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PUBLISHED BY THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION.

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The third edition of this nationally used text is up-to-date and in line with the most modern practices. New material has been added to the basic chapters on Lettering, Multiview Drawing, Sectioning, Auxiliary Views, and Dimensioning. Much useful information on industrial practices is included and the full chapter on shop practices is prepared with the advice and help of various industrial concerns. All problem layouts have been changed to agree with the American Standard size of $8\frac{1}{2}$ x 11, 11 x 17, etc., and wherever necessary, drawings have been enlarged to enable them to be read with ease. More than 200 new or improved illustrations are contained in the new edition. Throughout, the text is in accord with the American Standard Drawing and Drafting Room Practice, which is reproduced in full in the appendix. **$4.50**

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JOURNAL OF ENGINEERING DRAWING

PUBLISHED IN THE INTEREST OF TEACHERS OF ENGINEERING DRAWING AND RELATED SUBJECTS

VOL. 15, NO. 3 NOVEMBER, 1951 SERIES NO. 45

CONTENTS

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PUBLISHED IN FEBRUARY, MAY, AND NOVEMBER BY THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

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DIVISION OF ENGINEERING DRAWING

OF THE

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

RESOLVED:

THAT, WITH THE PRESENTATION OF THIS AWARD, THE ENGINEERING DRAWING DIVISION OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION BY THIS TOKEN ACKNOWLEDGES THE MANY DISTINGUISHED SERVICES RENDERED BY

FREDERICK E. GIESECKE

THROUGH THE YEARS 1893 - 1951

THE SOCIETY EXPRESSES ITS DEEP APPRECIATION FOR THOSE SERVICES, AND THE GREAT PERSONAL PLEASURE OF THE INDIVIDUAL MEMBERS IN HAVING HIS FRIENDSHIP.

PRESENTED THIS TWENTY-SIXTH DAY OF JUNE IN THE YEAR OF OUR LORD NINETEEN HUNDRED FIFTY-ONE.

ASEE

Ralph S. Paffenbarger

Chairman of the Division

Clifford H. Springer

Secretary of the Division

MID-WINTER CONFERENCE OF DRAWING DIVISION

A.S.E.E.

JANUARY 23, 1952 AT THE COOPER UNION

8:30-10:00 A.M.
1. Registration
2. Inspection of Department of Machine Design & Engineering Drawing
3. Tour of Historic Foundation Building of The Cooper Union for those who desire it.

10:00-11:30 A.M. Meeting:
1. Greetings:-Dr. Edwin S. Burdell, President of The Cooper Union
2. Welcome from the Engineering School:-Dean Norman L. Towle
3. Response for the Division:-Professor Clifford Springer, Chairman of the Division
4. Descriptive Geometry in Shipbuilding:-Mr. Renato P. Iodice-Assistant to the Naval Architect, Gulf Oil Company-Part-time Instructor, The Cooper Union Evening School
5. Questions

12:00 Noon Luncheon

1:00-1:20 P.M. Board buses for New York Naval Shipyard

2:00-4:15 P.M. New York Naval Shipyard
1. Welcome:-Rear Admiral P.B. Nibecker, Commander, New York Naval Shipyard
2. "Mold Loft Demonstration of the Development of a Shell Plate" by Lieutenant W.J. Dixon - Production Department
3. Tour of Shipfitter Shop
4. Tour of Ship under conversion

5:00 P.M. Arrive back at The Cooper Union. Open house for those who wish to come.

WOMEN'S PROGRAM

8:30-10:00 A.M. Registration, reception by The Cooper Union Women's Club

10:30 A.M.-12:00 Noon Trip to television studio including a program

12:30-2:00 P.M. Luncheon: Engineering Women's Club

2:00-4:15 P.M. Sightseeing tour of Greenwich Village, Chinatown, Old New York, The Battery, including all points of interest

4:15 P.M. Tea and open house at The Cooper Union

Tickets for Radio City Music Hall will be available for those who want them for the evening.

* * * * *

JANUARY 24, 1952 at THE UNITED STATES MILITARY ACADEMY West Point, N.Y.

8:30 A.M. Leave New York City by special bus

10:30 A.M. Arrive at West Point

11:00 A.M.-1:00 P.M. A. Men's Program, in the Department of Military Topography and Graphics:
1. The mission of West Point
2. The over-all curriculum and its effect on fulfilling this mission
3. The part played by the Department of Military Topography and Graphics in this curriculum
4. A demonstration of the methods used
5. An exhibition of facilities, teaching aids, etc.

B. Women's Program

Conducted tour of kitchens, bakeries, cadet mess hall and museum, as time permits.

1:00 P.M. Luncheon at Hotel Thayer (both men and women

2:00-4:00 P.M. Conducted tour of the points of interest on the West Point Reservation, concluding with a short organ recital in the Cadet Chapel (both men and women)

NOTE: Opportunity will be provided between 3:00 and 4:00 p.m. for members of the party who have friends or relatives in the Cadet Corps to meet with them.

4:00 P.M. Return to New York City, arriving about 6:00 p.m.

* * * * *

JANUARY 25, 1952 at COLUMBIA UNIVERSITY

A. MEN'S PROGRAM

9:00 A.M. Inspection of the Department of Graphics (6th floor, Engineering Bldg.)

10:30 A.M. At Harkness Academic Theatre:

Paper 1. "The Integration of Drafting with the Photographic Process." Lloyd E. Varden, Technical Director, Pavelle Color, Inc.

Discussion

Paper 2. To be announced.

12:30 P.M. Luncheon, John Jay Hall Mezzanine

2:00 P.M. Trip 1. By special bus to Nevis. Inspection of the Columbia University Cyclotron.

Trip 2. Inspection of the photographic color processing plant of Pavelle Color.

B. WOMEN'S PROGRAM

Morning: 1. Shopping or sight-seeing. Guides will be provided to conduct the ladies to the various stores or points of interest.

1:00 P.M. Luncheon

(Continued on page 29)

THE COOPER UNION for the ADVANCEMENT OF SCIENCE AND ART

by

Prof. Edward M. Griswald

We at The Cooper Union welcome the opportunity to entertain the members of the Drawing Division of the A.S.E.E. at our school for the Midwinter Conference. We hope that many of you will honor us by a visit. It was our thought that you might like to know a little about this privately-endowed institution, which has been serving the people of New York for 92 years. So, we have prepared this thumbnail sketch of the school and its Founder.

The Cooper Union formally opened its doors to students on November 7, 1859. History says of the first registration day that there was a mob assembled so large and eager that the efforts to register students almost resulted in a riot. Every class was filled in one night. Since then, the times have been rare when the student body has not filled both buildings of The Cooper Union to capacity.

The Foundation Building is an eight-story structure which was erected by the Founder, Peter Cooper. It is located between 3rd and 4th Avenues at Cooper Square. The Hewitt Building is located between 6th and 7th Streets across Third Avenue from the Foundation Building. In the Ramapo Mountains of Northern New Jersey, The Cooper Union owns a 1,000 acre camp, known as the Green Engineering Camp. This camp is equipped for surveying work, for making hydrological tests and measurements, for painting and sketching by art students, and for recreation. The use of the Camp for recreation by groups of students properly organized and chaperoned is encouraged. Weekends and vacation periods are booked far in advance by organized camper groups. A fourday Freshman Orientation Session is held annually at the Camp in September.

Many people do not know that The Cooper Union is tuition-free. Every student who comes here has what amounts to a four-year scholarship in the School of Engineering, or a three-year scholarship in the Art School. The large number of applicants makes the selection of students a very important problem as we want to make reasonably sure that those who are admitted are the ones most capable of profiting by their scholarships. The first selection is based on the high school record, the second hurdle is a competitive examination, and finally for the applicants in the School of Engineering there is a personal interview.

Peter Cooper, the Founder of The Cooper Union, always styled himself "a mechanic of New York", a phrase which describes him well. He was an inventor, mechanical genius, and a successfully business man. His business activities included a glue factory and gelatin plant, one of the first steel-rolling mills in the United States at Trenton, New Jersey, and a large portion of the financing of the first Atlantic Cables. During the laying of the cables, his technical advice in overcoming the mechanical difficulties was eagerly sought. He also had a financial and technical interest in the development of land telegraphic communication during its early years. As a side line, of which he had many during his life time, he engineered and helped to build the "Tom Thumb", the first successful steam locomotive made in the United States for the Baltimore and Ohio Railroad competition. He personally operated the "Tom Thumb" on its trial runs and during its famous race with a horse. He gave technical advice freely on mechanical problems to many a young inventor who sought it. Many successful inventions of his day were quietly financed by him. One of those who sought his help was John Erickson, the designer of the Monitor. Cooper was active in New York City politics during much of his life. He served a number of terms as councilman and for many years was a member of the Board of Education.

The idea for The Cooper Union came to Cooper some 25 to 30 years before he was financially able to make his dream come true. During this time he had in the back of his mind the idea of a school that would provide young men and women with the opportunity for education, an opportunity he never had. His formal schooling ended with the fourth grade. Cooper early learned the value of books, but was unable to obtain many at a price that he could afford. This gave him the idea of a free public reading-room, where anyone could go and be able to borrow the books that he wanted to read, Peter Cooper's ideas developed and matured so that at the time of its establishment he was able to state the aim of The Cooper Union as: "To aid the efforts of youth to acquire useful knowledge, and to find and fill that place in the community where their capacity and talents can be usefully employed with the greatest advantage to themselves and the community in which they live." Peter Cooper, always a little ahead of his time, provided that no one should be excluded from The Cooper Union "because of sex, race, color, creed, or political opinion."

Peter Cooper was a firm believer in the republican form of government. He believed in self-reliance, in leaving the individual free to make his own decisions, in the integrity and perfectability of man, and in man's ability to operate a democratic government. He believed in philanthrophy as both a duty and the highest self-interest, and in education both as a right and as a practical and moral necessity. He sought to transform his beliefs into deeds through the establishment of his Union. The meanings which he gave to the work "union" help us to better appreciate his philosophy. On one occasion he stated that the word meant: "a union of science and art." Another interpretation which he himself gave was: "a union of effort to make a republican form of government a blessing to all." Both ideas were basic

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SCHOOL OF ENGINEERING COLUMBIA UNIVERSITY

by

Professor Frank Lee

The Columbia School of Engineering is happy to be joint hosts with the United States Military Academy and The Cooper Union to the drawing division of A.S.E.E. at their mid-winter meeting in January of 1952. We hope that those who attend will find the trip both profitable and enjoyable.

The School of Engineering at Columbia was formally established in 1864 as the first School of Mines in America. The humble beginning consisted of the "setting apart" of rooms in the College building for the use of the new school and the appropriation of $500 for "the purchase of cases for specimens." The original faculty of seven - Thomas Egleston, Francis L. Winton, Charles F. Chandler, William G. Peck, Charles A.Joy, J. Howard Van Amringo and John S. Newberry - served without salary!

Although the engineering school was not established until 1864, the engineering tradition at Columbia goes back to Kings College and early Columbia College.

Colonel Stevens of Hoboken (Kings, 1768) missed by only one day the reputation of being the inventor of the American steamboat, and later built an experimental track on his Hoboken estate and on it operated the first locomotive in the United States.

The most influential of the early forerunners of the School of Engineering was Professor James Renwick (Columbia College, 1807), who became professor of natural and experimental chemistry in 1820 and retained this post until 1854, when he became Columbia's first emeritus professor.

At the beginning, the course of study in the School of Mines was three years. In 1868 a fourth year was added and additional courses in metallurgy, geology and natural history, and in analytical and applied chemistry were instituted. A year later a course in civil engineering appeared, in 1881 a course in architecture; in 1889 electrical engineering and in 1897, mechanical engineering.

Chemical engineering was added as a department in 1908 and industrial engineering in 1919.

The evolution of engineering education at Columbia has followed an unusual pattern. Many American schools were initiated as mechanics institutes or similar schools of an intensely practical, largely vocational type. Through the years they have steadily moved forward in professional stature, giving greater emphasis to sound, basic instruction in the natural sciences and, more recently, with increasing attention to general education of the engineer. At Columbia, on the other hand, the present departments of natural science - notably Chemistry, Physics and Geology - were developed under the engineering faculty and were not separated until the early 90's when the Faculty of Pure Science was created. Similarly, the first School of Architecture began life as a department of the old School of Mines.

Thus, on the one hand, the tradition of engineering education at Columbia has always been strong on the scientific side while, at the same time, its close association with Columbia College, the liberal arts division of the University, has led to special emphasis on the general education of the engineer. As early as 1897 the so-called professional option plan was adopted with the college, whereby a student received both the A.B. and his engineering degree. In 1914 this optional plan was made obligatory and it has since been extended on a cooperative basis with a number of other liberal arts colleges.

Under this plan a student transfers to the Columbia School of Engineering at the end of his junior year, that is, after three years of liberal arts education with, naturally, special emphasis on science and mathematics. Upon the successful completion of his first year in engineering at Columbia he is granted his arts degree by the college of his origin. Another year of undergraduate engineering study follows, at the end of which he receives his bachelor of science degree under the sponsorship of one of the six major departments of the school - chemical, civil, electrical, industrial, mechanical or mining and metallurgical engineering.

It is also possible for a prospective engineering student to meet the basic requirements of these three "pre-engineering" years in two years by following a special program of intensive study - such as that offered by Columbia College - and, thus, receive his B.S. degree in engineering in four years.

Columbia thus offers the undergraduate either a four or five year course of combined liberal arts and engineering education with special emphasis on those fundamentals which have been so strongly emphasized in all studies of engineering education. But, due to the interests and activities of its staff and probably also to its location in the engineering center of the world, the school has also long been interested and active in research and graduate instruction. The first doctor's degree granted by Columbia was given under the School of Engineering in 1875 and special courses of study for master's candidates were initiated before 1916.

Here again, in its graduate offerings, the emphasis is on the more advanced aspects of engineering science. As research develops new techniques and methods these new findings are organized into formal graduate offerings and constant change and progress, continual adventuring into new fields of technical and professional interest, thus, characterize the Columbia tradition.

(Continued on page 31)

Photo courtesy Douglas Aircraft Co., Inc.

WHAT you see above is a real plane inside and out . . . except that it is made of plywood, inside and out. It is a "mockup" in which no pilot will ever seat himself, a make-believe that will never fly.

There is a sad analogy here to youngsters in every classroom, seemingly equipped in every respect for "flying", but in whom the pilot of self-direction, ambition, vision and daring will never take a seat, never to lift the personality above humdrum earth. These are boys who have become unconsciously convinced by vile circumstance that their bodies and minds are but "make-believes," who through misdirection and indifference will be consigned to the great scrapheap of life.

It is the task of all right-minded men of Education to show these boys they are equipped for the great adventure of life, the expansion of the horizons of the mind, the uplift of spirit, winging to new heights of conquest. No educator worthy of the name will disclaim this responsibility but shoulder it to the full. And *no* educator has greater opportunity to establish habits of right thinking, of clear thinking, of strength of purpose, of high standards, of unfaltering ambition than the instructor in mechanical drawing. Here is the study that abuts so closely on one of the most honorable careers in the world. Here he can cite as examples and inspiration the deeds of great engineers. Here he can appeal to the creative desire that is instinct in all. Here the boy uses tools of precision, tools of creation, tools that link hand and brain and reflect back into moral standards. Here is an opportunity without equal. Shall the instructor cast it away through carelessness on his part, through lack of respect for his subject or its tools? Can he say it does not matter what drawing instruments the young student will use? The risk attending such negligence is great. The need for such negligence does not exist. The thoughtful instructor *demands* his students have the best drawing instruments it is possible to buy.

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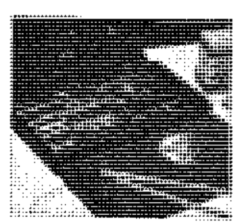

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EVERYTHING FOR DRAFTING AND SURVEYING

"WEST POINT" UNITED STATES MILITARY ACADEMY

by

Colonel L.E. Schick

The Academy is looking forward to the visits of the members of the Drawing Division, A.S.E.E., during West Point's part of the next mid-winter meeting. It is hoped that a large group will honor us with its presence as this meeting, which occurs during the Academy's Sesquicentennial Year, 1952.

The United States Military Academy traces its establishment to an Act of Congress dated 16 March 1802. It was initially located at West Point, a key Hudson River fortress during the Revolution, and has remained at this location continuously.

Two compelling reasons made the formation of an American military academy at that time both logical and necessary. The experience of the Revolutionary War, during which the United States had to rely almost entirely on foreign drillmasters, artillerists, engineers, and other military technicians, and the ominous international political situation, moved public opinion to demand better-trained military leaders. So it was that Congress authorized a military academy and set its strength at five officers and ten cadets, and provided that it should be stationed at West Point in the State of New York.

The original garrison site at West Point, consisting of 1795 acres just 50 miles north of New York City on the Hudson, had been occupied by American troops since 1778. Hence barracks and other buildings, although inadequate, were available for housing and instruction, and allowed Major Jonathan Williams, the first Superintendent, to open the Academy on 4 July 1802 with ten cadets present.

For the first ten years of its existence, the Academy struggled along at a very unimpressive scale. In 1812, the growing threat of war with England compelled Congress to increase the strength of the Corps of Cadets to 250, to enlarge the academic staff, and to place cadets at the Academy under the discipline of published regulations.

Following the War of 1812, the Academy's educational aims were once again affected by national interest. A young energetic nation required canals, roads, railroads, and exploitation of its natural resources. The development of the West required accurate mapping of rivers, development of channels, construction of lighthouses and beacon lights, in order to facilitate communication. The nation therefore turned to the Academy to develop leaders with the required capabilities.

In 1817 Colonel Sylvanus Thayer, now called the "Father of the Military Academy," was appointed Superintendent, Colonel Thayer, upon assuming his duties, molded the Academy on a two-fold course. First, he expanded the curriculum to develop excellence of character and excellence of knowledge, the two integrating qualities of leadership. He carefully guided the day-to-day routine of the Academy, constantly improving the character training, discipline, curriculum content, textbooks, teaching methods, extra-curricular activities, and physical plant, in order to produce men with of character, able to assume leadership. Secondly, Colonel Thayer grasped the need of the country for engineers; therefore he made courses in civil engineering subjects the core of the curriculum. Under his direction instruction in those subject included "the properties, preparations, and use of materials for construction; the art of construction generally, including decorative architecture; the manner of laying and constructing roads; the construction of bridges; the principles regulating the removal of obstructions impeding river navigation; the survey, location and construction of canals and railroads; and the formation of artificial and the improvement of natural harbors."

Many of the educational methods now employed at the Academy are direct results of the innovations made by Thayer. He constantly emphasized habits of regular daily study, he laid down the rule that every cadet must pass every course--and deficiency had to be made up within a specified time or the cadet would be dropped. To carry out his rigorous standards he limited classroom sections to 14 members; he rated these sections within each course in order of merit and directed that cadets be transferred from section to section as their averages rose or fell.

To the casual observer it might seem that until about 1860 West Point was filling the almost dual roles of being a national military academy and a national academy of civil engineering. But, despite the curricular emphasis on civil engineering and the renown of her graduates, the Academy never forgot her deepest and most abiding obligation to the nation--to send forth graduates trained in the art and science of war.

After the Civil War, changing conditions necessitated a shift in the Academy's curriculum away from the emphasis on civil engineering. Federal assistance in 1862 to the states for the endowment, support and maintenance of colleges, with branches of learning related to agriculture and the mechanical arts, enabled American education to expand enormously. New technical and engineering schools made it possible for the Academy to curtail its strong emphasis on engineering subjects. Even had these new schools not come into being, the Academy would have found it impossible to keep on producing adequately-trained engineers. Tremendous expansion of scientific knowledge during these years (last half of the 19th Century) was enforcing specialization in all technical fields. And,

(Continued on page 31)

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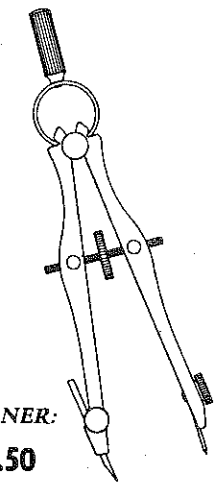

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PERSONALITY SKETCH OF PROFESSOR FRANCIS M. PORTER

The large number of cards and letters which Professor Francis Marion Porter received following the meeting of the Drawing Division at East Lansing, Michigan last June attest the feeling of close friendship and the high regard in which he is held by members of the Drawing Division.

Following his retirement from active teaching, as Professor Emeritus in 1949, ill health has limited Professor Porter's physical activity. His mental activity and in particular his love for descriptive geometry continue unabated. To visiting colleagues he often presents new and interesting solutions to difficult and novel descriptive geometry problems. Members of the drawing division have long recognized him as one of the leading authorities in this field.

Born on a farm near Tarlton, Ohio, February 14, 1881, Professor Porter got his education the hard way, walking four miles to and from high school each day, plus a few chores on the farm to round out the day. He worked his way through Ohio University by various jobs, one of which was assistant in Physics and Engineering Drawing. He received the degree of B.S. in E.E. in 1907.

His early habits of thorough painstaking work are still one of his great assets. He began his teaching career as an Assistant in the Department of General Engineering Drawing in 1907 and rose through the various academic ranks to full professorship. While carrying a full teaching load he earned his M.S. degree at the University of Illinois in 1911.

Professor Porter also found time for scholarly production. His text on Descriptive Geometry prepared in collaboration with Professor H.H. Jordan has long stood as one of the most thorough works in its field, covering as it does, both the classical Mongean and the auxiliary plane method. In this text as in his teaching Professor Porter strove always for rigorous analytical thinking.

In collaboration with Professor James T. Lendrum he prepared a text on Architectural Projections for the benefit of architectural students interested primarily in the application of Descriptive Geometry to their special field.

(Continued on page 12)

(Continued from page 11)

Although he carried the full responsibility of preparing the course material and thousands of problems in descriptive geometry for the department during most of his active career he always had time to help and encourage the slower students and to inspire and challenge the brilliant ones to their best efforts. His sincere interest in, and his friendliness toward his students are paying him fine dividends in letters and frequent visits from these former students.

Beside his academic work Professor Porter has always taken an active interest in Civic Affairs, being a member of the Board of Health of Urbana for a number of years and a member of the School Board for three years. Since 1917 he has been a Director of a local Building and Loan Association and is still active in this work. He was also a member of the Urbana Association of Commerce. He is a member of the Acacia Fraternity and Past Master of the Urbana Masonic Lodge. In all of these organizations he took a very active part.

He is a charter member of the Drawing Division of A.S.E.E. and contributed much to the success of this organization, being on its Executive Committee for five years. For three years he was Advertising Manager of the Journal of Engineering Drawing during its early and formative period, and editor of the T-square page shortly after this feature was introduced in the "Journal of Engineering Education".

He served as chairman of the committee on nomenclature in descriptive geometry which, after a most thorough study, presented a report which was accepted at the 1946 Summer School of the Drawing Division. He also compiled an extensive bibliography of Drawing and Descriptive Geometry texts which was published as a pamphlet and later with additional material as an appendix in the text Teaching of Mechanical Drawing by his colleague Professor R.P. Hoelscher.

Shortly after beginning his work at the University of Illinois, Professor Porter married his college sweetheart, Kathryn Jordan on September 10, 1908. Their four sons, David, John, Charles and Daniel are all married and are enjoying successful careers.

There are nine grandchildren and merry times occur when the young folks gather in the spacious family home for reunions.

All of the members of the Drawing Division who know him sincerely regret that his health no longer permits Professor Porter to attend our sessions where he contributed so much professionally and in fine friendship, good humor and good will.

FROM THE PRESIDENT'S DESK

C.E. Springer, Chairman
Drawing Division A.S.E.E.

Those who attended the Summer School for drawing teachers at Lansing last summer came away with a renewed enthusiasm for improving their teaching methods. The values of good teaching were thoroughly demonstrated and many helpful suggestions were given.

We all recognize that drawing and descriptive geometry are the subjects that we must teach and that nothing must be allowed to minimize their importance. However, our position as the first engineering teachers that our students meet seems to carry with it the responsibility of beginning their education in the ideals, aims, and ethics of engineering together with such necessary accomplishments as speaking, writing, and thinking clearly. Undoubtedly, we all have these aims in mind as we conduct our classes, but the mere act of writing them down may clarify our thoughts and confirm our intentions. Anything that we can do in this line can only be a beginning that must be carried on by their other engineering instructors.

Most people agree that engineers are frequently deficient in the ability to speak and write clearly. Many institutions have attempted to correct this by adding one or more courses in English and Public Speaking, but it is very doubtful if complete success can be obtained by this method unless each and every engineering course requires the use of these accomplishments to motivate their specialized courses.

By reason of their place in the curriculum and their course content, drawing and descriptive geometry provide ideal opportunities to begin this motivation. While the comprehensive examination with its multiple choice, true and false, and matching questions and other similar tests are very important and necessary, would it not be possible to require each student to write one short article and make one oral presentation before the class each semester without serious loss of time? Most of us by careful study and preparation could save the necessary time from our own discussion.

Clear thinking, logical reasoning, neatness and efficiency, personal and professional integrity and many other things should be by-products of our teaching without detracting from our teaching of subject matter. I know of no other profession that enjoys the confidence of the public to such an extent as the engineering profession. Does anyone hesitate to enter a building or cross a bridge for fear it will fall down? Who would doubt the ability of his automobile to complete a long trip or would even think that turning a switch might not cause the room to be lighted or the radio to produce singing commercials? Then should not every engineering instructor be instilling pride in the profession and a sense of responsibility to the public in each young student? Let us, as drawing teachers, set an example that other instructors may follow.

THE TRAINING AND EARLY EXPERIENCES OF THE ENGINEERING DRAWING TEACHER

by

Prof. J.S. Blackman

University of Nebraska

The specific title assigned for the discussion this morning is "The Training and early experiences of the Engineering Drawing Teacher" Someone has said a title is like a gate--it has two uses. You can either swing on it, or open it and pass through. I propose to swing on this title for a moment and then pass on through.

The thoughts I bring to you are neither new nor original, as you will see, but it is my hope that what I say may stimulate some of you to a greater awareness of the immense opportunity for improving the technical and personal tone of our engineering graduates through the medium of the required basic drawing courses taught in most engineering schools at the freshman and sophomore levels.

Engineering drawing is but one of a great many engineering subjects that the student must master to graduate. The basic drawing courses required of undergraduate engineers seldom are more than four to six per cent of the total course work required for graduation. Without considering whether the usual amount of drawing required is too great or too little, it must be stated that the success of our engineering drawing courses is measured in the light of their contribution to the finished product--our graduate engineers. The degree to which we succeed in contributing a full measure of competence and enthusiasm to the students is directly related to the competence and enthusiasm we bring to our teaching. The competence and enthusiasm of the teacher are in turn directly related to his training and experience. By experience I do not mean just practical experience--I mean the sum total of all the personal experiences of the man. The responsibilities accepted and carried out, each new personality met and won, each contract made and kept inevitably and vitally affects our thinking, our judgment, our attitudes and therefore our influence as teachers.

With this aspect in mind I will dare to state a set of objectives for an engineering curriculum.

> To lead the student to perceive the character and qualities of engineering as a profession; its arduous nature and its varied fields of application; its civic and ethical implications; the necessity for a thorough conception of its fundamentals--English, the sciences, mathematics and drawing; the joy of competent service.

> To equip the student with the technical training that will enable him to function intelligently in his chosen field of engineering.

> To counsel the student to the end that his perspective will be broadened, and his professional preparation will be pursued with understanding and enthusiasm.

> To give him pride in his profession, its accomplishments, and its further potential service to mankind.

There is a magnificent opportunity in the basic engineering drawing courses to inculcate in the beginning student those fundamental concepts of engineering common to all special fields. Accuracy, logical thought, method, and neatness are all as fundamental to the broader fields of engineering endeavor as they are to engineering drawing. This is true because engineering drawing knows no special field, it cuts horizontally across all fields of engineering. It is the language in which all engineering problems are stated, and in which their solutions are expressed. It follows then that the engineering drawing teacher is not necessarily the product of any one specialized curriculum, in fact, within a given drawing department it is desirable to have men trained in a variety of the fields of engineering endeavor. Co-operation toward the joint objective in such a group is bound to result in greater growth of the individual teachers.

The undergraduate training of the engineering drawing teacher consists usually of the undergraduate courses required in his field of specialization for the bachelors degree. This preparation is necessary but not enough if he expects to continue to teach even the basic drawing courses. Further courses in advanced descriptive geometry, projective geometry, nomography, graphic statics, etc. may be taken at the graduate level to broaden his preparation for the teaching of engineering drawing.

The major point in sketching the background of training for teaching engineering drawing is that the teacher remain a student--after graduation. New problems, new points of view and new developments must be incorporated into the drawing courses if they are to keep pace with engineering progress.

Practical experience in engineering while not an absolute prerequisite to the teaching of drawing can be a strong tool for superior teaching. Drafting room experience is especially helpful in the teaching of technique and speed. Experience in any phase of engineering work lends authority to the teachers instruction, and diversity to the engineering applications used as student problems.

An experience that may come early in the career of the teacher of engineering drawing,

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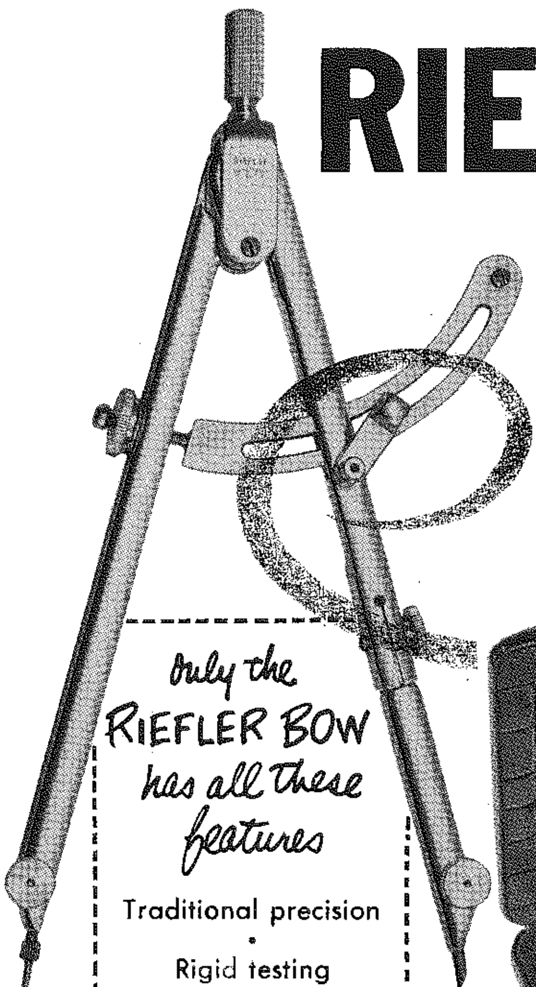

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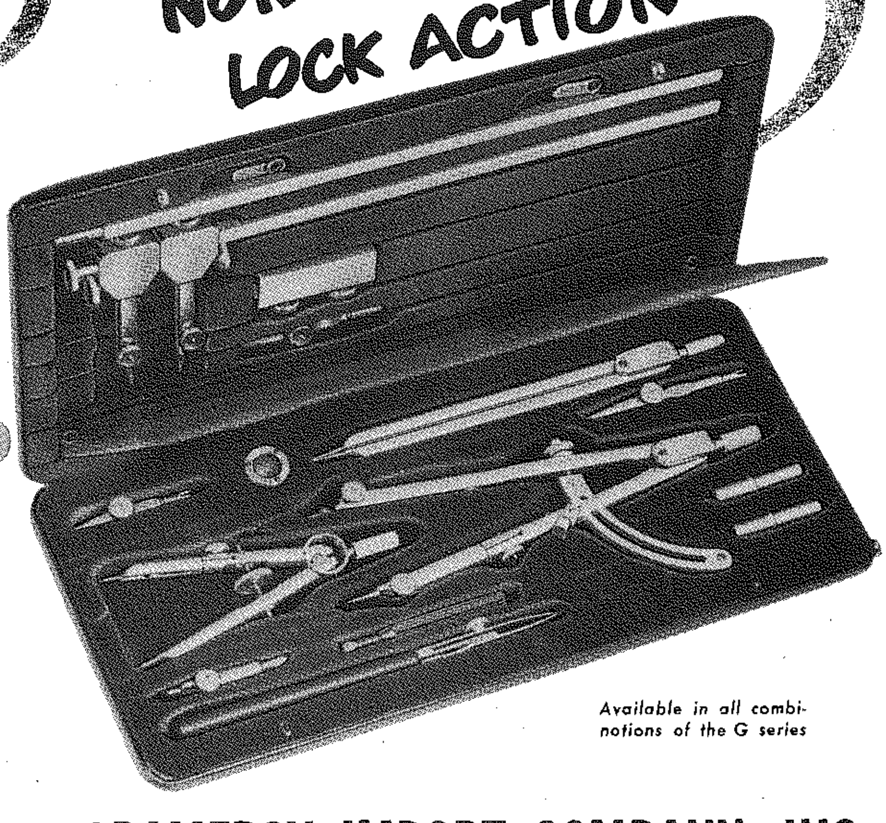

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(Continued from page 13)

is his first contact with another drawing teacher (or perhaps a department head) who believes the teaching of drawing is a sort of "boot training" for bigger and better things, that teaching drawing is a stepping stone to the more advanced or the more meaty courses. The attitude of such a critic is an exhibition of his ignorance. Such comments however, may have a devastating effect on the morale and self-confidence of the young drawing teacher. The subject which he previously considered as fundamental and necessary is relegated by the critic to the lower fringes of importance. If such an attitude is allowed to spread, the drawing instruction will suffer seriously. No man however well qualified will teach a subject well if he does not sincerely believe in its importance to the students he is teaching, and to the curriculum of which it is a part. The best answer to such a criticism is that the critic is not aware of the opportunities inherent in engineering drawing courses for building the solid foundation of fundamental knowledge that is the only real support for later specialization. In this same vein not all of us who teach the engineering drawing courses are blameless. We are often guilty by emission, of not matching or at least not encouraging the enthusiasm of our younger teachers of drawing. An apathetic attitude toward the importance of the drawing courses to the curriculum can do no one good, student or teacher.

The statement is frequently made that the students are not held to a high quality of drafting after they leave the courses in drawing. This in itself is a reflection on the drawing courses, for if the students are well taught, they will on the average derive enough satisfaction from a well done piece of work to continue the quality of work required of them throughout the drawing courses.

Students in engineering drawing may be roughly divided into two classes.

1. Those who have little interest beyond the fulfillment of the requirement for graduation.

2. Those who make the most of an opportunity to develop new skills and knowledge associated with graphical representation.

For the most part our potential engineering drawing teachers come from the second group. We teachers of drawing have given a minor amount of attention to our successors, whereas we should be encouraging some of our better students to prepare themselves for a calling that has for its return many remunerations that cannot be measured by the salary paid. Many engineering drawing teachers have more or less drifted into their positions, with no conscious effort to achieve a certain objective. This condition is, of course, not confined to the teaching of drawing, for it is present in many other engineering subjects. If we are to encourage our students to prepare themselves for teaching, we should then try to write a specification for the sort of individual who is likely to be successful teacher.

At the risk of falling far short of the mark I list these desirable qualities of an engineering drawing teacher.

1. A constant enthusiasm for his subject.

2. A sincere belief in its fundamental contribution to engineering competence.

3. A thorough grounding in the fundamental theory.

4. Facility as a draftsman.

5. A firm grasp of the applications of graphics to several fields of engineering.

6. An abiding desire to help his students to learn.

7. An ability to put forth sustained effort.

We as drawing teachers will do well to encourage those students who possess, or have the potential capacity to possess, the proper personal qualities for teaching to take assistantships in the drawing courses along with graduate work as a means of training them for responsible teaching. Students who are so inclined are then brought under the direct influence of experienced teachers of drawing at a time when graduate work can be directed toward increased training in graphics.

By no means the least valuable of the specification items for a drawing teacher are those items referring to the personal qualities of the man. Enthusiasm for the subject on the part of the teacher is infectious. The students catch the spark and are enthusiastic in spite of themselves. Insincerity in the presentation of subject matter takes the form of droning lectures taken entirely from the text. Students immediately note such an attitude, and apathy toward the course work immediately sets in. An abiding desire to help the students to learn, not just the subject at hand but other and related things as well, is the surest way to develop a warm response to the teachers efforts.

The effect of these personal qualities of the teacher has its best and greatest impact on the student in a course where the student-teacher relation is the most intimate, that is, in the laboratory or seminar type of course. In the more formal type of lecture course this intimate relation is lost. It would seem then as the instructor makes the rounds of the desks in the drawing laboratory, to correct, demonstrate, and encourage, that along with the actual representation of the structure or machine, there could be discussed the reasons for so representing it, the materials of which it is made, the function of the part with relation to the other elements and the operations that might be involved in the production of such elements. Too strict adherence to the exact topical outline of the course begets an attitude on the part of the student that when he has completed the course he is through; that he has learned all he needs to

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EFFECTIVE TRAINING IN GRAPHICS FOR INDUSTRY

by

Martin J. Bergen

E. I. du Pont de Nemours & Company, Inc.

Wilmington, Delaware

FOREWORD

For many years it has been my privilege, as well as my responsibility, to have talked with many young engineering school graduates, as they sought work after graduation. In several hundred cases, I was instrumental in assisting in either employing them or helping them find employment. During all this time one particular fact has stuck out, the fact that none of these young men like to consider a career on the drafting board. In fact, it isn't until after a great deal of discussion and investigation, on their part, that these men find that they really do want to start on the drafting board in the chemical industry, at least. The reactions shown by these young men caused us to make a general study of the attitudes of young engineering graduates toward drafting and design. This study led to an attempt to define effective training for drafting and design.

In getting the facts, we asked these young men many questions. We found that their concepts of what constituted drafting and design were greatly at variance with the actual facts, in the Process Industries. I surmise that the same difference between concept and fact, exists in the minds of young technical graduates, concerning the Mechanical Industries. We found that most of these young men thought of the drawing board as an instrument of torture--that they banged a hole in the middle of the board with their head, then carefully inserted their head in the hole, and mentally carried the board around as a punishment object or badge of servitude.

We found that the criterion used by these young men to determine what constituted effective engineering work, resided in the work being of a computational or calculating nature, and that, to them, this kind of work constituted "thinking". It did not take long for us to realize that we, in industry, were not making clear to these young men, or to the educators, what drafting and design actually are.

DEFINITION OF DRAFTING AND DESIGN

I wish to submit to you our definition of drafting and design in the Process Industries.

A. Design has two meanings:

1. The solution of one or a number of energy problems.

2. The fashioning, patterning, or executing according to a plan or a delineation, in which figure, symmetry, structure, beauty, or utility are involved.

Referring to these definitions of design--young men seem to be of the opinion that these constitute the entire scope of "real" design engineering. However, there are many solutions to many engineering problems that can be obtained by graphical menas, so that we find the drafting board a design instrument, as well as a contrivance for communication.

Therefore, I submit the following definition of drafting:

B. Drafting is the conversion of design into the universal graphical language of industry, so that the design decisions can be clearly interpreted and the piece, structure, equipment, process or assembly can be fabricated, assembled, or erected.

DRAFTING AS A LANGUAGE

At this point, it might be profitable to examine the drafting board as a contrivance to facilitate communication.

I brought out the fact that drafting is a language--the universal graphical language of industry and engineering, and it is not too much to say that a young engineer is not looking clearly at his career, if he does not possess a good working knowledge of this language. Even more important, this universal graphical language is the medium by which the engineer translates his decision, so that the "art" portion of engineering may be implemented by the use of the practices and skills of innumerable crafts, trades, and callings. Without this language, the engineer cannot use the skills of the craftsman, and without the engineer, the craftsman is lost in his attempt to improve design.

Since we define drafting as this universal language, let us explore the methods whereby this language is taught and learned. We find the alphabet and the rudiments of this language taught in elementary mechanical drawing. We find the basic grammar of this language in courses in descriptive geometry. We find a few elementary stories written in this graphical language, in the few courses in machine, and other types of design that the student might take.

Now, it is becoming increasingly obvious that the student or recent graduate is not well enough trained in the use of this language to enable him to use it with authority, when dealing with men who are masters of various mechanical or industrial crafts, nor does he have the lingual ability to produce the graphical prose of engineering or the graphical poetry of architecture. (Continued on page 19)

(Continued from page 15)

to know of the subject. If on the other hand the diversification of solution, of possible materials, of production processes, has been discussed, he is aware that there is nearly always a choice in the solution of a problem and that judgement is required to select the best possible of several ways of arriving at the final solution of any problem. The time and work, and it is hard work, that is expended during the early months of any drawing course on developing interest and inquiring minds in the class pays vast dividends in the case with which the later topics are absorbed, and in the satisfaction to the teacher when he contemplates the quality of the final work done by the class. Dividends so reaped in any single course are compounded in later courses and spread laterally to other subject not directly connected with engineering drawing. The final result is a finished product, the engineering graduate, who is able, intelligent, and willing to compete for his place in society. In many cases the spiral was started early in the students college career by a teacher of engineering drawing who was willing to go the second mile with his students in order to orient and inform them beyond and above the routine requirement of the topical outline of the course.

For the reasons outlined above it appears that the best trained and most experienced instructors of engineering drawing should be assigned to the entering freshmen classes. First year engineering students are often confused by the drastic change from high school or preparatory school environment to that of a university or technical school. The increased difficulty of class preparation, and the concentration of courses in the pure sciences often makes them wonder if they have made a right decision in choosing engineering for their life work. The influence of a course in engineering drawing under an inspiring teacher does much at this critical time to keep such students interested and enthusiastic until they are prepared to participate in a larger number of more specifically engineering courses. In effect then engineering drawing is one of the first truly engineering courses that the students come in contact with. First impressions are often very lasting, and it thus becomes important that the first experience be an accurate one. Most of us have had the experience of teaching second or later semester students who have been subjected to inept or indifferent teaching in their first semester of engineering drawing. Such a student is infinitely more difficult to interest and to teach than he who was well taught in his first experience with drawing. In the average case given competent and enthusiastic instruction in his first course in engineering drawing, the student will make his own way in subsequent courses.

There are several points that I would reemphasize, lest they become obscured in the wordiness of discussion,

1. Engineering drawing is one of many subjects that the student must master. If is effective to the extent that it contributes its full, and greater, share to the training of the competent engineering graduate.

2. Engineering drawing courses provide a magnificent opportunity to inculcate in the student the fundamental concepts of engineering--accuracy, direct and logical thinking, neatness. In these courses the students are exposed for the first time to the use of industrial materials and the representation of structures and machines.

3. Undergraduate training is a necessary training for teaching engineering drawing but it is not enough. Further courses in graphics and particularly the applications of graphics to engineering are desirable.

4. Good teaching of engineering drawing requires an enthusiasm for the subject, a thorough knowledge of the theory of projection, sincerity of presentation, an experience technique in drafting, a firm grasp of the applications of graphics to several engineering fields and perhaps most important of all an abiding desire to help the students to learn.

5. As a means of developing stronger and more self-reliant students, the first semester drawing courses should be taught by experienced teachers. I once read a couplet that seems to me to characterize drawing and certainly drawing teachers. You will recognize the quality of which I have been speaking.

Let us all be artists, every one

For after all is said and done

An artist is purely and simply he

Who does things better than they need to be.

PROCEEDINGS OF THE ENGINEERING DRAWING DIVISION 1946 SUMMER SCHOOL

The stock of this 639 page book in the hands of the publisher is now almost exhausted. It will, of course, not be reprinted. Engineering School and Teachers College libraries should order at once. Drawing Departments would be wise to have extra copies since it will shortly be impossible to replace lost or stolen copies.

The material in this volume is as valid today as it was when issued. It contains the opinions of many industrial leaders on the value of engineering drawing in the curriculum, a pertinent item in these days of pressure to reduce courses. The history of Graphics by Professor Higbee in itself, is worth the price of the book.

The excellent and authoritative treatment of topics such as teaching methods, use of visual aids, preparation and use of examinations, equipment of college drafting rooms and others are not likely to be again assembled in one volume. To be sure of your copy order now from the publisher, McGraw-Hill Book Company, 330 West 42nd Street, New York, New York.

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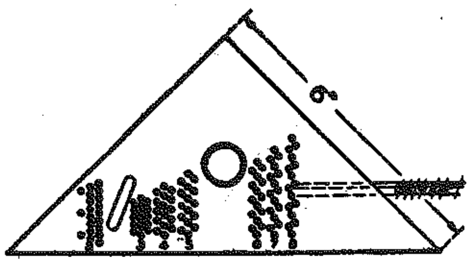

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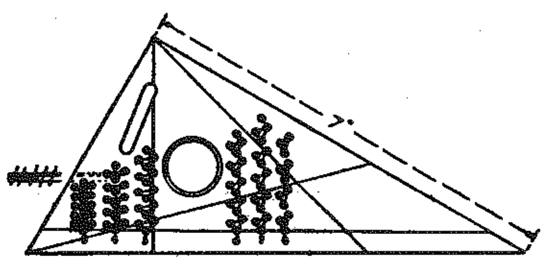

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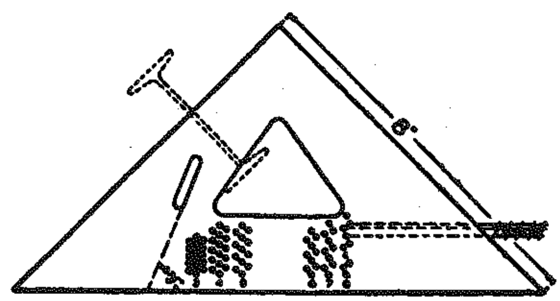

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(Continued from page 16)

He must learn to write this language and become its master. He would not be expected to be a master of the English language upon such short acquaintance, with only a study of the alphabet and the bare bones of grammar. (As a matter of fact, I have heard several industrialists cry out bitterly because of the lack of "report writing" experience and ability on the part of our engineering graduates.)

It has been said that the only way that a writer is made is by having him "write", and I know of no other way to become proficient in the language of drafting than to practice drafting.

Let us take up another angle concerning this language. Drafting is the medium of communication of engineering decision to foremen, inspectors machine operators, mechanics--the craftsmen who are the backbone of industry. In the acquiring of their trade, these men have had to learn blueprint reading and are usually very proficient in reading these engineering instructions and decision. Therefore, drafting is the method by which the engineer communicates with American industry and American construction. If the young engineer fails to become proficient in this method of communication, he has cut himself off from the potential direction of men in industry and construction. As a consequence, he places severe limitations on his OWN progress.

DESIGN AS A LANGUAGE

Let us examine the definition of design. If we think of design as the solution of one or a number of energy problems, we are confronted with the fact that we are using another lanuage of engineering--a powerful but not a universal industrial language--instead, a mathematical language. There are many men, young and old, in the engineering profession, whose ego is inflated because of the fact that they have to use calculus to solve difficult engineering problems. However, such solutions have been arrived at by the engineer using the unique, mathematical, analytical language of engineering,--and this language is not understood by the artisan! If the engineer considers his work completed at this stage, he is making a very serious mistake. If the engineer feels that it is beneath his dignity to translate his analytical efforts, solutions, and decisions into the universal graphical language he is again making a serious mistake, because he is again cutting himself off from the communication with, and the direction of large units of American industry, and the workmen in these units.

DESIGN ENGINEERING AND THE DESIGN ENGINEER

It is now clear that the competent design engineer must have a mastery of both the graphical and the analytical languages, if he is to be able to do a complete job. Many young and some older engineers, do not realize how much importance industry places on this total proficiency.

I have found that the following analogy is fairly effective in pointing out to these men the industrial importance of proficiency in both drafting and design.

Let us suppose that, in the process of hiring men, I have been asked to hire a man who both wrote and understood Chinese. Now let us suppose that among the next few men that I see, the first one comes in knows how to write Chinese but does not understand it, while the second one interviewed understands Chinese, but does not know how to write it. It would be necessary to hire two men and coordinate their efforts, in order to do the work that originally one man was requisitioned for.

Now let us suppose that a third man comes along who knows how to write Chinese and understands it. The potential saving of the effort of one man, and the disappearance of the necessity for coordination are important factors, so I think that it is obvious that the third man would get the job.

If we complicate the situation one step further, and say that the person hired also had to be able to understand and write another language, and then translate this language into written Chinese, then we would have in this little story the complete analogue to design engineering.

Any man who knows how to use the analytical, mathematical language of design, and who understands, and is able to translate this into the universal graphical language of industry, is a true design engineer, for by the use of these languages he multiplies his abilities and decisions, thereby helping to supply human needs in the form of structures, machines, manufactured products, etc., THROUGH the efforts of all men in industry and construction.

THE TEACHING OF DRAFTING AND DESIGN

In this paper, I have attempted to define some basic ideas concerning the TWO languages on which engineering and pure and supplied science rest. Since language is a mode of communication, and since the problem of communication in industry is one of the gravest facing all hands, it is very important to have the engineering graduate understand the kind of language he is trying to learn. It also is important that the teachers of fundamental drafting, descriptive geometry, and of design realize that they are language teachers, teaching a graphical language in which the industrial progress of the United States has been written. In addition, teachers of other engineering subjects must realize that they are teaching a second language, the mathematical, analytical language of engineering. These teachers should realize that this analytical language can reach its fullest and truest stature only by being integrated with the graphical language, because the great mass of American workmen do not understand the analytical language. Therefore, there should be no quarrel between the two languages, because they are complementary to each other.

There should be no tendency for the teacher of any analytical subject to look down his nose,

(Continued on page 33)

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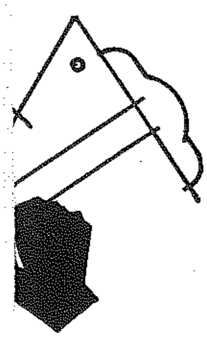

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By CHARLES D. COOPER, CHARLES J. VIERCK and PAUL E. MACHOVINA, The Ohio State University. Series I. $3.75

Practical, direct, and thorough, the authors present a series of problems in the most logical and usable order for first-year classes in engineering drawing. Arranged for and correlated with French's *Engineering Drawing*, the workbook offers many time-saving features and a flexibility in its broad content. The first work on writing and reading the language of orthographic is done freehand. This saves time and eliminates the complication of working with instruments while the student is studying orthographic projection. Time is also saved by presenting the use of instruments and applied geometry along with orthographic instrument drawing.

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SURFACE FINISH

by

Roy P. Trowbridge

GENERAL MOTORS ENGINEERING STANDARDS SECTION

While the draftsman or designer is interested primarily in rendering an accurate, readable drawing of an object that he desires to have constructed, it is highly desirable that he have knowledge of the application of the object and how the object must be made. The subject of this paper is, of course, the rendering of surface finish designation on drawings. However, to fully understand the subject of surface finish designation, one should know when and how surface finish is of importance, how surface finish may be measured and how varying degrees of surface finish may be produced. A good schooling in these points can overcome much of the hesitancy on the part of the designer and draftsman that is felt when it comes right down to applying surface finish symbols to the drawing.

In years past there have been many methods of designating surface quality. A favorite symbol was the "f" mark placed on the line or witness line depicting the surface to be finished. Certain organization improved on the "f" mark by specifying "f' sub 1", "f' sub 3" etc. for varying degrees of smoothness. The significance of the subscript was usually tied in with machined specimens to which the draftsman and the machinist had access for comparison purposes. Other methods of controlling the surface roughness included the use of the "G" symbol or a note indicating exactly what processing method was to be used on the surface in question.

After designation on the drawing that a refined surface was desired, the actual production of such a surface was up to the processing shop with which, in the past, the designer and draftsman had much closer contact than exists today. A skilled machinist on viewing the requirement for a refined surface finish would produce the required finish to the best of his ability so that it would compare with the samples on which the surface finish designations were based. Very often no samples existed and the final finish was left to the discretion of the machine shop foreman or even the machinist himself. In any one shop a fair degree of reproducibility could be expected depending on the nature of the controls. However, it is not hard to see that there could be little or no correlation between two different shops and none at all where the design agency and the processing shop were completely separate.

The use of the "f" symbol gave way to the 60° V symbol and with the advent of adequate definitions for roughness, a number specifying the roughness in micro-inches was added to the symbol. The significant step in the designation of surface roughness in microinches was the development of instrumentation capable of measuring these minute values. Instrumentation will be covered later in the paper.

Designation of surface roughness today is based on the American Standard for Surface Roughness, Waviness and Lay, B46.1-1947. The automotive version of this Standard appears in the SAE Handbook and was adopted in 1949. The SAE Surface Finish Standard agrees with the American Standard in all respects with the exception that the SAE Standard allows only one method of rating roughness whereas the American Standard allows three. In order to designate surface finish on a drawing, the draftsman should be familiar with the Standards.

The following definitions taken from the SAE Standard should be understood by the draftsman especially those for roughness and waviness because of the occasional close relationship between these two characteristics of a surface.

Surface - The surface of an object is the boundary which separates that object from another substance. Its shape and extent are usually defined by a drawing or descriptive specification. Figure 1 shows the conventional idealized surface.

Profile - The contour of any specified section through a surface, Figures 1, 2, 3, and 4 are profiles.

Roughness - Relatively finely spaced surface irregularities as shown in Figure 2. On surfaces produced by machining and abrasive operations, the irregularities produced by the cutting action of tool edges and abrasive grains, and by the feed of the machine tool, are roughness. Roughness may be considered as being superposed on a wavy surface as shown in Figure 3.

Waviness - The surface irregularities which are of greater spacing than the roughness. See Figures 3 and 4. On machined surfaces such irregularities may result from machine or work deflections, vibrations, etc. Irregularities of similar geometry may occur due to warping, strains or other causes.

Flaws - Irregularities which occur at one place, or at relatively infrequent intervals in the surface e.g. a scratch, ridge, hole, peak, crack or check.

Lay - The direction of the predominant surface pattern.

Microinch - One millionth of a linear inch (.000001 in.). (Unit of Height for Roughness.)

The SAE Standard rates roughness in microinches average or to be more exact in microinches arithmetical average deviation from the mean surface. (Continued on page 25)

FUNDAMENTALS OF ENGINEERING DRAWING, Revised

By WARREN J. LUZADDER, PURDUE UNIVERSITY

The basic principles of engineering drawing are here presented in such a way that the beginning student can find satisfying answers for all of his ordinary questions. Written in simple, understandable language, the major portion of the text leads up to the preparation of machine drawings. The methods used in such preparation are the same as those in other fields of engineering. Thus the student is given a good foundation for later study in some specialized field such as structural drawing. This revised edition includes many improved illustrations.

Published 1946 • 623 Pages • 6" x 9"

PROBLEMS IN ENGINEERING DRAWING, Third Edition

By WARREN J. LUZADDER, J. N. ARNOLD, PURDUE UNIVERSITY and F. H. THOMPSON, UNIVERSITY of CALIFORNIA (BERKELEY)

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Covering the basic material of elementary graphical theory applicable to engineering problems, this text develops the ability to solve such problems by the simplest graphical methods. It does not limit the student to one method of attack in solving problems. All methods are thoroughly described, enabling the student to choose the simplest solution to each problem.

Published 1946 • 301 Pages • 6" x 9"

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By EARLE F. WATTS and ARTHUR L. GOODRICH, MASSACHUSETTS INSTITUTE of TECHNOLOGY

These problems have been selected to illustrate the fundamentals of descriptive geometry, the special methods which branch out from those principles, and the application of those methods to the graphical solution of engineering problems. They are designed to correlate with Watts and Rule's DESCRIPTIVE GEOMETRY.

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(Continued from page 23)

THEORETICAL PROFILE

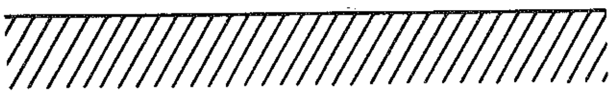


FIGURE 1

TRACE OF ACTUAL PROFILE.
75 TO 100 MICROINCHES HEIGHT AVERAGE PEAK TO VALLEY. MAGNIFICATION X2700.

FIGURE 2

ROUGHNESS SUPERPOSED ON WAVINESS

FIGURE 3

EXAGGERATED PROFILE OF WAVY SURFACE

FIGURE 4

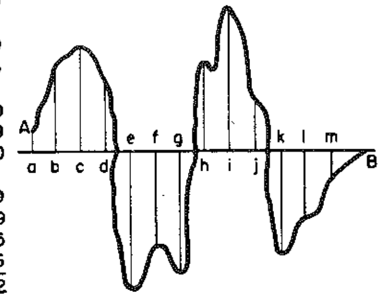
This value may be obtained from integration of the profile curve of a surface or, as shown in Figure 5, by dividing the sum of the ordinates of the profile curve by the number of increments taken.

Roughness width, waviness width and waviness height are all expressed in inches or decimal portions thereof. The Standard includes recommended roughness height values and waviness height values which have been chosen in reasonable steps to adequately cover the full range of roughness and waviness values to be specified.

Six varieties of lay are recognized by the Standard as shown in Figures 6 thru 11.

The method of designating the surface characteristics on drawings is by use of the surface finish symbol shown in Figures 12 and 13. The desired roughness value which represents the maximum allowable is placed inside the 60° V. When a lower limit is desired,

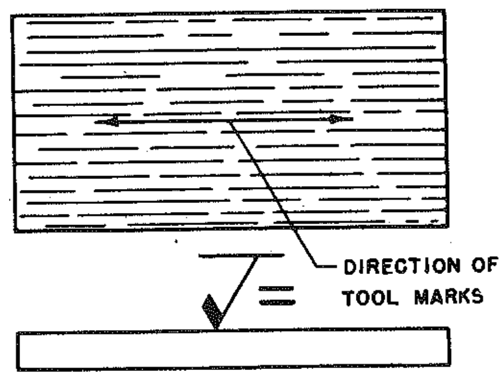
a = 4	a^2 = 16
b = 19	b^2 = 361
c = 23	c^2 = 529
d = 16	d^2 = 256
e = 31	e^2 = 961
f = 20	f^2 = 400
g = 27	g^2 = 729
h = 20	h^2 = 400
i = 31	i^2 = 961
j = 13	j^2 = 169
k = 23	k^2 = 529
l = 15	l^2 = 225
m = 6	m^2 = 36
Totals 248	5572



Arithmetical average $= \frac{248}{13} = 19.1$ microinches

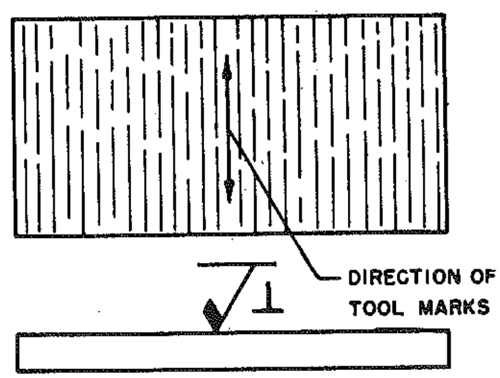
Root mean square average $= \sqrt{\frac{5572}{13}} = 20.7$ microinches rms

FIGURE 5



Parallel to the boundary line of the surface indicated by the symbol, as shown in Figure 6. Example - Parallel shaping, end view of turn or O.D. grind.

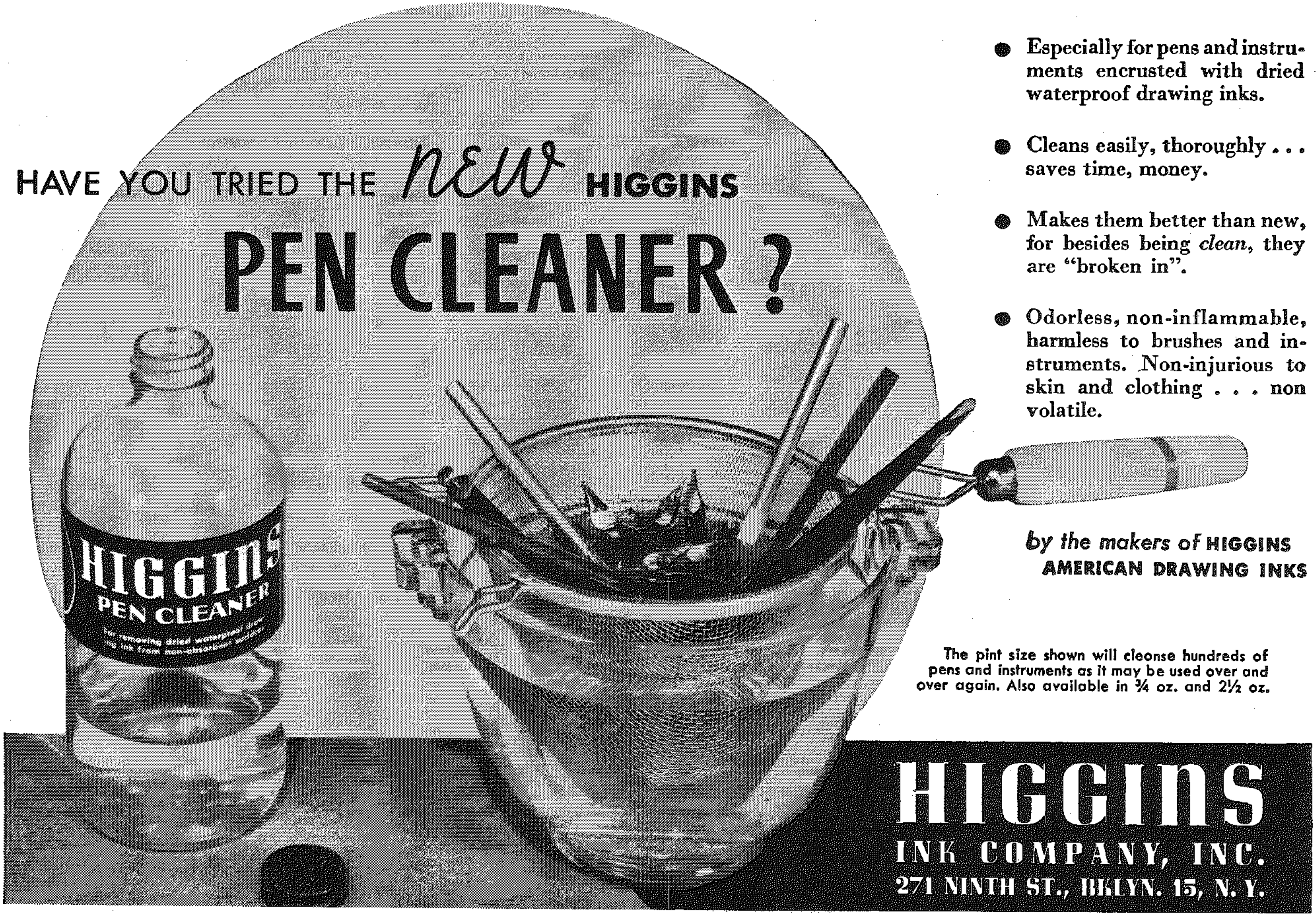
FIGURE 6



Perpendicular to the boundary line of the surface indicated by the symbol, as shown in Figure 7. Example - End view of shaping, longitudinal view of turn and O.D. grind.

FIGURE 7

(Continued on page 35)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SPRINGS — HELICAL AND FLAT

by

Otto R. Hills

William D. Gibson Co.
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It has been said that Engineering Drawing is simply the expression of the geometrical concepts of man expressed in a graphical language. I believe we agree that this is basically correct, but I feel that this definition is so broad that it over-simplifies the subject. If we were all proficient in this graphic language, we might assume that any drawing which conveys the correct measurements of lines, angles, and surfaces, was complete in itself. I feel that Engineering drawing goes beyond this basic requirement and would like to develop the relationship between 1, Drafting practice 2, Manufacturing procedure and 3, the end product as pertaining to springs both Helical and Flat.

I - Drafting Practice

There is nothing new and there is nothing I can add to your knowledge of the fundamentals of mechanical drawing. The basic principals of engineering drawing apply to spring drawings as they do to all types of mechanical drawings. As a manufacturer, we are primarily interested in simplicity of style, and sufficient information to enable us to produce the spring required. This can best be accomplished when the draftsman is familiar with the limitations of the spring design and has a working knowledge of shop terms.

Most spring manufacturers publish a handbook which could be well used in the classroom. These books include a glossary of spring makers' terms which each draftsman should have. There are also standards published by the Society of Automotive Engineers, the American Standards Association, the Spring Manufacturers' Association, and others, which you will find very helpful. (See Handbook).

We ask for simplicity in a drawing. Many companies have adopted a standard form drawing for their conventional type springs. These are set up for the helical type springs, one for the compression spring, one for the extension spring, and one for torsion spring. This is a time saver and also makes for standardization within the organization. (See Handbook).

Flat springs must be drawn in detail as they do not lend themselves to standard form drawings. Special ends on extension springs and special ends on torsion, should also be shown in detail, with auxiliary projections when necessary.

Drawing a long helical spring naturally includes much repeated detail. There is nothing gained by showing each coil of a spring. We recommend drawing the two coils on either end and using the ditto line between the two ends to show the repeated detail.

A spring usually becomes very small in an assembly drawing. Here we can use the single line representation. The single line drawing is only a symbol to indicate that a compression, extension or torsion spring is to be used. The complete specification must be included on the detail drawing.

2 - Manufacturing Procedure

We mentioned the complete specification, and this brings us right into manufacturing procedure. The spring industry is a jobbing industry and all springs are made to customers specifications. The information given on the spring drawing will determine the type of wire to be used and our method of manufacturing.

When an engineer designs a spring, many factors are considered, such as allowable stress for a given wire, ambient temperature, working conditions and type of load application. These considerations do not appear on the drawing, but the results of these considerations make up the complete specification. The specification will include such operations as magnaflux, heat setting or shotblasting if the engineer feels that such treatment is required. This is fine if the engineer is well versed in the art of spring making, but relatively few companies which use springs have an engineering staff capable of setting up manufacturing operations for their springs. We do not ask that they do, but if the specifications are not complete, we must have sufficient information pertaining to the functional requirements so that the spring maker can intelligently set up the manufacturing procedure.

All too often a draftsman is given a sample spring which a model maker has made or an engineer has found to serve his purpose. The draftsman is told to draw up a detail. You can easily see that we are heading for trouble for lack of information on the draftsman's part. Let me repeat: The information given on the spring drawing will determine our method of manufacturing, and the quality of the spring produced.

Some springs must operate with long life under fatigue conditions such as automotive valve springs. These springs are made of special quality wire, coiled on carbide tools to minimize tool marks, heat treated for maximum life, ground for squareness, shotblasted and heat treated a second time to increase fatigue life.

Another spring which may appear to be similar must only carry a static load or work infrequently. Such a spring could well use a commercial grade wire with no premium operations.

(Continued on page 29)

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IN MEMORIAM

Professor Walter Hiram McNeill

1889 - 1951

The University of Texas

Professor Walter Hiram McNeill, Chairman of the Department of Drawing of The University of Texas, died June 6, 1951. He evidently knew some six months before he died that his life was closing, and both he and his family set about to make his departure as natural as any other normal occurence. He contributed a lesson to all who came in contact with him at this time, revealing a sincerity and a greatness that was most extraordinary.

Professor McNeill was a member of the Department of Drawing at The University of Texas for thirty-three years, eighteen of which he served as chairman. He retired May 1, 1951.

Professor McNeill was a clear thinker, an excellent teacher and an able administrator, and he was highly respected by all who knew him.

(Continued from page 27)

This means that the draftsman must have more information than a sample spring will give him. If complete specifications are not available, he must convey the working requirements so that the finished spring will be functionally correct.

3 - The End Product

The end product is a spring regardless of shape, form or temper. If the draftsman will remember the definition of a spring, it may help him in conveying the necessary information. Actually a spring is a mechanical device designed to store energy when deflected and to return the equivalent amount of energy when released. This ability to do work is usually expressed as a load at a specified position, or as an increase in load when deflected between two positions. The latter is known as the load rate, and is specified only when critical.

The draftsman should be familiar with the working requirements of the assembly. He must remember that the commercial tolerance on springs is much greater than the tolerance on machined parts. For this reason, it is good to show the adjacent parts in phantom section. If a helical spring is to work in a hole or over a rod, this information should be given as a limiting dimension.

In conclusion, we suggest that the student obtain a spring manufacturer's catalog. Learn the shop terms, the various types of springs and their limitations. If possible, arrange an inspection trip to a spring plant. Most important of all, remember that quality in a spring is the combination of a good design and the manufacturing procedure employed in the fabrication of the spring.

(Continued from page 5)

2:00 P.M. Style Show

3:00 P.M. Trip 1. A behind-the-scene trip through "Vogue" publishing offices
Trip 2. Good Housekeeping Institute
Trip 3. McCall Home-Maker Institute
Trip 4. Costume Institute - Metropolitan Museum of Art

EVENING PROGRAMS

Wednesday, January 23, 1952

Executive Committee Dinner

Thursday, January 24, 1952

Theatre party. A block of seats has been received for the musical hit "Guys and Dolls".

Friday, January 25, 1952

Annual Dinner, Men's Faculty Club, Columbia University

Speaker: Dr. John R. Dunning, Dean of the School of Engineering, Columbia University.

(Continued from page 6)

to Peter Cooper and he wanted his Union to provide for education in engineering, art, political science, and the meaning of good citizenship.

Today, The Cooper Union offers free education in five different fields, the Art School, the Library, the Adult Education Program, the Museum for the Arts of Decoration, and the School of Engineering.

The Art School offers instruction during both day and evening, in the fine arts, in graphic arts, and in architecture. The quality of instruction is such that the students and graduates have won a great many prizes in both national and international competition.

The Library and Reading Room was the first free public library and reading-room in New York. Today, The Cooper Union Library serves not only the Art and Engineering Schools, but any of the public who care to avail themselves of its reading and research privileges

An average of 3,000 people per week attend the free public forums conducted in the Great Hall from October to May. The subjects at these forms run the gamut of human knowledge. The speakers are the outstanding authorities in their fields. The audience at these forums is permitted to ask questions of the speakers---and they do! The subjects chosen for each of the three evenings per week pertain to a general theme, which runs through a semester. Usually the theme on one of these evenings is in some way related to the field of political science and citizenship, thus carrying out another of the Founder's wishes.

Peter Cooper had desired to have a museum of science and invention and an art gallery as a part of his Union. He never was able to establish these in his lifetime. However, two of his grandaughters started a Museum for the Arts of Decoration, which has grown to fill an outstanding position in this field. The Museum is extensively used as a source of ideas by designers of textiles, wall paper, and other items of decoration and adornment.

The Old Mechanic's delight was his institute of science and mechanics, which he hoped would become a recognized engineering school. His wish has been fulfilled, for today the School of Engineering is an ECPD-accredited, degree-granting college whose graduates are readily accepted by both industry and government. Both the day and evening sessions offer degrees in chemical, civil, electrical and mechanical engineering. The normal period of time required to obtain a degree in the day session is four years: in the evening session it is eight years. The present enrollment in the day session of the school is 350, and in the evening session is 343. In June 1951 the School of Engineering (day and evening sessions) granted 106 degrees.

The Department of Machine Design and Engineering Drawing is a service department within the School of Engineering. The courses taught by this Department are Engineering Drawing. Descriptive Geometry, Kinematics of Machines, Machine Design, Dynamics of Machines, Mechanical Processes, Engineering Economy, and Industrial Organization. The Department has 8 full-time and 4 part-time members. The part-time instructors teach only in the evening session and are practicing engineers. Engineering Drawing and Descriptive Geometry are taught to all freshmen in both the day and evening session. It is our philosophy that every minute of time allotted to us be used to further the total education of the engineer. It is our belief that Engineering Drawing is a tool which in many cases may be closely related to the student's future practice of engineering, and that its study offers a great opportunity to begin the training of attitudes and habits which will make the kind of professional engineer that industry needs and seeks.

To achieve this goal requires positive attitudes and actions on our part as instructors. The instructor must know his students more intimately than as just names and faces. Each student, as we all know, ideally, should receive individualized treatment. Thus at The Cooper Union less time is devoted to general lecture and more instruction time to small groups or individuals. Therefore, not more than 15 students in the drawing room are assigned to one instructor. A section of 20 students has two instructors. All drawing is done in the drawing room under supervision, and the home-preparation time is spent in studying the text in preparation for the work of the drawing room. The instructor tries to see mistakes as soon after they are made as possible and he immediately calls the error to the student's attention. He then helps the student to understand why it is an error and to correct it at once. The instructor also observes a boy's work habits, and suggests ways of improving them. The student, however, must solve each problem for himself as best he is able from his study and past experience. Thus, each student's contribution forms a starting point from which the instructor can guide the student forward in the learning process. The student must also apportion and govern his own time, so that he will complete the whole problem in the time allotted.

Each problem that is given to the students is carefully selected to present, first, the basic principles of drawing or descriptive geometry to be illustrated, and, second, to exemplify those phases of engineering about which the student can be told with reasonable comprehension on his part. Wherever possible the student is not only shown the physical piece he is drawing, but where and how it fits in with relation to other parts and what is its function.

We hope that this brief story of The Cooper Union will help you to understand the unusual character of this institution, and to learn something of the unique philosophy and desires of Peter Cooper, our Founder. We hope that you will come to see us in January and give us the opportunity to show you The Cooper Union.

(Continued from page 7)

Columbia is generally, if erroneously - regarded as a center of large numbers. As a matter of fact, the total enrollment is large because Columbia is a large family of schools - over a dozen professional schools, three graduate faculties and three under-graduate colleges. Individually, each of these divisions is relatively small - concentrated, individual rather than mass education is the aim and rule. With a student body in engineering limited to junior and senior undergraduates plus graduate students, staff and student are in close contact; associated in a joint adventure in the ever-progressing and fascinating pursuit of engineering knowledge.

(Continued from page 9)

since the science of war likewise expanded greatly, it became obvious that the Army officer would need specialization in his particular profession.

To meet these changed conditions the Army established several post-graduate schools to fill the demand for officer specialization. West Point gradually became positioned as only the initial step in an Army officer's education.

Following World War I, General Douglas MacArthur became Superintendent in 1919. General MacArthur developed the curriculum in terms of the recent war. The curriculum was revised to insure the cadets a knowledge of national production, transportation and social problems. In addition, General MacArthur developed the physical fitness of the graduates by establishing a strenuous program of compulsory physical education complemented by an intramural program of fourteen sports in which every cadet had to take part.

Experience during World War II again revised the concepts of what professional military education should mean. In 1945 a special board of consultants, civilian and military, made a study of the Academy's curriculum, and, as a result of their recommendation, a number of changes were made. Among these were expansion of the work in English and international relations; the introduction of courses in electronics, economic geography, and military psychology and leadership. At the present time the humanities comprise about 40% of the curriculum, the sciences about 60%.

Today, after almost 150 years, the West Point Reservation comprises over 15,000 acres, including many firing ranges and training areas. The student body, or Cadet Corps, has grown to 2500 cadets.

Although its more spectacular military and athletic activities gain most publicity, each graduate during his four years of study receives a sound academic foundation comparative to any similar course in any major university. Upon graduation each graduate receives a BS degree. To and including graduation of June 1951, 18,500 graduates have left the Military Academy.

To accomplish its mission, West Point has a physical plant of great utility and beauty. The central plant consisting of barracks, mess hall, library, gymnasium, hospital, academic buildings and laboratories, some more than 100 years old and laden with ivy and tradition, attracts visitors from all over the world.

In the initial conception of the Military Academy three courses of academic instruction were considered necessary for the proper education of a gentleman and an officer--mathematics, French and drawing. The Department of Military Topography and Graphics (formerly Department of Drawing) therefore can be considered as one of the oldest of the Academy, having been established in 1803. Drawing of one form or another has since been an integral part of the Academy's instruction.

From its inception the course has gone through many changes--each in general following the industrial developments of our country. Initially the drawing course was pitched toward the fine arts, with stress on the human figure and landscape. In the 1820's with the pointing of the curriculum towards engineering, maps and sketching were added to the drawing course. Although not originally a part of the Drawing course, Descriptive Geometry was first brought to the United States by the Academy and introduced into the curriculum during the period of civil engineering emphasis. Descriptive Geometry initially was in the Department of Engineering, and then with the Department of Mathematics for over 100 years, before settling with the Department of Military Topography and Graphics, where it is now as an integrated subject with Engineering Drawing. Late in the 19th century, as the country developed industrially and mechanically, the drawing course assumed a flavor which included architectural drawing and technical drawings of machines, in addition to Topography. Even though the course changed, the results still contained a high degree of artistic embellishment.

The present course in its modernization has completely shed artistic tendencies and reflects the highly-specialized, technical requirements of mass production, map production, Engineering Drawing, and Descriptive Geometry.

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(Continued from page 19)

or attempt to take time away from the very necessary learning procedure connected with the learning of the graphical language. There should be many more attempts made by the teachers of analytical types of subject to point out graphical solutions, because of their time saving and utility values.

The teacher of graphics, on the other hand, should make sure that his concrete-minded engineering students are fed more than the dry bones of the abstract grammar of descriptive geometry by such devices as will bring into play a comprehension of and a coordination between the two languages. For example, in the strength of materials, the geometry of strength provides such an opportunity. In mechanics, where velocities and accelerations of machine parts can be graphically ascertained by graphical differentiation on the drafting board, the proper place of the drafting board as an engineering instrument, will soon be apparent to the student. The solution of difficult differential equations, and even the solution of harmonic analysis problems on the drafting board, will serve to open student's eyes to the fact that the board, plus training, plus ingenuity is a very powerful engineering instrument.

EFFECTIVE TRAINING IN DRAFTING

We now reach the crux of the whole matter, and it is the question, "What constitutes effective training in graphics for industry?"

Effective training in graphics for industry does not presuppose radical changes in the courses given at the schools, but rather takes for granted the fact that the present courses should be given in such a way that the student has a new degree of comprehension of what he is studying. It is unreasonable for industry to ask the technical colleges and universities to give more training along any particular line, in an under-graduate curriculum, but it is very definitely the prerogative of industry to ask that the student acquire comprehension and orientation of his knowledge as soon as possible. After the student comprehends that he is trying to learn a language, in learning elementary mechanical drawing, descriptive geometry, machine drawing, kinematics, machine design, etc., his attitude should be conditioned, so that he realizes that he will not acquire full proficiency in the use of this language until he has worked with drafting in industry for some reasonable length of time.

This attitudinal training is very important to young men, for they must be made to feel that work done to acquire proficiency in drafting and design is not wasted effort, on their part.

DRAFTING AS A PART OF ENGINEERING INTERNSHIP

We all know that today the young engineering graduate is living in "never-never" land. He is looking for progress, promotion, and success, but he faces two new developments, both of which are in existence, and both of which have not, as yet, been felt by him. One of them is the fact that the "G.I. hump" has now gone through the engineering schools. This gives the profession a greater number of engineers than ever before, with many thousands of them being in this young age group,--the group which went to college after serving in the war.

The second development is a consequence of the first. Since 1948 the drafting and design portions of engineering have been subjected to a continuous up-grading process. When the United States goes back to the normal conditions of producing only for peace, it is safe to predict that the trend of upgrading in drafting and design will continue. This means that a large number of technical graduates will acquire the ability as competent draftsmen and designers to write the engineering prose and poetry spoken of earlier. They, in turn will earn the jobs which involve the supervision of other men in this field.

Since many of these men, with this experience will be technical graduates, I think it is safe to predict that they will not be too anxious to serve under the engineer who has not acquired the same proficiency and skill that they have, so that the door to advancement and promotion may start to close on the engineer who feels that he, somehow or another, will avoid a tour of duty on the board.

If I were a young engineering graduate who wished to go into either design, production, or construction, I think I would make as quick a beeline to the drafting board as I could, in order to serve my interneship in this field as quickly as possible. This experience could and would open successive doors of promotion in design, construction, production, and eventually in management. In view of the above facts, I know of no better way to start an engineering interneship.

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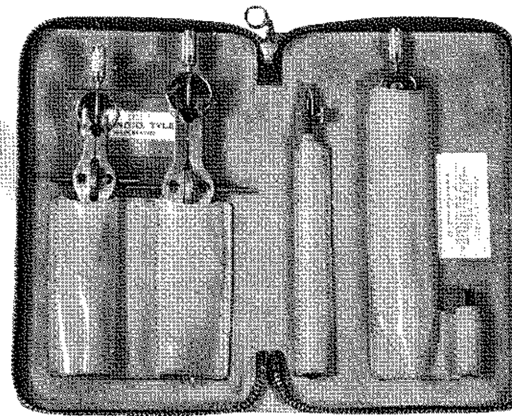

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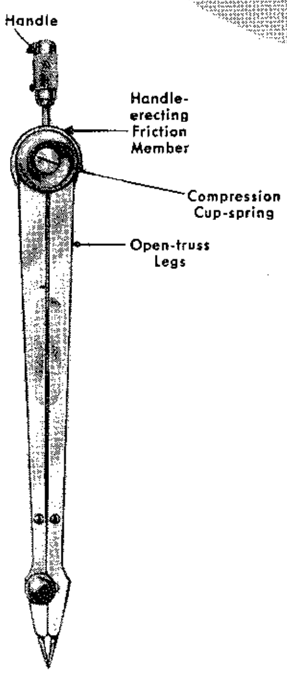

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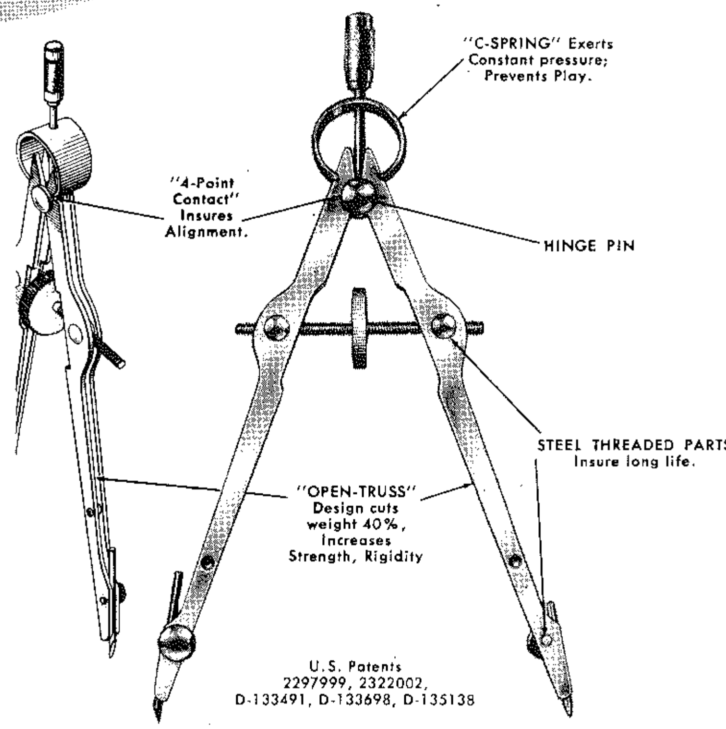

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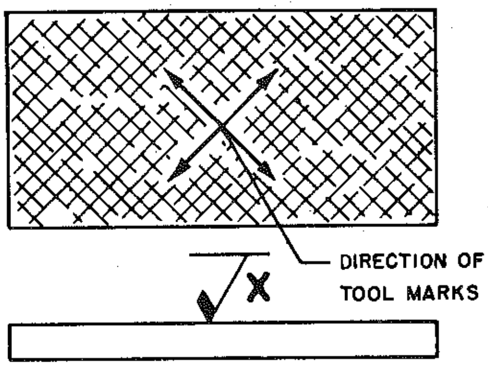
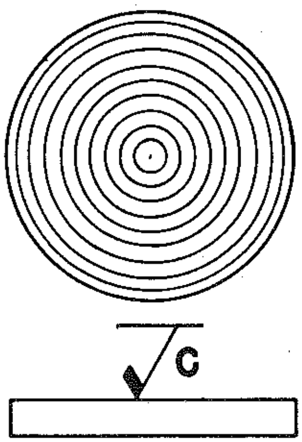


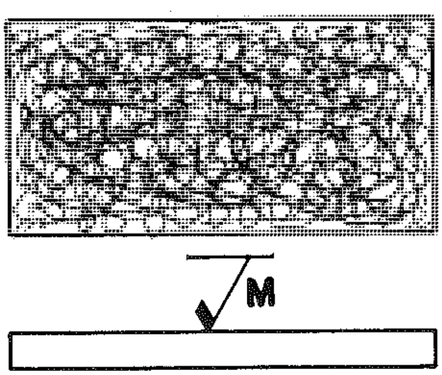
Angular in both directions to the boundary line of the surface indicated by the symbol, as shown in Figure 8. Example - Side wheel grind, and traversed end mill.

FIGURE 8



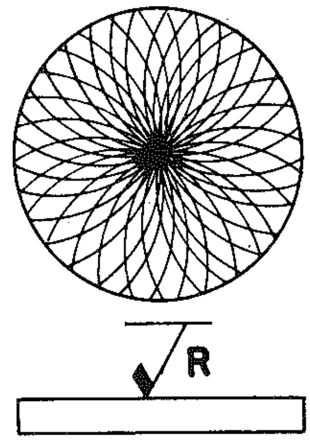
Approximately circular relative to the center of the surface indicated by the symbol as shown in Figure 9. Example - Facing.

FIGURE 9



Multidirectional, as shown in Figure 10. Example - Lap, superfinish.

FIGURE 10



Approximately radial relative to the surface indicated by the symbol, as shown in Figure 11. Example - Surface ground on a turntable, fly cut and indexed on a mill.

FIGURE 11

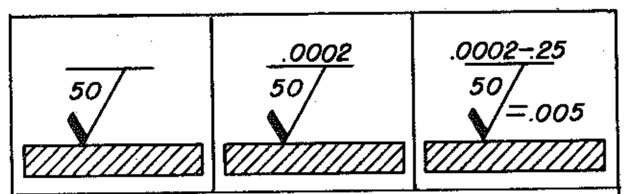


FIGURE 12

both upper and lower limits are shown. The roughness width and lay are shown to the right of the long leg of the surface finish symbol, and the waviness height and waviness width above the extension line as shown. The symbol is placed on the line representing the surface to be controlled or on a witness line or leader line pointing to the surface. For better reading it is recommended that the symbol appear upright on the drawing.

Surface roughness may be measured in a variety of ways. The choice of the method depends on the accuracy of control desired. Of the present day surface measuring instruments, the stylus type with integrating meter or oscilograph is the most widely used. This type of instrument probes the surface with a finely ground diamond stylus, the vertical motions of which are measured through electromagnetic means relative to a nominal surface created by the position of a rider shoe on the surface. Such instruments, when accurately calibrated, are limited only by the ability of the stylus tip to penetrate surface scratches finer than its diameter and by the frequency response characteristics of the instrument. For extremely accurate control it is recommended that such instruments be used in conjunction with precision type reference specimens such as the Geometric Surface Finish Standards.

The Geometric Surface Finish Standards are a set of precision ruled surfaces having values equivalent to the recommended roughness values of the SAE. A cross section of a typical Geometric Surface is shown in Figure 14. Original

(Continued on page 37)

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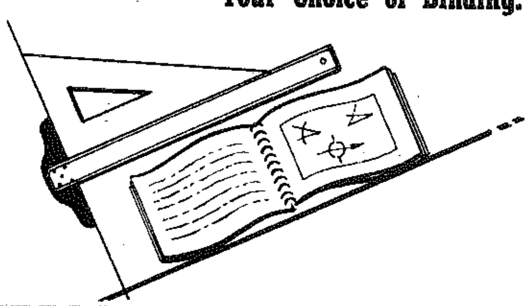

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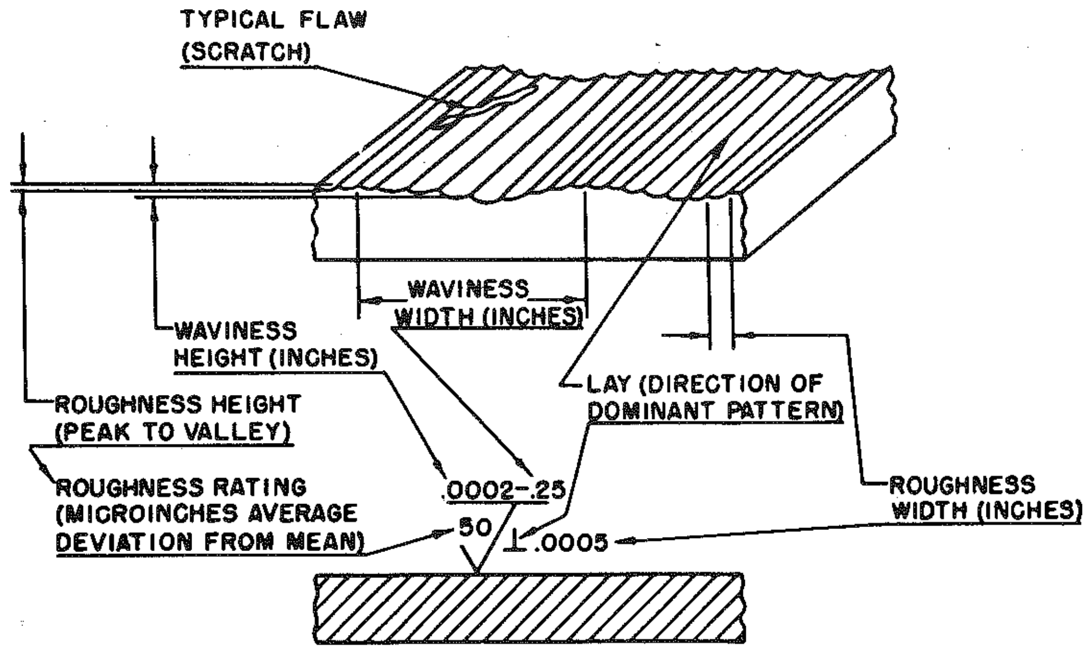

Meaning of Each Part of Symbol Defined

FIGURE 13

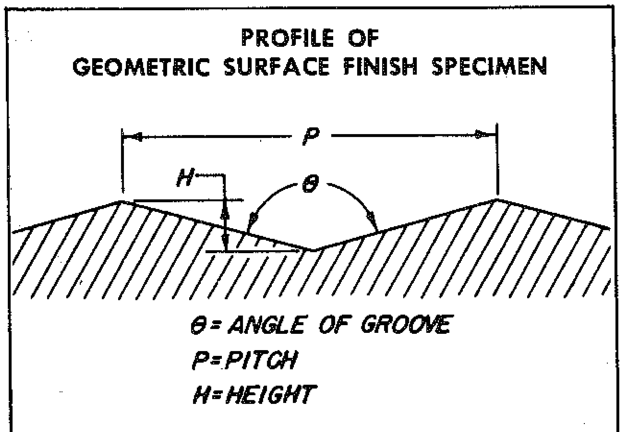

FIGURE 14

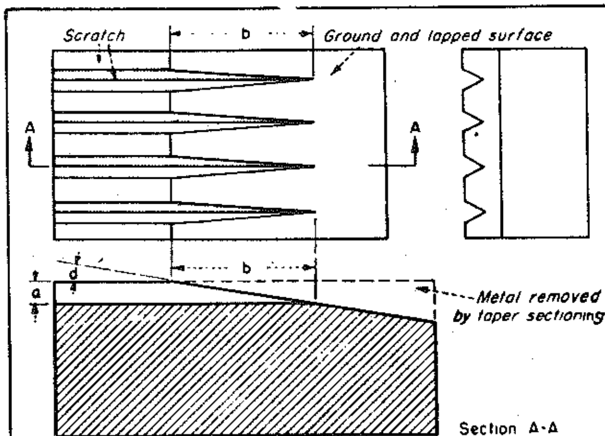

FIGURE 15

masters for the Geometric Standards are ruled on gold surfaces by a fine line ruling machine, with calibration being accomplished by taper sectioning electroform replicas as shown in Figure 15. It is estimated that the calibrated roughness values of these ruled standards are ten time more accurate and consistent than roughness values on ordinary machined or ground surfaces. Limited sets of the Geometric specimens will shortly be available for use by industry for surface finish control.

Other methods for control of surface roughness include reflection type meters, comparison microscopes, plastic replicas and visual or tactual comparison. These last methods of control are all based on calibration of the instrument or visual or tactual senses with pilot specimens of the work piece. The pilot specimens in turn should be calibrated against the precision reference specimens by stylus instrument.

It should be noted that using a pilot specimen of the surface to be measured differs from using a set of machined surface finish specimens. A pilot specimen represents the

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1 — Micrometer anvils, Mirrors, Gages

2 — Shop gage faces, Comparator anvils

4 — Vernier caliper faces, Wrist pins, O-ring grooves-motion, Hydraulic piston rods, Railroad axles, Precision tools, Honed roller and ball bearings

8 — Crankshaft bearings, Camshaft bearings, Connecting rod bearings, Valve stems, Cam faces, Hydraulic cylinder bores, Lapped roller and ball bearings

12 — Piston outside diameters, Cylinder bores

16 — Spline shaft, O-ring grooves-no motion, Gear teeth, Motor shaft bearings, Ground roller and ball bearings

32 — Brake drums, Beamed holes, Broached holes, Bronze bearings, Precision parts

64 — Gear locating faces, Gear shafts and bores, Cylinder head face, Cast iron gear box faces, Piston crown

130 — Mating surfaces-no motion, Drilled holes

250 — Clearance surfaces, Rough machine parts

FIGURE 16

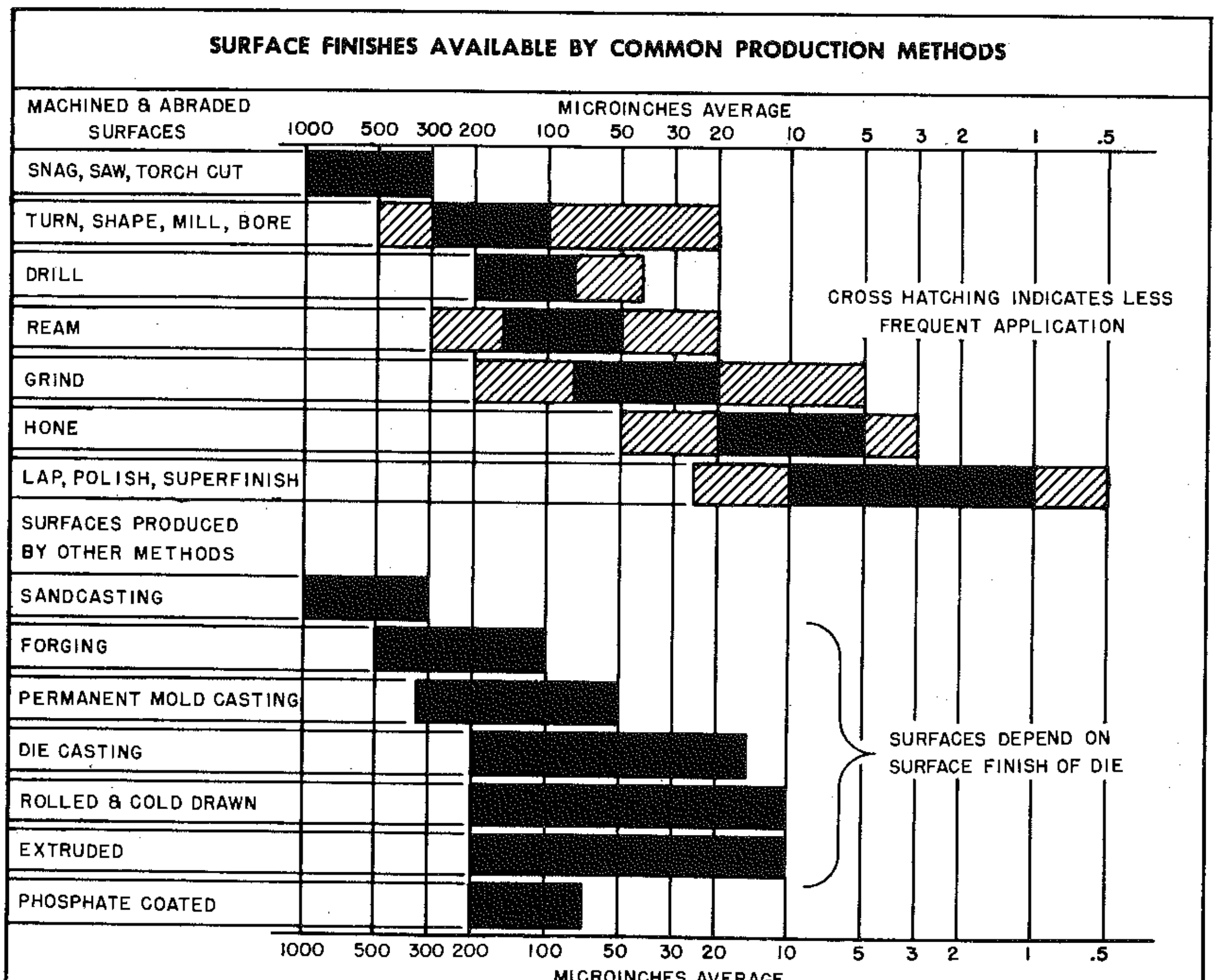

FIGURE 17

same material and the same processing methods as the work piece, whereas the machined specimen sets can only approximate these conditions and will not necessarily be equivalent to the work piece with respect to color, luster, roughness width or physical characteristics of the desired surface. While color, luster and physical characteristics of the surface are not defined or controlled by the surface finish designation, they are important factors in comparing surfaces by means other than stylus type instruments.

Surface waviness may be measured by dial indicators, optical flats or by a newly perfected surface measuring instrument which measures absolute deviation from accurately trued reference surfaces. Another well known method of waviness measurement is by bluing the surface. The accuracy of this method however depends on the experience and judgment of the inspector and results are not necessarily reproducible from person to person, let alone from one plant to another.

Not all machine surfaces require surface finish designation. To apply the surface finish symbol to every surface shown would detract from the emphasis desired for critical surfaces and in addition, would raise the cost of the product due to the requirement for inspection and special machining out of all proportion to the actual value gained. The basic criterion on which surface or surfaces that have been subjected to use similar to that contemplated for the subject surface have ever required refinement and control. Such information is usually available to the designer from service and experimental records. However, in new or radical designs and applications, the designer must rely on good judgment and, if possible, experimental data.

Normally the use of the surface finish symbol indicates that refinement of the surface is sought. However, there are cases where excessive smoothness has led to rapid failure, especially where metal to metal contact is experienced. As shown in Figure 16, there are many applications for surface finish control. These fall into four broad classifications, as follows: (1) where extreme accuracy of measurements is required, (2) where the surface under consideration must act as a bearing surface with the minimum of friction and wear, (3) where the appearance of the surface must be perfect and (4) where the surface is subjected to fatigue stresses.

Of these four classifications, the problem of combatting friction and wear is probably the most common. Typical surfaces falling within this classification are journal bearings, bushings for sliding shafts, pistons and cylinders, disc and drum type brakes, cutting tools, etc. As previously indicated, the roughness requirement for such surfaces will depend on such factors as the relative hardness of mating materials, the amount and type of lubrication, the degree of cooling, and the amount of loading. It can be seen that for any one type of application, more than one surface may be required. For example, because of dissimilar material, loading and lubrication, the wrist pins of two different engines may require two different surface finishes that differ by as much as two to one. Figure 16, therefore, should be used for advisory reference only, and the roughness values indicated for the various surfaces should not be construed as mandatory.

While it is of considerable importance that the designer be thoroughly familiar with the production methods of processing the products he designs, it is not his duty to formulate the processing steps. In fact, many processing shop foremen and production men are extremely jealous of their authority when it comes to setting up process sheets. Furthermore, the production supervisor may be able to plan production more economically if given complete freedom in choice of machining methods. The engineering drawing should therefore seldom carry the method by which a particular surface is to be produced. However, in some instances, experimental data have shown that one and only one method of finishing the subject surface may be employed. In these cases, it is advisable to indicate such surfaces with a note which indicates the processing method as well as the surface roughness desired.

Figure 17 shows the range of surface roughness available by common methods of production. It should be recognized that the values shown in the figure are not absolute limits. Reference to this figure is helpful to the designer by assuring him that the surface finish requirement is within the capability of the normally available production methods. The use of this figure in conjunction with specimen sets or machined samples of similar types of work is of considerable aid to the novice in surface finish designation.

Since the publication of American Standard B46.1 and the S.A.E. Standard for Surface Finish, automotive designers have become more and more conscious of their responsibility in the control of surface finish. To be sure, the adoption and implementation of the surface finish standards by all sections of the industry will require much time and training. Because of the emphasis placed on surface finish by the S.A.E. Surface Finish Standard and the S.A.E. Drafting Standards, many automotive concerns are now designating surface finish by the new method. It is anticipated that, with the advent of the availability of Geometric Surface Finish Specimens and expansion of the application of the surface finish standards, the automotive industry will be able to produce goods of ever higher quality.

SUPPLEMENTARY READING AND REFERENCES

Abbott, E.J., Bousky, S., and Williamson, D.E., "The Profilometer," Mechanical Engineering, Vol. 60, No.3, March, 1948, pp. 205-216.

Abbott, E.J., and Rupke, Edward, "The Proficorder - An Instrument for Recording Waviness and other Surface Profiles," Transactions A.S.M.E., Vol. 70, May, 1948, pp. 263-270.

Broshear, Ben C., "How Smooth is Smooth," American Machinist, Sept. 9 and 23, 1948.

Broadston, Jas. A., "Surface Finish Requirements in Design," A.S.M.E. Semi-Annual Meeting, June 27, 1949, San Francisco, California.

"New S.A.E. Finish Standard," S.A.E. Journal, July, 1949, p. 33.

Lewis, C.R., "The Calibration and Use of Master Roughness Standards," The Tool Engineer, Nov., 1949, pp.22-24.

Underwood, A.F., and Trowbridge, R.P., "Present Methods of Surface Finish Control and Development of Geometric Surface Finish Standards," The Tool Engineer, Nov., 1949, pp. 17-21.

Lewis, C.R., "Surface Finish Control," Product Engineering, August, 1950.

Trowbridge, R.P., "Surface Finish and the Designer," Product Engineering, September, 1950.

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