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Prepared by the National Council of Technical Schools, this reference may be used by prospective students , their parents, and counselors in learning the philosophy and objectives, historical background, and present status of technical schools and career opportunities as a technician. Career opportunities included are: (1) Aerospace/Aviation Engineering Technology, (2) Architecture and Building Construction Engineering Technology, (3) Chemical Engineering Technology, (4) Civil Engineering Technology, (5) Computer Engineering Technology, (6) Drafting and Design Technology, (7) Electrical Power Engineering Technology, (8) Electronic Engineering Technology, (9) Fluid Power Engineering Technology, (10) Industrial Engineering Technology, (11) Internal Combustion Engines Engineering Technology, (12) Mechanical Engineering Technology, (13) Metallurgical Engineering Technology, (14) Nuclear Engineering Technology, and (15) Refrigeration, Heating, Air Conditioning Technology. Supplementary material includes a comparison of engineering colleges, technical institutes, and trade schools. Some items of comparison were entrance requirements, level of studies, initial employment, work assignments of graduates, transfer of credit, accrediting or approving agency, and typical certification of graduates. (DM)

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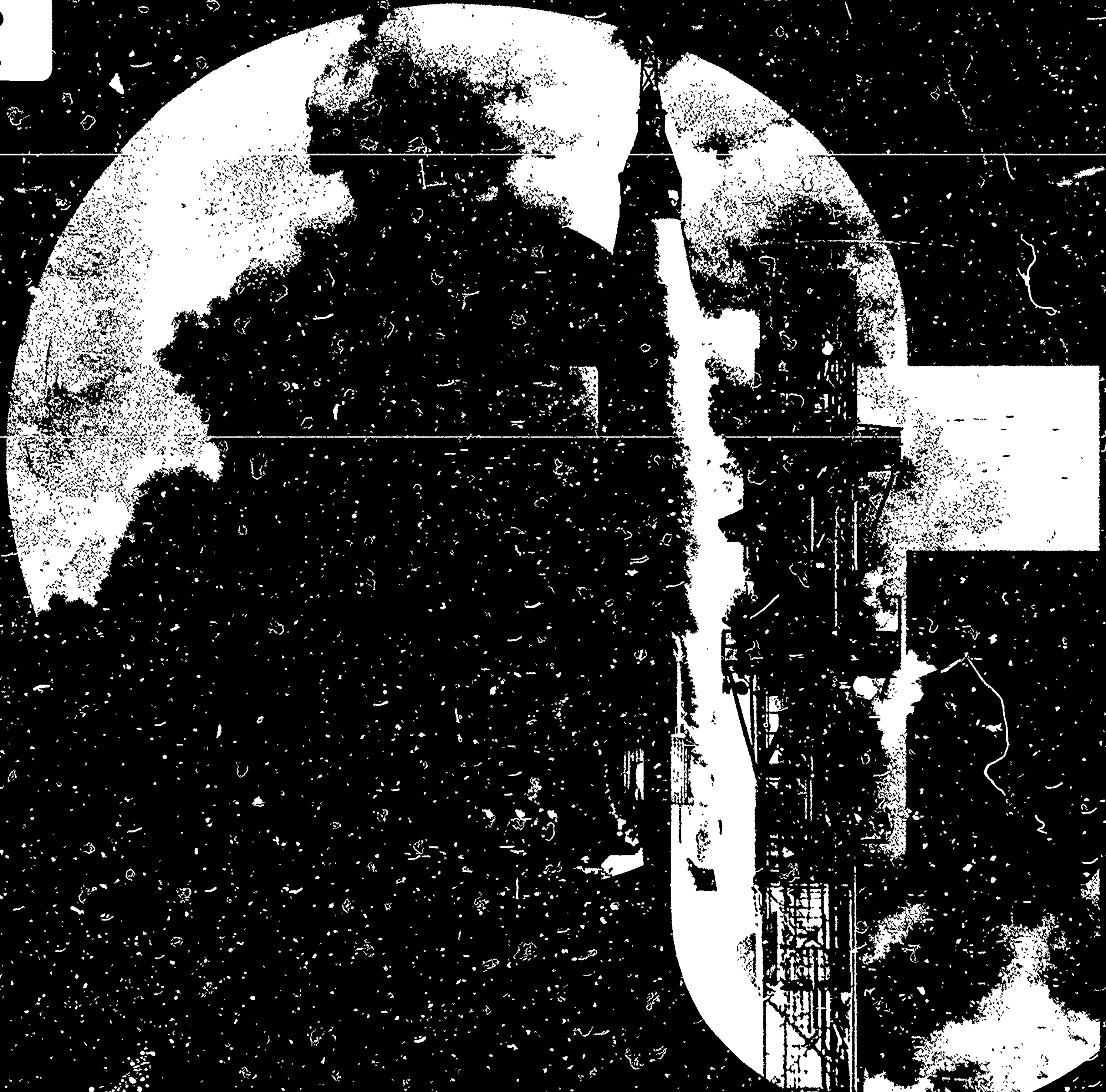

engineering technology Careers

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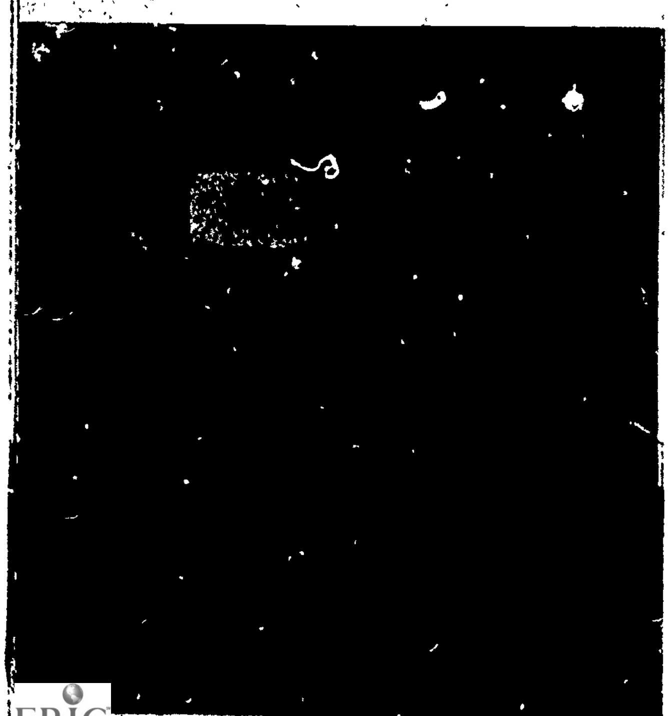
Career GUIDANCE INFORMATION for ENGINEERING TECHNICIANS

Prospective Students, their Parents and Counselors . . . Guidance Directors . . . Librarians . . . Industrial Executives . . . Engineers . . . Personnel Managers . . . Businessmen . . . Employment Offices . . . Counseling Centers . . . Government Officials . . . and others interested in this NEW and GROWING area of engineering-support occupations.



Prepared By The

NATIONAL COUNCIL OF TECHNICAL SCHOOLS

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"PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL HAS BEEN GRANTED BY National Council of Technical Schools TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U.S. OFFICE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER."

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The National Council of Technical Schools

The National Council of Technical Schools was organized in 1944 by a number of experienced technical school administrators for the purpose of formulating and promoting sound educational, ethical, and business standards in the area of engineering technology education.

These schools offer college-level courses which prepare graduates for immediate gainful employment in positions closely associated with the work of the engineer. Graduates are designated "engineering technicians" to distinguish them from medical technicians, dental technicians, industrial technicians, etc.

The National Council of Technical Schools is comprised entirely of schools deriving their financial support from student tuition, contributions, and/or endowment. Many of the Council member schools are chartered as non-profit. None is supported from public tax funds.

Many member schools have been in continuous and successful operation for more than 50 years. A minimum of five years continuous operation is a requirement for admission to membership in the Council. Every member school must schedule inspection of its course offerings every four years, thus assuring up-to-date curricula, facilities and procedures.

The National Council of Technical Schools is also a non-profit inspection and approval agency for private independent technical institutes offering college-level courses in engineering technology. It provides its services upon request to a school desiring membership. Compliance with the Council's Code of Minimum Standards is determined both by written reports as well as personal inspection of the school concerned. Approved courses, in addition to meeting the other requirements of the Code, must contain at least 64 semester hours (or equivalent) of classroom and laboratory work.

Philosophy and Objectives

. . . of the Private, Independent Technical Institute

THE PRIVATE, independent technical institute is an educational establishment of higher learning. Its philosophy derives from its specific objective within the spectrum of college-level institutions. That objective is to educate its students to a high degree of competence in a technology of their choice, and to support that competence with a solid working knowledge of mathematics, the fundamentals of science, written and oral English, laboratory practice, and exposure in depth to the principles and methodology of that particular technology.

To reach this objective, the private, independent technical institutes approved by the National Council of Technical Schools have adopted a Code of Minimum Standards which sets guidelines for the curriculums offered, admission requirements, faculty qualifications, student services, management integrity, and responsibility to their graduates.

The technical institute assumes the responsibility for the education of the modern, engineering technician. In discharging that responsibility, it designs and refines its curriculums to prepare him for specific job opportunities in a technological specialty after two or three years of college-level study. On completion of this study program, the technical institute graduate is usually awarded an Associate Degree.

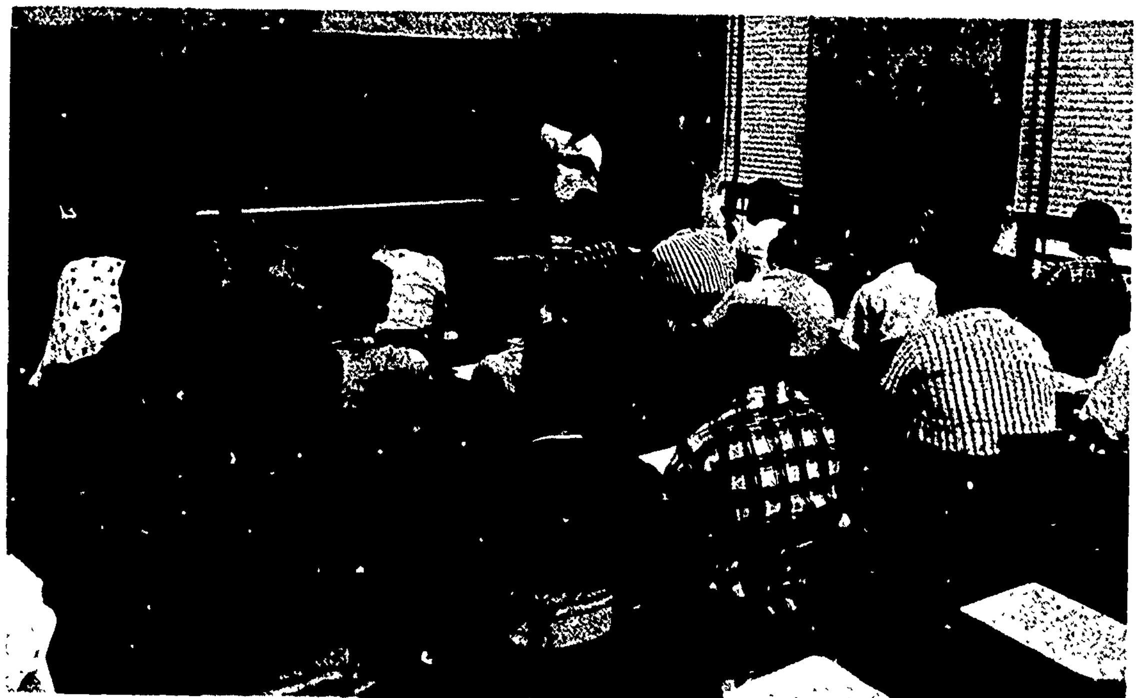
Modern technology is a rapidly expanding, almost explosive, reality. Its application, its development, its utilization for the benefit of mankind is the sole prerogative of neither the scientist nor the engineer. To be effectively productive, their work requires the support, the know-how, the assistance, and implementation by the modern engineering technician.

The philosophy of the private, independent technical institute is to recognize this important role of the technician, to recognize it in the firm and proven belief that many young people have the aptitude, intelligence, interest, and capacity to fill it, to build rewarding careers in this ever-expanding realm of technological specialization.

The engineering technician fills the gap between the engineer, the scientist, and the skilled industrial worker. He carries out basic functions of engineering, translating and putting into practical perspective engineering plans and specifications.

He makes direct applications of engineering principles. He operates engineering-type equipment, tools, and instruments. He is the engineer's man 'Friday,' the liaison between the engineer, the craftsman, and the skilled worker, yet working in closer association with the engineer than with the others.

The technician is competent, able, and at home in the design, development, installation, operation and repair of engineering or scientific equipment. It is the purpose of the private, independent technical institute to make him so.



A modern engineering technology curriculum consists of a well-balanced blend of college-level math, science, communication skills and laboratory practice. It is occupationally oriented and usually specializes in a particular field of technology. The class above is receiving instruction in applied calculus.

An RCA Institutes instructor (right) is shown here demonstrating the techniques of microwave transmission and reception using precision laboratory equipment.

Electronics engineering technology graduate James Callahan works as a Research and Development Laboratory Technician. He is shown here running a component evaluation test.

Historical Background

of the Private, Independent Technical Institute

IN COLONIAL America and in the United States prior to the Civil War, the country's economy was largely agrarian. Agricultural skills and knowledge were passed on from father to son. Craftsmen in such areas as surveying, navigation, metal working, mineral exploration, building, road and bridge construction learned their trades as apprentices. Their numbers were augmented as immigration brought trained journeymen from Europe.

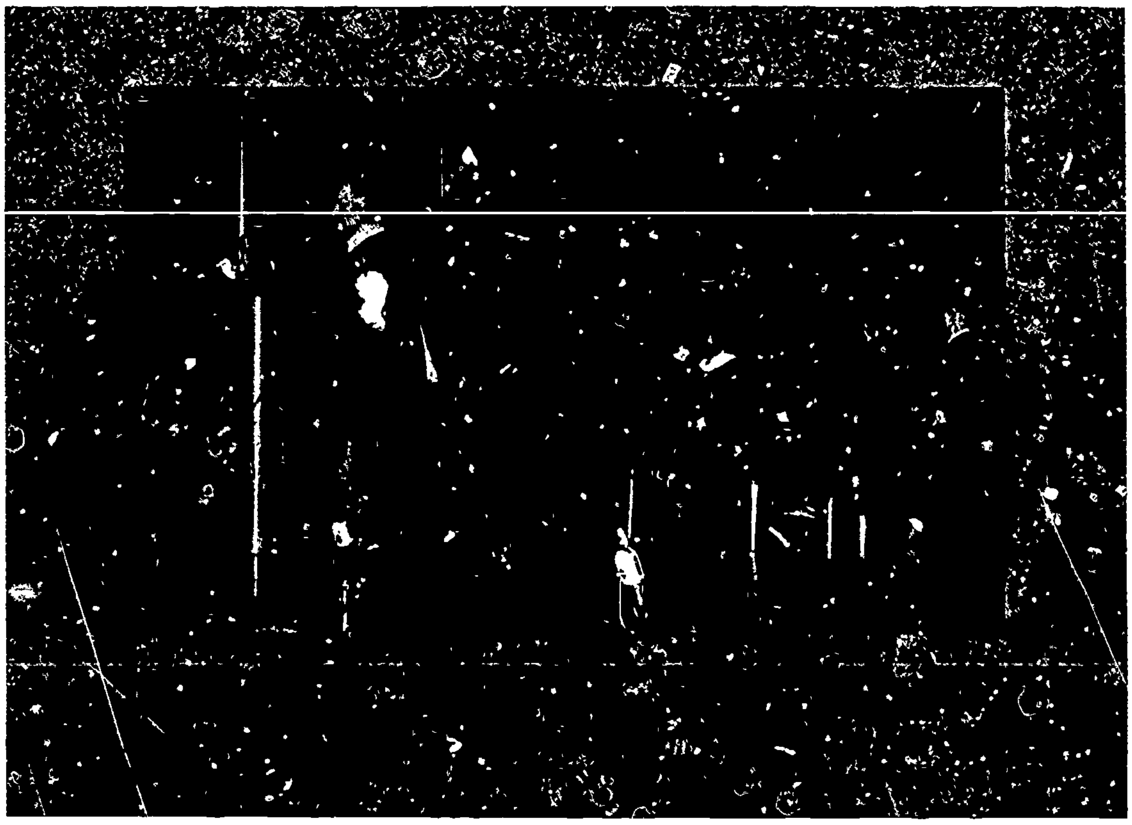
The industrial revolution during this era, the economic changes resulting from replacement of hand tools with machine and power tools, the advent of the railroad, national growth which in turn sparked industrial growth, all in some measure drew attention to the need for providing workingmen with some formal education in the fundamentals of industry and commerce.

Representative of, and pioneer in, this effort was the Gardiner (Maine) Lyceum, established in 1822. The two and three year courses of study included bookkeeping, algebra, geometry, trigonometry, surveying, navigation, calculus, chemistry, linear drawing, political economy, and natural philosophy.

Ohio Mechanics Institute, opened in 1822 in Cincinnati "for advancing the best interests of the mechanics, manufacturers, and artisans by the more general diffusion of useful knowledge in those important classes of the community," is considered the oldest of present-day technical institutes.

Others were started in this era with similar purpose. Some expanded their curriculums to the four-year college pattern, and some closed their doors because of financial or other reasons.

With the opening of the great west and further development of industry after the Civil War, employment opportunities multiplied. Apprenticeship was not adequate to



supply the demand for technical personnel, the technical institutes were too few, the secondary schools were not equipped, and the engineering colleges were not oriented to do so.

Federal land grants under the Morrill Act of 1862 made possible the rapid establishment and growth of state universities, agricultural and mechanical colleges, and some technical schools. In many instances, however, states which had established technical institute curriculums deleted them in favor of four-year engineering programs.

The technical institute "idea" gained needed impetus here from the well-established Technikum in Germany. In essence, the Technikum integrated courses in science, mathematics and chemistry, technical practice, laboratory experiment, and shop experience in a core curriculum.

The first applied technology courses in the United States adopted the Technikum concept. Initially, most of the schools designed their curriculums for the needs of mature craftsmen, with some years of on-the-job experience in industry. Graduates were then upgraded to semi-professional positions.

Entrance requirements and the level of instruction differed from those of the vocational school, then emerging in U. S. secondary education. Curriculum content differed also from that of schools in the vocational-trade area. The basic two-to-three year pattern with its emphasis on practical engineering applications differed finally from the college and university pattern.

The growth and development of applied technology curriculums took place largely in private, independent schools up until World War II. The pioneering efforts of these institutions produced a solid base for expanding the facilities to train technicians in 1941, and thereafter. Today, engineering technology curriculums are offered by a great variety of institutions, but the basic designs and objectives are essentially the same as in the beginning . . . to produce a graduate qualified to fill the gap between the craftsman and the engineer, and to take on increased responsibilities in practical engineering.

Growth and Present Status

of the Private, Independent Technical Institute

AMONG TECHNICAL institutes established since 1900 were these:

1903—Milwaukee School of Engineering
1904—Chicago Technical College
1905—National Technical Schools, Los Angeles
1908—Franklin Institute of Boston
1909—RCA Institutes, Inc., New York City
1927—Capitol Institute of Technology, Washington, D. C.
1931—Central Technical Institute, Kansas City
1931—DeVry Technical Institute, Chicago
1932—Academy of Aeronautics, New York City
1940—Embry-Riddle Aeronautical Institute, Daytona Beach
1947—Penn Technical Institute, Pittsburgh
1952—Ohio Technical Institute, Columbus

These foundations reflect both the growth pattern of engineering technology, and the adaptability of technical institute educational programs to keep pace with this pattern.

Secondly, and of prime significance, is the fact that this adaptability to growth and development led to acceptance by professional engineering groups and accrediting agencies of the technical institute as a unique and necessary entity in the American educational system.

Two factors accelerated the movement: one, the rapid and complex advancement in technology; and, two, the continuing shortage of competent technical manpower.

During these years, as in prior years of the past century, the technical institute program proved the validity of its stature by doing what no other curriculum succeeded in doing, namely, educating the engineering technician for immediate gainful employment in positions closely associated with the work of scientists and engineers.

Acknowledgment of this achievement took various forms.

Foremost among them was the establishment in 1944 of the National Council of Technical Schools with the purpose of promoting sound educational standards among private resident schools in the technical institute field.

In 1945, the Engineers' Council for Professional Development devised a set of standards and procedures for the accreditation of engineering technology curriculums.

The American Society for Engineering Education established a

(continued on next page)

An early (1950) meeting in Cleveland, Ohio of the Steering Committee for the Technical Institute Division of the American Society for Engineering Education.

Back row (left to right) E. E. Booher, R. W. Marsh, J. L. McKinley, C. C. Tyrell, L. V. Johnson, C. L. Foster, N. R. Rimboi. Front row (left to right) C. T. Reid, J. B. Harshman, C. S. Jones, K. O. Werwath, H. P. Rodes, H. P. Adams.

Growth and Present Status
of the Private, Independent Technical Institute

Technical Institute Division in 1947 as the discussion and action group concerned with technical intitute matters throughout the country. An outgrowth of part of the Division's work was the establishment of the Technical Institute Council in 1960 "to carry out efficiently the administrative developments and to carry on relations with agencies of education, industry and government for the advancement of technical institute type of education."

Other developments indicative of technical institute growth and stature include the following:

The President's Committee on Scientists and Engineers, established in April, 1956, included among its working groups one assigned specifically to study technical institute education;

In 1956, the American Society for Engineering Education endorsed the granting of the Associate Degree for the completion of accredited two-year curriculums in the engineering technologies;

In 1957, the National Society of Professional Engineers established a Committee on Engineering Technicians and Technical Institute Education;

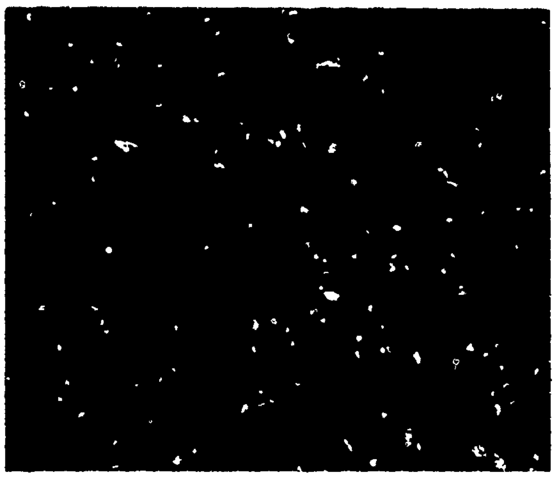
In 1961, the Institute for the Certification of Engineering Technicians, a national examining body sponsored by the National Society of Professional Engineers, was established to recognize the status of qualified engineering technicians;

In 1964, the American Society of Certified Engineering Technicians was formed to further the recognition, status, and professional advancement of the engineering technician.

The status of the engineering technician was further enhanced by action of the United States Civil Service Commission to include technical institute graduation among requirements for many positions, and by the United States Employment Service, Department of Labor, in posting many technician jobs in its Supplement to the Dictionary of Occupational Titles.

Recently, the Department of Labor has separated Engineering and Science Technicians from other technician occupations and assigned a new series of occupational titles, D.O.T. 0-50.20 through .99, in the Occupational Handbook.

The Epsilon Alpha Chapter of Tau Alpha Pi celebrates an anniversary with a dinner meeting. Tau Alpha Pi is the National Honor Society for students attending recognized engineering technology schools.



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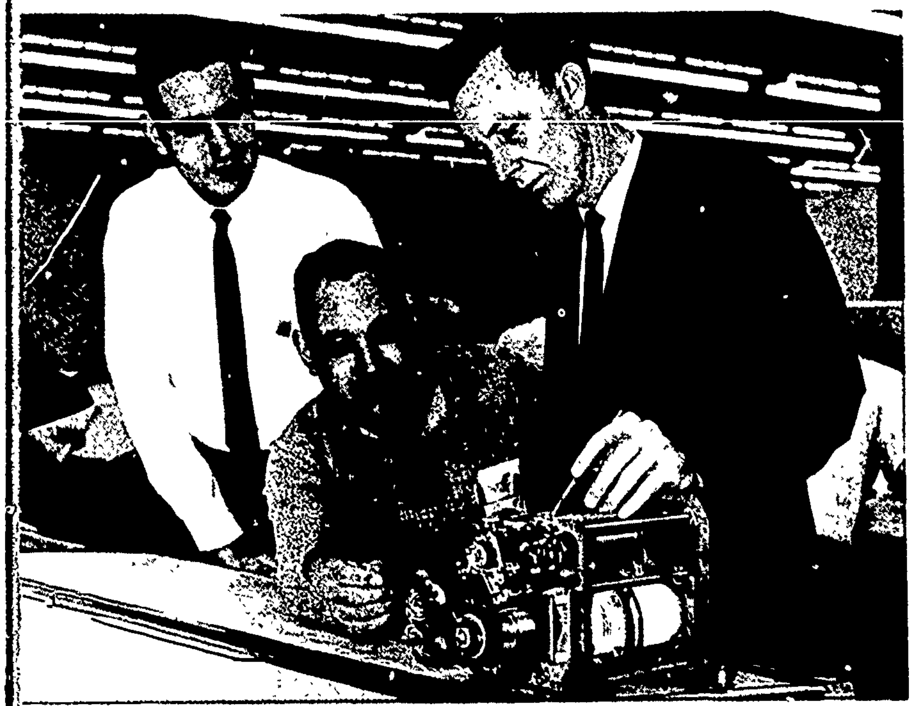
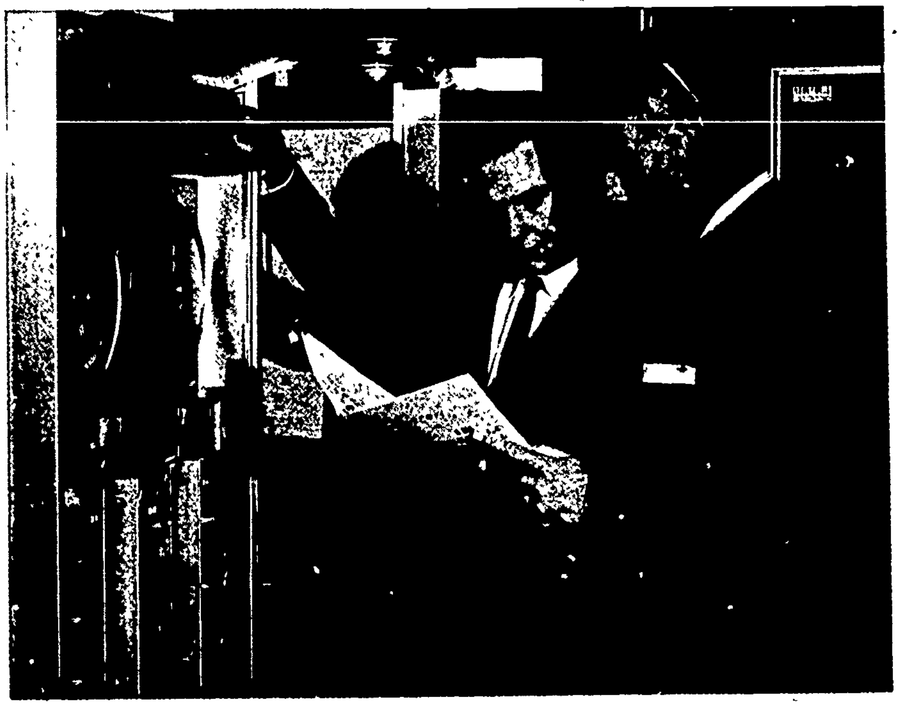
All private, independent technical schools encourage and sponsor extracurricular student activities such as participating sports, dances, field trips, etc.



Teamwork is modern industry's way of accomplishing technical advancements. The engineer designs and plans — his supporting technicians translate his instructions into action.

An engineering technician is one whose education and experience qualify him to apply scientific knowledge along with manual skills in support of engineering activities.



Electronic computers are revolutionizing the techniques of business and industry. Engineering technicians are needed by all major computer manufacturers to assist in the design, manufacturing and field service of computers.

A technician and an engineer are engaged in the final assembly of a space satellite to be used for weather observations. Many technicians work in "clean" rooms, free of air pollution and with controlled temperature.

The Technician and The Engineer

THE TECHNICIAN and the engineer have been defined in terms of their respective occupations — what they do — and in terms of their respective educations — what they must learn to enable them to do specific work in their occupational category.

In its 30th Annual Report published September 30, 1962, The Engineers' Council for Professional Development defined engineering as "the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind."

An evaluation of technical institute education in the United States undertaken by the American Society for Engineering Education was published in 1962 under the title "Characteristics of Excellence in Engineering Technology Education."

Among other things the study proposed these definitions:

"*Engineering technology* is that part of the engineering field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational area between the craftsman and the engineer at the end of the area closest to the engineer."

"An *engineering technician* is one whose education and experience qualify him to work in the field of engineering technology. He differs from the craftsman in his knowledge of scientific and engineering theory and methods and from an engineer in his more specialized background and in his use of technical skills in support of engineering activities."

The engineering team concept associates the scientist, the engineer, and the technician together in common cause, and each with individual identity.

The scientist is concerned with probing the secrets of nature and in defining the laws of nature.

The engineer takes these defined laws and principles of nature and reduces them to applications useful to mankind.

The engineering technician supports the activities of the scientist and engineer either directly as a co-worker, or as the liaison man in supervising production, distribution, or maintenance of technical equipment.

The Working Committee for the Development of Supporting Technical Personnel in its final report to the President's Committee on Scientists and Engineers, explained the occupational category in more detail.

"The scientific or engineering technician generally works in one of three areas:

"1. Research, design, or development;

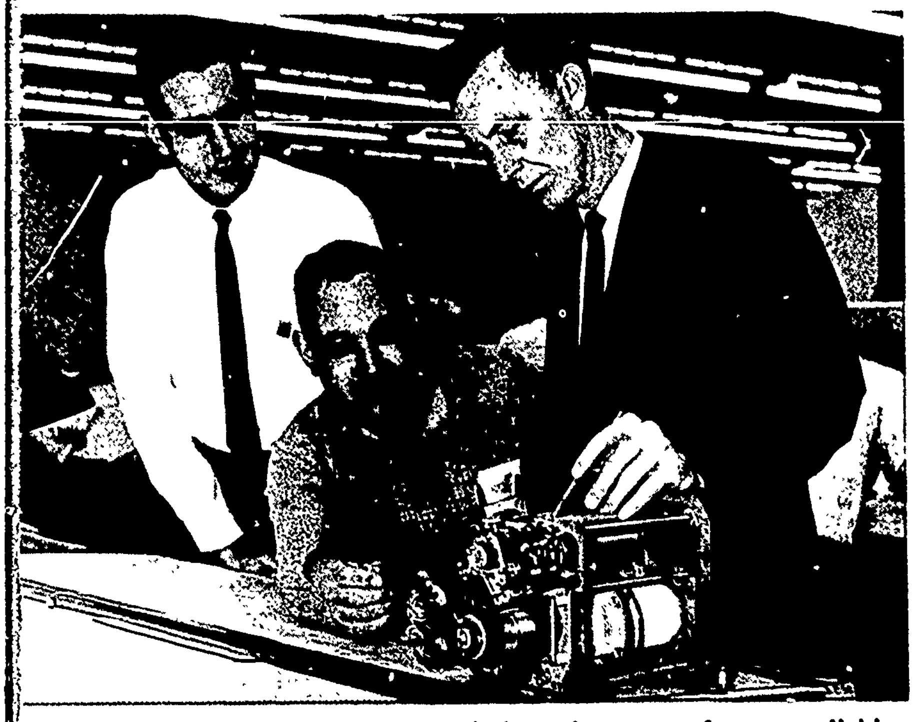
"2. Production, operation, or control;

"3. Installation, maintenance, or sales engineering.

"When serving in the first of these functional categories, he directly assists the scientist or engineer. When employed in the second category, he executes a plan laid out by the scientist or engineer, but he does not actually work under direct supervision. When active in the third category, he frequently does what would otherwise have been done by the scientist or engineer.

"In our growing technologically based economy, the scientific or engineering technician must have a background in post-secondary school mathematics and the principles of physical and natural science, which makes it possible for him to understand and communicate scientific or engineering data, mathematically, graphically, and linguistically.

"While the engineer plans, the technician makes and does; while the engineer creates, the technician applies. The scientific or engineering technician often provides the liaison between the professional man and the craftsman and may thus have varying degrees of leadership responsibility. He must have the same characteristics and fulfill the same fundamental educational requirements as his professional counterparts, except that his interest and education are more in the direction of application, with less mathematical and theoretical depth. He takes the instructions of the professional scientist or engineer and either personally translates them into ac[illegible] or directs their execution by [illegible] supporting technicians and craftsmen. Therefore, his preparation must of necessity be offered in the area of higher education."



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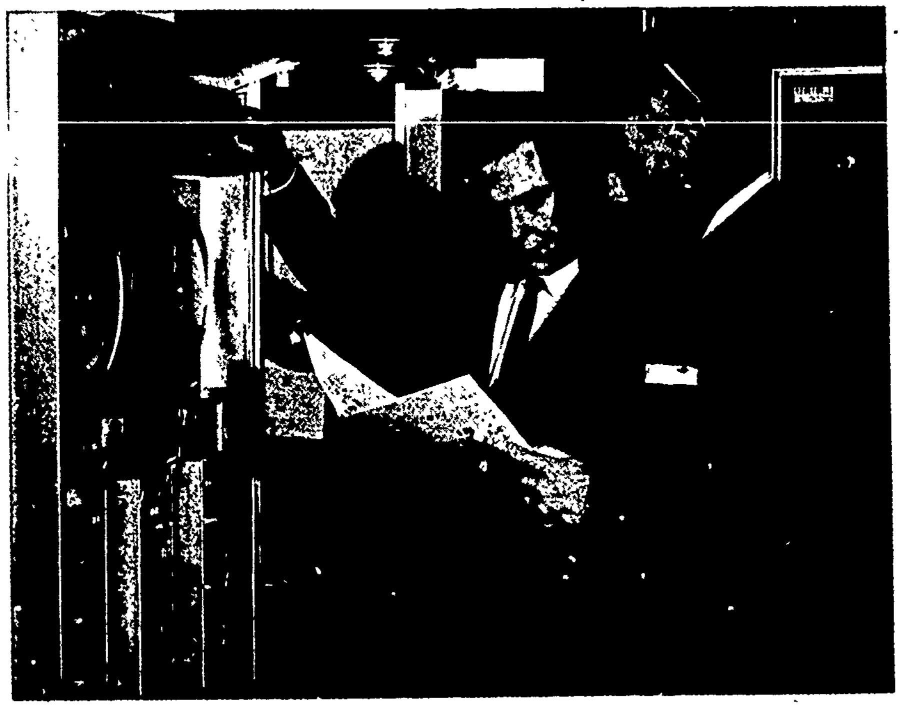

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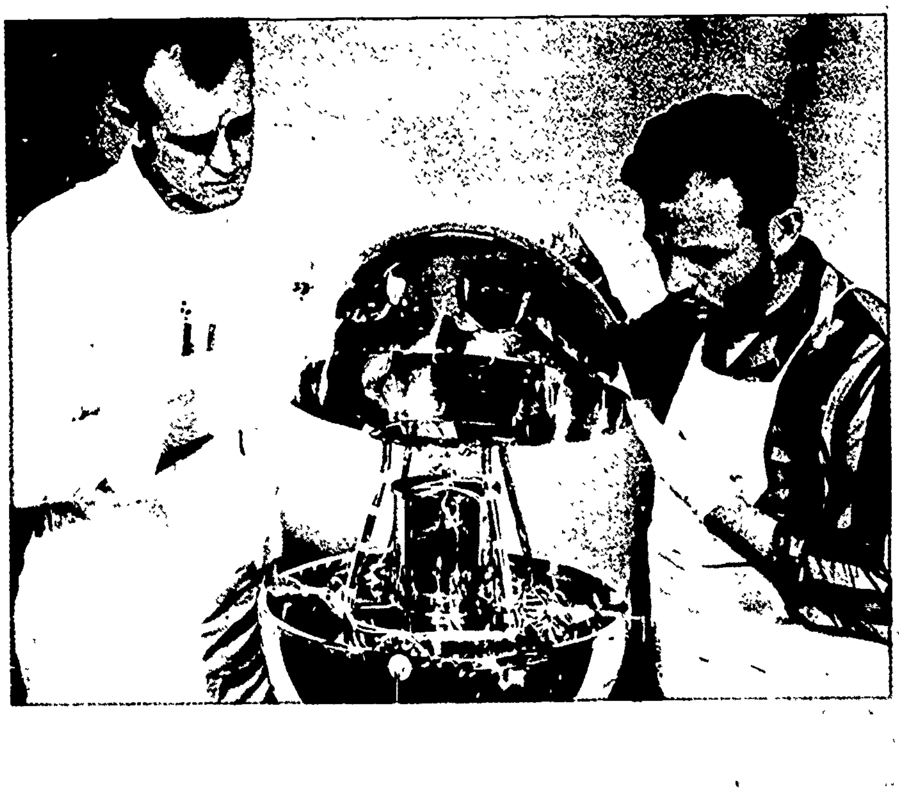


What Is Engineering Technology Education?

ENGINEERING TECHNOLOGY education is a specific type of college-level education which prepares the student for specific job opportunities in both industry and national defense echelons.

The curriculum is an integrated sequence of courses organized and planned to fulfill a particular objective within a specified time. The objective is the education of the engineering technician. The time specified is usually two years, occasionally three. The courses integrated into the curriculum sequence include mathematics and physical sciences; general studies such as English, economics, industrial commerce, and management; and technical subjects — specialties and skills — which usually account for about one-half of the total student effort and class time.

The engineering technology curriculum is post-high school, college-level study. Courses differ in content and purpose from those of vocational or trade schools which emphasize trade training. Courses are intensive, highly practical, terminal in occupational objective, shorter than professional engineering programs, and generally lead to an associate degree.

Most of the courses in engineering technology which meet industry standards are approved by the National Council of Technical Schools or accredited by the Engineers' Council for Professional Development. These are the two agencies most generally accepted by industries which recruit engineering technicians nationwide. Approximately 150 courses have been approved or accredited in some 50 institutions.

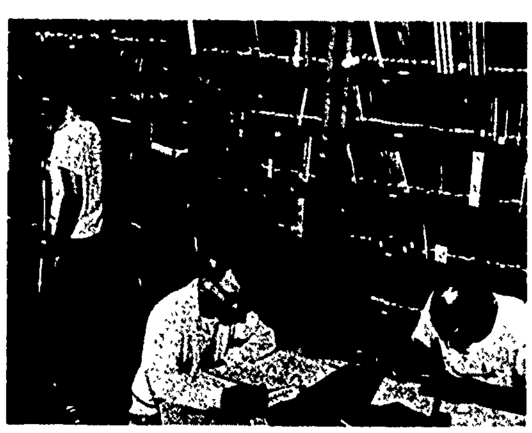
The Engineers' Council for Professional Development is a federation of engineering societies, organized to assist in and to advance education for engineering and to further the intellectual development of individuals who are or may become engineers or engineering technicians.

In describing engineering technology curriculums as college-level, both engineers and educators indicate the degree of achievement demanded for entrance and graduation, as well as the rigor and, certainly in accredited programs, the standard of quality.

The degree of achievement required in pursuing an engineering technology education may be gauged from the courses generally considered essential in accredited and approved programs. These may be grouped in three major categories:

1. *Mathematics* and the *physical sciences.* Both are college-level in rigor and expected degree of achievement. Mathematics programs — analytic geometry, calculus, algebra, and differential equations — are essentially applied in nature and emphasize problem solving rather than extensive proofs. Physical science courses are accom ed by appropriate laboratory sessions.

Engineering Technology differs from professional engineering curricula mainly in that students receive a great deal of practical laboratory instruction and less emphasis is placed on math and theory.



To enroll in a technical institute the student should plan his high school courses exactly the same as if he were going to enter an engineering school.

2. The *communication arts,* written and oral, and what of late has been designated by the general term, *humanities,* namely: psychology, sociology, history, economics, industrial management and organization.

3. *Technical skills* — industrial techniques, engineering graphics, manufacturing processes, and engineering fundamentals, including a comprehensive introduction to the uses and programming of computers. Finally, *technical specialties,* courses which orient the student to accepted standards of competence in a major occupation. These major fields include, among others, the following:

- Aeronautical or aerospace-aviation engineering technology;
- Architectural engineering technology;
- Chemical engineering technology;
- Civil engineering technology;
- Computer engineering technology;
- Drafting and design technology;
- Electrical power engineering technology;
- Electronics engineering technology;
- Fluid power engineering technology;
- Industrial engineering technology;
- Internal combustion engines engineering technology;
- Mechanical engineering technology;
- Metallurgical engineering technology;
- Nuclear engineering technology;
- Refrigeration, heating, and air conditioning engineering technology.

ERIC

Admission Requirements

for Approved Technical Institute Programs of Higher Education

THE PRIVATE, independent technical institute is an educational establishment of higher learning. Its objective is to educate students to a high degree of competence in a technology of their choice, and to support that competence with a solid working knowledge of mathematics, the fundamentals of physical science, written and oral English, laboratory practice, and exposure in depth to the principles and methodology of that particular technology.

All technical institutes that are approved by the National Council of Technical Schools require high school graduation, or the recognized equivalent, for entrance. In addition, it is understood that evidence of sufficient motivation for satisfactory achievement in engineering technology curriculums is also a prerequisite.

This implies that the strongest possible high school preparation in mathematics and the physical sciences is of such increasing value as to border on necessity.

At least one year of high school algebra is universally required and most technical institutes, in addition, require credits in geometry and physics. Students planning to enter a technical institute after high school graduation are urged to determine the credits required well in advance of their senior year. While some technical institutes offer pre-technology courses in algebra, geometry and physics, it is strongly recommended that these subjects be taken in high school.

The engineering technician must be able to communicate clearly and accurately with his associates in industry. The importance of courses in English, in public speaking, in oral and written communication, is obvious. Most technical institutes require a minimum of three units of English for entrance to their curriculums.

Since technical institutes are dedicated to the placement of all graduates in suitable positions, it is most important that all graduates meet industry standards for education, physical health, and personal integrity.

Placement Information

Incentives to study admission requirements and to be prepared to meet them may be offered in a brief summary of where engineering technicians are employed and what they earn.

In 1964, an estimated 620,000 engineering and science technicians were in the U. S. work force. Private industry employed about three-fourths, or roughly 475,000. Industries employing the largest number were aerospace, electronics, electrical equipment, machinery and chemicals.

In mid-1964, the Federal Government employed about 75,000 technicians, chiefly as engineering aides, electronic technicians, equipment specialists, cartographic aides, meteorological technicians, and physical science technicians. The largest number worked in the Department of Defense, and most of the others in the Departments of Agriculture, Commerce, and the Interior.

State government agencies employed over 40,000 engineering and science technicians, and local governments about 15,000. The remainder were employed by colleges and universities, in university-operated research institutes, and in non-profit organizations.

In general, a technician's earnings depend upon his education, his technical specialty, and his work experience.

In 1964, annual starting salaries for graduates of post-high school technical schools averaged about $5,000 in private industry.

In Federal Government agencies in early 1965, starting engineering and science technicians were offered from $4,000 to $5,000 depending on the type of job vacancy, the applicant's educational background and other qualifications.

Most technicians can look forward to an increase in earnings as they move to higher positions through experience and qualifications. In 1964, annual salaries of technicians in high level positions in private industry averaged $8,500, and about one-fourth earned over $9,200 a year, according to a survey conducted by the Bureau of Labor Statistics.

Aerospace/Aviation Engineering Technology

FROM THE sand dunes of Kitty Hawk to the launching pads of Cape Kennedy, the aerospace/aviation industry has captured man's imagination.

The conquest of space, the military and commercial uses of rockets and guided missiles, the conversion of the airlines to the use of jet powerplants, the development of larger and more efficient helicopters, and the tremendous growth in business and private flying offer unique career opportunities to engineering technicians in the aerospace and aviation industries.

The aerospace/aviation engineering technician should be well grounded in analytical mechanics, strength of materials, thermodynamics, aerodynamics, aircraft structures, aircraft powerplants, and the art of technical expression, both oral and written.

He must also be trained in engineering fundamentals, be familiar with practical applications of the laws of science, and be capable of performing a variety of technical and mechanical operations.

The engineering technician will find work to do in the operation of wind tunnels, in the testing and check-out of instruments, in repair and maintenance procedures, and in field service.

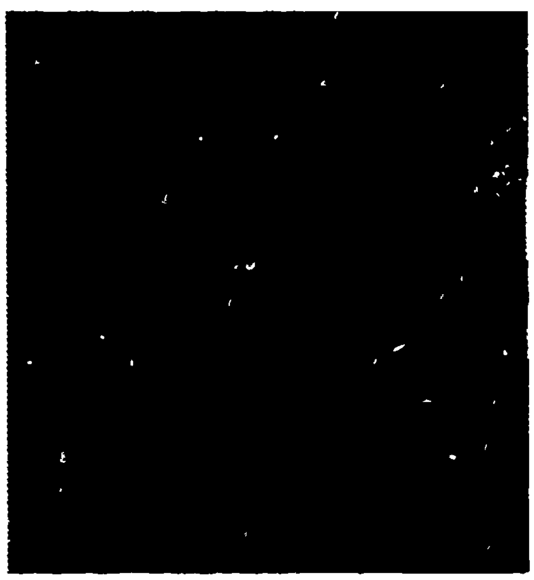
Finally, his talents as a technical writer will find plenty of opportunity for development in drawing up outlines of work to be done as well as reporting in clear detail work which has been done, in preparing project progress reports, procedure sheets, reference bulletins, sales and service brochures for field men, and the important presentations designed for customer appraisal.

Working Conditions

Because of the rapid and continuing technical advancement characteristic of the aerospace-aviation industry, the glow of newness never seems to quite wear off. Laboratories, research and engineering departments, manufacturing plants — the whole complex of where-you-work — all are modern, clean, temperature controlled, inviting.

Equipment, tools, and working materials are of the latest design and develop incentives for good work, and they require the services of engineers and technicians for optimum utilization.

Here, team work is essential. The foundation for this essential is laid in educational institutions where engineers and technicians learn team work values and team work disciplines in classroom study and laboratory practice.



Fred Bodnarchuk, a graduate from the Academy of Aeronautics, is performing utilization tests on a high altitude pressure suit. Private industry needs men with training in Aerospace Engineering Technology.

Opportunities

Aviation has made great strides in the past 50 years, yet the opportunities for young men of vigor and vision continue to be unlimited. Today's jet liners are fascinating machines, but larger, faster, more efficient planes are already on order.

The development of the helicopter, and rapid strides in the manufacture and marketing of planes for private and business use offer fertile fields of opportunity for engineering technicians.

In research and development associated with the exploration of space, these technicians are now in great demand.

As aviation becomes more complex, more engineering technicians with greater degrees of skill have become necessary. In 1950, there were 11 production workers for every one person in engineering work. In 1955, there were 9 production workers to every engineering employee. In 1960, there were only 4 production workers to every engineering employee.

As we move rapidly toward the conquest of space, it is evident that the engineering technician stands on

Aviation engineering technicians work in all phases of aircraft design, production and flight testing. Technicians must be well trained in the fundamentals of aeronautical engineering plus a variety of mechanical operations.

the threshold of his supreme adventure.

How to Enter the Industry

There are no short-cuts to success in aerospace/aviation careers. Preparation for the future as well as for the present is becoming more essential day by day.

This preparation begins in high school where the student should acquire a sound grounding in mathematics, science, and English. He should develop interest in the sciences, a curiosity about practical problems, and the ability to adapt himself to a variety of assignments.

The aerospace/aviation engineering technician is educated in an accredited or approved course of study, either at a private or public technical institute. Courses in this particular engineering technology usually require a minimum of two years of work. They are college-level curriculums.

Prospective students are advised to investigate the academic standing of schools in which they are interested, and also the record of achievement of alumni in the aerospace-aviation industry.

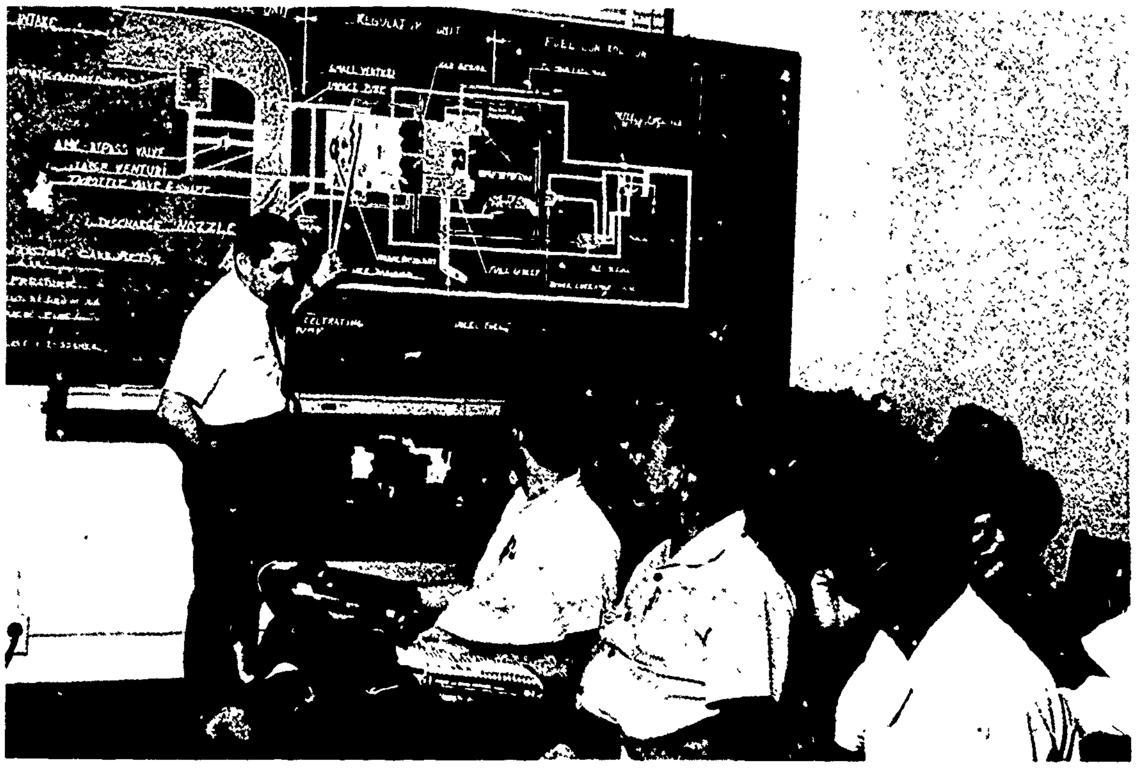
Critical Need

Qualified engineering technicians are needed in all technical phases of this varied industry. Aircraft manufacturers need more trained and qualified people to design and produce high-performance aircraft, guided missiles, and satellite systems. Avionics (aviation electronics) manufacturers need men who are trained in both aeronautics and electronics. The airlines need technicians who can plan and supervise airline maintenance operations, and adapt new procedures as new equipment becomes available.

Graduates of aerospace/aviation technology courses have sufficient training to accept assignments in military aviation should they enter the Armed Forces.

Graduates of certain accredited technical institute curricula in aeronautics are eligible for Flying Cadet training or for Officer Candidate School. The Air Force, Navy and Marine Corps are in critical need of trained technicians.

An instructor at Embry-Riddle Aeronautical Institute is conducting a practical demonstration lecture session on carburetion. The tremendous growth of the commercial airlines, as well as business and private flying, offers unique career opportunities for engineering technicians in the aerospace and aviation industries.



Aerospace engineering technicians are fortunate to witness and participate in man's supreme adventure — the conquest of outer space. At a time when possible military missions for manned spacecraft have not yet been clearly defined, the National Aeronautics and Space Administration (NASA) and the U. S. Air Force space programs are developing American space flight technology and operating experience at a rapid rate.

ERIC

Architecture and Building Constructio

ONE OF man's most basic needs is shelter for himself and his family, for his goods and services. Today's exploding population indicates a corresponding increase in the need for many kinds of shelters — homes, churches, schools, recreation centers, stores, offices, and the complex of structures in areas of urban renewal.

Building is one of America's largest industries. In 1962, more than 60 billion dollars were spent for all types of building construction. In residential housing alone, there were almost 1,500,000 "starts" in 1962.

The construction industry is nation-wide in scope, offering employment opportunities to technicians almost anywhere — in small communities, rural areas, as well as in municipalities where industrial developments and housing renewal projects mushroom.

Thus, unlike some industries which are restricted to certain geographical locations for one reason or another, construction offers the technician as much opportunity in his home community as elsewhere.

Although architectural firms and construction companies are the principal employers of technicians, there are many job opportunities in allied businesses such as building materials manufacturers, lumber dealers, realtors, building and loan associations and property management firms.

A technician trained in architecture or building construction may choose from a variety of attractive employment opportunities. In general these may be classified in two groupings, those concerned with the planning of structures, and those which involve actual construction work.

In planning activities, the technician may be an architectural draftsman, designer, estimator, specifications writer, quantity surveyor or materials buyer. These are normally "office" jobs where the extensive preparation necessary in the planning of any building is done before construction starts.

In construction activities, the technician may become a foreman, supervisor, superintendent, or inspector.

He may be a manufacturer's representative in selling construction equipment, building materials and supplies.

He may become a construction contractor, self-employed, owning his own business, in housing, business, or industrial work.

In all these occupations, the architectural or construction engineering technician requires a considerable amount of technical information on a variety of subjects. His training must include mathematics and physics. He must learn and understand the structure and use of materials. He must have knowledge of architectural forms and concepts. He must be skilled in drafting, and be able to read and interpret blue print plans readily.

The technician must thoroughly understand types of construction. He must have knowledge of office practices, business systems, accounting and estimating. Finally, knowledge of computer programming is of value for an understanding of "critical path" in construction.

Working Conditions

The construction industry is complex, and occupations in it are varied. In planning activities, an office is home base for architect, contractor and technician with many outside contacts and trips afield entailed.

Outside supervision activities are more rigorous, subject to weather conditions, occasional overtime work, require considerable physical activity, all of which has appeal for individuals who prefer out-of-doors occupations.

Jobs in both categories are interesting, non-repetitive, and inviting use of originality and ingenuity on frequent occasions.

Income potential varies with the nature of the work, experience of the person, and responsibilities delegated to him.

Opportunities

Opportunities in an industry so large, complex, and stable are practically continuous. Population growth and population shifts, industrial expansion and relocation, housing developments and urban renewal projects — these among other factors continue the fast pace of the construction industry. Reconstruction, necessitated by obsolescence, fire losses, slum clearance, modernization, adds considerably to the volume.

The demand for qualified technicians in architecture and building construction is continuous. The industry offers real opportunity and demands a high order of performance.

How to Enter the Industry

Technical training, and lots of it, is essential to a person who wants to enter the building industry. Operations are so complex, costs so great, and financial involvement so large that employers will delegate responsibilities only to those who are adequately prepared and qualified to assume them.

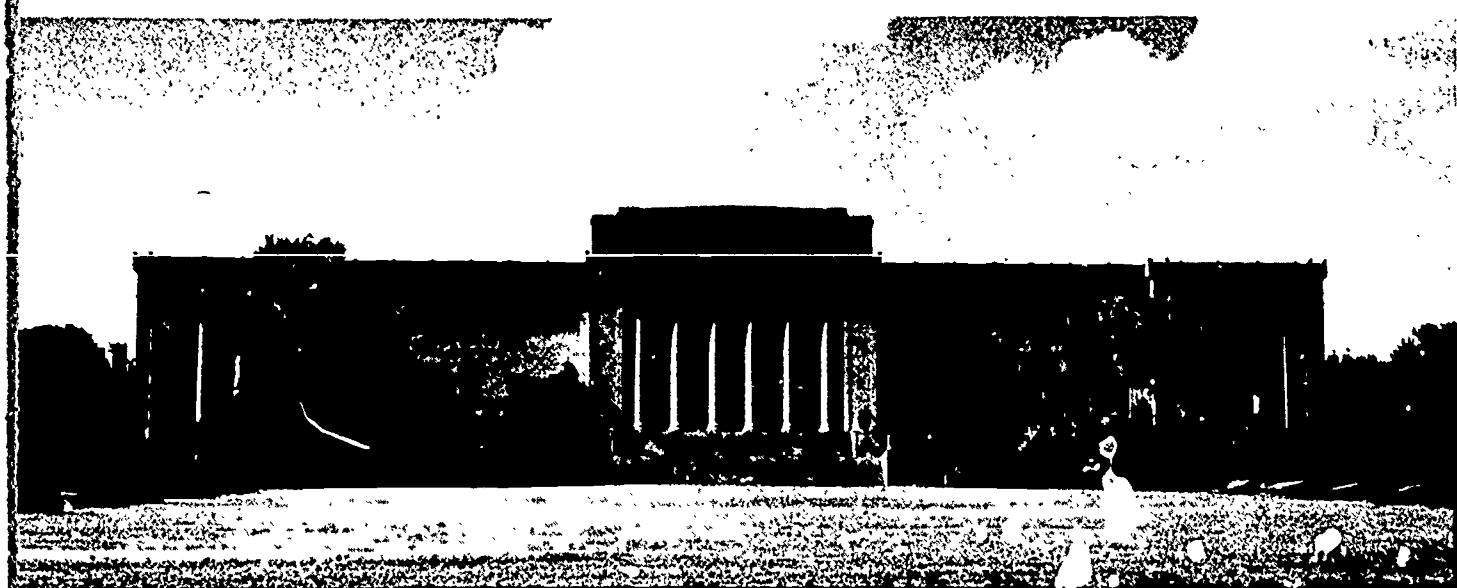
Preparation after secondary school entails technical training in construction methods, strength of materials, architectural drafting, designing and composition, and the fundamentals of industrial commerce.

Approved or accredited courses in public or private technical institutes are packaged to give the student the proper preparation in from two to three years.

Interested students are well advised to investigate the academic standing and industry recognition of any particular school before enrolling.

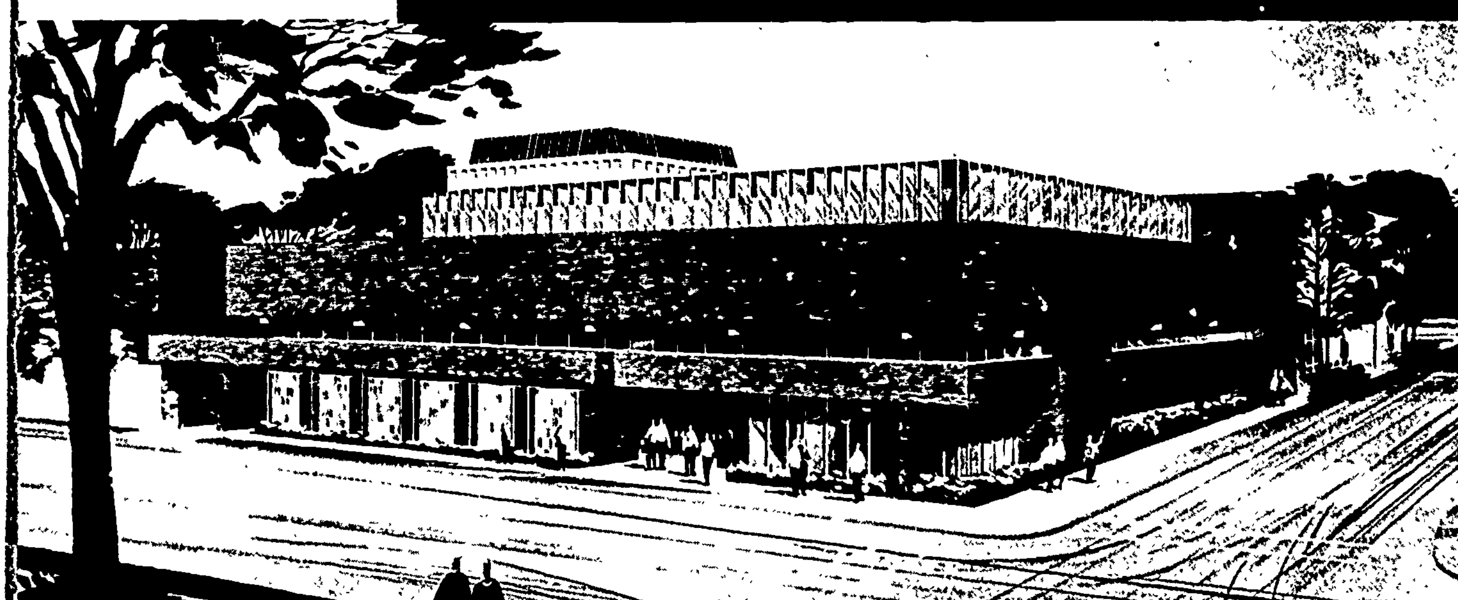
ERIC

Engineering Technology



The impressive designs of our public buildings, art galleries, libraries and museums are the result of "team" efforts of architectural engineers and technicians working together from concept to completion.

Today's exploding population creates the need for many kinds of shelters — hotels, office buildings, auditoriums, churches, schools, homes, recreation centers, etc. The demand for qualified technicians in architecture is continuous.

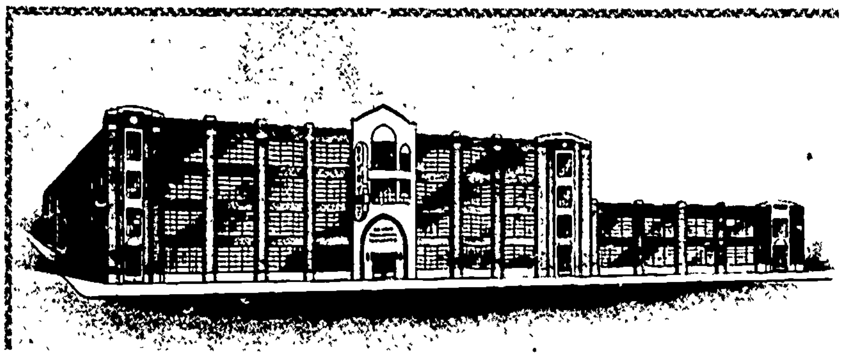


Architect's drawing of a proposed new mechanical engineering building at the Milwaukee School of Engineering. Designed by Fitzhugh Scott, AIA, Milwaukee architect and campus planner, the building is exclusively for technology instruction.

ERIC

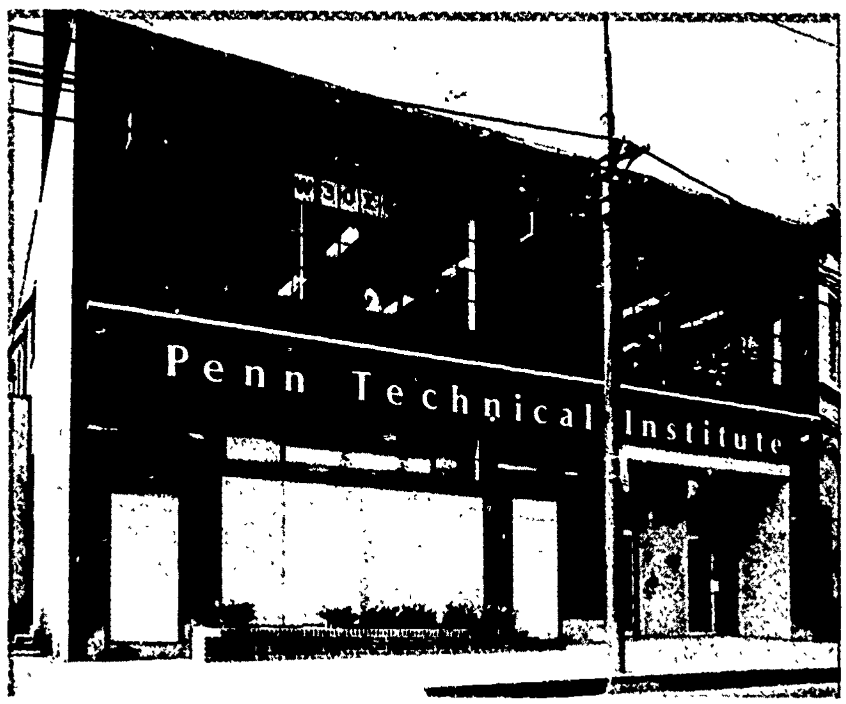
Some of America's Outsta

Franklin Institute of Boston, founded 1908 under the Will of Benjamin Franklin. The Institute serves so.ne 900 evening students as well as 700 day students. Associate in Engineering degree courses are offered in the following fields: Chemical, Civil, Electric Design, Electrical and Electronic, and Mechanical.



DeVry Technical Institute, Chicago, founded 1931. Specializing in Electronic Engineering Technology, the Institute has graduates employed across the United States, in Canada and in countries throughout the world. The classrooms and laboratories in Chicago are large, well equipped, and will accommodate approximately 2,000 students.

Capitol Institute of Technology, Washington, D. C., founded 1927. One of the long established and leading technical institutes in the United States. The Institute's programs in electronics are widely recognized in private industry and government agencies. Students are recruited from throughout the U. S. and graduate placement is nationwide.

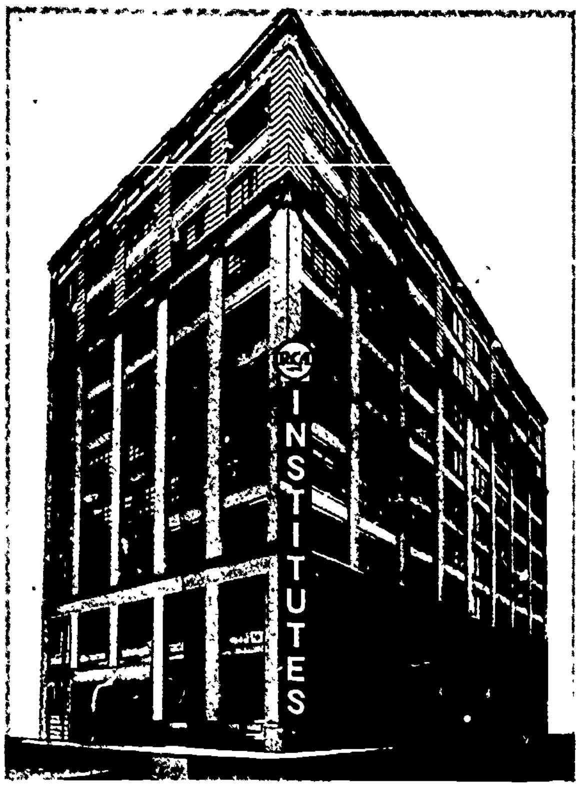


Penn Technical Institute, Pittsburgh, Pennsylvania, founded 1947. Dedicated exclusively to training in electronics and instrumentation. Its faculty and graduates are recognized by the community, technical societies and educational and industrial leaders as highly competent in the field of electronics.

Central Technical Institute, Kansas City, Missouri, founded 1931. A pioneer school in commercial radio and television broadcasting. Present courses include Broadcast Technology, Electronic Engineering Technology, Automation Technology and select courses for training commercial airline personnel. 600 resident day students can be accommodated.

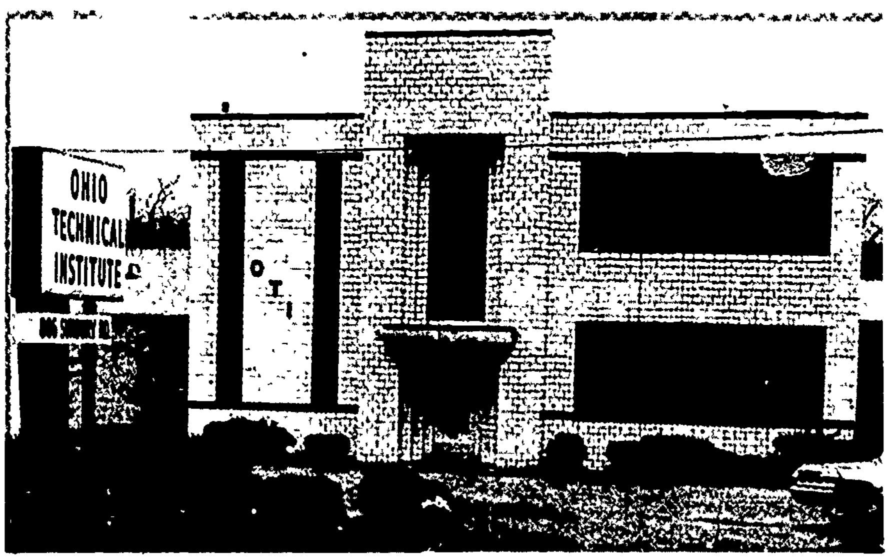
ERIC

nding Private Technical Schools



RCA Institutes, New York City, founded 1909. One of the oldest and best known electronic schools in the United States. With a capacity for over 3,000 day and evening students, the Institute provides programs in electronic technology to qualify students for responsible technical positions.

Embry-Riddle Aeronautical Institute, Daytona Beach, Florida, founded 1940. Courses of study at Embry-Riddle are designed to prepare the graduate for employment in aviation and the allied industries. The Institute offers pilot training as well as courses in engineering technology, drafting, and A-P license preparation.



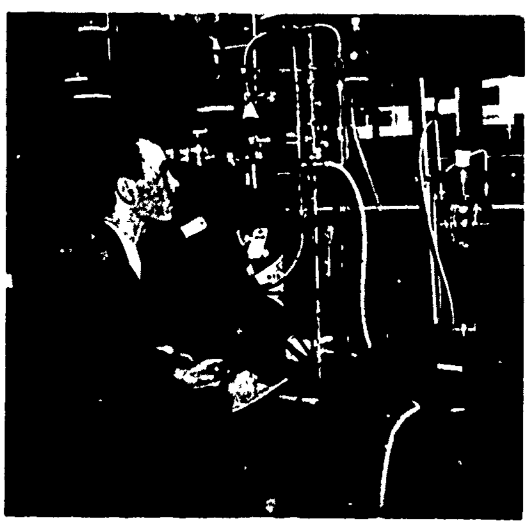
Ohio Technical Institute, Columbus, Ohio, founded 1952. A well established institution, justly proud of its many successful Electronic Engineering Technology graduates. Small, informal and stimulating study groups are stressed by the Institute in all classroom and laboratory work.

Academy of Aeronautics, LaGuardia Airport, New York, founded 1932. A private Junior College, chartered by the Board of Regents of the University of the State of New York. Noted for its excellence, the Academy offers degree and certificate courses to serve the world-wide needs of the aviation aerospace industry.

Milwaukee School of Engineering, Milwaukee, Wisconsin, founded 1903. MSOE pioneered a program of technical education known as the "Concentric Curriculum", a system of higher education in engineering which combines practical training with basic engineering sciences and humanities.

Chemical Engineering Technology

Chemical Engineering Technology students at the Franklin Institute of Boston are trained in both laboratory and production processes. Graduates find positions in research, development, testing, sales and customer relations. The work is highly-skilled, interesting and the financial rewards are substantial.



Whenever manufacturing processes convert raw materials into useful end products, the skills of a chemical technologist are required. New employment areas are rapidly developing in nuclear power and electronic equipment manufacturing.

SINCE WORLD WAR II, applications of chemical technology have become indispensable to the progress of American industry, particularly where manufacturing processes convert raw materials into useful end products.

Affected by this development are leather and paper manufacturing, plastics and synthetic fibers production, food processing including brewing, petroleum chemistry, and specialized processes based on inorganic, organic, or nuclear chemical reactions.

The chemical industry, as the research arm for other industries, investigates raw materials to determine their properties, characteristics, reactions and possible uses when treated in one way or another. It supplies raw materials to other industries, and through research it develops new uses for the products of other industries.

Basic research in the chemical industry has led to the development of thousands of new products, and chemical agents, additives and apparatus which are essential to production processes. One particular chemical company carries on research in more than a dozen fields and offers more than 1,200 products or product lines. Another has doubled in size six times in the past 30 years.

The continued emphasis on research and development, the complexity of chemical processes and products, the imposing array of solids, liquids, and gases being analyzed for an imposing array of specific purposes — all these point up the career opportunities in the chemical industry for engineering technicians. This particular technical specialty is as much a field for women as it is for men.

Trained in both laboratory and production processes, these men and women will find responsible positions in research, development, testing, sales and customer relations. In these areas, these essential technical personnel are concerned with developing and improving processes and products, designing and procuring equipment, building and operating plants, marketing products, and other related management functions.

Working Conditions

Chemical analysis, research, production, storage and transfer — all are in the nature of precision operations. All of necessity require a clinical cleanliness and safeguards for the human operator. These requirements assure a pleasant working environment.

Opportunities

As in many specialized areas, opportunities for technicians in chemical production and related industries are varied and inviting.

Graduates will find employment as chemical technologists, research laboratory technicians, technical aides, staff specialists, and chemical research assistants . . . . not only in those industries traditionally employing chemical processes, such as heavy chemical manufacture, paper making and metallurgy, but also in the new industries of nuclear power and electronic equipment manufacture.

The work of a chemical engineering technician is highly skilled, interesting and the financial rewards are substantial.

How to Enter the Industry

Preparation required for positions in the chemical industry is exacting as it is rewarding. The student spends approximately eighteen months or two years of study in a technical institute curriculum which offers basic courses in engineering fundamentals, materials processing, mathematics, calculus, the physics of mechanics, English, psychology and engineering graphics.

Special subjects include the study of chemistry and chemical process controls, industrial fluid dynamics and polymers, industrial chemistry, organic chemistry, analytical chemistry and bio-chemistry, the physics of electricity and magnetism, the physics of heat and wave motion, as well as speech, social science, and industrial organization.

Interested students are well advised to investigate the academic standard and industry recognition of any particular school before enrolling.

ERIC

CIVIL ENGINEERING is concerned with the planning, design, and construction of fixed structures and ground facilities for land, sea, and air transportation, for the control of the flow and uses of water, for protection in war and peace against the forces of nature and the highly destructive forces recently devised by man, for the building of facility systems in communication, urban development, housing, manufacturing, and distribution.

Thus, civil engineering technology is one of the broadest fields in the over-all practice of engineering because its work is coordinated with so many other branches of the science. It embraces the construction of highways, railroads, bridges, viaducts, dams, harbor facilities, power supply houses, pipelines, irrigation systems, reclamation projects, community and industrial planning.

Civil engineers and technicians must have a variety of special skills and be trained in a variety of special techniques, particularly in areas such as hydraulics, structures, field surveying, traffic control, computations, and the fundamentals of construction.

Technicians in civil engineering occupations may work as contractor aides, draftsmen, estimators, inspectors, supervisors, photogrammers, or specification writers.

Preparation of necessity includes sound training in mathematics, physics, chemistry, calculus, surveying, statics and dynamics, soil mechanics, fluid mechanics, elementary structural design and the fundamentals of engineering construction. A knowledge of computer programming is especially helpful today, and courses in industrial commerce, business and economics are essential. The technician also should be skilled in the use of surveying instruments, in engineering graphics, and in knowledge of the composition, properties, and use of structural materials. He is also trained to draw up plans and specifications, estimate costs and quantities, prepare maps, inspect jobs, and supervise construction.

Civil Engineering Technology

Working Conditions

Jobs in civil engineering technology could hardly be called dull or uninteresting. They appeal to the venturesome, to those who like physical activity, out-of-doors work, challenge to stamina, travel, and perhaps faraway places.

There are stirring opportunities in under-developed nations of the world and in our own country where slum clearance, urban redevelopment, water shortages, industrial waste pollution and traffic congestion, among others, demand attention. The technician's chances for advancement in responsibility and income are excellent.

Opportunities

As the country continues to grow, industrially and economically, the field of civil engineering technology will offer increasing opportunities to skilled and trained technicians. Construction and the development of natural resources constitute a stable and essential industry. Civil engineering technology offers technicians a splendid opportunity to participate actively in the continued growth of the country.

How to Enter the Industry

Technical training is essential to one who plans a career in civil engineering technology. Duties are so varied, construction operations so complex, costs so great, and financial risks so large that employers can delegate responsibilities only to those who are adequately prepared.

Specialized technical training in the subjects outlined above requires resident attendance at a public or private technical institute for from two to three years.

Many excellent courses are available. Students interested in civil engineering technology are well advised to investigate the academic standing and industry recognition of any particular school before enrolling.

Civil engineering technology offers technicians a splendid opportunity to participate actively in the continued growth of our country. Highway construction is one important area.

Computer Engineering Technology

THE COMPUTER is a tool, a powerful mathematical tool which is helping to shape our world and our future. It has a place in almost every form of human activity and is finding new places, new uses, new techniques every day.

This wide range of applications has created a tremendous demand for technically trained personnel. Engineering technicians with specialized c er training are being utilized in many phases of this fascinating technology, from research, design and development, through production and installation, to operation and servicing.

The first tabulating machine was built to speed up the taking of the census in 1890. After the turn of the century, the census-taking machinery was applied more and more to commercial work.

Through the years, machines were developed which could add and subtract figures, do record-keeping and business accounting operations, handle data processing and the mounting volume of paper work resulting from industrial growth and expansion.

During World War II, electronics became an industry. The application of electronics to business accounting and data processing machinery led to the development of computers and computer systems. These electronic tools and systems have been refined and improved since the 1950s, and is a continuing process.

Their use in business and industry has mushroomed at a rapid rate. So has their use in government defense and military projects. Computers form the keystone of the electronic air defense system guarding the North American frontiers. Another system handles data pouring in from around the globe at the Strategic Air Command. Computers keep track of the position of all satellites, American and Russian, that have been launched.

Computers now quickly and efficiently solve research and production problems which were previously impossible to calculate manually. They are being used to test theory in advance of construction and to reduce uncertainties by applying the laws of probability to problems.

Forecast for the Future

Few segments of technology are advancing as rapidly as techniques in the design and manufacture of computers and data processing equipment. Thus, engineering technicians may find promising futures working with engineers and scientists in such career fields as programming, parts and components engineering, systems testing, production calibration, manufacturing and systems research and development, quality control and reliability evaluation, and field engineering in customer facilities.

Technicians likewise are employed by insurance companies, banks, the financial departments of large organizations, manufacturing companies, commercial business, railroads, the airlines, and research firms among many others.

In these jobs they may prepare payrolls, compute and print bank statements, keep records, do accounting, control inventory, establish time schedules, and similar data processing work.

Preparation

In this highly specialized field, sound basic and technical training is essential. Preparation requires a secondary school education with a thorough background in mathematics and the physical sciences. The increasing complexity of the field also demands a thorough exposure to fundamentals and theory.

A course in computer engineering technology at a technical institute will provide training in engineering fundamentals, circuit analysis, college algebra, chemistry, physics, analytic geometry and calculus.

It will offer training in electronics and pulses, in computer systems and elements, computer arithmetic and control functions, computer component circuits and magnetic storage elements, punched card and tape input/output systems, high speed printers, computer applications and programming.

The student is well advised to check the academic standing and industry recognition of any school under consideration before enrolling.

After just 21 months of electronics training, Charles Wiltrot, a graduate of Penn Tech, was employed as a customer engineer by a leading computer manufacturing company.

The wide range of electronic computer applications has created a tremendous demand for trained personnel . . . from research, design, and development, through production, installation and servicing.

Drafting and Design Technology

BEFORE THINGS are made, manufactured, or produced, they are ideas in the mind of someone. Between the idea and the finished article, a third element enters in, namely, what does it look like, what is the size, shape, which are the dimensions? This, in substance, is the field of drafting and design technology.

Before the idea of the engineer or scientist can be made reality, its detail must be set down on paper. From specifications furnished by the engineer or scientist, the draftsman prepares scale drawings.

Because of the many varied fields in which his skills are used, the draftsman, the design technician tends to specialize. Many draftsmen on the engineering team are specialists in machine design, and prepare drawings of machines, or parts of manufactured articles. Large numbers are also found in the aeronautical, civil, electrical, electronic, structural, tool and gauge design, and in industrial technology.

Draftsmen may make calculations concerning the strength, reliability, and cost of materials, and check dimensions of parts and their relationship to each other. Through their drawings and specifications, they describe exactly what materials and processes skilled craftsmen are to use on a particular job. In developing their drawings, draftsmen use such instruments as compasses, dividers, protractors, and triangles, as well as machines that combine the functions of several devices. They may also use engineering handbooks and tables to assist in solving technical problems.

Technical illustration and industrial design further calls for visual perception in three dimensions as well as creative imagination, and the ability to become adept in the translation of blueprints into three-dimensional drawings.

A good draftsman, an able design technician, must use constructive imagination. He must be able to visualize the completed article or part from a sketch or scale drawing. As indicated above, he must have a thorough background and knowledge of drafting and design techniques, of mathematics and the basic sciences.

Since he most probably will specialize in a particular field, he must also be well versed in the practical aspects of his chosen area of work. Thus, the mechanical draftsman must understand mechanics, shop operations, and the principles of gears, to mention only a few. The architectural draftsman, on the other hand, must be familiar with the principles of construction, the properties of building materials, wiring, lighting, heating, and the many other subjects peculiar to the architectural field.

Opportunities

Employment opportunities for skilled drafting and design technicians have been excellent in recent years. The technology is an exacting and challenging one, requiring manual dexterity, good vision, imagination, and a certain amount of creative drive.

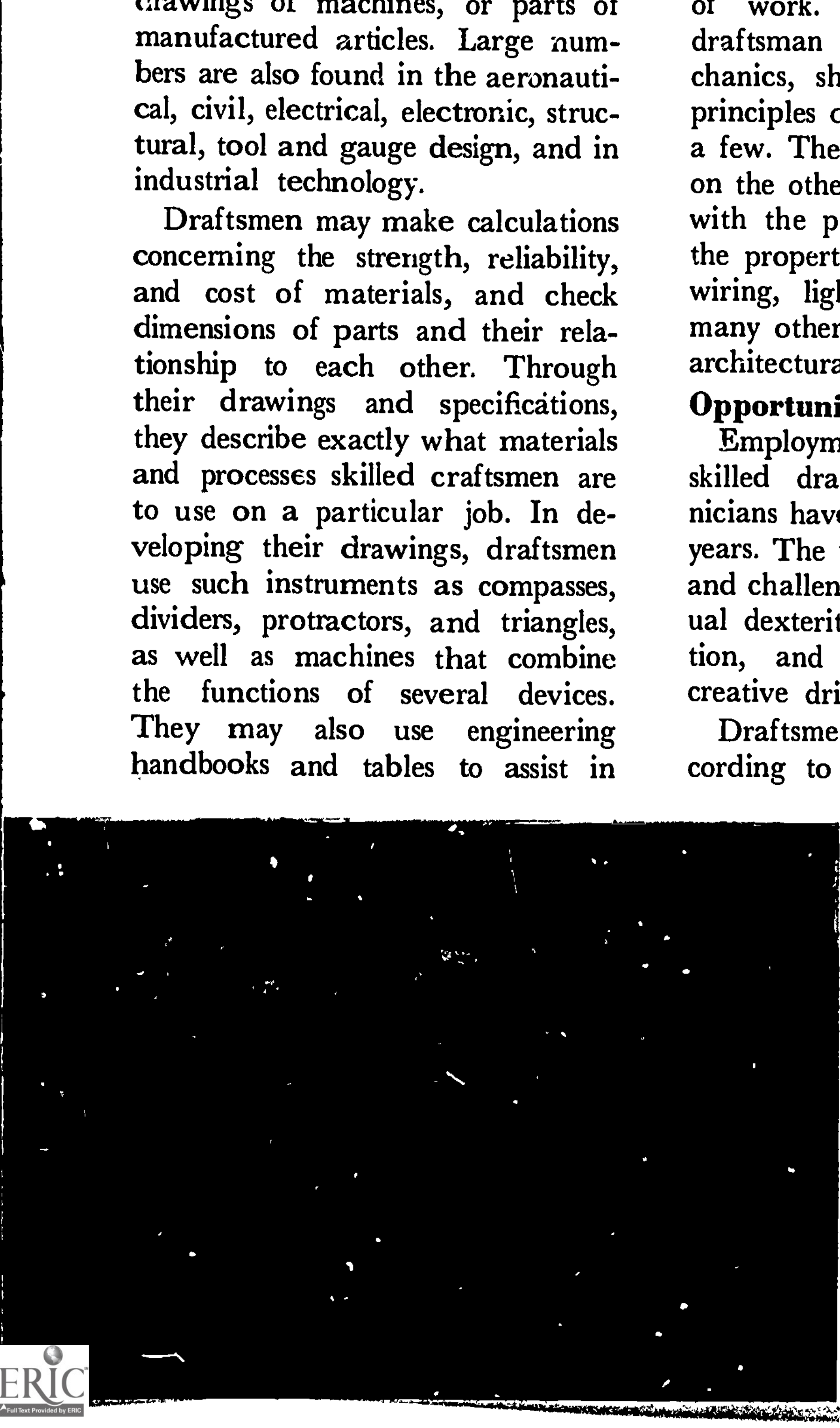
Draftsmen are often classified according to the type of work they do or their level of responsibility. *Senior draftsmen* use the preliminary information provided by engineers and architects to prepare design "layouts" (drawings made to scale of the object to be built). *Detailers* make drawings of each part shown on the layout, giving dimensions, material, and any other information necessary to make the detailed drawing clear and complete. *Checkers* carefully examine drawings for errors in computing or in recording dimensions and specifications. *Tracers* make corrections and prepare drawings for reproduction by tracing them on transparent cloth, paper, or plastic film. The initial job classification will depend largely on the extent of formal training.

Since draftsmen are on the ground floor, so to speak, they are in a position to acquire knowledge and skills fitting them for advancement to positions such as inspectors, sales engineers, estimators, engineering or architectural assistants, technical report writers, installation technicians, and supervisors.

How to Plan a Career

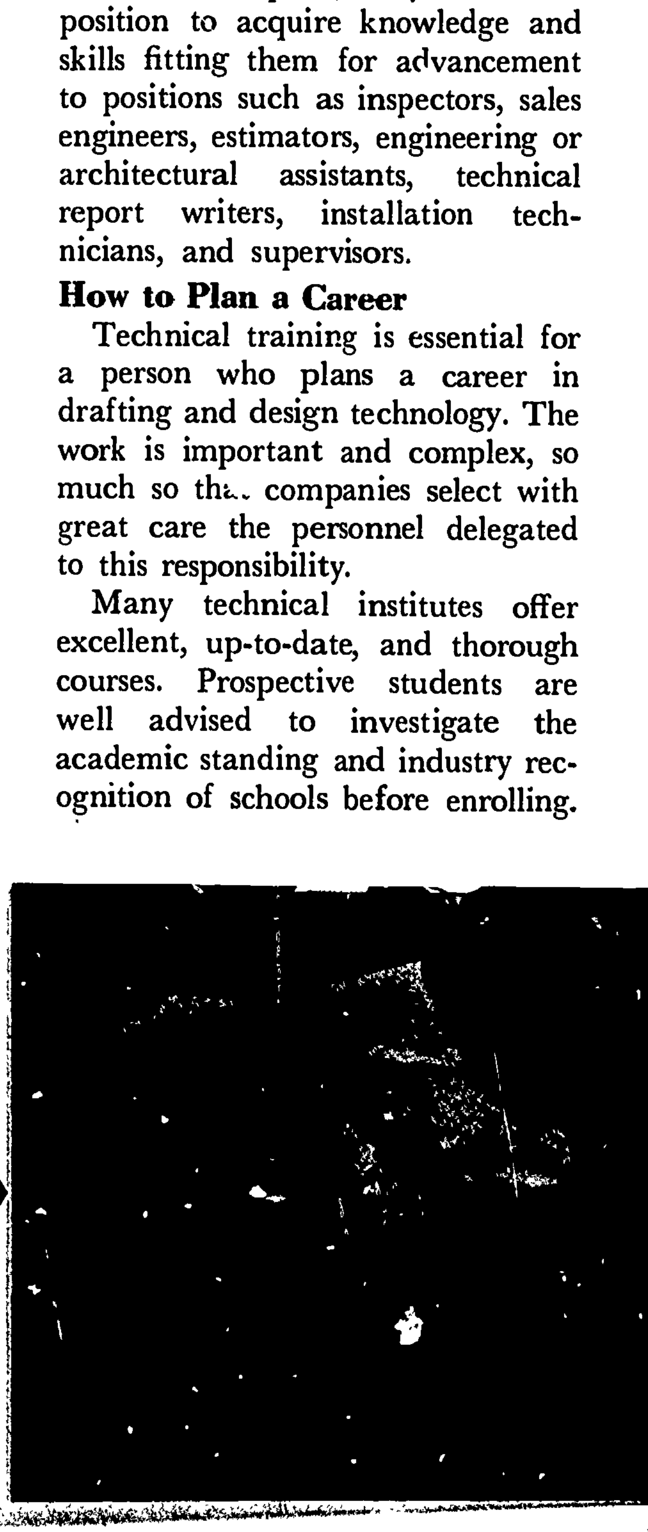
Technical training is essential for a person who plans a career in drafting and design technology. The work is important and complex, so much so that companies select with great care the personnel delegated to this responsibility.

Many technical institutes offer excellent, up-to-date, and thorough courses. Prospective students are well advised to investigate the academic standing and industry recognition of schools before enrolling.



Employment opportunities for drafting and design technicians have been excellent in recent years. Drafting requires manual dexterity, good vision, imagination and creative ability.

Engineering drawing is one of many advanced techniques required of the aircraft engineering technician. Here an Academy of Aeronautics student performs a final inspection of his design.



Electrical Power Engineering Technology

THE EDISON Electric Institute forecasts an expanding future for the electric power industry. Industrial civilization seems to be moving toward all-electric homes, industries, and cities.

In 1964 the per capita generation of electric power for 193 million people in the United States was about 5,700 kilowatt hours. For a population that may increase to 340 million people by the turn of the century, per capita annual use by that time may rise to 20,000 kilowatt hours.

These projections are indicative of the tremendous development that is already under way and that will be accelerated in the future in the electric power industry. This development, according to Walker Le. Cisler, Chairman of the Board of Detroit Edison Company, means that research and engineering must prepare for these increases in load by the design of even larger generating units, both conventional and nuclear; by higher transmission voltages; by even more extensive system interconnections on a continental basis; by the automatic control of power stations and electrical systems; by advanced electronic information systems and computer facilities in our offices and laboratories and at the service of management; and by advanced methods of power generation such as magnetohydrodynamics.

The demand for scientific, engineering and technical talent is obviously increasing proportionately. The demand will accelerate in the future for another reason.

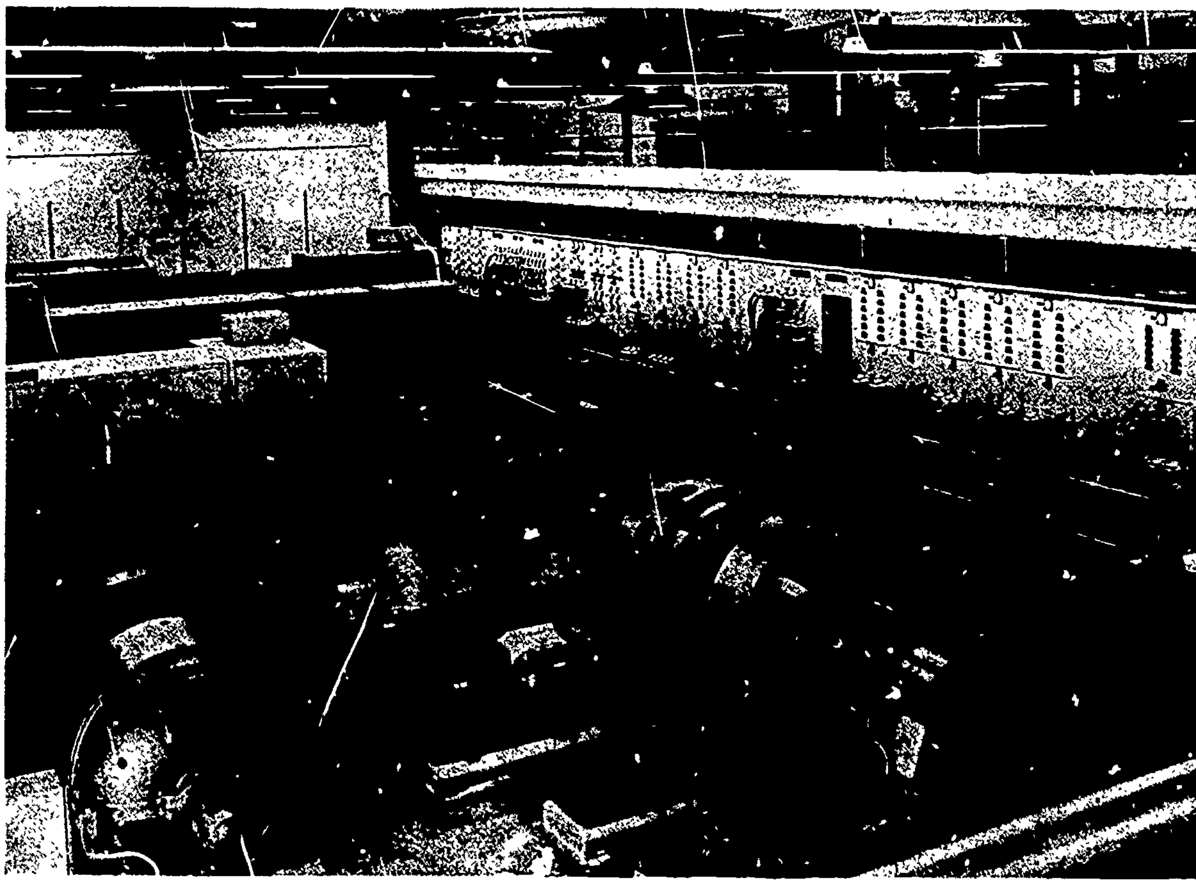
It is estimated that only about one-fifth of the world population of more than three billion people now enjoy to any degree the advantages of economic development. Since the world population is expected to increase to six billion by the end of the century, more nations will seek more and more industrial development. Consequently, the demand for electrical energy, for the engineers and technicians who develop and process electrical power, will increase rapidly.

There is a third factor in this picture and that is the fact that since World War II the image of electrical power engineering technology has sagged among students, and is just now entering a new era of renewed interest and enlightenment. There are good reasons for this new ·ptance.

Electrical energy is the nation's most important resource. Few if any industrial complexes could function without it; thus, millions of jobs, in one way or another, depend on it for their existence. The necessities and the comforts of home likewise would not exist without it.

The electric power industry which meets these basic needs is fundamentally a technological industry employing a large number of engineers and technicians.

The industry began on September 4, 1882, when Thomas Alva Edison opened the Pearl Street Station in New York City. Since the earliest days, the electric power industry has maintained a growth pattern of doubling every ten years. It has an enviable record of employment stability for engineers and technicians, a record that means long-time career opportunities for them, in both engineering technology and management. The industry, finally, encourages research, continuing education and the professional development of its people.



This general view of the test power house at the General Electric Company in Utica, New York illustrates a typical working environment for the Electrical Power Engineering Technologist. As the demand for electric power increases, the need for trained personnel goes up proportionately.

There are four major areas in which the power industry employs engineers and technicians.

Electric energy suppliers are concerned with the generation, transmission, distribution, and use of electricity. Their engineers and technicians are engaged in research to analyze, synthesize, construct, operate, maintain, manage and sell the many components which make up the huge interconnected power systems — from generating plants to load control centers.

The manufacturers of power apparatus employ engineers and technicians in the research, development, design, testing, production and sales of a large variety of complex power equipment.

The large industrial users of electric energy — chemical, automotive, steel, aluminum, glass — employ engineers and technicians to design and operate as well as maintain complicated electro-mechanical systems.

Consulting engineering firms employ engineers and technicians in their own specialized services.

Opportunities in Electrical Power

It is evident from the foregoing that the opportunities in electrical power are inviting, many, and varied.

Engineering technicians will find challenging work, for instance, in the illumination field for specialized commercial and industrial installations.

They will find challenging work in the planning and operation of large power plants, and the systems which distribute electricity efficiently and reliably, even during adverse weather conditions. Many of these systems are now being interconnected and the changing patterns in the field of electrical transmission and distribution has called for extensive applied research and development in extra high voltage, corona discharges, switching surges, insulation coordination, automatic system operation, and load control centers.

All this calls for a vast and complicated array of static and rotating equipment which must be designed, built or manufactured, installed and maintained.

How to Plan a Career

Technical training is essential for a man who plans a career in electrical engineering technology. Electricity is a highly potent form of energy and men who deal with it in any form must know what they are doing.

Such knowledge requires the study of engineering fundamentals, algebra, geometry, chemistry and calculus, the physics of mechanics, the physics of electricity and magnetism, engineering graphics, DC and AC machines, controls, measurements and standards, as well as English, speech, social science and industrial organization.

Many technical institutes offer excellent, up-to-date, and thorough courses. Prospective students are well advised to investigate the academic standing and industry recognition of schools before enrolling.

In preparing for a career in the electrical power field, the student will study electrical engineering fundamentals, mathematics, chemistry, physics, English, social science and industrial organization. Extensive laboratory practice develops the needed manual skills.

A combination nuclear and steam power generating station located at Indian Point in New York state. Nuclear energy is predicted to be a major source of electrical power in the future.

Electronic Engineering Technology

THE DICTIONARY defines an electron as "any of the non-nuclear, negatively charged particles that form a part of all atoms, each carrying one negative charge." It defines electronics as "the science that deals with the action of electrons in vacuums and gases, and with the use of vacuum tubes, photoelectric cells, etc." The "et ceteras" are multiplying rapidly, so much so that the definition has become dated.

The physical manifestations of electronics are commonplace today whereas barely half a century ago they didn't even exist. These include the radio aerials and television antennas on homes and cars, the microwave relays strung along the countryside, radar scanners on ships and planes, installations by means of which men can communicate easily and freely with one another over great distances.

Electronics made possible the present status of the entertainment industry — radio and television broadcasting, sound motion pictures, Hi-Fi and stereo, color TV.

Through controls and communications, electronics made possible the pace and volume of modern air transportation.

Through controls and communications, electronics made possible the successful feats of the space age — rockets, satellites, capsules, and spacecraft — in orbit, on target, mission successfully completed.

The solid-state transistor is another major achievement of the age of electronics. So, too, are tunnel diodes, thin-film memories, electron microscopes, ultrasonic oscillators, superconductors, all magnetic circuitry, applications of coherent light, and facsimile transmitters.

Electronic systems and electronic instruments have opened new eras in therapy, medical treatment and research, as well as in branches of science and engineering.

In electronic controls, electronic switching, telemetering, servo systems, computers, etc., mechanical devices are combined with electronic circuitry to perform at amazing speeds. This is another area of specialization, requiring a combination of electronic and mechanical skills.

Electronics is altering traditional methods of business and industry in many ways, and has opened up totally new frontiers for science and education.

Electronics offers great challenge to resourceful individuals. Yet the fact is that today, and most likely in the future, the bulk of research and development in this area will be done by scientists, engineers, and technicians working together as members of coordinated teams.

Sandia Corporation, a prime contractor for the Atomic Energy Commission, has about 1,700 technicians working in support of its over 2,000 scientists and engineers. Bell Telephone Laboratories have put over 4,000 people into its research and development organization. Collins Radio Company is a global enterprise utilizing the talents of over 12,000 scientists, engineers, technicians and supporting personnel.

Electronic applications have progressed at a pace which few other branches of applied science can equal, and more skilled engineering technicians are needed in all phases of the field. Expanding civilian demands, together with major defense needs and the space program demands for electronics equipment,

David Koker graduated from Ohio Technical Institute and is now a research associate with the Xerox Corporation. Electronic Engineering Technicians are in great demand to assist engineers and scientists in research and development laboratories. Two to three years of college-level preparation is essential.

Students at the Capitol Institute of Technology use "live" equipment to set up problems in radar range finding. Communications is one of the several electronic fields in need of highly-skilled technicians.

assure continuing growing employment opportunities for qualified electronic engineering technicians.

THE U. S. DEPARTMENT OF LABOR PREDICTS:

"Many thousands of job opportunities will be available for new workers in electronics manufacturing plants each year during the remainder of the 1960's and in the longer run. During the next 10 to 15 years, electronics employment is expected to grow more rapidly than manufacturing employment as a whole. In addition to the jobs created by expanded electronics activity, many thousands of openings will become available each year as a result of the need to replace workers who transfer to jobs in other industries, or who retire or die . . .

"The demand for engineers, scientists and technicians is expected to increase at an especially rapid rate, because of additional expenditures for research and development and the trend toward production of increasingly complex equipment. The demand for skilled assembly, inspecting, and testing work is also expected to grow at above-average rate, for the same reason. The demand for semi-skilled workers may rise more slowly because assembly line operations are expected to become more mechanized and automated."

—Occupational Outlook Handbook U. S. Department of Labor

How to Enter the Industry

Individuals planning careers in electronics engineering technology must be adequately prepared — because of the complexity in any selected area, there are no short cuts. Preparation requires a secondary school education (or the equivalent) and the student ought to have a sound background, interest and skill in the basic sciences and mathematics. The increasing complexity of electronics equipment demands a firm foundation in fundamental theory.

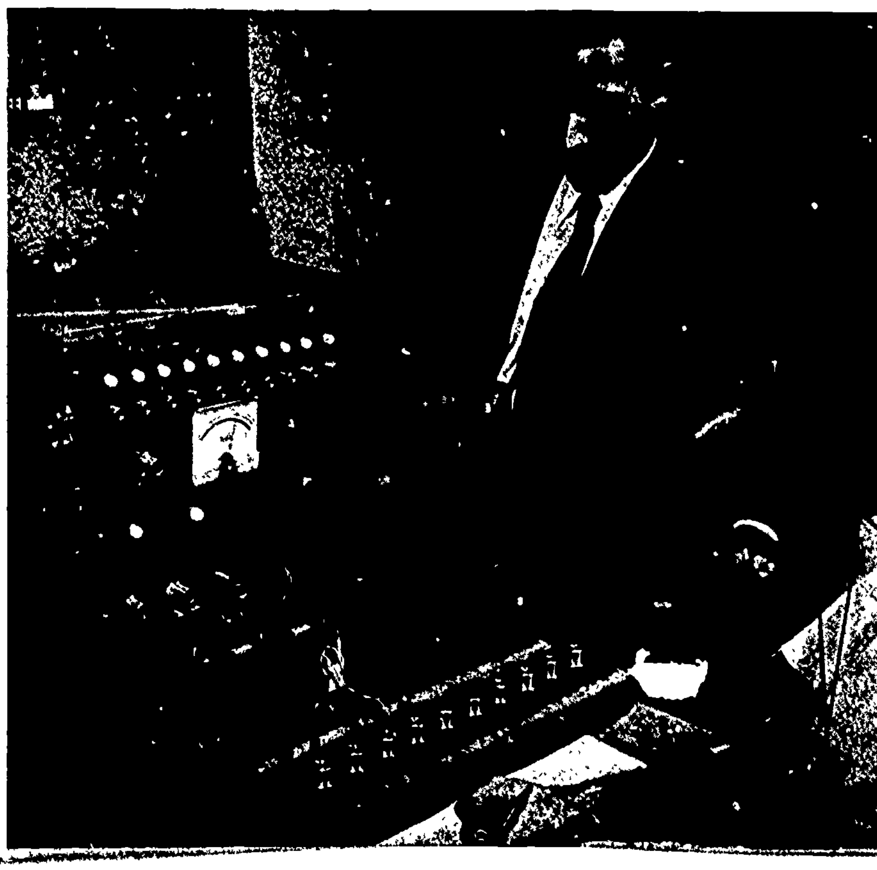
One of the best ways to prepare for a career in this field is by enrolling in an accredited or approved course offered by a public or private technical institute. These are college-level two or three year courses which give the student sound training in depth in the basic sciences, mathematics, English, speech, industrial organization as well as in engineering fundamentals and engineering graphics, pulses, electronic circuitry, communication systems, ultra-high frequency, television systems, radio, the physics of electricity and magnetism, plus the needed laboratory work.

The student should investigate the academic standing and industry recognition of any school under consideration before enrolling. A sound grounding in the fundamentals of the technology will enable him to specialize in one of the many branches or applications which appeal to him. Advances in electronics are rapid and complex, requiring higher, better and parallel advances in the "know-how" of the electronics engineering technician.

Hence the need for prospective students to prepare themselves well through proper schooling and proper school selection.

Working as part of Collins Radio Company's space-age electronics team are these Research and Development Technicians — all graduates of Central Technical Institute. The group is posed in front of a full scale mockup of the Project Apollo capsule.

Students at DeVry Technical Institute gain practical experience on a wide variety of electronics precision measuring equipment. Here are two students using an analog computer in a typical laboratory experiment.



Fluid Power Engineering Technology

FLUID POWER is "the art of generating, controlling, and applying smooth, effective power of pumped and compressed fluids (like oil and air) as used to push, pull, rotate, regulate or drive the mechanisms of modern life," according to the definition given by the National Fluid Power Association.

The French scientist, Blaise Pascal (1623-1662) was the first to demonstrate that pressure exerted anywhere on a confined fluid is transmitted undiminished in all directions, acting with equal force on all equal areas.

Fluid power is based on well-established principles of fluid mechanics. For a time it was treated historically as a facet of some industrial activity. This resulted in the development of industrial hydraulics, mobile equipment hydraulics, industrial pneumatics, and similar technologies.

With the advent of World War II and since then, a more sophisticated and analytical approach to the fluid power field has evolved. Instead of the older "static equilibrium" sort of analysis previously applied to fluid power systems, the new dynamic or "systems" approach came into favor. With this change, fluid power has become one of the newer and more promising fields in engineering technology.

Today's fluid power products range from the highly sophisticated servo-controlled drives to packings. They include such things as high pressure piston pumps, cylinders, an endless variety of control valving for air and liquid applications and vane and gear pumps.

Fluid power has made possible the modern construction equipment industry such as power shovels, dump trucks, and self-loading scrapers, machinery whose power transmission and control problems would be hard to solve without the use of fluid power techniques.

Another use of fluid power is in the machinery and machine tool field. Electro-hydraulic servosystems are used in many tracers, both mill and lathe. High power density, plus the low inertia high response characteristics in hydraulic drives prove them highly satisfactory for rotating machinery of many types.

Heavy industrial presses are another application area for fluid power. They include baling presses, stamping and forging presses, die casting, and injection molding machines. Fluid power techniques have been applied in many clamping devices, transfer devices used for loading or unloading machines, feed mechanisms and air motor drives.

Thus, applications of the principles of fluid power are found in many industrial areas insuring that billions of dollars worth of appliances, equipment and machines function smoothly in manufacturing enterprises, the national defense systems, building and construction projects, transportation and agriculture, as well as in people's homes and garages.

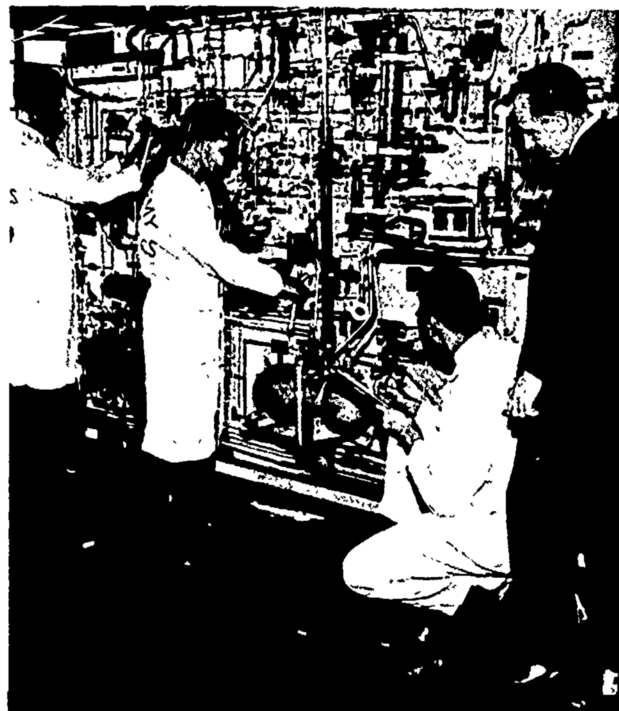
How to Enter the Industry

Specialized technical training is obviously a necessity for the young man who plans to enter the field of fluid power engineering technology. Preparation after completion of high school includes the study of engineering fundamentals, materials processing, college algebra, analytic geometry and calculus, chemistry, the physics of mechanics, engineering graphics and English.

Technical specialty subjects to be studied include fluid mechanics, circuit analysis, industrial pneumatics, hydraulic components, hydraulic circuits, analytical techniques in fluid power, advanced hydraulic circuits and systems, and problems in fluid power.

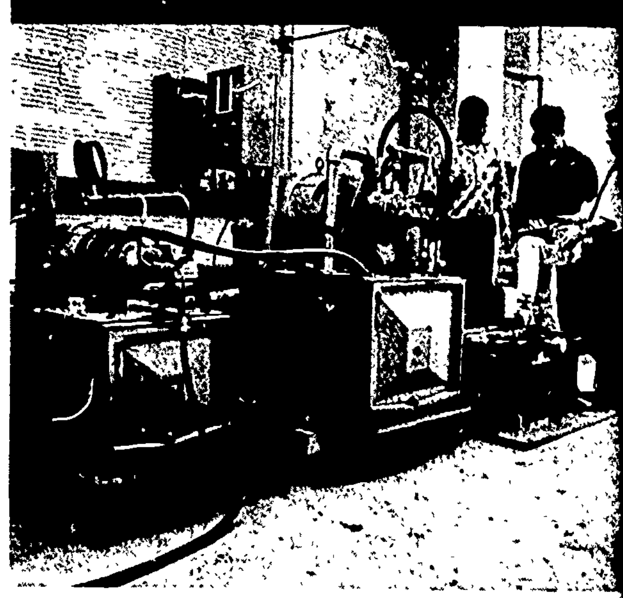
Occupations available to successful graduates are many — laboratory technicians, production supervisors, field service technicians are in demand as are design and development technicians. Surveys of industry and contact with government agencies confirm the need for men trained in fluid power engineering technology.

Paradoxically, few schools offer programs in fluid power engineering technology, though of late a growing appreciation of fluid power is developing within the general community of engineering educators.



Fluid power is used to push, pull, rotate, regulate or drive the mechanisms of modern life. Here an instructor and students are working closely in the analysis of an aircraft hydraulic system in the Academy of Aeronautics airplane laboratory.

Students and instructor in a laboratory section of the Fluid Power Institute, Milwaukee School of Engineering. Preparation for this field includes a study of engineering fundamentals, math through calculus, graphics, English and subjects in the technical specialty.



Industrial Engineering Technology

INDUSTRIAL ENGINEERING, an encompassing production science, looks for ways and means to get things done promptly, efficiently, at minimum cost, and with a well-designed end product. Industrial engineering technology thus involves the coordination of industrial equipment and its output with the men and women who operate the equipment.

Industrial technology consists of the related engineering and technical management activities involved in the development, production, distribution, use, maintenance and repair of manufactured products.

Here work is either performed on an organized basis, or it must be put on an organized basis. The industrial engineering technician serves as an aide in performing many engineering and technical management activities pertaining to the planning and control of all phases of production operations.

The industrial engineering technician must be trained to know how to do these things — perform time and motion studies, eliminate waste, control cost and quality output, plan work flow, evaluate jobs and personnel requirements, make statistical studies and analyses of production costs, and generally, do those things which must be done to achieve efficient and profitable coordination of men and machinery.

The engineering technician specializing in this particular engineering technology works with industrial engineers and management representatives who are responsible for the over-all design, planning and control of plant systems, operations and programs. His work brings him into contact with persons in the different phases of production and manufacturing from engineers and executives to workers-on-the-job, combining the use of technical knowledge with a common sense use of human relations techniques.

A young man who is interested in the efficient arrangement of equipment and machinery, planning work flow, evaluating jobs and personnel, quality control, making statistical studies, analyses of production costs, will find a challenging career in industrial engineering technology.

Experience gained in industrial engineering technology frequently qualifies engineering technicians for specialization in such fields as industrial safety, setting job standards, materials handling, or interviewing, testing, and training personnel.

Preparation Required

How can a young man or woman prepare for a career as an industrial engineering technician? This is a broad field and a lot of preparation is required for success in it. The individual must have the necessary aptitudes and desire to learn. He should have a sound aptitude for mathematics, drawing, and science. He must be a good student of English, with the ability to express himself clearly, both orally and in writing.

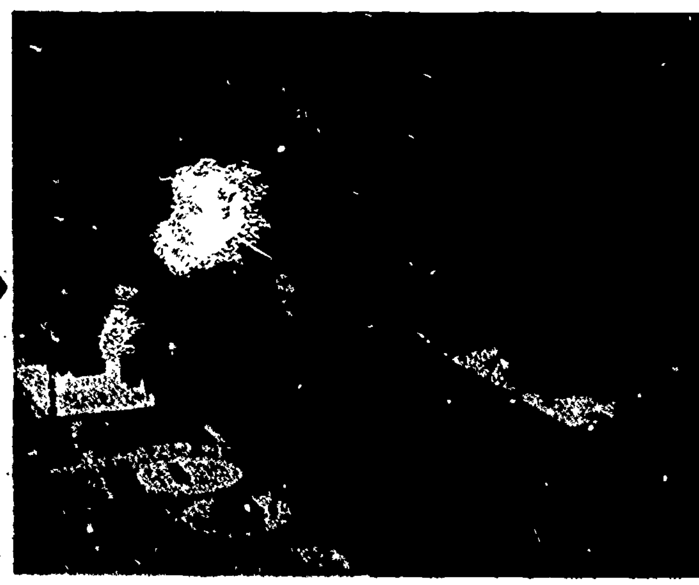
The industrial engineering technician will deal in his work with many different groups and kinds of people. For this reason a good course will include social science, industrial organization and industrial psychology as well as technical subjects.

Courses in Industrial Engineering Technology include the basic mathematics, chemistry, physics, and engineering graphics, plus English, speech, social science, industrial organization and psychology. Technical subjects offered are in statistics and quality control, budgeting and accounting, time and motion study, process and production planning, linear programming, plant layout and materials handling, operations research and industrial engineering.

The field of activity is very broad and it is advisable for the engineering technician to select one or two closely related areas for his academic training and leave to later experience and on-the-job study the extension of areas in which he acquires competence.

Industrial Engineering Technicians find their employment to require a knowledge of plant layout, efficient work flow, job evaluation, time and motion study, etc.

In the microelectronics laboratory of the Westinghouse Electric Company, industrial engineers and technicians assisted in the planning of work stations in "clean" rooms where the sub-miniature units are assembled and inspected.



Internal Combustion Engines

Engineering Technology

THIS INDEED is an age of engines. Spark ignition engines have built a giant industry since the turn of the century when the first automobile appeared. The number of cars and trucks, motors of all types, which have been manufactured since that time runs into a substantial quantity.

Ever since man began to seek more efficient ways and means to get things done, the engine has been his chief helper. Engines are machines which use energy to develop mechanical power, machines which create motion and energy in other machines.

The steam engine was the work horse for many decades in the field of transportation on land and sea. Steam also provided the power for construction work, for factory and industrial projects, for threshing grain and, in turbine systems, the power for generating electrical energy.

In transportation, the diesel engine has replaced the steam engine on land and sea. It is now widely used for generating electrical energy. Diesel sets supply the power for the Titan II underground launching complex, as well as for the worldwide space track network, and for the Nike guided missile sites.

Gas turbine engines are also being used in trucking tests and for military needs. These needs are projected on demands for a light, compact, low-fuel consumption engine, and particularly one capable of consuming many types of fuels. The Navy has found gas turbine engines suitable for use in amphibious vehicles, in antisubmarine warfare craft, in hydrofoils, hydroskimmers, and mine sweepers. The Army's needs are for a power plant for heavy vehicles, particularly tanks, auxiliary generator sets, and a variety of portable power plant applications.

From World War I through World War II practically all airplanes were powered by piston engines. Motors have uses in marine installation and boating, around the home, on the farm, in office, community and service buildings

Continued expansion in this field seems inevitable as additional applications for providing tremendous mobile horsepower at minimum cost are realized.

A direct result of this growth in the manufacture and use of all types of motors has been an increased demand for skilled engineering technicians with a thorough knowledge of the theory and applications of internal combustion engines and auxiliary equipment such as pumps, generators, and compressors. These technicians are widely needed in all phases of this vast and complex industry, from research, design and development, through production, installation, operation, repair, and maintenance.

Opportunities

The tremendous opportunities in this vast field for trained engineering technicians are self-evident. The motor car industry alone, stretching as it does from factory to dealer through test centers, filling stations, and parts suppliers, is loaded with jobs that lead to careers and top salary for men trained to think as well as to work with their hands.

Research, design, developments — new engineering and new products — are constant and continuous in the internal combustion engine field. Men with proper training can and do rise through departmental and supervisory positions to management posts with correspondingly lucrative salaries.

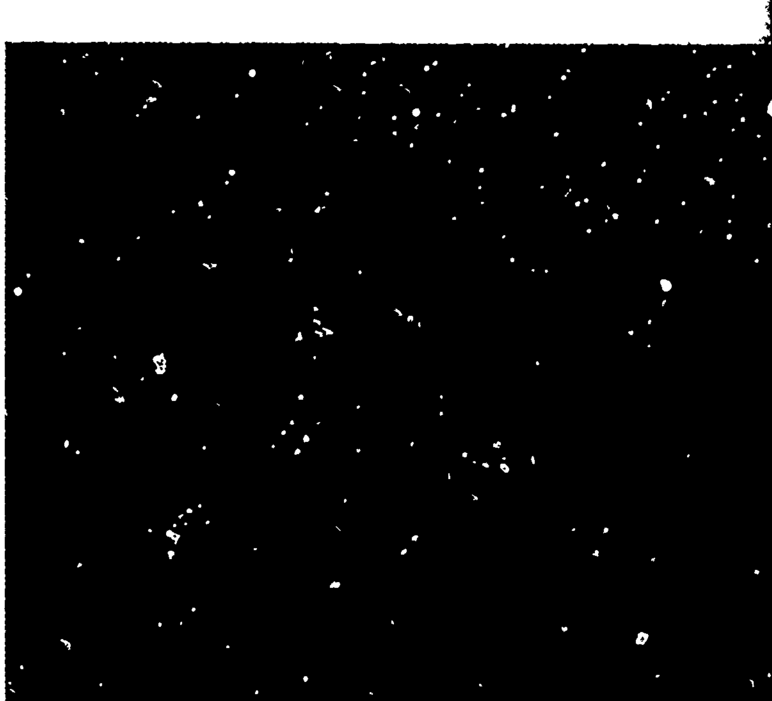
How to Enter the Industry

An ambitious person realizes that advancement in any chosen field depends upon adequate preparation and adequate knowledge. In this day of modern technology, there is no substitute for the technical school with laboratories properly equipped and instructors highly skilled.

Basic courses include the study of algebra, chemistry, geometry, calculus, engineering fundamentals and engineering graphics, materials and the physics of mechanics, English, psychology, speech and social science. This field requires special studies such as internal combustion engine elements and thermodynamics, DC and AC machines, industrial hydraulics, testing, fuels, lubricants and combustion processes, diesel, turbine, and spark ignition engines.

Prospective students are well advised to investigate the academic standing and industry recognition of schools before enrolling.

Spark ignition engines have built a giant industry since the turn of the century. A direct result of this growth is an increased demand for skilled engineering technicians with a thorough knowledge of the theory and applications of internal combustion engines and auxiliary equipment. A modern course in this technology provides for theoretical study, mathematical applications, and extensive laboratory work on engines, transmissions, carburetors, and electrical systems.



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Mechanical Engineering Technology

MECHANICAL ENGINEERING technology is a broad field which may be described as the applied science of designing, producing, testing, installing and operating machines, equipment, instruments, and devices. It involves the tooling required to manufacture a product economically. It involves machines operated by steam, gas, or electricity, and machines which use power or produce power from coal, gas, oil, or nuclear fuels.

The mechanical engineering technician aids the mechanical engineer. He will frequently perform tasks previously done by the engineer, thereby releasing a considerable part of the engineer's time for other professional work. The mechanical engineering technician has been trained to visualize data from sketches, diagrams, blueprints, and verbal information in two- or three-dimensional forms.

Thus, the technician may be assigned to an engineering team which has the task of deciding design, materials, tooling, and fabrication methods for a particular project.

The technician may be assigned to test the performance and endurance of mechanically or electrically propelled devices, and to determine weight, stress and strain of components. In this assignment he must select, arrange, and connect, as well as calibrate his test equipment and measuring instruments. Most likely, the assignment will require him to record results and prepare a test report.

Thus, the mechanical engineering technician must have an aptitude for applying mathematics to calculate, interpret, and convert test data into report form.

He may be assigned to make drawings, designs, layouts of tools or machines. With experience and training, he may become an inspector, machine and tool maintenance man, machine and parts salesman, industrial supervisor, production expediter, or cost estimator.

His aptitude and training may cover a wide variety of talents and skills which will be in continuing demand in the future because of the growing complexity of technology and the high level of expenditure for research and development.

Mechanical engineering technology touches industrial plants and manufacturing concerns of every type and size in the country. Many companies and corporations have plants abroad with methods and materials adapted to the customs and power distribution systems of foreign countries.

Mechanical engineering technology is also at work in the many industries supplying materials for national defense, and in the newer areas such as atomic power, automation, and aerospace.

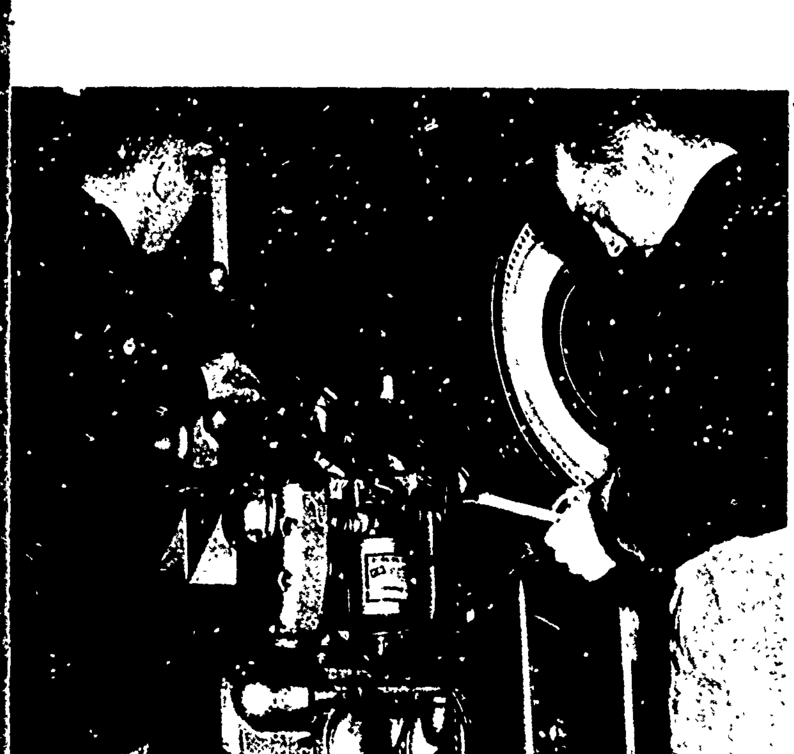
Preparation

For professional breadth and depth to meet these challenges of today and tomorrow, mechanical engineering technicians must acquire a broad personal and social perspective as well as a well-rounded preparation in engineering fundamentals. This includes a good foundation in mathematics, the physical sciences, the engineering sciences together with necessary background in the humanities and general studies.

Other special subjects include mechanics, power systems, materials, circuits and industrial organization.

Approved or accredited courses in public or private technical institutes are packaged to give the student the proper preparation in two to three years time. Some of these schools have developed a cooperative education system under which students may work in an industrial plant whose product lines are related to the area of his academic study. This plan is an integrated schedule which correlates the engineering and technology principles learned in classrooms and laboratories with extensive, practical, on-the-job experience gained in industry. It also provides the student with an opportunity to earn while learning.

Interested high school graduates or students with an equivalent background that will qualify them for college work and admission to college are advised to investigate the academic standing and industry recognition of any particular school before enrolling.



Mechanical engineering technology involves machines operated by steam, gas, or electricity, and machines which use power or produce power from coal, gas, oil or nuclear fuels. Employment opportunities for qualified technicians continue to increase year by year.

In addition to mechanical aptitude and training, a successful mechanical engineering technician must have a good foundation in mathematics, the physical sciences, engineering science, and general studies.

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Metallurgical Engineering Technology

METALLURGICAL ENGINEERING technology is concerned with the processing and production, the physical properties, and the use of metals and alloys. The art of processing metals is as old as history, but the sciences which underlie the art as it has been practiced and developed during the past century are opening new frontiers today.

The search for metals in both quality and quantity is an internationally competitive one. The research effort to open new fields for their use has been at times cooperative and at times competitive.

Since metals comprise about three-fourths of the elements in the periodic system and as the fundamental matter of the universe have remarkable properties which make them especially useful to mankind, metals have been and continue to be the essential working substance of modern industry.

Metallurgical technology embraces a number of disciplines. It involves both mining and chemical engineering in the extraction of metals from ores. It involves both physics and chemistry for an understanding of metallic states and properties. And it involves mechanical engineering in the fabrication of metals into useful products.

Research in this field is intensive and extensive as science continues to test the older metals and the newer alloys for specific combining and reactive properties in today's electronic and space-age developments. Here steel, iron, brass, copper, and aluminum have been joined by such recently discovered rare-earth cousins as germanium, erbium, cerium, titanium, and gadolinite.

Before a substance can be safely and properly used, its behavior under a variety of known (and occasionally unknown) circumstances must be ascertained. This has been true in the processing and manufacture of metals for industrial and commercial services. It is also true in the newer fields of study and development — supersonic aircraft, jet engines, gas turbines, guided missiles, and nuclear reactors.

Metallurgical engineering technology involves mining, chemical, and mechanical engineering principles. The technologist will be engaged in extracting metals from ores, determining the physical properties of metals, and fabricating metals and alloys into useful products.

[illegible] shown here making [illegible] of materials tests in [illegible] metallurgical laboratory. After graduation, they will find jobs in the automotive, aircraft, heavy machinery, and similar industries. Jet engine design and nuclear power developments involve metallurgy.

Opportunities

Since it is difficult to think of any product today which does not require the help of metal instruments and tools in its manufacture, or does not contain metal, it should be evident that the need for metallurgical technicians is continuing.

They may find jobs in the basic metal producing companies that make steel, copper, aluminum, brass, titanium, and special alloys. They may find jobs in the automotive, aircraft, heavy machinery, or specialized controls equipment industries.

In jet engine design and nuclear power developments the principal problems involve metallurgy. Research in atomic energy projects requires the skill of metallurgists and their technicians.

Metallurgical technicians may assist in testing metals and alloys to determine their physical properties and, with experience, may perform laboratory tests for microstructures, strength, hardness, ductility, and other qualities. They may be employed in such areas as welding, spectography, production planning, heat treating, research, manufacturing materials and processes, and physical, process, or foundry metallurgy.

How to Enter the Industry

As well with all engineering technologies today, the complexities are such that technical training and lots of it is essential for a man who wishes to enter the field of metallurgy.

Preparation after secondary school entails the essential courses in mathematics, chemistry, and physics, engineering graphics, engineering fundamentals, and materials processing. It entails special technical courses in physical metallurgy, extractive metallurgy, heat treating, metallurgical design, nonferrous metallurgy, welding, and foundry work plus necessary courses in English, speech, industrial organization, and social science.

Interested students are well advised to investigate the academic standing and industry recognition of any particular school before enrolling.

Nuclear Engineering Technology

NUCLEUS, IN physics, may be defined as the central part of an atom, the fundamental particles of which are the proton and neutron.

Nuclear physics is defined as the branch of physics dealing with the structure of atomic nuclei and the energies involved in nuclear changes.

Nuclear fission is described as the splitting of the nuclei of atoms, accompanied by a conversion of part of the mass into energy. This is said to be the principle of the atomic bomb.

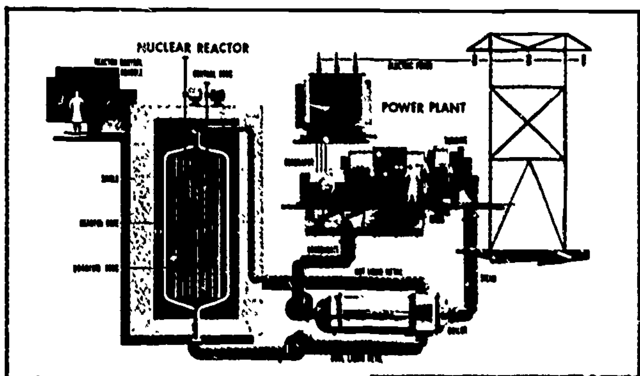
Nuclear fusion is the fusion of atomic nuclei, as of heavy hydrogen or tritium, into a nucleus of heavier mass, as of helium, with a resultant loss in the combined mass, which is converted into energy. This is said to be the principle of the hydrogen bomb.

Now, as is well known, research to develop nuclear energy for peaceful purposes has been progressing for some time. Nuclear engineering has made possible atomic powered submarines and land installations which produce heat and power, as well as neutrons, gamma radiation, and radioisotopes.

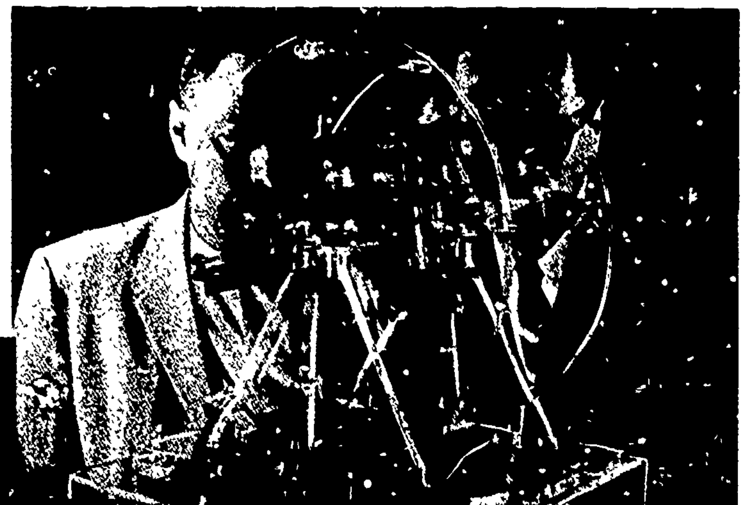
In this highly specialized area of nuclear science and engineering, the technician has a place. It may be in radiation safety, radiation instrumentation, reactor operations and controls, instrument repair and maintenance, or in chemistry laboratory.

To obtain positions in this exacting scientific field, a sound background is required in mathematics, physics, chemistry, electronics, and electrical circuits and machines, as well as in nuclear physics and instrumentation, radioisotopes and reactor principles, thermodynamics and physical metallurgy. Courses in the communication arts round out the program of preparation.

Graduates may find continued study necessary for technical positions in development, manufacturing, testing, research, and maintenance in the nuclear field. This is to be expected, for the scientists and engineers who specialize in nuclear engineering find that continuing study is essential to their safety, success, and progress.



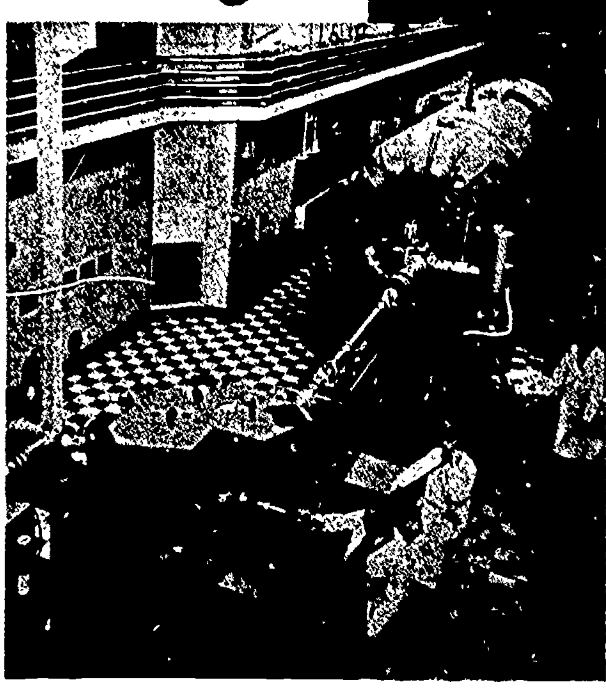
A nuclear reactor may be used to generate steam to run a turbine, which in turn rotates a generator to produce electrical power.



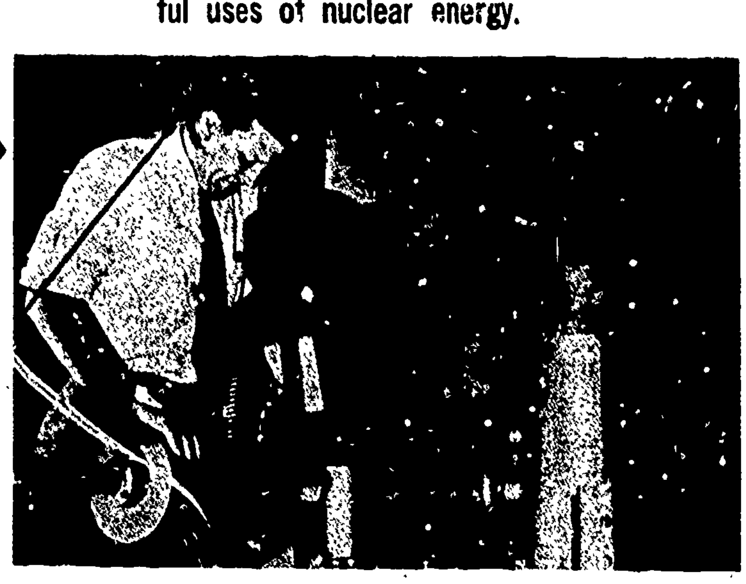
Republic Aviation Corporation is developing a nuclear gyroscope which will operate without moving parts. The nuclear gyro will have greater accuracy and less drift than the best existing mechanical gyroscopes.

The center of operations for the world's first full-scale atomic-electric generating station at Shippingport, Pennsylvania. Installations such as this are increasing rapidly in our program to develop peaceful uses of nuclear energy.

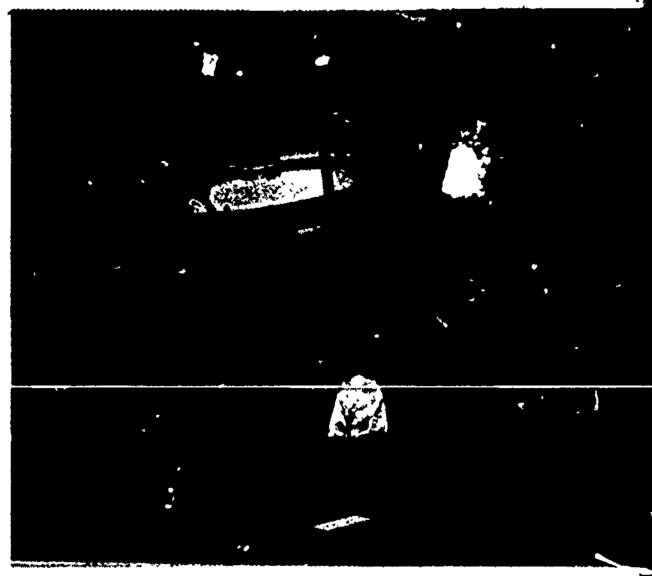
A Van de Graaff particle accelerator constructed by the Atomic Energy Commission. This 10-million electron volt installation is used as a research tool in the study of nuclear energy.



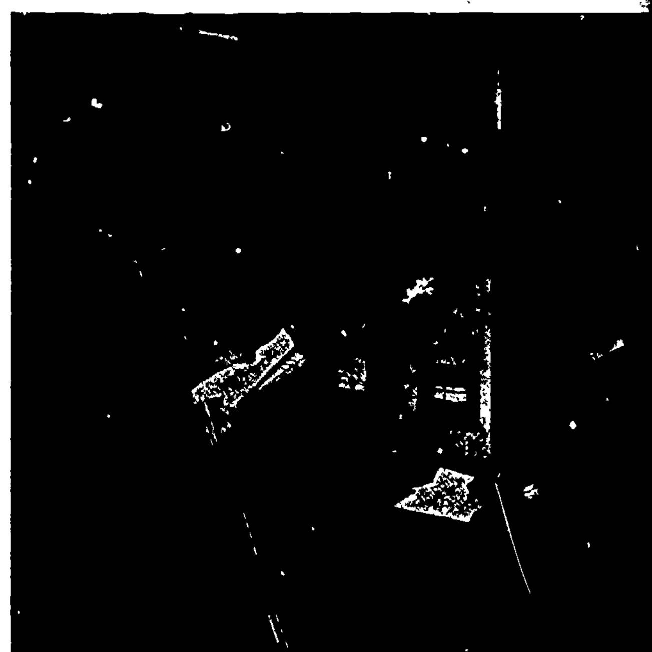
At Upton, L. I., New York, the Brookhaven National Laboratory has a "baby" Van de Graaff generator, capable of developing 2-million electron volts.



Refrigeration, Heating, Air Conditioning Technology



Harvesting energy from the sun is one of man's current research projects. A 120-inch solar furnace is shown here. Under ideal conditions the furnace can develop a temperature of 8500° Fahrenheit.



The wide-spread need for temperature control has created a tremendous demand for engineers and technicians in this field. Students are shown here performing an experiment on a thermostat with associated electronic controls.

HEATING, COOLING, and ventilating the homes we live in, the offices and industrial plants we work in, the hospitals, schools, churches, and other institutions we gather in, the cars, ships, trains, and planes we travel in — all these offer continuing challenge to an indispensable industry.

Temperature control is indispensable for continued good health and very often for safety. Temperature control is an implicit public demand which builders of new construction and remodelers of old recognize. The public is not inclined to patronize or frequent stores, restaurants, theaters, office buildings, terminals, hotels, hospitals, etc., where provisions for proper personal comfort have not been made.

The widespread use of air transport today would simply not be possible were it not for proper environmental control within the cabin.

Advancements in production technology have also been dependent on precise control of environmental conditions.

Foods and beverages require reliable temperature control in their processing, storage, transportation, and distribution.

The production of chemicals, drugs, and medicines; the manufacture of electronic components, computers, and the countless precision instruments designed for use in aerospace machines; printing, petroleum processing and many other industries require carefully regulated environmental conditions for quality control.

Thus, refrigeration, heating, and air conditioning is a growing, progressive, and necessary industry. Its potential in view of the ever-present population growth is great in the future.

The demand for men trained in this varied technology likewise is expected to be very great. The design, manufacture, test, sale, and installation of temperature control equipment requires technically competent people, and proves both interesting and challenging to men with technical training.

Areas of Work

The refrigeration, heating, and air conditioning technician may find himself placed in one of many areas essential to the industry. These include drafting and design where accurate production drawings are made for the plant and installation drawings for customers. They include research which seeks the creative invention of new products and components and systems, the analysis of plant and competitive lines, performance testing, and the investigation of new fields of application.

Development concerns itself with continuing improvement in all product lines and systems, with marketing methods, as well as the preparation of installation, operating, and maintenance manuals.

Thus, the man trained in refrigeration, heating, and air conditioning technology may be a development technician, research assistant, sales representative, a systems designer, manufacturer's representative, installation supervisor, control specialist, or an independent dealer and contractor.

How to Enter the Industry

Refrigeration, heating, and air conditioning is a complex engineering technology whose practice requires education in kind and depth. Preparation after secondary school includes exposure to college algebra, engineering graphics, computer programming, engineering fundamentals, materials processing, the physics of mechanics, geometry and calculus.

Technical subjects include refrigeration, air conditioning design and applications, electric motors and controls, kinetic theory, heat transfer mechanisms, and thermodynamics.

Approved or accredited courses in technical institutes are arranged to prepare the student for engineering technician work in these areas in two to three years.

Interested students are well advised to investigate the academic standing and industrial recognition of any particular school before enrolling.

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Comparison of Engineering College, Technical Institute and Trade School

ITEM OF COMPARISON	THE ENGINEERING COLLEGE	THE TECHNICAL INSTITUTE	THE TRADE SCHOOL
1. Entrance requirements	High school graduation or equivalent with applicable credits in Mathematics and Science.	High school graduation or equivalent with applicable credits in Mathematics and Science.	May be high school undergraduate.
2. Treatment of fundamentals	Mathematics and Science taught with principal emphasis upon theoretical derivations and basic laws.	Mathematics and Science taught with principal emphasis upon application to industrial uses.	Trade Mathematics, a form of excerpts from Arithmetic for specialized use in the trade.
3. Industrial Arts and craft skills	Not offered	Not offered, except as a minor supplement in laboratory programs for the purpose of industrial application.	Principal area of instruction.
4. Level of studies	Post high school and graduate	Post high school	Grade or high school
5. Designation of educational levels	"Higher Education," "College," "University," "Professional."	"Higher Education," "College"	"Secondary School," "Trade School"
6. Initial Employment	Engineer, Engineering Designer	Engineering Aide, Research Associate, Engineering Technician, etc.	Mechanic, Tradesman, Operator
7. Work assignments of graduates	Synthesizing, analyzing, designing, testing and supervising	Assisting engineers in analyses, design, testing and supervision.	Installation, maintenance, repair and manufacturing.
8. Proportion of theoretical engineering instruction and practice	Emphasizes theoretical instruction and less practical application.	Adequate coverage of theory with emphasis upon practical application.	Little theory, nearly all practice.
9. Transfer of credit to professional training	Considerable, often full credit is given although this varies substantially between colleges.	In general some transfer credit is granted. Achievement examinations may be required.	None
10. Accrediting or approval agency	Engineers' Council for Professional Development and Regional Associations.	Engineers' Council for Professional Development and The National Council of Technical Schools.	No information.
11. Typical certification of graduates	Bachelor of Science Degree	Associate in Science Degree, Diploma, or Associate in Engineering.	Certificate or Diploma.

NOTE: The starting positions of Engineering College and Technical Institute graduates are often similar. Advancement thereafter within industry depends upon individual qualifications with the Technical Institute graduate favoring applied technology.

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