DOCTORAL DISSERTATION SERIES

PUBLICATION: 7603

AUTHOR: Willard Mather Bateson, Ph. D., 1954
University of Michigan

TITLE: THE DETERMINATION OF STANDARDS FOR INDUSTRIAL-ARTS LABORATORIES

University Microfilms, Ann Arbor, Michigan

THE DETERMINATION OF STANDARDS FOR INDUSTRIAL-ARTS LABORATORIES

by
Willard M. Bateson

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
University of Michigan

1953

Committee in charge:

Professor Francis D. Curtis, Chairman
Doctor Francis W. Dalton
Professor Paul S. Dwyer
Professor Howard R. Jones
Associate Professor Robert E. McKee

Abstract

THE DETERMINATION OF STANDARDS FOR INDUSTRIAL-ARTS LABORATORIES

by Willard M. Bateson

Statement of the problem.--The purpose of this study was to develop a check list of standards for use by teachers and others in evaluating the physical facilities in the industrial-arts laboratory.

Techniques used in the study.--A list of the facilities of the industrial-arts laboratory that met certain criteria was secured from an analysis of the literature. This array of facilities was organized as a check list and submitted to a jury of industrial-arts specialists to secure their opinions regarding the appropriateness and comprehensiveness of the list. From the available sources, all suggested standards for the facilities were recorded. The facilities were grouped in five categories (illumination, heat and ventilation, architecture, electric, and shop planning), and a check list for each category was constructed. These check lists were submitted to specialists for the purpose of determining the optimal standard for each facility.

The facilities, with their optimal standards, were submitted to a jury of specialists representing the field of industrial arts to determine the relative contribution to a functional laboratory of each facility with its selected optimal standard. The opinions of these specialists were used in the following formula for computing the weight of each facility with its accompanying standard.

$$w = \frac{(v_1 \cdot f) + \cdots + (v_5 \cdot f)}{N}$$

Where: w = Weight.
v = Value of the selected rating.
f = Frequency of rating.
N = Total raters.

A check list of standards for evaluating the physical facilities of the laboratory was then made by assembling the list of facilities, together with their optimal standards, and the weights as determined from the previous steps in this investigation. To check its practicability,

this check list was used to evaluate two laboratories. This use of the check list indicated the desirability of making a few minor changes, which were incorporated in the final form of the check list. A sample of the check list, with the directions for marking, follows:

A CHECK LIST OF STANDARDS FOR USE IN EVALUATING THE PHYSICAL FACILITIES OF THE INDUSTRIAL-ARTS LABORATORY

Directions for Marking

1. Place a check in the "YES" column if the facility in the laboratory evaluated satisfies all of the following conditions:

   a. The facility meets or exceeds the minimum value of the standard stated in the check list.

   b. The facility does not exceed the maximum value of the standard stated in the check list.

2. Place a check in the "NO" column if the facility does not satisfy the above conditions.

3. If the instructional program does not include provisions for the facility, leave the spaces in the columns blank.

4. If the facility is missing, place a check in the "NO" column.

Facility	Standard	Weight	Laboratory Facility Meets Standard: YES	NO
LABORATORY SPACE				
Minimum height of ceiling	12 feet	3	____	____
Minimum width of laboratory	30 feet	4	____	____
Minimum ratio of the width to the length	1 : $1\frac{1}{2}$	3	____	____

Conclusions.--To the extent that the techniques employed in this study may be accepted and the results secured may be considered typical, the following conclusions seem justified:

1. Sixty-two of the sixty-eight physical facilities identified at the start by the investigator were judged by the majority of the specialists as important enough to warrant establishing standards for them. Fifty-six, or approximately 82 percent, were unanimously approved. Therefore, specialists in the field of industrial arts agree closely with respect to what are the physical facilities in the laboratory for which standards are justified.

2. The highest percentage of check lists returned from the juries of specialists whose services had not been requested prior to their direct involvement in the study was approximately 72; the highest percentage of check lists returned by the juries of specialists whose cooperation had previously been solicited was 100. These facts provide some basis for the conclusion that specialists whose services have been requested in advance of their participation, are more likely to return the check lists than are those whose willingness to participate has not been previously ascertained.

ACKNOWLEDGMENTS

I am profoundly grateful to Dr. Francis D. Curtis, Professor of Education, and chairman of my doctoral committee, for his encouragement, his time, and his friendly guidance. His kindness will long remain in my memory, and his scientific approach to educational problems shall always remain an inspiration to me. I also wish to extend my gratitude to the associate members of my committee: Dr. Francis W. Dalton, Lecturer in Vocational Education and Practical Arts; Dr. Paul S. Dwyer, Professor of Mathematics and Consultant in the Statistical Research Laboratory; Dr. Howard R. Jones, Professor of School Administration; and Mr. Robert E. McKee, Associate Professor of Production Engineering.

The study would not have been possible without the cooperation of the juries of specialists which participated throughout the investigation. To each specialist, I am especially indebted.

Willard M. Bateson

TABLE OF CONTENTS

CHAPTER		Page
I.	THE PROBLEM	1
	Related Studies and Literature	1
	Summary	10
	Statement of the Problem	11
	Delimitations	12
	Definition of Terms	12
II.	THE DETERMINATION OF THE PHYSICAL FACILITIES IN THE INDUSTRIAL-ARTS LABORATORY	14
	Statement of the Problem	14
	Development of Tentative List of Facilities	14
	Preparation and Use of the Check List	16
	Selection of Jury Members	18
	Findings	24
III.	THE CONSTRUCTION OF AN INSTRUMENT FOR EVALUATING THE PHYSICAL FACILITIES OF THE INDUSTRIAL-ARTS LABORATORY	26
	Statement of the Problem	26
	Determination of the Proposed Standards	26
	Preparation and Use of the Check Lists	28
	Findings	39
	Selection of Optimal Standards	40
	Determination of Relative Contribution of the Facilities	40
	Computation of the Weights	44
	Development of the Check List of Standards	45

CHAPTER Page

IV. SUMMARY AND CONCLUSIONS 47

Statement of the Problem 47

Techniques Used in the Study 47

A Check List of Standards for Use in Evaluating the Physical Facilities of the Industrial-Arts Laboratory 49

Conclusions 79

BIBLIOGRAPHY 80

APPENDICES

I. ROSTER OF MEMBERS OF THE SEVEN JURIES OF SPECIALISTS WHO ASSISTED IN THIS INVESTIGATION 88

Members of the Jury of Experts Representing the Field of Industrial-Arts Education 88

Members of the Jury of Specialists Representing the Field of Illumination 89

Members of the Jury of Specialists Representing the Field of School-Plant Construction . . 90

Members of the Jury of Specialists Representing the Field of Industrial-Arts Education . . 92

Members of the Jury of Specialists Representing the Field of Heat-and-Ventilating Engineering 93

Members of the Jury of Specialists Representing the Field of Electrical Engineering 94

Members of the Pilot Group 95

II. THE CHECK LISTS EMPLOYED IN THE STUDY . . 96

Check List of Physical Facilities 97

Check List for Specialists in Industrial-Arts Education 103

Check List for Specialists in School-Plant Construction 133

APPENDICES

	Page
Check List for Specialists in Illumination	139
Check List for Specialists in Heating-and-Ventilating Engineering	148
Check List for Specialists in Electrical Engineering	152
Check List [sent to jury of experts to determine the relative contribution of the facilities to a functional laboratory]	155
III. DISTRIBUTION OF THE SELECTIONS MADE BY THE JURORS OF THE OPTIMAL STANDARDS FOR THE VARIOUS STANDARDS FOR THE FACILITIES	185

CHAPTER I

THE PROBLEM

The purpose of this investigation is to determine standards for the physical facilities of the industrial-arts laboratories on the secondary-school level.

Related Studies and Literature

The literature dealing with the various facilities of the industrial-arts laboratory is voluminous. Most of it consists of articles in professional magazines and journals. It represents merely opinions, more-or-less authoritative, and suggestions, more-or-less practical. Moreover, it is highly repetitious. No statistical investigations relative to the physical facilities of the industrial-arts laboratory have been reported. Two noteworthy attempts to establish standards for such facilities have, however, been made. The first of these is presented in the volume Evaluative Criteria,[1] produced as a part of the Cooperative Study of Secondary-School Standards; the second is reported in a publication of the American Technical Society titled A Procedure for Evaluating a Local Program of Trade and Industrial Education.[2]

---

[1] Evaluative Criteria (1950 Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, 1950), pp. v + 305.

[2] A Procedure for Evaluating a Local Program of Trade and Industrial Education (Chicago: American Technical Society, 1952), pp. 64.

Although only the 1950 edition of Evaluative Criteria is directly germane to the present investigation, a brief resumé of the monumental work of the General Committee in charge of the Cooperative Study seems desirable.

The Committee was organized in August, 1933, by representatives of the six regional associations of colleges and secondary schools of the United States. The main aims were (1) to determine the characteristics of a good secondary school, (2) to find practical means and methods of evaluating the effectiveness of a school in terms of its objectives, (3) to determine the means and processes by which a good school develops into a better one, and (4) to devise ways by which regional associations can stimulate and assist secondary schools to continuous growth.

Actual work on the project was started in 1934. During that year, O. I. Frederick and M. L. Altstetter were employed to construct bibliographies and to abstract significant research studies and other materials. As the work of these two men progressed, voluntary assistance in abstracting material in specific fields was contributed by professors and graduate students at certain colleges and universities throughout the country. Thus, in all, approximately twenty-five hundred abstracts of studies and reports were assembled. By a technique that is not described, these materials made the basis for determining the criteria to be used in evaluating secondary-school programs. The first edition of Evaluative Criteria appeared in mimeograph form[1] in July, 1935.

---

[1] Evaluative Criteria (First Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, July, 1935, Mimeographed), pp. 217.

Copies of the first edition were submitted for study and criticism to members of the Cooperative Study, graduate students in education, and to faculty members at a number of institutions. A detailed study was made by the central staff of the Cooperative Study of the criticisms obtained from these groups, on the basis of which certain changes were introduced into the organization of the material. The material, thus revised, was published in December, 1935, as the second edition.[1]

Critical evaluations of the first two editions were made by approximately five hundred collaborators. These collaborators included national leaders in secondary education, active principals of secondary schools in every state, specialists in secondary education in state departments, professors of secondary education in leading universities, groups of graduate students in education, school librarians, and classroom teachers in the principal instructional fields. The third edition,[2] substantially changed in both form and content on the basis of these criticisms, was published in April, 1936.

The third edition was reviewed by members of the Cooperative Study at a meeting in Washington, May 7 to 9, 1936. Approval was given to the general content of the third edition, but numerous suggestions for further improvement were made. Some further

---

[1] Evaluative Criteria (Second Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, December, 1935, Mimeographed), pp. 100.

[2] Evaluative Criteria (Third Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, April, 1936, Hectographed), pp. 129.

changes were made, and, in September, 1936, the fourth edition[1] was published.

The next step in the validation and improvement of the criteria for evaluating secondary schools involved two hundred experimental schools. During the school year 1936-37, Edition IV of Evaluative Criteria was used extensively by the staffs of these schools and certain members of the Cooperative Study, to evaluate the programs of these schools. From the experiences thus gained, Edition IV was further revised under the direction of the General Committee. Certain items were eliminated, others were added; changes in phrasing individual items were made to avoid ambiguities; and many changes were made in typography, headings, and forms. In October, 1938, the fifth edition[2] was published.

More than ten thousand copies of the fifth edition were distributed to schools during the academic year 1938-39. As a result of this extensive use, many modifications and improvements for the utilization of the criteria in evaluating secondary schools were suggested to the Cooperative Study. As in the preceding editions, changes deemed desirable by the Cooperative Study were instituted, and the final copy of the 1940 edition[3] was approved for publication in May, 1939.

---

[1] Evaluative Criteria (Fourth Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, September, 1936), pp. 132.

[2] Evaluative Criteria (Fifth Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, 1938), pp. 132.

[3] Evaluative Criteria (1940 Ed.; Washington, D. C.: Cooperative Study of Secondary-School Standards, 1940), pp. 175.

Early in 1948, a research staff was secured by the Cooperative Study to evaluate the suggestions that had been obtained from users of the 1940 edition of Evaluative Criteria. These suggestions were later submitted to approximately 150 consultants and specialists in the various fields of secondary education for their recommendations. In 1949, the proposed revision was submitted to the General Committee for final review and approval. The revised edition was approved by the General Committee and authorized for publication as the 1950 edition of Evaluative Criteria.[1]

The second report, cited on page 1 of the present study, was developed by the combined efforts of the National Association of State Supervisors of Trade-and-Industrial Education, the National Association of Local Administrators of Vocational Education and Practical Arts, the National Association of Industrial Teacher Educators, and the California State Department of Education in cooperation with the United States Office of Education.

In 1947, the California State Superintendent of Public Instruction appointed a committee to develop a guide for the housing and layout of school shops in California. The committee was made up of twenty administrators and supervisors of programs of trade-and-industrial education, and of industrial-arts education in California. On June 1, 1948, this committee's recommendations were published in hectographed form.[2] No description of any of the techniques

---

[1] Evaluative Criteria, op. cit.

[2] Suggested Guide for the Housing and Layout of School Shops (Sacramento, California: California State Department of Education, Bureau of Trade and Industrial Education, 1948, hectographed), pp. 11.

employed in arriving at these recommendations was given, but only the assertion that

> . . . the specifications . . . were derived from statements of principles, standards, criteria, and objectives obtained from the literature on school shop planning plus others recommended by members of the committee. The statements so obtained were appraised and rephrased by the committee members working individually, the rephrased statements edited by a steering committee, and the edited statements accepted or rejected by the entire committee.[1]

In December of the same year, at the meeting of the National Association of State Supervisors of Trade-and-Industrial Education, in Milwaukee, Wisconsin, the President of the Association appointed a five-man committee to develop criteria for evaluating local programs of trade-and-industrial education. In December, 1949, this committee presented a report of its year's work at the annual meeting of the Association, in Atlantic City. The recommendations of the committee were later revised by the Bureau of Trade-and-Industrial Education of the California State Department of Education, and were included in a revision of the Suggested Guide for the Housing and Layout of School Shops, published by the California State Department of Education. This revised edition[2] was published in 1950.

In 1949, during the time when the committee of five of the National Association of State Supervisors of Trade-and-Industrial Education was developing criteria, another committee, also interested in developing evaluative criteria, was organized in the North Atlantic Region. The purposes of the North Atlantic Region Committee were

---

[1] Ibid.

[2] Guide for Housing and Layout of School Shops in California (Sacramento, California: California State Department of Education, 1950), pp. 40.

(1) to develop more adequate evaluative criteria, and (2) to develop more satisfactory procedures in the evaluation of vocational industrial schools and classes. In September, 1949, two members of this committee, together with three supervisors and teacher educators, held a two-day conference in State College, Pennsylvania, during which they developed tentative criteria for evaluating vocational industrial-education programs. These criteria were revised, refined, and expanded by C. F. Fitz and M. W. Knerr, of the Department of Industrial Education of the Pennsylvania State College.

On December 5, 1949, this material was reviewed by the whole committee, which made certain changes in its organization. The report of this committee was submitted for criticism to a group of seven educators on March 17, 1950, at a meeting in Lewiston, Pennsylvania. Later that year the final draft[1] was approved by the membership of the North-Atlantic States Regional Conference called by the United States Office of Education.

At the annual convention of the American Vocational Association, in Miami, in December, 1950, the National Association of State Supervisors of Trade-and-Industrial Education, the National Association of Local Administrators of Vocational Education and Practical Arts, and the National Association of Industrial Teacher Educators authorized the appointment of a Joint Committee on Evaluation Procedures in Trade-and-Industrial Education. This joint committee was requested to arrange for the preparation and publication of an evaluative instrument that could be used on a national basis for evaluating local programs. Mr. William Penn Loomis, from the United

---

[1] An Instrument for Evaluating the Effectiveness of Vocational Industrial Education Programs (Washington, D. C.: Vocational Division, U. S. Office of Education, 1950), pp. v + 64.

States Office of Education, was assigned to work with the Joint Committee in preparing a procedure for evaluation that would embody the essential elements and practices of the several methods that had been developed up to that time. No description of the techniques employed was included in the report[1] which was published in 1952.

A project[2] related to the industrial-arts laboratory was sponsored by the Illuminating Engineering Society and the American Institute of Architects. The purpose of the project was "to establish criteria of good illumination for the guidance of architects, engineers, school people, and others interested in the conservation of children's vision and in the efficiency of pupils and teachers."[3] The following quotation provides the background of this project:

> In 1918 the Illuminating Engineering Society prepared and issued a "Code of Lighting School Buildings."
>
> In 1923 the forerunner of the American Standards Association initiated a Sectional Committee on School Lighting and invited the Illuminating Engineering Society and the American Institute of Architects to become co-sponsors. This committee produced their first report in 1924. Revisions under the same procedure were made in 1932 and 1938.
>
> Since the printings of the 1938 edition were exhausted, and since the technique of lighting application in schools had advanced considerably due to the development and study of brightness relationships in the illuminated environment and to the introduction of new light sources, it was thought appropriate to develop a new revision.[4]

---

[1] A Procedure for Evaluating a Local Program of Trade and Industrial Education, op. cit.

[2] American Standard Practice for School Lighting (New York: Illuminating Engineering Society, 1948), p. 79.

[3] American Standard Practice for School Lighting, op. cit., p. 6.

[4] Loc. cit.

The School Lighting Committee of the Illuminating Engineering Society began work on a proposed revision in 1943. In the General Secretary's Report[1] for 1943-1944, the following statement appears:

> This committee [School Lighting Committee], . . . organized late in the year, . . . was engaged in laying plans for the revision of the American Recommended Practice for School Lighting. . . . The committee has had several meetings outlining some of the material needed for the revision of the Recommended Practice.

In the General Secretary's Report[2] for 1944-1945, the following statement is included concerning the progress of the committee:

> . . . The work of the committee has been carried on through sub-committee study of sections of the whole report. A considerable mass of material has been assembled and as the year closes, the final report is being edited for approval by the committee and presentation to the Council.

During April, 1946, the Revision of the Standards was submitted to the Council, and after discussion was referred back to the committee by the Council for further revision. After an additional year's work by the committee on the revision, their report was accepted by the Council and was forwarded to the American Standards Association for consideration. In September, 1948, the revised standards were approved and published.[3] No information concerning the techniques or procedures used in any part of this project is given in this report.

---

[1] Annual Report of General Secretary, Illuminating Engineer, XXXIX (December, 1944), 684.

[2] Annual Report of General Secretary, Illuminating Engineer, XL (December, 1945), 893.

[3] American Standard Practice for School Lighting, loc. cit.

Summary

Although the problem of providing adequate school facilities has become intensely acute only within the past ten years, the need for sensible planning for school buildings was expressed by school personnel many years ago. In March, 1921, three men, Samuel A. Challman of Minnesota, Charles McDermott of New Jersey, and Frank H. Wood of New York, met in Atlantic City to formulate an organization of persons who were primarily concerned with school building problems. They declared the purpose of the organization to be "to promote the establishment of reasonable standards for school buildings and equipment with due regard for economy of expenditure, dignity of design, utility of space, healthful conditions, and safety of human life."[1] The organization that evolved from this meeting is the National Council on Schoolhouse Construction.

The National Council has dealth with over-all problems affecting the total school plant, but it has given little attention to the specific standards for specialized areas of instruction. Thus, there appears to be a need for investigations dealing with standards for the physical facilities of specific program areas.

Two volumes having to do with standards for industrial-education laboratories on the secondary-school level have been produced since 1950. The first, Evaluative Criteria, is the product of the Cooperative Study for Secondary-School Standards; the second, A Procedure for Evaluating a Local Program of Trade-and-Industrial Education, is a combination of several independent committee reports made under the sponsorships of different organizations. Both projects

---

[1] Ray L. Hamon et al., Guide for Planning School Plants (Nashville, Tennessee: Peabody College, 1949), p. 5.

have been carried to completion in response to the need recognized by school personnel for an appropriate instrument to evaluate school programs of industrial arts.

The criteria, or standards, for the evaluation of the physical facilities of the industrial-arts laboratory contained in the reports of the projects seem to be in need of refinement. Both volumes contain statements of standards that may be interpreted in ways likely to yield entirely different evaluations of facilities by different raters. To illustrate, in Evaluative Criteria[1] this specification occurs: "Sufficient light . . . [should be] provided to meet the requirements for work in each part of the entire shop." In the volume[2] published by the American Technical Society is the corresponding specification: "There . . . [should be] adequate and suitable provisions for lighting for the type of activity." "Sufficient" or "adequate and suitable" are adjectives subject to many interpretations. Such statements cannot be considered as standards, because of their indefiniteness, though they may be accepted as guiding principles. There remains, then, the task of determining exact and definite standards that meet the requirements identified in such principles.

Statement of the Problem

The purpose of the present investigation is, therefore, to develop a check list of standards that can be used by teachers of industrial arts, principals, and others, in evaluating with an acceptable degree of objectivity the physical facilities of industrial-arts laboratories.

---

[1] Evaluative Criteria (1950 Ed.), op. cit., p. 127.

[2] A Procedure for Evaluating a Local Program of Trade and Industrial Education, op. cit., p. 38.

In the process of developing this instrument, the following problems must be solved:

a. The physical facilities in the industrial-arts laboratory for which standards seem appropriate must be identified. Chapter II has been devoted to this phase of the study.

b. Standards must be determined for those physical facilities identified as being important enough to be considered in evaluating the industrial-arts laboratory. Chapter III deals with this phase.

c. The relative importance of each of the physical facilities, together with its accompanying standard, must be determined, if the instrument is to be of practical value to the user. This phase of the study is presented also in Chapter III.

Delimitations

The study will be limited to the general industrial-arts laboratory on the secondary-school level, which includes the following five areas of instruction: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

Although it is believed that the majority of the standards to be developed will be applicable to other school laboratories besides those for courses of industrial arts (for example, the farm shop and trade-and-industrial laboratories), there are basic differences in program objectives that seem to warrant this delimitation. No attempt will be made in this investigation to establish standards for the selection of the equipment and supplies used in the laboratory.

Definition of Terms

The term "industrial arts," as used in this study, designates that part of general education whose primary purpose is to acquaint pupils with the materials and processes used to convert raw materials to their finished state.

"Vocational industrial education" designates that type of education whose primary objective is to prepare individuals for careers in industry.

"Laboratory," or "shop," means the room, or rooms, used in carrying on the activities of instruction in industrial arts.

"Industrial education" includes all phases of education that have as their main objective the orientation or the preparation of individuals for trades and industry. In this study it has been used as a generic term that includes both industrial arts and vocational industrial education.

"Physical facilities" are the facilities, or elements, of the industrial-arts laboratory that directly, or indirectly, affect the safety, or the visual, auditory, or physical comfort of the pupil; or that contribute to such characteristics of the laboratory as flexibility, accessibility, and efficiency.

A "standard" is an exact specification of what the dimensions, location, type, or other essential characteristic of the laboratory facility should be. For example, for the facility "window area" in the laboratory, a suggested standard might be, "20 percent of the floor area."

A "functional" laboratory is one in which the safety, and the visual, auditory, and physical comfort of the pupils are of concern; and also, is one in which such laboratory characteristics as flexibility, accessibility, and efficiency are present to a marked degree.

CHAPTER II

THE DETERMINATION OF THE PHYSICAL FACILITIES IN THE INDUSTRIAL-ARTS LABORATORY

Statement of the Problem

The purpose of this unit of the investigation is to determine the physical facilities of the industrial-arts laboratory, for which standards are important.

Development of Tentative List of Facilities

The first step was to develop a bibliography of the materials dealing with the industrial-arts laboratory. These sources included professional books, pamphlets, catalogues, and articles in periodicals, as well as unpublished dissertations and special reports.

The sources were examined, and all physical facilities (as defined on page 13) that were considered by the investigator to be important, were recorded. These facilities were then classified under seven major headings:

ARCHITECTURAL ITEMS

1. Ceiling
2. Doors
3. Floors
4. Orientation
5. Partitions
6. Trim
7. Walls
8. Windows
9. Natural-light control
10. Chalkboard

ELECTRICAL ITEMS

1. Power circuits
2. Power-circuit controls
3. Outlets
4. Intercommunication system
5. Fire-alarm system
6. Shop-signal system
7. Clock
8. Light circuits
9. Light-circuit controls
10. Light fixtures

VENTILATING ITEMS

1. Ventilating system
2. Ventilating controls
3. Exhaust system

HEATING ITEMS

1. Heating system
2. Temperature controls

PLUMBING ITEMS

1. Air compressor
2. Air outlets
3. Air controls
4. Gas outlets
5. Drinking fountain
6. Work sinks
7. Sprinkler system
8. Wash basins

SHOP-LAYOUT ITEMS

1. Auxiliary areas
   a. Assembly
   b. Display
   c. Finishing
   d. Planning
   e. Office
   f. Open areas
2. Storage areas
   a. Equipment
   b. Large-project
   c. Supply

d. Waste
e. Pupil-property
f. Wardrobe

3. Aisles
4. Work-stations
   a. Bench
   b. Circular saw
   c. Jointer
   d. Wood planer
   e. Wood lathe
   f. Band saw
   g. Jig saw
   h. Metal lathe
   i. Metal shaper
   j. Miller
   k. Floor grinder
   l. Drill press
   m. Power saw
   n. Kiln
   o. Potter's wheel
   p. Glazing booth
   q. Drafting table

MISCELLANEOUS ITEMS

1. Fire extinguishers
2. First-aid cabinet

Preparation and Use of the Check List

A check list including all these items was constructed for the purpose of obtaining the opinions of a jury of experts concerning the comprehensiveness of the list and the appropriateness of its items. The use of jury judgments throughout this investigation was deemed defensible from the evidence assembled by Keeslar. According to Keeslar[1] ". . . group judgments are both reliable and valid within

---

[1] Oren O. Keeslar, "Contributions of Instructional Films to the Teaching of High School Science" (Unpublished doctor's dissertation, University of Michigan, 1945), pp. 104-15.

the frame of reference set up for them providing (1) that the judges be well trained and experienced, i.e., experts in their fields of specialization, and (2) that the criteria in terms of which the judgments are to be made be clearly and concisely stated for that purpose." Further evidence[1,2,3,4,5] presented by Keeslar demonstrates that the average of the ratings made by a small number of experts is very similar to the average of the ratings made by a greater number of experts, provided that the criteria are clearly and concisely stated.

The check list and the instructions to the jury were submitted to a pilot group[6] of three members of the School of Education, University of Michigan. These men were requested to offer constructive criticism of the instructions, and to add to the list items they deemed desirable for inclusion.

---

[1] Fred P. Frutchey, "Measuring the Ability to Apply Chemical Principles," Educational Research Bulletin (Ohio State University), XII (December 13, 1933), 255-260.

[2] Willard C. Olson and Muriel M. Wilkinson, "The Measurement of Child Behavior in Terms of Its Social Stimulus Value," Journal of Experimental Education, I (1932), 92-95.

[3] Harold H. Anderson, "Domination and Integration in the Social Behavior of Young Children in an Experimental Play Situation," Genetic Psychology Monographs, XIX (August, 1937), 343-408.

[4] Margaret Nesbitt, "Adult Child Relationships, Student Child Relationships in the Nursery School" (Unpublished doctor's dissertation, University of Michigan, 1942), pp. xii + 204.

[5] Ralph W. Tyler, "Ability to use the Scientific Method," Educational Research Bulletin (Ohio State University), XI (January 6, 1932), 1-9.

[6] The names, positions, and addresses of the members of the pilot group are listed in the Appendix, p. 95.

This pilot group suggested the addition of three items to the check list of physical facilities. The items were "picture molding," "gas controls," and "visual-aids area."

Selection of Jury Members

Seven experts in the field of industrial-arts education were selected by the investigator to serve on the jury to evaluate the augmented list of physical facilities. The competence of the individual to serve on the jury was determined by: (1) the position he then held, or had held, in the field of industrial education; or (2) by his familiarity with this field, as evidenced by his publications or his experience. Each of the seven experts was invited to serve after being informed of the purpose of the investigation and the responsibilities of the jury.

A copy of the letter sent to the jurors requesting them to serve, follows:

Dear _____:

I am undertaking a study for the purpose of developing an instrument for evaluating certain physical facilities of the industrial-arts laboratory. I should appreciate your cooperation in this undertaking to the extent of serving as a member of a jury of experts chosen from the field of industrial arts.

Should you consent to serve, you will be asked to evaluate a list of physical facilities of the laboratory for which standards seem appropriate. At a later date you will be asked also to rate them.

In return for approximately two hours of your time, I should be pleased to send you the evaluation instrument when it is completed, and with it an abstract of the results of the study.

The enclosed reply card is for your convenience in answering. I wish to thank you in advance for any assistance you may be able to render.

Cordially yours,
Willard M. Bateson
Signed
enc. 1

Every juror selected to serve expressed his willingness to serve. The check list, with directions for marking, and a letter giving more details were sent to the jury. A copy of the letter accompanying the check list, and a sample of the check list,[1] with directions for marking, follow:

Dear _____:

I want to express my appreciation of your willingness to participate in the development of an instrument for evaluating the physical facilities of the industrial-arts laboratory.

As stated in my previous letter, the purpose of the study is to develop a check list of standards for evaluating the physical facilities of the industrial-arts laboratory. The first step in the procedure is to identify the facilities in the laboratory for which standards seem appropriate.

The enclosed check list of facilities has been derived from a review of approximately one hundred and fifty publications and special studies dealing with the industrial-arts laboratory. These were the criteria used in selecting the facilities listed: (1) Does the facility contribute directly or indirectly to the safety, or the visual, auditory, or physical comfort of the pupil; or (2) does the facility contribute to such laboratory characteristics as flexibility, accessibility, or efficiency.

I am now asking you to evaluate the accompanying check list for comprehensiveness and appropriateness of the items listed. Comprehensiveness should be interpreted as meaning that all the facilities in the laboratory that meet the criteria of selection have been included. Appropriateness of the item should be interpreted as meaning that every facility included is of sufficient importance to justify the determination of standards for it.

I have enclosed a self-addressed envelope for your convenience in returning the check list. May I thank you again for your cooperation.

Cordially yours,
Willard M. Bateson
Signed
enc. 2

---

[1] For the complete check list, refer to the Appendix, p. 97.

[SAMPLE]

CHECK LIST OF PHYSICAL FACILITIES

Introduction:

The numbered items appearing in the check list are physical facilities found in a general industrial-arts laboratory in which woodworking, machine-shop practice, sheet-metal working, ceramics, and drafting are taught. The facilities have been grouped under seven major headings: Architecture, Electric, Ventilation, Heat, Plumbing, Shop-layout, and Miscellaneous.

Directions:

If, in your opinion, the numbered item is important enough to justify the determination of standards for it, please indicate by placing a check in the "YES" column; on the other hand, if you believe the item is not important enough to justify standards being determined for it, please place a check in the "NO" column.

If, in your opinion, there are facilities that warrant consideration but do not appear on the list, will you please write them in the space provided.

Note: In parentheses below each numbered item are some characteristics for which standards are being considered.

ARCHITECTURAL FACILITIES	YES	NO
1. Ceiling . . . . . (height, reflection value, sound-absorbing value)	____	____
2. Floor . . . . . (material, area, proportions)	____	____
3. Doors . . . . . (type, width, hardware, reflection value)	____	____
4. Partitions . . . . . (material)	____	____
5. Walls . . . . . (height of wainscoting, reflection value, sound-absorbing values)	____	____
6. Windows . . . . . (height, fenestration, glass, area)	____	____

Every juror promptly marked and returned his copy of the check list. Table I represents the reactions of the jurors to the items of the check list.

TABLE I

NUMBERS OF JURORS WHO GAVE THE INDICATED RESPONSES WITH REGARD TO THE APPROPRIATENESS OF ESTABLISHING STANDARDS FOR THE PHYSICAL FACILITY

Physical Facility	Yes	No	Unanswered
Ceiling	7	0	0
Doors	7	0	0
Floor	7	0	0
Orientation	7	0	0
Partitions	7	0	0
Trim	4	3	0
Picture molding	1	6	0
Walls	7	0	0
Windows	7	0	0
Natural-light control	7	0	0
Chalkboard	7	0	0
Power circuits	7	0	0
Power-circuit controls	7	0	0
Outlets	7	0	0
Intercommunication system	2	4	1
Fire-alarm system	5	1	1
Shop-signal system	2	4	1
Clock	3	4	0

TABLE I--Continued

Physical Facility	Yes	No	Unanswered
Light circuits	7	0	0
Light-circuit controls	7	0	0
Light fixtures	7	0	0
Ventilating system	7	0	0
Ventilating controls	7	0	0
Exhaust system	7	0	0
Heating system	7	0	0
Temperature controls	7	0	0
Air compressor	7	0	0
Air outlets	7	0	0
Air control	2	4	1
Gas outlets	7	0	0
Gas control	2	5	0
Drinking fountain	5	2	0
Work sinks	5	2	0
Sprinkler system	4	3	0
Washing facilities	6	1	0
Auxiliary areas			
Assembly	6	1	0
Display	7	0	0
Finishing	7	0	0
Planning	7	0	0
Office	7	0	0
Visual-aids	5	2	0
Open areas	7	0	0

TABLE I--Continued

Physical Facility	Yes	No	Unanswered
Storage areas			
Equipment	7	0	0
Large-projects	7	0	0
Supply	7	0	0
Waste	7	0	0
Pupil-property	6	1	0
Wardrobe	5	2	0
Aisle	6	1	0
Work-stations			
Bench	7	0	0
Circular saw	7	0	0
Jointer	7	0	0
Planer, wood	7	0	0
Wood lathe	7	0	0
Band saw	7	0	0
Jig saw	7	0	0
Lathe, metal	7	0	0
Shaper, metal	7	0	0
Miller	7	0	0
Floor grinder	7	0	0
Drill press	7	0	0
Power saw	7	0	0
Kiln	7	0	0
Potter's wheel	7	0	0

TABLE I--Continued

Physical Facility	Yes	No	Unanswered
Drafting table	7	0	0
Miscellaneous			
Fire extinguishers	7	0	0
First-aid cabinet	7	0	0

Findings

1. Sixty-two of the sixty-eight physical facilities listed on the check list were judged appropriate[1] by the majority of the members of the jury. This represents over 91 percent agreement between the judgments of the investigator and the jurors with respect to the appropriateness of the items.

2. Six items on the list of physical facilities were judged by the majority of the jurors as not appropriate. The six items were: picture molding, intercommunication system, shop-signal system, clock, air controls, and gas controls. These items were eliminated from the final list of the physical facilities for which standards were determined.

3. Fifty-six items on the list, or approximately 82 percent, were unanimously approved by the members of the jury.

4. Only one item was added to the list, namely "tackboard," but this was added by a majority (four) of the jurors. This represents

[1] Items were judged appropriate if they were considered by the majority of the jurors as important enough to warrant establishing standards for them.

over 98 percent agreement between the judgments of the investigator and jurors with respect to the comprehensiveness of the list.

On the basis of all these results, therefore, the final list of the physical facilities to be used in the succeeding units of this study was accepted as consisting of the original list appearing on pages 21-24, together with the three items suggested by the pilot group and the one item suggested by the majority of the members of the jury, minus the six items judged by the jury as not appropriate.

CHAPTER III

THE CONSTRUCTION OF AN INSTRUMENT FOR EVALUATING THE PHYSICAL FACILITIES OF THE INDUSTRIAL-ARTS LABORATORY

Statement of the Problem

The purpose of this unit of the investigation is (1) to determine the standards for the physical facilities of the industrial-arts laboratory, (2) to determine their relative contributions to a functional laboratory, and (3) to construct a check list of standards for use by industrial-arts teachers in evaluating the physical facilities of the laboratory.

These physical facilities,[1] for which standards are now to be determined, are those that have been already judged by a jury of experts as contributing materially to the safety, or the visual, auditory, or physical comfort of the pupils in the laboratory, or to such laboratory characteristics as flexibility, accessibility, or efficiency.

Determination of the Proposed Standards

From the literature previously assembled, that related to all aspects of this investigation, the materials dealing directly with either the industrial-arts laboratory as a whole, or with its physical facilities specifically, were set apart for examination. Whenever,

---

[1] Chapter II was devoted to the determination of the physical facilities of the laboratory for which standards were deemed important.

as this examination progressed, a suggested standard was found for any of the facilities previously identified, the standard was recorded on a card under the designation of the facility; other suggested standards for the same facility were added as they were discovered. For example, four suggested standards found for the "height of the wainscoting" were thus recorded.

The height of the wainscoting.
a. Approximately 40 to 48 inches[1]
b. About 5 feet[2]
c. Seven feet[3]
d. Not less than 8 feet[4]

These data served as the basis for the proposed standards assigned by the investigator to the height of the wainscoting in the laboratory. The following represents the treatment of the item as it appeared in the check list sent to the jury.

The height of the wainscoting (dado) should be
Three feet . . . . . ____
Four feet . . . . . ____
Five feet . . . . . ____
Six feet . . . . . ____
Seven feet . . . . . ____
If others, specify . . . . . ____

---

[1] Guide for Planning the Industrial Arts and Trade and Industrial Departments (Richmond, Virginia: State Department of Education, 1948), p. 16.

[2] Ohio High School Standards, A Guide for Industrial Arts Shop Planning (Columbus, Ohio: Department of Education, 1949), p. 11.

[3] Industrial Arts in Pennsylvania (Harrisburg, Pennsylvania: Department of Public Instruction, Bulletin 331, 1951), p. 111.

[4] Recommendations on School Facilities, Equipment, and Supplies, Preliminary Report for Presentation to the Executive Committee of the American Vocational Association (Unpublished Report).

Preparation and Use of the Check Lists

Before the check lists were constructed for obtaining a selection of the standards by juries of specialists, the standards were grouped arbitrarily in the following five categories: illuminating features, heating-and-ventilating features, architectural features, electrical features, and shop-planning features. These categories were defined or delimited thus: illuminating features--all those facilities of the laboratory that directly affect the visual comfort of the pupils; heating-and-ventilating--all those concerned with heat and ventilation; architectural features--those primarily concerned with school-plant construction; shop-planning features--those facilities, the precise characteristics of which, in the judgment of the investigator, teachers of industrial arts would best be able to judge. These latter features included such facilities as work-station areas, storage areas and locations, and room proportions.

A check list was constructed for each of the categories for the purpose of obtaining the opinions of specialists with respect to the optimal value or nature of each proposed standard. The check lists, with directions for marking them, were submitted to a pilot group of three faculty members of the School of Education, University of Michigan, who were requested to examine the lists only for ambiguities. The unanimous judgment of this pilot group was that the check lists were thus free.

Specialists[1] to judge the items in each of the major categories were selected on the same basis as were those who had been selected to serve on the jury of experts to judge the appropriateness of the

---

[1] The criteria used in selecting members for the juries appear on p. 18.

facilities, and the comprehensiveness of the list of physical facilities in the laboratory (Chapter II). Specialists from the following five fields--namely, illumination (specifically, school lighting), heating and ventilating, school-plant construction, electrical engineering, and industrial-arts education--were chosen to select the optimal standards for all features of the laboratory that could logically be considered as belonging in their respective fields.

A letter was sent to each of the specialists who had been selected to evaluate only the items of the check list dealing with the illuminating features, architectural features, and shop-planning features, asking him whether he would be willing to evaluate the list in view of the probability that its marking would demand more than twenty minutes' time. No such letter was sent, however, to the specialists in heating and ventilating, and electrical engineering because the time that would be required to evaluate the assigned lists was estimated by the investigator to be less than fifteen minutes.

The letter requesting the services of the specialists follows:

Dear _____:

I am undertaking a study for the purpose of developing an instrument for evaluating certain physical facilities in the industrial-arts laboratory. I should appreciate your assistance in this undertaking to the extent of serving as a member of a jury of specialists chosen from the field of _____.

Should you consent to serve, you will be asked to complete a check list of proposed standards for such a laboratory. Marking the check list will require about _____ minutes. The enclosed postal card is for your convenience in answering.

If you wish a summary of the study after it has been completed, I should be pleased to send it to you. I wish to thank you in advance for any assistance you may be able to render.

Sincerely yours,
Willard M. Bateson
Signed
enc. 1

The numbers of specialists requested to serve and the numbers who consented are shown in Table II.

TABLE II

NUMBERS OF SPECIALISTS WHOSE SERVICES WERE REQUESTED AND NUMBERS WHO CONSENTED TO SERVE

Jury	Number of Specialists	
	Whose Services Were Requested	Who Consented to Serve
Specialists in industrial-arts education	12	11
Specialists in school-plant construction	14	12[a]
Specialists in illumination . . .	15	12

[a] Includes a specialist who was not in the original selected group but whom a member of that group recommended to judge the items of the list in his place.

To each specialist in each of these three fields of specialization was sent a copy of the check list made up of the items related to his field of specialization. A copy of the form letter that accompanied the check list follows:

Dear _____:

I wish to express my appreciation of your willingness to participate in the development of an instrument for evaluating the physical facilities in the industrial-arts laboratory.

The standards that appear in the enclosed check list have been derived from materials secured from a comprehensive examination of the literature relating to the many different aspects of the industrial-arts laboratory. These standards are based on what seems to the investigator to be the most nearly valid information that might serve as a basis for formulating the standards. The enclosed check list includes those standards,

the values of which specialists like yourself are best qualified to judge.

Other check lists have been sent to specialists in such areas as _____, _____, and _____. It is hoped that, with the help of juries, each selected for a special area of the study, more valid and reliable results will be obtained than would otherwise be possible.

I have enclosed a self-addressed envelope for your convenience in returning the check list. May I thank you again for your cooperation.

Yours truly,
Willard M. Bateson
Signed
enc. 2

A sample of each of the three check lists that the selected specialists had consented to mark, follows. The complete check lists are presented in the Appendix.[1]

[SAMPLE]

CHECK LIST
FOR
SPECIALIST IN INDUSTRIAL-ARTS EDUCATION

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.

---

[1] See pages 103, 133, and 139 of Appendix.

3. The laboratory has been equipped to accommodate 25 pupils.

4. The laboratory is located in a one-story building.

Instructions to the juror:

Please place a check in the space opposite the one standard of each group that, in your opinion, is most completely defensible, or acceptable. If in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The location of the laboratory with regard to grade (ground) level should be

First floor . . . . . ____
Few feet above grade level . . . . . ____
Few feet below grade level . . . . . ____
If other, specify

_____

2. The minimum ceiling height for the laboratory should be

12 feet . . . . . ____
14 feet . . . . . ____
16 feet . . . . . ____
18 feet . . . . . ____
If other, specify

_____

3. The minimum width of the laboratory should be

22 feet	____	32 feet	____
24 feet	____	34 feet	____
26 feet	____	36 feet	____
28 feet	____	38 feet	____
30 feet	____	40 feet	____

If other, specify . . . . . ____

[SAMPLE]

CHECK LIST
FOR
SPECIALIST IN SCHOOL-PLANT CONSTRUCTION

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.

3. The laboratory has been equipped to accommodate 25 pupils.

4. The laboratory is located in a one-story building.

Instructions to the juror:

Please place a check in the space opposite the one standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The location of the industrial-arts laboratory with regard to the main plant should be

   Front corridor of main plant . . . . . ____
   Wing on the main plant . . . . . ____
   Separate building attached to the main plant . . ____
   Separate building . . . . . ____
   If others, specify _____
   _____

[SAMPLE]

CHECK LIST
FOR
SPECIALIST IN ILLUMINATION

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.

3. The laboratory has been equipped to accommodate 25 pupils.

4. The laboratory is located in a one-story building.

Instructions to the juror:

Please place a check in the space opposite the one standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The window area in the laboratory should be

   20% of the floor area . . . . . ____
   25% of the floor area . . . . . ____
   30% of the floor area . . . . . ____
   35% of the floor area . . . . . ____
   If others, specify _____
   _____

Check lists for the selection of standards related to the heating-and-ventilating, and the electrical facilities (the marking of which, as stated, would require less than 15 minutes) were sent, along with the following letter, to fourteen and ten specialists in these two fields, respectively.

Dear _____:

As part of a study that has for its purpose the determination of standards for the physical facilities in the industrial-arts laboratory, standards (specifications) are being determined for certain _____ facilities of the laboratory. The study is being limited to a general industrial-arts laboratory on the secondary-school level, in which the following areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

As a member of a select jury of specialists chosen from the field of _____, would you be kind enough to complete the enclosed check list? The marking of the check list will require about fifteen minutes. The enclosed envelope is for your convenience in returning the check list.

In return for your courtesy in cooperating in this undertaking, I shall be pleased to send you a summary of the study when it is completed. I wish to thank you in advance for any assistance you may be able to render.

Yours truly,
Willard M. Bateson
Signed
enc. 2

On the following pages are samples of the check lists,[1] and of their accompanying directions that were sent to the juries of specialists in the fields of heating-and-ventilating engineering and electrical engineering.

---

[1] Copies of the complete check lists appear in the Appendix, pp. 148-52.

[SAMPLE]

CHECK LIST
FOR
SPECIALIST IN HEATING-AND-VENTILATING ENGINEERING

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.

3. The laboratory has been equipped to accommodate 25 pupils.

4. The laboratory is located in a one-story building.

Instructions to the juror:

Please place a check in the space opposite the <u>one</u> standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The minimum quantity of air per pupil supplied in the laboratory should be

   10 cubic feet per minute . . . . . ____
   15 cubic feet per minute . . . . . ____
   20 cubic feet per minute . . . . . ____
   25 cubic feet per minute . . . . . ____
   30 cubic feet per minute . . . . . ____
   If others, specify _____
   _____

[SAMPLE]

CHECK LIST
FOR
SPECIALISTS IN ELECTRICAL ENGINEERING

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, three assumptions have been made to simplify the process of determining the standard.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.

3. The machine tools in the laboratory are the following:

Woodworking Area	Machine-Shop Area
3 Lathes	3 Lathes
1 Shaper	1 Shaper
1 Circular saw	1 Miller
1 Band saw	1 Power hack saw
1 Jig saw	
1 Drill press	
1 Jointer	Ceramics Area
1 Planer	
1 Grinder (floor)	3 Potter's wheels
1 Sander	1 Kiln

Instructions to the juror:

Please place a check in the space opposite the one standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

[SAMPLE--Continued]

1. The power-circuit wiring system used in the laboratory should be
   - Two-wire, single-phase . . . . . ____
   - Three-wire, single-phase . . . . . ____
   - Three-wire, three-phase . . . . . ____
   - Four-wire, three-phase . . . . . ____
   - If others, specify _____

2. There should be one branch power-circuit for every
   - Machine . . . . . ____
   - Two machines . . . . . ____
   - Three machines . . . . . ____
   - Four machines . . . . . ____
   - If others, specify _____

3. Raceway system for power-circuits should be
   - Rigid metal conduit . . . . . ____
   - Metallic tubing . . . . . ____
   - Wireways . . . . . ____
   - Busways . . . . . ____
   - If others, specify _____

4. In a new installation there should be one spare circuit for every
   - 4 active circuits . . . . . ____
   - 5 active circuits . . . . . ____
   - 6 active circuits . . . . . ____
   - 7 active circuits . . . . . ____
   - If other, specify . . . . . ____

5. The means whereby power circuits are protected from damage should be by the use of
   - Circuit breakers . . . . . ____
   - Plug-fuses . . . . . ____
   - If other, specify _____

The extent to which the jurors[1] responded to the request for help is indicated in Table III.

TABLE III

NUMBERS OF CHECK LISTS SENT AND THE NUMBERS AND PERCENTAGES RETURNED

Jury	Check Lists		
	Number Sent	Number Returned	Percentage Returned
Specialists in industrial-arts education	11	11	100
Specialists in heating and ventilating	14	10	72
Specialists in illumination . .	12	11	92
Specialists in electrical engineering	10	7	70
Specialists in school-plant construction	12	11[a]	92

[a] Two check lists were returned too late for their data to be included in the study.

Findings

1. The percentages of check lists returned by the five juries varied from 70 percent to 100 percent.

2. The juries made up of specialists whose services were requested before the check lists were sent to them returned a higher

[1] The names, positions, and addresses of all specialists who returned completed check lists appear in the Appendix, pp. 88-95.

percentage of the check lists than did the juries whose members' services were not first requested.

In the light of Keeslar's findings[1] with regard to the validity and reliability of group judgments, the number of specialists serving on each of the juries was deemed ample for the intended purpose.

Selection of Optimal Standards

A sample of the tabulations of the responses on the returned check lists is shown in Table IV. The complete results are not presented here because they are incorporated in tables[2] that follow, and in the final check list.

The optimal standard for each facility was considered to be (1) the median numerical value selected for it by the evaluators, or (2) the majority opinion of the evaluators in every case in which opinions could not be expressed on a scale of values.

In a few cases no standard was selected by a majority of the judges. In such cases either the standard that was selected by the greatest number of judges or the ones that were designated as optimal by equal numbers of the judges were selected. The standard chosen on each of these bases is illustrated in Table IV.

Determination of Relative Contribution of the Facilities

The next step was the determination of the relative contribution that each facility, when meeting the optimal standard determined

---

[1] Oren O. Keeslar, op. cit., pp. 104-15.

[2] The complete summary of the tabulations of the jurors' responses for the items in all five check lists appears in the Appendix, Table VI, pp. 185-222.

TABLE IV

DISTRIBUTION OF THE SELECTIONS BY THE JURORS OF THE OPTIMAL STANDARDS FOR THE VARIOUS STANDARDS FOR THE FACILITIES

Facilities	Standards	Frequency of Selection
Minimum width of laboratory	22 feet	0
	24 feet	1
	26 feet	1
	28 feet	1
	30 feet	4*
	32 feet	2
	34 feet	1
	36 feet	0
	38 feet	0
	40 feet	0
Floor material in the sheet-metal area	Wood	6*
	Concrete	3
	Linoleum	1
	Asphalt tile	0
Floor material in the ceramics area	Wood	5*
	Concrete	4
	Linoleum	1
	Asphalt tile	
Heating system in the laboratory	Direct wall radiation (radiators)	1
	Wall-unit ventilators with fan	6*
	Overhead unit heaters	0
	Forced warm air from central plant	2
	Split system (forced warm air and convectors)	6*
	Radiant-panel heating	6*
	Baseboard heating	1

* Standards selected for the facilities.

for it, would make to a functional industrial-arts laboratory. An appropriate evaluation sheet,[1] provided in the form of a check list, was submitted to a jury[2] of experts in the field of industrial-arts education.

A copy of the letter that accompanied the check list sent to the jury follows:

Dear _____:

The completion of the enclosed check list is the second and final step to be completed by the jury of experts from the field of industrial arts of which you are a member. You will recall that with the previous check list you were requested to express your opinion regarding (1) the comprehensiveness of the list of physical facilities and (2) the appropriateness of the items included.

Standards have been determined for those facilities judged by the majority of the jury to be important enough to warrant standards. The standards for the facilities were first derived from an analysis of the literature, and the optimal ones were then determined by juries of specialists chosen to represent the following groups: heating-and-ventilating engineers, electrical engineers, school-lighting specialists, and specialists in school-plant construction.

At present you are being asked only to rate each of the standards with regard to its contribution to a FUNCTIONAL industrial-arts laboratory. The standard is assumed to be valid as stated.

I have enclosed a self-addressed, special-delivery envelope for your convenience in returning the check list. May I again thank you for your cooperation.

Cordially yours,
Willard M. Bateson
Signed
Enc. 2

---

[1] The complete check list appears in the Appendix, pp. 155-84.

[2] This jury was the same jury employed earlier in the investigation to identify the physical facilities in the industrial-arts laboratory. The selection of this jury is described in Chapter II, pp. 18-19.

The following is a sample of the check list sent to the jury to determine the relative contribution that each facility, when meeting the optimal standard determined for it, would make to a functional laboratory.

[SAMPLE]

CHECK LIST

The purpose of this check list is to determine, by group judgment, the relative contribution of the standards that have been developed to a functional laboratory. For the purpose of this investigation, a functional laboratory has been defined as one in which the safety, and the visual, auditory, and physical comfort of the pupil is of concern; and also as one in which such characteristics as flexibility, accessibility, and efficiency are present to a marked degree.

Please place a check at the space that indicates your opinion of the contribution of the standard to a functional laboratory. Please do not question the validity of the standard, but rate only its contribution to a functional laboratory.

FACILITY	STANDARD	Relative Contribution of the Standard to a Functional Laboratory: Very Little	Little	Moderate	Much	Very Much
LABORATORY SPACE:						
Minimum height of the ceiling in the laboratory	12 feet	[ ]	[ ]	[ ]	[ ]	[ ]
Minimum width of the laboratory	30 feet	[ ]	[ ]	[ ]	[ ]	[ ]
Minimum ratio of the width to the length	1:1½	[ ]	[ ]	[ ]	[ ]	[ ]
Maximum ratio of the width to the length	1:2	[ ]	[ ]	[ ]	[ ]	[ ]

Computation of the Weights

Each of the jurors returned his completed check list, and the relative contribution of each facility, with its accompanying standard, to a functional laboratory was determined by the use of the following formula:

$$w = \frac{(v_1 \cdot f) + \cdots + (v_5 \cdot f)}{N}$$

Where:

w = Relative contribution of the item to a functional laboratory (weight)

v = Value for each rating on the scale: Very little = 1; Little = 2; Moderate = 3; Much = 4; Very much = 5

f = Frequency, or number of raters assigning the accompanying indicated value

n = Total number of raters

The following example will illustrate the use of the formula in determining the relative contribution of an item listed in the check list to a functional laboratory:

FACILITY	STANDARD	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much
Minimum height of the ceiling in the laboratory	12 feet	[ ]	[ ]	[4]	[1]	[ ]
		1	2	3	4	5

These ratings are interpreted thus: Four jurors judged the contribution of this item as "moderate," and one judged it as contributing "much" to a functional laboratory. By substituting these values in the formula above, the composite value of "w" was thus obtained:

$$w = \frac{(3 \cdot 4) + (4 \cdot 1)}{N} = \frac{12 + 4}{5} = 3.2$$

By arbitrarily "rounding off" the value to the nearest whole number, 3.2 becomes 3.

This result is interpreted in this way: Since a value of 3 indicates a moderate contribution to a functional laboratory, a minimum ceiling height of 12 feet, though judged to be the optimal minimum height, contributes only moderately to a functional laboratory.

A sample of the results of this step of the procedure is given in Table V. The weights of all the facilities will be found in the final check list to be presented later.

Development of Check List of Standards

The all-but-final step in this investigation was the construction of the check list for use by industrial-arts teachers in evaluating the physical facilities in the laboratory. This check list was made by assembling the list of physical facilities and the standards and weights, as determined from the previous steps of this investigation. Directions for marking the check list were prepared to accompany it.

To determine whether this check list could be used as intended, without difficulty or confusion, it was tried out by two industrial-arts teachers. Mr. Howard Gerrish, Head of the Industrial-Arts Department, University High School, and Mr. James Peden, Industrial-Arts Instructor at the Ann Arbor High School, Ann Arbor, used it in evaluating their respective laboratories. These men were requested to note any difficulties that they might encounter in its use. They were given no further instructions, and the investigator was not present when either evaluated his laboratory. No major changes were found to be necessary as a result of these trials; the only ones suggested were minor changes of wording here and there, and a few shifts of items.

TABLE V

WEIGHTS[1] ASSIGNED TO THE PHYSICAL FACILITIES AND THEIR ACCOMPANYING STANDARDS

Facility	Standard	Weight
Minimum height of the ceiling in the laboratory	12 feet	3
Minimum width of the laboratory	30 feet	4
Minimum ratio of the width to length	1:1½	3
Maximum ratio of the width to length	1:2	3
Minimum floor area in square feet per pupil	55	4
Floor material in the woodworking area	Wood	4
Floor material in the sheet-metal area	Wood	3
Floor material in the machine-shop area	Concrete	4
Floor material in the ceramics area	Wood	3
Floor material in the drafting area	Wood	4

[1] The relative contribution of the facility, with its standard, to a functional laboratory.

The incorporation of these minor changes into the check list constituted the final step of the study. This check list will be found in the final chapter of this report, on page 49.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Statement of the Problem

The purpose of this study was to develop a check list of standards for use by teachers, principals, and others in evaluating the physical facilities in the industrial-arts laboratory.

Techniques Used in the Study

A list of the facilities of the industrial-arts laboratory that met certain criteria was secured from an analysis of all available published sources. This array of facilities was organized as a check list and submitted to a jury of specialists in the field of industrial arts to secure their opinions regarding the appropriateness of the items and comprehensiveness of the list. From the available published sources, all suggested standards for the physical facilities already determined were assembled and recorded. The facilities, with their accompanying standards, were grouped arbitrarily in five categories: illuminating features, heating-and-ventilating features, architectural features, electrical features, and shop-planning features.

A check list consisting of the facilities and standards proposed for them was constructed for each of these five categories. These check lists were submitted to juries of specialists for the purpose of having them decide the optimal standards for each facility.

The facilities, with their optimal standards as determined by these five juries, were submitted to a jury of specialists representing

the field of industrial arts. This jury was requested to rate the relative contribution to a functional laboratory of each facility, with its selected optimal standard. The specialists who served on this jury were the ones who had earlier served on the jury to identify the facilities of the laboratory. Their opinions were used in the following formula as the basis for computing the weight of each facility when meeting the optimal standard determined for it:

$$w = \frac{(v_1 \cdot f) + \cdots + (v_5 \cdot f)}{N}$$

Where:

w = Weight of the item, or the relative contribution to a functional laboratory of the facility, with its standard

v = Value of the rating on the scale of values

f = Frequency of the value selected

n = Total number of raters

A check list of standards for evaluating the physical facilities of the laboratory was then made by assembling the list of facilities, together with their standards and the weights as determined from the previous steps in this investigation. To test its practicability, this check list in tentative final form was used by two industrial-arts teachers for evaluating the laboratories in which they were teaching. This use of the check list indicated the desirability of making a few minor changes. The incorporation of these changes in the check list constituted the final step of the study.

The finished check list in complete and final form for use in evaluating the physical facilities of an industrial-arts laboratory follows:

A CHECK LIST OF STANDARDS FOR USE IN EVALUATING THE PHYSICAL FACILITIES OF THE INDUSTRIAL-ARTS LABORATORY

The purpose of this check list is to provide a basis for evaluating the physical facilities of the industrial-arts laboratory on the secondary-school level. The check list should assist the industrial-arts teacher to identify those facilities in the laboratory that are contributing most, as well as those that are contributing least to a functional laboratory.

The standards and the weight assigned to each facility are based on extensive research. The weight of an item, represented by a numerical value in the check list, should be interpreted as follows:

Weight	Interpretation
5	The facility, with its accompanying standard, contributes very much to a functional laboratory.
4	The facility, with its accompanying standard, contributes much to a functional laboratory.
3	The facility, with its accompanying standard, contributes moderately to a functional laboratory.
2	The facility, with its accompanying standard, contributes little to a functional laboratory.
1	The facility, with its accompanying standard, contributes very little to a functional laboratory.

Directions for marking:

1. Place a check in the "YES" column if the facility in the laboratory evaluated satisfies all of the following conditions:
   a. The facility meets or exceeds the minimum value of the standard stated in the check list.
   b. The facility does not exceed the maximum value of the standard stated in the check list.
2. Place a check in the "NO" column if the facility does not satisfy the above conditions.
3. If the instructional program does not include provisions for the facility, leave the spaces in the columns blank.
4. If the facility is missing, place a check in the "NO" column.

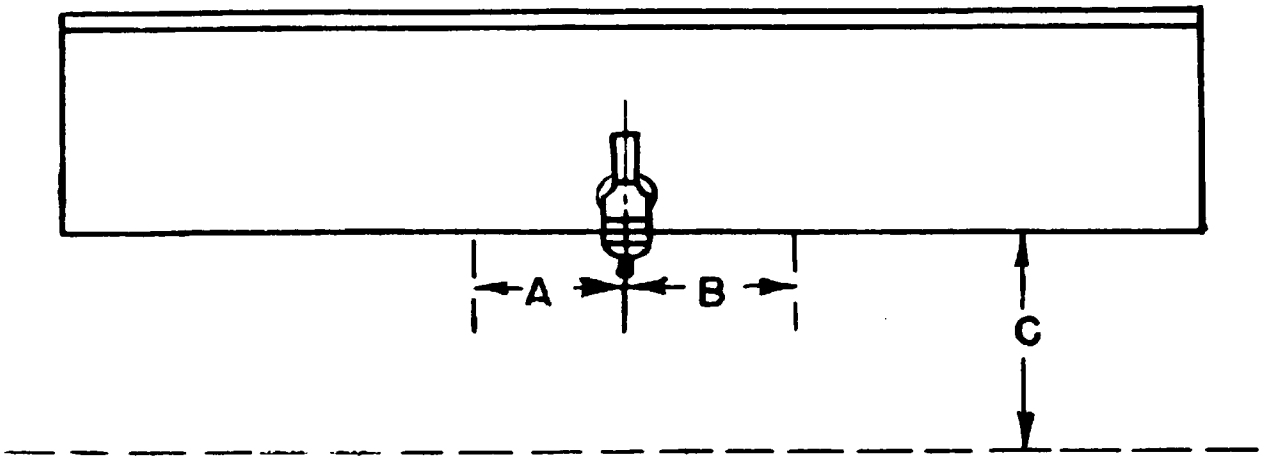
Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
LABORATORY SPACE				
Minimum height of ceiling	12 feet	3	____	____
Minimum width of laboratory	30 feet	4	____	____
Minimum ratio of the width to the length	1:1½	3	____	____
Maximum ratio of the width to the length	1:2	3	____	____
Minimum floor area in square feet per pupil	55	4	____	____
FLOOR				
Floor material in the woodworking area	Wood	4	____	____
Floor material in the sheet-metal area	Wood	3	____	____
Floor material in the machine-shop area	Concrete	4	____	____
Floor material in the ceramics area	Wood	3	____	____
Floor material in the drafting area	Wood	4	____	____
DOORS				
Width of the corridor door to the laboratory	60 inches	4	____	____
Width of the service door to the laboratory	96 inches	4	____	____
Type of service door	Overhead	4	____	____
Type of hardware on doors leading from the laboratory, except service door	Panic hardware	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
PARTITIONS AND WALLS				
Material of movable partitions in the laboratory proper	Metal	4	____	____
Wall finish to height of wainscoting	Hard plaster, painted, or glazed material	3	____	____
Height of wainscoting	4 feet	3	____	____
Height of window sill	4 feet	3	____	____
ORIENTATION				
Location of laboratory with regard to main plant	Wing	4	____	____
Location of laboratory with regard to grade level	Grade level	4	____	____
STORAGE AND SPECIAL AREAS				
Location of waste storage	In each area of activity	4	____	____
Total space for waste storage	Approximately 100 cu. ft.	4	____	____
Total space for pupil property (small projects, aprons, etc.)	Approximately 200 cu. ft.	4	____	____
Nature of assembly area	Flexible, serves more than one activity	4	____	____
Space available for assembly area	Approx. 10% of laboratory space	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
STORAGE AND SPECIAL AREAS (Continued)				
Location of display area	Near entrance to laboratory	4	____	____
Space for display area	Approx. 30 cu. ft.	4	____	____
Space for finishing room	Approx. 5% of total laboratory area	4	____	____
Location of instructor's area	Near entrance to laboratory	4	____	____
Space for instructor's area	Approx. 55 sq. ft.	4	____	____
Location of open areas (areas for accommodating traffic)	Entrance way Tool cribs and/or panel approaches Around wash basins Around drinking fountains Instructor's area	5	____	____
Location of visual-aids area	Combined with planning center	4	____	____
Space for visual-aids area	Sufficient to accommodate entire class	5	____	____
Location of supply-and-material storage (large quantities of stock, nails, screws, clay, etc.)	Within shop or centrally located for several shops	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard: YES	NO
STORAGE AND SPECIAL AREAS (Continued)				
Space for supply-and-material storage	Approx. 1,000 cu. ft.	4	____	____
Space for equipment storage (tools, auxiliary machine parts, etc.)	Approx. 300 cu. ft.	4	____	____
Space for large-project storage	Approx. 300 cu. ft.	4	____	____
Location of wardrobe	Near entrance to laboratory	3	____	____
Space for wardrobe	Approx. 100 cu. ft.	3	____	____
Chalkboard area	Approx. 30 to 35 sq. ft.	4	____	____
Tackboard area	Approx. 25 sq. ft.	4	____	____
Location of planning center	Centrally located on one wall	4	____	____
Space for planning center	Approx. 10% to 15% of laboratory area	4	____	____
Width of main aisle of travel	4 feet	4	____	____

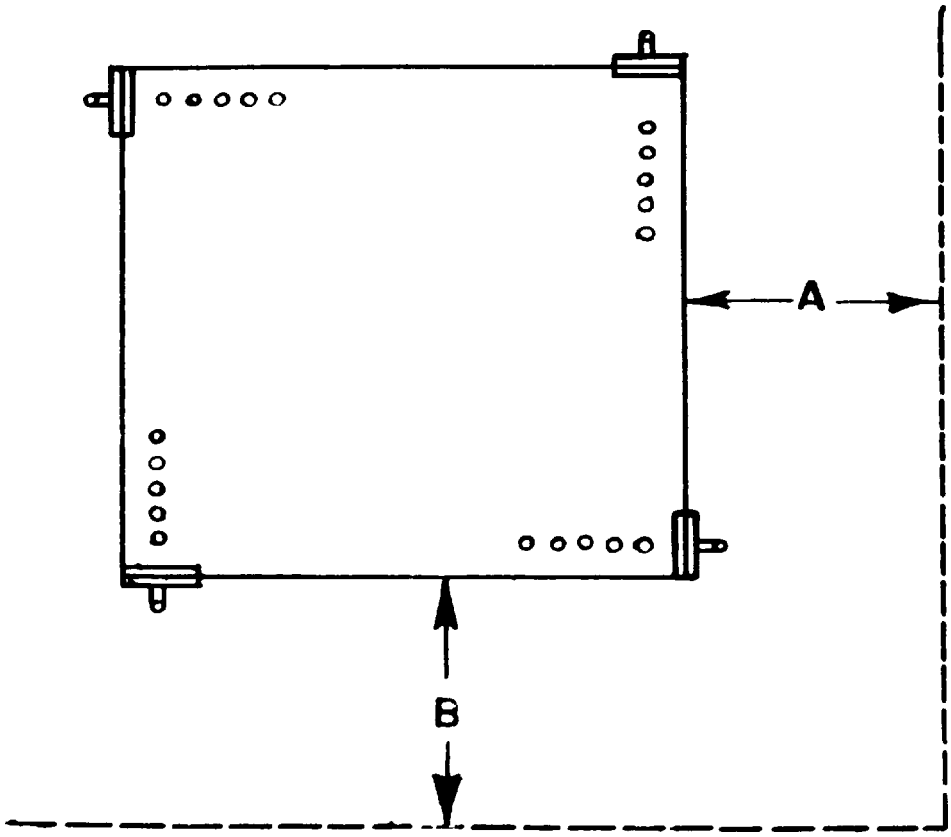
Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO



WALL BENCH

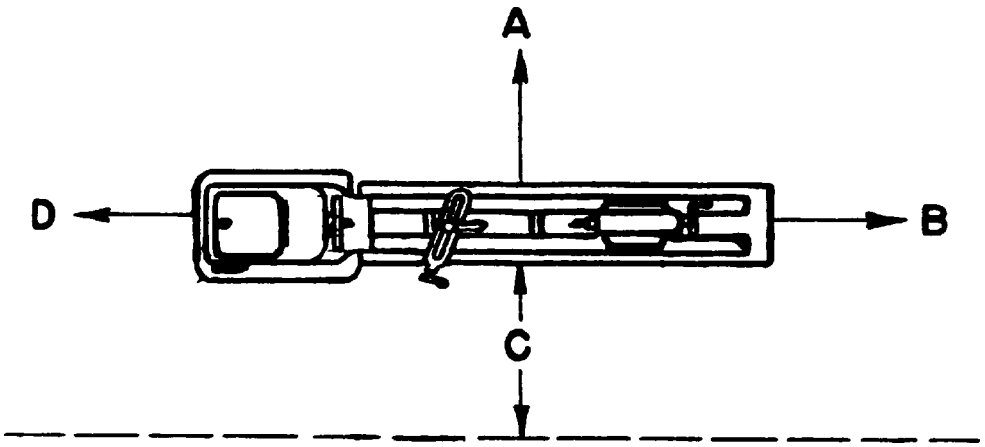
A = 24 in. B = 24 in. C = 36 in.	4		____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO

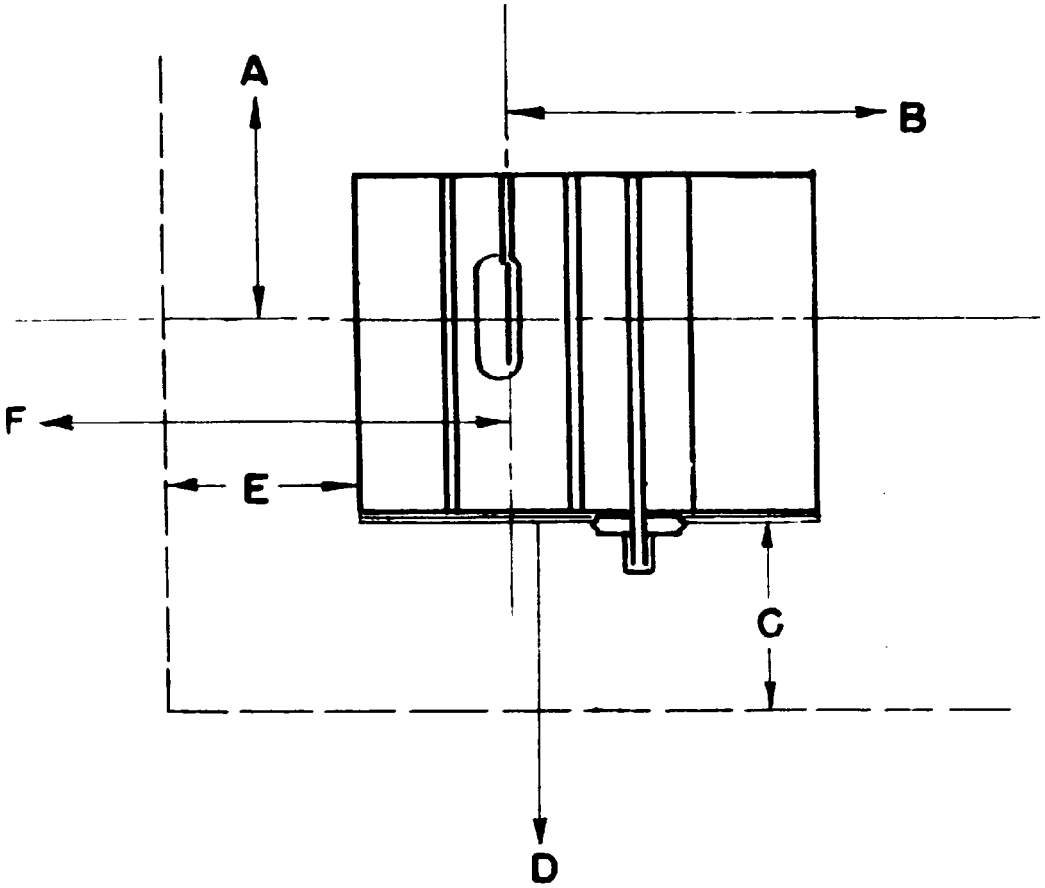


FLOOR BENCH (4 PLACE)

A = 36 in. B = 36 in.		4	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO
 WOOD LATHE				
	A = 12 in. B = 12 in. C = 36 in. D = 24 in.	5	____	____

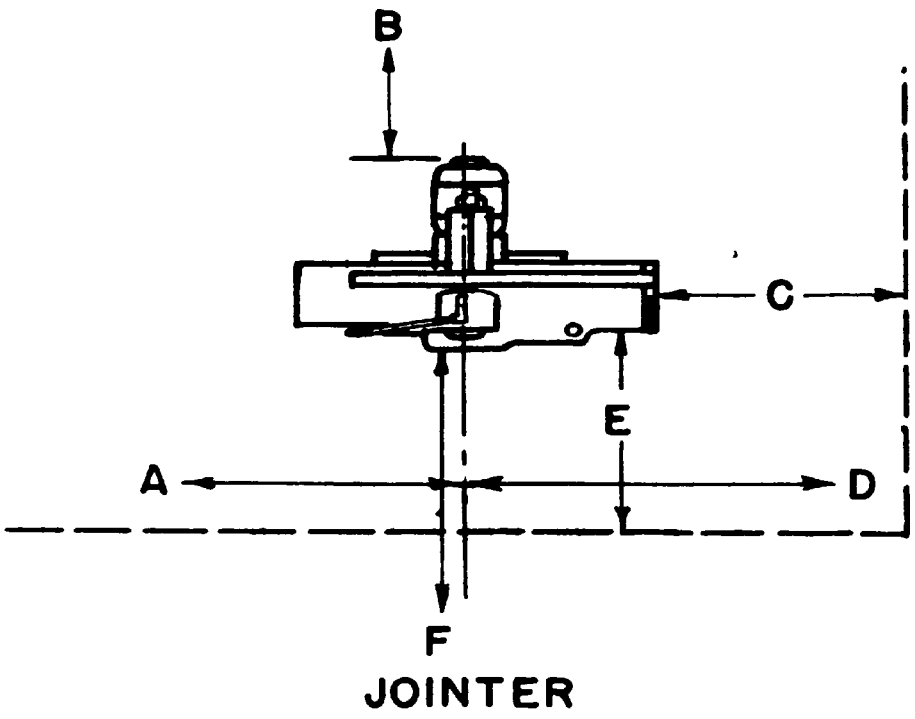
Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO



CIRCULAR SAW

A = 12 ft. B = 8 ft. C = 36 in. D = Always clear E = 36 in. F = 8 ft.	5		____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO

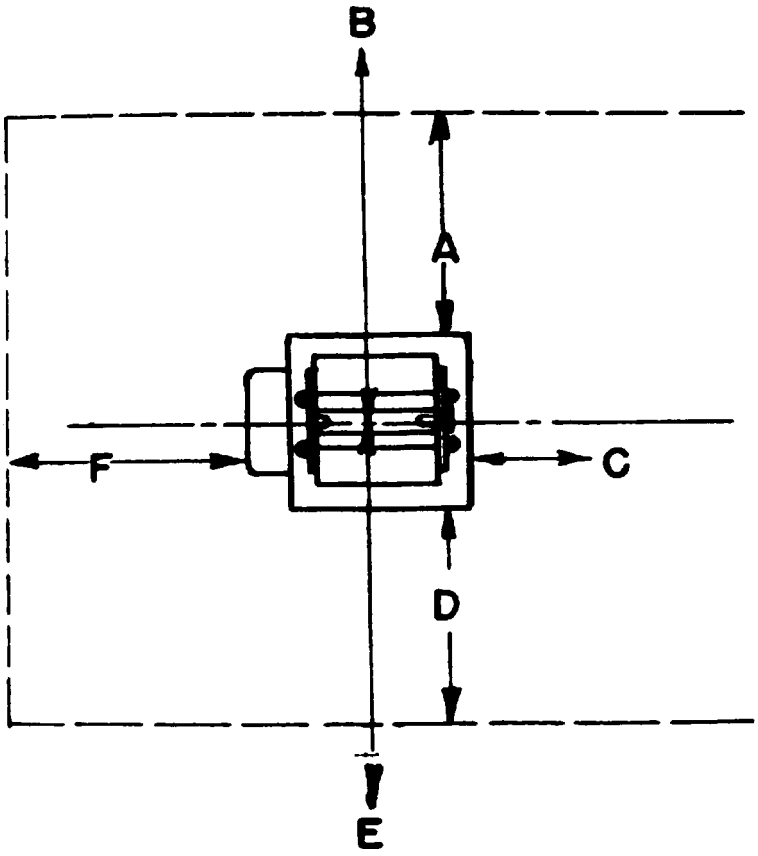


JOINTER

A = 10 ft.
B = 12 in.
C = 36 in.
D = 10 ft.
E = 36 in.
F = 6 ft.

4 ____ ____

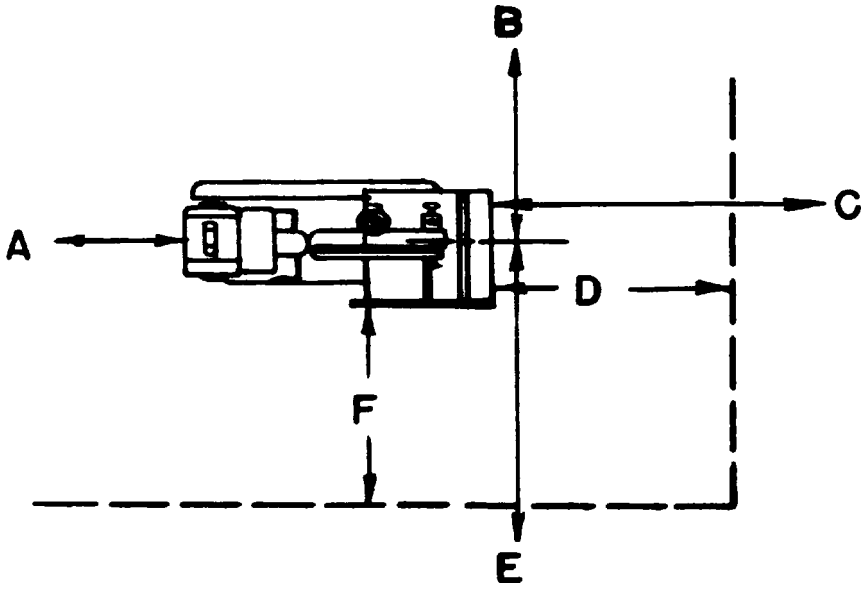
Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO



WOOD PLANER

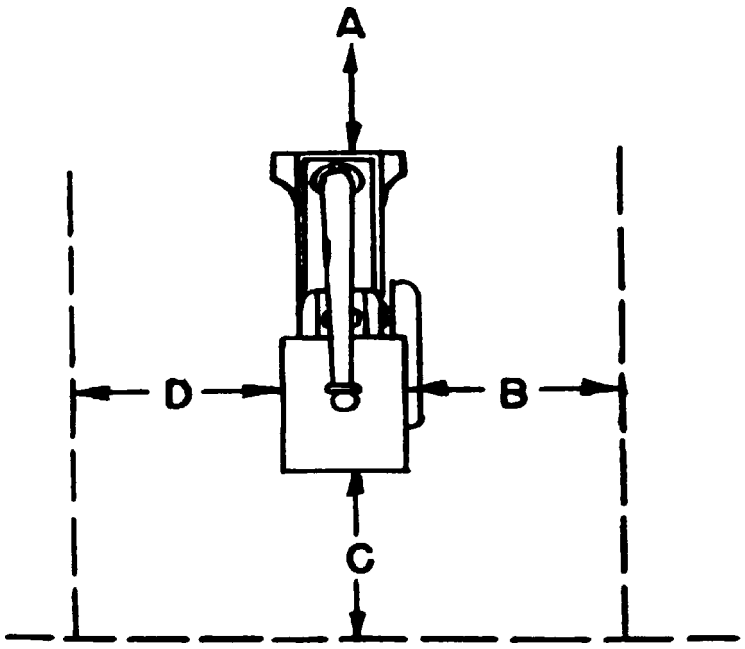
A = 36 in. B = 12 ft. C = 12 in. D = 36 in. E = 12 ft. F = 36 in.		4	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO

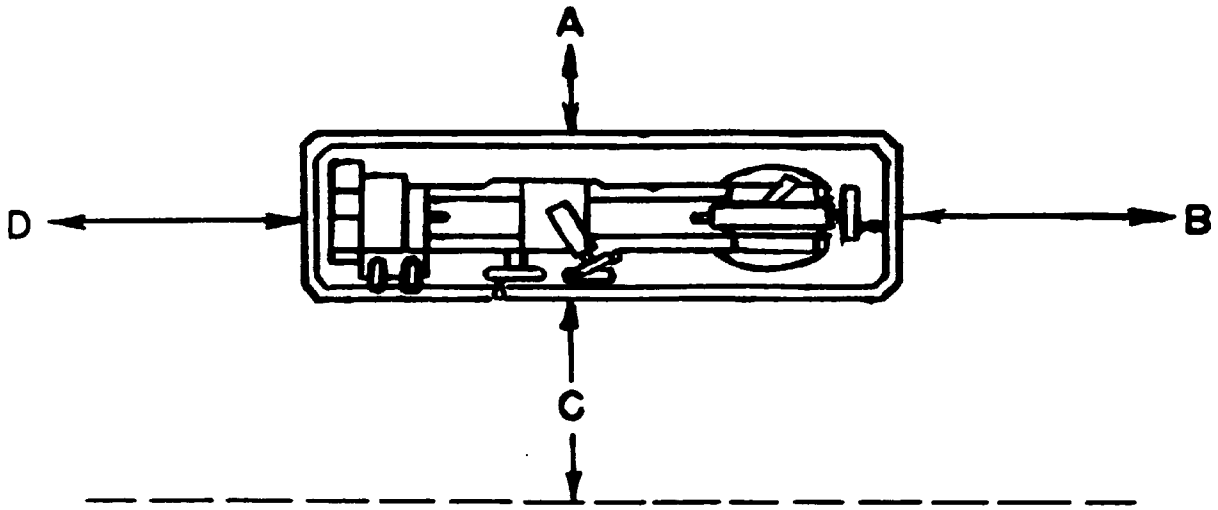


BAND SAW

A = 12 in. B = 8 ft. C = 6 ft. D = 36 in. E = 10 ft. F = 36 in.		5	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO
 JIG SAW	A = 12 in. B = 36 in. C = 36 in. D = 36 in.	4	____	____

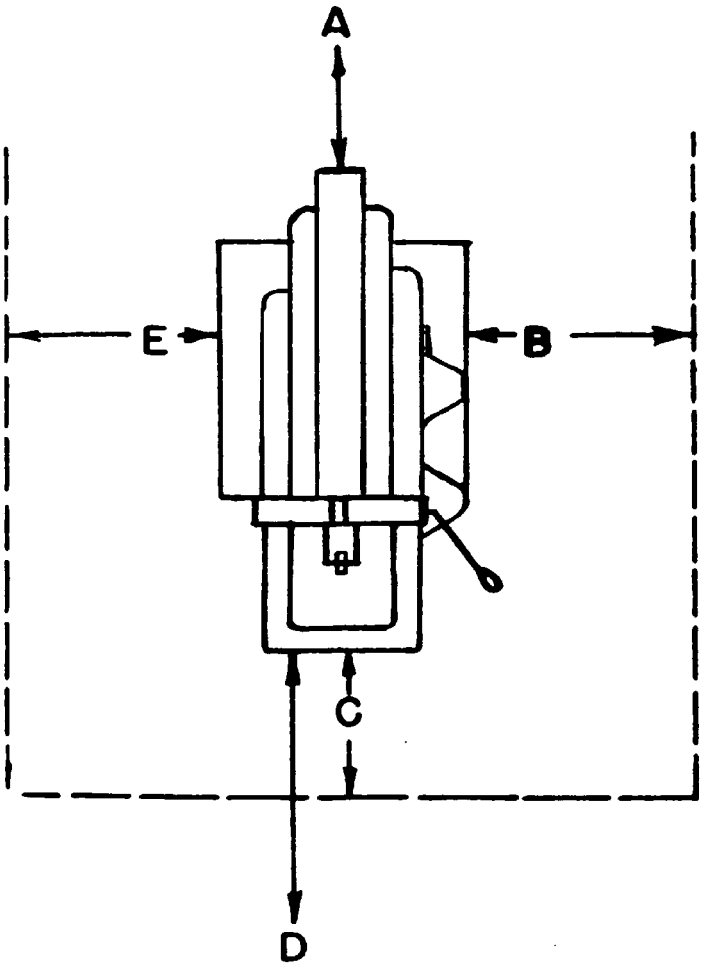
Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO



METAL LATHE

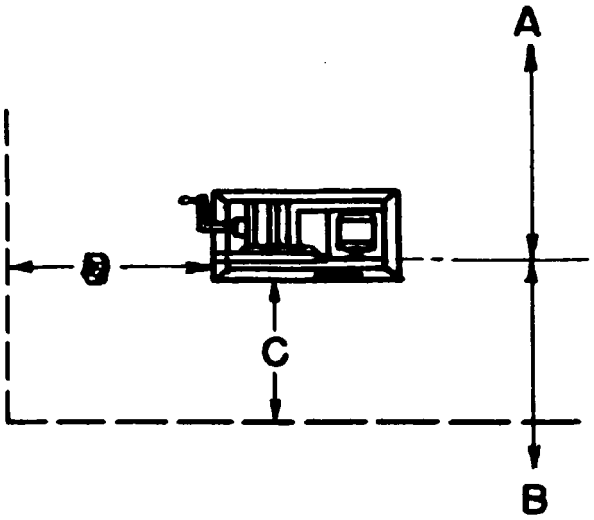
A = 12 in. B = 12 in. C = 36 in. D = 4 ft.		4	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO

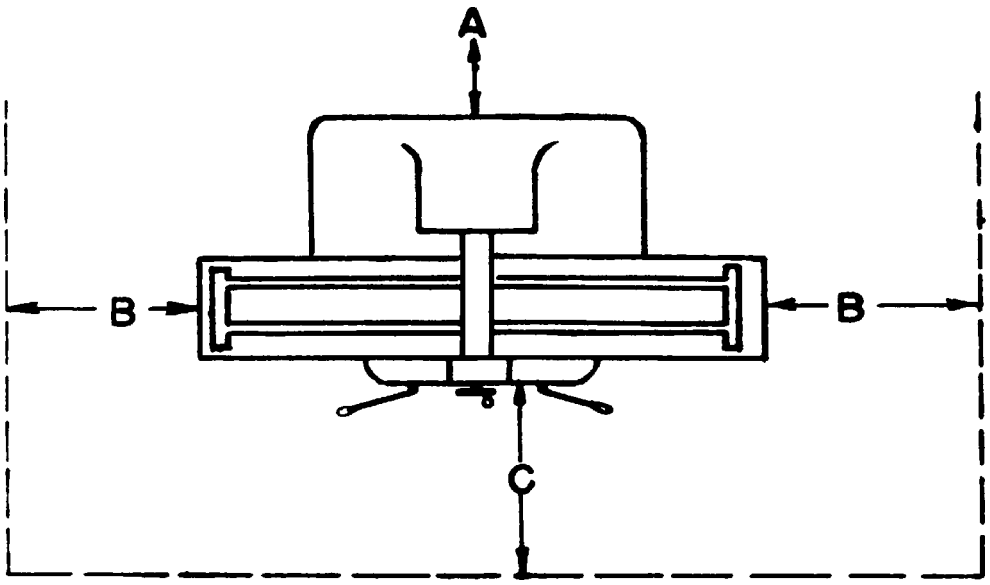


METAL SHAPER

A = back limit of ram + 2 ft. B = 36 in. C = 36 in. D = Same as C E = 36 in.		4	____	____

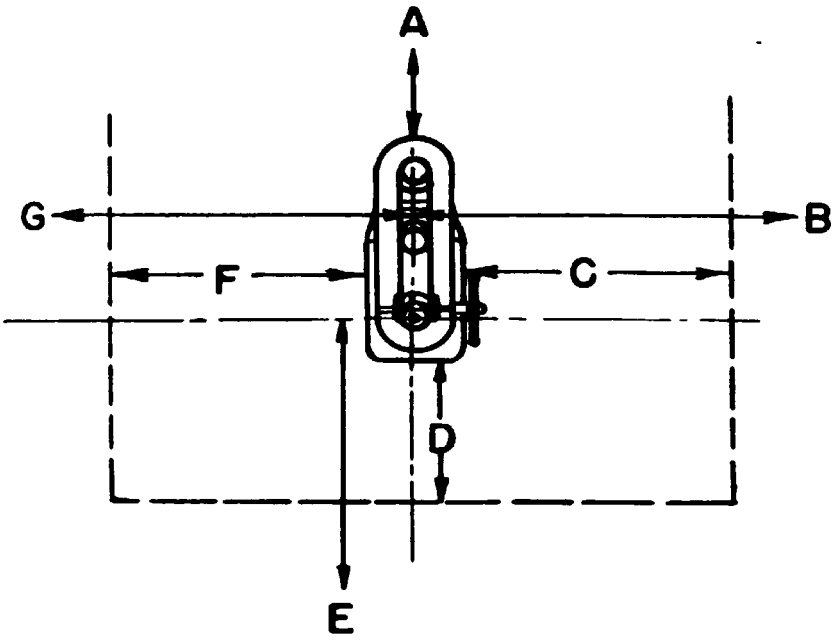
Work Station Areas	Standard	Weight	Laboratory Facility-Meets Standard YES	NO
 HACK SAW	A = 13 ft. B = 6 ft. C = 36 in. D = 36 in.	4	____	____

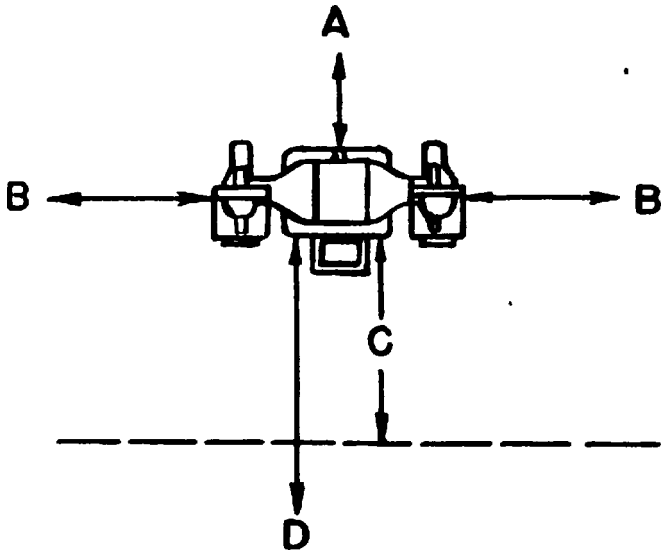
Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO

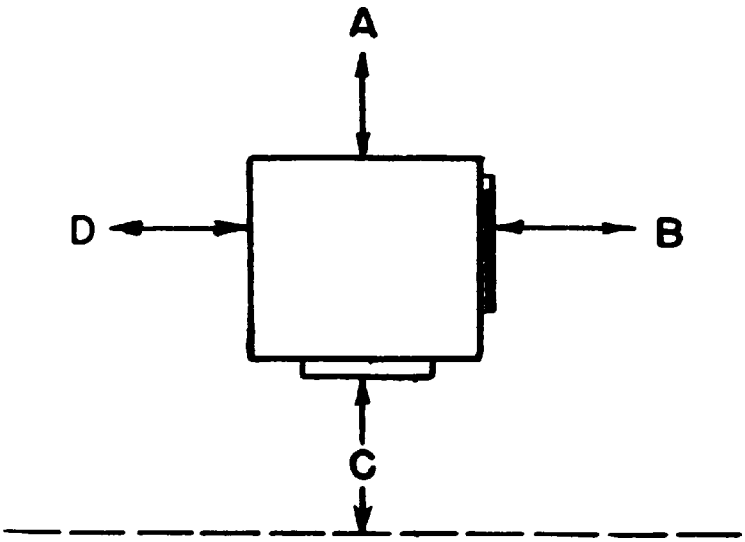


HORIZONTAL MILL

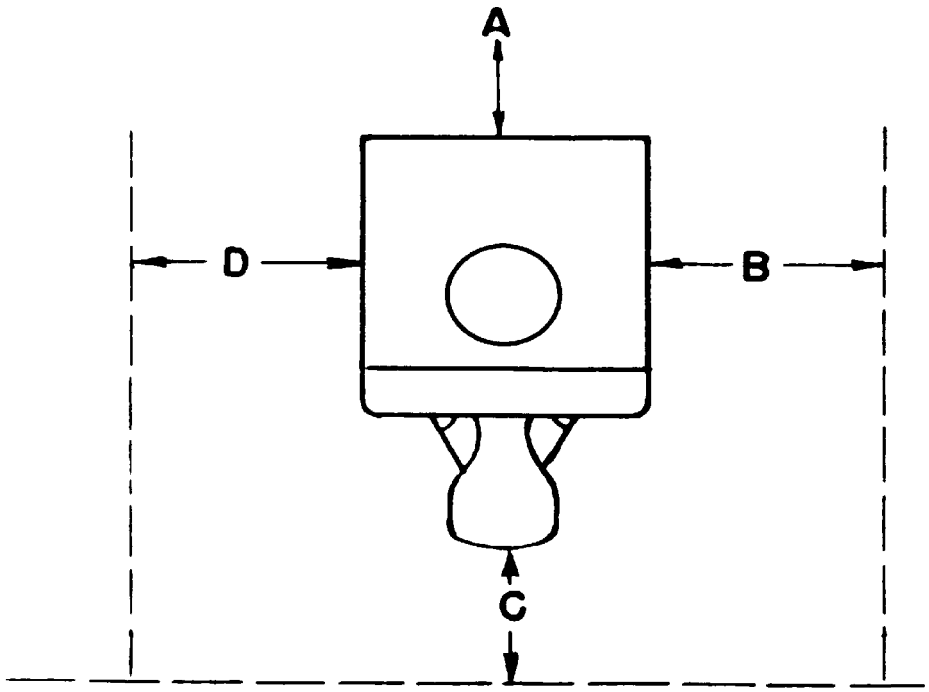
A = 2 ft. B = Limit of table-travel + 2 ft. C = 36 in.		4	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO
 DRILL PRESS	A = 12 in. B = 4 ft. C = 36 in. D = 36 in. E = 4 ft. F = 36 in. G = 4 ft.	4	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO
 FLOOR GRINDER	A = 6 in. B = 24 in. C = 36 in. D = 4 ft.	5	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO
 CERAMIC KILM				
	A = 2 ft. B = 2 ft. C = 4 ft. D = 2 ft.	4	____	____

Work Station Areas	Standard	Weight	Laboratory Facility Meets Standard YES	NO



POTTERS WHEEL

A = 12 in. B = 36 in. C = 36 in. D = 36 in.		4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard: YES	NO
VISUAL-COMFORT DETAILS				
Window area in laboratory	Approx. 25%	5	____	____
Window arrangement	Bilateral; either windows on both walls, or clerestory on one wall	4	____	____
Height of window tops	Ceiling height	4	____	____
Window glass in laboratory	Clear glass	4	____	____
Control of natural light	Light-colored diffusing shades	4	____	____
Artificial light source	Fluorescent	4	____	____
General lighting system	Semidirect (25% upward, 75% down); no direct lighting	4	____	____
Light-reflection[1] value of ceiling	Minimum, 80% Maximum, 90%	4	____	____

---

[1] The light-reflection value for a given surface is computed by dividing the total amount of light (foot-candles) falling upon a surface into the amount of light (foot-candles) reflected by that surface.

Example: Amount of light falling upon a surface is 30 foot-candles, as measured by a light meter. Amount of light reflected from the surface is 15 foot-candles, as measured by a light meter.

$$\text{Reflection value} = \frac{15}{30} = 50\%$$

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
VISUAL-COMFORT DETAILS (Continued)				
Light-reflection value of wall	Minimum, 50% Maximum, 70%	4	____	____
Light-reflection value of wainscoting	Minimum, 30% Maximum, 50%	3	____	____
Light-reflection value of work-bench tops	Minimum, 30% Maximum, 50%	3	____	____
Light-reflection value of furniture	Minimum, 30% Maximum, 50%	3	____	____
Light-reflection value of trim and doors	Minimum, 30% Maximum, 50%	3	____	____
Light-reflection value of chalkboard	Minimum, 15% Maximum, 25%	4	____	____
Light-reflection value of tackboard	Minimum, 50% Maximum, 60%	3	____	____
Light-reflection value of machinery	Minimum, 30% Maximum, 50%	4	____	____
Light-reflection value of floor	Minimum, 20% Maximum, 30%	3	____	____
Illumination level in service at following work stations:				
Wood bench	50 ft-c	4	____	____
Wood lathe	50 ft-c	4	____	____
Jointer	30 ft-c	4	____	____
Circular saw	30 ft-c	4	____	____
Band saw	50 ft-c	4	____	____
Jig saw	50 ft-c	4	____	____
Sander	30 ft-c	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
VISUAL-COMFORT DETAILS (Continued)				
Machine shop bench	50 ft-c	5	____	____
Power saw	40 ft-c	4	____	____
Drill press	50 ft-c	4	____	____
Metal lathe	50 ft-c	5	____	____
Shaper	50 ft-c	4	____	____
Miller	50 ft-c	4	____	____
Floor grinder	50 ft-c	5	____	____
Ceramics bench	40 ft-c	4	____	____
Potter's wheel	30 ft-c	4	____	____
Sheet metal bench	30 ft-c	4	____	____
Bending and forming machines	30 ft-c	4	____	____
Punching and shearing machines	30 ft-c	4	____	____
Drafting table	50 ft-c	5	____	____
Reference room	30 ft-c	5	____	____
General illumination level in service 30 inches from floor	30 ft-c	5	____	____
AUDITORY-COMFORT DETAILS				
Sound-absorbing value[1] of ceiling	Minimum, 50% Maximum, 70%	4	____	____
Sound-absorbing value of wall	Minimum, 30% Maximum, 60%	4	____	____

[1] The sound-absorbing values of ceiling and walls cannot be determined under normal circumstances; therefore, if the ceiling and

Facility	Standard	Weight	Laboratory Facility Meets Standard: YES	NO
PLUMBING DETAILS				
Drinking facilities	One station per 25 pupils	4	____	____
Washing facilities	One station per 10 pupils	4	____	____
Work (slop) sinks	One for each area of activity	4	____	____
Automatic sprinkler system (in each area indicated)	Shop proper	3	____	____
	Tool cribs	2	____	____
	Storage rooms	4	____	____
	Finishing room	4	____	____

---

walls have been treated or are constructed with acoustical material, the standards are assumed to be satisfied.

Sound-Absorbing Values of General Building Materials

Material	Value
Brick wall, painted	2%
Brick wall, unpainted	3%
Glazed tile	1%
Plaster, gypsum, or lime, smooth finish	3%
Plaster, gypsum, or lime, rough finish	6%
Wood paneling	6%
Vercoustic (acoustical plaster)	65%
Acousti-Celotex	70%
Acoustone F	70%
Fiberglas acoustical tile	70%
Transite acoustical panels	85%
Fir-tex	65%

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
PLUMBING DETAILS (Continued)				
Location of air compressor	Outside of laboratory proper	4	____	____
Distribution of compressed air outlets	On wall at 20-ft. intervals	4	____	____
Distribution of gas outlets	On wall at 20-ft. intervals	4	____	____
HEATING AND VENTILATING DETAILS				
Minimum quantity of air per pupil supplied by ventilating system[1]	15 cu.ft./min.	4	____	____
Fresh outdoor air included in air circulated[1]	25% to 30% of total air	4	____	____
Air velocity past occupant during heating season[1]	25 lineal ft./min.	4	____	____
Air velocity past occupant during cooling season[1] (outside air)	85 lineal ft./min.	4	____	____
Ventilating system used in the laboratory	Mechanical, either integral or separate part of main plant	4	____	____

[1] The evaluation of the laboratory in respect to these standards may be impossible under normal circumstances. Their inclusion in the check list may assist those concerned with planning the ventilating system for new laboratories.

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
HEATING AND VENTILATING DETAILS (Continued)				
Relative humidity of laboratory	Winter, 40 Summer, 50	4	____	____
Relative humidity of storage area	40	3	____	____
Temperature of laboratory, 60 in. from floor	68 degrees	4	____	____
Heating system used in laboratory	Wall-unit ventilators with fan, or split system (forced warm air and convectors), or radiant panel	4	____	____
Temperature controls	Automatic, room control	4	____	____
Location of radiators (if used)	Floor level, against wall, or recessed in wall	4	____	____
Installation of exhaust system	Each area served by separate system	4	____	____
Installation of exhaust system ducts	Overhead	4	____	____
ELECTRICAL-CIRCUIT DETAILS				
Power-circuit system	Three-wire, three-phase	4	____	____
Branch power circuits	One per machine	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
ELECTRICAL-CIRCUIT DETAILS (Continued)				
Spare power circuits	One for every 4 active circuits	4	____	____
Overload protection on power circuits	Circuit breakers	4	____	____
Raceway system for power circuits	Wireways	4	____	____
Installation of power-circuit raceways	Exposed on ceiling	4	____	____
Installation of light-circuit raceways	Concealed in ceiling	4	____	____
Spare light circuits	One for every 5 active circuits	4	____	____
Overload protection for light circuits	Circuit breakers	4	____	____
Convenience outlets	Installed on walls at intervals of 10 feet	4	____	____
Spare circuits for convenience outlets	One spare for every four outlets	4	____	____
Power cut-out safety buttons	Installed on wall at intervals of 15 or 20 feet	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard YES	NO
ELECTRICAL-CIRCUIT DETAILS (Continued)				
Fire-alarm system	Integral part of main system	4	____	____
	Alarm sounding station in the laboratory	4	____	____
MISCELLANEOUS				
Fire-extinguishing agents for the laboratory	Fire blanket	4	____	____
	Vaporizing liquid (carbon tetrachloride)	4	____	____
First-aid cabinet supplies	1-in. bandage roll	4	____	____
	2-in. bandage roll	3	____	____
	3-in. bandage roll	3	____	____
	Gauze	4	____	____
	Cotton	4	____	____
	Waterproof adhesive	4	____	____
	Mercurochrome	3	____	____
	Aromatic ammonia	4	____	____
	Analgesic balm	3	____	____
	Scissors	4	____	____
	Tweezers	4	____	____

Facility	Standard	Weight	Laboratory Facility Meets Standard: YES	Laboratory Facility Meets Standard: NO
MISCELLANEOUS (Continued)				
First-aid cabinet supplies (continued)	Cotton-wound applicators	4	____	____
	Steripads	4	____	____
	Waterproof Band-aids	4	____	____
	Buckle tourniquet	3	____	____
	Boric-acid solution	3	____	____

Conclusions

To the extent that the techniques employed in this study may be accepted and the results secured may be considered typical, the following conclusions seem justified:

1. Sixty-two of the sixty-eight physical facilities identified at the start by the investigator were judged by the majority of the specialists as important enough to warrant establishing standards for them. Fifty-six, or approximately 82 percent, were unanimously approved by the specialists. Therefore, specialists in the field of industrial arts agree closely with respect to what are the physical facilities in the laboratory for which standards are justified.

2. The highest percentage of check lists returned from the juries of specialists whose services had not been requested prior to their direct involvement in the study was approximately 72; the highest percentage of check lists returned by the juries of specialists whose cooperation had previously been solicited was 100. Moreover, the median values for these respective juries were 71 percent and 92 percent. These facts provide some basis for the conclusion that specialists whose services, for evaluating such check lists as were used in this study, have been requested in advance of their participation, are more likely to return the check lists than are those whose willingness to participate has not been previously ascertained.

BIBLIOGRAPHY

"A Guide for Instruction in Industrial Arts." St. Paul, Minnesota: State of Minnesota Department of Education, 1950, Part One Administration Curriculum Bulletin No. 13. Pp. 58.

"A Handbook in Industrial Arts for Connecticut Secondary Schools." Hartford, Connecticut: Connecticut State Department of Education, July, 1945, Curriculum Laboratory Bulletin 15. Pp. 76.

A Planning Guide for Vocational-Industrial and Vocational-Technical Building Facilities. Albany, New York: The University of the State of New York, 1950. Pp. 38.

A Procedure for Evaluating a Local Program of Trade and Industrial Education. Chicago: American Technical Society, 1952. Pp. 64.

Allphin, Willard. "Brightness Control in a Model Schoolroom," Illuminating Engineering, XLI (January, 1946), 21-34.

American Recommended Practice of Industrial Lighting. New York: Illuminating Engineering Society, 1942. Pp. 51.

American Standard Practice for School Lighting. New York: Illuminating Engineering Society, 1948. Pp. 78.

An Instrument for Evaluating the Effectiveness of Vocational Industrial Education Programs. Washington, D. C.: Vocational Division, U. S. Office of Education, 1950. Pp. 64.

Anderson, H. W. "What Teachers Should Know About Classroom Lighting," National Education Association Journal, XL (December, 1951), 628-9.

Beebe, Robert O. "Planning the Vocational School Plant for Future as Well as Present Needs," The American School and University, VII (1934-35), 350-53.

Biesele, R. L., Folsom, W. E., and Graham, V. J. "The Control of Natural Light in Classrooms," Illuminating Engineering, XL (September, 1945), 590.

Bollinger, Elroy W. "Securing the Right Kind of Light," Industrial Arts and Vocational Education, XXII (March, 1933), 135-41.

Bollinger, Elroy W. "Suggestions for Planning Industrial Arts Facilities," The American School and University, XXI (1949-50), 211-20.

Brown, Leland H. "Planning Schools With A View to High-Level Daylight Illumination in Every Classroom," American School and University, XIV (1942), 57-61.

Buckingham, B. R. "The Questionnaire," Journal of Educational Research, XIV (June, 1926), 54-58.

Classroom Lighting. New York: National Society for the Prevention of Blindness. Pp. 15.

Darley, William G. "Seeing in the Schoolhouse, I," American School Board Journal, III, No. 2 (August, 1945), 29.

Darley, William G. "Seeing in the Schoolhouse, II," American School Board Journal, III, No. 3 (September, 1945), 39.

Diamond, Thomas. "Planning the New School Shop," School Shop, XII (April, 1953), 7-9.

Dick, Arthur A. "Planning School Shops in Baltimore County, Maryland," Industrial Arts and Vocational Education, XXXIX (March, 1950), 83-88.

Eastman, Herschel F. "Check List for School-Shop Planning," Industrial Arts and Vocational Education, XXXVII (March, 1948), 126-128.

Easton, J. A. G. "Specifications for School Shops," American School and University, XXXII (1951), 327-36.

Egeler, Carl E., and Linsday, E. A. Planned Lighting for Industry. Cleveland, Ohio: General Electric Co., 1951. Pp. 47.

Elliott, Eugene B. A Guide for Planning School Buildings. Lansing, Michigan: Department of Public Instruction, 1945. Pp. 147.

Ericson, Emanuel E. "A Practical Approach to Shop and Laboratory Planning," Industrial Arts and Vocational Education, XXXVII (March, 1948), 83-84.

Ericson, Emanuel E. Teaching the Industrial Arts. Peoria, Illinois: The Manual Arts Press, 1946. Pp. 376.

Evaluation of Secondary Schools--General Report. Washington, D. C.: Cooperative Study of Secondary School Standards, 1939. Pp. xxx + 526.

Evaluative Criteria. Washington, D. C.: Cooperative Study of Secondary-School Standards, 1950. Pp. v + 305.

Folsom, W. E., and Biesele, R. L., Jr. "The Measurement of Illumination and Brightness in a Classroom," Illuminating Engineering, XLIII (April, 1948), 355.

Gallington, Ralph O. "Improving Shop Layouts for the Industrial Arts Program," School Shop, VIII (April, 1949), 36-38.

General Suggestions for Providing Housing and Equipping Vocational Shops. Olympia, Washington: State Board for Vocational Education, 1948. Pp. 15.

Givens, Harrison C. "Planning Housing and Equipment for a Vocational Program," American School and University, XVII (1944-45), 78-83.

Groneman, Chris H. "A Plan for the Small General Shop," Industrial Arts and Vocational Education, XXXVI (March, 1947), 92-94.

Guide for Housing and Layout of School Shops in California. Sacramento, California: California School Shop Planning Committee, California Department of Education, 1950. Pp. 39.

Guide for Industrial Arts Shop Planning. Columbus, Ohio: Ohio State Department of Education, 1949. Pp. 40.

Guide for Planning the Industrial Arts and Trade and Industrial Departments. Richmond, Virginia: State Department of Education, September, 1948. Pp. 37.

Hamon, Ray L., and Others. Guide for Planning School Plants. Nashville, Tennessee: Peabody College, 1949. Pp. vii + 176.

Harrison, E. C. "Lighting the Industrial Arts Laboratory," Industrial Arts and Vocational Education, XLI (March, 1952), 90-93.

Haskell, Douglas. "Planning the General Shop," School Shop, V (June, 1946), 12-14, 54.

Haskell, Douglas. "16 Ways of Daylighting Classrooms," Architectural Record, XCV (May, 1944), 75-83.

Higgins, Thomas J. "Mechanical Equipment for the School," Architectural Record, XCV (March, 1944), 89-90.

How to Plan a School Workshop. Milwaukee, Wisconsin: Delta Manufacturing Company. Pp. 40.

Hughes, Wayne P. "Safety Factors in Shop Planning," School Shop, VIII (April, 1949), 7-8.

Hunter, William L. "Industrial Arts Laboratory Planning - I," Industrial Arts and Vocational Education, XXVII (March, 1938), 101-4.

Hunter, William L. "Industrial Arts Laboratory Planning - II," Industrial Arts and Vocational Education, XXVII (April, 1938), 137-42.

Hunter, William L. "Industrial Arts Laboratory Planning - III," Industrial Arts and Vocational Education, XXVII (May, 1938), 182-84.

Hunter, William L. "Industrial Arts Laboratory Planning - IV," Industrial Arts and Vocational Education, XXVII (June, 1938), 232-35.

"Industrial Arts." Harrisburg, Pennsylvania: Department of Public Instruction, 1951, Bulletin 331. Pp. xii + 115.

Industrial Arts Education for Junior and Senior High Schools. Columbus, Ohio: State of Ohio Department of Education, 1947. Pp. 26.

Industrial Arts for Secondary Schools. Des Moines, Iowa: Department of Public Instruction, 1948. Pp. 190.

"Industrial-Arts Handbook." Jefferson City, Missouri: Missouri State Department of Education, 1941, Bulletin 7B. Pp. 153.

Industrial Arts Handbook. Richmond, Virginia: State Board of Education, 1948. Pp. viii + 123.

"Industrial Arts in Louisiana." Baton Rouge, Louisiana: State Department of Education, January, 1948, Bulletin No. 627. Pp. 140.

"Industrial Arts in Oklahoma." Stillwater, Oklahoma: Oklahoma State Department of Education, 1951, Bulletin No. 105. Pp. 129.

"Industrial Arts in the Modern School - Its Function and Organization." Springfield, Illinois: State of Illinois Board for Vocational Education, March, 1949, Series A - Bulletin No. 94. Pp. 51.

Industrial Ventilation. Lansing, Michigan: Committee on Industrial Ventilation, 1951. Pp. 17.

James, Leonard V. "Good Seeing Conditions in Schools, from the Standpoint of the Illuminating Engineer," The American School and University, XIX (1947-48), 93-99.

Johnson, C. W. "Sound Control in the Industrial-Arts Laboratory," Industrial Arts and Vocational Education, XXXIII (March, 1944), 91.

Keeslar, Oreon Pierre. "Contributions of Instructional Films to the Teaching of High School Science." Doctor's dissertation, University of Michigan, 1945. Pp. vii + 320.

Koos, Leonard V. The Questionnaire. New York: The MacMillan Company, 1928. Pp. 178.

Lancaster, Walter B. Illumination Levels and Eye Comfort Conditions. New York: National Society for the Prevention of Blindness, 1938. Pp. 12.

Land, S. Lewis. "Evaluative Criteria for Vocational - Industrial Schools and Classes," Industrial Arts and Vocational Education, XXXV (April, 1946), 163-64.

Lewis, Samuel R. "Postwar School-Building Heating and Ventilating," Industrial Arts and Vocational Education, XXXIV (March, 1945), 109-10.

Lighting for Shops and Special Classrooms. Washington, D. C.: National Education Association, 1947. Pp. 43.

London, H. H. "Laying Out the One-Teacher Industrial Arts Department," Industrial Arts and Vocational Education, XXXVII (March, 1948), 81-82.

Mays, Arthur B., and Casberg, Carl H. School Shop Administration. Milwaukee, Wisconsin: Bruce Publishing Company, 1947. PP. vii + 231.

Neidhart, J. M. "Protect Their Eyesight," Nations Schools, XXXIV (October, 1944), 34.

Newkirk, Louis V. Organizing and Teaching the General Shop. Peoria, Illinois: The Manual Arts Press, 1947. Pp. vi + 200.

Newkirk, Louis V., and Klingensmith, Wiley P. "Planning the Industrial Arts Shop," Industrial Arts and Vocational Education, XXXVI (November, 1947), 374.

Odell, C. W. Standards for the Evaluation of Secondary School Buildings. Ann Arbor, Michigan: Edwards Brothers, Inc., 1950. Pp. 75.

Ohio High School Standards. Columbus, Ohio: Department of Education, 1949. Pp. 26.

Paine, H. W. "Designing Industrial Arts and Vocational Education Shops and Classrooms," Industrial Arts and Vocational Education, XXXV (April, 1946), 163-64.

"Planning the Industrial-Arts Shop," Architectural Record, C (July, 1946), 100-106.

"Principles of Good Shop Planning," School Shop, VIII (April, 1949), 5-6.

Proffitt, M. M. "Ten Points to be Considered in Planning Shop Layouts and Equipment," The American School and University, III (1930-31), 420-23.

Putman, C. "Modern Trends in School Lighting," Nations Schools, XXXIX (May, 1947), 44.

Recommendations on School Facilities, Equipment and Supplies. Detroit, Michigan: Automobile Industry Education Conference on Public School Automotive Instruction, December, 1948. Pp. 61.

Reid, Kenneth. School Planning - The Architectural Record of a Decade. New York: F. W. Dodge Corporation, 1951. Pp. 456.

Schmidt, Fred J. "Development, Use, and Evaluation of an Arts Workshop," Industrial Arts and Vocational Education, XXXI (March, 1942), 119-26.

School Shop Planning Manual. Plainfield, New Jersey: Walker-Turner Division, Kearney and Trecker Corp., 1952. Pp. 21.

Schulz, George. "New Window Design," The American School and University, XX (1948-49), 138-40.

"Shop Planning Portfolio," School Shop, V (June, 1946), 62-65.

Shop Safety Education. Albany, New York: The University of the State of New York, 1949. Pp. xiv + 319.

Shubin, John A., and Madeheim, Huxley. Plant Layout. New York: Prentice-Hall, 1951. Pp. xi + 433.

Slocum, Chester A. "Plumbing Requirements of Educational Institutions," The American School and University, XI (1939), 46-51.

Smith, Eberle M. "Interior Walls in School Buildings," The American School and University, XIX (1947-48), 86-92.

"Sound Absorption Coefficients of Architectural Acoustical Materials." New York: Acoustical Materials Association, 1950, Bulletin XII. Pp. 14.

Stoner, Theodore F. "Types of Floor Material Most Desirable for Industrial Education Laboratories." Unpublished Master's thesis, Wayne University, 1949. Pp. 25.

Struck, Theodore F. Creative Teaching. New York: John Wiley and Sons, Inc., 1938. Pp. ix + 489.

Sturrock, Walter. "Recommended Levels of Illumination," Magazine of Light, X (August, 1941), 45-54.

Suggested Guide for the Housing and Layout of School Shops. Sacramento, California: State Department of Education, 1947-48. Pp. 9.

Suggested Guide for the Housing and Layout of School Shop. Stillwater, Oklahoma: State Board for Vocational Education. Pp. 12.

Suggested School Shop Layouts and Equipment for Industrial Vocational Programs. Austin, Texas: The University of Texas and the Texas Education Agency, February, 1953. Pp. 57.

"The Industrial Arts General Shop - A Program for the Small School." Springfield, Illinois: State of Illinois Board for Vocational Education, September, 1950, Series A - Bulletin 123. Pp. 102.

The Trade Machine Shop: Minimum Physical Requirements with Suggestions for Arrangement and Upkeep. Lansing, Michigan: State Board of Control for Vocational Education, 1943. Pp. 14.

Thurston, Lee M. Planning Together for Better School Buildings. Lansing, Michigan: State Department of Public Instruction, 1950. Pp. 141.

Turner, A. S., and Brainerd, A. A. "Classroom Fields of Vision," Illuminating Engineering, XLII (April, 1947), 350.

Viles, N. E. "The Effect of Directional Glass Blocks on Daytime Lighting in Classrooms," The American School and University, XXI (1949-50), 293-96.

"Vocational-Industrial Education in Pennsylvania." Harrisburg, Pennsylvania: Department of Public Instruction, 1951, Bulletin 330. Pp. xii + 177.

Waldeck, P. S. A Guide for Industrial Arts Shop Planning. Columbus, Ohio: Department of Education, 1949. Pp. 44.

Warner, William E. "Principles and Examples of School Shop Planning," The American School and University, III (1930-31), 425-30.

Warner, William E. "Studies in School Shop Planning," Industrial Arts and Vocational Education, XXIII (February, 1934), 31-38.

Weaver, Gilbert G. "Initial Steps in Planning Shops," Industrial Arts and Vocational Education, XXX (June, 1941), 232-35.

Weaver, Gilbert G., and Associates. Shop Organization and Management for Vocational Teachers. New York: Industrial Teacher Training. Pp. 166.

Whitcomb, M. "Classroom Lighting," Nations Schools, XXXIX (May, 1947), 35-37.

Wilber, Gordon O. Industrial Arts in General Education. Scranton, Pennsylvania: The International Textbook Company, 1946. Pp. 362.

Wright, H. "Classroom Heating and Ventilating," The American School and University, XXII (1951), 197-216.

Wright, Welcom E. "Planning the Comprehensive General Shop," Industrial Arts and Vocational Education, XL (March, 1951), 88-91.

Yager, Sylvan A., and Schmidt, Fred J. "Shop Planning for the Small High School," Industrial Arts and Vocational Education, XXXVI (March, 1947), 87-91.

APPENDIX I

ROSTER OF MEMBERS OF THE SEVEN JURIES OF SPECIALISTS WHO ASSISTED IN THIS INVESTIGATION

Members of the Jury of Experts Representing the Field of Industrial-Arts Education

Gerald Baysinger, Associate Professor,
Department of Industrial Education,
Wayne University,
Detroit, Michigan.

Lawrence Borosage, Chief,
Trade and Industrial Education Branch,
Department of Health, Education, and Welfare,
Office of Education,
Washington 25, D. C.

Duane G. Chamberlain, Assistant Professor,
Department of Industrial Arts,
Michigan State Normal College,
Ypsilanti, Michigan.

Francis W. Dalton, Lecturer,
Practical Arts and Vocational Education,
School of Education,
University of Michigan,
Ann Arbor, Michigan.

Thomas Diamond, Professor Emeritus,
Industrial Education,
321 Juniper Lane, Barton Hills,
Ann Arbor, Michigan.

Howard H. Gerrish, Head,
Industrial-Arts Department,
University High School,
University of Michigan,
Ann Arbor, Michigan.

Chris Harold Groneman, Head,
Industrial Education Department,
The Agriculture and Mechanical College,
College Station, Texas.

Members of the Jury of Specialists Representing the Field of Illumination

Willard Allphin,[1,2]
Sylvania Electric Products, Inc.,
Salem, Massachusetts.

A. A. Brainerd,[2]
Philadelphia Electric Co.,
1015 Chestnut Street,
Philadelphia, Pennsylvania.

W. W. Caudill,[3] Professor of Architecture,
The Agriculture and Mechanical Arts College,
College Station, Texas.

Leo T. Doherty,[3] Assistant Superintendent of Schools,
School Plant Division,
Worcester, Massachusetts.

Charles D. Gibson,[3] Field Representative,
State Department of Education,
257 South Spring Street,
Los Angeles 12, California.

William F. Little,[2]
Electrical Testing Laboratories,
2 East End Avenue,
New York, New York.

---

[1] Members of the School Lighting Committee of the Illuminating Engineering Society.

[2] Member of the Illuminating Engineering Society.

[3] Member of the National Council of Schoolhouse Construction.

R. W. McKinley,[1]
Pittsburgh-Corning Corporation,
307 Fourth Avenue,
Pittsburgh, Pennsylvania.

John J. Neidhart,[1]
Westinghouse Corporation,
1216 West 58th Street,
Cleveland, Ohio.

Russell C. Putnam,[1,2] Professor,
Case Institute of Technology,
Cleveland, Ohio.

Paul Seagers,[3] Professor,
School of Education,
Indiana University,
Bloomington, Indiana.

Floyd W. Sell,[1]
Detroit Edison Company,
Second Avenue,
Detroit, Michigan.

Members of the Jury of Specialists[4] Representing the Field of School-Plant Construction

John L. Cameron, Director,
Division of School-House Planning and Surveys,
Department of Public Instruction,
Raleigh, North Carolina.

---

[1] Member of the Illuminating Engineering Society.

[2] Members of the School Lighting Committee of the Illuminating Engineering Society.

[3] Member of the National Council of Schoolhouse Construction.

[4] All members of this jury are members of the National Council of Schoolhouse Construction.

W. F. Clapp, Assistant Superintendent of Public Instruction,
State Department of Public Instruction,
Lansing, Michigan.

I. O. Friswold, Director,
Division of Buildings and Business Administration,
State Department of Public Instruction,
St. Paul, Minneapolis, Minnesota.

John H. Herrick, Professor,
Bureau of Educational Research,
Ohio State University,
Columbus, Ohio.

W. R. Lehr,
Division of School Facilities,
Department of Education,
3 East Twenty-fifth Street,
Baltimore 10, Maryland.

John E. Marshall,
Massachusetts Building Assistance Commission,
88 Broad Street,
Boston, Massachusetts.

T. W. Pickel,
State Department of Education,
Nashville, Tennessee.

N. E. Viles, Specialist,
School Plant Management,
U. S. Office of Education,
Washington, D. C.

Russell Wilson, Director,
Planning and Information,
Dearborn Schools,
5757 Neckel,
Dearborn, Michigan.

Members of the Jury of Specialists Representing the Field of Industrial-Arts Education

Dewey F. Barich, Director,
Educational Services,
Ford Motor Company,
3000 Schaefer Road,
Dearborn, Michigan.

George F. DePuy, Head,
Industrial-Arts Department,
Central Michigan College of Education,
Mount Pleasant, Michigan.

Ralph F. Gilden, Assistant Professor,
Industrial-Arts Department,
Michigan State Normal College,
Ypsilanti, Michigan.

John M. Hurley, Acting Director,
Industrial-Arts Division,
Board of Education,
New York, New York.

S. Lewis Land, Head,
Department of Industrial Education,
The Pennsylvania State College,
State College, Pennsylvania.

Ludwig Madsen, Director,
Bureau of Vocational Activities,
Board of Education,
New York, New York.

Alan R. Pawelek, Head,
Industrial-Arts Department,
Western Washington College of Education,
Bellingham, Washington.

Ammon Swope, Professor,
Trade-and-Industrial Education Department,
Purdue University,
Lafayette, Indiana.

George A. Willoughby, Head,
Industrial-Arts Department,
Michigan State Normal College,
Ypsilanti, Michigan.

Members of the Jury of Specialists Representing the Field of Heat-and-Ventilation Engineering

Arthur T. Bersey, Engineer,
Eberle M. Smith Associates, Inc. (Architects),
Room 626,
153 East Elizabeth Street,
Detroit, Michigan.

George H. Bush, Specialist,
School Buildings,
Purdue University,
Lafayette, Indiana.

James F. Churan, Senior Mechanical Engineer,
Division of School Buildings and Grounds,
The University of New York,
State Education Department,
Albany 1, New York.

H. L. Heilman, Director,
Division of Plant Maintenance and Operation,
Board of Education,
Pittsburgh, Pennsylvania.

Roger E. Hewitt, Ventilating and Heating Engineer,
2211 Alpha,
Lansing, Michigan.

Axel Marin, Professor,
Mechanical Engineering,
College of Engineering,
University of Michigan,
Ann Arbor, Michigan.

Lorin G. Miller, Dean Emeritus,
232 University Drive,
East Lansing, Michigan.

Kenneth E. Robinson, Heating and Ventilating Engineer,
211 Smith Street,
Lansing, Michigan.

Snyder and MacLane, Architects,
Penobscot Building,
Detroit, Michigan.

J. L. Turnbull, Consultant,
School Buildings,
Oregon State Department of Education,
Salem, Oregon.

Members of the Jury of Specialists[1] Representing the Field of Electrical Engineering

D. M. Allison,[2]
Westinghouse Electric Corporation,
600 S. Main Street,
Tulsa 3, Oklahoma.

H. H. Angel,[3] Electrical Engineer,
Construction Engineering Department,
Bethlehem Steel Company,
Bethlehem, Pennsylvania.

H. G. Barnett,[3]
Westinghouse Electrical Corporation,
Industry Engineering Department,
East Pittsburg, Pennsylvania.

---

[1] All members of this jury are members of the American Institute of Electrical Engineers.

[2] Member of the American Institute of Electrical Engineers' Committee on Industrial Control. This committee is concerned with all matters in which the dominant factors are the design, construction, and performance of industrial control, and the way in which it serves to govern in some predetermined manner the electrical power delivered to the apparatus to which it is connected.

[3] Member of the American Institute of Electrical Engineers' Committee on Industrial Power Systems. The scope of this committee's work covers all matters in which the dominant factors are the requirements, selection, coordination, installation, and operation of machines, devices, and equipment necessary for generating and transmitting electrical power within an industrial plant for use solely by that plant. Design of distribution systems within the industrial plant are a part of the scope of the committee.

J. A. Cortelli,[1]
Clark Controller Company,
1146 E. 152nd Street,
Cleveland 10, Ohio.

C. T. Evans,[1]
2626 Lefeber Avenue,
Wauwatosa 10, Wisconsin.

J. A. Gienger,[1]
17 Flower City Park,
Rochester, New York.

A. E. Pringle,[2]
Pringle Electrical Manufacturing Company,
1906 North 6th Street,
Philadelphia, Pennsylvania.

Members of the Pilot Group

Charles F. Lehmann,[3] Director,
Research on Citizens Committees,
School of Education,
University of Michigan,
Ann Arbor, Michigan.

Henry A. Sonsmith, Lecturer,
Practical Arts and Vocational Education,
School of Education,
University of Michigan,
Ann Arbor, Michigan.

A. A. Vezzani, Lecturer,
Practical Arts and Vocational Education,
School of Education,
University of Michigan,
Ann Arbor, Michigan.

---

[1] See Footnote 2, preceding page.

[2] See Footnote 3, preceding page.

[3] Mr. Lehmann was formerly on the staff of the Department of Public Instruction, Division of School Organization and Plant, Lansing, Michigan.

APPENDIX II

THE CHECK LISTS EMPLOYED IN THE STUDY

CHECK LIST OF PHYSICAL FACILITIES

Introduction:

The numbered items appearing in the check list are physical facilities found in a general industrial-arts laboratory in which woodworking, machine-shop practice, sheet-metal working, ceramics, and drafting are taught. The facilities have been grouped under seven major headings: architecture, electric, ventilation, heat, plumbing, shop-layout, and miscellaneous.

Directions:

If, in your opinion, the numbered item is important enough to justify the determination of standards for it, please indicate by placing a check in the "YES" column; on the other hand, if you believe the item is not important enough to justify standards being determined for it, please place a check in the "NO" column.

If, in your opinion, there are facilities that warrant consideration but do not appear on the list, will you please write them in the space provided.

Note: In parentheses below each numbered item are some characteristics for which standards are being considered.

ARCHITECTURAL FACILITIES	YES	NO
1. Ceiling . . . . . (height, reflection value, sound-absorbing value)	____	____
2. Floor . . . . . (material, proportions, area)	____	____
3. Doors . . . . . (types, width, hardware, reflection value)	____	____
4. Orientation . . . . . (location of shop with regard to main plant and grade level)	____	____
5. Partitions . . . . . (material)	____	____
6. Trim . . . . . (finish)	____	____

ARCHITECTURAL FACILITIES (Continued)	YES	NO
7. Picture Molding . . . . . (type, height)	____	____
8. Walls . . . . . (height of wainscoting, reflection value, sound-absorbing value)	____	____
9. Windows . . . . . (heights, fenestration, glass, area)	____	____
10. Natural-Light Control . . . . . (type, location)	____	____
11. Chalkboard . . . . . (area, finish)	____	____

Other architectural facilities that in your opinion should be considered:

_____

_____

_____

ELECTRICAL	YES	NO
1. Power circuits . . . . . (current, voltage, phase, installation)	____	____
2. Power-circuit controls . . . . . (master switches and circuit breakers)	____	____
3. Outlets . . . . . (installation)	____	____
4. Intercommunication system . . . . . (type)	____	____
5. Fire-alarm system . . . . . (installation)	____	____
6. Shop-signal system	____	____
7. Clock	____	____
8. Light circuit . . . . . (installation)	____	____
9. Light-circuit control . . . . . (type, location)	____	____

ELECTRICAL (Continued)	YES	NO
10. Light fixtures . . . . . (type)	____	____

Other electrical facilities that in your opinion should be considered:

_____

_____

_____

VENTILATION	YES	NO
1. Ventilating system . . . . . (type, capacity, installation)	____	____
2. Ventilating controls . . . . . (type, installation)	____	____
3. Exhaust system . . . . . (type, installation)	____	____

Other ventilating facilities that in your opinion should be considered:

_____

_____

_____

HEATING	YES	NO
1. Heating system . . . . . (type, capacity, installation)	____	____
2. Temperature controls . . . . . (type, installation)	____	____

Other heating facilities that in your opinion should be considered:

_____

_____

_____

PLUMBING (Gas, Air, Water)	YES	NO
1. Air compressor . . . . . (installation)	____	____
2. Air outlets . . . . . (number, location)	____	____

PLUMBING (Gas, Air Water)(Continued)	YES	NO
3. Air controls (location, type)	____	____
4. Gas outlets (number, location)	____	____
5. Gas controls	____	____
6. Drinking fountain (number)	____	____
7. Work sinks (number, location)	____	____
8. Sprinkler system (location)	____	____
9. Washing facilities (capacity)	____	____

Other plumbing facilities that in your opinion should be considered:

_____

_____

_____

SHOP LAYOUT	YES	NO
1. Auxiliary areas (location, area, finish, illumination)		
Assembly	____	____
Display	____	____
Finishing	____	____
Planning	____	____
Office	____	____
Visual-aids	____	____
Open areas (in heavy traffic areas)	____	____

Others:

_____

_____

_____

SHOP LAYOUT (Continued)	YES	NO
2. Storage areas (location, area, finish, illumination)		
Equipment	____	____
Project, large	____	____
Supply	____	____
Waste	____	____
Pupil property	____	____
Wardrobe	____	____
Others:		
_____		
_____		
_____		
3. Aisles (dimensions, designation)	____	____
4. Work-stations (area, reflective factors, illumination, designation)		
Bench	____	____
Circular saw	____	____
Jointer	____	____
Planer, wood	____	____
Lathe, wood	____	____
Band saw	____	____
Jig saw	____	____
Lathe, metal	____	____
Shaper, metal	____	____
Miller	____	____
Floor grinder	____	____
Drill press	____	____
Power saw	____	____
Kiln	____	____
Potter's wheel	____	____
Glazing booth	____	____
Drafting table	____	____
Others:		
_____		
_____		
_____		
_____		
_____		

MISCELLANEOUS	YES	NO
1. Fire extinguishers (type, location)	____	____
2. First-aid cabinets (supplies)	____	____

Others: _____

_____

_____

_____

_____

CHECK LIST
FOR
SPECIALISTS IN INDUSTRIAL-ARTS EDUCATION

Part A

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.
2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.
3. The laboratory has been equipped to accommodate 25 pupils.
4. The laboratory is located in a one-story building.

Instruction to the juror:

Please place a check in the space opposite the <u>one</u> standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The location of the laboratory with regard to grade (ground) level should be

   First floor . . . . . ____
   Few feet above grade level . . . . . ____
   Few feet below grade level . . . . . ____
   If other, specify _____

   _____

2. The minimum ceiling height for the laboratory should be

12 feet	____	16 feet	____
14 feet	____	18 feet	____

If other, specify _____

_____

3. The minimum width of the laboratory should be

22 feet	____	32 feet	____
24 feet	____	34 feet	____
26 feet	____	36 feet	____
28 feet	____	38 feet	____
30 feet	____	40 feet	____

If other, specify _____

_____

4. The ratio of the width to the length of the laboratory should be

Minimum		Maximum	
1:1	____	1:2	____
1:1½	____	1:2½	____
1:2	____	1:3	____
1:2½	____	1:3½	____
If other, specify _____		If other, specify _____	

_____ _____

5. The minimum floor area in square feet per pupil should be

35	____	55	____
40	____	60	____
45	____	65	____
50	____	70	____

If other, specify _____

_____

6. The floor material in the woodworking area should be

Wood	____
Concrete	____
Asphalt tile	____
Linoleum	____

If other, specify _____

_____

7. The floor material in the sheet-metal area should be
   - Wood . . . . . ____
   - Concrete . . . . . ____
   - Asphalt tile . . . . . ____
   - Linoleum . . . . . ____
   - If other, specify _____

   _____

8. The floor material in the machine-shop area should be
   - Wood . . . . . ____
   - Concrete . . . . . ____
   - Linoleum . . . . . ____
   - Asphalt tile . . . . . ____
   - If other, specify _____

   _____

9. The floor material in the ceramics area should be
   - Wood . . . . . ____
   - Concrete . . . . . ____
   - Linoleum . . . . . ____
   - Asphalt tile . . . . . ____
   - If other, specify _____

   _____

10. The floor material in the drafting area should be
    - Wood . . . . . ____
    - Concrete . . . . . ____
    - Linoleum . . . . . ____
    - Asphalt tile . . . . . ____
    - If other, specify _____

    _____

11. The corridor door to the shop should be
    - 30 inches wide . . . . . ____
    - 60 inches wide . . . . . ____
    - If other, specify _____

    _____

12. The service door of the laboratory should be
    - 30 inches wide . . . . . ____
    - 60 inches wide . . . . . ____
    - 96 inches wide . . . . . ____
    - 120 inches wide . . . . . ____
    - If other, specify _____

    _____

13. The service door of the laboratory should be
    - Overhead . . . . . ____
    - Sliding . . . . . ____
    - Swing type . . . . . ____
    - If other, specify _____

14. Partitions within the laboratory should be constructed of
    - Wood . . . . . ____
    - Metal . . . . . ____
    - Concrete . . . . . ____
    - Brick or block . . . . . ____
    - If other, specify _____

15. The distance from the floor to the window sill should be
    - Three feet . . . . . ____
    - Four feet . . . . . ____
    - Five feet . . . . . ____
    - Six feet . . . . . ____
    - If other, specify _____

16. Height of wainscoting (dado) should be
    - Three feet . . . . . ____
    - Four feet . . . . . ____
    - Five feet . . . . . ____
    - Six feet . . . . . ____
    - Seven feet . . . . . ____
    - If other, specify _____

17. Wall finish to the height of wainscoting (dado) should be
    - Wood . . . . . ____
    - Hard plaster, painted . . . . . ____
    - Linoleum . . . . . ____
    - Glazed material . . . . . ____
    - If other, specify _____

18. There should be a drinking fountain for every
    - 10 pupils ..... ____
    - 15 pupils ..... ____
    - 20 pupils ..... ____
    - 25 pupils ..... ____
    - 30 pupils ..... ____
    - If other, specify _____

19. There should be one wash station per
    - 5 pupils ..... ____
    - 7 pupils ..... ____
    - 10 pupils ..... ____
    - 12 pupils ..... ____
    - 15 pupils ..... ____
    - If other, specify _____

20. There should be one work sink (slop sink) for every
    - Area of activity ..... ____
    - Two areas of activity ..... ____
    - Three areas of activity ..... ____
    - If other, specify _____

21. An automatic sprinkler system should be provided in (check areas that apply)
    - Shop proper ..... ____
    - Storage rooms ..... ____
    - Crib ..... ____
    - Finishing room ..... ____
    - None ..... ____

22. The air compressor unit should be located
    - Outside of the laboratory proper ..... ____
    - Inside the laboratory proper ..... ____
    - If other, specify _____

23. Air outlets should be distributed throughout the laboratory at intervals of
    - 15 feet on walls ..... ____
    - 20 feet on walls ..... ____
    - 25 feet on walls ..... ____
    - If other, specify _____

24. Gas outlets should be distributed throughout the laboratory at intervals of

15 feet . . . . . ____
20 feet . . . . . ____
25 feet . . . . . ____
Only in the ceramics area . . . . . ____
Only in the sheet-metal area . . . . . ____
Only in the machine-shop area . . . . . ____
If other, specify _____

_____

25. Regardless of the heating system used, the temperature in the laboratory at a distance 60 inches above the floor should be

65 degrees . . . . . ____
66 degress . . . . . ____
67 degrees . . . . . ____
68 degrees . . . . . ____
69 degrees . . . . . ____
70 degrees . . . . . ____
If other, specify _____

_____

26. The heating system for the laboratory should be

Direct wall radiation (radiators) . . . . . ____
Wall-unit ventilators with fan . . . . . ____
Overhead-unit heaters with fan . . . . . ____
Forced warm air from central heating plant . . . . . ____
Split system (forced warm air and connectors) . . . . ____
Radiant-panel heating . . . . . ____
Baseboard radiation . . . . . ____
If other, specify _____

_____

27. The control of room temperature should be by

Total plant system . . . . . ____
Zone system . . . . . ____
Room, hand control . . . . . ____
Room, automatic control . . . . . ____
If other, specify _____

_____

28. If radiators are used as heating elements in the laboratory they should be placed at
    - Floor level against wall . . . . . ____
    - 4 feet from floor on wall . . . . . ____
    - 5 feet from floor on wall . . . . . ____
    - 6 feet from floor on wall . . . . . ____
    - 7 feet from floor on wall . . . . . ____
    - Suspended from ceiling at strategic locations . . . . . ____
    - Recessed in wall . . . . . ____
    - If other, specify _____

29. The ventilation system used in the laboratory should be
    - Open window and door . . . . . ____
    - Gravity activated . . . . . ____
    - Mechanical, integral part of main plant . . . . . ____
    - Mechanical--unit type, separate from main plant . . . ____
    - If other, specify _____

30. The exhaust system should be installed so that
    - Whole shop is served by one system . . . . . ____
    - Areas are served by separate systems . . . . . ____
    - Each work station (where exhausting is necessary) is served by a separate system . . . . . ____
    - If other, specify _____

31. Exhaust systems used in the laboratory for expelling fumes, dust, etc., should be installed
    - In the floor . . . . . ____
    - Overhead . . . . . ____
    - If other, specify _____

32. Convenience outlets (110 volts) should be installed in the walls of the laboratory at intervals of
    - Five feet . . . . . ____
    - Ten feet . . . . . ____
    - Fifteen feet . . . . . ____
    - Twenty feet . . . . . ____
    - If other, specify _____

33. In a new installation there should be one spare light circuit for every
    - 4 active circuits . . . . . ____
    - 5 active circuits . . . . . ____
    - 6 active circuits . . . . . ____
    - 7 active circuits . . . . . ____
    - If other, specify _____

    _____

34. There should be one branch power circuit for every
    - Machine . . . . . ____
    - Two machines . . . . . ____
    - Three machines . . . . . ____
    - Four machines . . . . . ____
    - If other, specify _____

    _____

35. In a new installation there should be one space circuit for every
    - 4 active circuits . . . . . ____
    - 5 active circuits . . . . . ____
    - 6 active circuits . . . . . ____
    - 7 active circuits . . . . . ____
    - If other, specify _____

    _____

36. There should be a separate circuit for every
    - Four convenience outlets . . . . . ____
    - Five convenience outlets . . . . . ____
    - Six convenience outlets . . . . . ____
    - Seven convenience outlets . . . . . ____
    - Eight convenience outlets . . . . . ____
    - If other, specify _____

    _____

37. Power safety buttons (any one of which will turn off all power in the shop) should be installed on the walls at intervals of
    - 10 feet . . . . . ____
    - 15 feet . . . . . ____
    - 20 feet . . . . . ____
    - 25 feet . . . . . ____
    - If other, specify _____

    _____

38. The power circuit wiring system used in the laboratory should be

Two-wire (115 volts) . . . . . ____
Three-wire, single-phase . . . . . ____
Three-wire, three-phase . . . . . ____
Four-wire, three-phase . . . . . ____
If other, specify _____

_____

39. The following fire-extinguishing agents should be provided in the laboratory (check those that apply)

Water and water fog . . . . . ____
Water and foam . . . . . ____
Water, soda, and acid . . . . . ____
Carbon dioxide gas and water . . . . . ____
Carbon dioxide gas alone . . . . . ____
Vaporizing liquid (carbon tetrachloride) . . . . . ____
Sand and dry chemical powders . . . . . ____
Fire blanket . . . . . ____
If other, specify _____

_____

40. The first-aid cabinet should contain the following supplies (check those that apply)

1" bandage roll . . .	____	Scissors	____
2" bandage roll . . .	____	Tweezers	____
3" bandage roll . . .	____	Cotton-wound applicators	____
Gauze	____	Steripads	____
Cotton	____	Waterproof Band-aids	____
Waterproof adhesive	____	Buckle tourniquet . .	____
Iodine	____	Wood splints	____
Mercurochrome . . .	____	Synol soap	____
Aromatic ammonia .	____	Camphenol	____
Analgesic balm . . .	____	Bicarbonate soda and petrolatum . .	____
Joncolia	____	Boric-acid solution .	____
Castor oil	____		
Tongue depressors .	____		

If other, specify _____

_____

_____

_____

Part B

Introduction:

The work-station area as defined in this study is that area needed by a pupil to safely and conveniently do his work at a machine or bench. The area must be free of traffic and interference from adjacent work stations. Whether the station is utilized as a bona fide or a supplementary work station is of no concern.

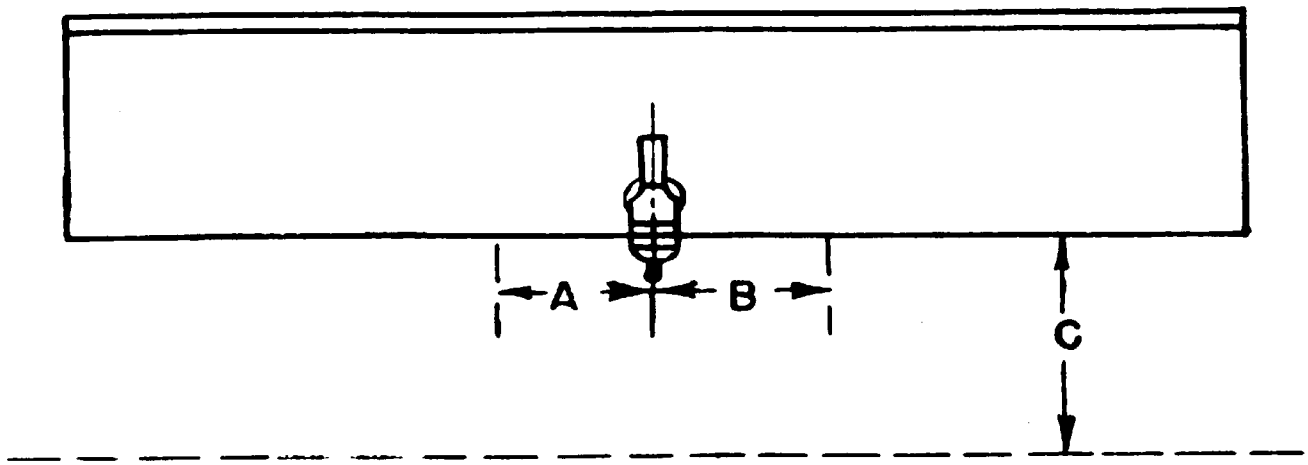
Directions:

Each sketch represents a work station in the laboratory.[1] The area that surrounds the station is dimensioned by letters. Dimensions that may be appropriate for the different aspects of the area are in columns accompanying each sketch.

Please place a check in the space opposite the dimension that, in your opinion, should prevail at the place on the sketch identified by the letter.

---

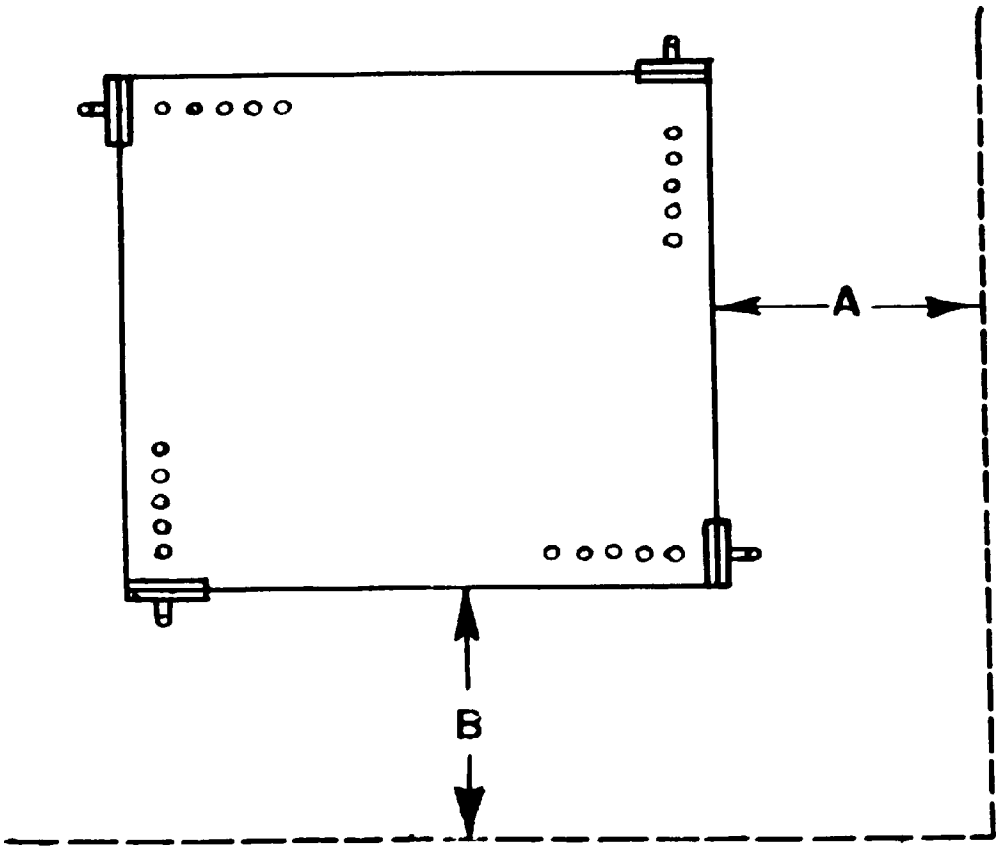
[1] A general industrial-arts laboratory doing work in the following five areas: wood, sheet metal, machine shop, ceramics, drafting.



WALL BENCH

Clearance A		Clearance B		Clearance C	
12 inches	____	12 inches	____	24 inches	____
18 inches	____	18 inches	____	30 inches	____
24 inches	____	24 inches	____	36 inches	____
30 inches	____	30 inches	____	42 inches	____
36 inches	____	36 inches	____	48 inches	____
If other, specify	____	If other, specify	____	If other, specify	____

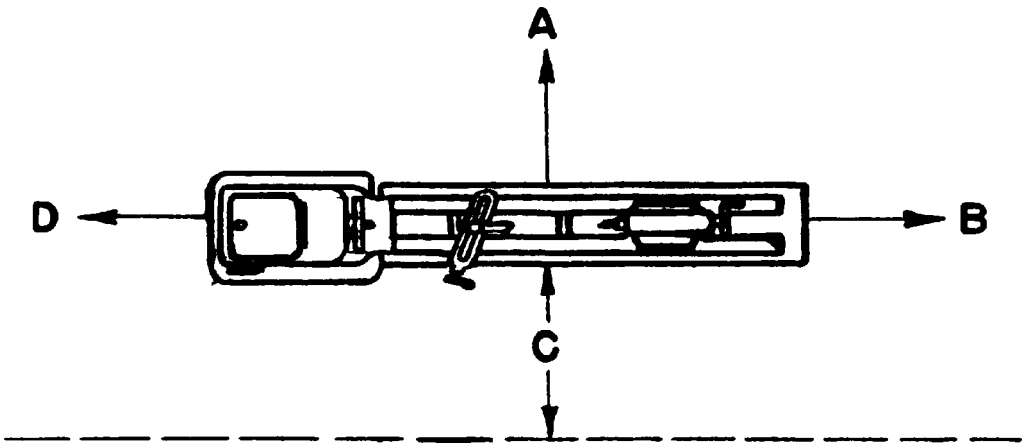
2.



FLOOR BENCH (4 PLACE)

Clearance A,B	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

3.



WOOD LATHE

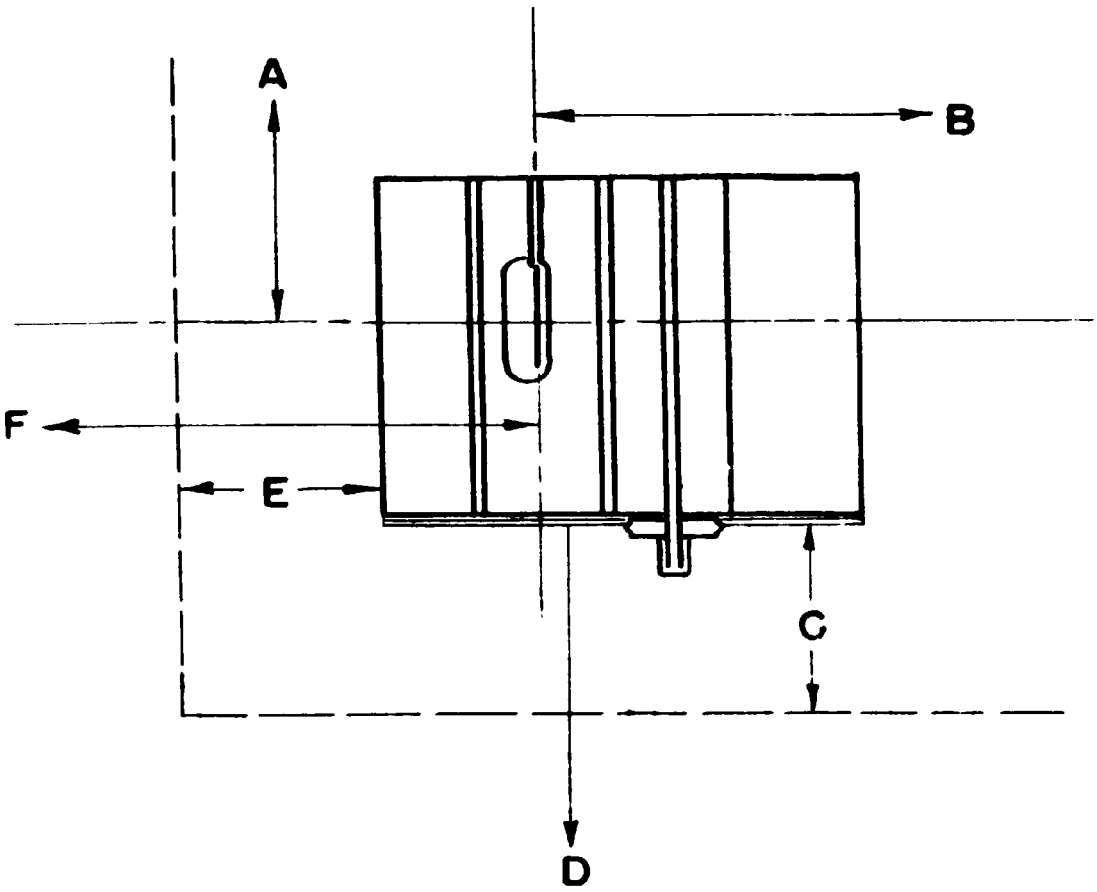
Clearance A	
0 inches	____
6 inches	____
12 inches	____
18 inches	____
24 inches	____
If other, specify	____

Clearance B	
0 inches	____
6 inches	____
12 inches	____
18 inches	____
24 inches	____
If other, specify	____

Clearance C	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance D	
0 inches	____
6 inches	____
12 inches	____
18 inches	____
24 inches	____
If other, specify	____

4.



CIRCULAR SAW

Clearance A (no obstructions)	
8 feet	____
10 feet	____
12 feet	____
14 feet	____
If other, specify	____

Clearance B (no obstr. up to)	
4 feet	____
6 feet	____
8 feet	____
10 feet	____
If other, specify	____

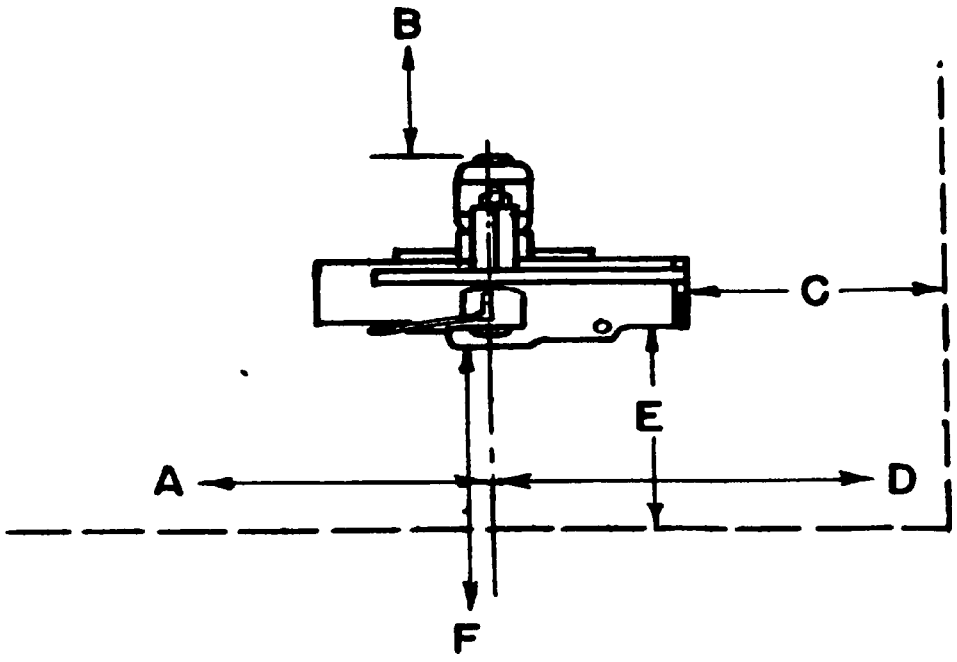
Clearance C	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance D	
12 feet	____
14 feet	____
16 feet	____
Always keep clear due to kickback	____
If other, specify	____

Clearance E	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance F (no obstructions)	
4 feet	____
6 feet	____
8 feet	____
10 feet	____
12 feet	____
If other, specify	____

5.



JOINTER

Clearance A (no obstructions)	
8 feet	____
10 feet	____
12 feet	____
14 feet	____
If other, specify	____

Clearance B	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

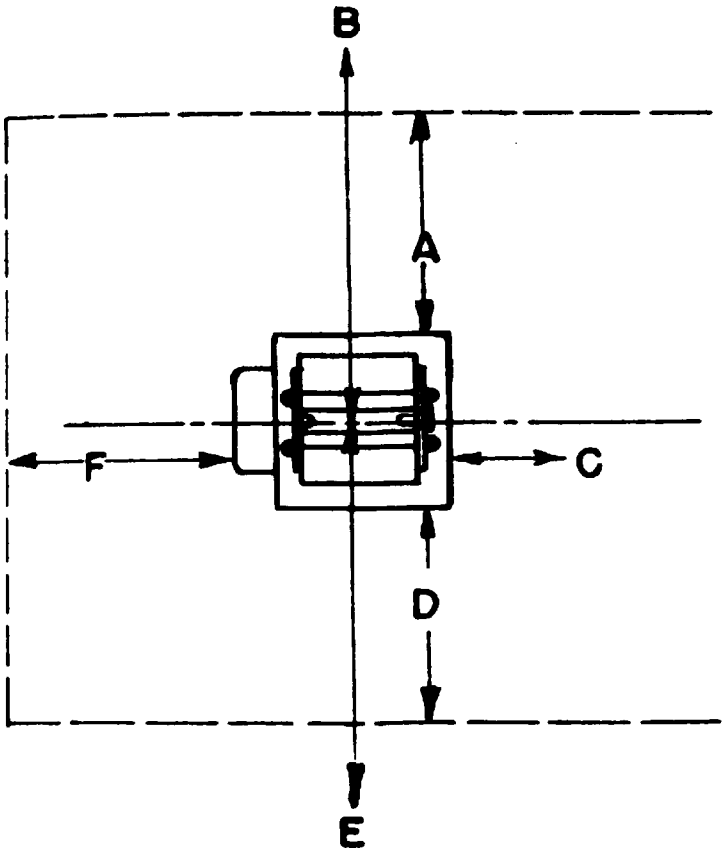
Clearance C	
18 inches	____
24 inches	____
30 inches	____
36 inches	____
42 inches	____
If other, specify	____

Clearance D (no obstructions)	
8 feet	____
10 feet	____
12 feet	____
14 feet	____
If other, specify	____

Clearance E	
18 inches	____
24 inches	____
30 inches	____
36 inches	____
42 inches	____
If other, specify	____

Clearance F (no obstructions)	
Same as E	____
4 feet	____
6 feet	____
8 feet	____
10 feet	____
If other, specify	____

6.



WOOD PLANER

Clearance A	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance B (no obstructions)	
8 feet	____
10 feet	____
12 feet	____
14 feet	____
16 feet	____
If other, specify	____

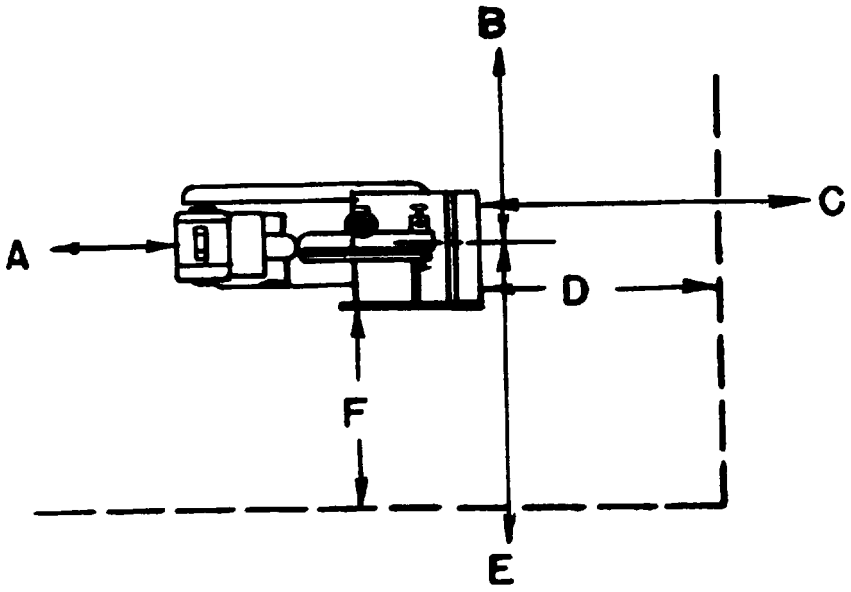
Clearance C	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

Clearance D	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance E (no obstructions)	
8 feet	____
10 feet	____
12 feet	____
14 feet	____
16 feet	____
If other, specify	____

Clearance F	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

7.



BAND SAW

Clearance A	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

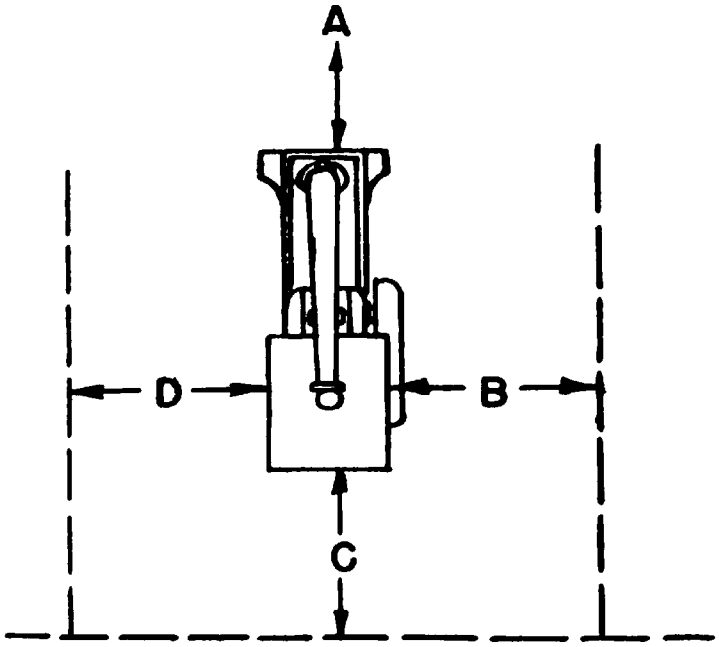
Clearance B (no obstructions)	
6 feet	____
8 feet	____
10 feet	____
12 feet	____
If other, specify	____

Clearance C (no obstructions	
6 feet	____
8 feet	____
10 feet	____
12 feet	____
If other, specify	____

Clearance D	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance E (no obstructions)	
6 feet	____
8 feet	____
10 feet	____
12 feet	____
If other, specify	____

Clearance F	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____



JIG SAW

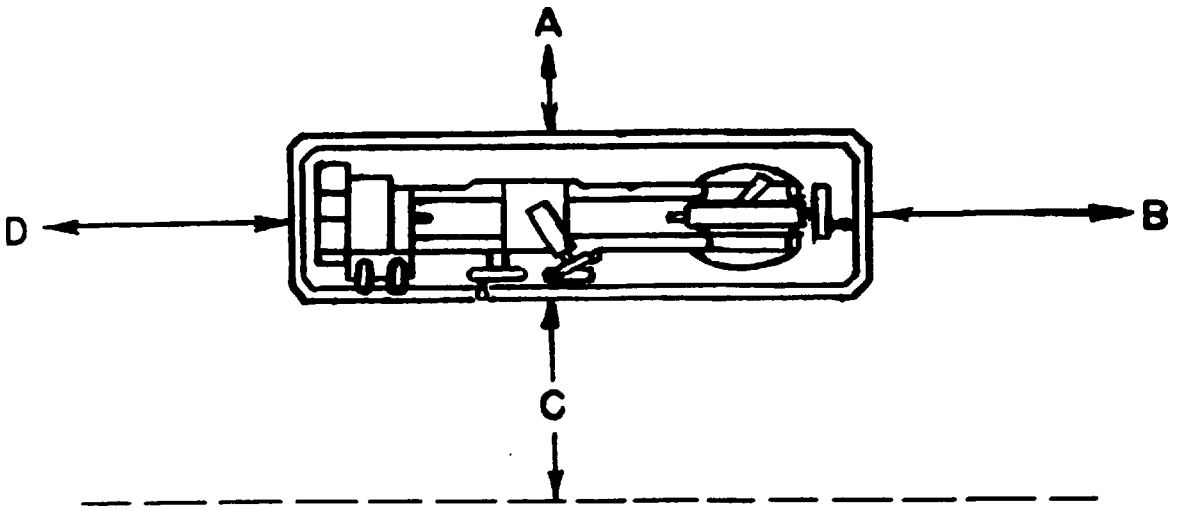
Clearance A	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

Clearance B	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance C	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance D	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

9.



METAL LATHE

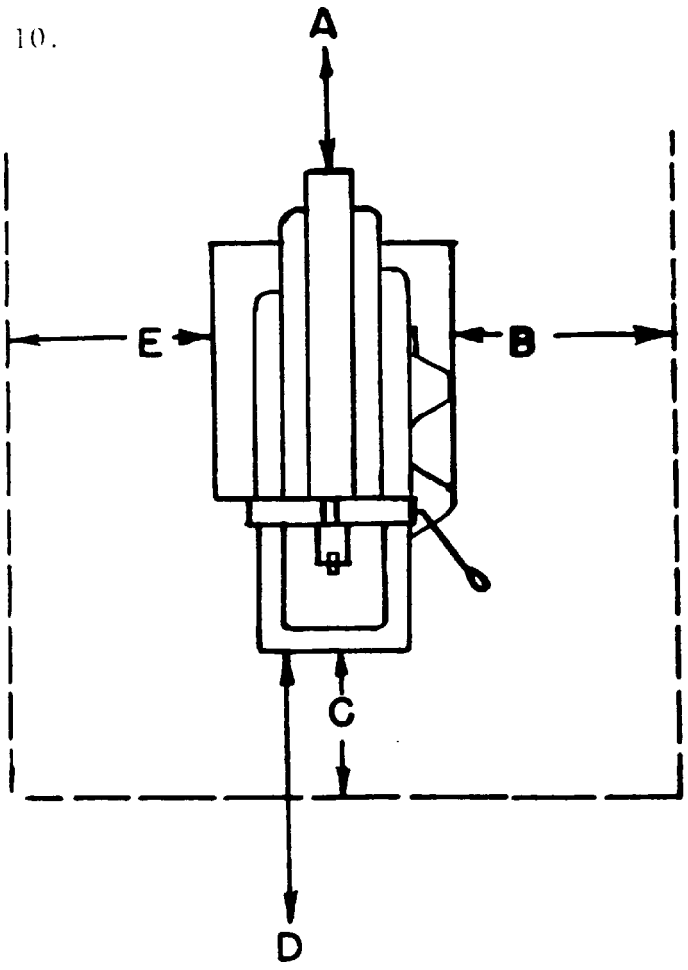
Clearance A	
inches	____
6 inches	____
12 inches	____
If other, specify	____

Clearance B	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

Clearance C	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance D (no obstructions)	
2 feet	____
4 feet	____
6 feet	____
8 feet	____
10 feet	____
If other, specify	____

10.



METAL SHAPER

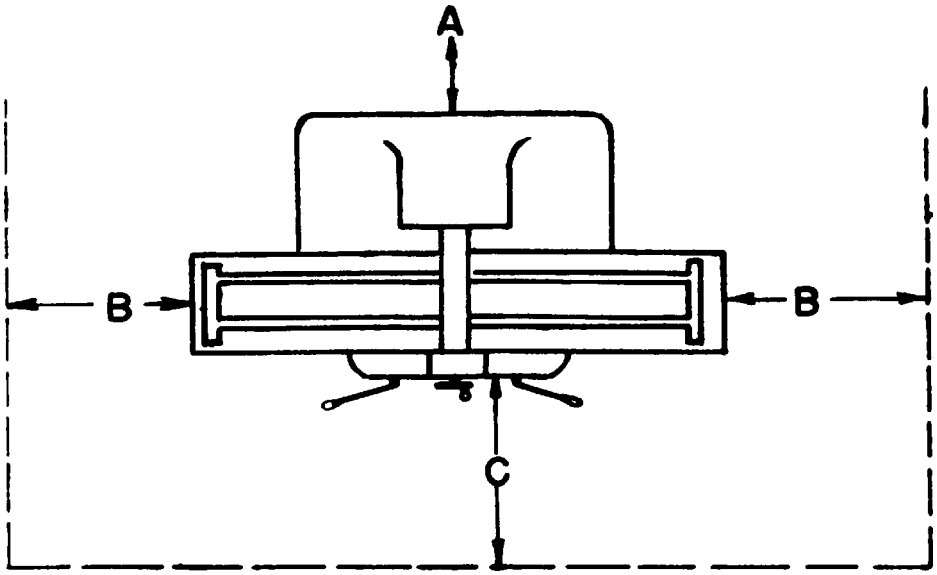
Clearance A	
Back limit of ram	___
Back limit of ram + 1 foot	___
Back limit of ram + 2 feet	___
Back limit of ram + _ feet	___
If other, specify	___

Clearance B	
24 inches	___
30 inches	___
36 inches	___
42 inches	___
48 inches	___
If other, specify	___

Clearance C	
24 inches	___
30 inches	___
36 inches	___
42 inches	___
48 inches	___
If other, specify	___

Clearance L	
Same as C	___
6 feet	___
8 feet	___
10 feet	___
If other, specify	___

Clearance E	
24 inches	___
30 inches	___
36 inches	___
42 inches	___
48 inches	___
If other, specify	___



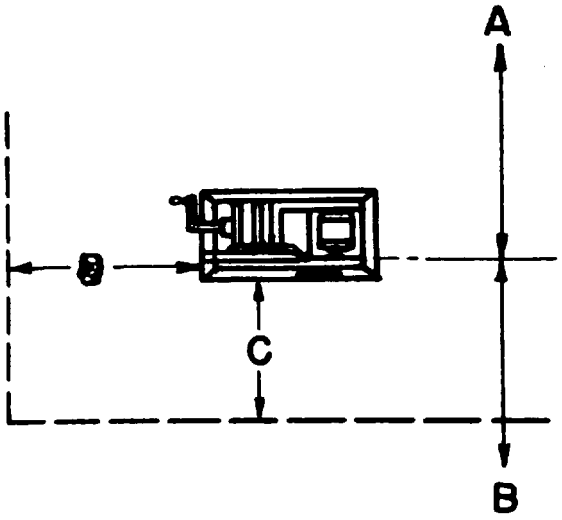
HORIZONTAL MILL

Clearance A
(no obstructions)
2 feet ____
4 feet ____
6 feet ____
If other, specify ____

Clearance B
Limit of table travel ____
Limit of table travel + 1 foot ____
Limit of table travel + 2 feet ____
Limit of table travel + 3 feet ____
If other, specify ____

Clearance C
24 inches ____
30 inches ____
36 inches ____
42 inches ____
48 inches ____
If other, specify ____

12.



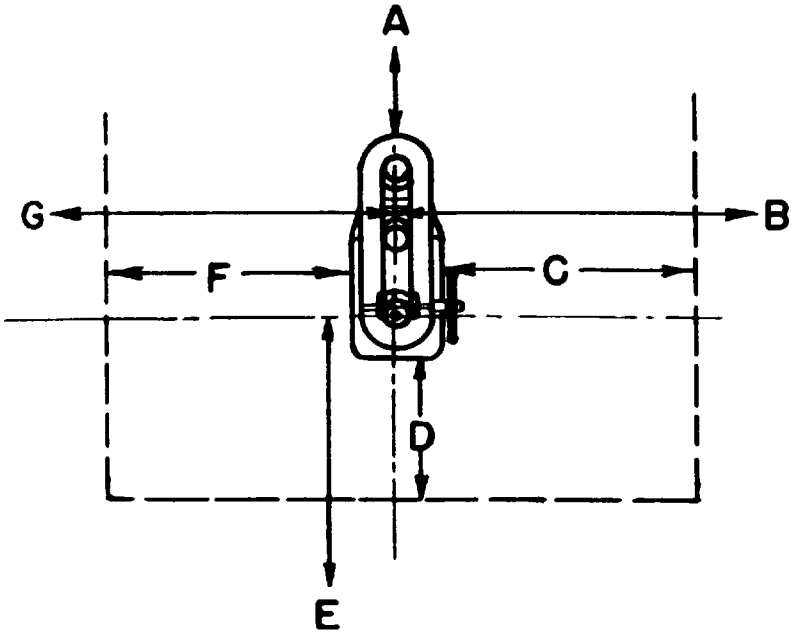
HACK SAW

Clearance A (no obstructions)	
12 feet	____
14 feet	____
16 feet	____
If other, specify	____

Clearance B	
4 feet	____
[illegible] feet	____
6 feet	____
If other, specify	____

Clearance C	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

Clearance D	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____



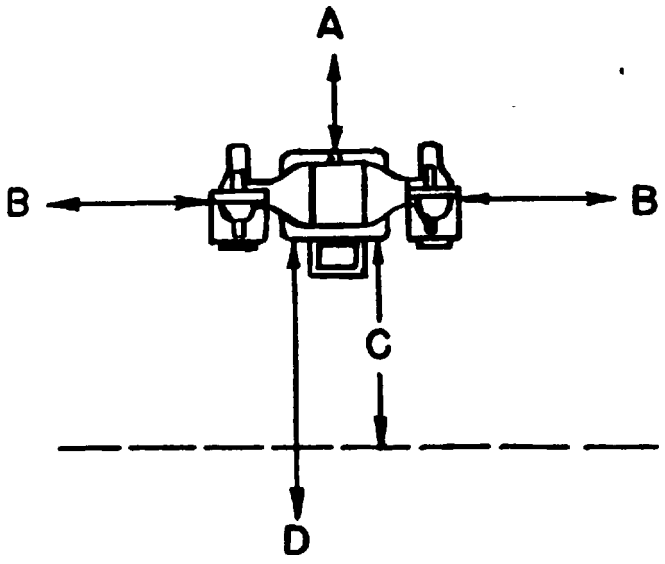
DRILL PRESS

Clearance A	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

Clearance B,E,G (no obstructions)	
2 feet	____
4 feet	____
5 feet	____
6 feet	____
If other, specify	____

Clearance C,D,F	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

4.



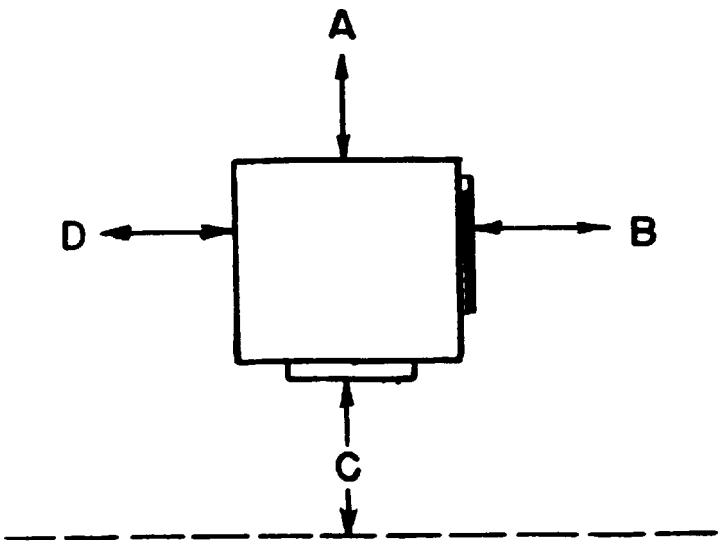
FLOOR GRINDER

Clearance A	
0 inches	____
6 inches	____
12 inches	____
If other, specify	____

Clearance B	
0 inches	____
6 inches	____
12 inches	____
18 inches	____
24 inches	____
36 inches	____
If other, specify	____

Clearance C	
24 inches	____
30 inches	____
36 inches	____
42 inches	____
48 inches	____
If other, specify	____

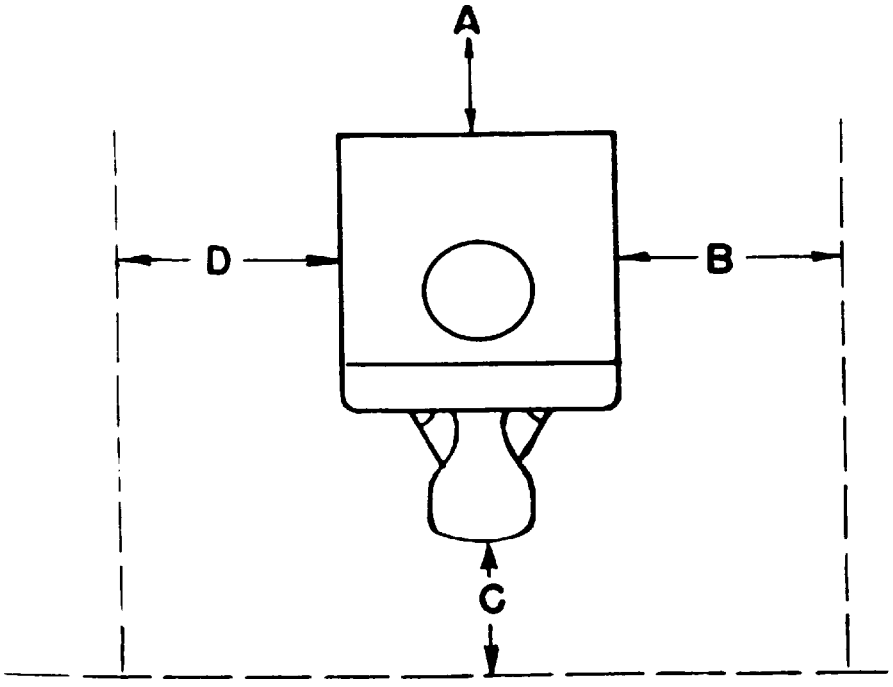
Clearance D	
Same as C	____
3 feet	____
4 feet	____
5 feet	____
6 feet	____
If other, specify	____



CERAMIC KILM

Clearance A,B,D	
1 foot	___
2 feet	___
3 feet	___
4 feet	___
If other, specify	___

Clearance C	
2 feet	___
3 feet	___
4 feet	___
5 feet	___
If other, specify	___



POTTERS WHEEL

Clearance A	
0 inches	___
6 inches	___
12 inches	___
18 inches	___
24 inches	___
If other, specify	___

Clearance B,C,D	
24 inches	___
30 inches	___
36 inches	___
42 inches	___
48 inches	___
If other, specify	___

The main aisles of travel should be

3 feet wide . . . . . ____
4 feet wide . . . . . ____
5 feet wide . . . . . ____
6 feet wide . . . . . ____
If other, specify _____

Part C

1. Waste storage (sawdust, scrap lumber, chips, rubbish, etc.) should be provided

In each work area of laboratory . . . . . ____
Centrally located in the laboratory . . . . . ____
Outside of the laboratory . . . . . ____
If other specify _____

2. Total space for waste storage should be approximately

50 cu. feet (3 x 4 x 4) . . . . . ____
100 cu. feet (4 x 4 x 6) . . . . . ____
150 cu. feet (4 x 4 x 10) . . . . . ____
200 cu. feet (4 x 4 x 12) . . . . . ____
If other, specify _____

3. Total space for pupil property (small-project, aprons, etc.) should be approximately

150 cu. feet . . . . . ____
200 cu. feet . . . . . ____
250 cu. feet . . . . . ____
300 cu. feet . . . . . ____
If other, specify _____

4. The assembly area should be

Distinct and apart from all other work areas in the laboratory . . . . . ____
Flexible, serving more than one activity when necessary . . . . . ____
If other, specify _____

5. The area available for the assembly center should be approximately
   - 1% of the total shop . . . . . ___
   - 10% of the total shop . . . . . ___
   - 15% of the total shop . . . . . ___
   - 20% of the total shop . . . . . ___
   - If other, specify _____

6. The display area (shop projects, etc.) should be
   - Located near the entrance . . . . . ___
   - Located in each of the areas of activity . . . . . ___
   - Centrally located in the laboratory . . . . . ___
   - Located outside the laboratory . . . . . ___
   - If other, specify _____

7. The total amount of space for display purpose should be approximately
   - 10 cubic feet (1 x 2 x 5) . . . . . ___
   - 15 cubic feet (1 x 2 x 5) . . . . . ___
   - 20 cubic feet (1 x 2 x 7) . . . . . ___
   - 30 cubic feet (1 x 4 x 8) . . . . . ___
   - If other, specify _____

8. The area of the finishing room should be approximately
   - 5% of total laboratory . . . . . ___
   - 10% of total laboratory . . . . . ___
   - 15% of total laboratory . . . . . ___
   - If other, specify _____

9. The instructor's area (office) should be approximately
   - 35 sq. feet (5 x 7) . . . . . ___
   - 50 sq. feet (6 x 8) . . . . . ___
   - 65 sq. feet (8 x 8) . . . . . ___
   - 80 sq. feet (8 x 10) . . . . . ___
   - If other, specify _____

10. The instructor's area should be located
    Near the entrance to the laboratory . . . . . ____
    Middle of long wall . . . . . ____
    Center of floor area . . . . . ____
    If other, specify _____

    _____

11. Open areas (areas for accommodating traffic) should be provided at the following locations (check those that apply)
    Entrance way . . . . . ____
    Before tool cribs and/or panels . . . . . ____
    Washing facilities . . . . . ____
    Drinking fountain . . . . . ____
    Instructor's area . . . . . ____
    If other, specify _____

    _____

12. The area for showing films (visual-aids area) should be
    Apart from all other areas (separate room) . . . . . ____
    In any area of the laboratory . . . . . ____
    Combined with planning center . . . . . ____
    If other, specify _____

    _____

13. The visual-aids area should accommodate
    Total class . . . . . ____
    50% of class . . . . . ____
    25% of class . . . . . ____
    If other, specify _____

    _____

14. Supply and material (large quantities of lumber, sheet metal, bar stock, clay, nails, screws, etc.) storages should be provided
    Within the shop . . . . . ____
    Outside the shop . . . . . ____
    Centrally located for several shops . . . . . ____
    If other, specify _____

    _____

15. Space for supply and material storage should be approximately
    500 cu. feet (5 x 10 x 10) . . . . . ____
    1,000 cu. feet (7 x 10 x 14) . . . . . ____
    1,500 cu. feet (7 x 10 x 20) . . . . . ____
    2,000 cu. feet (7 x 10 x 25) . . . . . ____
    2,500 cu. feet (7 x 10 x 36) . . . . . ____
    If other, specify _____

16. Space for equipment storage (tool cribs and/or panels, auxiliary machine parts, etc.)
    200 cu. feet (2 x 7 x 15) . . . . . ____
    300 cu. feet (2 x 7 x 22) . . . . . ____
    400 cu. feet (2 x 7 x 28) . . . . . ____
    500 cu. feet (2 x 7 x 36) . . . . . ____
    If other, specify _____

17. Space for large-project storage should be approximately
    200 cu. feet (4 x 7 x 7) . . . . . ____
    250 cu. feet (4 x 7 x 9) . . . . . ____
    300 cu. feet (4 x 7 x 11) . . . . . ____
    350 cu. feet (4 x 7 x 13) . . . . . ____
    If other, specify _____

18. Wardrobe (provisions for suit coats, sweaters, hats, books, for class in session) should be located
    Near entrance to laboratory . . . . . ____
    Within each work area . . . . . ____
    Centrally located in laboratory . . . . . ____
    If other, specify _____

19. Total space for wardrobe should be approximately
    50 cu. feet (1 x 5 x 10) . . . . . ____
    100 cu. feet (1 x 6 x 16) . . . . . ____
    150 cu. feet (1 x 6 x 25) . . . . . ____
    If other, specify _____

20. The approximate square footage of chalkboard in the laboratory should be

15 . . . . . ____
20 . . . . . ____
25 . . . . . ____
30 . . . . . ____
35 . . . . . ____
40 . . . . . ____
If other, specify _____

_____

21. The approximate square footage of tackboard in the laboratory should be

10 . . . . . ____
15 . . . . . ____
20 . . . . . ____
25 . . . . . ____
30 . . . . . ____
If other, specify _____

_____

22. The area of the planning center should be approximately

10% of total laboratory . . . . . ____
15% of total laboratory . . . . . ____
20% of total laboratory . . . . . ____
If other, specify _____

_____

23. The planning center should be located

Centrally along one wall . . . . . ____
With reference to the corridor entrance . . . . . ____
With reference to the noise in the laboratory . . . . . ____
If other, specify _____

_____

CHECK LIST
FOR
SPECIALISTS IN SCHOOL-PLANT CONSTRUCTION

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.
2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.
3. The laboratory has been equipped to accommodate 25 pupils.
4. The laboratory is located in a one-story building.

Instruction to the juror:

Please place a check in the space opposite the <u>one</u> standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The location of the laboratory with regard to the main plant should be

Front corridor of main plant . . . . . ____
Wing of main plant . . . . . ____
Separate building . . . . . ____
Separate building attached to main plant . . . . . ____
If other, specify _____

_____

2. Partitions within the laboratory should be constructed of
   - Wood . . . . . ____
   - Metal . . . . . ____
   - Concrete . . . . . ____
   - Brick or block . . . . . ____
   - If other, specify _____

3. Panic hardware should be installed on
   - All doors leading from shop . . . . . ____
   - Service door only . . . . . ____
   - If other, specify _____

4. The sound-absorbing values of the ceiling should be

Minimum		Maximum	
30%	____	50%	____
40%	____	60%	____
50%	____	70%	____
60%	____	80%	____
If other, specify . . .	____	If other, specify . . .	____

5. The sound-absorbing values of the wall above the wainscoting should be

Minimum		Maximum	
30%	____	50%	____
40%	____	60%	____
50%	____	70%	____
60%	____	80%	____
If other, specify . . .	____	If other, specify . . .	____

6. Wall finish to the height of (assume 5 feet height) of wainscoting (dado) should be
   - Wood . . . . . ____
   - Hard plaster, painted . . . . . ____
   - Linoleum . . . . . ____
   - Glazed material . . . . . ____
   - If other, specify _____

7. Source of natural light in the laboratory should be
   - Unilateral (windows on one wall) . . . . . ____
   - Unilateral (windows on one wall in addition to clerestory) . . . . . ____
   - Bilateral (windows on opposite walls) . . . . . ____
   - Bilateral (clerestory windows on one side) . . . . . ____
   - Saw-tooth lighting . . . . . ____
   - If other, specify _____

8. Window glass for the laboratory should be
   - Clear glass . . . . . ____
   - Light diffusing . . . . . ____
   - Light diffusing with vision strip . . . . . ____
   - Light directional . . . . . ____
   - Light directional with vision strip . . . . . ____
   - If other, specify _____

9. Window area in the laboratory should be
   - 20% of floor area . . . . . ____
   - 25% of floor area . . . . . ____
   - 30% of floor area . . . . . ____
   - 35% of floor area . . . . . ____
   - If other, specify _____

10. Natural-light control in the laboratory should be
   - Light-colored, diffusing, translucent shades . . . . . ____
   - Venetian blinds . . . . . ____
   - Fiber glass diffusing screens of 60% transmission . . ____
   - Light-diffusing glass . . . . . ____
   - Light-directional glass . . . . . ____
   - If other, specify _____

11. The general lighting system used in the laboratory should be
   - Indirect (90-100% upward, 10-0% downward) . . . . . ____
   - Semi-indirect (60-90% upward, 40-10% downward) . . ____
   - General diffuse (40-60% upward, 60-40% downward) . ____
   - Semidirect (10-40% upward, 90-60% downward) . . . . ____
   - Direct (0-10% upward, 100-90% downward) . . . . . ____
   - If other, specify _____

12. The fire-alarm system in the laboratory should be (check those that apply)

Integral part of the main fire-alarm system . . . . . ____
Independent of the main fire-alarm system . . . . . ____
Have an alarm-sounding station in the laboratory . . ____
Separate and distinct from all call and program systems . . . . . ____
Others: _____

_____

_____

13. The amount of outdoor air included in the total air circulated (except during heating-up period) should be

15% . . . . . ____
20% . . . . . ____
25% . . . . . ____
30% . . . . . ____
40% . . . . . ____
If other, specify _____

_____

14. The minimum quantity of air per pupil supplied in the laboratory should not be less than

10 cu. ft. per min. . . . . ____
15 cu. ft. per min. . . . . ____
20 cu. ft. per min. . . . . ____
25 cu. ft. per min. . . . . ____
30 cu. ft. per min. . . . . ____
If other, specify _____

_____

15. The ventilation system used in the laboratory should be

Open window and door . . . . . ____
Gravity activated . . . . . ____
Mechanical, integral part of main plant . . . . . ____
Mechanical--unit type, separate from main plant . . . ____
If other, specify _____

_____

_____

16. During heating seasons the air velocity in lineal feet per minute should not exceed (past occupant)

15 . . . . . ____
20 . . . . . ____
25 . . . . . ____
30 . . . . . ____
40 . . . . . ____
If other, specify _____

17. The air velocity in lineal feet per minute for cooling purposes should not exceed (past occupant)

80 . . . . . ____
90 . . . . . ____
100 . . . . . ____
110 . . . . . ____
120 . . . . . ____
If other, specify _____

18. The relative humidity of the laboratory should be approximately

Winter		Summer	
30	____	30	____
40	____	40	____
50	____	50	____
60	____	60	____
70	____	70	____
If other, specify _____		If other, specify _____	

19. Regardless of the heating system used, the temperature in the laboratory at a distance 60 inches above the floor should be

65 degrees . . . . . ____
66 degrees . . . . . ____
67 degrees . . . . . ____
68 degrees . . . . . ____
69 degrees . . . . . ____
70 degrees . . . . . ____
If other, specify _____ ____

20. The heating system for the laboratory should be
    - Direct wall radiation (radiators) . . . . . ____
    - Wall-unit ventilators with fan . . . . . ____
    - Overhead-unit heaters with fan . . . . . ____
    - Forced warm air from central heating plant . . . . . ____
    - Split system (forced warm air and convectors) . . . . ____
    - Radiant-panel heating . . . . . ____
    - Baseboard radiation . . . . . ____
    - If other, specify _____

21. The control of room temperature should be by
    - Total plant system . . . . . ____
    - Zone system . . . . . ____
    - Room, hand control . . . . . ____
    - Room, automatic control . . . . . ____
    - If other, specify _____

22. Exhaust systems used in the laboratory for expelling fumes, dust, etc., should be installed
    - In the floor . . . . . ____
    - Overhead . . . . . ____
    - If other, specify _____

23. If radiators are used as heating elements in the laboratory they should be placed at
    - Floor level against wall . . . . . ____
    - 4 feet from floor on wall . . . . . ____
    - 5 feet from floor on wall . . . . . ____
    - 6 feet from floor on wall . . . . . ____
    - 7 feet from floor on wall . . . . . ____
    - Suspended from ceiling at strategic locations . . . . . ____
    - Recessed in wall . . . . . ____
    - If other, specify _____



CHECK LIST
FOR
SPECIALISTS IN ILLUMINATION

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.
2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.
3. The laboratory has been equipped to accommodate 25 pupils.
4. The laboratory is located in a one-story building.

Instruction to the juror:

Please place a check in the space opposite the one standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. Window area in the laboratory should be
   - 20% of floor area . . . . . ___
   - 25% of floor area . . . . . ___
   - 30% of floor area . . . . . ___
   - 35% of floor area . . . . . ___
   - If other, specify _____

   _____

2. The height of window tops should be
   - One-half width of laboratory . . . . . ___
   - Ceiling height . . . . . ___
   - Governed by window area required . . . . . ___
   - If other, specify _____

3. The source of natural lighting in the laboratory should be
   - Unilateral (windows on one wall) . . . . . ___
   - Unilateral (windows on one wall in addition to clerestory) . . . . . ___
   - Bilateral (windows on opposite walls) . . . . . ___
   - Bilateral (clerestory windows on one side) . . . . . ___
   - Saw-tooth lighting . . . . . ___
   - If other, specify _____

4. Window glass for the laboratory should be
   - Clear glass . . . . . ___
   - Light diffusing . . . . . ___
   - Light diffusing with vision strip . . . . . ___
   - Light directional . . . . . ___
   - Light directional with vision strip . . . . . ___
   - If other, specify _____

5. Natural-light control in the laboratory should be
   - Light-colored, diffusing, translucent shades . . . . . ___
   - Venetian blinds . . . . . ___
   - Fiber glass diffusing screens of 60% transmission . . ___
   - Light-diffusing glass . . . . . ___
   - Light-directional glass . . . . . ___
   - If other, specify _____

6. The type of artificial light source should be
   - Incandescent . . . . . ___
   - Fluorescent . . . . . ___
   - Cold cathode . . . . . ___
   - Incandescent and fluorescent . . . . . ___
   - If other, specify _____

7. The general lighting system used in the laboratory should be

Indirect (90-100% upward, 10-0% downward) . . . . . ___
Semi-indirect (60-90% upward, 40-10% downward) . . ___
General diffuse (40-60% upward, 60-40% downward) . ___
Semidirect (10-40% upward, 90-60% downward) . . . . ___
Direct (0-10% upward, 100-90% downward) . . . . . ___
If other, specify _____

8. The light-reflection values of the ceiling in the laboratory should be

Minimum		Maximum	
65%	___	75%	___
70%	___	80%	___
75%	___	85%	___
80%	___	90%	___
If other, specify _____		If other, specify _____	

9. The light-reflection values of the walls in the laboratory should be

Minimum		Maximum	
40%	___	55%	___
45%	___	60%	___
50%	___	65%	___
55%	___	70%	___
60%	___	75%	___
If other, specify _____		If other, specify _____	

10. The light-reflection values of the wainscoting (height 5 feet) should be

Minimum		Maximum	
25%	___	35%	___
30%	___	40%	___
35%	___	45%	___
40%	___	50%	___
45%	___	55%	___
If other, specify _____		If other, specify _____	

11. The light-reflection values of the work bench tops should be

Minimum		Maximum	
25%	____	40%	____
30%	____	45%	____
35%	____	50%	____
40%	____	55%	____
45%	____	60%	____
If other, specify _____		If other, specify _____	

12. The light-reflection values of the furniture should be

Minimum		Maximum	
25%	____	40%	____
30%	____	45%	____
35%	____	50%	____
40%	____	55%	____
45%	____	60%	____
If other, specify _____		If other, specify _____	

13. The light-reflection values of the trim and doors should be

Minimum		Maximum	
25%	____	40%	____
30%	____	45%	____
35%	____	50%	____
40%	____	55%	____
45%	____	60%	____
If other, specify _____		If other, specify _____	

14. The light-reflection values of the chalkboard should be

Minimum		Maximum	
5%	____	15%	____
10%	____	20%	____
15%	____	25%	____
20%	____	30%	____
If other, specify _____		If other, specify _____	

15. The light-reflection values of the tackboard should be

Minimum		Maximum	
40%	____	50%	____
45%	____	55%	____
50%	____	60%	____
55%	____	65%	____
60%	____	70%	____
If other, specify ____		If other, specify ____	

16. The light-reflection values of the machinery in the laboratory should be

Minimum		Maximum	
25%	____	40%	____
30%	____	45%	____
35%	____	50%	____
40%	____	55%	____
45%	____	60%	____
If other, specify ____		If other, specify ____	

17. The light-reflection values of the laboratory floor should be

Minimum		Maximum	
5%	____	20%	____
10%	____	25%	____
15%	____	30%	____
20%	____	35%	____
25%	____	40%	____
If other, specify ____		If other, specify ____	

The numbered items appearing below represent work stations found in a typical industrial-arts laboratory on the secondary-school level. In parentheses under each numbered item, some of the more common operations performed at the work station in question are listed.

After each numbered item place a check in the column which in your opinion represents the minimum foot-candles that should be in service at the work station in question.

Woodworking Area	Minimum Foot-Candles									
	10	20	30	40	50	60	70	80	90	If Other, Specify
1. Bench (Reading blueprints and measuring instruments; sawing, planing laying out, boring, gouging, sanding, assembling, inspecting, and adjusting tools)										
2. Lathe (Straight, taper, and contour turning; shouldering, facing, sanding, finishing, and polishing)										
3. Jointer (Surfacing, and rabbeting)										
4. Circular Saw (Ripping, cross-cutting, grooving, rabbeting, dadoing, mitering, measuring, and inspecting work)										
5. Band Saw (Straight and contour sawing, inspecting and measuring work)										

Woodworking Area	Minimum Foot-Candles									
	10	20	30	40	50	60	70	80	90	If Other, Specify
6. Jig Saw (Straight and contour sawing, and inspecting work)										
7. Sander (Sanding straight and contour surfaces, inspecting finish)										
Machine-Shop Area										
1. Bench (Sketching, blueprint reading, filing, laying out work, taping, scraping, precision measuring, sawing, reaming, and assembling)										
2. Power Saw (Adjusting saw and measuring)										
3. Drill Press (Drilling to lay out, reaming, inspecting work, measuring, tapping, spotfacing, lapping, counterboring, honing, and polishing work)										
4. Lathe (Adjusting machine, measuring and inspecting work, threading, facing, boring, turning and polishing)										

Machine-Shop Area	Minimum Foot-Candles									
	10	20	30	40	50	60	70	80	90	If Other, Specify
5. Shaper (Reading blueprints, measuring and inspecting work, adjusting machine; straight, vertical, angular, and contour shaping; slotting and keyseating)										
6. Miller (Reading blueprints, measuring and inspecting work, adjusting machine; plain, side, and face milling; profiling, fluting, boring, slotting and keyseating)										
7. Floor Grinder (Grinding to form, inspecting work and burring)										
Ceramics Area										
1. Bench (Inspecting details of design and finish of work; smoothing, wetting, wedging, glazing, molding, and inscribing)										
2. Potter's Wheel (Operations performed similar to those done at the bench)										

Sheet-Metal Area	Minimum Foot-Candles									
	10	20	30	40	50	60	70	80	90	If Other, Specify
1. Bench (Measuring, inspecting and laying out work; sketching, blueprint reading, filing; cutting, forming, and soldering work)										
2. Bending and Forming Machines (Forming circles, tapers, arcs, grooves, working to lay-out lines, inspecting and measuring work)										
3. Punching and Shearing Machines (Punching and cutting sheet metal to lay-out marks)										
Planning Area										
1. Drafting (Sketching and mechanical drawing)										
2. Reference Work (Library)										

GENERAL ILLUMINATION OF LABORATORY 30 INCHES FROM FLOOR SHOULD BE _____FOOT-CANDLES.

CHECK LIST
FOR
SPECIALISTS IN HEATING-AND-VENTILATING ENGINEERING

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, four assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.
2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.
3. The laboratory has been equipped to accommodate 25 pupils.
4. The laboratory is located in a one-story building.

Instruction to the juror:

Please place a check in the space opposite the <u>one</u> standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The minimum quantity of air per pupil supplied in the laboratory should be
   - 10 cu. ft. per min. . . . . ____
   - 15 cu. ft. per min. . . . . ____
   - 20 cu. ft. per min. . . . . ____
   - 25 cu. ft. per min. . . . . ____
   - 30 cu. ft. per min. . . . . ____
   - If others, specify _____

     _____

2. The amount of outdoor air included in the total air circulated (except during heating-up period) should be

15% . . . . . ____
20% . . . . . ____
25% . . . . . ____
30% . . . . . ____
40% . . . . . ____
If others, specify _____

_____

3. The ventilation system used in the laboratory should be

Open window and door . . . . . ____
Gravity activated . . . . . ____
Mechanical, integral part of main plant . . . . . ____
Mechanical - unit type, separate from main plant . . ____
If other, specify _____

_____

_____

4. During heating seasons the air velocity in lineal feet per minute should not exceed (past occupant)

15 . . . . . ____
20 . . . . . ____
25 . . . . . ____
30 . . . . . ____
40 . . . . . ____
If other, specify _____

_____

5. The air velocity in lineal feet per minute for cooling purposes should not exceed (past occupant)

80 . . . . . ____
90 . . . . . ____
100 . . . . . ____
110 . . . . . ____
120 . . . . . ____
If other, specify _____

_____

6. The relative humidity of the laboratory should be approximately

30 . . . . . ____
40 . . . . . ____
50 . . . . . ____
60 . . . . . ____
70 . . . . . ____
If other, specify _____

_____

7. The relative humidity of storage areas (lumber, supplies, equipment, etc.) should be approximately

30 . . . . . ____
40 . . . . . ____
50 . . . . . ____
60 . . . . . ____
70 . . . . . ____
If other, specify _____

_____

8. Regardless of the heating system used, the temperature in the laboratory at a distance 60 inches above the floor should be

65 degrees . . . . . ____
66 degrees . . . . . ____
67 degrees . . . . . ____
68 degrees . . . . . ____
69 degrees . . . . . ____
70 degrees . . . . . ____
If other specify _____

_____

9. The heating system for the laboratory should be

Direct wall radiation (radiators) . . . . . ____
Wall-unit ventilators with fan . . . . . ____
Overhead-unit heaters with fan . . . . . ____
Forced war air from central heating plant . . . . . ____
Split system (forced warm air and convectors) . . . . . ____
Radiant-panel heating . . . . . ____
Baseboard radiation . . . . . ____
If other, specify _____

_____

10. The control of room temperature should be by
    Total plant system . . . . . ____
    Zone system . . . . . ____
    Room, hand control . . . . . ____
    Room, automatic control . . . . . ____
    If other, specify _____

11. The exhaust system should be installed so that
    Whole shop is served by one system . . . . . ____
    Areas are served by separate systems . . . . . ____
    Each work station (where exhausting is necessary)
    is served by a separate system . . . . . ____
    If other, specify _____

CHECK LIST
FOR
SPECIALISTS IN ELECTRICAL ENGINEERING

Introduction:

Due to the many variables that make difficult the establishment of certain standards for the facilities in the industrial-arts laboratory, three assumptions have been made to simplify the process of determining these standards.

1. The laboratory in question is a general industrial-arts laboratory on the secondary-school level, in which the following five areas of instruction are included: woodworking, sheet-metal working, machine-shop practice, ceramics, and drafting.

2. The dimensions of the laboratory proper are approximately 35 feet wide, 60 feet long, and the ceiling height, 12 feet.

3. The machine tools in the laboratory are the following:

Woodworking Area	Machine-Shop Area
3 Lathes	3 Lathes
1 Shaper	1 Shaper
1 Circular saw	1 Miller
1 Band saw	1 Power hack saw
1 Jig saw	
1 Drill press	
1 Jointer	Ceramics Area
1 Planer	
1 Grinder (floor)	3 Potter's wheels
1 Sander	1 Kiln

Instructions to the juror:

Please place a check in the space opposite the <u>one</u> standard of each group that, in your opinion, is most completely defensible, or acceptable. If, in your opinion, none of the standards is defensible, or acceptable, insert your recommended substitute for it in the space provided.

NOTE: If you believe yourself not qualified to express an opinion with respect to what the standard for a particular item should be, omit that item.

1. The power-circuit wiring system used in the laboratory should be

   Two-wire (115 volts) ..... ____
   Three-wire, single-phase ..... ____
   Three-wire, three-phase ..... ____
   Four-wire, three-phase ..... ____
   If other, specify _____

   _____

2. There should be one branch power circuit for every

   Machine ..... ____
   Two machines ..... ____
   Three machines ..... ____
   Four machines ..... ____
   If other, specify _____

   _____

3. Raceway system for power circuits should be

   Rigid metal conduit ..... ____
   Electrical metallic tubing ..... ____
   Wireways ..... ____
   Busways ..... ____
   If other, specify _____

   _____

4. In a new installation there should be one spare circuit for every

   4 active circuits ..... ____
   5 active circuits ..... ____
   6 active circuits ..... ____
   7 active circuits ..... ____
   If other, specify _____

   _____

5. The means whereby power circuits are protected from damage should be by the use of

   Circuit breakers ..... ____
   Plug-fuses ..... ____
   If other, specify _____

   _____

6. Power-circuit raceways should be
   - Concealed in floor ..... ____
   - Concealed in ceiling ..... ____
   - Exposed on ceiling ..... ____
   - Exposed on wall ..... ____
   - Exposed overhead, but not on ceiling ..... ____
   - If other, specify _____

7. In a new installation there should be one spare light circuit for every
   - 4 active circuits ..... ____
   - 5 active circuits ..... ____
   - 6 active circuits ..... ____
   - 7 active circuits ..... ____
   - If other, specify _____

8. There should be a separate circuit for every
   - Four convenience outlets ..... ____
   - Five convenience outlets ..... ____
   - Six convenience outlets ..... ____
   - Seven convenience outlets ..... ____
   - Eight convenience outlets ..... ____
   - If other, specify _____

9. Light-circuit raceways should be
   - Concealed in ceiling ..... ____
   - Exposed on ceiling ..... ____
   - Exposed overhead but not on ceiling ..... ____
   - If other, specify _____

10. The means whereby light circuits are protected from damage should be by the use of
    - Circuit breakers ..... ____
    - Plug-fuses ..... ____
    - If other, specify _____

CHECK LIST

[sent to jury of experts to determine the relative contribution of the facilities to a functional laboratory]

The purpose of this check list is to determine by group judgment the relative contribution of the standards that have been developed to a functional laboratory. For the purpose of this investigation, a functional laboratory has been defined as one in which the safety, the visual, auditory, and physical comfort of the pupil is of concern; and also as one in which such characteristics as flexibility, accessibility, and efficiency are present to a marked degree.

Please place a check at the space that indicates your opinion of the contribution of the standard to a functional laboratory. Please do not question the validity of the standard, but rate only its contribution to a functional laboratory.

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory: Very Little	Little	Moderate	Much	Very Much
LABORATORY SPACE						
Minimum height of the ceiling in the laboratory	12 feet					
Minimum width of the laboratory	30 feet					
Minimum ratio of the width to the length	1:1½					
Maximum ratio of the width to the length	1:2					
Minimum floor area in square feet per pupil	55					

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
FLOOR		
Floor material in the woodworking area	Wood	
Floor material in the sheet-metal area	Wood	
Floor material in the machine-shop area	Concrete	
Floor material in the ceramics area	Wood	
Floor material in the drafting area	Wood	
DOORS		
Width of the corridor door to the laboratory	60 inches	
Width of the service door to the laboratory	96 inches	
Type of service door	Overhead	
Type of hardware on doors leading from the laboratory, except service door	Panic hardware	

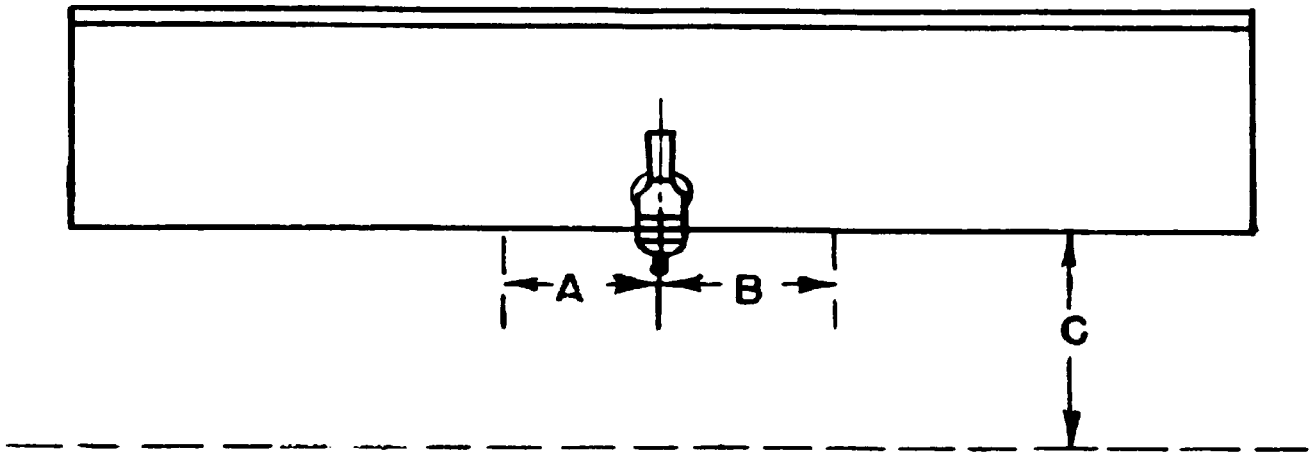
Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
PARTITIONS AND WALLS		
Material of movable partitions in the laboratory proper	Metal	[ ][ ][ ][ ][ ]
Wall finish to height of wainscoting	Hard plaster, painted or glazed material	[ ][ ][ ][ ][ ]
Height of wainscoting	4 feet	[ ][ ][ ][ ][ ]
Height of window sill	4 feet	[ ][ ][ ][ ][ ]
ORIENTATION		
Location of laboratory with regard to main plant	Wing	[ ][ ][ ][ ][ ]
Location of laboratory with regard to grade level	Grade level	[ ][ ][ ][ ][ ]
STORAGE AND SPECIAL AREAS		
Location of waste storage	In each area of activity	[ ][ ][ ][ ][ ]
Total space for waste storage	Approx. 100 cu. ft.	[ ][ ][ ][ ][ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
STORAGE AND SPECIAL AREAS (Continued)		
Total space for pupil property (small projects, aprons, etc.)	Approx. 200 cu. ft.	[ ][ ][ ][ ][ ]
Location of assembly area	Flexible, serves more than one activity	[ ][ ][ ][ ][ ]
Space available for assembly area	Approx. 10% of laboratory space	[ ][ ][ ][ ][ ]
Location of display area	Near entrance to laboratory	[ ][ ][ ][ ][ ]
Space for display area	Approx. 50 cu. ft.	[ ][ ][ ][ ][ ]
Area of finishing room	Approx. 5% of total laboratory area	[ ][ ][ ][ ][ ]
Location of instructor's area	Near entrance to laboratory	[ ][ ][ ][ ][ ]
Space for instructor's area	Approx. 55 sq. ft.	[ ][ ][ ][ ][ ]
Location of open areas (areas for accommodating traffic)	Entrance way	[ ][ ][ ][ ][ ]
	Tool cribs and/or panel approaches	[ ][ ][ ][ ][ ]
	Around wash basins	[ ][ ][ ][ ][ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory: Very Little	Little	Moderate	Much	Very Much
STORAGE AND SPECIAL AREAS (Continued)						
	Around drinking fountains					
	Instructor's area					
Location of visual-aids area	Combined with planning center					
Capacity of visual-aids area	Sufficient to accommodate entire class					
Location of supply and material storage (large quantities of stock, nails, screws, clay, etc.)	Within shop or centrally located for several shops					
Space for supply and material storage	Approx. 1,000 cu. ft.					
Space for equipment storage (tools, auxiliary machine parts, etc.)	Approx. 300 cu. ft.					
Space for large-project storage	Approx. 300 cu. ft.					
Location of wardrobe	Near entrance to laboratory					

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
STORAGE AND SPECIAL AREAS (Continued)		
Space for wardrobe	Approx. 100 cu. ft.	[ ][ ][ ][ ][ ]
Chalkboard area	Approx. 30 to 35 sq. ft.	[ ][ ][ ][ ][ ]
Tackboard area	Approx. 25 sq. ft.	[ ][ ][ ][ ][ ]
Location of planning center	Centrally located on one wall	[ ][ ][ ][ ][ ]
Area of planning center	Approx. 10% to 15% of laboratory area	[ ][ ][ ][ ][ ]
Width of main aisles of travel	4 feet	[ ][ ][ ][ ][ ]

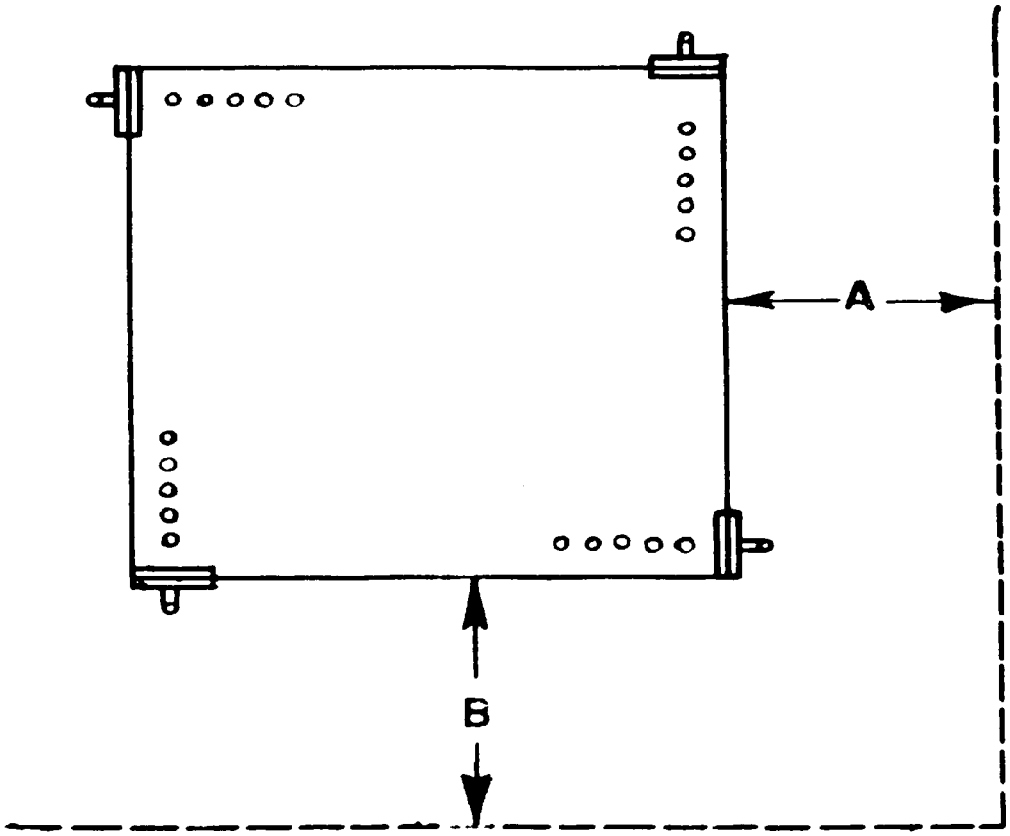
Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much



WALL BENCH

A = 24 in.
B = 24 in.
C = 36 in.

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

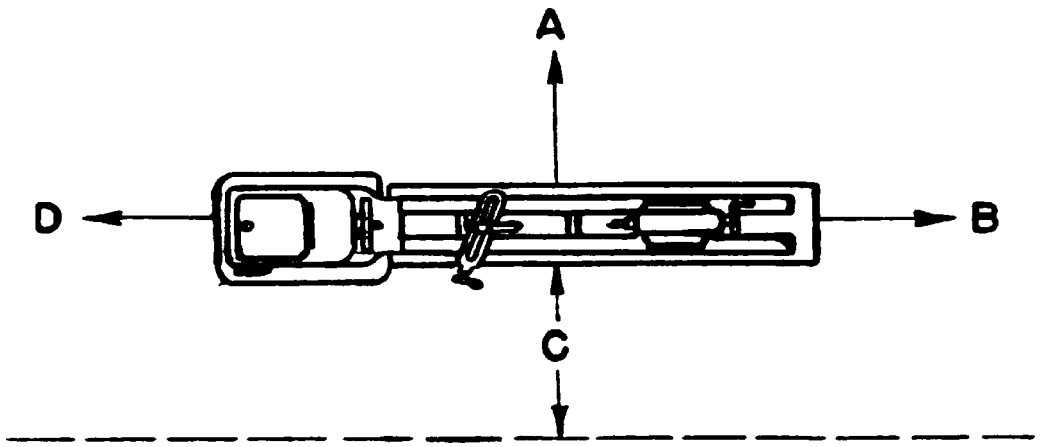


FLOOR BENCH (4 PLACE)

A = 36 in.
B = 36 in.

[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

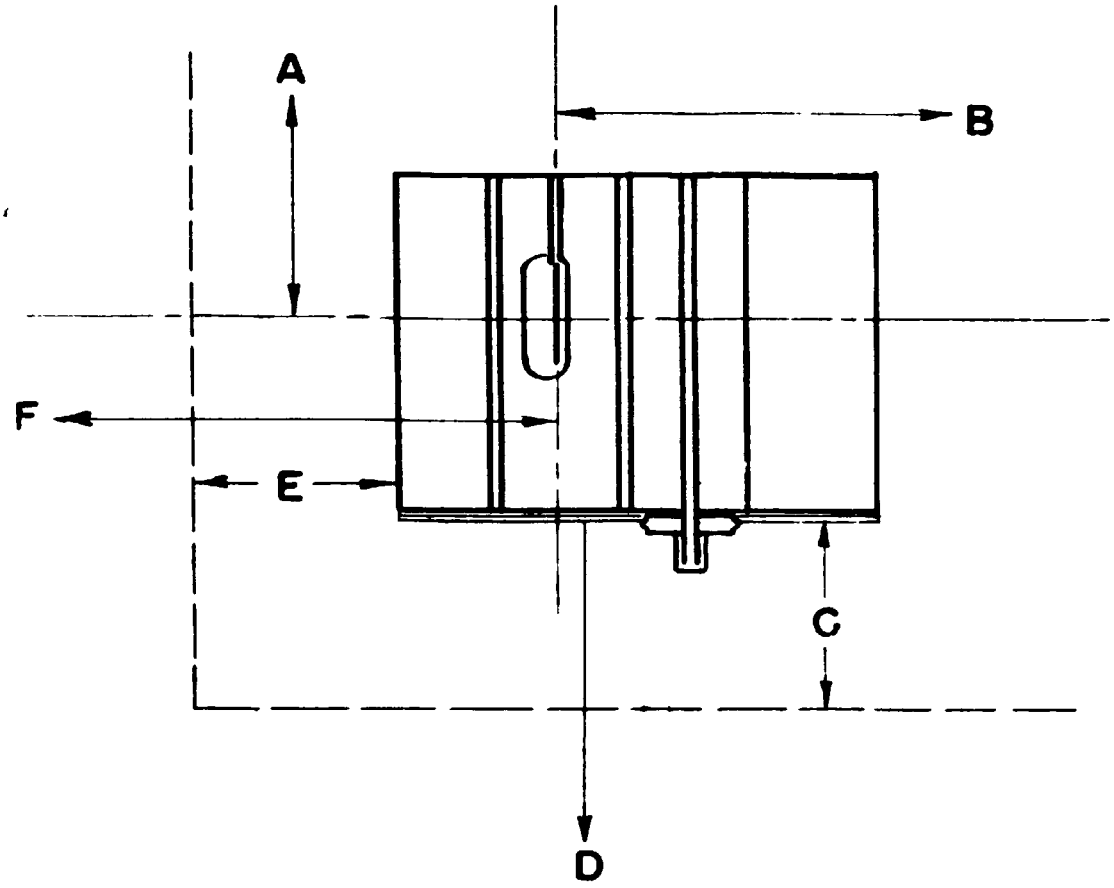


WOOD LATHE

A = 12 in.
B = 12 in.
C = 36 in.
D = 24 in.

[ ][ ][ ][ ][ ]

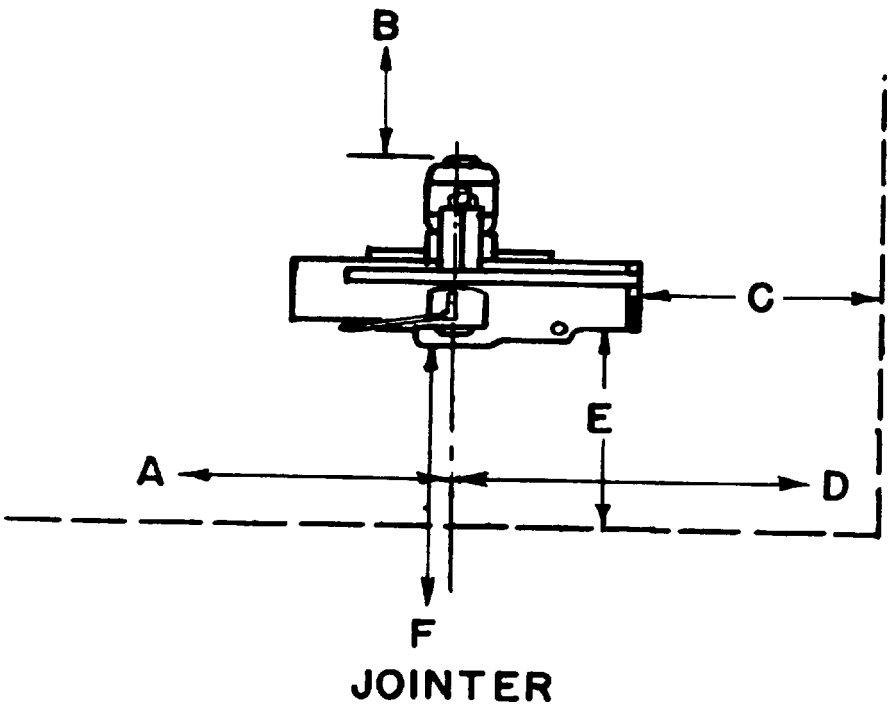
Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much



CIRCULAR SAW

A = 12 ft.
B = 8 ft.
C = 36 in.
D = Always clear
E = 36 in.
F = 8 ft.

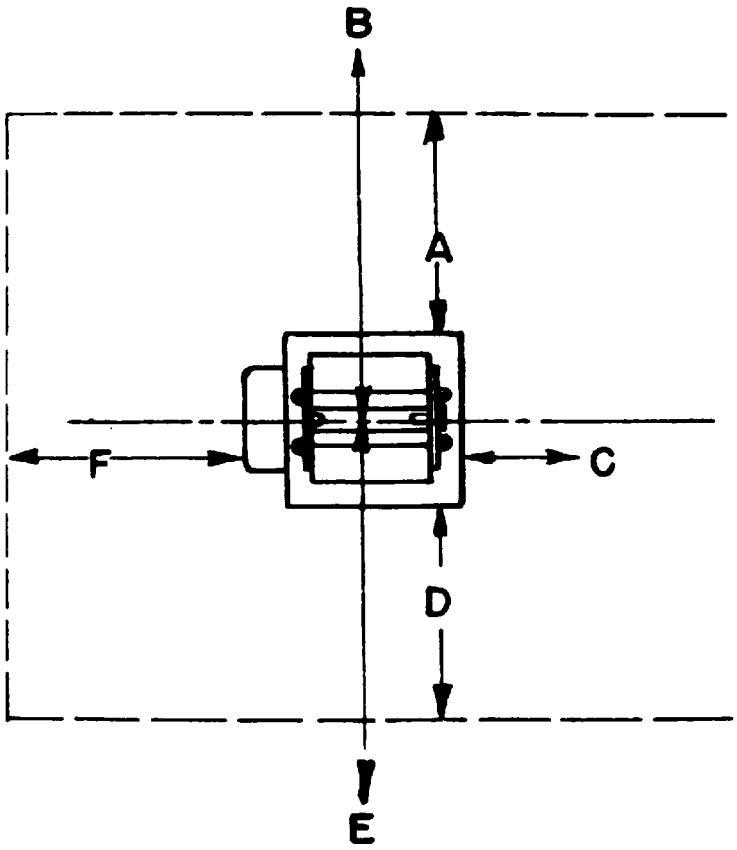
Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much



JOINTER

A = [illegible] ft.
B = 12 in.
C = 36 in.
D = 10 ft.
E = 36 in.
F = 6 ft.

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

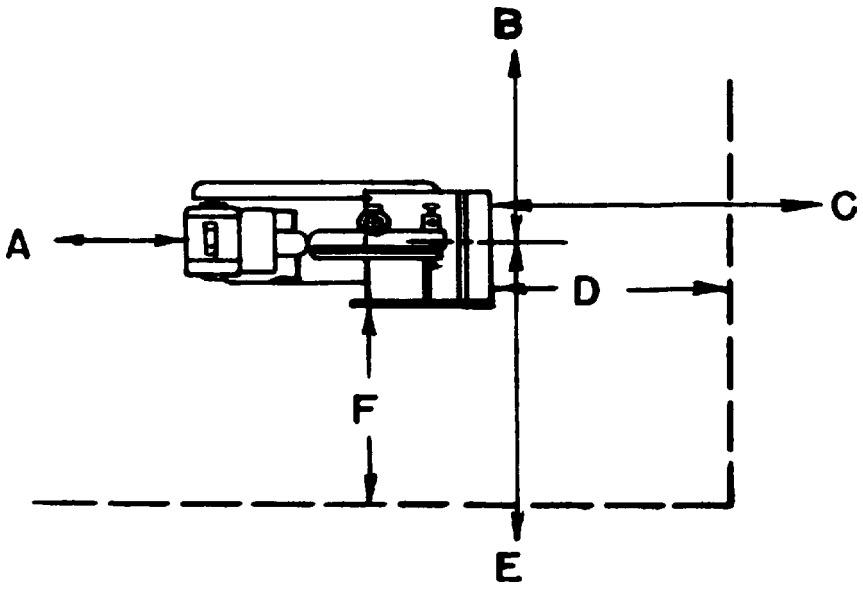


WOOD PLANER

A = 36 in.
B = 12 ft.
C = 12 in.
D = 36 in.
E = 12 ft.
F = 36 in.

[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

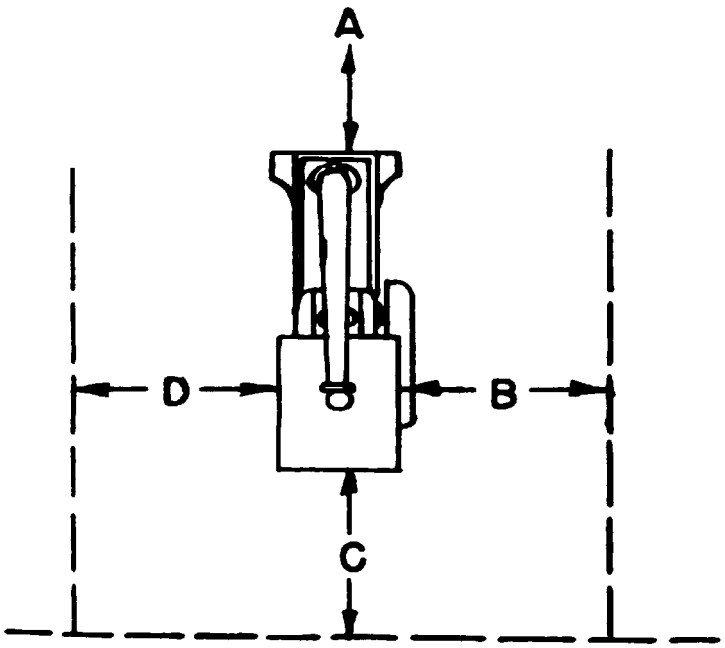


BAND SAW

A = 12 in.
B = 8 ft.
C = 6 ft.
D = 36 in.
E = 10 ft.
F = 36 in.

[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Mod-erate / Much / Very Much

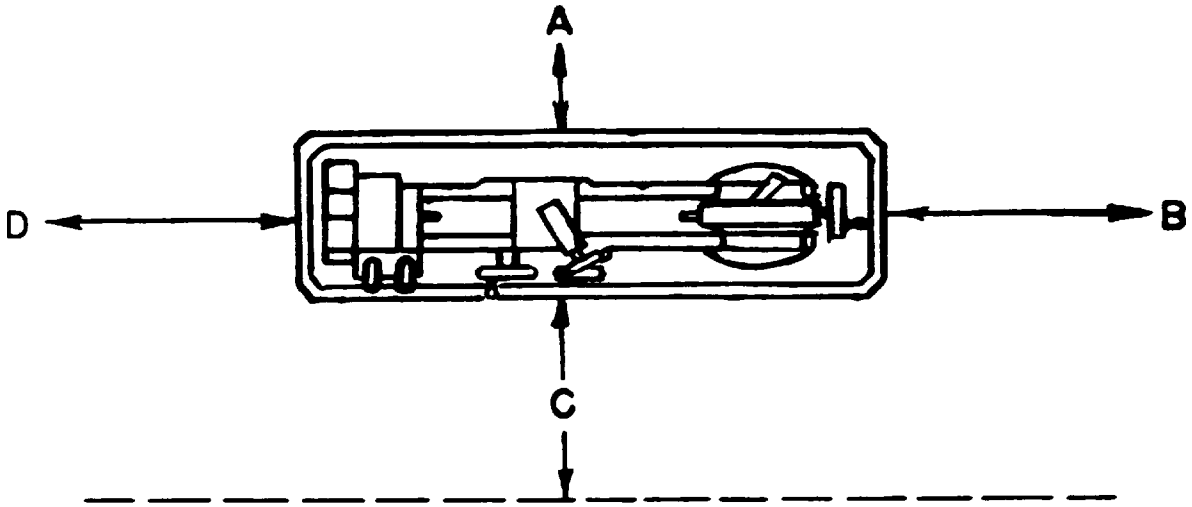


JIG SAW

A = 12 in.
B = 36 in.
C = 36 in.
D = 36 in.

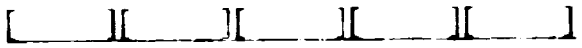
[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

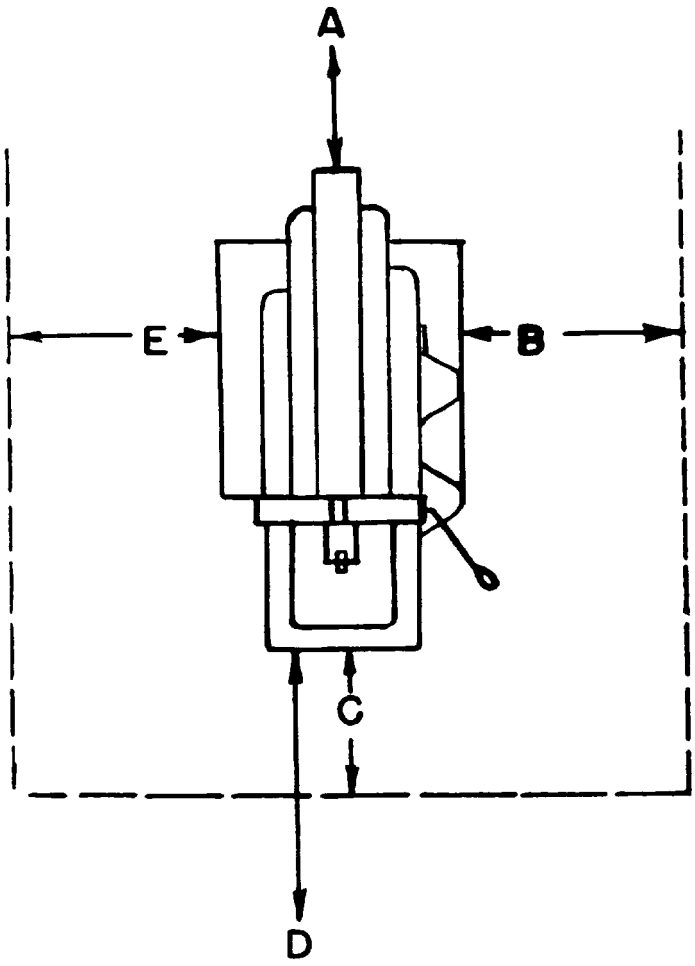


METAL LATHE

A = 12 in.
B = 12 in.
C = 36 in.
D = 4 ft.



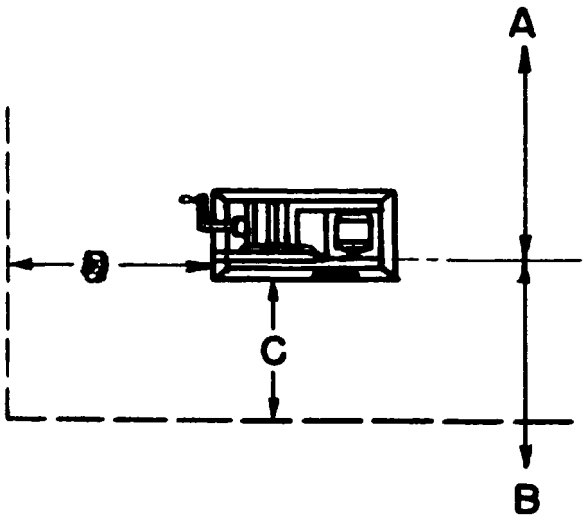
Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much



METAL SHAPER

A = Back limit of ram + 2 ft.
B = 36 in.
C = 36 in.
D = Same as C
E = 36 in.

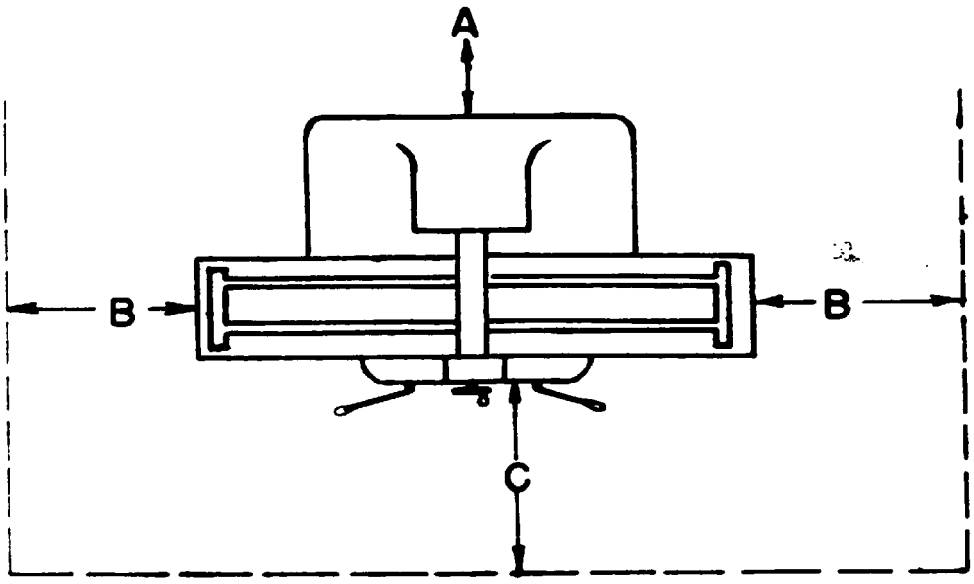
Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Moderate	Much	Very Much



HACK SAW

A = 14 ft.
B = 6 ft.
C = 36 in.
D = 36 in.

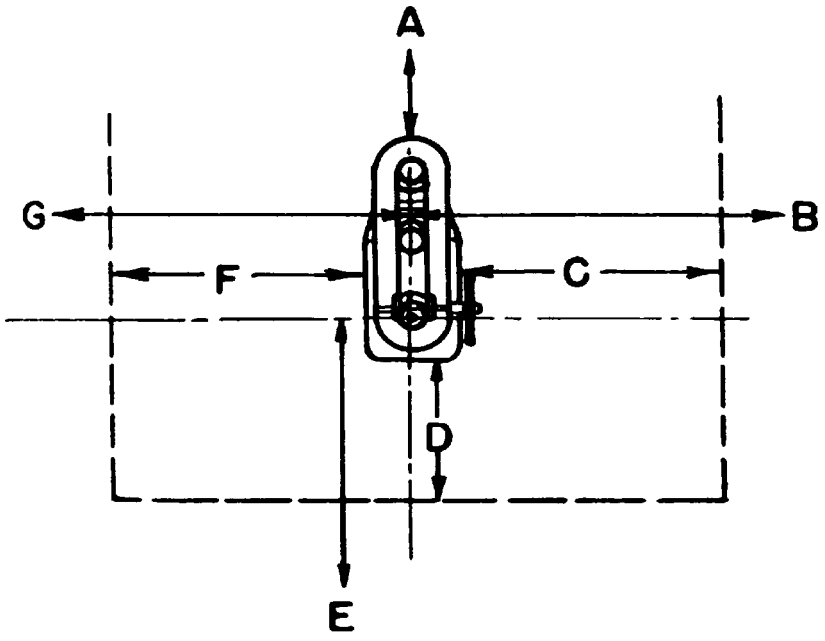
Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much



HORIZONTAL MILL

A = 2 ft.
B = Limit of table travel + 2 feet
C = 36 in.

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Moderate	Much	Very Much

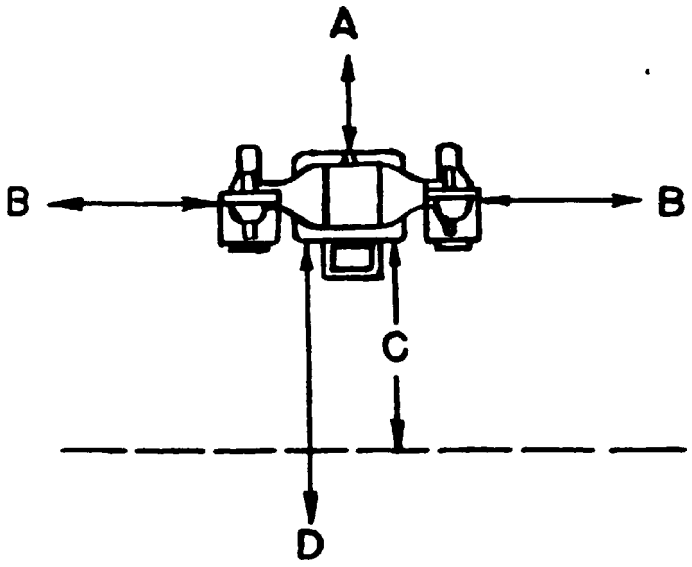


DRILL PRESS

A = 12 in.
B = 4 ft.
C = 36 in.
D = 36 in.
E = 4 ft.
F = 36 in.
G = 4 ft.

[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

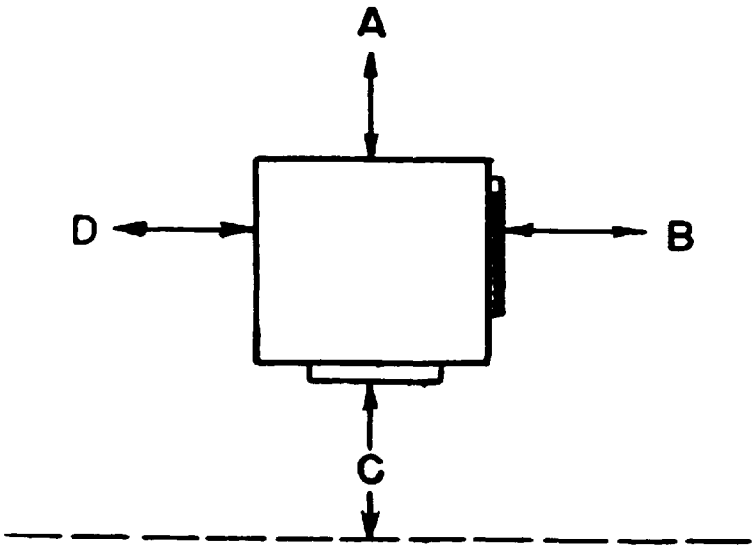


FLOOR GRINDER

A = 6 in.
B = 24 in.
C = 36 in.
D = 4 ft.

[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much

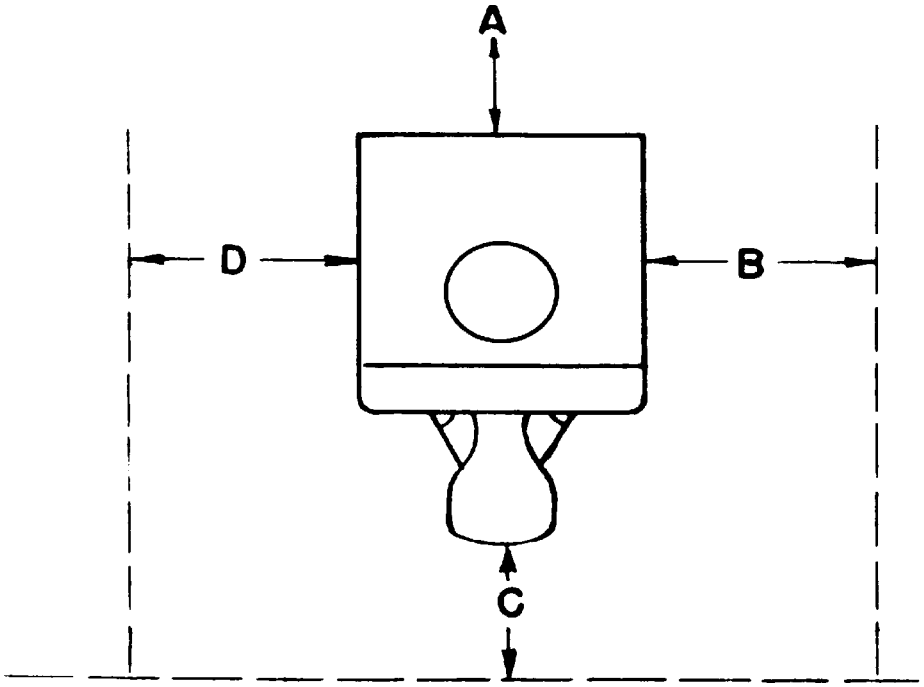


CERAMIC KILM

A,B,D = 2 ft.
C = 4 ft.

[ ][ ][ ][ ][ ]

Work Station Area	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Moderate	Much	Very Much



POTTERS WHEEL

A = 12 in.
B = 36 in.

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
VISUAL-COMFORT DETAILS		
Window area in laboratory	Approx. 25%	[ ][ ][ ][ ][ ]
Window arrangement	Bilateral; either windows on both walls, or clerestory on one wall	[ ][ ][ ][ ][ ]
Height of window tops	Ceiling height	[ ][ ][ ][ ][ ]
Window glass in laboratory	Clear glass	[ ][ ][ ][ ][ ]
Control of natural light	Light-colored, diffusing shades	[ ][ ][ ][ ][ ]
Artificial light source	Fluorescent	[ ][ ][ ][ ][ ]
General lighting system	Semidirect (25% upward, 75% down)	[ ][ ][ ][ ][ ]
Light-reflection value of ceiling	Minimum, 80% Maximum, 90%	[ ][ ][ ][ ][ ]
Light-reflection value of wall	Minimum, 50% Maximum. 70%	[ ][ ][ ][ ][ ]
Light-reflection value of wainscoting	Minimum, 30% Maximum, 50%	[ ][ ][ ][ ][ ]
Light-reflection value of work bench tops	Minimum, 30% Maximum, 50%	[ ][ ][ ][ ][ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
VISUAL-COMFORT DETAILS (Continued)		
Light-reflection values of furniture	Minimum, 30% Maximum, 50%	[ ][ ][ ][ ][ ]
Light-reflection value of trim and doors	Minimum, 30% Maximum, 50%	[ ][ ][ ][ ][ ]
Light-reflection value of chalkboard	Minimum, 15% Maximum, 25%	[ ][ ][ ][ ][ ]
Light-reflection value of tackboard	Minimum, 50% Maximum, 60%	[ ][ ][ ][ ][ ]
Light-reflection value of machinery	Minimum, 30% Maximum, 50%	[ ][ ][ ][ ][ ]
Light-reflection value of floor	Minimum, 20% Maximum 30%	[ ][ ][ ][ ][ ]
Illumination level in service at following work stations:		
Wood bench	50 ft-c	[ ][ ][ ][ ][ ]
Wood lathe	50 ft-c	[ ][ ][ ][ ][ ]
Jointer	30 ft-c	[ ][ ][ ][ ][ ]
Circular Saw	30 ft-c	[ ][ ][ ][ ][ ]
Band saw	50 ft-c	[ ][ ][ ][ ][ ]
Jig saw	50 ft-c	[ ][ ][ ][ ][ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory: Very Little	Little	Moderate	Much	Very Much
VISUAL-COMFORT DETAILS (Continued)						
Sander	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Mach. shop bench	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Power saw	40 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Drill press	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Metal lathe	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Shaper	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Miller	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Floor grinder	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Ceramics bench	40 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Potter's wheel	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Sheet metal bench	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Bending and forming machines	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Punching and shearing machines	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Drafting table	50 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
Reference work	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]
General illumination level in service 30 inches from floor	30 ft-c	[ ]	[ ]	[ ]	[ ]	[ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory: Very Little	Little	Moderate	Much	Very Much
AUDITORY-COMFORT DETAILS						
Sound-absorbing value of ceiling	50% to 70%	[ ]	[ ]	[ ]	[ ]	[ ]
Sound-absorbing value of walls	30% to 60%	[ ]	[ ]	[ ]	[ ]	[ ]
PLUMBING DETAILS						
Drinking fountains	One per 25 pupils	[ ]	[ ]	[ ]	[ ]	[ ]
Washing facilities	One station per 10 pupils	[ ]	[ ]	[ ]	[ ]	[ ]
Work (slop) sinks	One per area of activity	[ ]	[ ]	[ ]	[ ]	[ ]
Automatic Sprinkler system in following areas	Shop proper	[ ]	[ ]	[ ]	[ ]	[ ]
	Storage rooms	[ ]	[ ]	[ ]	[ ]	[ ]
	Tool crib	[ ]	[ ]	[ ]	[ ]	[ ]
	Finishing room	[ ]	[ ]	[ ]	[ ]	[ ]
Location of air compressor unit	Outside of laboratory proper	[ ]	[ ]	[ ]	[ ]	[ ]
Distribution of air outlets	20 ft. intervals on wall	[ ]	[ ]	[ ]	[ ]	[ ]
Distribution of gas outlets	20 ft. intervals on wall	[ ]	[ ]	[ ]	[ ]	[ ]
HEATING AND VENTILATING DETAILS						
Minimum quantity of air per pupil supplied by ventilating system	15 cu.ft./min.	[ ]	[ ]	[ ]	[ ]	[ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
HEATING AND VENTILATING DETAILS (Continued)		
Fresh outdoor air included in air circulated	25% to 35% of total air	[ ][ ][ ][ ][ ]
Air velocity past occupant during heating season	25 lineal ft./min.	[ ][ ][ ][ ][ ]
Air velocity past occupant during cooling season (outside air)	85 lineal ft./min.	[ ][ ][ ][ ][ ]
Ventilating system used in the laboratory	Mechanical, either integral or separate part of main plant	[ ][ ][ ][ ][ ]
Relative humidity of laboratory	Winter, 40 Summer, 50	[ ][ ][ ][ ][ ]
Relative humidity of storage area	40	[ ][ ][ ][ ][ ]
Temperature of laboratory, 60 in. from floor	68 degrees	[ ][ ][ ][ ][ ]
Heating system used in laboratory	Wall-unit ventilators with fan, or split system (forced warm air and convectors), or radiant panel	[ ][ ][ ][ ][ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory: Very Little	Little	Moderate	Much	Very Much
HEATING AND VENTILATING DETAILS (Continued)						
Temperature controls	Automatic, room control	[ ]	[ ]	[ ]	[ ]	[ ]
Location of radiators (if used)	Floor level, against wall or recessed in wall	[ ]	[ ]	[ ]	[ ]	[ ]
Installation of exhaust system	Each area served by separate system	[ ]	[ ]	[ ]	[ ]	[ ]
Installation of exhaust system ducts	Overhead	[ ]	[ ]	[ ]	[ ]	[ ]
ELECTRICAL CIRCUIT DETAILS						
Power-circuit system	Three-wire, three phase	[ ]	[ ]	[ ]	[ ]	[ ]
Branch power circuits	One per machine	[ ]	[ ]	[ ]	[ ]	[ ]
Spare power circuits	One for every 4 active circuits	[ ]	[ ]	[ ]	[ ]	[ ]
Overload protection on power circuits	Circuit breakers	[ ]	[ ]	[ ]	[ ]	[ ]
Raceway system for power circuits	Wireways	[ ]	[ ]	[ ]	[ ]	[ ]
Installation of power-circuit raceways	Exposed on ceiling	[ ]	[ ]	[ ]	[ ]	[ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory Very Little / Little / Moderate / Much / Very Much
ELECTRICAL CIRCUIT DETAILS (Continued)		
Installation of light-circuit raceways	Concealed in ceiling	[ ][ ][ ][ ][ ]
Spare light circuits	One for every 5 active circuits	[ ][ ][ ][ ][ ]
Overload protection for light circuits	Circuit breakers	[ ][ ][ ][ ][ ]
Convenience outlets	Installed on walls at intervals of 10 feet	[ ][ ][ ][ ][ ]
Spare circuits for outlets	One spare for every four outlets	[ ][ ][ ][ ][ ]
Power cut-out safety buttons	Installed on wall at intervals of 15 or 20 feet	[ ][ ][ ][ ][ ]
Fire-alarm system	Integral part of main system	[ ][ ][ ][ ][ ]
	Alarm sounding station in the laboratory	[ ][ ][ ][ ][ ]
MISCELLANEOUS		
Fire-extinguishing agents for the laboratory	Fire blanket	[ ][ ][ ][ ][ ]
First-aid cabinet supplies	1" bandage roll	[ ][ ][ ][ ][ ]
	2" bandage roll	[ ][ ][ ][ ][ ]
	3" bandage roll	[ ][ ][ ][ ][ ]

Facility	Standard	Relative Contribution of the Standard to a Functional Laboratory				
		Very Little	Little	Mod-erate	Much	Very Much
MISCELLANEOUS (Continued)						
	Gauze	[ ]	[ ]	[ ]	[ ]	[ ]
	Cotton	[ ]	[ ]	[ ]	[ ]	[ ]
	Waterproof adhesive	[ ]	[ ]	[ ]	[ ]	[ ]
	Mercurochrome	[ ]	[ ]	[ ]	[ ]	[ ]
	Aromatic ammonia	[ ]	[ ]	[ ]	[ ]	[ ]
	Analgesic balm	[ ]	[ ]	[ ]	[ ]	[ ]
	Scissors	[ ]	[ ]	[ ]	[ ]	[ ]
	Tweezers	[ ]	[ ]	[ ]	[ ]	[ ]
	Cotton-wound applicators	[ ]	[ ]	[ ]	[ ]	[ ]
	Steripads	[ ]	[ ]	[ ]	[ ]	[ ]
	Waterproof Band-aids	[ ]	[ ]	[ ]	[ ]	[ ]
	Buckle tournequet	[ ]	[ ]	[ ]	[ ]	[ ]
	Boric-acid solution	[ ]	[ ]	[ ]	[ ]	[ ]



APPENDIX III

TABLE VI

DISTRIBUTION OF THE SELECTIONS BY THE JURORS OF THE OPTIMAL STANDARDS FOR THE VARIOUS STANDARDS FOR THE FACILITIES

Facilities	Standards	Frequency of Selections
Location of the laboratory with regard to main plant	Front corridor of main plant	0
	Wing of main plant	4-1/2[a]
	Separate building attached to main plant	1
	Separate building	2-1/2
Location of the laboratory with regard to grade (ground) level	First floor	9
	Few feet above grade level	1
	Few feet below grade level	0
Minimum ceiling height	12 feet	6
	14 feet	3
	16 feet	0
	18 feet	1
Minimum width of laboratory	22 feet	0
	24 feet	1
	26 feet	1
	28 feet	1
	30 feet	4
	32 feet	2
	34 feet	1
	36 feet	0
	38 feet	0
	40 feet	0

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Minimum ratio of width to length	1 x 1	0
	1 x 1-1/2	7
	1 x 2	2
	1 x 2-1/2	0
Maximum ratio of width to length	1 x 2	8
	1 x 2-1/2	1
	1 x 3	0
	1 x 3-1/2	0
Minimum floor area per pupil	35	0
	40	0
	45	0
	50	2
	55	3
	60	2
	65	0
	70	1
	75	1
Floor material in woodworking area	Wood	9
	Concrete	0
	Asphalt tile	2
	Linoleum	0
Floor material in sheet-metal area	Wood	6
	Concrete	3
	Linoleum	1
	Asphalt tile	0
Floor material in machine-shop area	Wood	4
	Concrete	6
	Linoleum	0
	Asphalt tile	1
Floor material in ceramics area	Wood	5
	Concrete	4
	Linoleum	1
	Asphalt tile	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Floor material in drafting area	Wood	8-1/2
	Concrete	0
	Linoleum	1-1/2
	Asphalt tile	1
Width of corridor door to laboratory	30 inches	½
	60 inches	6
Width of service door to laboratory	30 inches	0
	60 inches	1
	96 inches	8
	120 inches	2
Type of service door	Overhead	9
	Sliding	0
	Swing type	2
Type of hardware on all doors except service	Panic hardware	4
	Standard	1
Construction material of movable partitions[b]	Wood	4
	Metal	7
	Concrete	1/2
	Brick or block	3-1/2
Wall finish to the height of wainscoting (dado)[b]	Wood	0
	Hard plaster, painted	6
	Linoleum	1
	Glazed material	6
Height of wainscoting (dado)	Three feet	1
	Four feet	6
	Five feet	1
	Six feet	0
	Seven feet	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Distance from floor to window sill	Three feet	3
	Four feet	7
	Five feet	0
	Six feet	0
Location of waste storage	In each work area of laboratory	7
	Centrally located in laboratory	3
	Outside of laboratory . .	0
Total space for waste storage	50 cu. feet (3 x 4 x 4) .	4
	100 cu. feet (4 x 4 x 6).	5
	150 cu. feet (4 x 4 x 10)	1
	200 cu. feet (4 x 4 x 12)	0
Total space for pupil property (approximately)	150 cu. feet	5
	200 cu. feet	4
	250 cu. feet	2
	300 cu. feet	0
Location of assembly area	Distinct and apart from all other work areas in laboratory	2
	Flexible, serving more than one activity when necessary	8
Space available for assembly center (approximately)	5% of the total shop . . .	1
	10% of the total shop . .	8
	15% of the total shop . .	0
	20% of the total shop . .	0
Location of display area	Located near the entrance	6
	Located in each of the areas of activity . . .	1/2
	Centrally located in laboratory	0
	Located outside the laboratory	4-1/2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Total space for display purpose (approximately)	10 cu. feet (1 x 2 x 5) .	0
	15 cu. feet (1 x 3 x 5) .	1
	20 cu. feet (1 x 3 x 7) .	2
	30 cu. feet (1 x 4 x 8) .	8
Area of finishing room (approximately)	5% of total laboratory .	7
	10% of total laboratory .	3
	15% of total laboratory .	1
Instructor's area (office) (approximately)	35 sq. feet (5 x 7)	4
	50 sq. feet (6 x 8)	1
	65 sq. feet (8 x 8)	3
	80 sq. feet (8 x 10) . . .	2
Location of instructor's area	Near entrance of the laboratory	7
	Middle of long wall . . .	2
	Center of floor area . . .	1
Location of open areas (check those that apply)	Entrance way	11
	Before tool cribs and/or panels	11
	Washing facilities	11
	Drinking fountain	9
	Instructor's area	6
Location of visual-aids area	Apart from all other areas (separate room)	2
	In any area of the laboratory	1-1/2
	Combined with planning center	7-1/2
Capacity of the visual-aids area	Total class	10
	50% of class	0
	25% of class	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Location of supply and material storage	Within the shop	4-1/2
	Outside the shop	2
	Centrally located for several shops	4-1/2
Space for supply and material storage	500 cu. feet (5 x 10 x 10)	0
	1,000 cu. feet (7 x 10 x 14)	6
	1,500 cu. feet (7 x 10 x 20)	3
	2,000 cu. feet (7 x 10 x 25)	0
	2,500 cu. feet (7 x 10 x 36)	2
Space for equipment storage	200 cu. feet (2 x 7 x 15)	2
	300 cu. feet (2 x 7 x 22)	5
	400 cu. feet (2 x 7 x 28)	3
	500 cu. feet (2 x 7 x 36)	1
Space for large project storage	200 cu. feet (4 x 7 x 7)	5
	250 cu. feet (4 x 7 x 9)	0
	300 cu. feet (4 x 7 x 11)	3
	350 cu. feet (4 x 7 x 13)	3
Location of wardrobe	Near entrance to laboratory	7
	Within each work area .	1
	Centrally located laboratory	3
Space for wardrobe (approximately)	50 cu. feet (1 x 5 x 10)	3
	100 cu. feet (1 x 6 x 16)	4
	150 cu. feet (1 x 6 x 25)	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Chalkboard area (sq. ft.)	15	1
	20	3
	25	0
	30	1
	35	2
	40	2
	Others, specified	
	60	1
Tackboard area (sq. ft.)	10 feet	1
	15 feet	0
	20 feet	3
	25 feet	2
	30 feet	5
Area of planning center	Centrally along one wall	4
	With reference to the corridor entrance	2
	With reference to the noise in the laboratory	3
Width of main aisles of travel	3 feet	0
	4 feet	7
	5 feet	2
	6 feet	0
Clearance dimensions for all bench	Clearance A	
	12 inches	0
	18 inches	2
	24 inches	4
	30 inches	3
	36 inches	0
	Clearance B	
	12 inches	0
	18 inches	2
	24 inches	2
	30 inches	3

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	36	1
	Others, specified	
	20	1
	Clearance C	
	24 inches	1
	30 inches	1
	36 inches	5
	42 inches	3
	48 inches	0
Clearance dimensions for floor bench	Clearance A & B	
	24 inches	1
	30 inches	1
	36 inches	4
	42 inches	3
	48 inches	1
Clearance dimensions for wood lathe	Clearance A	
	0 inches	0
	6 inches	3
	12 inches	3
	18 inches	3
	24 inches	0
	Others, specified	
	30 inches	1
	Clearance B	
	0 inches	1
	6 inches	2
	12 inches	3
	18 inches	1
	24 inches	3
	Clearance C	
	24 inches	1
	30 inches	3
	36 inches	2
	42 inches	2
	48 inches	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance D	
	0 inches	0
	6 inches	0
	12 inches	3
	18 inches	0
	24 inches	5
Clearance dimensions for circular saw	Clearance A	
	(No obstructions)	
	8 feet	2
	10 feet	2
	12 feet	2
	14 feet	2
	Others, specified	
	16 feet	1
	Clearance B	
	(No obstructions up to)	
	4 feet	3
	6 feet	1
	8 feet	2
	10 feet	3
	Clearance C	
	24 inches	0
	30 inches	2
	36 inches	3
	42 inches	0
	48 inches	4
	Clearance D	
	12 feet	3
	14 feet	0
	16 feet	0
	Always keep clear due to kickback	4

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance E	
	24 inches	2
	30 inches	0
	36 inches	3
	42 inches	1
	48 inches	3
	Clearance F (No obstructions)	
	4 feet	1
	6 feet	1
	8 feet	3
	10 feet	3
	12 feet	1
Clearance dimensions for jointer	Clearance A (No obstructions)	
	8 feet	4
	10 feet	3
	12 feet	1
	14 feet	1
	Clearance B	
	0 inches	0
	6 inches	2
	12 inches	5
	Clearance C	
	18 inches	0
	24 inches	1
	30 inches	1
	36 inches	3
	42 inches	3
	Clearance D (No obstructions)	
	8 feet	2
	10 feet	4

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	12 feet	2
	14 feet	1
	Clearance E	
	18 inches	0
	24 inches	1
	30 inches	2
	36 inches	2
	42 inches	3
	Others (48)	1
	Clearance F	
	(No obstructions)	
	Same as E	1
	4 feet	2
	6 feet	3
	8 feet	1
	10 feet	2
Clearance dimensions for wood planer	Clearance A	
	24 inches	0
	30 inches	2
	36 inches	3
	42 inches	0
	48 inches	3
	Others	
	12 inches	1
	Clearance B	
	(No obstructions)	
	8 feet	1
	10 feet	1
	12 feet	5
	14 feet	0
	16 feet	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance C	
	0 inches	0
	6 inches	0
	12 inches	5
	Others	
	24 inches	1
	Clearance D	
	24 inches	0
	30 inches	2
	36 inches	3
	42 inches	1
	48 inches	2
	Others	
	12 inches	1
	Clearance E	
	(No obstructions)	
	8 feet	1
	10 feet	0
	12 feet	6
	14 feet	0
	16 feet	2
	Clearance F	
	24 inches	1
	30 inches	2
	36 inches	2
	42 inches	1
	48 inches	3
Clearance dimensions for band saw	Clearance A	
	0 inches	1
	6 inches	1
	12 inches	8

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance B	
	(No obstructions)	
	6 feet	2
	8 feet	4
	10 feet	2
	12 feet	1
	Clearance C	
	(No obstructions)	
	6 feet	5
	8 feet	2
	10 feet	2
	12 feet	0
	Clearance D	
	24 inches	0
	30 inches	1
	36 inches	4
	42 inches	2
	48 inches	2
	Clearance E	
	(No obstructions)	
	6 feet	2
	8 feet	2
	10 feet	5
	12 feet	2
	Clearance F	
	24 inches	0
	30 inches	1
	36 inches	5
	42 inches	1
	48 inches	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Clearance dimensions for band saw	Clearance A	
	0 inches	1
	6 inches	1
	12 inches	8
	Clearance B	
	(No obstructions)	
	6 feet	2
	8 feet	4
	10 feet	2
	12 feet	1
	Clearance C	
	(No obstructions)	
	6 feet	5
	8 feet	2
	10 feet	2
	12 feet	0
	Clearance D	
	24 inches	0
	30 inches	1
	36 inches	4
	42 inches	2
	48 inches	2
	Clearance E	
	(No obstructions)	
	6 feet	2
	8 feet	2
	10 feet	5
	12 feet	2
	Clearance F	
	24 inches	0
	30 inches	1
	36 inches	5
	42 inches	1
	48 inches	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Clearance dimensions for jig saw	Clearance A	
	0 inches	2
	6 inches	3
	12 inches	5
	Others, specified	
	18 inches	1
	Clearance B	
	24 inches	1
	30 inches	2
	36 inches	5
	42 inches	1
	48 inches	1
	Clearance C	
	24 inches	1
	30 inches	0
	36 inches	6
	42 inches	1
	48 inches	2
	Clearance D	
	24 inches	1
	30 inches	2
	36 inches	5
	42 inches	1
	48 inches	1
Clearance dimensions for metal lathe	Clearance A	
	0 inches	1
	6 inches	2
	12 inches	6
	Others, specified	
	30 inches	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance B	
	0 inches	1
	6 inches	0
	12 inches	8
	Others, specified	
	24 inches	1
	Clearance C	
	24 inches	1
	30 inches	1
	36 inches	3
	42 inches	3
	48 inches	1
	Clearance D	
	(No obstructions)	
	2 feet	4
	4 feet	4
	6 feet	1
	8 feet	1
	10 feet	0
Clearance dimensions for metal shaper	Clearance A	
	Back limit of ram	0
	Back limit of ram plus one foot	5
	Back limit of ram plus two feet	4
	Back limit of ram plus three feet	2
	Clearance B	
	24 inches	1
	30 inches	2
	36 inches	4
	42 inches	2
	48 inches	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance C	
	24 inches	0
	30 inches	1
	36 inches	4
	42 inches	3
	48 inches	1
	Clearance D	
	Same as C	5
	6 feet	2
	8 feet	1
	10 feet	1
	Clearance E	
	24 inches	1
	30 inches	3
	36 inches	3
	42 inches	0
	48 inches	2
Clearance dimensions for horizontal mill	Clearance A (No obstructions)	
	2 feet	9
	4 feet	0
	6 feet	0
	Clearance B	
	Limit of table travel . .	0
	Limit of table travel plus one foot	3
	Limit of table travel plus two feet	3
	Limit of table travel plus three feet	3

TABLE VI--Continued

	Clearance C	
	24 inches	0
	30 inches	1
	36 inches	4
	42 inches	2
	48 inches	2
Clearance dimensions for power hack saw	Clearance A (No obstructions)	
	12 feet	4
	14 feet	4
	16 feet	2
	Clearance B	
	4 feet	1
	5 feet	1
	6 feet	8
	Clearance C	
	24 inches	0
	30 inches	2
	36 inches	4
	42 inches	1
	48 inches	2
	Clearance D	
	24 inches	0
	30 inches	1
	36 inches	6
	42 inches	1
	48 inches	2
Clearance dimensions for drill press	Clearance A	
	0 inches	1
	6 inches	3
	12 inches	5
	Clearance B, E, G (No obstructions)	
	3 feet	0
	4 feet	5
	5 feet	2
	6 feet	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance C, D, F	
	24 inches	0
	30 inches	2
	36 inches	4
	42 inches	2
	48 inches	1
Clearance dimensions for floor grinder	Clearance A	
	0 inches	0
	6 inches	5
	12 inches	4
	Clearance B	
	0 inches	0
	6 inches	0
	12 inches	0
	18 inches	1
	24 inches	4
	36 inches	4
	Clearance C	
	24 inches	0
	30 inches	1
	36 inches	6
	42 inches	1
	48 inches	1
	Clearance D	
	Same as C	1
	3 feet	0
	4 feet	5
	5 feet	0
	6 feet	2
Clearance dimensions for ceramic kiln	Clearance A, B, D	
	1 foot	3
	2 feet	2
	3 feet	3
	4 feet	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Clearance C	
	2 feet	0
	3 feet	4
	4 feet	2
	5 feet	3
Clearance dimensions for potter's wheel	Clearance A	
	0 inches	2
	6 inches	2
	12 inches	3
	18 inches	1
	24 inches	1
	Clearance B, C, D	
	24 inches	2
	30 inches	2
	36 inches	3
	42 inches	1
	48 inches	1
Window area[b]	20% of floor area	3
	25% of floor area	5
	30% of floor area	0
	35% of floor area	2
	Others (As much as can be controlled)	1
Source of natural lighting[b]	Unilateral (windows on one wall)	3
	Unilateral (windows on one wall in addition to clerestory)	1-1/2
	Bilateral (windows on opposite walls)	4-1/2
	Bilateral (clerestory windows on one side).	4-1/2
	Saw-tooth lighting	2-1/2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Height of window tops	One-half width of laboratory	0
	Ceiling height	3
	Governed by window area required	2
	Others specified	
	6 feet	1
	7 feet	1
Window glass for laboratory[b]	Clear glass	7-1/2
	Light diffusing	0
	Light diffusing with vision strip	0
	Light directional	1/2
	Light directional with vision strip	1
Natural-light control[b]	Light colored, diffusing, translucent shades	3-1/2
	Venetian blinds	1-1/2
	Fiber glass diffusing screens of 60% transmission	1
	Light diffusing glass	1/2
	Light directional glass	2-1/2
Artificial light source	Incandescent	0
	Fluorescent	5
	Cold cathode	0
	Incandescent and fluorescent	3
General lighting system used in the laboratory[b]	Indirect (90-100% upward, 10-0% downward)	0
	Semi-indirect (60-90%, 40-10% downward)	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	General diffuse (40-60% upward, 60-40% downward)	6
	Semi-direct (10-40% upward, 90-60% downward)	8
	Direct (0-10% upward, 100-90% downward) .	0
Minimum light reflection value of the ceiling	65%	0
	70%	3
	75%	0
	80%	6
Maximum light reflection value of ceiling	75%	0
	80%	0
	85%	3
	90%	4
Minimum light reflection values of walls	40%	0
	45%	0
	50%	6
	55%	1
	60%	2
Maximum light reflection values of walls	55%	0
	60%	0
	65%	2
	70%	3
	75%	3
Minimum light reflection values of wainscoting	25%	0
	30%	5
	35%	2
	40%	2
	45%	0

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Maximum light reflection values of wainscoting	35%	0
	40%	1
	45%	2
	50%	5
	55%	2
Minimum light reflection values of work bench tops	25%	1
	30%	5
	35%	2
	40%	1
	45%	1
Maximum light reflection values of work bench tops	40%	2
	45%	2
	50%	2
	55%	0
	60%	4
Minimum light reflection values of furniture	25%	1
	30%	4
	35%	1
	40%	2
	45%	1
Maximum light reflection values of furniture	40%	2
	45%	1
	50%	2
	55%	1
	60%	3
Minimum light reflection values of trim and doors	25%	1
	30%	5
	35%	1
	40%	1
	45%	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Maximum light reflection values of trim and doors	40%	2
	45%	2
	50%	2
	55%	1
	60%	2
Minimum light reflection values of chalkboard	5%	1
	10%	2
	15%	3
	20%	2
Maximum light reflection values of chalkboard	15%	0
	20%	2
	25%	2
	30%	3
	Others, specified	
	10%	1
	80%	1
Minimum light reflection values of tackboard	40%	2
	45%	1
	50%	5
	55%	1
	60%	0
Maximum light reflection values of tackboard	50%	0
	55%	1
	60%	4
	65%	1
	70%	3
Minimum light reflection values of machinery	25%	2
	30%	4
	35%	2
	40%	1
	45%	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Maximum light reflection values of machinery	40%	2
	45%	2
	50%	3
	55%	0
	60%	3
Minimum light reflection values of laboratory floor	5%	0
	10%	0
	15%	4
	20%	2
	25%	3
	Others, specified	
	30%	1
Maximum light reflection values of laboratory floor	20%	0
	25%	0
	30%	6
	35%	1
	40%	1
Illumination level at wood bench	10 foot candles	0
	20 foot candles	0
	30 foot candles	5
	40 foot candles	0
	50 foot candles	4
	60 foot candles	0
	70 foot candles	1
	80 foot candles	1
	90 foot candles	0
Illumination level at wood lathe	10 foot candles	0
	20 foot candles	0
	30 foot candles	5
	40 foot candles	0
	50 foot candles	3
	60 foot candles	0
	70 foot candles	0
	80 foot candles	2
	90 foot candles	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Illumination level at jointer	10 foot candles	0
	20 foot candles	0
	30 foot candles	6
	40 foot candles	2
	50 foot candles	1
	60 foot candles	1
	70 foot candles	0
	80 foot candles	1
	90 foot candles	0
Illumination level at circular saw	10 foot candles	0
	20 foot candles	0
	30 foot candles	7
	40 foot candles	1
	50 foot candles	1
	60 foot candles	0
	70 foot candles	0
	80 foot candles	2
	90 foot candles	0
Illumination level at band saw	10 foot candles	0
	20 foot candles	0
	30 foot candles	4
	40 foot candles	1
	50 foot candles	3
	60 foot candles	0
	70 foot candles	1
	80 foot candles	1
	90 foot candles	1
Illumination level at jig saw	10 foot candles	0
	20 foot candles	0
	30 foot candles	5
	40 foot candles	0
	50 foot candles	3
	60 foot candles	0
	70 foot candles	1
	80 foot candles	0
	90 foot candles	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Illumination level at sander	10 foot candles	0
	20 foot candles	0
	30 foot candles	6
	40 foot candles	1
	50 foot candles	3
	60 foot candles	0
	70 foot candles	0
	80 foot candles	0
	90 foot candles	1
Illumination level at machine bench	10 foot candles	0
	20 foot candles	0
	30 foot candles	4
	40 foot candles	1
	50 foot candles	4
	60 foot candles	0
	70 foot candles	1
	80 foot candles	1
	90 foot candles	0
Illumination level at power saw	10 foot candles	0
	20 foot candles	0
	30 foot candles	5
	40 foot candles	2
	50 foot candles	2
	60 foot candles	0
	70 foot candles	0
	80 foot candles	2
	90 foot candles	0
Illumination level at drill press	10 foot candles	0
	20 foot candles	0
	30 foot candles	4
	40 foot candles	1
	50 foot candles	2
	60 foot candles	1
	70 foot candles	1
	80 foot candles	1
	90 foot candles	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Illumination level at metal lathe	10 foot candles	0
	20 foot candles	0
	30 foot candles	4
	40 foot candles	1
	50 foot candles	2
	60 foot candles	1
	70 foot candles	0
	80 foot candles	2
	90 foot candles	1
Illumination level at shaper	10 foot candles	0
	20 foot candles	0
	30 foot candles	5
	40 foot candles	0
	50 foot candles	2
	60 foot candles	1
	70 foot candles	0
	80 foot candles	2
	90 foot candles	1
Illumination level at miller	10 foot candles	0
	20 foot candles	0
	30 foot candles	3
	40 foot candles	2
	50 foot candles	1
	60 foot candles	2
	70 foot candles	1
	80 foot candles	1
	90 foot candles	1
Illumination level at floor grinder	10 foot candles	0
	20 foot candles	0
	30 foot candles	3
	40 foot candles	1
	50 foot candles	2
	60 foot candles	2
	70 foot candles	1
	80 foot candles	1
	90 foot candles	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Illumination level at ceramic bench	10 foot candles	0
	20 foot candles	0
	30 foot candles	5
	40 foot candles	2
	50 foot candles	3
	60 foot candles	0
	70 foot candles	0
	80 foot candles	1
	90 foot candles	0
Illumination level at potter's wheel	10 foot candles	0
	20 foot candles	0
	30 foot candles	7
	40 foot candles	2
	50 foot candles	1
	60 foot candles	0
	70 foot candles	0
	80 foot candles	1
	90 foot candles	0
Illumination level at sheet-metal bench	10 foot candles	0
	20 foot candles	0
	30 foot candles	6
	40 foot candles	0
	50 foot candles	3
	60 foot candles	0
	70 foot candles	1
	80 foot candles	1
	90 foot candles	0
Illumination level at bending and forming machines	10 foot candles	0
	20 foot candles	0
	30 foot candles	6
	40 foot candles	1
	50 foot candles	2
	60 foot candles	1
	70 foot candles	0
	80 foot candles	1
	90 foot candles	0

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Illumination level at punching and shearing machines	10 foot candles	0
	20 foot candles	0
	30 foot candles	7
	40 foot candles	0
	50 foot candles	2
	60 foot candles	0
	70 foot candles	0
	80 foot candles	2
	90 foot candles	0
Illumination level at drafting table	10 foot candles	0
	20 foot candles	0
	30 foot candles	1
	40 foot candles	1
	50 foot candles	5
	60 foot candles	2
	70 foot candles	0
	80 foot candles	1
	90 foot candles	1
Illumination level at reference work (library)	10 foot candles	0
	20 foot candles	0
	30 foot candles	9
	40 foot candles	1
	50 foot candles	1
	60 foot candles	0
	70 foot candles	0
	80 foot candles	0
	90 foot candles	0
General illumination level of laboratory 30 inches from floor	20 foot candles	0
	30 foot candles	8
	40 foot candles	1
	50 foot candles	2
	60 foot candles	0
	70 foot candles	0

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Minimum sound absorbing values of ceiling	30%	1
	40%	2
	50%	3
	60%	0
	Others, specified	
	80%	1
Maximum sound absorbing values of ceiling	50%	1
	60%	2
	70%	2
	80%	1
	Others, specified	
	90%	1
Minimum sound absorbing values of wall above wainscoting	30%	4
	40%	1
	50%	1
	60%	0
	Others, specified	
	80%	1
Maximum sound absorbing values of wall above wainscoting	50%	3
	60%	0
	70%	1
	80%	1
	Others, specified	
	90%	1
Drinking fountain for every	10 pupils	2
	15 pupils	0
	20 pupils	2
	25 pupils	5
	30 pupils	2
One wash station per	5 pupils	2
	7 pupils	1
	10 pupils	8
	12 pupils	0
	15 pupils	0

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
One work sink (slop sink) for every	Area of activity	6
	Two areas of activity	2
	Three areas of activity	1
	Others, specified	
	Whole shop	1
Location of automatic sprinkler system (check areas that apply)	Shop proper	8
	Storage rooms	8
	Tool crib	6
	Finishing room	8
	None	1
Location of air compressor unit	Outside of the laboratory proper	7
	Inside the laboratory proper	4
Distribution of compressed air outlets	15 feet on walls	3
	20 feet on walls	6
	25 feet on walls	1
	Others, specified	
	Where needed	1
Distribution of gas outlets	15 feet	3
	20 feet	4
	25 feet	1
	In each area	2
Power-circuit wiring system[b]	Two-wire - (115 volts)	0
	Three-wire, single-phase	2-1/2
	Three-wire, three-phase	9
	Four-wire, three-phase	4-1/2
Branch power-circuit for every[b]	Machine	11
	Two machines	3
	Three machines	2
	Four machines	1

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
One spare circuit for every[b]	4 active circuit	6
	5 active circuit	5
	6 active circuit	0
	7 active circuit	0
Protection of power-circuits	Circuit breakers	7
	Plug-fuses	0
Type of raceway system for power circuits	Rigid metal conduit ...	1/2
	Electrical metallic tubing	1-1/2
	Wireways	3
	Busways	1
Installation of power-circuit raceways	Concealed in floor	0
	Concealed in ceiling ...	0
	Exposed on ceiling	4
	Exposed on wall	0
	Exposed overhead, but not on ceiling	2
Installation of light-circuit raceways	Concealed in ceiling ...	3
	Exposed on ceiling	1
	Exposed overhead, but not on ceiling	1
One spare light circuit for every[b]	4 active circuits	2
	5 active circuits	6
	6 active circuits	3
	7 active circuits	2
Protection of light circuits	Circuit breakers	7
	Plug-fuses	0
Installation of convenience outlets	Five feet	2
	Ten feet	5
	Fifteen feet	1
	Twenty feet	2

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Separate circuit for every[b]	Four convenience outlets	10
	Five convenience outlets	0
	Six convenience outlets .	3
	Seven convenience outlets	1
	Eight convenience outlets	0
Installation of power-safety buttons	10 feet	1
	15 feet	2
	20 feet	2
	25 feet	2
	Others, specified Strategic points	1
The fire-alarm system (check those that apply)	Integral part of the main fire alarm system . .	8
	Independent of the main fire alarm system . .	0
	Have an alarm sounding station in the laboratory	6
	Separate and distinct from all call and program systems	1
Fire extinguishing agents (check those that apply)	Water and water fog . . .	5
	Water and foam	3
	Water, soda, and acid . .	3
	Fire blanket	9
	Carbon dioxide gas and water	3
	Carbon dioxide gas	4
	Vaporizing liquid (carbon tetrachloride)	9
	Sand & dry chemical powders	5

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
First aid cabinet contents (check those that apply)	1" Bandage roll	11
	2" Bandage roll	9
	3" Bandage roll	9
	Gauze	10
	Cotton	10
	Waterproof adhesive	10
	Iodine	5
	Mercurochrome	8
	Aromatic Ammonia	9
	Analgesic balm	6
	Joncolia	0
	Castor oil	1
	Tongue depressors	3
	Scissors	11
	Tweezers	10
	Cotton wound applicators	9
	Steripads	10
	Waterproof band-aids	11
	Buckle tourniquet	8
	Boric acid solution	7
Amount of outdoor air included in the total air circulated (except during heating up period)[b]	15%	1
	20%	0
	25%	5
	30%	5
	40%	0
	Others, specified 50%	1
Minimum quantity of air supplied per pupil[b]	10 cu. ft. per min.	7
	15 cu. ft. per min.	5
	20 cu. ft. per min.	1
	25 cu. ft. per min.	2
	30 cu. ft. per min.	3

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Velocity of air past occupant during heating season[b]	15 lineal feet per min. .	1
	20 lineal feet per min. .	3
	25 lineal feet per min. .	6
	30 lineal feet per min. .	1
	40 lineal feet per min. .	1
Velocity of air past occupant during cooling season[b]	80 lineal ft. per min. . .	5
	90 lineal ft. per min. . .	1
	100 lineal ft. per min. .	4
	110 lineal ft. per min. .	0
	120 lineal ft. per min. .	1
	Others, specified	
	20 lineal ft. per min. . .	1
Ventilation system[c]	Open window and door .	2-1/2
	Gravity activated	4-1/2
	Mechanical, integral part of main plant	10-1/2
	Mechnical - Unit type, separate from main plant	10-1/2
Relative humidity of the laboratory (winter)[b]	30	5
	40	5
	50	3
	60	1
	70	0
Relative humidity of the laboratory (summer)[b]	30	1
	40	3
	50	7
	60	2
	70	0
The relative humidity of storage areas	30	4
	40	4
	50	2
	60	0
	70	0

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
Temperature in laboratory at a distance 60 inches above the floor[c]	65 degrees	2
	66 degrees	0
	67 degrees	3
	68 degrees	16
	69 degrees	2
	70 degrees	6
Heating system[c]	Direct wall radiation (radiators)	1
	Wall unit ventilators with fan	6
	Overhead unit heaters with fan	0
	Forced warm air from central heating plant	2
	Split system (forced warm air and convectors)	6
	Radiant panel heating	6
	Base board radiation	1
Control of room temperature[c]	Total plant system	0
	Zone system	4
	Room, hand control	3
	Room, automatic control	22
Location of radiators (if used)[b]	Floor level, against wall	4
	4 feet from floor on wall	0
	5 feet from floor on wall	0
	6 feet from floor on wall	1
	7 feet from floor on wall	3

TABLE VI--Continued

Facilities	Standards	Frequency of Selections
	Suspended from ceiling at strategic locations.	3
	Recessed in wall	4
Installation of exhaust system[b]	Whole shop is served by one system	6
	Areas are served by separate systems . . .	9-1/2
	Each work station (where exhausting is necessary) is served by a separate system) . . .	5-1/2
Installation of ducts for exhaust systems[b]	In the floor	5-1/2
	Overhead	11-1/2

[a] Fractional values indicate that one or more of the jurors considered more than one item of equal merit.

[b] Item was submitted to two juries.

[c] Item submitted to three juries.