A STUDY OF THE VARIOUS TYPES OF TESTING PROGRAMS
USED BY TEACHERS OF MECHANICAL DRAWING
IN THE HIGH SCHOOLS OF TEXAS

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A STUDY OF THE VARIOUS TYPES OF TESTING PROGRAMS
USED BY TEACHERS OF MECHANICAL DRAWING
IN THE HIGH SCHOOLS OF TEXAS

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CHAPTER I

INTRODUCTION

It is probable that there exists a wide variation in the testing programs used by teachers teaching mechanical drawing since these teachers have different professional training, different administrative requirements, class periods of various lengths and different sizes of classes and teaching loads. In the interest of fairness to the student, greater efficiency on the part of the teacher and a higher standard of instruction in the field of industrial arts, an effort should be made to improve the testing programs used in mechanical drawing. Through research and study there should result a more reliable, objective and standardized testing program in this field in the high schools of Texas.

Statement of Problem

The problem of this study is to determine what types of tests are being used in mechanical drawing by the high school teachers of Texas and to suggest ways in which testing in mechanical drawing may be improved.

This study will attempt to answer the following questions:
1. Are the testing programs used by teachers of mechanical drawing in the high schools of Texas adequate?

2. What type of tests or combinations of tests are the most used?

3. What is the best method of presenting a mechanical drawing test?

4. What per cent of the student's final grade should be determined by the testing program?

5. Do the teachers of mechanical drawing use standardized tests?

6. How can the testing program used in mechanical drawing be improved?

Limitations of the Problem

This problem will be limited to those accredited high schools which include mechanical drawing in their curriculum as listed in Bulletin No. 469 of the State Department of Education.¹ One hundred and seventy-seven high schools were found to be in this group.

Source of Data

Data for this study were contributed by seventy-eight mechanical drawing teachers teaching in the schools

selected for the study. Additional data were obtained from professional magazines and literature. The Industrial Education Magazine and the Industrial Arts and Vocational Education magazine were very helpful.

Method of Investigation

Three published tests on mechanical drawing were enclosed with each questionnaire so the teacher might become familiar with the form of such tests. Research found these three tests to be the best suited for this study. A list of published tests for mechanical drawing was collected from professional magazines and from publishing companies. Aptitude tests were not included in this list. Of the six publishing companies contacted, only two were still printing tests in mechanical drawing. These two were: The Manual Arts Press of Peoria, Illinois, (which published "Reading Problems in Mechanical Drawing," by Charles Quinlan, Jr. and "Shop Tests," by W. L. Hunter), and The Bureau of Educational Measurements, Kansas State Teachers College, Emporia, Kansas, (which published "Mechanical Drawing Tests," by Charles Schoonover, C. L. Jackson, and H. E. Schrammel).

A questionnaire was prepared for the 177 high schools in Texas which gave credit for mechanical drawing, as listed in Bulletin No. 469 published by the State Department
of Education.² With each questionnaire the three above named published tests were enclosed, so that each teacher could compare the three tests, make comments and give a preference as to the one he liked best.

Of the 177 questionnaires sent out 106 were returned. Fourteen of the 106 were returned because of insufficient address. Fourteen other questionnaires were returned because the school in each case did not offer mechanical drawing in their curriculum during the school year of 1948-49. This left seventy-eight usable questionnaires, which was a return on the survey of 52.4 per cent.

Definition of Terms

A "standardized test" means a standard published test given under controlled conditions and furnished with norms.³

"Norms" refers to the student's rank as established by giving the test to a great number of students.

The "informal objective" test may be a published test without norms, or it may be a test constructed by the teacher.

²Ibid.


⁴Ibid.
An "objective test is one that can be scored without the use of any personal judgment. Two teachers can mark an objective test and get the same mark on it.

"Validity" means that the test measures what it claims to measure.

A "reliable" test must measure well whatever it is measuring.

A "published" test is one put out by a publishing company.

A "printed" test is one that appears in a professional magazine or professional literature.

Related Studies

Several related studies were published from 1928 to 1932 in the professional magazines; however, no recent studies were found. Victor J. Smith, Professor of Industrial Education at Sul Ross State Teachers College in Alphine, Texas, tells what is expected of a teacher as to the use of tests. He states:

Concerning the instructor and his use of tests, it seems reasonable to accept the following as essential items among the industrial arts teacher's duties:

1. Testing to determine what has already been learned in order to eliminate repetition and to isolate items which have not as yet been taught.

2. The selection of teaching materials which still remain to be presented, such selection to be based upon clearly defined objectives.
3. Testing in order to determine whether or not the essential parts of the new subject matter have been successfully presented.

4. The strengthening of weak spots or re-trenching.

5. Retesting from time to time in order to measure the student's retentivity and his ability to react with information or skill in accord with accepted standards.

The testing or checking phase of industrial arts instruction has probably never received its due share of attention. Tests ought to be designed not only to indicate what remains to be accomplished by the student but also to show how teaching methods can be re-organized in order to gain greater efficiency and economy of time. That the industrial arts teacher should use more such tests in the evaluation of his work is not to be doubted. Tests imply standards.

It is probable that many teachers in mechanical drawing tend to rely almost wholly on the drawing of plates as a means of instruction and grading in their courses with little thought or time spent on testing. As we consider reasons for testing in mechanical drawing, it might be wise to consider the opinions of two other men who have spent much time in this type of work: Harry B. Nash, Director of Research; and Roy R. Van Duzee, Supervisor of Industrial Arts of the West Allis Public Schools, West Allis, Wisconsin. Their opinions are:

The major thought for testing in the mind of the average teacher is to determine a school mark. Other

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important reasons for testing are: (1) to make an inventory of the pupil's knowledge and skills; (2) to diagnose and find the learning difficulties of the student; (3) to check his progress from grade to grade; (4) to compare classes doing the same work in several schools in the same system; (5) to compare the work done in one grade with that done in the preceding and following grades; (6) to compare work of a given school with that done in other representative schools throughout the country; (7) to determine if certain goals have been reached; (8) to determine the value of different methods of teaching.

While there are countless reasons for using standardized tests in mechanical drawing, there are also some reasons why they are not used. Amon Swope, Associate Professor of Industrial Education at Purdue University writes:

An adequate testing program is an integral part of every well organized course of instruction. Much attention has been given in the field of general education to the standardization of tests for the various subjects. In the industrial arts field, however, not so much has been done. Efforts have been made to standardize tests in certain industrial subjects. One finds however, that for some reason or other they have not been widely received. There may be a number of reason for this. The cost may be prohibitive in some places or the content of the course of instruction may vary. Also there are many teachers who believe that the product which the student delivers is sufficient objective evidence to warrant a grade which may be taken as an index of his ability.

Before a teacher would give much thought to a testing program, he would probably like to know some of the advantages of such a program. Victor J. Smith gives the

6 Nash and Van Duzee, op. cit., p. 125.
the following advantages which may be expected from the proper use of informal objective tests:

1. They measure to a fair degree the progress of the student in certain technical or informational phases of the industrial arts subject matter.
2. They call the student's attention to important details as well as to assist him in the organization of larger bodies of worth while materials.
3. They provide the instructor with a definite written record of progress which is a more reliable and useful index than an estimate or less carefully worked out system.
4. They tend to increase the student's respect for the subject.
5. They tend to keep the student's attention better focused upon text assignments, related readings, etc.
6. They provide the instructor with a check upon himself and his methods as well as indicating important points which should receive further stress.
7. They bear an important relationship to grades.

What type of tests should be used in a testing program?

The objective type seems to be preferred to most cases.

William L. Hunter of the Iowa State College, discusses the different types of tests in this manner:

Objective tests are really objective insofar as authorities are in agreement regarding correctness of responses to the tests. Many forms of objective tests have been devised. The yes-no and true-false tests have been extensively used. The main objections to the true-false tests are that it is subject to guessing and that it may fix wrong responses in the mind of the pupil. The latter of these objections has not been raised so strongly in the case of the yes-no test. The multiple-choice test has been used widely and is especially adapted to the testing of factual information.

Smith, op. cit., p. 321.
The completion and recall tests are to be preferred in some ways to the other types. They tend to be less objective but are not so subjective to guessing. All of these tests can be made more valid (worth while), more reliable, and more objective if they are made up in accordance with the foregoing suggestions.9

Ammon Swope suggests that the objective test is to be preferred. He states:

While it is true that there are many situations in which the use of standardized tests is not practical, never the less, a testing program is highly desirable. It is unlikely that, of those teachers who set up some testing scheme for promotion, a very large per cent give a written essay or discussion type of examination. A considerable body of evidence has been obtained to show the unreliability of this form and the corresponding reliability of the objective test in its various forms.

In the construction of any test one must be concerned with two criteria. The first of these is validity. When a test is valid it tests the thing it is supposed to test. The second criterion is that of reliability and refers to the accuracy obtained in testing. The reliability of a test is usually procurable thru statistical treatment but the validity is not so easily determined.

It seems obvious that no test is a good one that does not truly sample the subject matter of the course. To the extent that a subject is analyzed and synthesized into units of instruction, is it possible to sample accurately the effectiveness of instruction in that subject.

A testing program should be an integral part of every course of study and should be planned as assiduously as the selection of subject matter itself.10

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10Swope, op. cit., p. 8.
This thought projected by Nash and Van Duzee seems to give the proper picture of a testing program:

A standard test is not to set standards or determine objectives of teaching. In the industrial arts field, as in other fields, the standard test merely measures what is being done in terms of accepted industrial arts objectives. As the objectives change, tests will have to be constructed to meet the changing objectives and teaching emphasis.\(^\text{11}\)

From the opinions expressed by the authorities who have made studies along this same line, the testing program in mechanical drawing needs to be surveyed in an effort to make some suggestions for improvement. Practically all of these educators are in agreement on the advantages of giving frequent, objective type tests. It even seems probable that the mechanical drawing teachers have been overlooking one of the most important teaching aids in refraining from the use of such tests. These related studies tend to give added emphasis to the problem of a testing program in mechanical drawing.

\(^{11}\) Nash and Van Duzee, \textit{op. cit.}, p. 125.
CHAPTER II

A STUDY OF TESTS AVAILABLE FOR USE IN MECHANICAL DRAWING IN HIGH SCHOOL

A list of published tests for mechanical drawing was collected from the professional magazines and publishing companies. Since these tests were made by educators in the field of mechanical drawing, a study was made of them to help determine adequate criteria. However, before any of these tests could be effectively used, they would have to fit the subject matter or course of study. This was brought out by Ammon Swope, Associate Professor of Industrial Education, Purdue University, who stated, "A testing program should be an integral part of every course of study and should be planned as assiduously as the selection of subject matter itself."

Following a list of published tests that was compiled from the Industrial Arts and Vocational Education magazine of June, 1937, page 177:


Of the above listed publishing companies, the Manual Arts Press, Peoria, Illinois was the only one still printing a test in mechanical drawing. Other publishing companies contacted were:

1. The World Book Company, Dallas, Texas.
4. C. A. Gregory Company, Cincinnati, Ohio.
5. Bureau of Educational Measurements, Kansas State Teachers College, Emporia, Kansas.

The C. A. Gregory Co. had in stock the "Mitchell Drawing Aptitude Test," but it was not satisfactory for this study. A "Mechanical Drawing Test," published by the Bureau of Educational Measurements, Kansas State Teachers College, Emporia, Kansas, was used. The probable reasons for some of these companies to discontinue printing tests in mechanical drawing are: the tests get out of date and thus are not fitted for present day texts; or the mechanical drawing teachers did not use the published tests enough
to create a demand for them, causing the publishing
companies to stop printing such tests.

The first test considered was the "Mechanical
Drawing Test," by Schoonover, Jackson and Schremmel. It
was obtained from the Bureau of Educational Measurements,
Kansas State Teachers College, Emporia, Kansas. This test
cost three cents per copy and is a combination type of
test, as it includes a matching test, multiple-choice,
true-false, completion and practical problem. The test
covers practically a year's work in mechanical drawing
and would probably be best suited as a final examination
test to be given at the end of the school year. This
test comes in packages of twenty-five and is furnished
with a key, directions for giving, class record and norms,
which makes it a standardized test. The authors recommend
the profitable use of this test (1) for determining pupil
achievement; (2) for checking the efficiency of instruction;
(3) for assigning school marks; (4) for analyzing pupil
and class weaknesses; and (5) for motivating pupil effort.2

The second test used in this study, "Reading Problems
in Mechanical Drawing," by Charles Quinlan, Jr., was
This test contained eight sheets of practical problems.

2H. E. Schremmel, C. L. Jackson and Charles Schoonover,
"Manual of Directions Mechanical Drawing," Bureau of
Educational Measurements, Kansas State Teachers College,
Emporia, Kansas, p. 3.
each sheet costing one cent. For this study only the first sheet of the test was used, as it represents the same type of test contained on the other seven sheets. This test shows different block shapes, giving two views in each drawing. The problem is to find the third view for each block. This is a practical problems test to be worked by matching the correct third view with the two views given. Page 1 of this test shown in the appendix is a test on orthographic projection. This test is not furnished with a key or norms.

Another published test included in this survey, "Shop Tests," by William L. Hunter, was also published by the Manual Arts Press and cost one cent per copy. As with the second test studied, this test has no key or norms, and cannot be called a standardized test. It is in reality a multiple choice type of test, although it is titled, "True-False Test for Mechanical Drawing." This test covers general information on lines, orthographic projection, dimensions, and sections.

It is hoped that these three published tests, copies of which appear in the appendix, will show a fair sample of objective mechanical drawing tests. They also give some idea of the limited number of published tests available to the average teacher of mechanical drawing. This concludes the study of the published tests which are available. The
next part of this chapter will describe some of the
different types of printed tests available through pro-
fessional magazines and literature.

In all probability, tests printed in the professional
magazines are more within the reach of the average teacher
of mechanical drawing and will come nearer to fitting his
needs than most published tests. From 1927 to 1949 about
fifty articles and tests for mechanical drawing have
appeared in the *Industrial Arts and Vocational Education*
magazine and the *Industrial Education Magazine*. These
tests represent the work of thirty-one different men,
most of whom are well known and recognized for their work
in the testing field. Practically all types of tests can
be found on nearly any phase of mechanical drawing. The
articles or discussions give ideas on composing tests, the
advantages and disadvantages of certain types and reasons
why we, as mechanical drawing teachers, could profit from
the use of such tests.

With all of the above material and facts on testing,
there no doubt are still some teachers who believe that
they can measure a student's ability entirely by the kind
of drawing plates or sheets he turns in. When a student's
drawings are laid on the table, there is no argument about
his achievement, as far as we are able to see. There may
be some doubt, however, as to whether or not he understands
the principles involved in his drawings. A very small percentage of high school students become draftsman, while large groups will possibly become technical men in contact with drawings and blue prints. To this large technical group, intelligent comprehension is as valuable as good execution of drawing. In this light, the student who draws poorly, but has the technical knowledge, as revealed by tests, is not the failure the teacher might otherwise judge him to be. The use of tests might widen the range of values of our work.3

Before the different types of tests are considered, we might examine some of the points that should be stressed when making up a test. According to William J. Micheals, and M. Ray Karmes, both of whom were associated with the Teacher Training Department of the Armoured Force School during the war, a systematic procedure should be followed in making a test. They think:

If a test is to be valid, reliable, and objective; if it is to be comprehensive, discriminating, and easily administered and scored, a definite, systematic procedure must be followed in its construction. One such procedure is itemized briefly below:

1. Decide on the specific points or objectives that are to be measured.
2. Write each objective on a separate sheet or card. List items of subject matter which contribute to the realization of each objective.

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3. Determine which type of test item will measure best the extent to which each specific objective has been attained.
4. Construct one or more test items for each objective listed.
5. Assemble the items for the test. List all items of the same type (completion, matching, multiple-choice, etc.) together. Arrange questions within each type so that those concerning related material appear together.
6. Write clear and concise directions for each type of question.
7. Study every aspect of the assembled test.
8. Have other instructors criticize and actually take the test.
9. Make any necessary revisions.
10. Construct the key.
11. After the test has been administered to one or two groups of students, study carefully the student responses. Correct any weaknesses that they reveal. Continue to revise and improve the test from time to time.  

Several factors entered into the selection of the different types of tests used for this part of the study. A collection of tests were compiled and then grouped into various types. According to the authorities, the types discussed in this study appear to be the ones most often used. William L. Hunter, Department of Industrial Arts, Iowa State College reports:

There have been many kinds of tests invented, but thus far only four or five have been used extensively in industrial arts education. The true-false, the multiple choice, the completion, the recall and the

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matching types have probably included 90 to 95 per cent of all tests given in industrial arts work.\(^5\)

A copy of each type of test discussed is included in the appendix. These tests were originally collected for the subject matter they covered, but will be used in this study to show a certain type or form of test.

The true-false (or yes-no) type of test is made up of sentences containing either a true statement or a false one. The student makes the decision and then marks it accordingly. Encircling the correct response is much preferred to writing the response in, since less time is taken this way by the student and less time will be consumed by the instructor in scoring. The true-false test should always be corrected by the students immediately after it is taken, as this greatly increases its educational value. By doing this the student is able to fix more firmly in his mind the correct answer and to change his mind in regard to the wrong answers. William L. Hunter believes that pupils like the yes-no type of test better than the true-false and that it has fewer objections from a psychological angle.\(^6\)

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\(^6\)Ibid.
Michaels and Karnes list some uses, advantages and limitations of the true-false type of test:

1. The true-false item can be used effectively as an instructional test item to promote interest and to introduce points for discussion.
2. It can be used to sample effectively wide ranges of subject matter.
3. It can be scored readily in an objective manner.
4. It can be made a factual question or a thought question that requires reasoning.
5. It has doubtful value as an item for measuring achievement.
6. Difficulty is encountered in constructing items that are either completely true or false, without making the correct response obvious.
7. It encourages guessing.
8. A true-false test is likely to be low in reliability unless it includes an extremely large number of items.

Points to be observed in constructing the true-false test item:
1. Make approximately half of the items true and half false.
2. Do not make one part of a statement true and the other part false.
3. Do not make the true statements consistently longer than the false statements.
4. Direct students to clearly indicate responses.
5. Avoid negative and involved statements.
6. Make application of things learned in as many of the items as possible.
7. Avoid using such words as "all," "none," "never," etc.
8. Where possible, make the crucial elements come near the end of the statement.

In the multiple choice type of test from three to six responses are given with each question; the student chooses the response he thinks is correct. There are several variations to this type of test. Some are made with only two or three responses in parenthesis following the statement.

7Michaels and Karnes, op. cit., p. 270.
This arrangement makes the test harder to score as the correct response must be underlined. If only two responses are given the chances are greater for the student to guess the response, as with the true-false. Most authorities agree that each statement should have at least four responses, preferably listed below, with letters or numbers, so that the student may encircle the correct response letter or number. This makes for greater efficiency in giving and in scoring this type test. Some multiple choice tests are made with only one right answer; while others contain several plausible answers, but with one best answer. The best answer type seems to be recommended, since the selection of the best response involves an element of judgment. Much teaching can be done with the specific purpose of getting students to the point where they can form judgments, draw conclusions, and arrive at decisions. This is the way we live.

The uses, advantages, and limitations of the multiple choice tests are summed up very nicely by Micheels and Karnes:

1. The multiple choice item can be designed to measure effectively the student's ability to form judgments and make application of things learned. It is the most valuable of the new-type test items for this purpose.

2. It can be used to measure what one can recognize, which represents a much wider field than what one can recall.
3. It can be varied to suit many kinds of subject matter and to measure various types of achievement; command of fundamentals, formation of judgments, etc.

4. Its scoring is entirely objective.

5. It is space consuming.

6. There is danger of including more than one response that can be marked correctly.

Points to be observed in constructing the multiple choice test item:

1. Include at least four and preferably five, but not more than six possible responses in each item. The fewer the possible responses, the greater the possibility of guessing the response.

2. Include no responses that are obviously wrong.

3. In constructing the items, the choice should be placed near the end of the incomplete statement. This makes for continuity of reading.

4. Avoid the inclusion of irrelevant clues to the correct response.

5. Do not make the correct response consistently longer or consistently shorter than the incorrect.

The completion type of test is still another well known and used type of test. The important difference between the completion test and the above two types is that the response must be invented by the student. In the true-false and the multiple choice types the responses were supplied. In real life situations our responses or answers must be invented. To this extent the completion test is more difficult and probably a more valid method of testing work which has been done in mechanical drawing. This type of test as well as the identification type is often referred to as a recall test. The recall test is probably more similar to test situations as they appear in

8 Ibid.
life than most objective tests. One frequent objection to the completion test is that it is difficult to find statements for which one word always seems to be the plausible response. It can be used to sample a wide field without taking up too much space. Other advantages and disadvantages are:

1. The simple completion item can be used to test the student's ability to recall specific facts; it demands accurate information.
2. It can be used effectively to sample a wide range of subject matter.
3. The completion item has high discrimination value.
4. It is difficult to make entirely objective.

Points to be observed in constructing the completion test item:
1. Omit not more than three words in a given sentence.
2. Place the blanks near the end or at least past the center of the sentence.
3. Design each statement in such a manner that it will remain incomplete until the correct response is inserted.
4. Omit only key words.
5. Do not copy statements directly from textbooks.
6. It is usually poor practice to omit verbs.
7. If possible, construct the item so that there can be only one correct response.
8. If synonyms are to be accepted, include them in the key.

Some educators recommend the matching type of test since it can be varied to fit the subject. The matching test also has the advantage of taking little time to give and score. There appears to be a very limited number of matching type tests in the professional magazines. Possibly this is because they look very simple when made up, but

9 Ibid., p. 271.
are in reality rather difficult to compose so that they will not encourage guessing. Using two or three more answers than questions helps to eliminate the guessing problem. Another fault found with this type of test is that it does not tend to make the student think or recall things taught as well as the completion type of test. Some authoritative data by Micheels and Karmec on the matching type test follows:

1. The student's ability to recognize relationships and make associations can be tested readily with the matching exercise.
2. The matching exercise may require the student to match:
   a. terms or words with their definitions.
   b. characteristics with mechanical units to which they apply.
   c. short questions with their answers.
   d. symbols with their proper names.
   e. descriptive phrases with other phrases.
   f. causes with effects.
   g. principles with situations in which the principles apply.
   h. parts of mechanical units with their proper names.
   i. parts with the unit to which they belong.
3. A large number of responses can be obtained in a small space and with one set of directions.
4. It can be made totally objective.
5. It can be completed quickly by the student and scored quickly by the instructor.
6. It tends to be highly reliable and discriminating.
7. Since the phrases or clauses must necessarily be short, the matching exercise provides a poor measure of complete understanding and interpretations.
8. It is inferior to the multiple choice item in measuring judgments and applications of things taught.
9. It is likely to contain irrelevant clues to the correct response. Difficulty is encountered in eliminating such clues.
Points to be observed in constructing the matching test item:

1. Require the student to make at least five and not more than twelve responses in completing each matching exercise.
2. Include at least three extra terms from which responses must be chosen. This tends to reduce the possibility of guessing.
3. Only related material should be included in any one exercise.
4. In matching the parts of the item, each part should be used only once.10

The identification type test differs very little from the matching test. It does seem to be used a great deal more though in mechanical drawing. The test is well adapted to present certain types of materials, such as orthographic projection. Students seem to like this type of test too, as it gives pictures, actual drawings or the objects themselves to identify. William L. Hunter emphasizes the importance of this type of test with the following statement, "The use of drawings should be encouraged in the make-up of the industrial arts tests, since so much dependence in industry is being placed on an understanding of graphical language."11

Good and bad points of the identification type test are:

1. The identification item can be substituted for the matching when it is desired to have the student recall outright the proper names.
2. It can be made to measure well the application of certain knowledges as in detecting the errors in a drawing, etc.

10 Ibid., p. 272. 11 Hunter, op. cit., p. 166.
Points to be observed in constructing the identification test item:
1. Make all sketches clear and of sufficient size.
2. Make sure that lines indicating parts to be named terminate at the proper places.
3. Wherever practical display the actual parts or units instead of using sketches.
4. If the actual parts or units are to be displayed, place the identification items at either the beginning or end of test.
5. Have a good sample of the item to be identified.
6. Make sure that only one definite answer is possible.\textsuperscript{12}

The practical problem type of test is no doubt widely used for testing in mechanical drawing, but since it can be made up by the local teacher to fit his specific material in any number of ways, apparently the educators have avoided making many samples of it. The practical problem type of test is rather difficult to classify. The test may be used to check the student's knowledge of orthographic projection by giving two views of a block to draw the third view. Also, this type of test can be used very effectively to test a student's ability to use the architect's scale. Frequently it is used as a test on dimensioning. The practical problem should be kept as simple as possible, with definite points to be scored, so that it will remain objective. In this type of test the student's ability to draw can better be measured.

Stanley S. Radford, Michigan State College of Agriculture and Applied Science, gives this tip on the problem type

\textsuperscript{12}Michaels and Karnes, \textit{op. cit.}, p. 270.
of test, "It consists of a carefully selected project or problem which brings out as much practical knowledge as possible. Tests of this type are very worthwhile, but are often difficult to grade objectively."\(^{13}\)

The essay type of test is probably used sparingly in mechanical drawing, since a copy of one could not be found in any of the professional magazines and little could be found to recommend its use in mechanical drawing. It was not included in the appendix. The essay can be used effectively to measure the student's ability to organize and express thoughts. Such a test has the advantage of determining the extent to which the student understands a certain point. Probably the greatest disadvantage of this test lies in the fact that its scoring becomes subjective. Also much time is required for the student to cover a limited amount of material and even more time is consumed by the instructor in scoring it.

Another test of interest, the cluster true-false, is similar to the original true-false type of test. No sample of this type of test for mechanical drawing could be found, so it does not appear in the appendix. According to some educators, it has definite advantages over the ordinary true-false test. This test is made up by giving four to six responses for each item or statement. Approximately

half of the responses for each item should be true and
half false. Michaels and Karmes recommend it with these
suggestions:

1. The cluster true-false items possesses all of the
advantages of the plain true-false. It possesses
several additional advantages.
2. It can be used to check several points, with
respect to such things as particular concept,
principle or mechanical unit.
3. It requires less space and time per point.
4. It tends to reveal more closely the student's
complete understanding.
5. It is considered slightly higher in reliability
than the simple true-false.

Points to be observed in constructing cluster
true-false items:
1. Design items that require the student to make
application of things learned.
2. Make all of the responses plausible and approxi-
mately half of them true.
3. Avoid qualifying words that make the answer obivous.
4. Check each item carefully for ambiguous and
hidden meanings.

Stanley 3. Radford gives some good advise on the use
of tests. He states:

Expose all types of students to a variety of
tests. It is only as the instructor uses all types
of tests, gains experience in their use, that all the
inherent values of each kind of test become more
apparent. As students take these tests and become more
experienced in answering or writing each kind, a more
comprehensive grasp of subject matter is attained and
many misconceptions are revealed and corrected.15

This is by no means a complete review of all the types
of tests, but rather a summary of the most frequently used

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14 Michaels and Karmes, op. cit., p. 271.
and recommended types for mechanical drawing. In this study it was found that the "published" tests available for use in mechanical drawing are very limited now. This was not the case in 1937 when at least ten different published tests were in print. It is possible that the "printed" tests found in the professional magazines are taking the place of the published test. The true-false, multiple choice, completion, matching and identification types of tests are to be found in The Industrial Education Magazine and the Industrial Arts and Vocational Education magazine. The mechanical drawing teacher is urged to make use of such tests and to make up some of his own. It would appear that the educators give the multiple choice test a little preference, although all of the objective type tests are highly recommended.
CHAPTER III

A SURVEY OF THE TESTING PROGRAMS USED BY
SEVENTY-EIGHT HIGH SCHOOL MECHANICAL
DRAWING TEACHERS IN TEXAS

After a study of the different types of tests available for use in mechanical drawing, the next consideration of the study was to study the types of testing programs the mechanical drawing teachers recommended and were actually using. In addition to the test there are several factors which enter into the make-up of a testing program. Some of the factors to be considered and discussed are: the frequency of testing, the types of tests preferred by teachers, methods of presenting mechanical drawing tests, grading, averaging tests up with the semester grade, and the extent that teachers use the standardized test. These factors will be discussed by using the results taken from the questionnaires returned by the high school teachers of mechanical drawing in Texas. In order to understand the results more clearly, most of them will be presented in table form.

The first question asked of the teachers was, "Do you think the testing program is adequate in mechanical drawing
in your school?" Of the seventy-eight usable questionnaires: thirty-nine teachers, or 50 per cent, replied that they felt that their testing program was adequate; thirty-four teachers, or 43 per cent thought their program was inadequate; and five teachers did not answer.

Table 1 shows the frequency of testing in weekly intervals that was preferred by the seventy-eight teachers answering the survey.

**TABLE 1**

<table>
<thead>
<tr>
<th>Interval</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>One week</td>
<td>2</td>
<td>2.6</td>
</tr>
<tr>
<td>Two weeks</td>
<td>10</td>
<td>12.8</td>
</tr>
<tr>
<td>Three weeks</td>
<td>27</td>
<td>34.6</td>
</tr>
<tr>
<td>Four weeks</td>
<td>4</td>
<td>5.1</td>
</tr>
<tr>
<td>Six weeks</td>
<td>24</td>
<td>30.8</td>
</tr>
<tr>
<td>Completion of each unit</td>
<td>11</td>
<td>14.1</td>
</tr>
</tbody>
</table>

Data in Table 1 show that more teachers prefer giving tests in mechanical drawing every three weeks. The six weeks period follows very closely as the preferred time to give tests. Both of these periods could be affected by an administrative rule, or by the grade period coming at
the end of each six weeks. Several teachers preferred to give a test at the completion of each unit, regardless of the time involved, which also has its good points.

A comparison of the types of tests that were preferred by the mechanical drawing teachers is shown in Table 2.

**TABLE 2**

A COMPARISON OF TYPES OF TESTS USED TO TYPES PREFERRED BY SEVENTY-EIGHT MECHANICAL DRAWING TEACHERS

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Number Who Used Test</th>
<th>Number Who Preferred Test</th>
<th>Number Who Preferred Test But Did Not Use It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical problem</td>
<td>57</td>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>Completion</td>
<td>24</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>True-False</td>
<td>22</td>
<td>26</td>
<td>4</td>
</tr>
<tr>
<td>Essay</td>
<td>16</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Multiple choice</td>
<td>12</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Identification</td>
<td>9</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Matching</td>
<td>5</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Other types</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

In referring to Table 2, the top three tests in use and in preference are: practical problems, completion, and true-false. Multiple choice ranks fourth in preference, but fifth in actual use. This might be because it is
considered one of the best tests to use, but it is rather difficult to make. The essay test on the other hand ranks fourth in use and seventh as to preference. Most educators do not recommend the essay type of test too highly for mechanical drawing, but it is an easy test to compose, which probably accounts for its wide usage. Two other tests which rated high in the preference column and low in actual use were the identification and the matching type of tests. The same reasons would no doubt apply to these two tests as they did to the multiple choice. They are recognized as good objective tests, but take more time and thought to construct. The practical problem type of test was the big favorite for use in mechanical drawing. It seems strange that so few tests of this type appear in the professional magazines.

Proper presentation of the test is another factor which enters into a testing program. Table 3 gives a comparative study of the methods used in presenting a test in mechanical drawing to the methods preferred.

There seems to be two outstanding methods of presenting mechanical drawing tests. Eighty-two per cent of the teachers preferred mimeograph copies for each student. No doubt all of the teachers did not have the time nor the equipment for mimeographing, which would explain why only 60 per cent used this method. For this
TABLE 3

CHOICE OF METHODS OF PRESENTING TESTS IN MECHANICAL DRAWING AS PREFERRED BY SEVENTY-EIGHT MECHANICAL DRAWING TEACHERS

<table>
<thead>
<tr>
<th>Method</th>
<th>Number Who Use Method</th>
<th>Number Who Prefer Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mimeograph copies</td>
<td>47</td>
<td>67</td>
</tr>
<tr>
<td>Blackboard</td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>Students take questions from the book.</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Teacher reads questions</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Other methods</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

same reason possibly, more teachers use the blackboard, when they would prefer to have the test mimeographed. Other methods used and preferred included; blocks, blueprints, slide projections, and film strips.

One reason why teachers give tests is to arrive at a grade or mark for the student. Some teachers probably depend on the test score to a large extent in arriving at the student's semester grade, while others depend largely on the drawings completed. Table 4 gives the per cent that tests count on final grade in mechanical drawing as reported by the seventy-eight teachers.

One thing which probably determines the amount the teacher counts the test grades on the final grade of the
### TABLE 4
PER CENT OF FINAL GRADES BASED ON TESTING PROGRAMS
IN MECHANICAL DRAWING AS REPORTED BY
SEVENTY-EIGHT TEACHERS

<table>
<thead>
<tr>
<th>Number of Teachers</th>
<th>Per cent That Tests Count on Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>33</td>
<td>33 1/3</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>1</td>
<td>60</td>
</tr>
</tbody>
</table>

Student is the amount or per cent set up by the administrative staff of the individual school. The teacher in such a case would have very little to do with the amount he could count the test grade. The figure given by the majority of the teachers was 33 1/3 per cent. About 30 per cent of the teachers count the tests as one-fourth of the student's total grade.

Fifty-one teachers thought that a standardized test for first-year drawing would be practical for their school. Some of the reasons given for using this type test were:
1. Such a test if given at the beginning of the year and again at the end would check the student's progress.

2. Beginning drawing should be nearly the same in content in all schools, tests like this would help to achieve a standardization of fundamental drawing.

3. A standardized test would save some valuable time on the part of the instructor.

4. By using some standard test, the teacher could compare his work with that of other teachers in his field.

5. To give each student a variety of testing techniques.

6. If the test fits the subject matter, it could be used as a teaching aid.

Several reasons given by the twenty-six teachers for thinking the standardized test impractical were:

1. It does not fit the subject matter taught.

2. Tests should be changed every year in order to be up to date.

3. Teachers should teach the student, not the subject.

4. Standardized tests are too general.

5. They do not test drawing procedure.

6. A standardized test is only good with a standardized course of study, and the course of study should be varied to fit the community.

Do teachers check their students and themselves by using a test made up by some authority in the mechanical drawing field? In answer to this question, thirty-one teachers replied that they did, and forty-five teachers reported that they did not. This test would not have to be a standardized test, but might be a printed test from a professional magazine. By comparing this question with the one directly before it (Would a standardized test for first-year drawing be practical in your school?) a good percent of teachers believe the standardized test is practical, but it seems that they do not make an effort to use one.
Educators seem to agree that there is definite educational value in the student's correcting and reviewing a test after it has been scored and returned to him. Of the seventy-eight teachers who answered, seventy agreed with this idea and had their students to correct and review a test after it had been graded.

If a test is to be easily graded or scored, it must be objective. Seventy-three teachers felt that they could score their tests quickly, accurately and objectively. Four teachers answered this question in the negative and one failed to answer the question.

In an effort to get the teacher's point of view, question number twelve on the questionnaire asked for ideas on improving the testing program in mechanical drawing. Seventy-eight people have nearly that many ideas. A great many were inclined to believe the standardized test would be of value in improving our testing program. Using a combination of tests also rated high. More time should be spent by the teacher in making and in re-organizing tests to fit his objectives, course of study and community. Below is a list of opinions as expressed by some of the teachers:

1. Classify the student at the beginning of the year as to his ability in drawing.
2. Use more types of test more often.
3. Use standardized tests.
4. Bring out the fundamentals of drawing in our tests.
5. Get more help from the teachers colleges.
6. Spend more time in preparing each test, so it will be reliable, valid and objective.
7. Put more practical problems in the tests.
8. Make it more real and true to life.
9. By using a combination of tests, constructed by authorities in this field.
10. Give more objective tests, not only for testing but as a teaching device.
11. Have tests co-ordinated with textbook.
12. By testing after each unit of work.
13. The proper selection of problems and the proper method of presentation will make drawings self-testing.
14. Use each plate as a test.
15. The testing program could be improved by using one text over the entire state.
16. Include more related work in our daily assignments.
17. By conducting more surveys on this subject.
18. Study the weaknesses of our own tests and the advantages of other tests and work out some that will fit our needs.
19. Use more visual aids.
20. Giving tests more often would help.
21. Co-operation and checking with teachers of other fields.
22. Keep the objectives of the course clearly in mind when making up a test.

Table 5 shows the number of teachers who preferred each type of published test included in this study.

The "Mechanical Drawing Test" is a combination of several types of tests. This probably accounts for its being selected by the largest number of teachers. "Reading Problems in Mechanical Drawing" is a practical problem test arranged on the order of the identification type of test. It did not cover the amount of material that the first test did and is composed of only the one type. Most teachers seem to prefer the practical problem type of test,
### TABLE 5

**PREFERENCE OF PUBLISHED TESTS AS EXPRESSED BY SEVENTY-EIGHT MECHANICAL DRAWING TEACHERS**

<table>
<thead>
<tr>
<th>Number</th>
<th>Name of Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Mechanical Drawing Test¹</td>
</tr>
<tr>
<td>23</td>
<td>Reading Problems in Mechanical Drawing²</td>
</tr>
<tr>
<td>16</td>
<td>Shop Tests³</td>
</tr>
</tbody>
</table>

which possibly accounts for its high rating. The "Shop Tests" is made up in the multiple choice form and covers a limited amount of material.

This survey tends to show that only 50 per cent of the teachers teaching mechanical drawing believe their testing program to be adequate. Approximately 60 per cent think the standardized test could be used to advantage in their program, but only 40 per cent actually do use some type of test made up by an authority in the field. Nearly 74 per cent of the teachers have no trouble in scoring their tests quickly, accurately, and objectively.

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¹H. E. Schramm, C. L. Jackson and Charles Schoonover, "Mechanical Drawing Test," Bureau of Educational Measurements, Kansas State Teachers College, Emporia, Kansas.


and 90 per cent believe in making the students correct and review their tests after they have been scored. Tests should be given about every three weeks according to 34.6 per cent of the mechanical drawing teachers; but 30.8 per cent felt that once every six weeks was sufficient in a drawing course. A test at the end of each unit of work completed was the recommendation given by 14 per cent. The practical problems type of test led with 61 votes, the completion was second and the true-false third in the types of tests preferred for use in drawing. Mimeograph copies for each student is the best way of presenting a test, with the blackboard considered the second best way of presentation. About 42 per cent of the teachers allow the test to count one-third of the student's grade, but 30 per cent only count the tests one-fourth of the final grade. Possibly the three answers given most for the improving of the testing program in mechanical drawing were: use more types of tests, preferably some standardized; test more often; and spend more time in selecting and making each test. The "Mechanical Drawing Test" was preferred by 51 per cent of the teachers.
CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The data from the seventy-eight questionnaires and the recommendations of the educators in the field of testing contributed the basis for the study. Although the educators and the teachers who were questioned did not agree on certain things, there was agreement on many of the factors included in the testing program used in mechanical drawing. No hard and fast rules should be made or followed in the use of a testing program, because each teaching situation will have different needs. However, there are basic factors common to any testing program, such as; the frequency of testing, the best types of tests to use, the accepted ways of presenting tests in mechanical drawing, grading and averaging of tests and the place of the standardized test in a high school program.

The general opinion of both the teachers in the field and the authorities writing articles on tests and testing was that testing should be done frequently. Both groups expressed the belief that the testing program could be improved and also the teaching program by the use of more
tests. The testing program should not become so important as to decrease the emphasis on the drawing procedure itself, but rather should supplement it and enhance the value of the course. The study indicates that tests should be given at three-week intervals in most cases. Another suggestion was the use of tests at the completion of each unit, but some educators believe that testing should be done at regular intervals so that material can be emphasized as the unit is being studied as well as at the end or at the completion of it.

Several published tests for mechanical drawing were obtained from publishing companies. Three were chosen as being representative of the group and were used in the study. These tests were: the "Mechanical Drawing Test," by Schoonover, Jackson and Schrammel; "Reading Problems in Mechanical Drawing," by Quinlan; and "Shop Tests," by Hunter. A copy of each test is included in the appendix.

The study was not limited to published tests, but included a study of tests available through professional magazines and literature. There is a wide variety of printed tests to choose from comprising several types, and it would be difficult to choose one type over all the others. The educators and teachers in the survey suggested the use of several types rather than sticking to one type of test during the entire year. It is by frequent testing
and the use of a variety of tests that the teacher accomplishes the desired results in a testing program. The teachers included in the survey preferred the practical problem type of test for mechanical drawing. The completion, true-false, multiple choice, identification, and matching test ranked next in the above order.

The practical problem type of test can be composed with a minimum amount of work and can be designed to fit any class or phase of the course. The practical problem is one of the best type of tests to measure the student's drawing ability. The student can show to advantage his ability and knowledge, perhaps better in this type of test than in most any other type of objective test.

The completion type of test, which ranked second with the teachers questioned, is possibly more difficult to make. Only one answer should fit each blank. This type of test is referred to as a recall test, as the student must recall the answer, rather than choose an answer already given. The completion test is probably more related to test situations in real life than most objective tests.

The true-false test has more value as an instructional aid than it does for measuring achievement. The student should always have the opportunity to correct and review over this type of test. A true-false test can sample a wide range of material, but it encourages guessing on the part of the student.
The multiple choice test is considered one of the best of the objective type tests. It tends to force students to form judgments and make decisions, which is one purpose of teaching. This type of test can be used to measure what one can recognize, which represents a much wider field than what one can recall. The big disadvantage of this test is the amount of space it consumes.

For mechanical drawing the identification test is very effective. Since it is more realistic than some of the other types of tests, the identification test seems to be popular with the students. Pictures, drawings, or the object itself may be used in an identification type of test. These drawings or parts should be plain and large enough to be clearly seen.

The matching test is very similar to the identification test. A matching test can be used to test the student's ability to recognize relationships; it can cover a wide field. A large number of responses can be obtained in a small space and it can be made totally objective. By including two or three more answers than questions, the chance of guessing is minimized in the matching test.

Other types of tests included in the study were the essay and the cluster true-false. The essay is not recommended for use in mechanical drawing by the majority of the authorities. The cluster true-false does appear to
have some advantages over the regular true-false. Less space is consumed per point with it, and it is considered more reliable than the original true-false. Several of the teachers questioned stated that they preferred to use a combination of the many types of tests.

There can be little doubt as to the best method of presenting a mechanical drawing test. Eighty-two per cent of the teachers in this study prefer the use of mimeograph copies for each student. One variation suggested was the use of blueprints. This might be an easier way to present drawing and could be done occasionally to stimulate interest. The blackboard was used by 40 per cent of the teachers and no doubt is a satisfactory way of presenting tests, but even these teachers who use the blackboard stated a preference for giving copies of the test to each individual student.

Efficient grading of work in mechanical drawing is a distinct factor in efficient teaching. Lack of an established system of grading causes unpleasant after effects. Every student who feels that his grade is unjust is a dissatisfied customer, but if the grading system is properly handled, it can be a device for creating and maintaining high interest. Grading should be frequent, but should take a minimum of the teacher's time. A uniform standard for grading should be applied, based upon a wide scope of
student responses and attainment. Some authorities even suggest letting the student check and grade his own drawing, which involves a useful self analysis on the part of the student. An open grading system, whereby the student may see what grade he is making on his work as the term progresses is also recommended.

In grading or scoring a test, the answers should be objective, so that any teacher scoring a pupil's paper would arrive at only one score. This is one point that all the educators and teachers emphasized. Ninety-four per cent of the teachers in the survey indicated that they tried to be objective in their grading. Forty-two per cent of these teachers count the tests as one third of the student's final grade. Thirty per cent of the teachers count the testing program as one fourth of the student's grade. After the tests have been scored they should be given back to the student for correction and review. This policy was used by 90 per cent of the teachers who answered, and was suggested by several educators.

A standardized test would be practical for a first year drawing course, according to 68 per cent of the teachers in the study. The "Mechanical Drawing Test," by Schoonover, Jackson and Schrammel was first choice as a standardized test, preferred by thirty-nine of the seventy-eight teachers.
Conclusions

Some very good studies have been made concerning the different types of tests and factors which enter into the makeup of a testing program; but no recent studies could be found. This problem is as urgent today as it was twenty years ago and there is still much improvement to be made in the testing programs used in the public schools.

The published tests are very limited. Few are available to the average mechanical drawing teacher in high school. One of the best standardized published tests available is the "Mechanical Drawing Test," by Schoonover, Jackson and Schrammel; published by the Bureau of Educational Measurements, Kansas State Teachers College, Emporia, Kansas. This test was preferred by 51 per cent of the teachers surveyed. This test could be used as a final examination in first year mechanical drawing.

The printed tests available through professional magazines and literature are more plentiful. These printed tests are probably more within the reach of the average drawing teacher and no doubt can be made to fit his individual needs better. Practically all types of tests for use in mechanical drawing can be found in the professional magazines. Of the different types of tests available, the ones most used were: the practical problem,
completion, true-false, essay, multiple choice, identification, and matching, in the above order.

The data indicates that for the best teaching results a test should be given every three weeks. This was reported by 34 per cent of the teachers surveyed. Six week intervals were preferred for giving tests by 30 per cent of the teachers, but a large per cent of this group of teachers stated that the testing program could be improved by the use of more frequent testing. Most of the tests should be mimeographed so that each student may have his own copy. Certain points should be emphasized in grading the student. These points include the quality of his work, the quantity, the effort he puts forth, his knowledge of facts and his attitude. The student's test grades should count one-third or one-fourth on his final grade.

The average testing program used in mechanical drawing is inadequate, so stated fifty per cent of the teachers who answered the questionnaire. Fifty-four per cent of the seventy-eight teachers did not use a test made up by some authority as a check on themselves, and 49 per cent stated that they believed standardized tests impractical for use in their school. How then can the testing program for mechanical drawing be improved? Some of the replies given by different teachers in the study were as follows:
1. Classify the student at the beginning of the year with an aptitude test.
2. Give frequent tests using practical problems.
3. Combine several types of tests each time so as to give the student a better chance.
4. Spend more time in preparing each test, so it will be reliable, valid and objective.
5. Co-ordinate tests with the textbook.
6. Use a standardized test at the beginning and at the end of the school year to measure student achievement and teacher progress.

Some of the important conclusions drawn from this study are: the number of published tests for mechanical drawing is very limited. However, there is a wide variety of printed tests available through professional magazines and literature. The most used types of tests were the practical problem, completion, true-false, multiple choice, identification, and matching. Combinations of these tests were preferred by many teachers. Such tests should be given about every three weeks. The best method of presenting a drawing test is to give each student a mimeographed copy. Grading should be objective and take a minimum of the teacher's time. The test should be returned to the student after it is scored, so he may correct and review it. Standardized tests could be used to advantage in helping the teacher to compare his classes, students, and himself.

Recommendations

In the light of the findings of the study, it appears reasonable to make the following recommendations:
1. A further study should be made of the testing programs as used in other industrial arts subjects.

2. A study of the testing programs used in mechanical drawing should be made in other states, so they could be compared.

3. Mechanical drawing teachers should take advantage of the tests available through professional literature and magazines.

4. The standardized test should be fitted to the course of study or the text if it is to be used by the majority of the teachers.

5. More time should be spent on the testing program in mechanical drawing. Since more students become skilled technicians than draftsmen, the technical knowledge should not be slighted.

6. Testing preferably should be done every three weeks in mechanical drawing. If this is not practical, the tests may be given at six week intervals or at the end of each unit.

7. Use combinations of the following types of tests; practical problems, completion, true-false, multiple choice; identification, and matching.

8. The mechanical drawing teacher should give standardized tests at the beginning and at the end of the school year to help measure student achievement and to give a truer picture of the progress of his classes.
9. Use mimeograph copies to present mechanical drawing tests. If this is impossible, the blackboard is the next choice. A few tests presented with blueprints will add variety and increase student interest.

10. Five factors which the drawing teacher will want to consider in grading the student are: quality of work, quantity of work, effort put forth, knowledge of facts, and proper attitude.

11. Be objective in grading tests. Use a key for all tests. The test grades usually count one-third or one-fourth on the student's final grade.

12. Have the students correct and review each test after it has been scored.

13. After the test has been given, study the weaknesses as shown by student reaction, and try to improve the test so it will more nearly fit the needs.
APPENDIX

April 28, 1949

Dear Fellow-teacher:

I am making a survey on the testing methods used in mechanical drawing in the State of Texas. The attached questionnaire should not take over ten minutes of your time. Enclosed also are three different published tests in mechanical drawing. Would you please check on the questionnaire the one you think would fit your needs best. You may have the tests.

Please use the self-addressed envelope to return the questionnaire as soon as possible. Thank you for your assistance.

Yours sincerely,

Tom McIlvain
Department of Mechanical Drawing
Carlsbad High School
Carlsbad, New Mexico

Enclosures
1. Do you think the testing program is adequate in mechanical drawing in your school? Yes____ No____

2. How often should tests in mechanical drawing be given? Each week__ Every two weeks__ Every three weeks__ Every Month__ Six weeks__

3. What type of test do you prefer? Essay__ True-False__ Multiple choice__ Completion__ Matching__ Identification__ Practical problems__ Other types__

4. What type of test do you give most often?________________

5. What is the best method of presenting a mechanical drawing test? Mimeoograph copies__ Blackboard__ Teacher reads questions__ Students take questions from book__ Other methods__

6. How do you present most of your tests?________________

7. What percent of the student's grade does your tests count?__________

8. Would a standardized test for first-year drawing be practical in your school? Yes__ No__ Why?________

9. Do you check your students (or yourself) by using a test made up by some authority in the mechanical drawing field? Yes__ No__

10. Do you have your students correct and review over tests after they have been graded? Yes__ No__

11. Can you score or grade your tests quickly, accurately and objectively? Yes__ No__

12. How could we improve our testing program in mechanical drawing?

13. Which of these standardized tests do you prefer? Check one:
   ______ "Mechanical Drawing Test," by Schoonover, Jackson and Schrammel.
   ______ "Reading Problems in Mechanical Drawing," by Charles Quinlan, Jr.
Name ........................................ School ........................................
Age ........................................ Grade ........................................ State ........................................ Date ........................................

PART I

DIRECTIONS: Study the drawings on this page carefully. In the "List of Answers" find the word which matches each of the items listed below, and write the number of this answer in the parenthesis before the statement. The numbers of the items correspond to the numbers of the figures.

List of Answers
1. Arc
2. Babbitt
3. Brass
4. Cast iron
5. Chord
6. Circle
7. Cone
8. Concrete
9. Ellipse
10. Hexagon
11. Leader
12. Octagon
13. Parallelogram
14. Polygon
15. Pyramid
16. Rectangle
17. Sphere
18. Steel
19. Trapezoid
20. Trapezium
21. Triangle
22. Wrought iron
23. Wedge
24. Prusium

What do the conventions of figure 1-4 represent?
( ) 1. Fig. 1
( ) 2. Fig. 2
( ) 3. Fig. 3
( ) 4. Fig. 4

What is the name of the sections shown in figures 5-12?
( ) 5. Fig. 5: Plane A-B is perpendicular to vertical, and parallel to horizontal.
( ) 6. Fig. 6: Plane A-B is parallel to vertical, and inclined to horizontal.
( ) 7. Fig. 7: Plane A-B is parallel to horizontal, and perpendicular to vertical.
( ) 8. Fig. 8: Plane A-B is inclined to horizontal, and perpendicular to vertical.
( ) 9. Fig. 9: Plane A-B is perpendicular to vertical, and inclined to horizontal.
( ) 10. Fig. 10: Plane A-B is parallel to horizontal, and perpendicular to vertical.
( ) 11. Fig. 11: Plane A-B is parallel to vertical, and perpendicular to horizontal.
( ) 12. Fig. 12: Plane A-B is inclined to vertical, and perpendicular to horizontal.

What is the name of the objects shown in figures 13-15?
( ) 13. Fig. 13
( ) 14. Fig. 14
( ) 15. Fig. 15

What is the name of this figure?
( ) 16. Fig. 16

Published 1937. All rights reserved.
PART II

DIRECTIONS: Place the number of the part which makes the best answer to the statement in the parenthesis before the statement. The example has been correctly marked.

Example:

(2) A square prism is: 1. a plane figure. 2. a solid. 3. a drawing instrument.

(17) Lines that represent edges and cannot be seen on the view should be shown by: 1. short dashed. 2. a light solid line. 3. a light line composed of short and long dashes. 4. alternate dots and long dashes.

(18) Sections are views with a part removed to: 1. show more clearly the interior construction. 2. show what the object is made. 3. give the drawing a better appearance. 4. reduce work.

(19) An assembly drawing is a working drawing used: 1. as an index to detail drawings. 2. for general illustration. 3. for a guide in assembling. 4. for all of the foregoing purposes.

(20) When ruling lines with the T-square use the: 1. upper edge. 2. lower edge. 3. either edge. 4. the head of the T-square.

(21) A tin cup has the shape of a: 1. polygon. 2. sphere. 3. cylinder. 4. octagon.

(22) All dimensions read from the: 1. bottom and right sides. 2. left and bottom sides. 3. top and left sides. 4. top and bottom sides.

(23) The type of point for a drawing pencil is: 1. short and dull. 2. short and sharp. 3. long and sharp. 4. like that of an ordinary writing pencil.

(24) Blueprints are: 1. printed like newspapers. 2. made by drawing with white ink on blue paper. 3. made by exposing sensitized paper to a bright light and then washing the paper in water. 4. ex—posing the drawing to chemicals to change the colors.

(25) Orthographic working drawings are most commonly used because: 1. they are the easier to make. 2. they are more easily understood. 3. this is the best method of showing size and shape of objects. 4. they are attractive in appearance.

(26) In the United States, working drawings are made by: 1. first angle projection. 2. second angle projection. 3. third angle projection. 4. fourth angle projection.

(27) An "HB" drawing pencil is harder than: (1) HH (2) 2H (3) 3H (4) 2B.

(28) The portion of a circle used in dimensioning is the: 1. diameter. 2. radius. 3. chord. 4. arc.

PART III

DIRECTIONS: Read the following sentences carefully. If a statement is true, place a plus (+) in the parenthesis before the statement; if the statement is false, place a minus (−) in the parenthesis, as shown in the examples below. Make the plus and minus small and clear.

Examples: (+) Drawing ink is made of carbon.
(−) Tracing cloth is made of silk.

(29) The scale to which a drawing is made should be placed in the title block.
(30) The small detail dimensions should be placed outside the over-all dimensions.
(31) A number of detail drawings on the same plate should use the same scale.
(32) An auxiliary view does not give the true shape of the part shown.
(33) Cross sections are shown on the right side of the view.
(34) Sections of adjacent parts should be crosshatched in assembly drawings.
(35) Half or whole sections of problems are cylindrical in shape.
(36) Dimensions on isometric drawings are on horizontal lines.
(37) It is poor practice to place dimensions on center lines.
(38) A square-head bolt used for ordinary purposes has U. S. Standard V-threads.
(39) A bolt threaded at both ends is called a through bolt.
(40) When the ink on a drawing does not dry quickly, use a blotter.
(41) The small piece of metal driven into the slot on a pulley is called a key.
(42) A plane cutting a cone parallel to the base forms an ellipse.
(43) One view of a cylinder forms a rectangle.
(44) Chalk dust may be used on tracing paper to prepare the surface for inking.
(45) Water will harm the surface of tracing cloth.
(46) Working drawings appear much the same as a photograph of the object.
(47) An H pencil is harder than a B.
(48) The ruling pen should be used in lettering with ink.
(49) The dimension line is about half as wide as the main object line.
(50) Center and extension or witness lines are the same thing.
(51) Leaders are used in the title strip.
(52) The shape of an isometric circle is elliptical.
(53) The first dash of a dotted line should not touch a solid line.
PART IV

DIRECTIONS: From the list of answers in Column II select the word or phrase which matches each item of Column I and write the number of the answer in the parenthesis at the left of the item. The answers of Column II may be matched with the items of the same section only. The example has been correctly marked.

Example: ( 5 ) The instrument used in making irregular curves

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) 54. Lines that are level or parallel to the horizon</td>
<td>1. Acute angle</td>
</tr>
<tr>
<td>( ) 55. Lines that are at right angles to the horizon</td>
<td>2. Caps</td>
</tr>
<tr>
<td>( ) 56. Lines that are constantly changing their direction</td>
<td>3. Curved</td>
</tr>
<tr>
<td>( ) 57. Lines that are always the same distance apart</td>
<td>4. Equilateral</td>
</tr>
<tr>
<td>( ) 58. Lines that are at right angles to each other</td>
<td>5. French curve</td>
</tr>
<tr>
<td>( ) 59. Angles of less than 90 degrees</td>
<td>6. Horizontal</td>
</tr>
<tr>
<td>( ) 60. Angles of more than 90 degrees</td>
<td>7. Inclined</td>
</tr>
<tr>
<td>( ) 61. Angles of 90 degrees</td>
<td>8. Lower case</td>
</tr>
<tr>
<td>( ) 62. Capital letters</td>
<td>9. Oblique angle</td>
</tr>
<tr>
<td>( ) 63. Small letters</td>
<td>10. Orthographic</td>
</tr>
<tr>
<td>( ) 64. A figure that has three equal sides</td>
<td>11. Parallel</td>
</tr>
<tr>
<td>( ) 65. A figure that has four equal sides and four right angles</td>
<td>12. Perpendicular</td>
</tr>
<tr>
<td>( ) 66. A four-sided figure with opposite sides equal and parallel</td>
<td>13. Projection</td>
</tr>
<tr>
<td>( ) 67. A figure having five equal sides</td>
<td>14. Radius</td>
</tr>
<tr>
<td>( ) 68. A figure having six equal sides</td>
<td>15. Right Angle</td>
</tr>
<tr>
<td>( ) 69. A figure having eight equal sides</td>
<td>16. Tangent</td>
</tr>
<tr>
<td>( ) 70. A figure having ten equal sides</td>
<td>17. Vertical</td>
</tr>
<tr>
<td>( ) 71. The special name for half of a circumference</td>
<td>1. Arc</td>
</tr>
<tr>
<td>( ) 72. The general term for a part of a circumference</td>
<td>2. Cube</td>
</tr>
<tr>
<td>( ) 73. Distance from center to circumference</td>
<td>3. Cylinder</td>
</tr>
<tr>
<td>( ) 74. A solid bounded by six square sides</td>
<td>4. Diameter</td>
</tr>
</tbody>
</table>

( ) 75. Texture of a 4H drawing pencil
( ) 76. Proper drawing pencil for lettering and sketching
( ) 77. The upper edge of a T-square
( ) 78. The instrument used in constructing vertical and inclined lines
( ) 79. The instrument used for constructing angles that are not standard
( ) 80. The type of scale used for first year mechanical drawing
( ) 81. Instrument for drawing circles
( ) 82. Instruments used for transferring distances
( ) 83. Instruments used for inking straight lines
( ) 84. Instruments with a spring head
( ) 85. Parts of inking instruments that touch the paper
( ) 86. Ink used for mechanical drawing
( ) 87. Material for cleaning instruments
( ) 88. Best types of light for drafting
( ) 89. Working edge

PART V

DIRECTIONS: If the actual distance between two points on a drawing is two inches, what distance does that space represent with each of the following scales? Write your answer on the line at the left of each item. The example has been correctly marked.

Example: 10. A one inch equals five feet and no inches

<table>
<thead>
<tr>
<th>Item</th>
<th>Distance Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>88.</td>
<td>One-eighth of an inch equals one foot and no inches</td>
</tr>
<tr>
<td>89.</td>
<td>One-fourth of an inch equals one inch</td>
</tr>
<tr>
<td>90.</td>
<td>One inch equals one foot and no inches</td>
</tr>
<tr>
<td>91.</td>
<td>Six inches equal one foot and no inches</td>
</tr>
<tr>
<td>92.</td>
<td>One-half inch equals one inch</td>
</tr>
<tr>
<td>93.</td>
<td>One inch equals one inch</td>
</tr>
</tbody>
</table>
PART VI

DIRECTIONS: The accompanying figure is a mechanical drawing of an offset bracket. Dimensions for all of the parts are given on one of the three views. Determine the distance that each letter represents, and write your answer on the short line following the same letter beneath the drawing. Be sure to specify whether the answer is in feet or inches, as 2'-3", 3'-0".

100. F ........................................  }
Reading Problems in Mechanical Drawing, by Charles Quinlan, Jr.

Published by THE MANUAL ARTS PRESS, Peoria, Illinois

**DIRECTIONS**—A circle indicates the location of a missing view in each of the drawings shown below. All missing views are given in the section at the extreme bottom of the sheet. This problem consists of making each drawing read correctly by placing the number of its missing view in the circle given. Four points for each view correctly identified will give your score. Bear in mind the following conditions:

1. The same view may be the correct answer for more than one drawing.
2. Although drawings may have more than one solution, only the one given here will be considered correct.
3. Missing views are drawn in the correct position and are not to be used in any other.

**SUGGESTED PROCEDURE**—After studying the two views given, sketch the missing view on a sheet of scrap paper and compare it with those given.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |

**Copyright. 1919, by Charles Quinlan, Jr.**

Student ___________________ Group ___________ Allotted Time _______ Score ___________
MD-4. TRUE-FALSE TEST FOR MECHANICAL DRAWING

Directions: Underline the word in the parenthesis that makes each of the following sentences read correctly. Time—5 minutes.

1. The (top) (end) view of an object never gives the height.
2. A 6H pencil is (harder) (softer) than a 4H pencil.
3. When inking a drawing (arcs) (straight lines) should be made first.
4. Hidden lines are made (lighter) (heavier) than dimension lines.
5. Section lines are ordinarily drawn at an angle of (45) (15) degrees with the horizontal.
6. When drawing vertical lines the (triangle) (T-square) is used as a straight edge.
7. For holes to be bored or drilled the (diameter) (radius) is usually given.
8. Horizontal lines should be drawn by right-handed persons from (left to right) (right to left).
9. Vertical lines are usually drawn (before) (after) horizontal lines.
10. Dimension figures should be drawn (parallel) (at right angles) to dimension lines.
11. For an arc of a circle the (radius) (diameter) is usually given.
12. For vertical lines a right-handed person usually uses the triangle with the ruling edge to the (right) (left).
13. Vertical lines should be drawn (toward) (away from) the T-square.
14. Inclined lines should be drawn (before) (after) vertical lines.
15. Dimensions (should) (should not) be given on center lines.
16. The (bottom) (top) horizontal lines of a drawing are usually inked first.
17. Views showing circular forms of objects should be drawn (first) (last).
18. A cross-hatching line always (stops at) (goes over) a hidden line.
19. Circles are ordinarily located by means of their (centers) (circumferences).
20. Fractions should be made with a (horizontal) (diagonal) division line.
21. If a right-circular cylinder appears as a circle in the top view the front view will be a (rectangle) (triangle).
22. Vertical dimensions should be legible from the (right) (left) end of the sheet.
23. In an isometric drawing the axes are at an angle of (90) (120) degrees to one another.
24. Dimension lines (should) (should not) be made as extensions of visible object lines.
25. When dimensions of parts of an object are measured continuously the dimensions should be (staggered) (aligned).

Your Name

Grade or Classification

School

Number Right
SOME MECHANICAL-DRAWING TESTS

by

August Flam

True-False

1. Lettering is of no particular importance in mechanical drawing.
2. Guide lines should never be drawn for the tops and bottoms of each line of lettering.
3. The shapes of the figures used on drawing are just as different from those used in ordinary figuring as the letters are from ordinary writing.
4. A $\frac{1}{8}$H pencil is harder than a 2H pencil.
5. Of the two pencils the $\frac{1}{8}$H is used for lettering and the 2H for lines.
6. In orthographic projection, objects are represented by a single view.
7. Since it is necessary to describe every part of an object, all surfaces must be represented whether they can actually be seen or not.
8. Horizontal lines may be drawn with either the top or bottom of the T-square.
9. The top view of an object never gives the height.
10. Surfaces which exist but which are invisible are represented by long and short dashes alternating.
11. Where the interior of an object is not very complicated, a section should be taken.
12. When two pieces are shown in section together, they are cross sectioned by lines running in the same direction.
13. Such parts as bolts, nuts, screws, and shafts are not usually sectioned.
14. The two essential things to be told about an object are its shape and size.
15. If a circle is parallel to a plane, its projection on that plane is a straight line.
16. The dimension line is made up of long dash lines.
17. The same dimension is not repeated on different views unless there is a special reason for it.
18. Dimensions should never be given from center lines.
19. A line of the drawing should never be used as a dimension line.
20. The drawing of a separate part is called a "detail drawing."

MECHANICAL-DRAWING TESTS
by
M. E. Wirth

Multiple-choice

1. A working drawing
   a. is a picture drawing
   b. shows one view without dimensions
   c. shows the necessary views and dimensions
   d. is always a sketch
   e. is drawn for the draftsman

2. A T-square is used to
   a. draw circles
   b. sketch with
c. draw vertical line
   d. draw horizontal lines
   e. test wood when planing

3. One of the angles in the 30-60 triangle is equal to
   a. 42 degrees
   b. 45 degrees
c. 50 degrees
   d. 90 degrees
e. 180 degrees

4. Both of the draftsman’s triangles have and angle of
   a. 30 degrees
   b. 60 degrees
c. 45 degrees
   d. 360 degrees
   e. 90 degrees

5. The draftsman’s triangle is used to draw
   a. arrowheads
d. arcs
   b. circles
e. vertical lines
   c. vertical lines

6. An over-all dimension gives the
   a. radius of an arc
d. dimension of a part of
   b. diameter of a hole the object
c. distance between
e. length of a drawing
   extreme points

7. The top view of an object is placed
   a. below the front view
d. to the right of the front
   b. above the front view view
c. to the left of the
e. in the center of the paper
   front view

8. The compasses are used to draw
   a. horizontal lines
d. inclined lines
   b. vertical lines
e. straight lines
   c. arcs

9. The needle point on the compasses should project beyond the lead point about
   a. 1/16 in.
d. 1/8 in.
b. 1/32 in.
e. 1/8 in.
c. 1/64 in.

10. Most objects have
    a. three over-all dimension
d. two over-all dimensions
    b. five over-all dimensions
e. four over-all dimensions
    c. one over-all dimensions

Completion Test

1. The _______ and _______ views of a simple solid object are usually required to fully describe it.

2. Surfaces which exist but which are invisible are shown by means of _______.

3. The _______ view of an object never shows the height.

4. A vertical line is one which is at right angles to a _______.

5. To draw an object 3 ft. long in a space which is but 1/4 in. long, a scale of _______ per foot should be used.

6. The usual slant of section lining is _______.

7. Such machine parts as _______ and _______ are never sectioned on a drawing.

8. The section lining on a small piece would be _______ than the section lining on a large piece.

9. In order to construct an ellipse we must have given the _______ and the _______.

10. The number of threads per inch of threaded length on a bolt is termed its _______.

11. The form of screw threads most commonly used in this country is the _______ thread.

12. A small threaded hole is said to be _______.

13. When a right circular cylinder is developed (stretched out), the figure that results is a _______.

14. A regular hexagon may be constructed when we have given (1) _______, or (2) _______.

15. The two arrowheads at the end of a pair of dimension lines should always point _______.

16. Orthographic projection represents an object on _______ which are at _______ angles to each other.

17. A center line is made up of _______.

18. A surface slanting in the front view is _______ in the end view.

19. In inking a pencil drawing, the ink lines should be of _______ thickness.

20. A half section shows the _______ of half the object, and the _______ of the other half.

---

3 Flam, op. cit., p. 150.
MECHANICAL-DRAWING TEST FOR SECOND-YEAR
STUDENTS IN HIGH SCHOOL

by
Hugh Norris

Underline the correct answer
1. The object lines of a drawing should be a (light, dot-
and dash, short dash, heavy) line.
2. The center line is made by a (dotted, short-dash, dot-
and dash, long dash) line.
3. When inking in a drawing, first draw the (border, object,
center, section) lines.
4. The lines connecting any parts of a drawing are
(dimension, extension, section, center) lines.
5. The dimension, or arrowhead lines are (dotted, fine
solid, heavy solid, heavy dotted) lines.
6. Angles are measured in (rods, meters, degrees, fathoms).
7. An obtuse angle is (greater, the same, smaller, longer)
than a right angle.
8. A right angle has (45, 90, 180, 360) degrees.
9. The radius of a circle will step around the circumference
(three, four, six, eight) times.
10. Any straight line passing through the center of a
circle, from side to side, is a (tangent, arc, radius,
diameter).
11. A regular polygon cannot have (two, three, four, six)
sides.
12. A rectangle is a straight-line figure whose opposite
sides are (equal, not equal) and whose angles are
(right angles, not right angles).
13. A cube might have (three, four, six, eight) sides.
14. The section of a cone, pyramid, or prism that is left
after the upper part has been cut off is called
(cylinder, sphere, truncated).
15. A triangle which has three equal sides is a (right-angle
triangle, equilateral triangle, parallelogram, rectangle).

Hugh Norris, "Mechanical Drawing Test For Second-Year
Students in High School," Industrial Arts and Vocational
MECHANICAL-DRAWING TEST

by

M. R. Klein

Fill in the blanks, indicating the meaning of the abbreviations.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dia.</td>
</tr>
<tr>
<td>2.</td>
<td>Circum.</td>
</tr>
<tr>
<td>3.</td>
<td>C'sink</td>
</tr>
<tr>
<td>4.</td>
<td>C. L.</td>
</tr>
<tr>
<td>5.</td>
<td>C'bоро</td>
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<tr>
<td>6.</td>
<td>Hd.</td>
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<tr>
<td>7.</td>
<td>Sq.</td>
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<td>8.</td>
<td>Std.</td>
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<td>9.</td>
<td>Scr.</td>
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<td>C. I.</td>
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<td>C.R.S.</td>
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<td>W. I.</td>
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<td>T. S.</td>
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<tr>
<td>17.</td>
<td>L. H.</td>
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<tr>
<td>18.</td>
<td>R. H.</td>
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<tr>
<td>19.</td>
<td>Min.</td>
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<tr>
<td>20.</td>
<td>Max.</td>
</tr>
<tr>
<td>22.</td>
<td>F.A.O.</td>
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<tr>
<td>23.</td>
<td>B. &amp; S.</td>
</tr>
<tr>
<td>25.</td>
<td>Fil.</td>
</tr>
<tr>
<td>27.</td>
<td>B.W.G.</td>
</tr>
<tr>
<td>28.</td>
<td>U.S.S.</td>
</tr>
<tr>
<td>29.</td>
<td>H.S.S.</td>
</tr>
<tr>
<td>30.</td>
<td>S.A.E.</td>
</tr>
<tr>
<td>31.</td>
<td>Gr.</td>
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<tr>
<td>32.</td>
<td>Dbl.</td>
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<tr>
<td>33.</td>
<td>Hex.</td>
</tr>
<tr>
<td>34.</td>
<td>Tnd.</td>
</tr>
<tr>
<td>35.</td>
<td>Hn.</td>
</tr>
<tr>
<td>36.</td>
<td>U.S.F.</td>
</tr>
<tr>
<td>37.</td>
<td>A.S.M.E.</td>
</tr>
<tr>
<td>38.</td>
<td>M.I.</td>
</tr>
<tr>
<td>39.</td>
<td>N.C.Thread</td>
</tr>
<tr>
<td>40.</td>
<td>N.F.Thread</td>
</tr>
</tbody>
</table>

### VOCABULARY TEST FOR MECHANICAL DRAFTING CLASS

By

Walter G. Hjortstedt

**Matching**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A short, metal, boltlike fastening, without threads, which is clinched by hammering.</td>
<td>Casting</td>
</tr>
<tr>
<td>2</td>
<td>The distance from one thread point of a screw thread to the next, measured parallel to the axis.</td>
<td>Countersink</td>
</tr>
<tr>
<td>3</td>
<td>The distance which a screw will move along the axis in one turn.</td>
<td>Clearance</td>
</tr>
<tr>
<td>4</td>
<td>To smooth the surface of a hole and finish it to size for a running fit.</td>
<td>Perspective</td>
</tr>
<tr>
<td>5</td>
<td>To recess a hole conically for the head of a screw or rivet.</td>
<td>Rivet</td>
</tr>
<tr>
<td>6</td>
<td>To define difference in dimensions to allow for variations in manufacture.</td>
<td>Ream</td>
</tr>
<tr>
<td>7</td>
<td>A gradual and uniform decrease in size.</td>
<td>Bolt</td>
</tr>
<tr>
<td>8</td>
<td>A circular disk cast or attached to some mechanical part.</td>
<td>Taper</td>
</tr>
<tr>
<td>9</td>
<td>A fastening; commonly a piece of metal with head, and threaded body for the reception of a nut.</td>
<td>Pitch</td>
</tr>
<tr>
<td>10</td>
<td>The metal part made by pouring metal, when in a liquid state; into a mold.</td>
<td>Fillister</td>
</tr>
<tr>
<td>11</td>
<td>A projection of irregular shape as from a casting.</td>
<td>Lug</td>
</tr>
<tr>
<td>12</td>
<td>The amount of space, open or free, between adjacent parts.</td>
<td>Boss</td>
</tr>
<tr>
<td>13</td>
<td>Resulting from or established by custom.</td>
<td>Tolerance</td>
</tr>
<tr>
<td>14</td>
<td>The art or science of representing on a plane surface objects as they actually appear to the eye.</td>
<td>Conventional</td>
</tr>
<tr>
<td>15</td>
<td>A cylindrical head of a cap screw slotted for a screw driver.</td>
<td>Lead</td>
</tr>
</tbody>
</table>

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Walter G. Hjortstedt, "Vocabulary Test for Mechanical Drafting Class," *Industrial Arts and Vocational Education*, XXXIV (June, 1945), p. 256.
ASSOCIATION TEST FOR MECHANICAL DRAWING

BY

Hugh Norris

Identify each of the symbols shown by placing the proper number before each of the names.

1. Right angle
2. Circle
3. Semi-circle
4. Obtuse angle
5. Tangent
6. Parallel lines
7. End view
8. Acute angle
9. Top view
10. Truncated
11. Top view
12. Development
13. Side view
14. Threads
15. Radius
16. Direction
17. Section
18. Swinging door
19. Riveting
20. Thickness of nut
21. Isometric projection
22. Eraser
23. Protractor
24. Width of nut
25. Perpendicular
26. Lettering

\[ w = \frac{1}{2} d + \frac{1}{8} \]

\[ T = \frac{5}{4} d + \frac{1}{16} \]

\[ \text{Norris, op. cit., p. 13.} \]
AN ACCURACY TEST FOR THE DRAFTING ROOM

by

H. V. Olds

The following test problem can be placed on a 7 by 9 in. working space. All lines should be light construction lines.

1. Draw a horizontal line 1½ in. above the lower border line.
2. Upon this line, locate point A, 2 in. from the left-hand border line.
3. From A draw a vertical line upward, and upon this line located point B, 2 3/4 in., using a full-sized scale.
4. From B draw a line at 45 deg. upward to the right, and upon this line locate point C, 2 ft., 7 1/2 in. to a scale of 1 in. equals 1 ft.
5. From point C draw a line down and toward the left, making 60 deg. with the horizontal. Upon this line locate point D, 7 ft., 6 in. from C, laying off the dimension to a scale of 1 in. equals 1 ft.
6. Through D draw a horizontal line, and upon this line locate E, 2 3/4 in. to the right of D, using a full-sized scale.
7. From point E draw a line making 60 degrees with the horizontal and slanting upward to the left. Upon this line locate point F 3 ft. 9 in. from E, using a scale 1 in. equals 1 ft.
8. Through F draw a horizontal line to the right, and upon it locate point G, 16 in. from F to a scale of 1 1/2 in. equals 1 ft.
9. From G drop a vertical line downward and upon it to a scale of 3 in. equals 1 ft., locate H 20 1/2 in. from G.
10. Through H draw a horizontal line to the left. Upon this line locate point J, 5 in. from H using a full-sized scale.

BIBLIOGRAPHY

Books


Public Documents


State Department of Education, Regulations, Standards and Activities of the Division of Supervision, 1941-1942, Bulletin No. 459, pp. 139-194.

Published Tests


Articles


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Coltharp, R. J., "Pretest of Industrial Arts Lab Classes," Industrial Arts and Vocational Education, XXXI (January, 1942), p. 16.


