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ARMOUR RESEARCH FOUNDATION
of
Illinois Institute of Technology
Technology Center
Chicago 16, Illinois

REVISION OF STANDARDS FOR
ATTENUATION MEASUREMENTS OF SHIELDED ENCLOSURES

First Quarterly Progress Report
18 June 1958 - 30 September 1958
Contract No. NObSr-72824
ARF Project No. E108

For:

Bureau of Ships
Washington 25, D. C.

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REVISION OF STANDARD FOR
ATTENUATION MEASUREMENTS OF SHIELDED ENCLOSURES

I. PURPOSE

The purpose of this research is to develop improved techniques for measuring the effectiveness of shielded enclosures in the frequency range 14 kilocycles to 10,000 megacycles per second and to provide recommendations for standard methods of evaluating such enclosures.

II. GENERAL FACTUAL DATA

A. Identification of Personnel

<u>Name</u>	<u>Title</u>	<u>Man-Hours</u>
R. B. Schulz	Research Engineer	28
L. C. Peach	Research Engineer	24
H. Zucker	Research Engineer	8

B. References

The following references have been used during this quarterly period.

- (1) "Electromagnetic Waves", S. A. Schelkunoff, D. Van Nostrand Co. Inc., 1943.
- (2) Military Standard-285.
- (3) "Theory, Design and Engineering Evaluation of Radio-Frequency Shielded Rooms", C. S. Vasaka, Report No. NADC-EL-54129, 13 August 1956.
- (4) "Notes on Design, Construction, and Evaluation of Shielded Rooms", G. A. Morgan, Jr., NRL Report 3578.
- (5) "Measuring the Shielding Efficiency of Screened Enclosures", H. E. Dinger and J. E. Raudenbush, NRL Report 3908.
- (6) "A Technique for Measuring the Effectiveness of Various Shielding Materials", H. E. Dinger and J. E. Raudenbush, NRL Report 4103.
- (7) "Research Investigations of the Radio Frequency Shielding Effectiveness of Screening Materials", E. R. Radford, Proceedings of the Second Conference on Radio Interference Reduction, Armour Research Foundation, March 1954.

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- (8) "Theoretical Formulas for Calculating the Shielding Effectiveness of Perforated Sheets and Wire Mesh Screens", J. P. Quine, Proceedings of the Third Conference on Radio Interference Reduction, Armour Research Foundation, February 1957.

C. Meetings and Conferences

Date: September 9, 1958

Place: Bureau of Ships, Washington 25, D. C.

Personnel Attending:

Mr. D. G. Berg, Bureau of Aeronautics
Mr. A. P. Massey, Bureau of Ships
Mr. C. S. Vasaka, Naval Air Development Center
Mr. M. Epstein, Armour Research Foundation

The subject of a portion of this conference was shielded enclosures. Mr. Vasaka listed some technical changes and corrections needed in MIL-STD 285 and also gave an outline of the measurement of attenuation of plane waves at microwave frequencies. Two copies of Report No. NADC-el-54129 were obtained from Mr. Berg. Mr. Vasaka recommended the following two sources of information concerning measurement of shielded enclosures.

- (1) "Theory, Design Characteristics, and Test Methods for Shielded Enclosures from 60 cps to 10,000 mc", Publication No. PB No. 121927, Department of Commerce.
- (2) "A Technique for Measuring the Effectiveness of Various Shielding Materials", H. E. Dinger and Y. E. Randenbush.

Date: September 18, 1958

Place: IRE Headquarters, New York, N. Y.

Personnel Attending:

Mr. E. Chapin, Federal Communications Commission
Mr. C. W. Frick, Chairman, Consulting Engineer
Mr. F. W. Haber, University of Pennsylvania
Mr. R. W. Lisk, Wyeth Engineering
Mr. E. Mittleman, Consulting Engineer
Mr. R. B. Schuls, Armour Research Foundation
Mr. L. W. Thomas, Bureau of Ships, Navy Department

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This conference constituted the organizational meeting of the Institute of Radio Engineers Subcommittee 27.5, one of whose responsibilities is to establish standards for enclosure measurements. During the course of the year it is expected that Armour Research Foundation will contribute information obtained under Contract No. NObsr-72824 and, also will receive assistance from the subcommittee in the form of suggestions on the execution of the research program.

III. DETAILED FACTUAL DATA

A. Introduction

The purpose of this program of research is to develop improved techniques for measuring the effectiveness of shielded enclosures in the frequency range of 14 kilocycles to 10,000 megacycles. The research will be concerned with an experimental and theoretical analysis of measurement techniques used to evaluate shielded enclosures. The starting date of the contract was June 18, 1958 and it is of twelve months duration.

The research is to be conducted from two viewpoints:

- (1) To define quantities which have significance as far as shielded enclosures performance is concerned.
- (2) To define, analyze, and test measurement procedures which will yield the above quantities and be practical of execution.

The amount of effort expended on the project during the first quarterly period has been extremely limited primarily because of the normal delay experienced in obtaining the government-loaned equipment necessary to the research. For this reason no experimental work has been carried on.

The theoretical analysis was delayed to some extent by the time normally required to transfer the required personnel from their previous duties. Thus far, the only work done in the theoretical phase has been to examine several

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pertinent articles.

In order to prevent the possibility of duplicating analysis already performed, papers concerned with shielding theory are being compiled and reviewed. The papers examined thus far are listed in section IIB. One result of this literature survey will be the compilation of a complete and up-to-date bibliography of articles concerned with shielded enclosures.

B. Theoretical Analysis

The theoretical problems to be examined during this program of research have not been precisely formulated to date. However, a brief review of a portion of the literature has indicated several pertinent problems:

(1) The concepts of insertion loss and attenuation have been examined to a reasonable extent when the shielding geometry is an infinite plane face. The extension of these concepts to rectilinear geometries should be examined.

(2) The transparency of a material, having small perforations, to an electromagnetic field can be considered from a microscopic viewpoint by examining the flow of energy through individual perforations. Transparency can also be examined from a macroscopic viewpoint by assigning equivalent electrical constants to the perforated material. The connection between the two approaches should be demonstrated for the high-and low-frequency situation.

(3) In many instances, and primarily at the higher frequencies, leakage around doors and wall junctions is the primary means by which the electromagnetic field penetrates or leaves the enclosure. The possibility of establishing a theory for such leakage should be examined.

The theoretical problems listed above may be altered as the literature survey proceeds and a more complete evaluation of shielding theory is obtained.

C. Project Schedule Chart

The anticipated scheduling of the program of research is shown in Figure 1. The open areas represent planned effort while the shaded areas represent completed work. The financial status of the project is as follows:

For the period ending August 31, 1958*

Original money allocated for research	\$37,672.
Total expenditures	256.
Total commitments	8.
Balance available for research	\$37,408.

IV. CONCLUSION

Insufficient effort has been expended on the project to warrant the formulation of conclusions.

V. PROGRAM FOR NEXT INTERVAL

A. Theoretical Phase

(1) The literature survey and compilation of a complete bibliography will be continued.

(2) The review of shielding theory will be continued.

(3) The work on the theoretical problems outlined in section III B will be initiated.

*Cost sheets for the month of September do not become available until October 20.

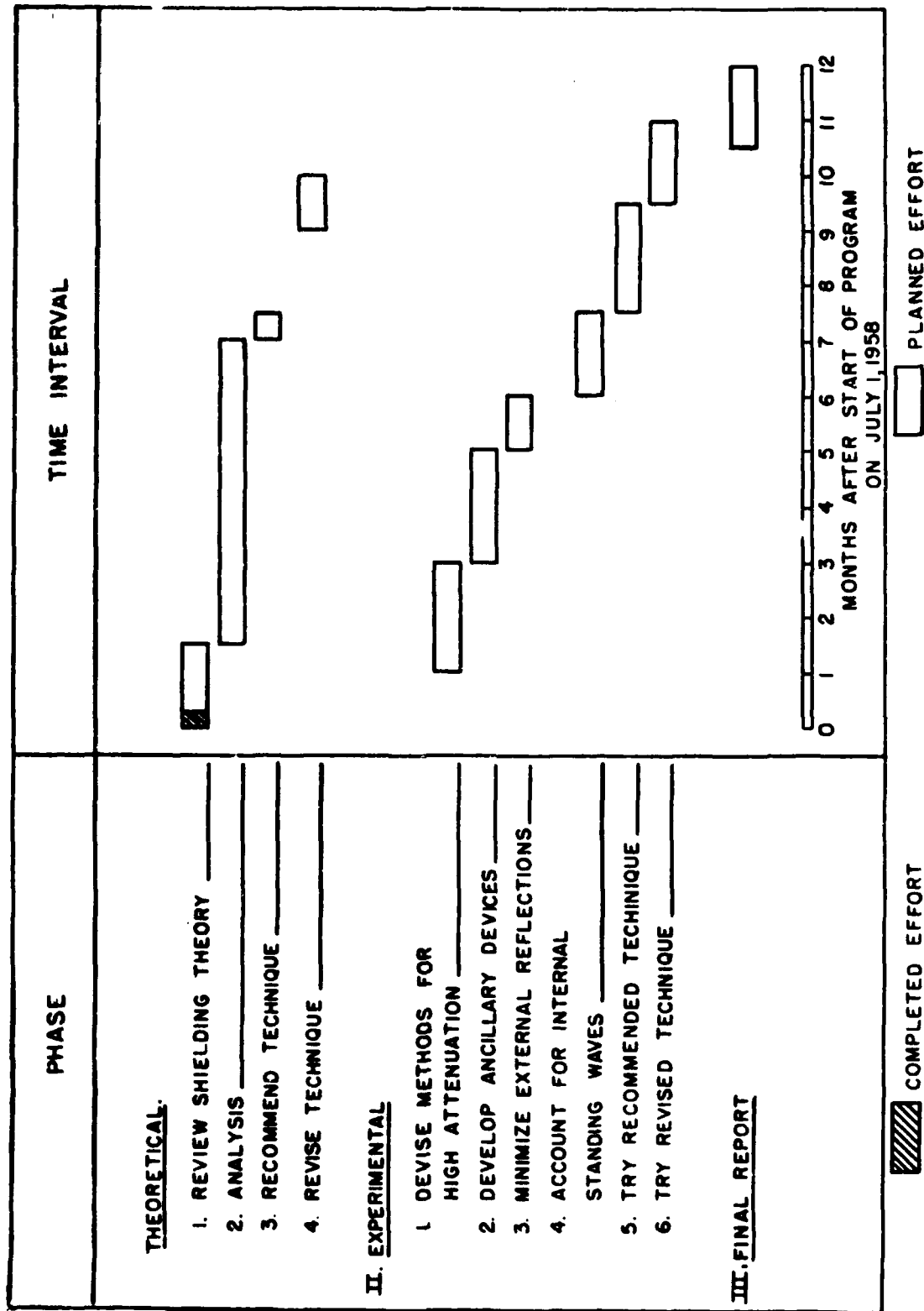


FIGURE 1. PROJECT SCHEDULE CHART

B. Experimental Phase

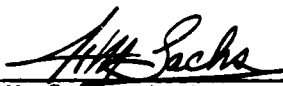
(1) It is anticipated that the shielded enclosure, which will be used in evaluating the measurement procedures, will be installed during the forthcoming quarter.

Respectfully submitted,

ARMOUR RESEARCH FOUNDATION
of Illinois Institute of Technology



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Research Engineer



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