TERMS OF REFERENCE FOR R&D PROJECT

1. TITLE

Review of Indian Standards of Basic and Advanced Statistical Design of Experiments with Analysis of variances

2. BACKGROUND

2.1 Bureau of Indian Standards (BIS), engaged in activities of standardization, quality control and certification marking; had recognized the importance of statistical quality control (SQC) from the very beginning and established a Sectional Committee [the then Indian Standards Institution (ISI)]. This Sectional Committee "Statistical Methods for Quality, Data Analytics and Reliability" (MSD 3) has been preparing Indian Standards relating to statistical techniques, data analytics and reliability with an idea of propagating their knowledge in industry and promoting their application for quality improvement. This Committee coordinates with the work of ISO/TC 69 `Application of Statistical Methods

2.2 Some of Indian Standards under the purview of MSD 3 are now outdated and may no longer reflect contemporary practices. The goal of this R&D project is to revise these standards, ensuring they align with the latest practices in use both nationally and internationally.

2.3 This R&D project is designed to review following Indian Standards

Sl. No.	**IS No.**	**Title**
1	IS 7600: 1975	Analysis of variance
2	IS 10427 (Part 1): 1982	Designs for industrial experimentation: Part 1 standard designs
3	IS 10427 (Part 2): 1982	Designs for industrial experimentation: Part 2 Orthogonal arrays
4	IS 12347: 1988	Analysis of means - A graphical procedure

2.4 The scopes of the above standards are given in Annex A

3 OBJECTIVES

Since the publication of these Indian Standards, there have been significant advancements in techniques, technology, and the definitions of various terms. Therefore, the primary objectives of this project are to

a) **Revise these Indian Standards** to incorporate the latest practices currently being used internationally.

b) **Harmonize the terminology** to align with the most recent Indian and ISO standards.

c) **Include industry-specific examples** from various sectors to enhance the relevance and applicability of these standards.

d) **Simplify the language** of the Indian Standards to ensure they are easily understood and implemented by the industry.

e) **Support the Indian industry** in improving the quality of its products and services through the updated standards.

4 SCOPE

The scope of this R&D project is to present report on outcome from the study to review each of the aforementioned Indian Standards, taking into account the latest technology, techniques, tools, and terminology available in these areas. The revised standards will include practical examples from various industrial sectors and will be written in clear, user-friendly language, ensuring they are easily understandable by the general user and applicable across industries.

5. RESEARCH METHODOLOGY

5.1 Literature Review

The following tasks are to be undertaken as part of this R&D project:

a) **Review each of the identified Indian Standards** alongside the corresponding ISO standards, if any, covering the same or similar subjects.

b) **Identify and analyse regional or national standards** from other countries in the absence of relevant ISO standards.

c) **Examine other Indian Standards** published after the release of the standards under revision to assess the feasibility of merging them where applicable.

d) **Review available research papers** on the subject to gather additional insights and perspectives.

e) **Explore information from other reliable sources**, if available, to enhance the understanding of the subject.

f) **Compare the terminology** used in the existing Indian standards with that of the latest Indian and ISO standards to identify any changes or updates needed.

5.2 Field survey and Data collection

Based on the literature review, a questionnaire will be developed for each Indian Standard and circulated to various organizations that are currently implementing these standards. The questionnaire will aim to gather feedback on the practical applicability of the standards, identify areas for improvement, and assess the need for updates.

5.3 Field visit

A detailed justification for the field visit, including the Number and details of industry/companies/organizations, purpose, duration, and expected outcomes, shall be submitted to BIS for consideration and approval in advance.

5.4 Analysis and report preparation

5.4.1 Analytical Report Preparation

The proposer is expected to prepare an analytical report for each standard, addressing various aspects of the scope and supporting the analysis with relevant data. The data collected should be thoroughly analysed, and conclusions drawn from the analysis should be included in the report. The report should address the following points:

a) Identification of any standards (or portions of other standards) that could be merged, if applicable.

b) Identification of gaps or shortcomings in the current standard.

c) Recommendations for changes to be incorporated in the standard.

d) Proposed additions to the standard, including their specific location within the document.

5.4.2 Submission of Report

The proposer shall submit a comprehensive report covering the points listed above, along with a proposed revised draft of the standard, incorporating all suggested changes and updates, to the Bureau of Indian Standards (BIS) for review.

6 OUTLINE OF THE TASKS AND FINAL DELIVERABLES EXPECTED FROM THE PROPOSER(S):

6.1 Project Report Submission

The project report should cover all points mentioned in Clause 5, including a revised draft of the standards that incorporates the proposed changes. The report must be submitted in both hard and soft copies, along with digital formats, ensuring that it addresses all aspects outlined in the project scope.

6.2 Appendices to the Report

The project report should include the following as appendices:

a) Responses to the questionnaires from various organizations.
b) Records of discussions held during any on-site visits, if applicable.
c) Data collected during the study and its corresponding analysis.

7 DELIVERY MILESTONES AND REVIEW PROCESS

Timeline for the project is 6 months from the date of award of the project.

8. STAGES FOR REVIEW

8.1 Stage I: Comprehensive Planning (End of 2nd Month)

By the end of the 2nd month, the proposer shall prepare a comprehensive plan that includes the following:

a) A detailed list of the standards and other documents reviewed, accompanied by a summarized report.

b) Identification of various organizations, stakeholders, beneficiaries, and regulators to be visited, along with confirmation of their consent.

c) A description of the information to be collected through interactions with the identified stakeholders and details of the planned visits. The proposed format for gathering information should be shared with BIS for review.

BIS will evaluate the plan and provide feedback as necessary.

8.2 Stage II: Draft Report Submission (End of 5th Month)

By the end of the 5th month, the project researcher shall submit a draft report to BIS that covers the points outlined in Clauses 5 and 6, including the following information:

a) Reports detailing visits conducted to different organizations.

b) Information regarding the data collected during interactions with various stakeholders.

c) An analysis of the collected data, correlating it with the findings.

d) Inferences drawn from the analysis.

8.3 Evaluation of Draft Report

The MSD 3 Sectional Committee or the concerned subcommittee or the Chairman of MSD 3, will evaluate the draft report and the revised draft of the standard. They will provide feedback and suggest changes, if needed. The proposer shall address all feedback within a maximum of one month after receiving it and submit the final report along with the revised draft of the standard.

9 SUPPORT FROM BIS

BIS will provide access to latest editions of Indian and International Standards and available literature with BIS. All expenses, as per rules, for on-site visits (to be carried out with prior approval of BIS) are included in project cost.

10 **Nodal Officer**

Shri Abhijit Singh, Sc. C/Dy. Director, MSD, BIS, may be contacted at msd@bis.gov.in for any queries on the research project.

ANNEX A

SCOPE OF INDIAN STANDARDS UNDER REVIEW

IS 7600: This Indian Standard gives a brief outline of the general treatment of the analysis of variance technique with respect to some of the designs which are more frequently used in industrial experimentation. The techniques have been illustrated with examples wherein necessary computational details have also been given.

IS 10427 (Part 1): This Indian Standard provides methods of planning and conducting experiments under various conditions. It also describes the procedures for analyzing data recorded from such experiments. The various designs described in this standard are completely randomized designs, randomized block designs, latin square designs, balanced incomplete block designs and factorial designs.

IS 10427 (Part 2): This Indian Standard provides methods of planning and conducting experiments using orthogonal arrays when all factors are either at two or three levels. This standard also includes procedure when some of factors are at two levels and remaining at three or four levels.

IS 12347: This Indian Standard provides the possible effects of the factor by using analysis of means techniques. The method involves carrying out graphical analysis of the data obtained from different sources/groups and thereby comparing the relative importance as well as the statistical significance of various factors.