications.

Clause 12.3 Probe-Position Correction. Covers correction techniques for known probe position errors, particularly relevant for non-regular scanning geometries.

Clause 12.4 Truncation Mitigation. Provides updated techniques to minimize errors caused by limited scan areas.

Clause 12.5 Time Gating. Discusses modern approaches for isolating reflected signals in the time domain to improve measurement accuracy.

Clause 12.6 Single-Frequency Spatial Filtering & Scattering Suppression. Presents frequency-domain techniques using modal decomposition to suppress unwanted scattered signals without additional hardware.

Clause 12.7 Thermal Testing. Offers guidance on temperature-dependent testing using climate chambers, ensuring performance under varying environmental conditions.

Clause 12.8 Phase Retrieval Methods. Summarizes updated techniques for recovering phase information when not directly measured, including iterative and holographic methods.

Clause 12.9 Facility Comparison Campaigns. Recommends participation in inter-laboratory comparison efforts to validate measurement quality, promote best practices, and benchmark capabilities.

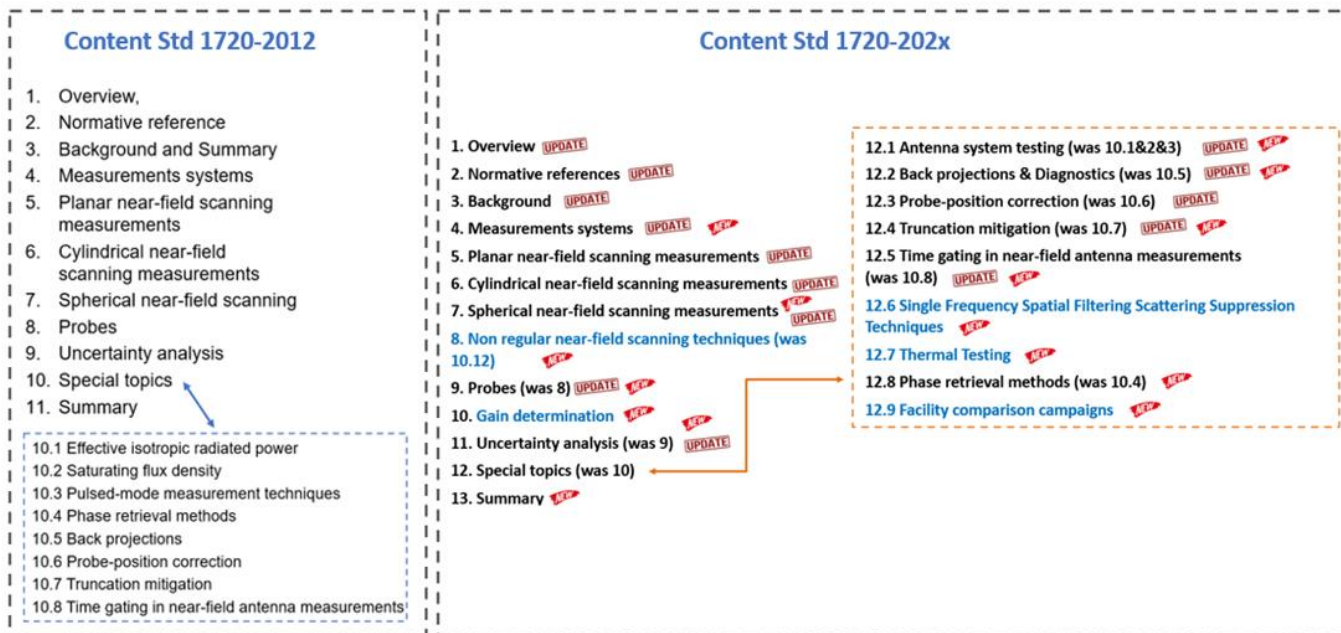


Figure 2: Evolution of the std 1720 (left) to the revised version (right). Updates and addition of new material is indicated for each clause. New clauses in the revised standard are indicated in blue.

IV. LESSONS LEARNED FROM THE STANDARD DEVELOPMENT PROCESS

Assigning responsible individuals to specific clauses has proven to be an effective strategy for managing large standardization efforts. This approach divides the workload into manageable tasks while allowing the Working Group (WG) chair to track progress, and identify stagnation, so that timely interventions can be made when necessary.

The use of a centralized platform for document updates, communication, and voting, in our case, iMeet supplied by IEEE SA, has functioned well overall. However, it does not support effective roster management. Given the large member group of more than sixty individuals, the long duration of the standard development project, participant engagement tends to fluctuate. As such, it is essential to review and revise the WG roster annually, particularly to ensure quorum for majority votes, such as PAR extension approvals or transitions to the balloting phase.

Copyright issues, especially those related to figures and photographs, should be addressed early in the editorial process. Deferring these considerations to the final stages, as occurred in this instance, introduces unnecessary delays and risk.

Finally, editing the IEEE-SA provided macro-enabled Word template has posed significant challenges. The document lacks the stability required for collaborative editing, as formatting inconsistencies and system-dependent glitches frequently arise. Moreover, the incompatibility between Microsoft Word's native equation editor and the equation tools preferred by IEEE further complicates the inclusion and formatting of mathematical content.

V. CONCLUSIONS

The IEEE Std 1720-2012™ "Recommended Practice for Near-Field Antenna Measurements" expired in 2022. A WG of the APS/SC has been formed in 2019 to update the standard. The work is nearing its completion.

ACKNOWLEDGEMENT

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